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Contemporary Management

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This book is dedicated to all my teachers, from my parents Mr. Tajammul Hussain and Ms. Shahazamani Hussain who taught me to successfully deal with adversity and believed in my dreams, to my teachers in medical school and residency, especially Dr. A R Undre and Dr. H R Manchanda in India who imparted their knowledge unselfishly in at a time when there was no internet and to my teachers at the Cleveland Clinic especially Dr. V W Fazio, Dr. I Lavery, Dr. S Strong and Dr. J Wu. The book is also dedicated to my husband Chiranjiv Zutshi who is always teaching me life's lessons, my brother Anjum Hussain who counsels me on all topics and now my new teacher in this the modern world, my son Samir Zutshi.

Foreword

The management of anorectal disease dates back over several millennia and continues to represent a challenge for both the patient and the physician. The earliest known reference to these disorders is seen in the Edwin Smith Surgical Papyrus that originated in 3000–2500 BCE when practitioners like the high priest Pepyankh, known as Iry, served as the Pharaohs' palace physician and chief of the medical corps. He was also an important specialist and bore the titles of "one understanding the internal fluids" and "guardian of the anus." In that era, the only mentioned treatment was an ointment derived from Acacia leaves that was applied to linen strips and placed within the anus. More than 1000 years later, the Ebers Papyrus showed that the management of these anorectal disorders had only slightly progressed as 33 prescriptions or recipes were detailed. In addition to cathartics, enemas, liniments, and ointments, suppositories containing cinnamon, cumin, cuttlebone, frankincense, juniper, honey, myrrh, and yellow ochre were "to be put in the hinder part" as a remedy for "burning in the anus" or in an attempt "to heal the anus when it is ill."

Operations for anorectal disorders were not mentioned until the Greek physician Hippocrates of Kos (460–370 BCE) extensively wrote about them during the Age of Pericles as evidenced by his dissertations "On Hemorrhoids" and "On Fistula." He discussed hemorrhoid inspection using a speculum, treatment with topical therapies, and surgical management that instructed the physician to "make the irons red-hot, and burn the pile until it be dried up, and so as that no part may be left behind." His essay about fistula-in-ano described drainage of an abscess "while still unripe, before it suppurate and burst into the rectum" as well as the use of fistulotomy and cutting setons comprised of "a very slender thread of raw lint" wrapped "with a horse hair."

During the Middle Ages, Sainte Fiacre (unknown–670) became the patron saint for hemorrhoid sufferers, but little else changed until Master John of Ardene (1307–1380), who is considered by many to be a founder of modern-day surgery, used his inventive skills to introduce new and lasting surgical techniques, especially those used for the management of fistula-in-ano that endure today. Moreover, Ardene challenged his peers to question dogma and adopt best-practice behavior.

Much interest over the ensuing centuries was focused on other areas (e.g., rectal cancer, stomas, traumatic injuries), but this began to change when Frederick Salmon (1796–1868) founded an institution with seven beds on London's Aldersgate Street in 1835 for the "poor afflicted with fistula and other diseases of the rectum."

This was the beginning of St. Mark's Hospital established in 1854. Surgeons from around the globe came to London to learn from the pioneers working at St. Mark's Hospital. Among these visitors was Joseph M. Mathews (1847–1928) who returned to the USA to publish an extensive treatise on "Diseases of the Rectum, Anus, and Sigmoid Colon" as well as serve as the inaugural president of the American Proctologic Society that later evolved into the American Society of Colon and Rectal Surgery.

This brief overview of the historical management of anorectal diseases underscores the significant role these disorders have played in the field of colon and rectal surgery. In this book, Dr. Massarat Zutshi has fashioned a comprehensive review of the subject that includes several issues our forefathers never encountered or imagined. Each author was carefully selected for her or his thoughtful approach and clinical experience related to the assigned topic. Furthermore, Dr. Zutshi's editing of the book draws from her own acumen based on decades of professional practice and innovative research dedicated to treating patients with both benign and malignant anorectal disorders. The completed product should serve as a resource for surgeons, physicians, trainees, and students with an interest in the management of patients afflicted with anorectal diseases. Furthermore, as advocated by Master John of Ardene centuries ago, the book encourages the reader to abandon unproven dogma, embrace contemporary evidence-based approaches, and prepare for future developments.

Chicago, IL, USA Scott A. Strong

Preface

Learning has always been a choice borne out of the desire for knowledge, which is a powerful tool. Teaching, however, has been an obligation upon us from the time we begin to receive knowledge. Teaching is an art form that is within all of us but perfected by only those who wish to share their love of learning. In today's world of instant access, knowledge is a few clicks away and can come from various sources, some of which may not be from "experts" in their field. In order to assimilate this knowledge, the topic to be learnt has to be presented in such a way that it not only imparts the knowledge but also sparks the interest to be taught again to another student.

I have been the recipient of such "sparks" in my student life and beyond, but those that impacted me most are those that I use daily and that include the knowledge of the medical sciences. True teachers give not to receive and impart their wisdom filled with emotion. Such knowledge creates a permanent place in a student's mind and comes forth when needed.

This book is the fruit of devotion of such teachers who took upon topics of anorectal disease which is essential not only to the medical student and resident but also to the practitioner who wants to go beyond the call of treating illnesses that are considered treatable based on their daily practice. This book is also for the new and practicing colorectal surgeon who has in-depth knowledge of many life-threatening diseases but may have paid little attention to what may be a common condition in a daily practice requiring patience and the knowledge of anatomy to successfully treat it.

Anorectal disease affects every population, race, ethnicity, and gender. It can be simple to diagnose and miss or complicated to treat even by the experts. Herein lies the charm for our expert teachers to simplify these topics such that they not only can be informative to the reader but also can be the source to make decisions of when they can treat and when the sufferer needs the attention of those with the expertise to treat them.

The authors have made a concerted effort to make most chapters case based with discussions that make reading this topic, which is vast for the small anatomical area it represents, easy to understand. There have been many books on this topic. This book aims to update the current knowledge, and the authors have taken time to make it easy to read and understand and to guide patients. The authors are from many countries to make this book as comprehensive as possible, yet simple to read and understand.

Cleveland, OH, USA — Massarat Zutshi, MD

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I cannot thank the authors enough for taking on the task of writing on topics that may seem rather simple in their vast experiences, for keeping to deadlines, and for their patience in all the editing. I have to thank the medical illustrators at Springer who have done wonderful work with the creation of the artwork for working closely with the authors. Lastly, there are no words to thank the developmental editor Margaret Burns for her patience and help with the editing and communication.

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Part I

Anatomy and Investigations

Anorectal Anatomy and Applied Anatomy

1

Alice C.A. Murray and Ravi Pokala Kiran

1.1 Rectum (Latin: Intestinum Rectum, Straight)

The colon is a distensible tube approximately 150 cm long and of varying diameters depending on location (2.5–7 cm maximal diameter at the cecum) [1]. It begins from the ileocecal junction and comprises the cecum, ascending colon, hepatic flexure, transverse colon, splenic flexure, and descending and sigmoid colon, whereby it ends at the rectosigmoid junction. The anatomical landmark for the rectosigmoid junction is controversial and considered to be the sacral promontory by surgeons, but the third sacral vertebra to anatomists. The transition to rectum can be identified by several changes: the absence of appendices epiploicae and teniae coli and the lack of a defined mesocolon [2]. The three teniae coli fan out to continue as a complete longitudinal muscular layer around the rectal tube. The rectum continues caudally for approximately 12–15 cm where it becomes the anal canal at the anorectal junction. At a point just above its termination, the rectal diameter fills out to form the rectal ampulla, and it is here that it provides a distensible reservoir for storage of feces prior to defecation. The caudal limit of the rectum is again disputed as being either at the level of the anorectal angle formed by the sling of puborectalis (anorectal ring) or instead at the dentate line.

At its beginning, the rectum courses over the pelvic brim, falling into the pelvic cavity, lying snug against the sacrococcygeal concavity. Its course within the

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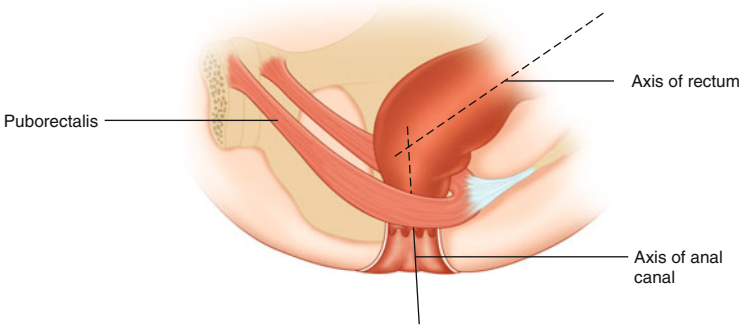

Fig. 1.1 Puborectalis forming the anorectal angle

confines of the pelvis is "s-shaped" in sagittal view, with a further anterior tilt of 90–110° at the anorectal angle (Fig. 1.1).

Lying posteriorly to the rectum are the sacrum, coccyx, and pelvic diaphragm, along with the associated presacral venous plexus and roots of the sacral nerve plexus. Anteriorly lie the rectovesical pouch, prostate and seminal vesicles in men, and the posterior wall of the vagina and uterine cervix in women.

The rectum traverses the pelvic floor, which is the muscular diaphragm separating the pelvis from the perineum and providing support for the abdominal cavity. The puborectalis slings around the rectum at approximately 5 cm from the anal verge creating the sharp anorectal angle and attaches anteriorly to the pubis. On either side of the rectum are the ischiorectal fossae containing loose areolar fat, branches of the inferior rectal vessel, and nerves which cross the fossae to enter the wall of the anal canal. These potential spaces allow the rectum to distend during defecation. The ischial tuberosities form the outer limits of the ischiorectal fossae.

1.1.1 Mesorectum

The "mesorectum" is a fatty cuff of tissue surrounding the rectum containing perirectal lymph nodes and terminal branches of the inferior mesenteric artery, but no functionally significant nerves. The mesorectum extends through the entire length of the rectum; the lower third of the rectum is completely enveloped by the mesorectum, but it begins to narrow caudally from the level of the insertion of the levator ani muscles [3]. It is thickest posteriorly and is enclosed by fascia propria. Its removal is crucial to the treatment of rectal cancer, since it is a site of metastasis. A total mesorectal excision (TME) is the gold standard for surgery of cancer in the middle and lower thirds of the rectum and is defined as the complete excision of the visceral mesorectal tissue to the level of the levators (Fig. 1.2) [4]. Technically the mesorectum is not a mesentery however, as it does not conform to the definition of "two layers of peritoneum that suspend an organ."

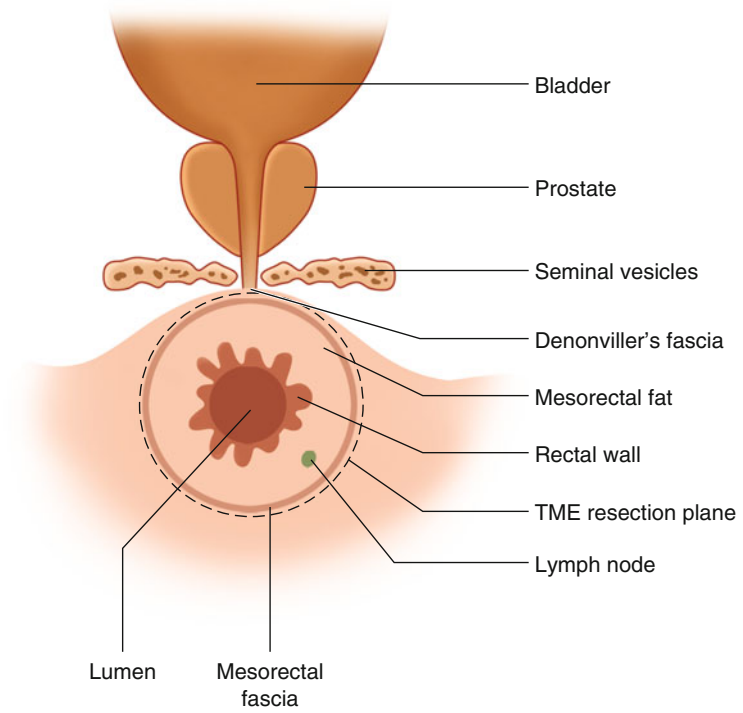

Fig. 1.2 A total mesorectal excision radically removes en bloc the tumor-bearing part of the rectum with the associated mesorectal compartment

Waldeyer's fascia propria recti (or fascia propria) is a thin membrane enveloping the mesorectum [5]. Posterior dissection of the rectum in TME follows the loose avascular areolar tissue in the retrorectal space between the outer edge of the fascia propria and the underlying presacral fascia. Beneath the presacral fascia lie the presacral veins which, if injured, can cause profuse and troublesome bleeding. The presacral fascia fuses with the fascia propria just above the anorectal junction posteriorly [6]. There is some debate about the presence of lateral ligaments or stalks. They have been variably described as either a thickening of connective tissue between the mesorectum and lateral pelvic wall or instead as a continuation of the pelvic parietal layer of the fascia, onto branches of the middle hemorrhoidal artery and the rectal nerve [6–8]. The fascia between the urogenital organs and the extraperitoneal anterior rectum, Denonvilliers' fascia, first described in 1836 by Charles Denonvilliers, is anatomically distinct from the fascia propria of the rectum [9]. The rectogenital septum (rectoprostatic or rectovaginal) consists of two layers of peritoneum partly or fully fused; this corresponds to Denonvilliers' fascia, the existence of which is disputed in the female. The rectogenital septum contains collagenous, elastic fibers as well as bundles of smooth muscle cells and nerve fibers that emerge from the autonomic inferior hypogastric plexus.

1.1.2 Peritoneal Coverage

The peritoneum completely invests the anterolateral aspects of the upper third of the rectum and the anterior surface of the middle third, but does not cover the lower third. The rectum is thus completely extraperitoneal posteriorly. The peritoneum reflects over the rectum to the apex and back of the body of the bladder in men and the uterus and posterior part of the vaginal fornix in women forming the rectovesical and rectouterine pouch (pouch of Douglas), respectively. This pouch is bordered laterally in women by the rectouterine fold containing the uterosacral ligament over which the pelvic splanchnic nerves lie. In men, the rectovesical pouch is bordered by a peritoneal fold that covers the inferior hypogastric plexus.

1.1.3 Rectal Wall

The rectal wall consists of six layers:

1. Simple columnar mucus-secreting epithelium
2. Lamina propria (loose connective tissue beneath the epithelium)
3. Muscularis mucosa (thin muscle layer)
4. Submucosa (blood vessels, lymph, and Meissner's plexus)
5. Muscularis propria (inner circular and outer longitudinal muscle layers between which lies Auerbach's plexus)
6. Serosa (upper third)/adventitia (mid- and lower third)

Rectal cancer spreads stepwise outwardly through the rectal wall, and this is reflected in Dukes' tumor staging. The muscular coat of the rectum consists of a complete longitudinal coat, which when peeled back exposes circular muscle fibers [10]. The circular muscle fibers become more tightly packed around the plicae transversales (valves of Houston), permanent transverse folds of the upper rectum [10]. There are three folds in total, lying convex to the right at 7–8 cm from the anal verge, to the left at 9–11 cm, and to the right again at 12–13 cm. Kohlrausch's plica (middle fold) is the most consistent of these folds and corresponds to the level of the anterior peritoneal reflection. Valves of Houston are absent in the mobilized rectum. They are optimal sites for rectal biopsy due to accessibility and a lower risk of iatrogenic perforation (Fig. 1.3).

1.1.4 Blood Supply

In sphincter-saving resections of the rectum, the major concern of the surgeon is to secure an adequate blood supply to the portions of the colon and rectum remaining for anastomosis [11]. There is a rich and homogenous vascular supply throughout all the rectal wall. The rectum receives its blood supply from the superior, middle, and inferior rectal arteries.

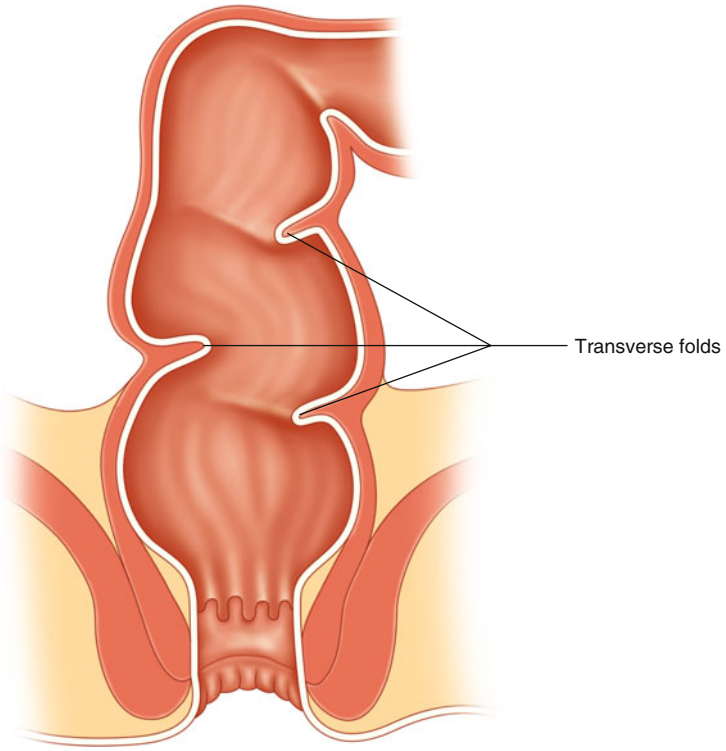

Fig. 1.3 Transverse folds in the rectum and anal canal

The superior rectal artery (SRA) is the terminal branch of the inferior mesenteric artery (IMA). The IMA courses downwards, crossing the left common iliac, and becomes the superior rectal artery in the pelvic mesocolon. The SRA reaches the posterior wall of the rectum at the level of the third sacral vertebra where it pierces the rectal wall and branches into two, left and right in approximately 80 % or occasionally multiply, diverging downwards and outwards while descending vertically or obliquely in the submucosa until approximately 8 cm from the anal margin [12, 13]. From here it supplies the lower rectum and anal canal, where branches reach the level of the rectal columns and condense in the hemorrhoidal plexuses. The middle rectal artery (MRA) is of variable origin, anatomy, and contribution to anorectal blood supply. It more commonly arises from the anterior division of the internal iliac artery, but can originate from the pudendal arteries. The MRA reaches the lower third of the rectum, close to the pelvic floor, and breaks up into several terminal branches. The vessel and its branches are susceptible to injury during low anterior resection when dissection of the rectum is performed close to the pelvic floor. The paired inferior rectal arteries arise from the internal pudendal artery (a branch of the internal iliac artery) as it passes through Alcock's (pudendal) canal. The inferior rectal artery is closely applied to the inferior surface of the levator ani

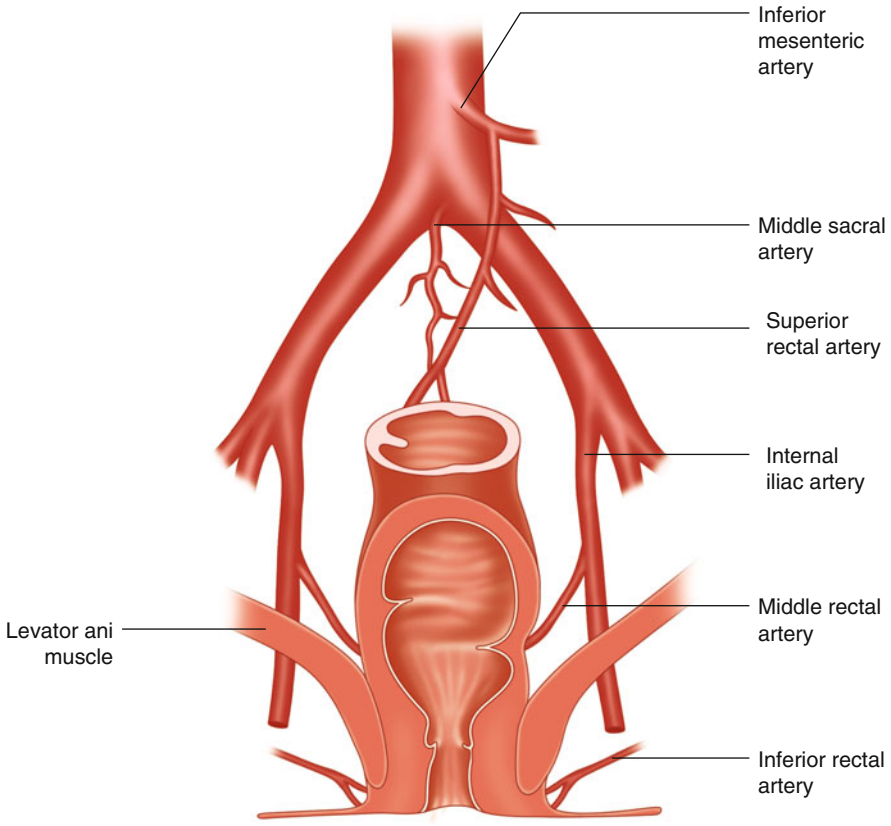

Fig. 1.4 Arterial blood supply of the rectum and mesorectum

muscles where it courses at the upper part of the ischiorectal fossa to pierce the rectal walls and enter the external anal sphincter (EAS) reaching the submucosa of the anal canal where it ascends in this plane (Fig. 1.4).

1.1.5 Venous Drainage

The paired middle and inferior hemorrhoidal veins and single superior hemorrhoidal vein originate from the three anorectal arteriovenous plexuses.

1. The external hemorrhoidal plexus around the dentate line.
2. The internal hemorrhoidal plexus above the dentate line.
3. The perirectal plexus, which drains to the middle and inferior hemorrhoidal veins only. Venous drainage tends to follow arterial supply in that the superior rectal vessels are the main contributors, draining back to the inferior mesenteric vein. The middle rectal veins are smaller tributaries but drain back to the internal iliac vein, while the inferior rectal vein drains via the internal pudendal vein to join the internal iliac vein and from thence the inferior vena cava.

1.1.6 Lymphatic Drainage

Villemin originally described how the lymphatic drainage differs between the upper and lower rectum, accompanying the superior, middle, and inferior rectal vessels. He referred to them as the superior, middle, and inferior trunks, respectively, the superior trunk draining the upper two thirds of the rectum and following the superior rectal nodes to the pararectal nodes, then to those at the inferior mesenteric arterial axis, and from there to the para-aortic nodes. The middle trunk drains the lower third of the rectum and runs mainly to the internal iliac nodes along the middle rectal vessels, while the inferior group drains the anal canal above the dentate line to the inguinal nodes (but can also drain to the internal iliac and superior rectal nodes) [14].

Lymphatic drainage, rather than "upward," can also to a variable degree follow an "outwards" path [15], although this is variable and inconsistent [16]. Japanese surgeons hence favor wide lateral clearance in rectal cancer, although this risks injury to the pelvic autonomic nerves, with consequent urinary and sexual dysfunction [17].

1.1.7 Innervation

The endoderm-derived rectum and left colon receive autonomic innervation by the parasympathetic and sympathetic nervous systems. Sympathetic fibers originate from L1, L2, and L3 and pass through ganglionated sympathetic chains to form the pre-aortic plexus, which is closely applied to the vessel. The pre-aortic fibers pass downwards below the aortic bifurcation at which point they form a presacral or (superior hypogastric) plexus. This hypogastric plexus branches into left and right along the pelvic sidewalls, running parallel and medial to the ureters, and then merges with parasympathetic nerve fibers originating from S2, S3, and S4. The parasympathetic fibers emerge from the sacral foramen as nervi erigentes or pelvic splanchnic nerves. These fibers pass inward and forward to form a network with the sympathetic fibers, which occurs at the pelvis plexus (inferior hypogastric plexus) lying above the levator ani. The inferior hypogastric plexus gives rise to the periprostatic plexus which is situated anterior to Denonvilliers' fascia and innervates the prostate, seminal vesicles, corpora cavernosa, vas deferens, urethra, ejaculatory ducts, and bulbourethral glands. In women it gives rise to the uterovaginal plexus supplying the vaginal walls, erectile tissue of the vestibule, clitoris, and uterus. The pelvic nerves also contain afferent sensory fibers, which transmit information from distension receptors in the rectal ampulla.

During an operation on the rectum the nerves supplying the urogenital organs are susceptible to damage at several points: the superior hypogastric plexus at the sacral promontory, the nervi erigentes at the posterolateral aspect of the pelvis, the pelvic plexus at the lateral pelvic wall and levator ani, and the periprostatic or uterovaginal plexus during anterior rectal dissection. Meticulous observance to the nervous anatomy during mobilization of the rectum is essential to minimize the risk of permanent bladder paresis or sexual dysfunction.

1.2 Anal Canal

The anatomical limits of the anal canal vary as to surgical or anatomical definition. The distal limit is at the anal verge, which is the junction between the anoderm and skin; however, proximally it can be described as either beginning at the dentate line (anatomical) or anorectal ring (surgical) [18]. Its length is approximately 2 and 4 cm, respectively. The anal orifice (anus) is closed, forming a tight, ridged seal, at rest.

Anatomical studies measuring the length of the surgical anal canal (anorectal ring to anal verge) demonstrate an average length of 4.2 cm (range 3.0–5.3 cm). There is a significant difference in length between men [4.4 cm (range 3.2–5.3 cm)] and women [4.9 cm (range 3.0–5.0 cm)]. The average length of the anal canal from the dentate line to the anal verge is 2.1 cm (range 1.0–3.8 cm), and there are, again, significant differences between the sexes, with women's marginally shorter [19] (Fig. 1.5).

1.2.1 Anatomical Relations

Anterior to the anal canal lies the perineal body; posteriorly the anococcygeal ligament separates it from the bony coccyx. Laterally lie the potential spaces that are the ischiorectal fossae, containing loose areolar tissue.

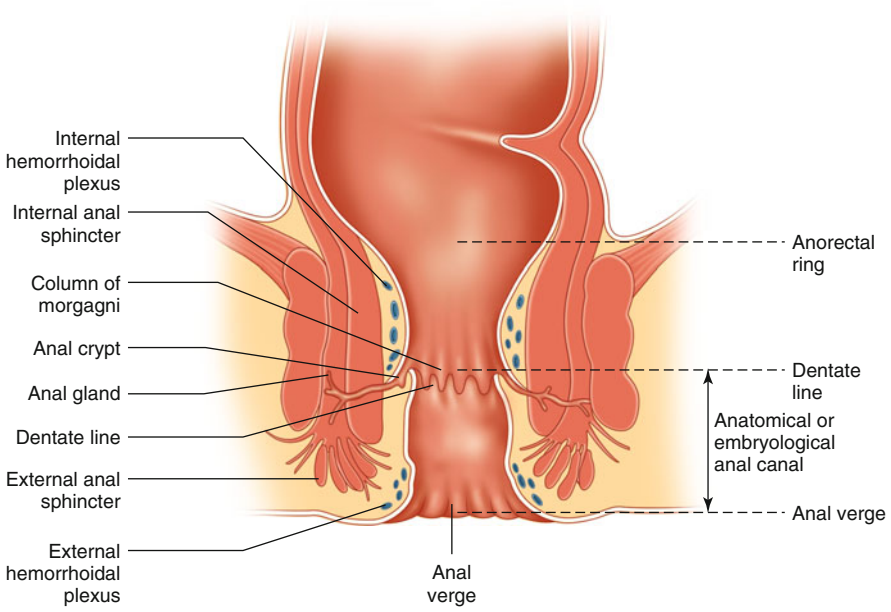

Fig. 1.5 Anal canal

1.2.2 Dentate Line

The dentate or pectinate line represents the boundary between the upper mucosal endoderm and lower cutaneous ectoderm (mucocutaneous junction) and lies approximately 1–2 cm from the anal verge (Fig. 1.5). Above the dentate line, the innervation of the intestine is by sympathetic and parasympathetic routes and blood supply and lymphatic drainage via the iliac vessels. Below, nervous innervation is somatic and the lymphovascular destination is the inferior hemorrhoidal system.

The cranial part of the dentate line is the point at which the anal valves lie. There are 6–12 vertical columns or ridges, called the columns of Morgagni, which have anal valves at their base and contain the internal hemorrhoidal plexus giving this area a characteristic purplish tinge on examination. Anal glands situated in the nearby submucosa discharge mucin via anal ducts to anal crypts at the level of the dentate line. Blockage of these ducts, perhaps by foreign material, is a causative factor in perianal sepsis, abscesses, and fistulae.

1.2.3 Histopathology

The epithelial type transitions from typical intestinal columnar epithelium of the rectum to stratified squamous epithelium at the anal verge (also known as the anocutaneous line of Hilton). Histologically the anal canal can be divided into three regions: the upper zone, from puborectalis to above the dentate line, the middle zone, or "anal transition zone (ATZ)," the morphology and extent of which is controversial, and the lower zone from the ATZ to the anal verge. The upper zone rectal mucosa is of simple columnar epithelium with short irregular crypts and more smooth muscle fibers within the lamina propria than the rectum. Around the dentate line, there is a transitional zone measuring 3–11 mm in length where the columnar mucosa becomes stratified squamous. As reported by Fenger, this is the zone interposed between uninterrupted colorectal-type mucosa above and uninterrupted squamous epithelium below, which has relevance for the treatment of anal canal carcinomas [20]. The anal transitional zone has been reported to be of stratified columnar or cuboidal epithelial type, although the majority consensus is that it consists of transitional-type epithelium. Here lie the anal crypts, sinuses, and ducts of the anal glands. The anorectal line was first described by Robin and Cadiat in 1874 as the junction between the glandular part of the anal canal and the simple columnar epithelium above. The anal glands, which are branched, straight, and tubular, extend into the submucosa and even muscularis mucosa and produce mucin onto the anal surface through anal ducts for lubrication of passing stool. The distal zone from the ATZ to the anal verge comprises non-keratinizing squamous epithelium with no glands or hair follicles (anoderm), and this then merges with the perianal skin which demonstrates features of normal skin such as hair follicles, keratin, and apocrine glands.

The cut-off between intestinal-type mucosa and anal canal is of importance in operations such as proctectomy and ileal pouch-anal anastomosis where it has been suggested that the ideal point of resection is at the anorectal line, thereby preserving all functions of the anal canal without residual intestinal mucosa [21]. It is thought that preservation of the ATZ via restorative proctocolectomy and ileal pouch-anal anastomosis improves clinically relevant and functional outcomes [22].

1.2.4 Continence

Continence to gas, liquid, and solid stool is facilitated by three main groups of contributory muscles: (1) circumferential closure provided by the two anal sphincters internal anal sphincter (IAS) and external anal sphincter (EAS), (2) pubococcygeus providing lateral compression, and (3) the angulation at the anorectal junction created by puborectalis. Continence is a highly complex function, still not yet fully understood, which also relies on the expansion of the anal cushions, the anatomical configuration of the rectum and anal canal, and the voluntary and involuntary reflexes coordinated by the colorectum and anus. The contribution to resting pressure of the anal canal is 55 % IAS, 30 % EAS, and 15 % vascular cushions [23].

1.2.5 Internal Anal Sphincter (IAS)

The internal anal sphincter is the distal 2–4 cm continuation of the inner circular muscle layer of the rectum and consists of smooth muscle (Fig. 1.6). It terminates with a well-defined rounded edge just above the external anal sphincter and anal orifice. It provides continuous tonic maximal contraction and is a natural barrier to the involuntary passage of gas and feces. It is the main contributor to anal resting pressure and thus continence [24]. The IAS also has periods of relaxation triggered by rectal distension (rectoanal inhibitory reflex, RAIR) and rectal sampling.

The length of the IAS is associated with the functional anal canal length and is measured by anorectal manometry or endoanal ultrasound as being shorter in women than in men (2.0–3.0 cm, 2.5–3.5 cm, respectively) [25]. This is important when considering sphincterotomy in women, whereby a similar length of division to that in men will sacrifice considerably more muscle in the shorter sphincter. There is also evidence to show morphological changes in its thickness with advancing age, ranging from 2 to 4 mm, an increase which is likely to be due to a process of smooth muscle fibrosis [26, 27].

The IAS receives innervation from the autonomic nervous system (sympathetic and parasympathetic), mainly from the inferior hypogastric plexus and from thence via the inferior rectal nerves. The parasympathetic system has an inhibitory effect on the tone of the IAS, causing relaxation [28].

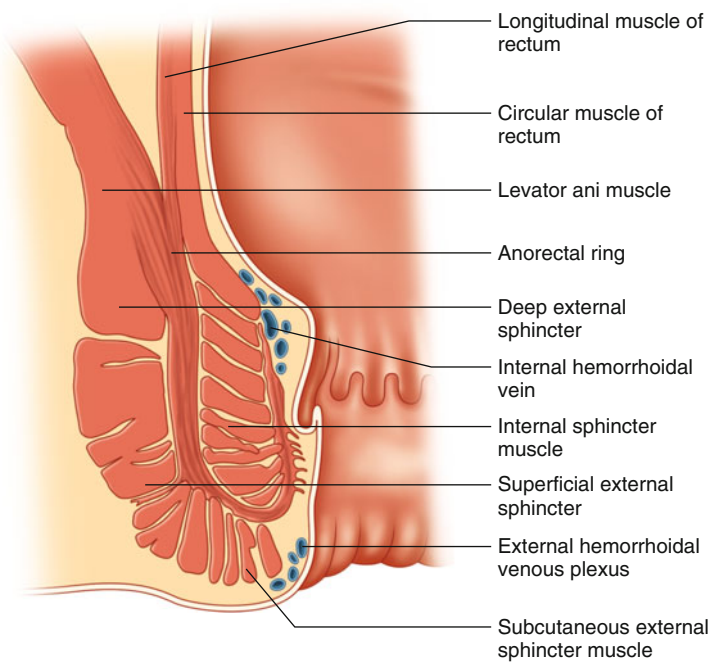

Fig. 1.6 Normal anatomy of the anal canal

1.2.6 External Anal Sphincter (EAS)

The external anal sphincter forms a clearly demarcated muscular tube around the anal canal and is made of striated, skeletal muscle. Originally, it was proposed that the EAS consisted of two parts [29], or was simply one whole muscle unit [30]. However, the general consensus is now that it is comprised of three parts: the subcutaneous, superficial and deep anorectal elements [31, 32].

The EAS is continuous with the puborectalis component of levator ani at its deepest part, forming the anorectal ring. Macroscopically the EAS is attached to the anococcygeal raphe posteriorly, whereas puborectalis is not. The morphology of the EAS differs between sexes, ages and after childbirth or instrumentation. The external sphincter is approximately 2.7 cm long, but is anteriorly shorter in women (approximately 1.5 cm) [26] and has a thickness of 4 mm on endoluminal imaging. A decrease in the thickness of the external sphincter over time is likely part of a normal ageing process for both women and men [26].

At its distal end, the EAS lies below the IAS, turning inward toward it. The edges of both sphincters are palpable at the anal verge, on either side of the intersphincteric groove that separates them. Laterally, inferior rectal branches of the internal pudendal nerve (S2, S3) and internal pudendal arteries cross the ischioanal fossa to

supply the external sphincter and anal mucosa on either side. The EAS also receives some innervation from the perineal branch of S4.

The pudendal nerve is a mixed motor and sensory nerve which arises from the sacral plexus S2–S4, leaves the pelvis through the greater sciatic foramen, and crosses this ischial spine. It then continues in Alcock's canal (pudendal canal) with the pudendal vessels, to enter the lateral aspect of the ischioanal fossae beneath the levator ani, toward the ischial tuberosity where it branches to give motor fibers to the EAS (inferior rectal nerve) and sensory fibers to the perineum (perineal nerve) as well as the dorsal nerve of the penis or clitoris.

1.2.7 Longitudinal Muscle

The outer longitudinal muscle layer of the rectum continues to the anorectal ring where it merges with fibers of the levator ani and becomes the conjoined longitudinal muscle. It descends between the IAS and EAS in the intersphincteric groove and breaks up at the level of the lower border of IAS into fan-like septa which interdigitate with the EAS and insert into the perianal skin as the corrugator cutis ani [33, 34]. The area enclosed by these septa is the perianal space. The longitudinal muscle is 2.5 mm thick and this decreases with age [26]. The longitudinal muscle consists of smooth muscle with some contributory striated muscle fibers from levator ani. It is thought that it contracts during defecation which leads to shortening of the anal canal; as such the muscle was called the "evertor ani muscle" by Shafik [35].

1.2.8 Levator Ani Muscles (LAM)

The pelvic floor consists of a complex interrelated structure of muscles, ligaments, and fascia. Its layers cranio-caudally include the endopelvic fascia, the muscular pelvic diaphragm (commonly referred to as the levator ani), the perineal membrane (urogenital diaphragm), and a superficial layer of muscles. The pelvic diaphragm is a striated, broad, thin, and funnel-shaped muscular shelf that supports the abdominal contents and plays an important role in continence and evacuation.

The levator ani muscles make up the pelvic diaphragm and consist of pubococcygeus, iliococcygeus, ischiococcygeus, and puborectalis muscles, although the latter's inclusion in the definition is disputed [36]. It has been suggested that the LAM are divided into a transverse and vertical portion and that puborectalis sits separately [37]. The LAM stretch from the peripheries of the bony pelvis, and then the bilateral LAM meet posteriorly in the midline to insert into the coccyx; the thick white fibers at insertion together are named the anococcygeal raphe [38].

Puborectalis muscle is a U-shaped loop muscular sling hooked around the rectum, forming the anorectal angle. It is not in itself connected to the rectum. Puborectalis originates from the posterior aspect of the pubis and the anterior obturator fascia, wrapping around the rectum to join corresponding fibers of the opposite side. Pubococcygeus runs from the anterior part of the pelvic fascia to the coccyx

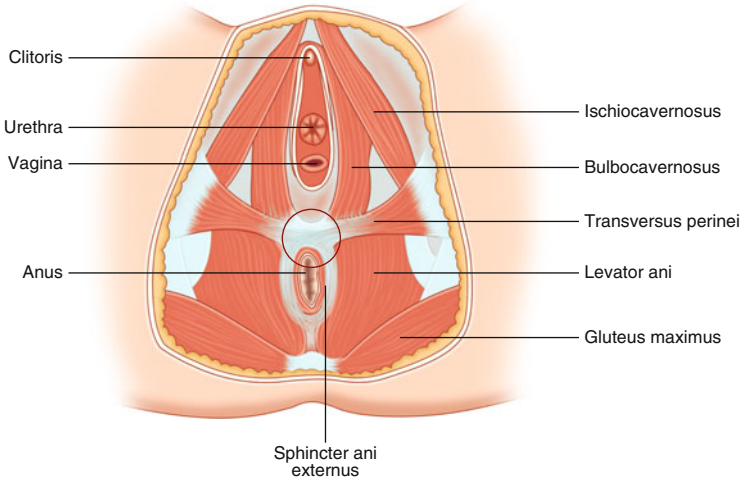

Fig. 1.7 The perineal body is a complex fibromuscular structure separating the urogenital organs and the anal sphincter

and lies directly above puborectalis. Iliococcygeus originates from the lateral part of the obturator fascia and inserts into the coccyx. Innervation of the levator ani is by the pudendal nerve on its perineal aspect and the nerve to levator ani (S3, S4) on its pelvic surface [36].

1.2.9 Perineal Body

The perineal body, a complex fibromuscular structure separating the urogenital organs and the anal sphincter, lies between the anal canal and the posterior fourchette in women and the penile bulb in men (Fig. 1.7). It is a vital constituent of both urinary and fecal continence mechanisms, supporting the perineum against increased abdominal pressure and is vulnerable to injury during childbirth. The perineal muscles (superficial and deep transverse perineal muscles) form the bulk of the perineal body as they cross the midline, but it also receives contributions from the external anal sphincter, bulbospongiosus muscle, and levator ani [39].

1.2.10 Blood Supply

Arterial supply to the anal canal is via the superior, middle, and inferior rectal arteries. Venous drainage is via the internal hemorrhoidal plexus to the superior rectal vein, to the inferior mesenteric vein, and to the portal system. The external hemorrhoidal plexus drains via the middle rectal vein to the pudendal, internal iliac vein and finally the inferior vena cava and via the inferior rectal vein to the internal pudendal vein.

1.2.11 Lymphatic Drainage

The lymphatic drainage of the rectum has been described above. The drainage of the upper anal canal, above the dentate line, is similar to the rectum, following the venous drainage path to the inferior mesenteric and internal iliac nodes. Below the dentate line, drainage follows the inferior rectal vein to the superficial inguinal nodes.

1.2.12 Perianal Skin

The perianal skin around the anal verge consists of keratinized stratified squamous epithelium with eccrine glands, pilosebaceous units, and apocrine glands. The skin is pigmented and corrugated over the underlying EAS and allows for a large degree of stretch. It is exquisitely sensitive, with somatic innervation via the pudendal nerves S2, S3, and S4. Lymphatic drainage is to the superficial inguinal lymph nodes. The perianal skin is susceptible to any normal dermatological diseases.

1.3 Radiological Evaluation

Ultrasound is readily available, inexpensive, valuable in assessing rectal malignancy, sphincter complex anatomy, and benign anorectal disease. Its operator dependency does however, limit its consistency.

1.3.1 Endorectal Ultrasound (ERUS)

Rectal imaging requires an ultrasound transducer probe covered by a water-filled balloon. The patient is given an enema and examined in the left lateral decubitus position. ERUS images are able to demonstrate five main layers: (1) balloon mucosa interface, (2) mucosa and muscularis mucosa, (3) submucosa, (4) muscularis propria, and (5) interface with fat (Fig. 1.8a, b).

Occasionally there is an additional layer seen, the submucosa being separated into inner circular and outer longitudinal muscle. ERUS is a valuable tool for assessing the depth of tumor invasion in rectal cancer; however, the detection of malignant involvement of perirectal lymph nodes is less accurate.

1.3.2 Endoanal Ultrasound

Endoanal ultrasound is valuable in the assessment of benign and malignant disease as well as providing detailed views of the anal sphincter complex in the assessment of incontinence. Similar to the ERUS, a transducer is placed inside the anal canal

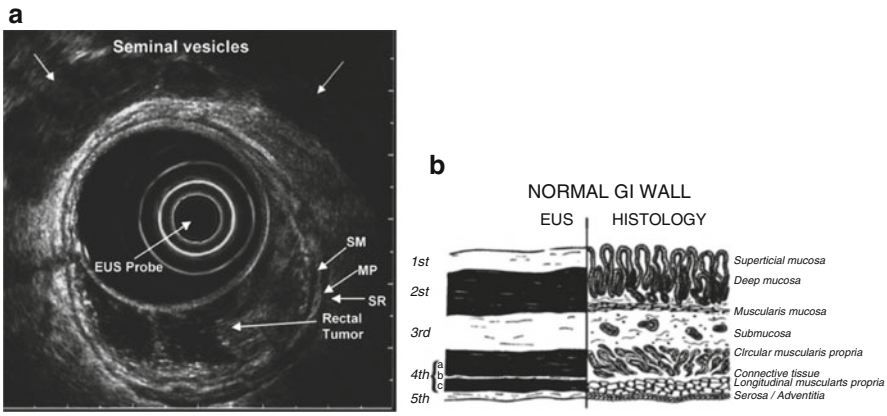

Fig. 1.8 (**a**) ERUS showing T1 rectal cancer confined to the mucosa and superficial submucosa. *SM* submucosa, *MP* muscularis propria, *SR* serosa. (**b**) Corresponding ERUS and histological layers (from Siddiqui et al. [40], with permission)

but covered with a water-filled plastic cap. The probe is introduced to cover the entire anal canal and it is viewed at the upper, mid, and lower anal levels. The upper level is delineated by puborectalis, the IAS, and EAS seen at the mid-level by a hypoechoic and hyperechoic band, respectively. The anal vascular cushions of variable thickness can also be visualized at this point. At the distal anal canal, the IAS is no longer seen, only the hyperechoic EAS and surrounding fatty tissue. Defects in the sphincters can be accurately assessed and are seen as missing segments of the circumferential band, or in the EAS these may be seen as hypoechoic or amorphous and mixed echogenicity defects [41]. In complete sphincter disruption, there will be a complete gap in the sphincter concentric ring with scar tissue replacing vital muscle. Fistula tracts can be seen as hypoechoic defects and their paths can be traced in relation to the sphincter mechanism. More recently, 3D ultrasound images have shown reliable assessment of anal sphincter complex morphology with the ability to capture anal sphincter volume [38].

1.3.3 MRI

The two main approaches for MRI are with an external or an endoanal coil. The benefit of the latter is greater spatial discrimination, but this is at the expense of breadth of field. This then suits endocoil MRI to conditions of the anal canal specifically sphincter defects, abscess, and complex fistulae. MRI with an externally placed coil provides valuable information about rectal and anal anatomy within the general landscape of the pelvic anatomy. Endocoil MRI has provided colorectal surgeons with a more detailed anatomical understanding of the sphincter complex and pelvic musculature [26].

1.4 Clinical Evaluation

Following a thorough history and discussion with the patient, a general and abdominal examination is performed. A routine digital rectal examination should be performed on all patients presenting with anorectal or lower gastrointestinal symptoms. After gaining consent, the patient is placed in a comfortable position for examination of the perianal region, perineum, anus and rectum. The left lateral decubitus position is most commonly used, but patients can also be examined in the genucubital or lithotomy position. It is important to obtain consent and ensure patient comfort and dignity, optimum lighting, and the presence of a chaperone. Parting the buttocks allows for adequate inspection, and here the skin should be examined for dermatological disease and external stigmata of perianal or gastrointestinal disease. The surgeon should specifically look for any previous scars, any swellings or ulceration, external fistula openings on the skin, and any obvious pus, mucus, or bloody discharge. A closer look at the anoderm may reveal the characteristic ulcer of an anal fissure. The patient should be asked to strain, looking for rectal prolapse, prolapsing hemorrhoids or anal polyps, and perineal descent.

If the patient will tolerate digital rectal examination, a gloved and lubricated index finger is inserted gently into the anus. The finger is advanced meanwhile assessing for any discomfort. The areas examined are the wall of the anal canal and rectum; the anterior aspect allows palpation of the prostate in men and posterior cervix in women, and the coccyx can be felt posteriorly. Resting and then voluntary sphincter tone can be assessed. Examination of the gloved finger upon withdrawal may show signs of pus, blood, mucus, or melena.

1.4.1 Proctoscopy/Anoscopy

This is a quick and inexpensive method to examine the anus and anorectum to approximately 10 cm following digital rectal examination. This should be performed in all patients with proctological signs or symptoms when tolerated. In addition, it allows the surgeon to perform outpatient treatments of hemorrhoidal disease.

The anoscope should be well lubricated and assembled before beginning the procedure. The introducer of the anoscope is inserted slowly into the anal canal to the hilt. The introducer is removed and a close inspection of the anal canal mucosa made. Here any mucosal inflammation or ulceration, any anal polyps, or low tumors in the anal canal should be visible. Hemorrhoids will be seen above the dentate line as purple-tinged grapelike swellings that extend into the lumen of the anal canal. They may bleed on contact.

1.4.2 Hemorrhoid Injection Therapy

Before any treatment in clinic, the patient should be warned of potential post-procedure discomfort and minor bleeding. After informed consent, the correct equipment should be prepared.

Injection of hemorrhoids with 5 % oily phenol (arachis oil) requires a long needle and syringe and anoscope. With the hemorrhoids demonstrated and the dentate line identified on anoscopy, the needle is advanced and, using a gentle, but purposeful, stabbing motion, pierces the submucosa. The patient should not feel any pain if one is correctly above the dentate line. If any sensation is felt, the needle needs to be removed and reinserted cranially. Injection of the sclerosant should raise a bleb of mucosa. Approximately 3–5 ml is injected into each visible hemorrhoid taking care not to inject too deep anteriorly as the misplaced injection of phenol can cause prostatitis, perineal pain, and in severe cases urinary sepsis.

1.4.3 Rubber Band Ligation

The suction hemorrhoid applicator ensures ease of application of the rubber band. The applicator is introduced through the anoscope, and with suction of the mucosa overlying a visible hemorrhoid, a rubber band is deployed over the hemorrhoid bundle. Although a dull sensation of pressure within the anal canal is expected, sharp pain signifies incorrect application of the band at or below the dentate line suggesting the need for removal. The bands usually fall out after 5–10 days.

1.4.4 Rigid Sigmoidoscopy/Proctosigmoidoscopy

This is an essential diagnostic tool in the outpatient and operating room setting and provides a view of the rectal mucosa for the evaluation of inflammation, ulceration, or bleeding. In addition rectal polyps and tumors can be visualized and their distance from the anal verge measured. In the acute setting, a sigmoid volvulus can often be conservatively managed by insertion of a flatus tube via a proctosigmoidoscope with subsequent decompression of the bowel.

With the patient comfortable, consented, and chaperoned, the lubricated rigid sigmoidoscope is gently inserted. After entry into the anal canal, the introducer is removed. The light source should allow direct visualization of the anal canal and then the rectal mucosa. The rigid scope is gradually advanced with the gentle insufflation of the rectum with air as required to view the walls clearly while constantly viewing the rectal lumen. This helps advancement of the tube in such a way that it follows the course of the rectum within the pelvis and reduces the risk of mucosal damage or rectal perforation. With the patient in the left lateral position, the rigid sigmoidoscope is first angled toward the sacrum and then advanced with an anterior tilt at the anorectal angle. The sigmoidoscope in an empty rectum can optimally reach 20–22 cm.

1.4.5 Flexible Sigmoidoscopy

Flexible sigmoidoscopy allows visualization of the rectum and distal colon to a greater distance than the rigid tube. In a comfortable and well-prepped patient, the entire sigmoid, left colon, and splenic flexure can be seen. With the patient in the

left lateral position, the flexible fiber-optic tube is inserted into the anal canal. The rectal mucosa is pink and folded. Upon air insufflation, the walls expand outwards to offer a clear view of the lumen. The valves of Houston can be negotiated to allow more proximal examination. The majority of adenocarcinomas are found in the left colon (27 % rectum, 7 % rectosigmoid junction, 20 % sigmoid, 3 % descending colon). Flexible sigmoidoscopy can be used for biopsy, polypectomy, hemostasis of actively bleeding lesions, and tattooing of lesions.

1.4.6 Positioning in the OR

Optimal positioning in the OR allows for good exposure of the relevant anatomy, unimpeded access for the surgeon in order to perform the procedure and safety for the patient. Padded supports provide protection against pressure injuries, for example, common peroneal nerve injuries in the lithotomy position due to compression from the supporting bar on the nerve as it wraps around the fibula. Aside from the supine position, some of the most common positions used are lithotomy, Lloyd-Davies, and prone jackknife (Fig. 1.9 a–c).

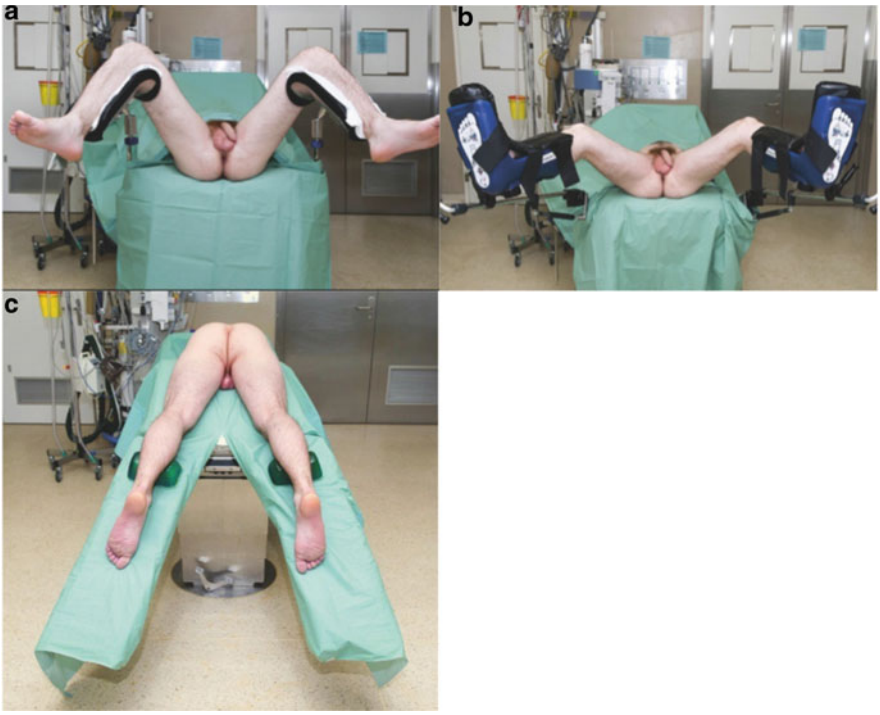

Fig. 1.9 (**a**) Lithotomy. (**b**) Lloyd-Davies. (**c**) Prone jackknife (from Givel [42], with kind permission)

1.5 Common Anorectal Conditions and Applied Anatomy

1.5.1 Fissure

Fissure in ano is a common and problematic benign anorectal condition, which makes up 15 % of proctology consultations [43]. The condition is defined as a linear tear or ulcer in the anorectal squamous epithelium that occurs beyond the dentate line, at the anal verge. A chronic anal fissure is one that persists for more than 6 weeks despite medical management and may have the classic features of rolled edges, exposure of the internal anal sphincter fibers, and a sentinel tag or anal papilla. Fissures are usually in the posterior midline, but can also be found anteriorly, laterally, or in multiple locations. The location of the fissure may suggest a cause, with lateral fissures suggesting an underlying chronic disease process such as Crohn's, ulcerative colitis, syphilis, tuberculosis, leukemia, cancer, or HIV. It is hypothesized that hypertonia and relative sphincter hypoperfusion result in ischemia of the posterior anal canal which causes pain and poor wound healing associated with a chronic anal fissure. This may be further exacerbated by recurrent minor anal trauma.

Digital rectal examination and proctoscopy may not be tolerated due to pain. If permitted, the gloved finger may identify a tender ridge at the position of the fissure, while proctoscopy reveals a raw ulcer or split in the anoderm. Longstanding fissures may reveal fibers of the internal anal sphincter and sentinel tag(s) or anal papilla(e). Patients will exhibit varying degrees of sphincter spasm on examination consistent with the hypothesized pathophysiology of hypertonic sphincter.

The first steps to treating any acutely symptomatic fissure in ano are conservative, with analgesia, stool softeners and sitz baths. Many will heal spontaneously; however, if that fails, topical ointments which act to reduce internal anal sphincter tone and improve local blood flow such as nitroglycerine, diltiazem, or nifedipine are used. Surgical treatment options include injection of Botox, fissurectomy, lateral internal sphincterotomy (LIS), and anal advancement flaps. Lateral internal sphincterotomy can be performed using an open or closed technique and involves a controlled division of the internal sphincter. In LIS the internal sphincter is divided from its caudal edge, to a variable proximal distance, but no further than the dentate line. Over-extensive cutting can lead to incontinence.

1.5.2 Hemorrhoids (from the Greek Haem = Blood, Rhoos = Flow. Piles in Latin Pila = a Swelling or Ball)

The anal cushions are physiological highly vascular structures, present in all individuals, and located above the dentate line at the transition zone. Their vascular nature enables them to vary in size and they become engorged with blood during periods of raised intra-abdominal pressure. This aids closure of the anal canal, contributing to the maintenance of continence [44]. The vascular cushions consist of the lining mucosa, the underlying vascular plexus, smooth muscle, and the connective

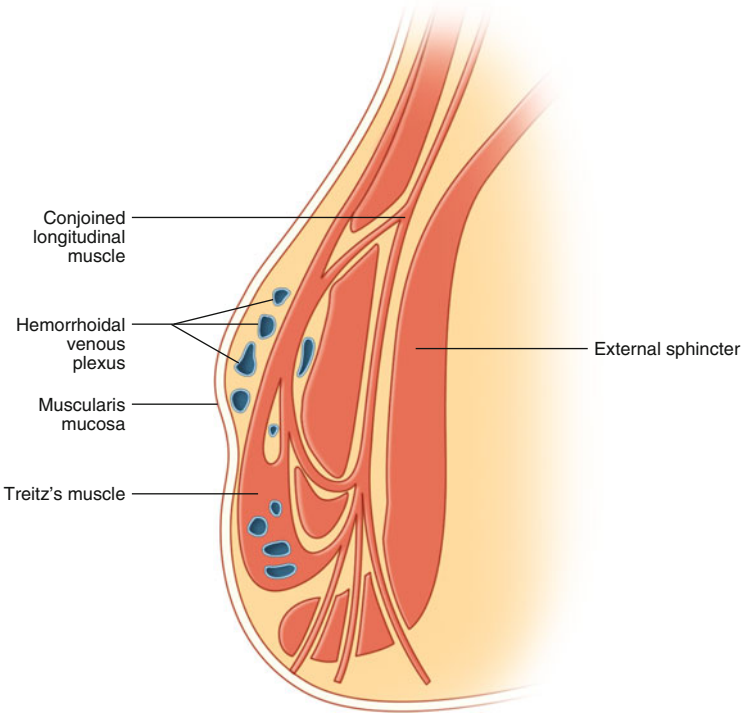

Fig. 1.10 The vascular cushions consist of the lining mucosa, the underlying vascular plexus, smooth muscle, and the connective tissue scaffolding which anchors the hemorrhoids to the internal sphincter and the conjoined longitudinal muscle

tissue scaffolding which anchors the hemorrhoids to the internal sphincter and the conjoined longitudinal muscle (Fig. 1.10) [45]. The anal submucosal smooth muscle, or Treitz's muscle, originates from the longitudinal muscle and passes through the internal anal sphincter anchoring the hemorrhoids to the submucosa. Smooth muscle fibers interdigitate the vascular plexus forming a scaffold support, which is susceptible to damage in hemorrhoidal disease. Described by Thomson in 1975, the anal cushions are classically located in the left lateral, right anterior, and right posterior positions (3, 7, 11 o'clock) [46]; however, only 19 % of patients are found to have this arrangement of hemorrhoids.

1.5.3 Anal Cushion

The hemorrhoidal plexus within the submucosa is also called the corpus cavernosum recti [47] as it is a dense vascular network which fills and engorges, similar to erectile tissue. The arteriovenous network does not have interposing capillaries. When patients notice fresh red rectal bleeding, the pH when tested confirms mainly arterial bleeding. The vascular plexus is primarily fed by terminal branches of the

superior hemorrhoidal artery with anastomoses to the middle and inferior hemorrhoidal arteries [46]. Transanal hemorrhoidal dearterialization (THD) and Doppler-guided hemorrhoidal artery ligation (DG-HAL) are surgical techniques to treat hemorrhoids and are targeted at restricting arterial blood flow.

Venous drainage follows that of the arterial supply from superior rectal to the inferior mesenteric and the middle rectal and inferior rectal (via the pudendal) to the internal iliac vein and thus to the inferior vena cava. The anal canal is an example of a portosystemic anastomosis, whereby the superior rectal vein drains into the portal system (via the inferior mesenteric vein) and the middle and inferior rectal veins drain into the systemic circulation (internal iliac and pudendal vein).

Hemorrhoids can be classified as either internal or external, depending on their relation to the dentate line. Internal hemorrhoids derive from the embryonic endoderm and are lined with the columnar epithelium of the anal mucosa. The internal hemorrhoidal plexus above the dentate line is drained by the middle rectal vein to the internal iliac vein. The external hemorrhoids are derived from ectoderm and are covered by squamous epithelium. The exterior hemorrhoidal plexus lies below the dentate line and drains via the inferior rectal vein to the pudendal vein and hence to the internal iliac vein. Either can prolapse and be identified from the anal verge on examination.

The inferior rectal nerve and perineal nerve (branches of the pudendal nerve) provide somatic innervation distal to the dentate line. Proximally the only sensation is supplied by visceral afferent fibers which join the inferior hypogastric plexus. Clinically this explains why painful hemorrhoids tend to be those that are either external hemorrhoids or prolapsed or thrombosed internal hemorrhoids.

The etiology of hemorrhoids is still debated. It is proposed that if the anal cushions are distally displaced, by straining, sustained increased intra-abdominal pressure or laxity of the supporting structures with age (smooth muscle replaced with connective tissue) and increase an in size, they may become more susceptible to trauma and shearing forces and symptomatic hemorrhoids may then occur [48, 49]. Hypertonia of the internal anal sphincter has also been postulated [50]. Histologically, hemorrhoids show hypertrophy of the subepithelial smooth muscle of the anal cushions, thickened intramucosal vessels, and stromal hyperplasia. Submucosal thickening, in combination with thickening of the internal anal sphincter, has also been shown on ultrasonography. Based on the degree of prolapse, hemorrhoids are graded as grade I hemorrhoids that do not prolapse, grade II hemorrhoids that prolapse and spontaneously reduce, grade III hemorrhoids that prolapse but require manual reduction, and grade IV that remain persistently prolapsed [51]. Treatment depends on the degree of prolapse and severity of symptoms, with grades I and II generally amenable to local procedures in the clinic.

1.5.4 Perianal Sepsis

The majority of perianal sepsis is thought to be cryptoglandular in origin; it is hence vital to understand the anatomy of the anal glands. Above the dentate line are crumpled folds in the anal mucosa called the columns of Morgagni. At the base of these lie the anal crypts and these communicate with ducts that drain the anal glands.

The anal glands normally produce mucin for lubrication of the anal canal for the smooth passage of stool; however, if blocked, for example, by foreign material, infection may ensue. Anal glands lie mostly in the submucosal plane, but can also be found at the IAS, communicating with the intersphincteric space and extending to the conjoined longitudinal muscle.

1.5.5 Anal Glands

There are a number of potential spaces for infection to develop and these are called the perirectal spaces. Infection either can seed and spread upward from the perianal region or can spread downwards from the pelvic cavity. The perirectal spaces that can develop abscesses include:

1. Perianal space: Surrounds the anal canal at the anal verge. Its borders include the subcutaneous fat laterally and the anal canal medially. This space connects with the intersphincteric space.
2. Intersphincteric space: Between the IAS and EAS.

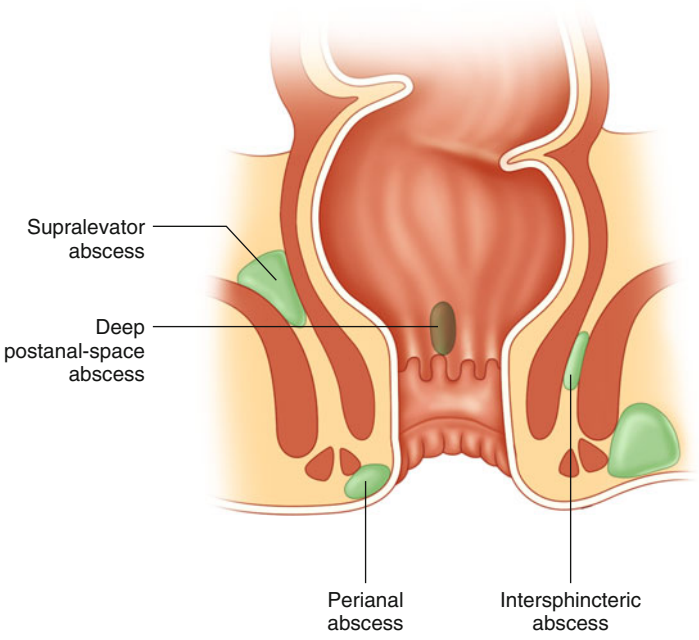

Fig. 1.11 The perirectal spaces that can develop abscesses include perianal space, intersphincteric space, ischiorectal space, and supralevator space

3. Ischiorectal space: This large area of loose adipose is bordered proximally by the levator ani, distally the perianal skin, medially the EAS, and laterally the ischial tuberosities.
4. Supralevator space: This space is bound above by the levator ani, medially by the rectum, and laterally by the pelvic side wall. It may extend as far cranially as the peritoneal reflection.
5. Postanal space: This space lies directly behind the anal canal, limited further posteriorly by the tip of the coccyx, and lies caudal to levator ani.

1.5.6 Abscess

An abscess is a localized collection of pus, which within the anatomical confines of the perianal spaces can cause a considerable amount of pain. Perianal abscesses are common and can range from a simple, small perianal abscess to large horseshoe, circumferential perianal collections.

On examination, classically there will be a tender, erythematous, fluctuant swelling. Some may have a central punctum with expressed pus. Patients may complain of severe pain without the obvious findings of an abscess, but this may reflect a deeper infective process. In this case on gentle rectal examination, a bulge or tenderness of the rectal wall may be felt, or pus may be found in the anal canal. Anoscopy may not be tolerated and an MRI perineum or examination under anesthesia may be necessary to provide further information (Fig. 1.11).

1.5.7 Fistula

A fistula is an abnormal connection between two epithelial-lined surfaces. A fistula in ano is an abnormal tract lined by granulation tissue communicating with the rectum or anal canal by an identifiable internal opening. Fistulae can be both recurrent and complex to manage. The majority of fistulae are cryptoglandular in origin and are preceded by anorectal abscesses. A failure to understand the anatomy of the fistula tract(s) in relation to the sphincter complex can result in recurrence, incontinence, or both. Sir Alan Parks classified the anatomy of fistulae in 1976 into those that are intersphincteric, transsphincteric, suprasphincteric, or extrasphincteric, based on the relationship of the tract to the external anal sphincter. These are presented here in order of increasing rarity (Fig. 1.12) [52].

1.5.7.1 Classification of fistulae

1. Intersphincteric: Passing within the intersphincteric space to the perianal skin.
2. Transsphincteric: Crossing the IAS and EAS through to the ischiorectal space and then to the perianal/gluteal skin. These can be classified as high, mid-, or low depending on the relation to the dentate line.

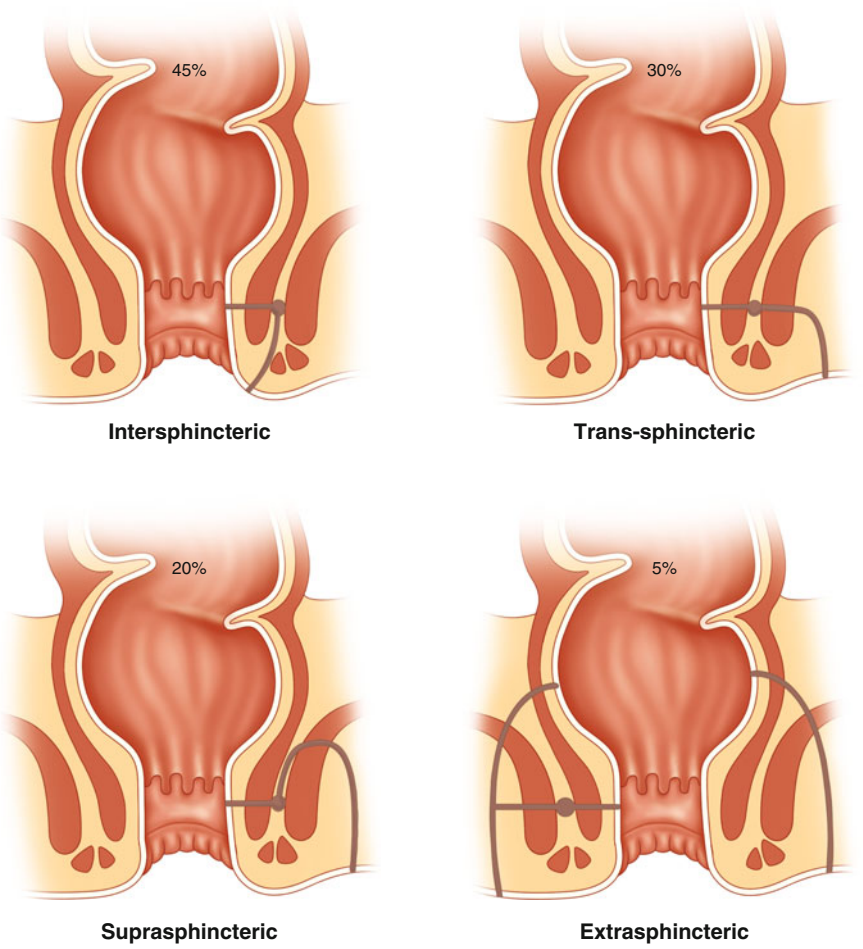

Fig. 1.12 Fistulae can be divided into intersphincteric, transsphincteric, suprasphincteric, or extrasphincteric, based on the relationship of the tract to the external anal sphincter

3. Suprasphincteric: Passing up within the intersphincteric space, beyond puborectalis to return back through levator ani and through the ischiorectal space, lateral to EAS to pierce the skin. The internal opening is at the level of the dentate line.
4. Extrasphincteric: Passing from the rectum, above levator ani, not involving the sphincters and passing through the ischiorectal space to the skin. The internal opening usually lies above the dentate line.

Examination may demonstrate an external opening of the fistula in the perianal skin or the buttocks. There may be mucus or pus discharge visible. On rectal examination, it may be possible to palpate the firm, cord-like tract of the fistula. An internal opening may be felt as a small nodule or pit and it may be possible to visualize this on anoscopy.

1.5.8 Goodsall's Rule

According to Goodsall's rule, the path of the tract can be predicted by the position of the external opening. An opening posterior to the transverse anal line suggests a curved tract toward the midline while an anterior opening suggests a straight tract to the nearest anal crypt. The greater the distance of the external opening from the anal verge, the more likely the tract will be complex. This knowledge guides preliminary examination under anesthetic.

In the operating room, it is important to identify the external opening, the internal opening, the course of the primary tract, and any additional connecting tracts or blind-ending sinuses. Fistulae involving a considerable proportion of the sphincter complex will be treated differently to those with minimal muscle involvement. The injection of hydrogen peroxide into the visible external opening can often help identify the internal opening.

1.6 Local Pain Blocks

A number of anorectal procedures can be carried out in the outpatient setting under local anesthetic safely and effectively. The benefit of local (and regional) anesthesia is that it provides good analgesia with minimal side effects, at a lower cost, with equivalent patient satisfaction, and can allow for earlier patient discharge.

Local anesthetics can be used with or without sedation as part of a minor procedure or in conjunction with general anesthetic to aid with postoperative pain relief [53]. The anal and perianal region is highly innervated and has a complex nervous anatomy; therefore, an understanding of the relevant underlying structures is essential to achieve effective anesthesia and total relaxation of sphincters.

1.6.1 Perianal and Perineal Block

Local anesthetics such as lidocaine, bupivacaine, and rupivocaine are routinely used, with or without the addition of adrenaline to delay absorption and prolong the anesthetic effect. Sedatives can be used as adjuncts for patient comfort. A number of techniques have been described for perianal block [54], and they have been shown to be effective in surgery for fissures, fistulae, as well as excisional and stapled hemorrhoidectomy [55, 56]. It is perhaps the lack of consensus on the optimum method of infiltration which prevents the majority of anorectal operations from being done under LA. Rather than blocking one specific nerve, these methods aim to block the terminal nerve branches supplying the anal canal from the pudendal nerve: the anococcygeal, inferior rectal, and perineal nerve branches. Prior to injection, the application of EMLA cream perianally has shown to reduce the discomfort associated with the initial needle point [57]. The majority of described methods resemble the posterior perineal block, first described by Marti [58] and modified by Gabrielli [59], whereby local anesthetic infiltration begins 2 cm from the anal verge

at the posterior commissure; the needle is inserted deeply, laterally, and forward deep to the levator; and finally the perineal skin is then anesthetized. Additions to complement the posterior perineal block include perisphincteric and submucosal [60] injection or intersphincteric injection [61]. Other perianal block techniques include injection in the intersphincteric plane [57], injection of columns of anesthetic perisphincterically to the levator [56], and submucosal injection [62]. Nivatvongs described a method of submucosal infiltration to reduce the pain of the superficial injections, whereby local anesthetic is injected cranial to the dentate line in the submucosal plane, where there is a lack of somatic sensation, and this is then milked caudally to reduce the discomfort during the perianal part of the anesthetic [63]. A similar effective method has been described using a hooked needle [64].

1.6.2 Pudendal

The pudendal nerve block can be used for the treatment of pudendal neuralgia or for elective anorectal procedures including fistula surgery and hemorrhoidectomy. It can be approached in several different ways, transvaginally, transperineally, or transgluteally. In addition it has been safely performed with ultrasound and CT guidance, as well as with peripheral nerve stimulation to reduce the risk of adjacent pudendal vessel damage [65]. The patient is in the prone jackknife position and additional sedation is normally given. The pudendal nerve is infiltrated with local anesthetic solution where it crosses the ischial spine. The ischial spine is palpated through the vagina or rectum and in a transgluteal approach the needle is inserted midway between the EAS and the ischial tuberosity. Pudendal nerve block provides both effective anesthesia and complete relaxation of the sphincters, which is necessary for dilation of the anal canal [66].

1.7 Summary

A detailed knowledge of anorectal anatomy is essential for both accurate clinical diagnosis and safe, effective therapeutic intervention. Benign anorectal conditions comprise a large proportion of the colorectal surgeon's workload. These are common problems that are not always simple to manage, with potentially devastating complications if not approached with meticulous care and a thorough anatomical understanding. Knowledge of in-vivo anatomy and its clinical application has significantly improved with the advent of advanced imaging and functional assessment techniques such as endocoil MRI, three-dimensional endoanal ultrasound, and anal manometry.

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Investigations for Anorectal Disease

2

Michael A. Valente

The office-based evaluation of anorectal disease consists of the focused history and the all-important anorectal physical examination. The anorectal examination is of paramount importance and should be undertaken in a logical, stepwise manner. Many patients who present to the specialist have yet to be examined and are often nervous, apprehensive, and scared. It is the colorectal surgeon's responsibility and duty to make this examination as comfortable as possible. A proper anorectal examination in the office will yield much information and allow for proper diagnosis and subsequent treatment. This chapter focuses on the examination of the patient with an anorectal complaint, including the digital rectal examination, anoscopy, rigid proctosigmoidoscopy, and flexible sigmoidoscopy. Anorectal physiology and endoanal ultrasound may also be performed in specific patient populations, and these are addressed.

2.1 History

The first and the most important aspect in evaluating a patient with an anorectal complaint is a focused and detailed history. Due to the fact that there may be a vast list of symptoms and signs for anorectal disease, the surgeon must ask the patient specific questions in a way to narrow the differential diagnosis. A good history will in most cases establish the diagnosis or at least suggest it. Past medical, surgical (including obstetrical), and family histories must be obtained as well as a list of current medications. Sexual practices should also be addressed, as these may be relevant in some cases. The patient may present with a wide variety of symptoms that will need to be explored by the surgeon in further detail. Conditions such as

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bleeding per anus, anorectal pain, change in bowel habits, rectal discharge, anal or feeling a perianal mass, and fecal incontinence all need to be evaluated with specific and focused questions in mind before the examination takes place. It is also very important to elicit a family history of colon cancer and a history of a recent or past colonoscopy. It should be noted that even today, many patients may have an anorectal complaint for a prolonged time without having had an examination performed and, hence, many diagnoses may be made for the first time in the surgeon's office.

2.2 Physical Examination

Following a detailed history, a focused general examination should be performed on all patients presenting with an anorectal or pelvic floor complaint. This should be undertaken to identify any coexisting systemic disease. Body mass index (BMI) should be recorded as a patient's weight may influence certain symptoms. An abdominal examination is performed, documenting any surgical incisions and the presence of any mass or ascites. Palpation is aimed at detecting any tenderness, peritoneal irritation, or abdominal masses. Inguinal examination should be completed as well, looking for the presence of lymphadenopathy.

It is compulsory to establish an anxiety-free and modest environment during the anorectal examination. Most patients will exhibit nervousness, embarrassment, and apprehension, which often will cause anal/gluteal spasm that will undoubtedly preclude an accurate assessment. The examiner must make every effort to reassure the patient and keep anxiety and embarrassment to a minimum. This can be accomplished by effective communication, keeping the patient covered as much as possible, keeping the number of personnel in the room to a minimum, and not rushing through the examination. Patients should be verbally explained exactly what the examination entails and this needs to be vocalized in real time as the examination is progressing. The local examination consists of proper patient positioning, visual inspection and manual palpation, and the digital rectal examination (DRE).

2.2.1 Positioning

There are several positions that may be used for effective anorectal examination. The choice of position may depend on several variables including available equipment, patient age and comorbid status, and physician preference. Regardless of the position chosen, both the patient and the examiner must be comfortable in order to carry out an effective evaluation and perform any diagnostic and/or therapeutic maneuvers.

The inverted prone jackknife position on a specialized proctoscopic table (Fig. 2.1) is used very commonly and allows for excellent visualization of the entire anus and perianal and perineal region, as well as the sacral region. The patient kneels and leans forward with their trunk and arms extended forward (Fig. 2.2). This is a comfortable position for the examiner and also allows for easy insertion of

Fig. 2.1 Ritter proctoscopic table used for examination in the prone jackknife position

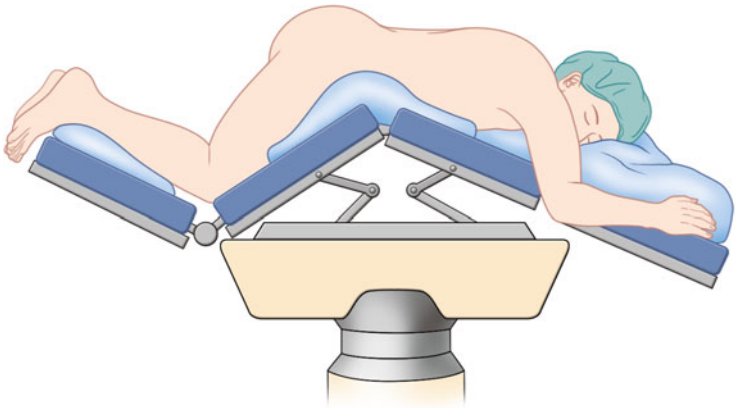

Fig. 2.2 Prone jackknife position

the anoscope or proctosigmoidoscope. This position is tolerated well by most patients, but should be avoided in various situations, such as debilitated patients, recent abdominal surgery, cardiopulmonary issues, issues with the knee joints or knee replacements, or late pregnancy.

Alternatively, the left lateral recumbent (Sims') position is also widely used, especially if a specialty bed is not readily available (Fig. 2.3). This position is very well tolerated and is well suited for elderly or debilitated patients. The patient lies on their left side and the thighs are flexed as to form a 90° angle with the trunk. It is imperative that the buttocks project slightly beyond the edge of the examining table. This position will allow for excellent visualization of the perianal and sacral regions, but the anterior perineum is obscured and requires the retraction of the buttock by an assistant especially in patients who are obese. Anoscopic and endoscopic evaluation is readily achieved in this position.

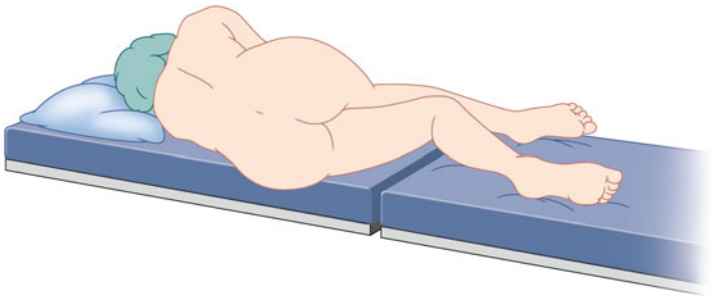

Fig. 2.3 Left lateral (Sims') position

2.2.2 Inspection and Palpation

Proper stepwise visual inspection of the perineum, anal canal, rectum, and vagina should precede any other examination. Proper lighting is essential, and various light sources are commercially available, including overhead lights, tall/gooseneck lamps on a stand, and head lamps. It should be noted that the "clockface" nomenclature is not recommended for localizing anorectal findings. This nomenclature is dependent upon the position of the patient, and hence different interpretations of the true location may differ from examiner to examiner. Rather, designation using the cardinal quadrants (i.e., left lateral, right anterior, right posterior) is commonly practiced by most colorectal surgeons.

An overall assessment of the shape of the buttock and inspection of the lower sacrococcygeal area is undertaken. Then a gentle spreading of the buttocks to gain proper exposure is undertaken. A great deal of information can be gained by visualization only, including scarring, fecal soiling, purulence, blood or mucous drainage, excoriations, erythema, anal sphincter shape, perineal body bulk, hemorrhoidal disease, skin tags, overt signs of inflammatory bowel disease, external fistulous openings, rectal prolapse (procidentia), neoplasm, and any evidence of previous anorectal surgery. Next, the patient is asked to strain (Valsalva maneuver) to help determine and assess for perineal descent, uterine/vaginal prolapse, or rectal prolapse. It should be noted that the best position to evaluate rectal prolapse is either in the squatting position or in the sitting position on the toilet or commode after an enema has been administered. The use of an illuminated handheld mirror is very useful to examine the patient while in the sitting position to diagnose prolapse and other anorectal pathology [1].

Gentle and directed palpation of the anorectal region also gives the examiner a great detail of information. Gently touching the anal verge will elicit the anocutaneous reflex (anal wink) which is indicative of an intact pudendal nerve. Additionally, gentle spreading of the anus will help elicit an anal fissure or ulceration. Palpation of the anal margin/gluteal region can help identify an abscess, external opening of a fistulous tract, or possibly a mass.

2.2.3 Digital Examination

The digital rectal examination (DRE) is a simple and well-tolerated procedure that should be performed in almost every patient who presents for an anorectal condition/complaint. A well-performed DRE will provide information regarding the contents and potential pathology of the anal canal, distal rectum, and adjacent organs. DRE may also permit an assessment of the neurological function of the muscles of fecal continence. Relative contraindications to performing a DRE are usually related to pain at the anal opening and include an acute or chronic anal fissure, thrombosed hemorrhoids, or grade IV internal hemorrhoids. The keys to a successful DRE can be summarized by simple rules: adequate lubrication, gentleness, and attention to detail [2].

After proper communication with the patient, a well-lubricated index finger is placed across the anus and the tip is gently inserted into the anal opening. Lubrication should be warmed if possible, and lidocaine jelly should also be available. If the patient's response is an involuntary spasm of the internal sphincter, the examiner should withdraw their fingertip and gently try again. Ask the patient to bear down as if to pass stool. This maneuver will cause relaxation of the entire sphincter complex and should facilitate an easy insertion [3]. The finger should be gradually and slowly advanced. The distal rectum and anal canal along with surrounding structures should be investigated in an organized and stepwise fashion. Resting anal tone followed by squeeze tone should be assessed. Assessment should be made of the entire circumference of the lumen by gently sweeping around the entire anus and distal rectum. Anteriorly in a male, the prostate should be palpated and assessed for nodularity, hypertrophy, and firmness. In the female, anteriorly feel for a rectocele and the cervix and uterus (if present) can also be palpated. Posteriorly, the presence of a presacral (retrorectal) mass may be palpated. Bimanual inspection may be necessary when examining a female patient in order to palpate the rectovaginal septum and associated vaginal/adnexal structures. Redundant rectal mucosa may be palpated as well as any stricturing or narrowing. Induration or a fibrous cord, representing an internal fistulous opening, may also be felt on DRE. Exclusion of any masses should be carefully performed. The patient should be asked to perform a Valsalva maneuver to potentially bring any lesions of the upper rectum/rectosigmoid into the examiners reach. If a mass is felt, its size, position, characteristics (sessile, polypoid, ulcerated), mobility (mobile, tethered, fixed), and relationship to other structures (distance from the anal verge, distance from the anorectal ring) must be accurately recorded.

The levator ani/puborectalis muscles can also be assessed on DRE with evaluation of both the strength and function of these muscles, along with any tenderness on direct palpation, indicating a possible pelvic pain disorder. When a patient with good sphincter function is asked to squeeze these muscles, the examiners finger will feel the muscle tighten and will have his finger pulled up into the rectum. Additionally, when the examiner pulls posteriorly on these muscles, the anal opening should gape and then return to normal, representing an intact reflex pathway to the thoracolumbar spinal cord.

2.3 Endoscopy

The anorectal examination in most cases should be followed with an endoscopic investigation to complete the work-up. This may include anoscopy, proctosigmoidoscopy, and flexible endoscopy. All three are typically performed in the clinic setting without sedation or mechanical bowel preparation and are tolerated quite well by the patient.

2.3.1 Anoscopy

Anoscopy is the examination of the anal canal and the distal rectum. Anoscopy offers the best way to evaluate the anoderm, dentate line, and distal rectal mucosa and to evaluate pathologies like internal and external hemorrhoids, papillae, fissures, and anal masses. There exist several variations in type, size, and length of anoscope available. Additionally, commercially available anoscopes include slotted or beveled styles, reusable or disposable, and lighted or unlighted. The particular type of instrument and light source used are based on individual preference, expense, and prior training (Fig. 2.4).

Regardless of the type of instrument used, the examination is initiated only after a DRE has been performed (if a DRE is unable to be performed secondary to pain, spasm, or stenosis, an anoscopic exam should not be attempted). For most instances, cleansing of the anorectum with an enema is not needed. The anoscope (with obturator in place) is liberally lubricated and gently and gradually advanced until the instrument

Fig. 2.4 Various beveled anoscopes. From top to bottom: Large Hirschman (short bevel) anoscope; Buie-Hirschman anoscope (long bevel); small (pediatric) Hirschman anoscope

is fully inserted. The obturator is then removed in order for proper examination of the anorectum. The obturator should then be reinserted and the anoscope rotated to examine a new area. The prone jackknife position offers good visualization and ease of insertion as well does the lateral position; however, an assistant must retract the buttock if the lateral position is utilized. During the examination, the patient is asked to strain while the anoscope is withdrawn to visualize any prolapsing anorectal mucosa or hemorrhoidal tissue. During an anoscopic examination, hemorrhoids may be banded or sclerosing agents injected, or biopsies of any suspicious lesions may be obtained after obtaining an informed consent of the patient. Complications are rare and may include bleeding from hemorrhoids or inadvertently tearing of the anoderm.

2.3.2 Proctosigmoidoscopy

Rigid proctosigmoidoscopy is suitable to examine the rectum, and in some patients, the distal sigmoid colon may also be evaluated. Proctosigmoidoscopes are available in three sizes, all 25 cm in length. Different luminal diameters include 11, 15, and 19 mm (Fig. 2.5). The largest scope is suited best for polypectomy or biopsies in which electrocoagulation may be needed. In most patients, the 15 mm × 25 cm scope is ideal for a general inspection. There is also a disposable plastic scope which is available for use. Illumination is supplied by a built-in light source, and a lens is attached to the external orifice of the scope after the obturator is removed. A bellows is attached to the scope which allows for insufflation of air to gain better visualization and negotiation of the scope proximally through the rectum (Fig. 2.6). A suction device or cotton-tipped swabs (chimney sweeps) can be used to remove any endoluminal debris or fluid to enhance visualization (Fig. 2.7). Ideally, the patient

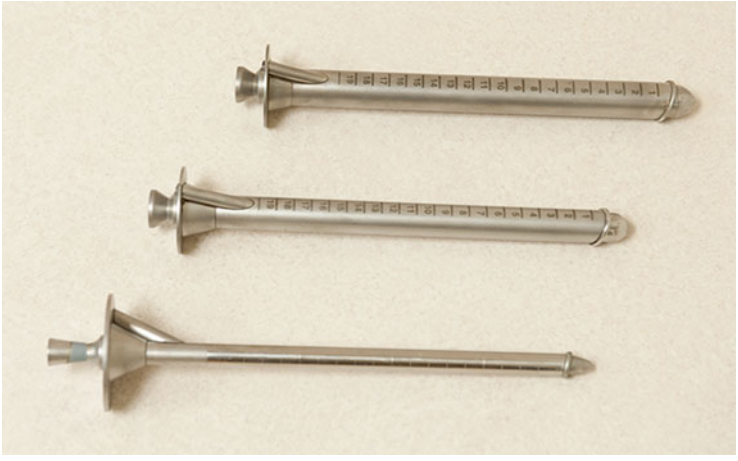

Fig. 2.5 Proctosigmoidoscopes. From top to bottom: large proctoscope, length 25 cm, diameter 19 mm; standard proctoscope, length 25 cm, diameter 15 mm; pediatric proctoscope, length 25 cm, diameter 11 mm

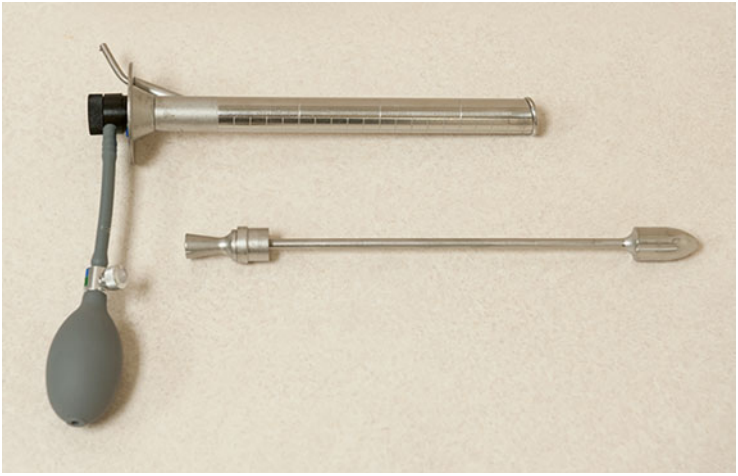

Fig. 2.6 Proctoscope with obturator removed. The viewing lens, bellows with insufflator are attached

Fig. 2.7 Proctosigmoidoscopy suction catheter and long cotton-tipped applicators for clearing small amounts of fecal debris. The cotton-tipped swaps are also used for manipulating the rectal and anal mucosa during anoscopy and proctoscopy

should receive an enema preparation within 2 h of the procedure in order to clear any stool, which may make passage of the scope and visualization difficult. The procedure can be performed in either the prone jackknife or left lateral position as previously described. When properly performed, the patient feels little to no discomfort. Pain may occur with stretching of the rectosigmoid mesentery due to over-insufflation of air or the scope hitting the rectal wall.

Unfortunately, the art of using the rigid proctoscope has dwindled in recent decades due to the widespread availability and use of flexible endoscopy. The proctosigmoidoscope, however, still has important indications, especially in the identification and precise localization of rectal lesions or in the evaluation of rectal bleeding. After adequate lubrication, the obturator is held in place with the right thumb, it is gently inserted into the anal canal and advanced approximately 4–5 cm toward the direction of the umbilicus. The scope is then aimed toward the sacrum for another 4–5 cm, and then the obturator is removed and the viewing lens is placed.

Gentle and minimal air insufflation is given in order to open the bowel lumen and withdrawing and advancing the scope as many times as necessary to straighten out angulations proximally to achieve successful navigation. It should be noted that the distal extent reach of proctosigmoidoscopy averages approximately 20 cm and very rarely can the scope be inserted to 25 cm [4]. If at any time, insertion is difficult or painful to the patient, the procedure should be terminated and the farthest extent reach should be recorded.

As the proctoscope is withdrawn from the farthest extent reach, a careful examination is performed on the entire circumference of the rectal walls with minimal air insufflation and rotation of the scope. The valves of Houston are flattened out with the tip of the scope to reveal areas just proximal to the folds. If any lesions are found, accurate measurements and descriptions are necessary. These include: size of the lesion, the exact distance from the anal verge, appearance, and location on the bowel wall. Several different types of biopsy forceps are available (Fig. 2.8), and biopsies can be done in the office setting with or without the use of electrocautery. Additionally, polyps or small lesions can be snared out (Fig. 2.9) or electrocoagulated. Proper suction, electrocautery, and irrigation devices should be readily available in the examining room (Fig. 2.10). Serious complications during rigid proctosigmoidoscopy are rare, with bleeding the most common, especially after biopsy or polypectomy. Perforation is a very rare occurrence and should not happen with a proper technique.

Fig. 2.8 Turell angulated biopsy forceps. A curved upper jaw allows for 360° rotation. A variety of jaw sizes and types are available

Fig. 2.9 Rigid-wire (Frankfelt) snare. This snare allows for polypectomy or tumor debulking via the anoscope or proctoscope

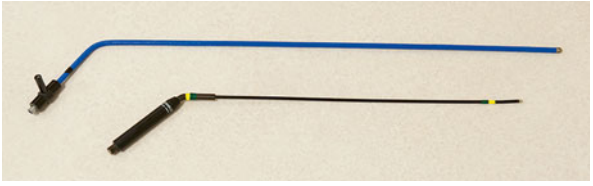

Fig. 2.10 Suction catheter/electrocoagulation catheter. From top to bottom: an insulated catheter for combining suction and electrocautery and an electrocoagulation catheter

2.4 Flexible Sigmoidoscopy

The use of the flexible sigmoidoscopy (FS) in the office setting has increased in popularity due to its many applications, ease of use, and high yield of findings over conventional rigid proctosigmoidoscopy. In approximately 50–85 % of patients, the entire sigmoid colon can be evaluated, and in some patients, the splenic flexure can be reached as well [5]. The flexible sigmoidoscope is easier to handle and learn than the colonoscope, but nonetheless, supervised training is compulsory. In terms of selective screening purposes, the flexible sigmoidoscope offers a three- to sixfold increase in the yield of findings, especially neoplasms, in the rectum and sigmoid colon compared to rigid proctoscopy. It should be noted, however, that FS is not an adequate substitute to colonoscopy for detection of colonic polyps and neoplasms.

The flexible sigmoidoscope is available from various companies and has some minor variations between them. In general, the channel size ranges between 2.6 and 3.8 mm, the diameter of the scope ranges between 12 and 14 mm, and the length varies from 60 to 71 cm (Fig. 2.11). Again, instrument selection is based on surgeon preference in regard to availability, cost, and surgeon experience.

The indications for FS in the office setting are broad. FS is an excellent tool to evaluate the patient with bright red rectal bleeding. Condition such as in radiation proctitis, nonspecific proctitis, rectal ulcer, anorectal Crohn's disease, and neoplasia may be found. FS also has utility in examining and acquiring cultures and/or biopsies of the distal colorectrum in diarrheal states, ruling out clostridium difficile, infectious colidities, and ischemic colitis. Radiographical abnormalities can be confirmed with the use FS as well as diagnosis or follow-up of inflammatory bowel disease. Additionally, postoperative evaluation of distal anastomoses can be performed, evaluating for stricture or recurrence of cancer as well as recurrences after local excision. Contraindications for FS include acute diverticulitis, fulminant colitis, toxic colitis, or peritonitis. Additionally, patients with anorectal pain, severe proctitis, or stenosis may not tolerate insertion of the scope.

Patients are given one to two enemas at least 2 hours before the procedure and generally do not require oral laxatives or dietary restrictions. The position that offers

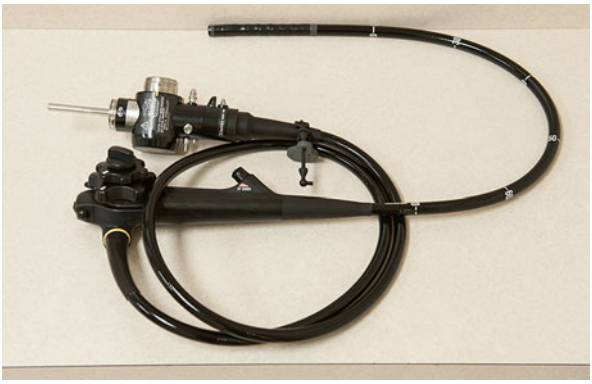

Fig. 2.11 Flexible sigmoidoscope

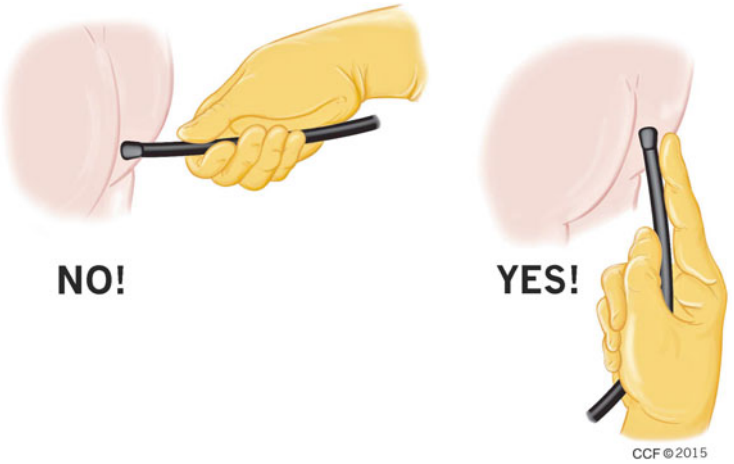

Fig. 2.12 The flexible endoscope should be inserted "side first" for less painful passage through the anal canal (reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015. All Rights Reserved)

the easiest approach is the left lateral recumbent but the prone jackknife position can also be used. Sedation is not necessary in the vast majority of patients. FS is performed after an adequate DRE has been performed as previously described. The well-lubricated scope is then inserted "side first" rather than "end on" which allows for the edge of the endoscope to act as a leading point and avoids pushing the blunt end *en face* against the anal sphincter with subsequent trauma and pain [3] (Fig. 2.12).

After proper insertion of the scope, gentle air insufflation is achieved, and the scope is advanced under direct visualization to approximately 10–12 cm. The instrument is then passed into the sigmoid colon by a combination of torquing (rotating) in either the clockwise or counterclockwise direction and short advancement and withdrawal (dithering). These maneuvers are used to advance the scope as far as the splenic flexure, if amendable. The endoscopist should use a combination of these techniques along with air insufflation, suction, and irrigation to successfully advance the scope. "Slide-by" maneuvers to advance the scope through a bend should be avoided, as this will undoubtedly cause pain and complications may arise, such as perforation or bleeding. After the scope has been advanced to its extent, careful and thoughtful withdrawal is achieved slowly, in order to evaluate the entire mucosal surface. Any lesions that are detected can be biopsied or have brush cytology performed to establish a diagnosis. Additionally, small polyps can be removed with cold or hot biopsy forceps. Larger polyp removal may be best suited during a subsequent colonoscopy when a full bowel preparation has been achieved. It is important to remember that FS is excellent at examining the proximal and mid-rectum as well as the left and sigmoid colon but is suboptimal for the most distal anorectal disorders, and therefore, retroflexion should be attempted. Retroflexion can be safely performed in the vast majority of patients, and it has been shown to increase the yield of adenoma detection [6].

Complications of FS are uncommon but may be serious or life threatening when they do occur. Over-distention of air will cause abdominal pain and patient discomfort or possibly perforation due to barotrauma. Perforation is most common at the distal sigmoid where it angulates from the relatively fixed rectum at the sacral promontory. It is therefore important to pay close attention to patient discomfort during the procedure and back off if necessary and use as little insufflation as necessary. Electrocoagulation should be avoided or used very judiciously in biopsies or snare techniques unless the patient has received a full mechanical bowel preparation to reduce the risk of explosion due to the presence of hydrogen and methane gas in the bowel lumen.

2.5 Office-Based Procedures for Pelvic Floor Dysfunction

In patients presenting with a potential pelvic floor dysfunction, the history and physical examination are of paramount importance and may be supplemented with a functional evaluation (anorectal physiology) along with imaging (anorectal ultrasound). Many tertiary centers that routinely deal with complex pelvic floor dysfunctional disorders have a dedicated pelvic floor unit with personnel to administer and interpret these tests accurately. Both anal physiology testing and ultrasound are performed in the clinic setting and require no mechanical bowel preparation or sedation.

2.5.1 Anorectal Physiology/Manometry

Anorectal physiology is an invaluable tool that is available in the office setting which allows for a quantitative assessment of the anal sphincter complex, pressures in the anal canal and distal rectum, rectal compliance, and baseline defecatory function (Fig. 2.13). Anal manometry is one of the most widely accepted modalities to investigate the function of the external anal sphincter (EAS) and internal anal sphincter (IAS) and is commonly performed to evaluate fecal incontinence (FI). Besides FI, anal manometry can be used as a screening tool for obstructed defecation syndrome and Hirschsprung's disease and may be used during biofeedback therapy to assess response of treatment. Detailed information on resting, strain, and squeeze pressures, rectoanal inhibitory reflex (RAIR), rectal compliance and sensation, balloon expulsion test, and anal canal length can all be garnered from this relatively simple office-based procedure.

Even though anal manometry is widely used throughout the world, there exist several varieties of catheters and systems (water-perfused, microballoon, solid-state pressure-sensing) to perform the test. This variation leads to a wide spectrum of technique, equipment used, and normal values. Due to variations of normal ranges between institutions, comparison between one test and another is quite difficult to interpret. Regardless of technique or catheter used, the procedure should be performed in a comfortable environment with minimal personnel present.

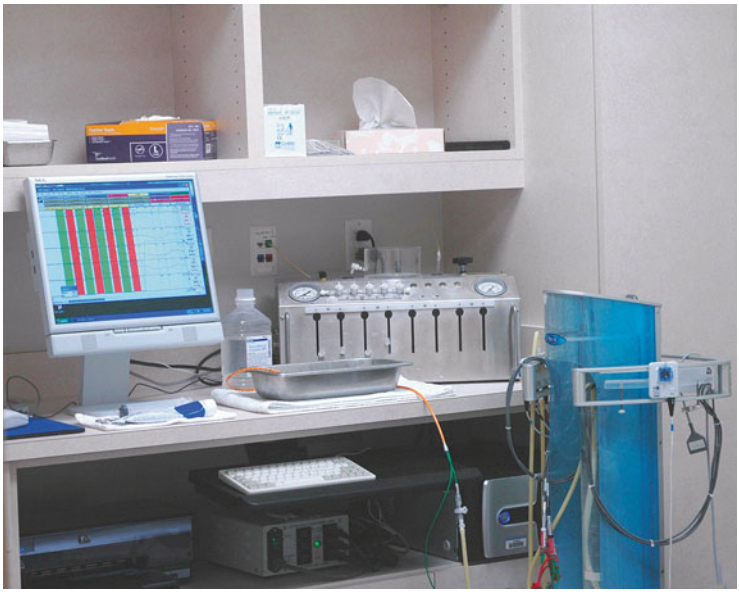

Fig. 2.13 Anorectal physiology apparatus

The patient is placed in the left lateral position, and a well-lubricated catheter is inserted into the anus to the 6 cm mark. Then, at 1 cm intervals, the catheter is extracted, recording both the resting state and then after voluntary contraction of the anal sphincter. The resting pressure reflects the IAS, as this muscle comprises about 60–85 % of the resting tone of the anorectum. The hemorrhoidal complex also contributes approximately 15 % of the resting tone, and the EAS may make up another 15 % as well. Squeeze pressure reflects the striated, voluntary EAS, and patients with low squeeze pressures may have EAS injury or nerve damage. Both the mean resting and squeeze pressures are calculated by averaging all of the pressure results across the anal canal length. Our institutional normal pressure readings are greater than 40 mmHg for resting pressure and greater than 100 mmHg for squeeze pressure.

The rectoanal inhibitory reflex (RAIR) can be elicited on manometry by rapidly inflating a balloon in the rectum causing rectal distention. This rectal distention normally causes a very brief increase in IAS tone followed by an inhibition of the tonic activity of the IAS, which allows for muscle relaxation. This reflex facilitates rectal relaxation and emptying which in turn allows for the sampling reflex to occur. The sampling reflex allows the anal canal to discriminate between gas and fecal material. RAIR is mediated by the myenteric plexus and is modulated by the spinal cord. Conditions in which the myenteric plexus is absent or decreased will not exhibit the RAIR, such as Hirschsprung's disease and Chagas disease. Patients who have undergone a low anterior resection, coloanal anastomosis, or ileal pouch-anal anastomosis may also not have an intact RAIR.

Rectal sensation and compliance can also be evaluated during anorectal physiology by intermittent balloon distention (300 cc maximum volume) in the distal rectum and recording the responses. Volumetric measurements include the rectal sensory threshold (first sensation that is felt as the balloon is filled), the first urge to defecate, and the maximum tolerated volume. Rectal compliance is defined as the ability of rectum to accommodate to different volumes without altering pressures. Conditions that may cause scarring of the rectum and resultant low compliance include conditions such as inflammatory bowel disease or radiotherapy. Alternatively, a highly compliant rectum may be caused by diabetes mellitus, megarectum, or other neurological conditions.

A relatively easy method to assess the evacuatory function of the rectum is the rectal balloon expulsion test. A balloon is placed in the rectum and first filled with 50cc of either water or air and the patient is then asked to expel the balloon; if the patient cannot, the balloon is filled to 100cc and then to 150cc. If the patient cannot expel the balloon in under 60 seconds, this may represent a pelvic floor dysfunction. It should be noted that false negatives are common and this test is supplemental to the other test and examinations mentioned prior.

2.5.2 Endoanal Ultrasound

Endoanal ultrasonography (EUS) is a highly reliable and reproducible imaging modality that provides information on the pelvic floor structures, anorectal disease processes (such as abscess and fistula), and anorectal tumors. In experienced hands, EUS is quite accurate, with high sensitivity and specificity for detecting anal sphincter injuries. Advantages of EUS include the relatively inexpensive cost to perform and its widespread availability. A disadvantage of EUS is that it is an operator-dependent test, with varied published results on various findings on the same disease process.

Circumferential assessment of the anal canal and distal rectum is made possible by a 360° rotating transducer that is either a 7 or 10 megaHertz (MHz) probe for two-dimensional (2D) units or a 13 MHz probe for three-dimensional (3D) (Fig. 2.14). In recent years, the use of 3D units has increased, with a similar sensitivity of detecting both EAS and IAS defects, but it has been shown that with the 3D units, intraobserver variation is decreased and diagnosis of pathology has been increased [7] (Fig. 2.14).

Prior to testing, patients receive an enema to clear the anorectum of any stool that may interfere with images due to artifact. Additionally, EUS should not be performed on patients diagnosed with anal stenosis or fissure in ano, as this will undoubtedly render the test painful and difficult to perform. EUS is most commonly performed with the patient in the left lateral recumbent position. After a gentle DRE, the well-lubricated ultrasound probe is inserted and slowly advanced and then withdrawn to view the entire area of the anal canal/rectum (in modern systems, a crystal moves up and down along the transducer to acquire images while the probe is held still).

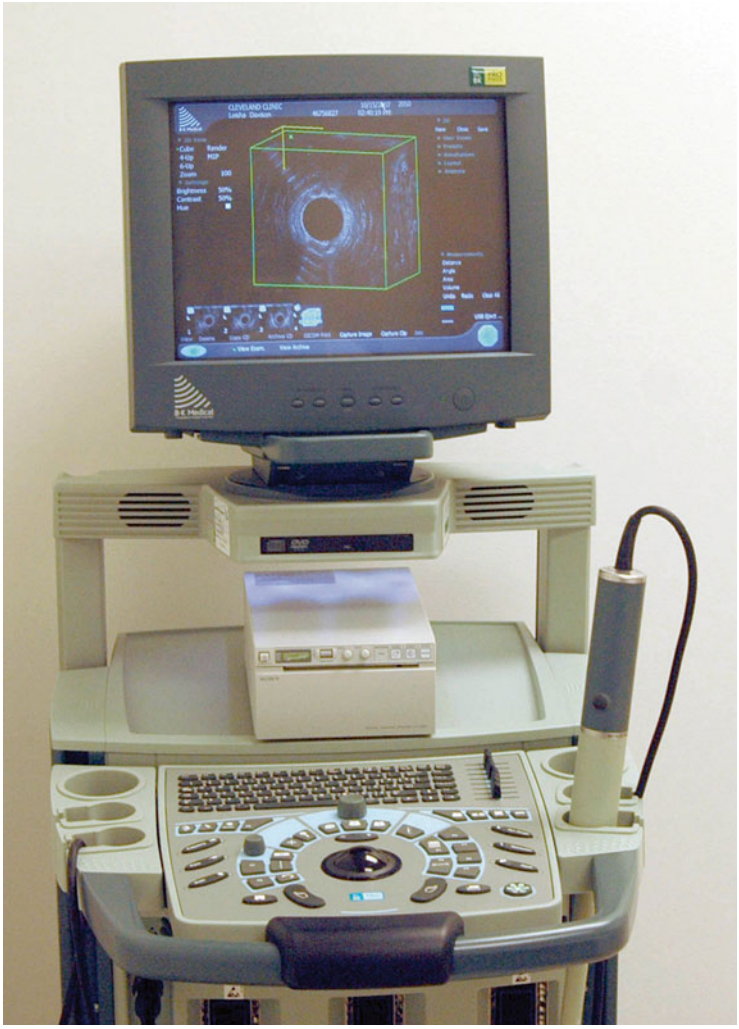

Fig. 2.14 B-K Medical (Herlev, Denmark) three-dimensional anorectal ultrasound equipment

The anal canal is divided into three levels on EUS: upper, middle, and lower based on anatomic landmarks. The upper anal canal is defined by the U-shaped puborectalis muscle, the middle canal has both EAS and IAS muscles (this is also where the IAS is at maximum width) (Fig. 2.15), and in the lower anal canal, where only the most distal external sphincter fibers are visualized (Figs. 2.16 and 2.17). Highly reflective tissue on EUS reveals a hyperechoic (white) image, while poorly reflective tissues are hypoechoic (black). Thus, the smooth muscle-based IAS, which has a high water content, shows up black on EUS. In post-obstetrical sphincter injuries, the defect is usually located anteriorly and encompasses the EAS and

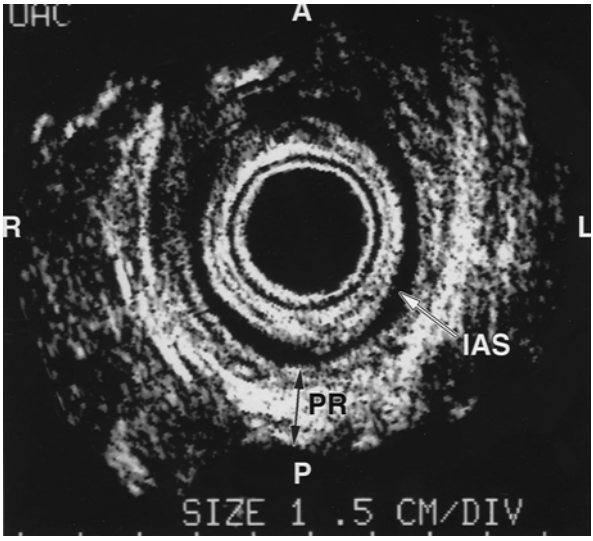

Fig. 2.15 Two-dimensional endoanal ultrasound view of the U-shaped puborectalis muscle (PR). *IAS* internal anal sphincter

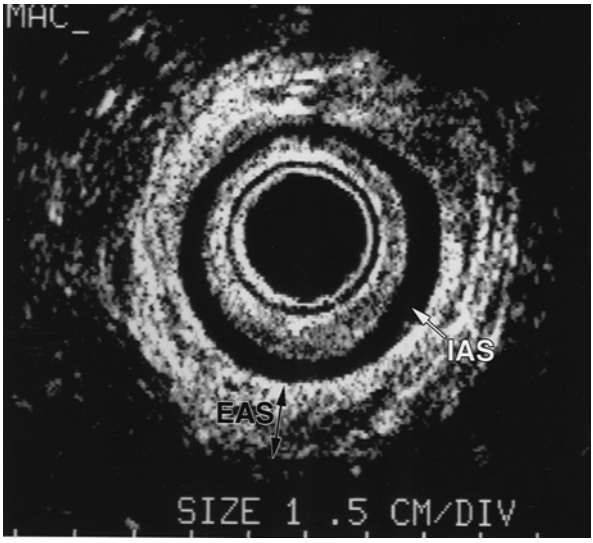

Fig. 2.16 Two-dimensional ultrasound from the mid-anal canal. This ultrasound image represents normal, intact internal anal sphincter (IAS) (hypoechoic) and external anal sphincter (EAS) (hyperechoic)

may involve the IAS as well. In cases of postsurgical or posttraumatic injuries of the anal sphincters, defects can involve either or both muscles and may be unifocal or multifocal in nature (Fig. 2.18). The accuracy of EUS compared to surgical findings has been reported to be as high as 90–100 % by some authors, and additionally, EUS has been used after operative sphincter repair to show the overlap of the muscles and to confirm a proper repair has been performed.

Anal ultrasonography has also been used to help diagnose and manage anorectal abscess and fistulae. In most patients, surgical examination will reveal the abscess

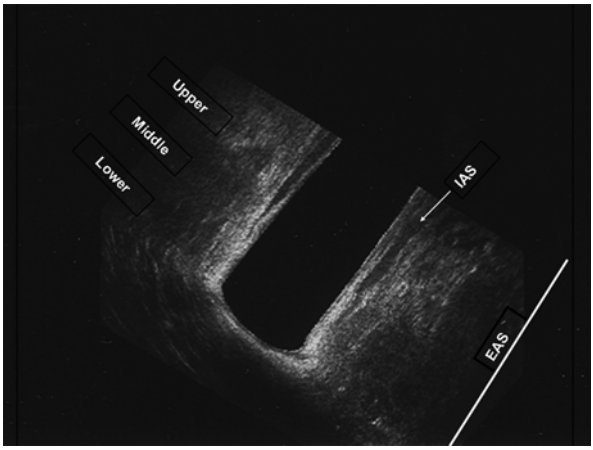

Fig. 2.17 Three-dimensional coronal view of the upper, middle, and lower anal canal. *EAS* external anal sphincter, *IAS* internal anal sphincter

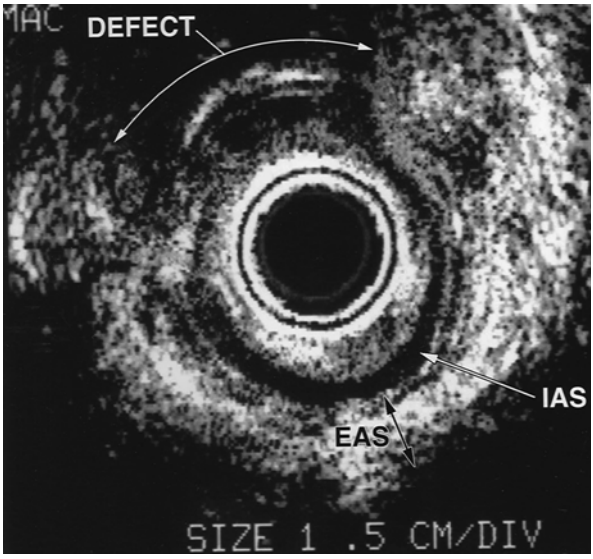

Fig. 2.18 Anteriorly located defect of both the EAS and IAS in the mid-anal canal

and/or fistulous tracts, but some patients may have deep-seated or complex collections or fistulae which may be difficult to find on clinical examination. EUS may be used in these situations to try and elucidate abscesses and fistulae. Additionally, the addition of injecting diluted hydrogen peroxide into an external fistulous opening may help identify complex fistulous tracts, resulting in a hyperechoic image. Several studies have been performed on the use of EUS for anorectal sepsis and fistulae with good to excellent correlation of ultrasound findings to surgical findings [8, 9]. EUS provides a useful tool in the work-up and treatment of anorectal abscess and fistulae and should be used when the exact location of the sepsis is in question and especially with recurrent, complex fistulae.

2.6 Conclusion

Successful diagnosis and subsequent treatment of anorectal diseases must first begin with a thorough history and well-performed physical examination. The anorectal history is of paramount importance and will guide further testing and examination. The examination portion is one that gives much anxiety and fear to patients. The examination must be performed with comfort and modesty in mind. A well-performed anorectal examination will give much information and will lead to an accurate diagnosis and allow proper treatment to commence. Endoscopic evaluation allows for a more detailed evaluation of the anorectum and distal colon with the advantage of timely diagnosis and sometimes treatment in the office setting. Anal manometry and endoanal ultrasound may be performed in select patients in which certain anorectal or pelvic floor diseases may exist.

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CT and MRI of the Pelvis for Anorectal Disease

3

Myra K. Feldman, Zachary E. Friess, and Joseph C. Veniero

Although direct visualization with or without the aid of sigmoidoscopy and colonoscopy is the primary screening and diagnostic tool for identifying anorectal disease, cross-sectional imaging has become indispensable in the workup of many pathologic entities [1]. From cancer staging and mass characterization to fistula identification and procedural guidance, computed tomography (CT) and magnetic resonance imaging (MRI) are critical in the detection and treatment of anorectal pathology and have largely supplanted fluoroscopic barium studies as the radiologic contribution in the primary workup of most of these patients [1].

The main advantage of cross-sectional imaging over direct visualization and fluoroscopic barium studies is the ability to see beyond the mucosal surface [1, 2]. A flexible sigmoidoscopy can show you that there is a mass effacing or indenting the rectal wall, but the useable information ends there. Cross-sectional imaging can show the anatomic structure that mass originates from and identify other structures involved in the disease process. It can suggest a diagnosis based on benign or malignant imaging characteristics as well as indicate the severity of disease to help guide treatment [1, 2].

3.1 Computed Tomography

CT is an imaging technique that creates images utilizing X-ray beams which are generated and detected in a 360° scan performed around the patient. The data that is acquired is put through a computed reconstruction algorithm to create a stack of sequential axial images [3, 4]. In addition, computer-generated, three-dimensional reconstructions can be rendered in any plane to create the desired image.

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Table 3.1 Sample CT densities of common tissues

	Density (Hounsfield units)
Air	−1000
Fat	−30 to −100
Simple fluid	−10 to 20
Water	0
Blood	30–50
Muscle	45
Cortical bone	200–600

CT images are graphical density maps created from the X-ray data. Everything present on a CT image has a density value which is expressed in Hounsfield units (Table 3.1). Water is considered to be a neutral reference density on CT and is assigned a value of 0 Hounsfield units. The other reference is air which is assigned a value of −1000 Hounsfield units. When comparing different regions of an image, the brighter region is referred to as being hyperdense or having increased attenuation relative to the darker region. Conversely, darker parts of a CT image are considered hypodense or having decreased attenuation relative to a reference [3, 4].

A limitation often encountered with CT imaging is that it is difficult to distinguish many biologic tissues since they have similar densities. The administration of different contrast agents introduces other densities that better define and distinguish biologic tissues. For example, when evaluating the GI tract, one of two different types of enteric contrast can be used depending on the type of pathology that is suspected. When evaluating the bowel wall for enhancement, luminal narrowing, and inflammatory changes, a neutral density or "negative" enteric contrast is used. This type of contrast distends the bowel lumen and, because it is less dense than the adjacent bowel wall, allows evaluation of their mural enhancement patterns [5]. When evaluating for obstruction, leak, or differentiation of the bowel from adjacent structures, a high density or "positive" enteric contrast is used. This type of contrast makes the bowel stand out against less dense abdominal structures and helps to assess transit through the bowel [6]. It is important to remember that positive contrast can linger in the bowel for several days and follow-up studies may be affected by residual contrast [7].

Another type of contrast that can be used to differentiate tissues on CT scans is intravenous contrast. Although many brands are available, they all contain iodine, a relatively dense atom with properties that result in increased absorption of X-rays. IV contrast is typically administered through a peripheral vein and increases the density wherever it accumulates. Initially it is located in the intravascular space, allowing studies such as arteriograms to be acquired if the scan is performed at the appropriate time after contrast is given. As contrast passes through capillary beds, some of it leaks out of the vessels into most of the interstitial tissues of the body, increasing their density to different degrees, helping to differentiate them on the scan. All living tissue enhances, a fact that helps in the characterization of nonliving

tissue such as cysts, abscesses, and necrosis. Intravenous contrast is eventually eliminated through the kidneys.

CT is commonly used in imaging anorectal disease because of its widespread availability and relatively lower cost when compared to MRI. However, CT uses ionizing radiation like any other X-ray technique; a fact that needs to be considered when deciding among the different imaging modalities. CT is often used as a screening exam for a multitude of abdominal and pelvic pathologies, both in the hospital and in the outpatient setting. As a result of this, anorectal disease is often first identified on a CT scan as an incidental finding [8].

Scanning methods have been developed to screen the colon for polyps and cancer. Colonographic screening can identify previously unknown rectal masses. CT colonography is a low-dose screening technique which provides anatomic detail of the colon and rectum without the inherent invasiveness of a standard colonoscopy. Although no colonoscope is used in the procedure, adequate preparation and colonic distention is crucial to achieve a diagnostic result [9]. A full discussion of this technique is beyond the scope of this chapter.

3.2 Magnetic Resonance Imaging

MRI is an imaging technique that generates images based on the behavior of the hydrogen atoms in water molecules. The majority of the human body is composed of water molecules. When placed in the strong magnetic field of the MR machine, the hydrogen nuclei tend to align either with the field, in a lower-energy state, or against the field, in a higher-energy state. At equilibrium, there are more nuclei in the lower-energy state. When radio-frequency (RF) energyis applied at specific frequencies, that energy is absorbed by the low-energy nuclei, raising them into the higher-energy state. As they relax back to the lower-energy state, they release RF energy which is recorded by the system as the MRI signal. This signal is detected and reconstructed into images through a process called spatial localization. The result is an image that shows the amount of signal returning from each region of the tissue represented on the image with brightness that is proportional to the amount of signal returning [10].

MRI images can be acquired in multiple planes. A typical MRI examination consists of a combination of multiple views of the area of interest, each obtained to emphasize different components of the tissue and/or obtained in different orientations. These views are referred to as imaging sequences. They can be tailored to emphasize or eliminate fluid or fat. In addition, both intraluminal and intravascular contrast can be utilized to further enhance tissue differences in similar ways to those previously described for CT [11, 12]. It is important to use proper terminology when describing MRI findings. In general, things that appear brighter or more white are said to have “increased signal intensity” or be “hyperintense,” and things that appear darker or more black are said to have “decreased signal intensity” or be “hypointense.” Two common MRI sequences are referred to as “T1” and “T2” weighted. Only a few things appear hyperintense on T1-weighted sequences including fat,

Table 3.2 General intensity on MR images

	T1 appearance	T2 appearance
Air	Black	Black
Fat[a]	Hyperintense	Hyperintense
Simple fluid	Hypointense	Hyperintense
Hemorrhagic fluid	Hyperintense	Hypointense
Muscle	Hypointense	Hypointense
Cortical bone	Black	Black

[a]Fat appears hypointense on all fat-saturated sequences

some hemorrhage, melanin, protein, and gadolinium-based contrast agents. Simple fluid is typically hypointense on T1-weighted sequences. T2-weighed images are "fluid sensitive," and many water-containing substances typically appear hyperintense including fluid, fat, edema, and tumor (Table 3.2). Air has no signal and is black on both sequences. If desired, the signal from fat can be suppressed or eliminated from T2-weighted sequences in order to differentiate between fluid and fat. When trying to decide if a sequence is T1 or T2 weighted, look for structures that usually contain fluid such as the bladder or spinal canal; if they are hyperintense, the sequence is likely T2 weighted. Intravenous contrast, which is gadolinium based, can be added to T1-weighted sequences to image vessels or look for abnormal enhancement. Like CT, tissues with leakier capillary beds, such as those in areas of inflammation and tumor, will tend to accumulate more contrast and enhance more avidly than normal tissue [13].

Standard rectal protocol MRI images are oriented in three planes to the rectum (axial, sagittal, and coronal). In the setting of cancer, the most important images for staging are high-resolution T2-weighted images that are oriented perpendicular to the long axis of the rectum. Air within the rectal lumen appears black on MRI. Certain lesions, especially small or polypoid masses, can be difficult to identify in the collapsed rectum. In order to accentuate the rectal wall or rectal lesions extending into the lumen, an aqueous gel can be used as a luminal contrast agent to fill the cavity. This appears very hyperintense on T2-weighted images and is hypointense on T1-weighted images [13]. In other cases, especially those with sessile lesions, overdistention of the rectum by the gel can cause underestimation of tumor size and involvement. Advanced techniques such as diffusion-weighted imaging (DWI) may be used for identification of subtle lesions and pelvic lymphadenopathy [13].

Some of the advantages of MR imaging for evaluating anorectal disease include superior resolution, increased anatomic detail, and imaging without ionizing radiation. Often, MRI can identify disease characteristics that suggest a specific pathology or pathologic subtype. Although there are many advantages to MRI, disadvantages include higher cost, longer exam times, and technical limitations that can result in imaging artifacts. MR is not considered safe in patients with certain implanted mechanical devices. Fortunately, developing technical innovations and improvements in methodologies continue to reduce these disadvantages.

3.3 Imaging Anatomy

The anal canal is the channel extending from the perineum, at the anal verge, cranially to the anorectal junction, where the rectal ampulla narrows at the puborectalis sling. The dentate line, an important morphologic landmark, can't be seen on MRI but is located in the upper anus and is the level of transition between the rectal mucosa of the upper anus and the squamous epithelium of the lower anus [14]. The internal anal sphincter (IAS) which is formed by the circular muscle layer of the rectal wall appears hypointense on T2-weighted MRI. The muscular external anal sphincter (EAS), the inferiormost extension of the levator ani, also appears hypointense on T2-weighted MRI (Fig. 3.1a).

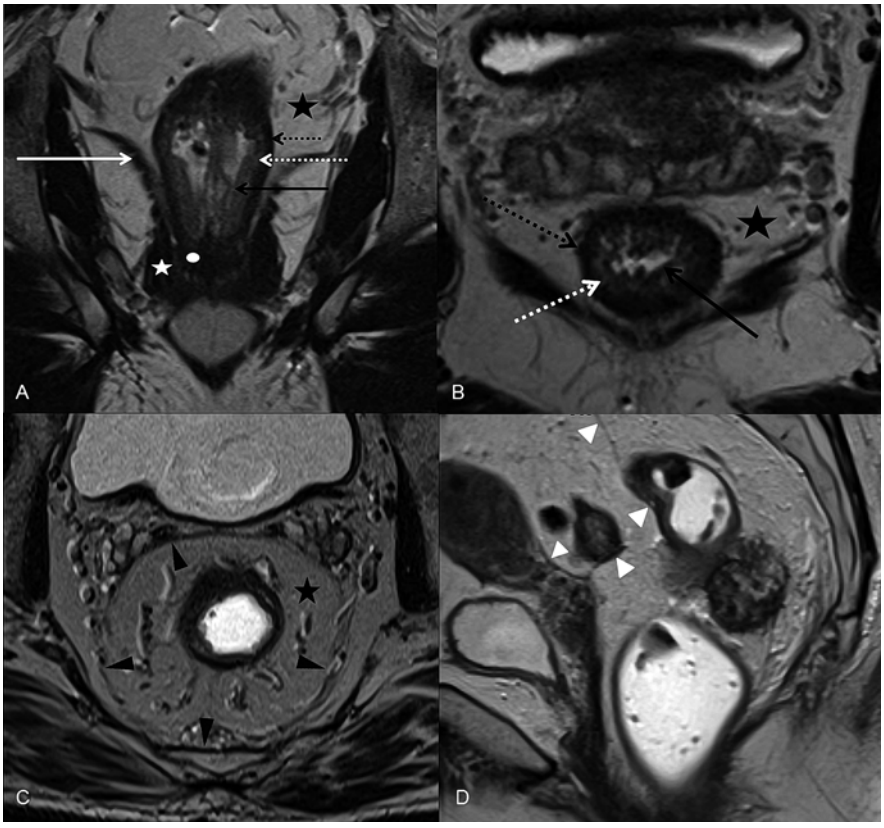

Fig. 3.1 Normal rectal anatomy on T2-weighted MR images. Coronal (**a**) and axial (**b**) images through the lower rectum, axial image through the mid-rectum (**c**) and sagittal near-midline image (**d**) including the upper rectum. The sphincter complex is seen in (**a**) including the levator ani (*white arrow*) which is contiguous with the external anal sphincter (*white star*) that surrounds the internal anal sphincter (*white circle*). The layers of the rectal wall are seen in coronal (**a**) and axial (**b**) including the outer T2 hyperintense mesorectal fat (*black star*), T2 hypointense muscularis propria (*dashed black arrow*), T2 intermediate to hyperintense submucosa (*dashed white arrow*), and thin T2 hypointense mucosa (*black arrow*). The mesorectal fascia (*black arrow heads*) is shown in the mid-rectum (**c**). The thin hypointense band representing the peritoneal reflection (*white arrowheads*) is seen on the sagittal image (**d**)

The rectum extends from the anorectal ring approximately 15 cm cephalad to about the level of the sacral promontory and is divided into upper, middle, and lower thirds. The five layers of the rectum, the mucosa, submucosa, muscularis propria, mesorectal fat, and mesorectal fascia, can be readily distinguished on a good-quality scan. On T2-weighted MR images, the rectal mucosa is represented by a thin hypointense line adjacent to the rectal lumen. The underlying submucosa is higher in signal intensity. The muscularis propria appears as a thin hypointense line surrounding the submucosa. The mesorectal fat, as most fat, appears hyperintense on both T1- and T2-weighted imaging. Finally, the mesorectal fascia is a thin hypointense line surrounding the mesorectal fat [13] (Fig. 3.1). Although all five layers are present through most of the rectum, the anatomy varies at both ends. The mesorectal fat and fascia are not present around the uppermost portion of the rectum, above the level of the peritoneal reflection, or around the lowest portion of the rectum as it transitions into the anus.

3.4 Anorectal Neoplasms

Imaging evaluation of primary anal and rectal carcinoma is currently performed with high-field pelvic MRI using dedicated rectal protocols that provide high-resolution, small field-of-view images. In everyday practice, this technique is supplanting previously standard endorectal ultrasound in the initial staging of disease.

3.4.1 Rectal Adenocarcinoma

As stated previously, the high inherent tissue contrast of MRI in combination with the high resolution possible with newer techniques allows visualization of the stratified rectal wall (Fig. 3.1). This level of detail makes it possible to stage nonlocally advanced rectal carcinoma (T1–T3) based on the depth of invasion of the tumor into the rectal wall. In many clinical cases, the distinction between T1 and T2 disease cannot be reliably made by MRI. However, the more clinically relevant distinction between those lower-grade tumors and T3 disease can usually be made. MRI is also excellent for the identification and evaluation of the local invasion found in T4 disease.

Originating in the mucosal layer, rectal adenocarcinomas are seen as intermediate-low signal lesions on T2-weighted images. Typically, they are hyperintense relative to muscle and hypointense relative to fat. The depth of invasion, best visualized on T2-weighted images obtained perpendicular to the rectal wall, corresponds to the tumor stage on MRI evaluation. T1-stage tumors may extend into the submucosal layer of the bowel wall, whereas T2-stage tumors extend into but not beyond the muscularis propria. Tumors that extend beyond this point, into the mesorectal fat, are designated T3 stage and are sometimes subtyped depending on their depth of invasion into the fat. When tumors invade into adjacent pelvic organs or extend into the peritoneal fat, they are T4 stage. Some modification of this system is required for tumors that extend very low or very high in the rectum [15] (Fig. 3.2).

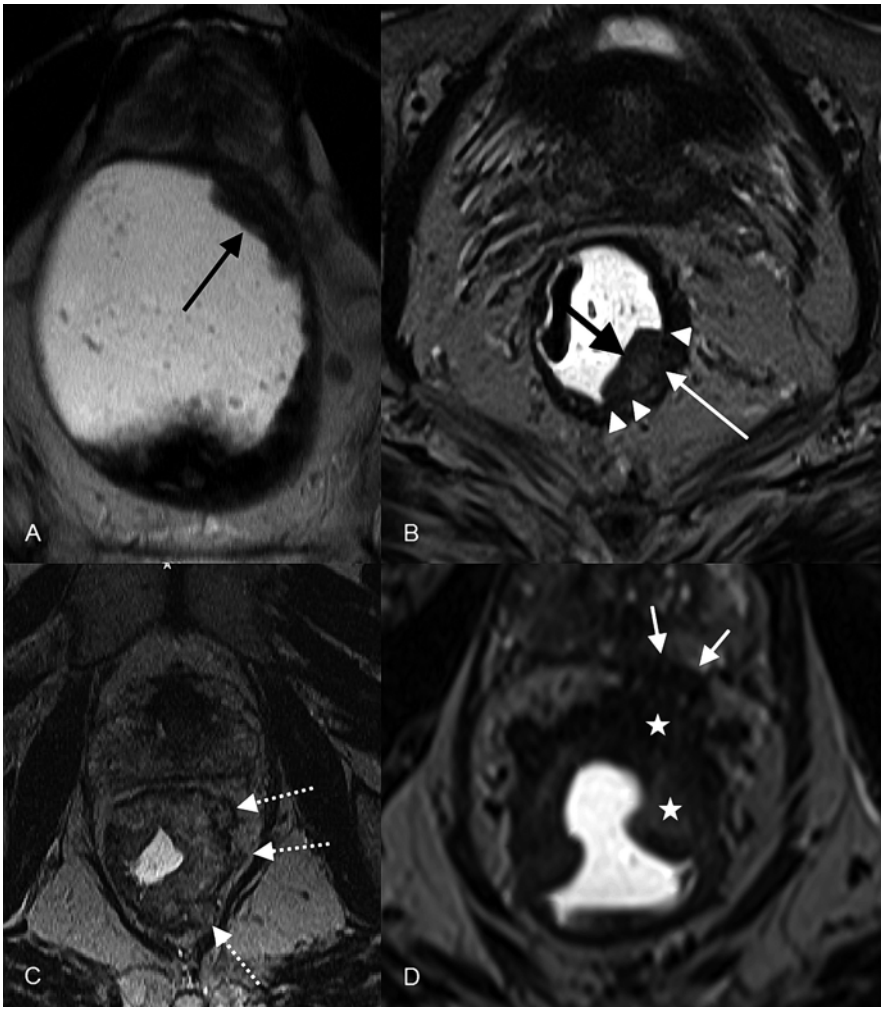

Fig. 3.2 Rectal cancer T-staging. Axial T2-weighted images through the rectum (**a**) showing a T1 tumor (*black arrow*) without invasion into the rectal wall. (**b**) A T2 tumor (*thick black arrow*) disrupting (*white arrow*) the rectal mucosa (*white arrow head*). (**c**) A T3 tumor with nodular extension into the mesorectal fat (*white dashed arrows*). (**d**) A T4 tumor (*white stars*) extending through the mesorectal fascia into the prostate (*short white arrows*)

3.4.2 Circumferential Resection Margin (CRM)

Among the more important measurements provided by the radiologist, the radiographic CRM is the shortest radial distance from the tumor or a tumor deposit in the mesorectal fat to the mesorectal fascia. A CRM of 1 mm or less is considered involving the mesorectal fascia, increasing the likelihood that the mass will not be completely resected with a typical mesorectal excision [16–18].

3.4.3 Low Rectal Cancer

Because of the anatomic changes present in the bowel wall as the rectum transitions into the anus, the classification system described previously does not necessarily apply here. At this level, the mesorectal fat thins and ends at the puborectalis sling. Tumors that extend below this level, to the internal anal sphincter, do not fit this staging system. Taylor et al. propose a staging system for these tumors that is based on the degree of extension through the muscle layers [15]. In this system, stage 1 tumors involve the rectal wall but do not extend into the sphincter complex. Stage 2 tumors extend into but not beyond the internal anal sphincter. Stage 3 tumors extend into the intersphincteric space and stage 4 tumors invade the external anal sphincter and beyond (Fig. 3.3).

3.4.4 High Rectal Cancer

Similarly, tumors that extend very high in the rectum require different evaluations when staging. If a high rectal tumor is above the level of the peritoneal reflection, any extension beyond the muscularis propria involves the peritoneal space, similar to typical colon carcinomas. It has been suggested that upper rectal cancers can be treated like colon cancer with limited benefit of neoadjuvant radiation [19]. It has also been suggested that these high intraperitoneal tumors are less aggressive, stressing the importance of localizing them before treatment [20]. On MR imaging, the peritoneal reflection can sometimes be seen directly. When it is not seen, its location can be inferred at the superior margin of the mesorectal fat. Since there are implications on surgical planning for resection, localization of the tumor in relation to the peritoneal reflection is important in the radiologic evaluation of these masses. Relationship to the sacral promontory can be easily determined and is important to report since it can be a helpful landmark during surgery as well.

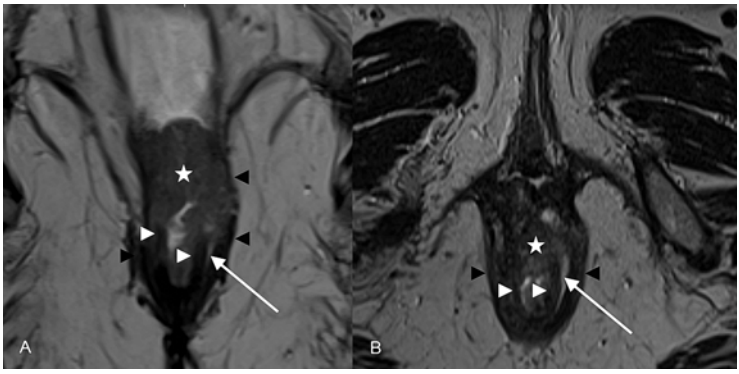

Fig. 3.3 Coronal (**a**) and axial (**b**) T2-weighted MR images showing a stage 4 low rectal tumor (*white star*) with extension into the IAS (*white arrow heads*), intersphincteric space (*white arrows*), and the EAS (*black arrow heads*)

3.4.5 Lymph Nodes

MRI excels at providing the anatomic detail needed to identify lymph nodes in the perirectal/mesorectal tissue and more distant locations in the pelvis and retroperitoneum. The difficulty is in the distinction between normal and abnormal nodes. Abdominal and pelvic lymph nodes are usually considered abnormal on cross-sectional imaging studies if their short axis measures 1 cm or more since statistically, these nodes are significantly more likely to be abnormal. However, in rectal cancer, the size distribution of normal and abnormal nodes shifts; there is a much higher percentage of abnormal nodes harboring metastatic disease with short axes less than 1 cm [21].

In order to increase the likelihood of correctly identifying abnormal lymph nodes, the evaluation of these nodes takes into account not only size but morphologic characteristics as well. Imaging features that make a node suspicious for neoplastic involvement include irregular borders and heterogeneous signal intensity [22–24] (Fig. 3.4). Nodal staging in rectal cancer is based on the number of abnormal nodes present. N1 disease is characterized by the presence of 1–3 abnormal nodes; four or more abnormal nodes indicate N2 disease [15].

3.4.6 Vascular Invasion

Tumor growth that extends beyond the muscularis propria into small vessels associated with the rectum in the region of the tumor is associated with poor prognosis, independent of other factors [25, 26]. High-resolution MR imaging can identify these small vessels and can evaluate them for the absence of flow and changes in morphology that suggest vascular invasion. It is also possible on post-contrast scans to distinguish tumoral enhancement seen in invasion from normal vascular opacification.

3.4.7 Mucinous Tumors

Although staged similarly, mucinous tumors of the rectum typically have a markedly different appearance on T2-weighted imaging because of their mucin content. Mucin, having high water content, is usually hyperintense and these mucinous tumors usually appear as multiseptated cystic masses (Fig. 3.5). Recent data suggests that patients with these tumors may not benefit from neoadjuvant therapy [27]. The ability of MRI to characterize these lesions allows this to be taken into consideration at the time of treatment planning.

3.4.8 Surgical Planning

In addition to traditional small field-of-view T2-weighted imaging performed to evaluate the stage of the tumor, at our institution, we utilize additional large-field T2-weighted imaging and post-contrast T1-weighted imaging in multiple planes.

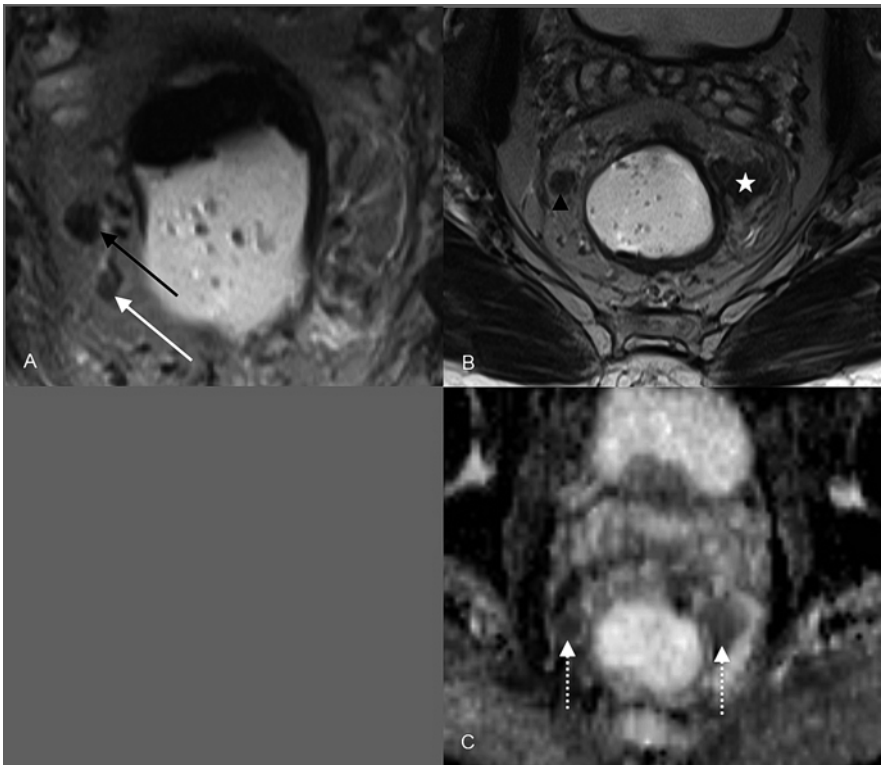

Fig. 3.4 Axial T2-weighted MR image through the rectum (**a**) showing a small smoothly marginated, oval mesorectal lymph node (*white arrow*) which is likely benign, inferior to an enlarged, irregularly marginated rounded lymph node (*black arrow*) which is likely malignant. A more caudal axial image (**b**) shows a similar-appearing malignant lymph node (*black arrow head*) and an opposite tumor nodule (*white star*). The corresponding slice from the apparent diffusion coefficient map (**c**) derived from the diffusion-weighted images (not shown) shows low signal within both lesions (*dashed white arrows*) indicating restricted water diffusion, compatible with tumor

These images help identify tumor involvement with adjacent structures. This can aid the surgeon in planning complex resections near the spine and the pelvic sidewall and in and around the sciatic foramen (Fig. 3.6).

3.4.9 Posttreatment

Patients who have undergone neoadjuvant therapy, typically those with T3 tumors and/or those with N1 or N2 disease, are usually restaged with pelvic MRI. The extent of disease is reassessed using the same criteria used in the primary evaluation. Downstaging after treatment can result in modification of the patient's treatment plan [28].

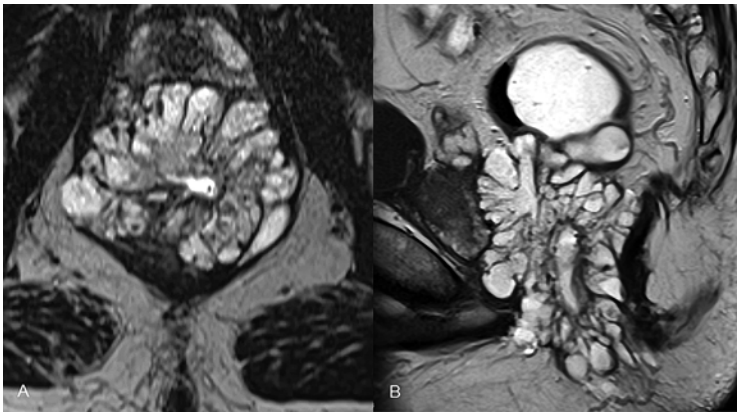

Fig. 3.5 High-resolution axial (**a**) and sagittal (**b**) T2-weighted images through the lower rectum showing a large multiloculated high-signal mucinous neoplasm extending into the anal canal. Multiple thin septations within the lesion are hypointense

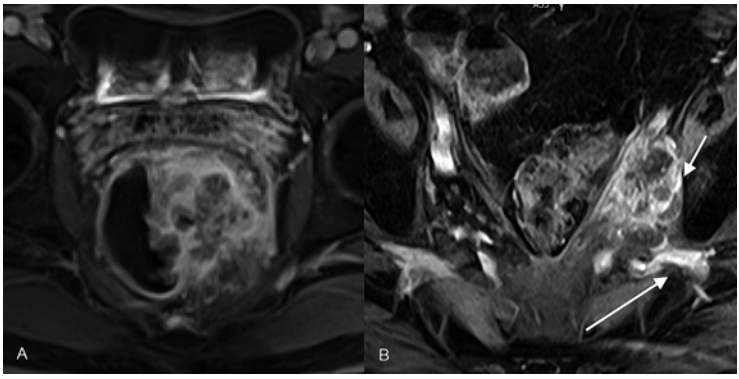

Fig. 3.6 Post-contrast T1-weighted axial MRI images showing (**a**) direct tumor extension of tumor into the mesorectal fat and inflammation extending to the pelvic sidewall. Recurrent adenocarcinoma (**b**) involving the pelvic sidewall to the hypointense cortical bone (*short arrow*) without extension into the greater sciatic notch (*long arrow*)

3.4.10 Anal Carcinoma

As opposed to rectal carcinoma staging, where depth of invasion determines the stage, anal cancer is primarily staged based on its size, with the length of the long axis of the tumor determining the T1–T3 stage. Less than 2 cm, 2–5 cm, and greater than 5 cm correspond to stages 1, 2, and 3, respectively [29]. The stage is unaffected by involvement of local structures such as the sphincter complex, rectum, or anal verge. Involvement of distal structures, however, such as the bladder and vagina, does upstage the mass to stage 4 (Fig. 3.7).

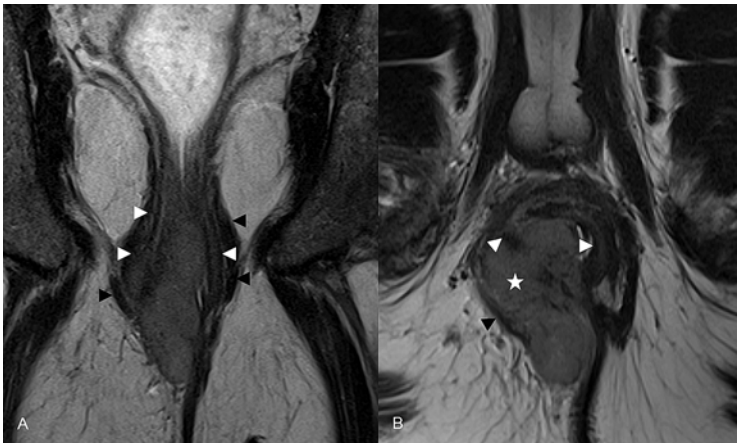

Fig. 3.7 Anal carcinoma. Coronal (**a**) and axial (**b**) T2-weighted images through the anus showing an intermediate intensity T4N0 anal carcinoma involving the IAS (*white arrow heads*) on the right and extending into the expanded intersphincteric space (*white star*) and through the posterior, inferior aspect of the EAS (*black arrowheads*) into the gluteal fat and finally through the skin (not shown)

3.4.11 Lymph Node Staging

Also contrary to rectal carcinoma staging, nodal staging of anal cancer is not based on the number of involved nodes but rather their distribution. So, involvement of perirectal nodes alone is considered N1; unilateral involvement of the inguinal or internal iliac nodes is N2 and involvement of both groups or bilateral involvement is considered N3 [30, 31].

3.4.12 Posttreatment Imaging

Posttreatment imaging can be quite challenging. After treatment findings can range from interval progression of disease to a complete radiologic response. Newer techniques, such as diffusion-weighted imaging, that assign image contrast based on the freedom of water movement within tissues can be used to help identify residual disease [14].

3.4.13 Distant Metastatic Disease

Evaluation of or screening for distal metastatic anorectal disease, when appropriate, is best performed with whole-body CT or PET imaging. Although PET/CT is a common modality employed in this evaluation, recently emerging PET/MRI examinations performed in high-field magnets can combine local staging studies and evaluation of/for distant metastases [32].

3.5 Other Rectal Neoplasms

3.5.1 Mesenchymal Lesions

Mesenchymal lesions of the rectum include lipomas, leiomyomas, leiomyosarcomas, and gastrointestinal stromal tumors (GIST). Rectal lipomas have a characteristic appearance on MR that makes their diagnosis straightforward. Lipomas are smoothly contoured ovoid or broad-based lesions which follow fat signal on all sequences. This means they are hyperintense on T1 and T2 images and hypointense on fat-suppressed sequences. These lesions will also show a particular artifact pattern on a specific type of T1-weighted imaging sequence referred to as out-of-phase images [2, 33]. There is overlap in the imaging features of the other mesenchymal tumors and diagnosis is usually made by histology. GISTs are the most common mesenchymal tumor to involve the rectum. These lesions are typically smoothly contoured with T1 hyperintense signal, variable precontrast T2 signal, and heterogeneous post-contrast enhancement [2, 33, 34] (Fig. 3.8).

3.5.2 Neuroendocrine Tumors

Neuroendocrine tumors and neuroendocrine carcinomas, also referred to as "carcinoid tumors," occur more frequently in the rectum than the colon. The usual imaging appearance of a rectal neuroendocrine tumor is a mural-based polypoid mass which is mildly T2 hyperintense and isointense to the rectal wall on T1. These lesions are very vascular and show avid post-contrast enhancement on both MRI and CT [35]. Poorly differentiated neuroendocrine carcinomas of the rectum show imaging features similar to rectal adenocarcinoma.

3.5.3 Lymphoma

The cecum and rectum are the most common areas in the large bowel affected by primary lymphoma. Primary rectal lymphoma can present as a focal mass or infiltrative process. One distinguishing feature of lymphoma is that, unlike adenocarcinoma, it typically does not cause luminal obstruction. Lymphoma tends to show intermediate signal intensity on T1-weighted images and high signal intensity on T2-weighted sequences. Although imaging features may suggest the diagnosis, biopsy is required to distinguish these lesions from adenocarcinoma and to guide management [36].

3.5.4 Metastatic Disease

The anorectum can be involved in metastatic disease by direct extension of adjacent neoplasms such as ovarian or prostate carcinoma as well as from hematogenous spread. Hematogenous metastatic disease will have variable imaging appearance

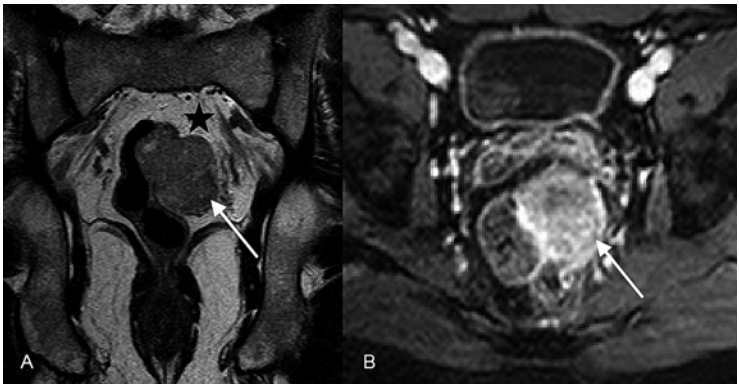

Fig. 3.8 High-resolution coronal T2-weighted image (**a**) through the rectum showing a lobulated intermediate-/high-signal GIST (*white arrow*) extending into the rectal lumen and mesorectal fat (*black star*). Axial post-contrast T1-weighted image (**b**) through the mass (*white arrow*) shows avid enhancement

that may mirror the primary tumor. For example, malignant melanoma usually produces a mass with characteristic T1 hyperintense signal due to melanin. Other hematogenous metastasis may show T2 hyperintense signal and heterogeneous enhancement. Large metastatic lesions can cause luminal obstruction [2].

3.5.5 Other Lesions

Rectal hemangioma is a rare, benign vascular neoplasm of the rectum. These lesions cause rectal wall thickening and prominence of the adjacent vasa recta. On CT, calcified phleboliths in the wall of the rectum are a key imaging feature that suggests the diagnosis (Fig. 3.9).

Endometriosis occurs when functioning endometrial tissue is present outside of the uterine cavity. Endometriosis deposits typically contain blood products and appear as T1 hyperintense lesions. They may also have internal T2 hypointense signal in a gradient pattern classically described as T2 "shading" related to layering blood products of differing ages. Atypical endometriomas that are hypointense on T1-weighted images can be confused with other adnexal masses [37, 38].

3.5.6 Retrorectal Cystic Lesions

The differential for a predominately cystic mass in the retrorectal space includes developmental cysts, teratoma, meningocele, lymphangioma, neurogenic tumor, and infection (Fig. 3.10). Retrorectal cystic lesions are often surgically excised due to the malignant potential of some of the lesions in this group. MRI adds value to the care of these patients in presurgical planning both directly and indirectly: directly, by showing the exact location of the lesion and its relationship to adjacent

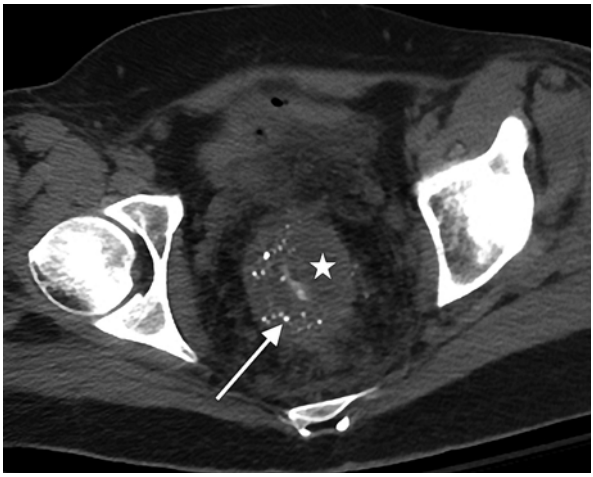

Fig. 3.9 Axial unenhanced CT of the pelvis shows diffuse rectal wall thickening (*white star*). Multiple calcifications are present in the rectal wall compatible with venous phleboliths (*white arrow*) characteristic of a rectal hemangioma

anatomic structures, and indirectly, by narrowing the differential and potentially changing the surgical plan.

Of the developmental lesions, retrorectal hamartomas, also called tailgut cysts, tend to be multiloculated with internal septations. Duplication cysts will have a muscular wall and may also have identifiable mucosa and submucosa. Another developmental cyst, the epidermoid cyst, is T1 hypointense, T2 hyperintense, and shows restricted diffusion on diffusion-weighted MR sequences [2, 39, 40].

Teratomas are usually first identified in children but may be suggested when a presacral T2 hyperintense, T1 hypointense cystic, and solid mass is present, especially if it contains fat or calcification [39].

A meningocele is a presacral meningeal cyst that develops secondary to a defect in the anterior sacrum. It has fluid intensity, is very hyperintense on T2-weighted images, and does not have enhancing components. A specific diagnosis of a meningocele is made when the stalk communicating with the thecal sac is identified [39].

3.6 Inflammatory and Infectious Diseases

MR imaging studies tailored for anorectal evaluation have become an important tool in diagnosis, surgical planning, and management of patients with complex anorectal inflammatory and infectious disease. The resolution and anatomic detail afforded by MR make it possible to delineate disease extent and sphincter involvement, information crucial for surgical planning and treatment monitoring.

3.6.1 Anorectal Abscess

Anal abscess can occur in healthy individuals or patients with underlying Crohn's disease. The widely accepted "cryptoglandular theory" suggests an anal abscess

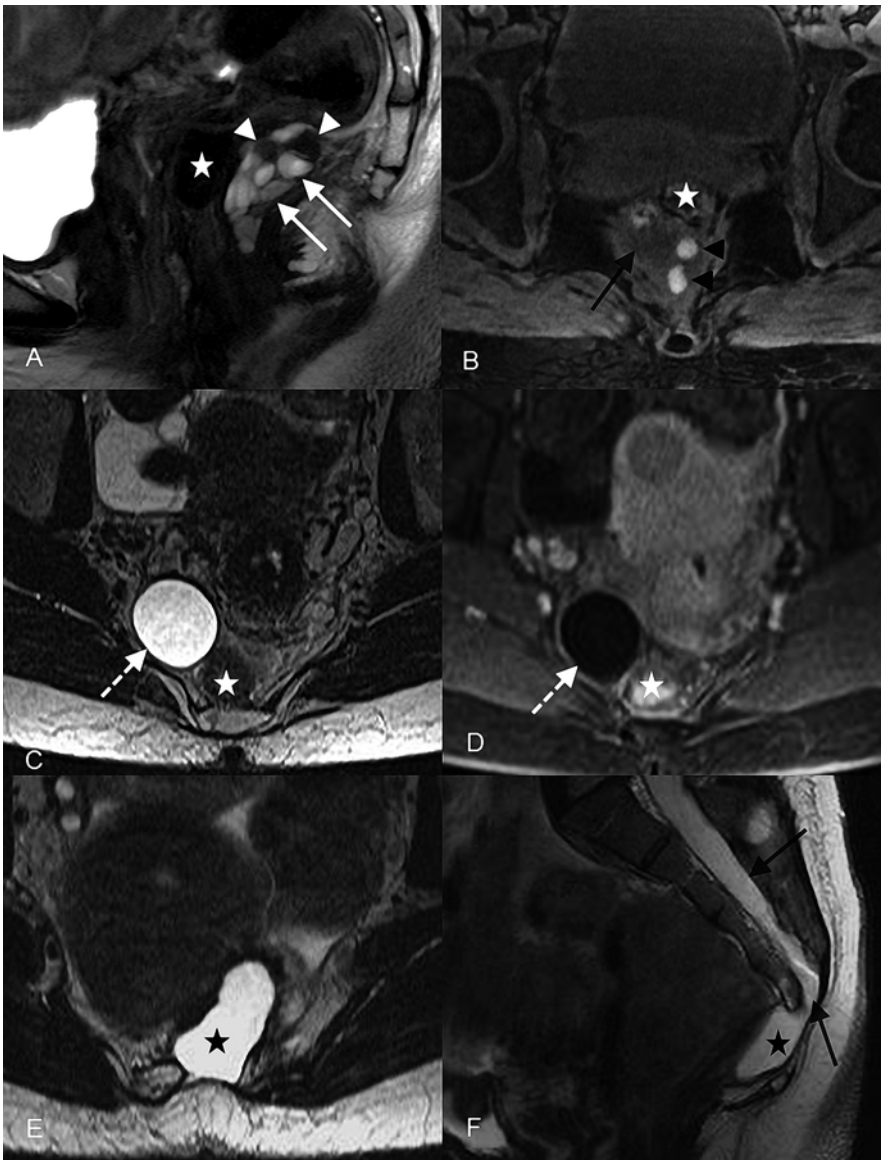

Fig. 3.10 Cystic lesions. Sagittal T2-weighted MR image (**a**) shows a multiloculated mass (*white arrows* and *arrow heads*) posterior to the rectum (*white star*). Several of the loculations are T2 hyperintense, suggestive of fluid (*white arrows*). Other loculations are T2 hypointense (*white arrowheads*). T1-weighted unenhanced image (**b**) shows the multiloculated mass (*black arrow*) posterior to the rectum (*white star*). Most of the loculations are T1 hypointense (*black arrow*); however, two of the loculations are T1 hyperintense (*black arrow heads*) suggestive of proteinaceous or hemorrhagic components. The location and multiloculated appearance with different signal intensities suggest the mass is a cystic hamartoma which was the final histopathologic diagnosis. Axial T2-weighted MR image (**c**) and T1 contrast-enhanced image (**d**) show a unilocular cystic lesion (*white dashed arrow*) adjacent and slightly anterior to the rectum (*white star*). This lesion showed restricted diffusion on diffusion-weighted imaging (not shown) suggestive of an epidermoid cyst, pathologically proven after resection. Axial T2-weighted image (**e**) shows retrorectal T2 hyperintense cystic lesion (*black star*). Sagittal T2-weighted image (**f**) from the same patient shows this cystic lesion (*black star*) communicates with the thecal sac (*black arrows*) through a sacral defect, findings diagnostic of an anterior meningocele

forms when anal glands become blocked with debris which leads to infection. Patients with superficial abscess commonly present with anal pain, swelling, and redness, while patients with supralevator abscess may present with fever and malaise. The diagnosis of anal abscesses can often be made by physical exam, especially when the abscess is superficial. Imaging studies may be necessary to establish a diagnosis of supralevator abscess. Imaging studies are also indicated in complex cases such as those with concurrent Crohn's disease or recurrent abscess [41, 42]. In these cases, dedicated anorectal MR imaging is the modality of choice due to superior resolution of the anorectal anatomy.

Anal abscesses are classified by their location and relationship to the sphincters as perianal (superficial between IAS/EAS and anal verge), ischiorectal (abscess penetrates through EAS), intersphincteric (between IAS and EAS), or supralevator (above the levator musculature) (Fig. 3.11). An abscess is identified on MR imaging as a focal area of rounded T2 hyperintense signal. Peripheral enhancement may be identified on post-contrast-enhanced images. If gas is present within an abscess, it will appear as a signal void (black) on T1- and T2-weighted images. An abscess may exert mass effect on adjacent structures. When anorectal abscess is identified, images should be scrutinized for the presence of an associated fistula (Fig. 3.12).

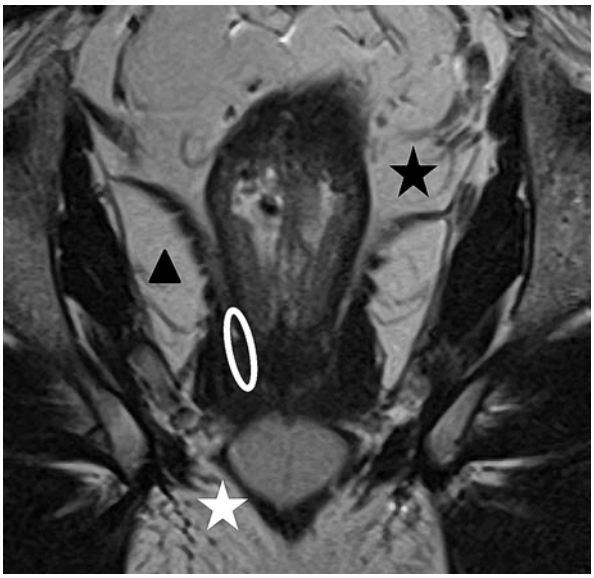

Fig. 3.11 Coronal T2-weighted MR image showing the classification of anorectal abscesses by location. Supralevator abscesses (*black star*) are located along the rectal wall cephalad to the levator musculature. Intersphincteric abscesses are located in a potential space, between the internal and external sphincters (*white oval*). Ischiorectal abscesses are located in the ischiorectal fossa (*black triangle*). Perianal abscess, the most common form of anorectal abscess, is located between the sphincter complex and the anal verge (*white star*)

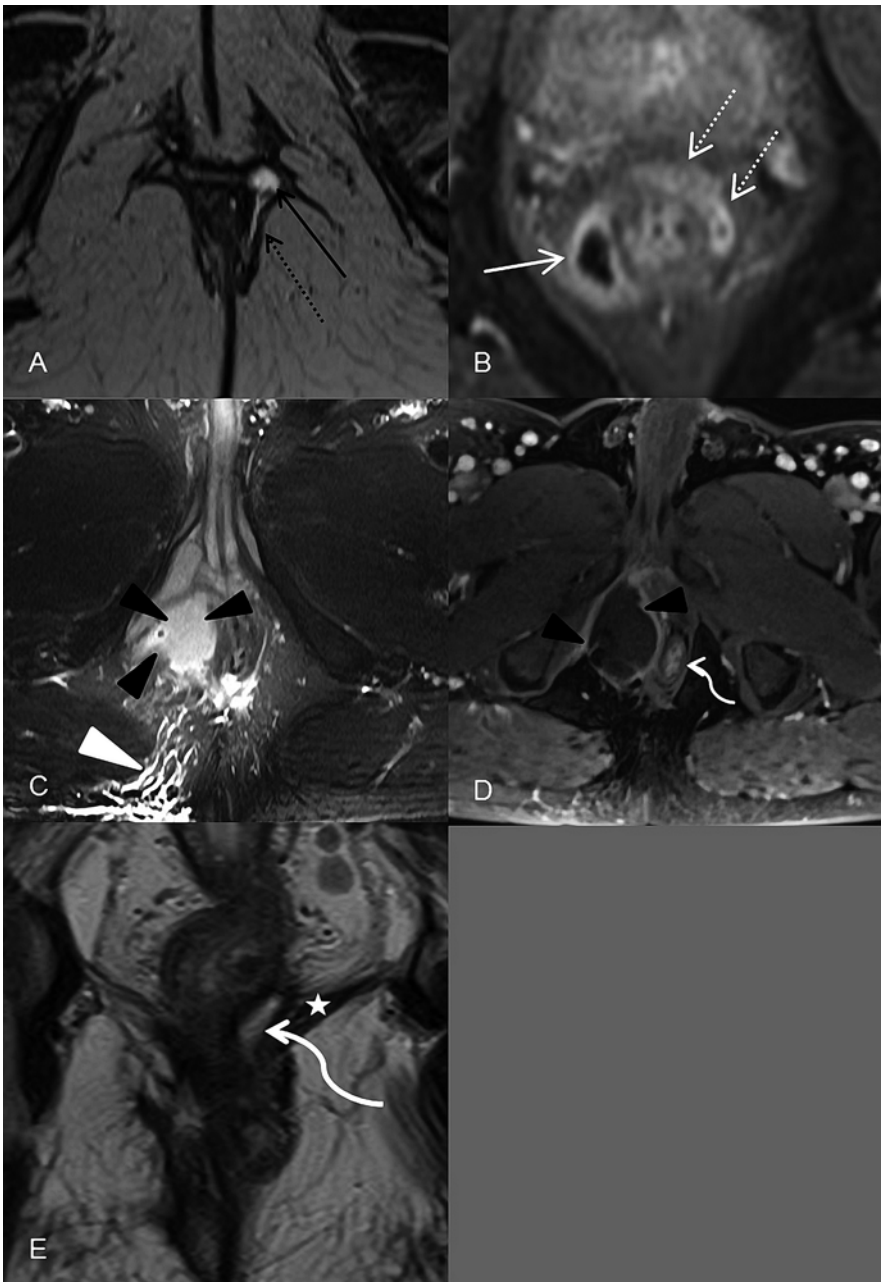

Fig. 3.12 Axial T2-weighted MR image (**a**) shows a perianal abscess (*black arrow*) and associated fistula (*dashed arrow*). Axial T1 contrast-enhanced image (**b**) from a different patient with an intersphincteric abscess (*white arrow*). The associated, peripherally enhancing intersphincteric fistula tract is also seen (*dashed white arrows*). Axial T2-weighted image with fat saturation (**c**) shows a rounded ischioanal fluid signal abscess (*black arrow heads*). Ill-defined fluid signal in the surrounding ischioanal subcutaneous tissues (*white arrow head*) is compatible with edema. Axial T1 contrast-enhanced image (**d**) in the same patient shows peripheral enhancement of the abscess (*black arrow heads*) which exerts mass effect on the adjacent anus (*curved white arrow*). Coronal T2-weighted image in a different patient (**e**) with a supralevator abscess (*curved white arrow*). The left levator is indicated by the *white star*

3.6.2 Anal Fistula

Anal fistulas are also thought to arise from cryptoglandular obstruction as a result of anal abscess. Different classification systems have been proposed for anal fistulas. The Parks classification system, proposed in 1976, organizes perianal fistulas by surgical anatomy. The St. James's University Hospital classification system uses MR anatomy to classify fistulas [43, 44]. Each system serves to classify the fistula according to its course and relationship to the internal and external anal sphincters (Fig. 3.13).

MR imaging is accurate for detecting and delineating primary fistulous tracts as well as secondary tracts and abscesses [43–45]. MR evaluation of perianal fistulas prior to surgery has been shown to provide additional information which may alter the planned surgery. Preoperative MR is also associated with improved outcomes, likely due to the identification of additional tracts and abscesses that would have otherwise been overlooked [43, 45]. More recent literature suggests MR imaging is valuable in assessing the response to medical therapy for patients with anal fistula in the setting of Crohn's disease receiving anti-TNF agents [43].

Active fistulas are identified on MR imaging as linear tracts which are hyperintense on T2-weighted sequences and hypointense on unenhanced T1-weighted sequences. Active tracts also show post-contrast enhancement. Inactive tracts will be hypointense on T1-weighted sequences and will not show T2 hyperintensity or post-contrast enhancement (Fig. 3.14).

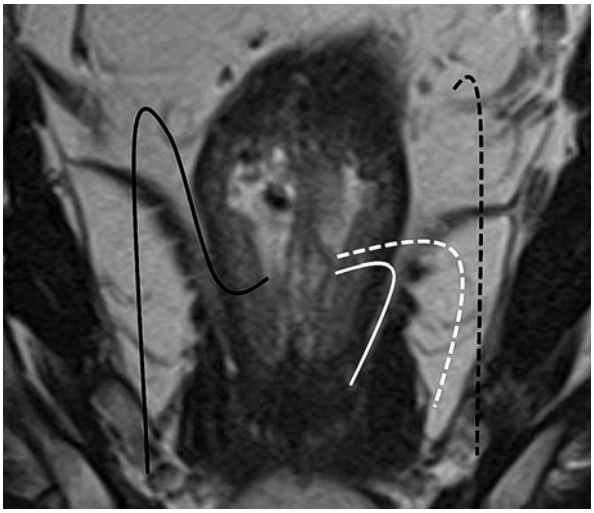

Fig. 3.13 Coronal T2-weighted MR image illustrates the classification of anorectal fistulas. Intersphincteric fistulas (*white solid line*) exit the anal canal and travel in a potential space between the internal and external anal sphincters. Transsphincteric fistulas (*dashed white line*) extend through the internal and external anal sphincters to the ischiorectal or ischioanal fossa. Supralevator fistulas (*solid black line*) extend above the levator ani. Extrasphincteric fistulas (*dashed black line*) extend from a pelvic infection, across the levator ani, and do not involve the internal or external anal sphincter

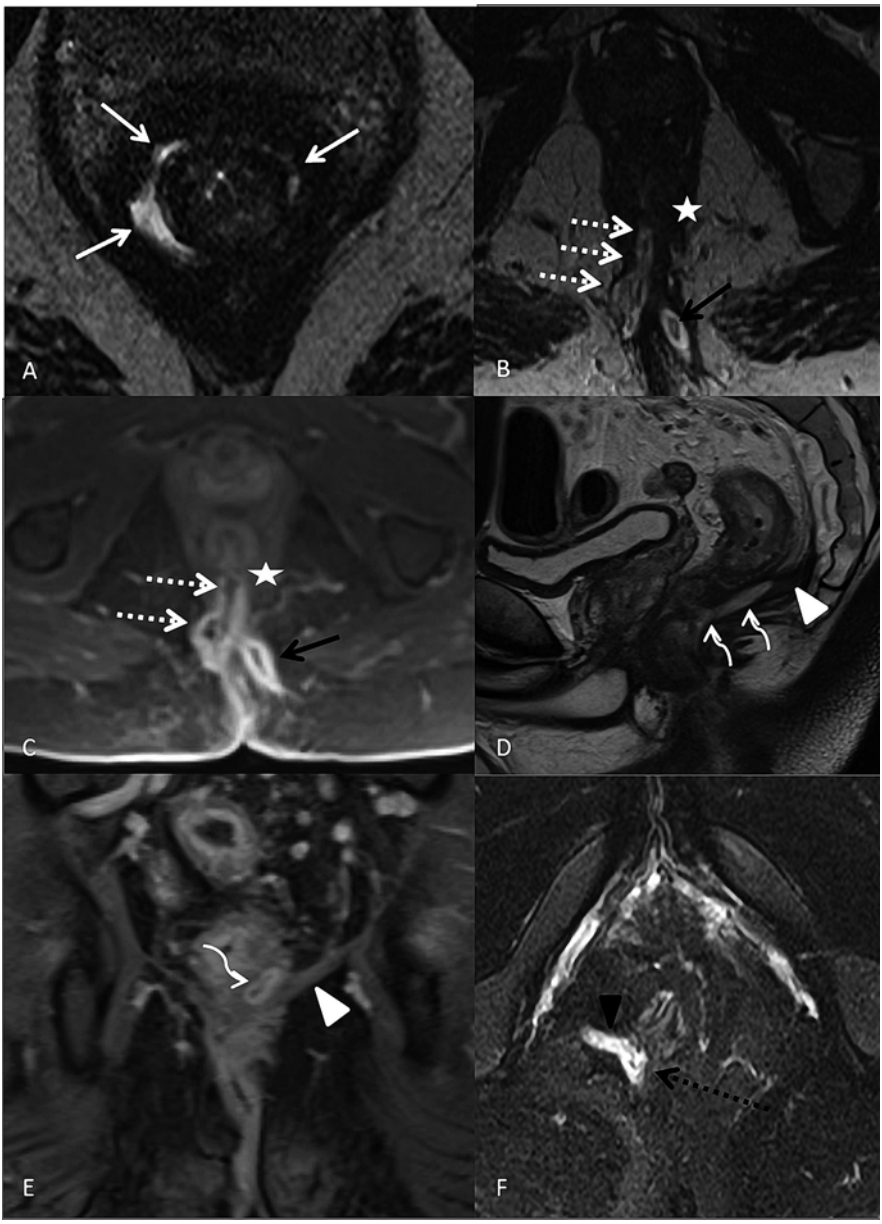

Fig. 3.14 Axial T2-weighted MR image through the anal canal (**a**) shows an intersphincteric fistula (*white arrows*) tracking in the space between the internal and external anal sphincters. Axial T2-weighted (**b**) and axial T1 contrast-enhanced (**c**) MR images through the anal canal in a different patient show a transsphincteric fistula (*dashed white arrows*) which extends through the external anal sphincter (*white star*) to the ischioanal fossa. Sagittal T2-weighted (**d**) and coronal T1-weighted contrast-enhanced (**e**) MR images from a different patient with a supralevator fistula. On the sagittal image, the fistula (*curved white arrows*) is seen in the intersphincteric space extending cephalad, above the levator ani (*white arrowhead*). The coronal contrast-enhanced T1 image shows the tract (*curved arrow*) with peripheral enhancement extending above the levator (*white arrowhead*). Axial T2-weighted, fat-suppressed image from a different patient (**f**) shows a T2 hyperintense branching tract with intersphincteric (*dashed black arrow*) and transsphincteric (*black arrow head*) components

3.6.3 Anorectal Vaginal Fistula

Rectovaginal or anovaginal fistulas can occur in the setting of Crohn's disease, as an iatrogenic injury following surgery or radiation or as a complication of malignancy [46]. The diagnosis is suspected in patients who present with gas and feculent vaginal discharge. The diagnosis may be confirmed by exam under anesthesia or imaging studies. Fluoroscopic studies (fistulography or barium enema), transrectal ultrasound, and anorectal MRI can be used to confirm the diagnosis. Of these options, only MRI clearly shows the anatomic detail of the surrounding tissues that may be important for surgical planning (Fig. 3.15). MRI may also add additional information important to surgical planning including the presence of additional fistula tracts or abscesses. The MR appearance is similar to other anorectal fistulas, typically a T2 hyperintense linear tract. Post-contrast imaging will show peripheral enhancement [46–48].

3.7 Postoperative Complications

3.7.1 Anastomotic Leak

Anastomotic leak may be clinically suspected in a patient with fever, leukocytosis, or pain following anorectal surgery. In the setting of pouch-anal anastomosis, a leak may originate from the over-sewn end of ileum, the ileoanal anastomosis or, less commonly, along the parallel suture lines of the linear ileal anastomosis. While it is possible to diagnose anastomotic leaks by contrast enema, this technique is less sensitive than CT for the diagnosis of pelvic abscess and does not depict other pelvic findings which could contribute to the patient's clinical symptoms.

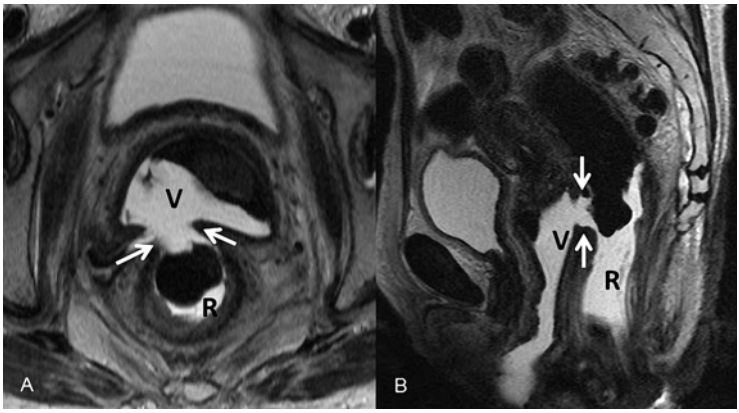

Fig. 3.15 T2-weighted axial (**a**) and sagittal (**b**) MR images in a patient with a prominent rectovaginal fistula which developed following radiation of a rectal adenocarcinoma. T2 hyperintense rectal contrast (ultrasound gel) was administered prior to imaging and can be seen extending from the rectum (R) through the fistula (*white arrows*) into the vagina (V)

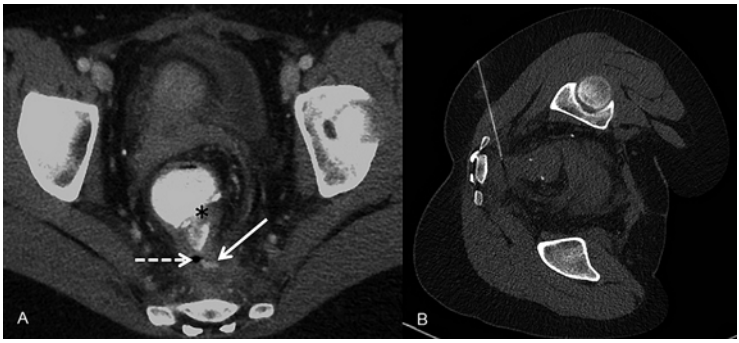

Fig. 3.16 Axial CT image (**a**) with intravenous, oral, and rectal contrast at the level of the pouch-anal anastomosis (*black asterisk*) shows extravasated, extraluminal rectal contrast (*white arrow*) and extraluminal gas (*dashed white arrow*), diagnostic of leak. Unenhanced CT image (**b**) shows trochar needle approach for drain placement

CT is the imaging modality of choice when pelvic sepsis is suspected in the early postoperative setting. At our institution, contrast-enhanced CT imaging with oral and rectal enteric contrast is the preferred study and performed when possible. Rectal contrast is essential as oral contrast rarely reaches the anorectum at the time of imaging and many patients with new anorectal anastomoses have upstream diversion. On CT imaging a leak can be identified as poorly defined extraluminal fluid or gas adjacent to the anastomosis. When enteric contrast is present at the level of the anastomosis, a leak may be identified as extraluminal, extravasated contrast [49] (Fig. 3.16).

Leaks are not as well seen on MR. When present, a leak will appear as T2 hyperintense fluid signal adjacent to the anastomosis. MR imaging can play an important role in surveillance of patients with established leak, fistula, or abscess who require repeated imaging over long periods of time to reduce radiation doses.

3.7.2 Ileal Pouch Complications

Ileal pouch-anal anastomosis (IPAA) offers patients requiring a total proctocolectomy for ulcerative colitis (UC) or familial adenomatous polyposis (FAP) fecal continence and thus improved quality of life. The procedure is technically demanding and is associated with long-term morbidity approaching 70 % [50]. In addition to previously described complications including leak, abscess, and fistula, complications unique to the IPAA such as pouchitis, cuffitis, and anal stenosis may occur.

3.7.3 Pouchitis

Pouchitis is the most common complication of IPAA, estimated to occur in 16–48 % of patients [51]. The diagnosis is most commonly made with endoscopic evaluation and biopsy. Cross-sectional imaging is not necessary in most cases of

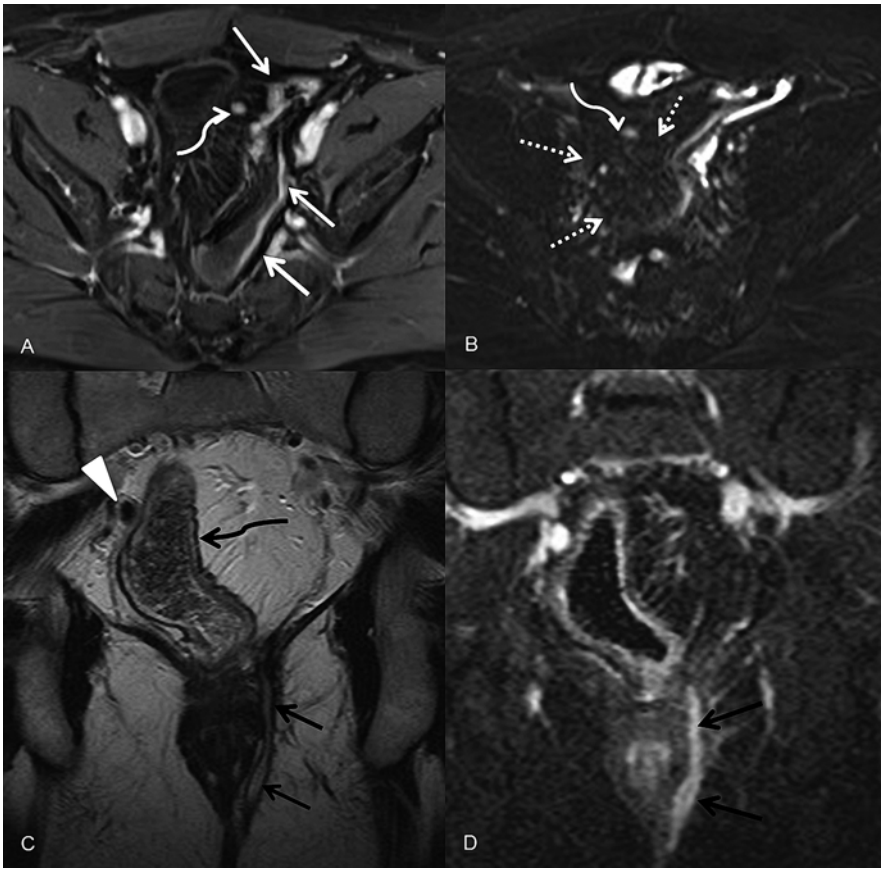

Fig. 3.17 Axial T1, contrast-enhanced MR image with fat suppression (**a**) in a patient with IPAA and symptomatic pouchitis shows thickening of the pouch wall with increased enhancement (*white arrows*). An enlarged lymph node is also present (*curved arrow*). Axial T2-weighted image with fat suppression (**b**) shows mild inflammatory stranding adjacent to the pouch (*dashed white arrows*). Enlarged lymph node is also seen (*curved arrow*). Coronal T2-weighted MR (**c**) image from a different patient with IPAA complications. Similar to the prior case, the pouch wall is thickened (*curved black arrows*), and there is a prominent lymph node adjacent to the pouch (*white arrowhead*). A T2 hyperintense intersphincteric fistula extends from the IPAA to the perineal subcutaneous tissues (*black arrows*). Coronal contrast-enhanced subtracted T1-weighted MR image (**d**) at the same level shows peripheral enhancement of the fistula (*black arrows*)

uncomplicated pouchitis. When imaging is performed, features of pouchitis on both CT and MR include pouch wall thickening of more than 2 mm and increased mural enhancement. Prominent peripouch lymph nodes or inflammatory stranding of the fat adjacent to the pouch may be seen. Fatty proliferation has also been described. MR imaging can add value in the evaluation of patients with complicated pouchitis as it may reveal mural and extramural causes of medical treatment failure such as fistula, leak, or abscess (Fig. 3.17). Imaging studies of patients with complicated pouchitis may show features suggestive of underlying Crohn's disease [50, 52].

3.7.4 Cuffitis

A cuff of rectal tissue may be used in the construction of the pouch-anal anastomosis. This residual rectal mucosa may become inflamed in as many as 15 % of patients [51]. The diagnosis of cuffitis is typically made endoscopically. When seen on imaging, cuffitis may appear as wall thickening, increased enhancement, and surrounding inflammatory change at the level of the anastomosis.

3.7.5 Stricture

Pouch stricture is a fairly common complication with incidence reported in 10–40 % of patients. Strictures most often occur at the pouch outlet (IPAA) but can also occur at the pouch inlet [51]. Anal stenosis can be shown by fluoroscopic imaging. Imaging findings on CT or MR suggestive of strictures include wall thickening at the level of the anastomosis with upstream bowel dilation [48].

3.8 Conclusion

Cross-sectional CT and MR imaging of the anorectum are powerful tools that provide valuable insight into the anatomy and pathology of patients with benign and malignant disease processes. Due to continued developments, these techniques continue to supplant other imaging modalities and compliment the clinical evaluation of these patients often providing information that helps the physician decide the most appropriate treatment plan.

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Part II

Pathology and Treatment

Anorectal Abscess

4

Nicole M. Saur and Dana R. Sands

Anorectal abscesses and associated fistulae are entities in a complicated disease spectrum. While the abscess represents the acute phase of the disease, the fistula represents the chronic phase of the disease [1]. The exact numbers are difficult to find due to the variety of settings where perianal abscesses are cared for from the emergency department to the operating room, but it has been postulated that perianal abscesses affect 68,000–98,000 patients annually with a persistent fistula in approximately 35 % of those patients [1–4]. Anorectal abscesses are more common in men with a ratio of 2:1 to 5:1 reported in the literature [1, 5–7]. It is imperative that physicians maintain a high level of suspicion for anorectal abscess in any patient with complaints of perianal pain. Proper management of anorectal sepsis depends on a thorough understanding of both the anatomy of the region and appropriate drainage strategies.

4.1 Anatomy and Pathophysiology

Perianal abscesses originate in the anal glands and crypts [8, 9]. Pus is then able to travel along the natural planes to reach the perianal, ischiorectal, intersphincteric, supralevator, and deep postanal spaces (Fig. 4.1) [6, 7, 10–12]. The appropriate treatment of anorectal abscesses is dependent on the space involved and is geared to maximize opportunity for resolution of the abscess and minimize postoperative complications such as recurrence and incontinence.

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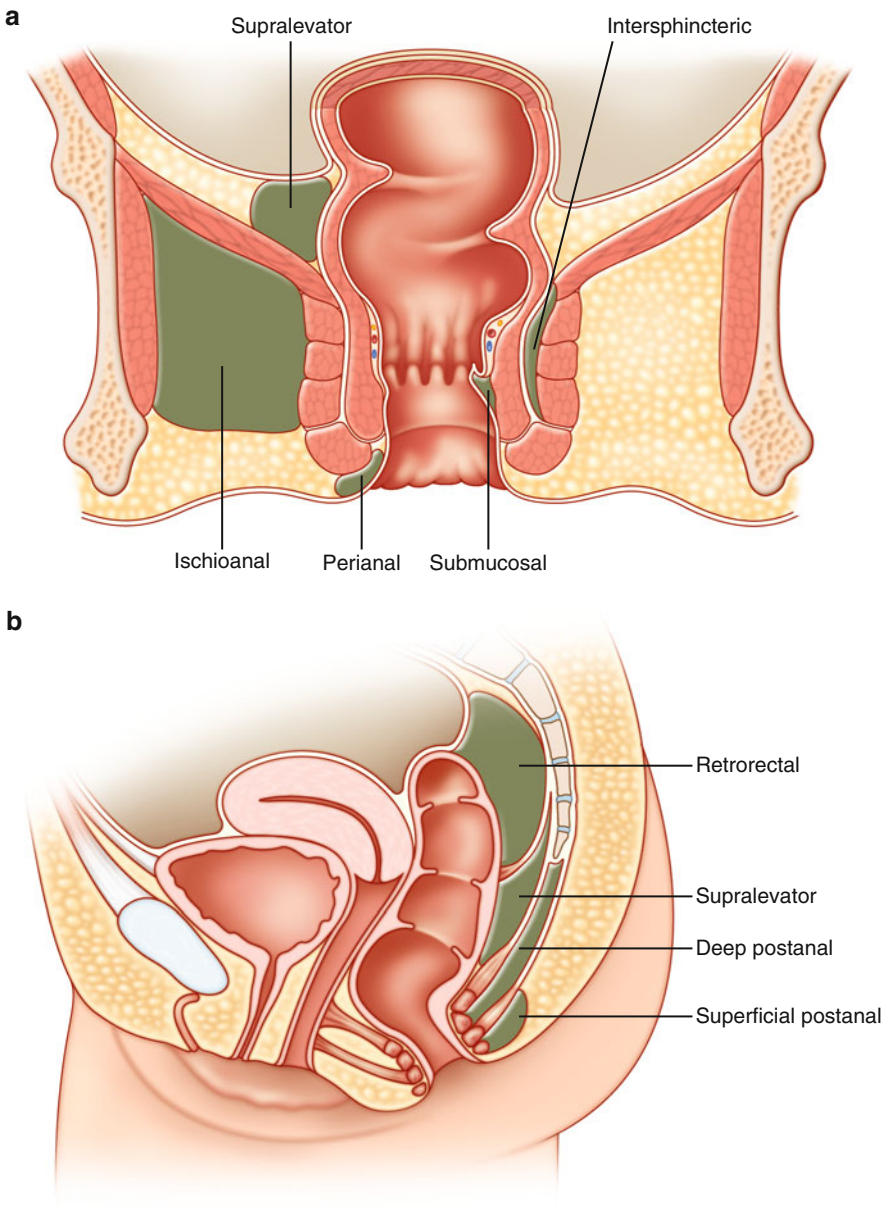

Fig. 4.1 (**a** and **b**) Normal anatomy of the perianal region sagittal (**a**) and lateral (**b**) views

4.2 General Considerations

There is little to no role for antibiotics in the treatment of uncomplicated anorectal abscesses [13]. Sözener et al. showed that antibiotics do not prevent fistula formation after abscess drainage [14]. However, antibiotics can be considered in the treatment of significant cellulitis. In addition, patients with underlying immunosuppression such as HIV infection may benefit from antibiotics. Finally, the American Heart Association recommends preoperative antibiotics prior to incision and drainage for patients with prosthetic valves and history of bacterial endocarditis or congenital heart disease [10, 13].

Perianal abscesses can be cared for in various clinical settings. Simple perianal abscesses can be treated at the bedside with local anesthetic, while intersphincteric abscesses usually require exam under anesthesia (EUA) to fully characterize and treat the abscess. Patients can generally be treated on an outpatient basis, but immunocompromised patients and those with advancing cellulitis or concern for developing necrotizing infection warrant inpatient monitoring. Delaying I&D while treating with antibiotics is inappropriate and may lead to a larger abscess that involves more of the sphincter complex and, in extreme circumstances, to necrotizing infection [3, 8, 13].

4.3 Workup and Treatment of Abscesses

4.3.1 Perianal Abscess

4.3.1.1 Incidence

Perianal abscesses make up 34.5–58.4 % percent of anorectal abscesses in several series [6, 7, 11, 12, 15].

4.3.1.2 Symptoms

Their symptoms are along the spectrum of fever, perianal pain, fluctuance, or spontaneous drainage of abscess [3, 10, 13, 16, 17].

4.3.1.3 Evaluation

Physical examination may reveal tenderness, erythema, induration, and/or fluctuance. Typically no further tests are needed for diagnosis. However, for patients where physical examination does not reveal an obvious abscess, endoanal ultrasound (EUS) can be used as an adjunct in the office setting.

4.3.1.4 Treatment

The treatment of perianal abscesses is incision and drainage. The area of maximal pain or fluctuance is identified, local anesthesia is injected (1 % lidocaine with epinephrine 1:200,000 or 0.25 % Marcaine with epinephrine 1:200,000), a cruciate incision is made, and purulence is expressed. Figure 4.2 demonstrates the location and appropriate drainage technique of a perianal abscess. Tonkin et al. demonstrated that it was safe and effective to not pack wounds after incision and drainage by

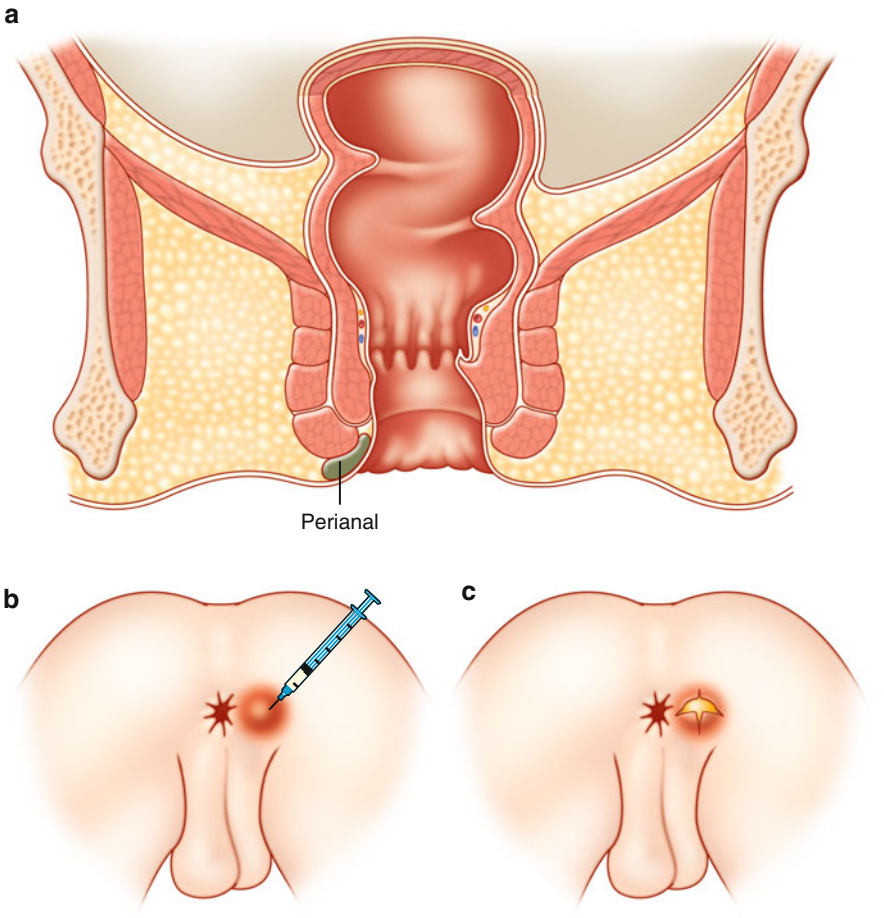

Fig. 4.2 (**a**) Perianal abscess. (**b** and **c**) Drainage of perianal abscess

showing similar rates ($p > 0.2$) of recurrence, fistulas, healing times, and pain scores at the first dressing change [2]. These results were verified by Perera et al. who showed that the non-packing group had a faster healing time with less pain while having similar recurrence rates [5]. Therefore, no packing is required unless necessary for hemostasis.

4.3.2 Ischiorectal Abscess

4.3.2.1 Incidence

Incidence of ischiorectal abscesses has been reported as 22–33.9 % in several studies [6, 7, 11, 12].

4.3.2.2 Symptoms

Their symptoms are similar to those for perianal abscess and fall along the same spectrum of fever, perianal pain, fluctuance, or spontaneous purulent drainage [3, 8, 10, 13].

4.3.2.3 Evaluation

Physical examination may reveal tenderness, erythema, induration, and/or fluctuance. Typically no further tests are needed for diagnosis.

4.3.2.4 Treatment

Ischiorectal abscesses can be drained in a similar fashion to perianal abscesses. However, it is important to note that the incision should be made as close as possible to the anal verge to shorten the potential fistula tract. Large ischiorectal or horseshoe abscesses are best drained under spinal or general anesthesia [15, 16]. In addition, if the abscess cavity is large, it is necessary to break up loculations to achieve adequate drainage [16, 17]. However, one is cautioned to avoid causing sphincter injury with aggressive disruption of loculations [18]. Figure 4.3 demonstrates the location and proper drainage technique for ischiorectal abscesses.

Alternatively, catheter drainage can be used instead of incision and drainage in stable patients without signs of sepsis. Local anesthetic of choice is injected at the area of maximal fluctuance and the surrounding skin. A stab incision is made as close as possible to the anal verge to minimize potential fistula length and complexity. The pus is evacuated and a 10–16 French mushroom catheter is placed in the incision. If the incision and mushroom catheter are sized appropriately, no sutures are needed. The mushroom catheter is trimmed to 2–3 cm from the skin to avoid making the external portion too short so it will not fall into the wound. The catheter is left in place until the drainage decreases to an acceptable level [8].

4.3.3 Intersphincteric Abscess

4.3.3.1 Incidence

Intersphincteric abscesses represent 23–47 % of anorectal abscesses in several large series [1, 6, 7, 10].

4.3.3.2 Symptoms

Patients typically present with pain without external signs of infection [3, 8].

4.3.3.3 Evaluation

In a patient with no external signs of infection but with pain, an intersphincteric abscess should be suspected and an examination under anesthesia undertaken. Because of increased patient pain and lack of diagnostic information at the bedside, it would be inappropriate to proceed with further invasive testing in this setting [3, 8].

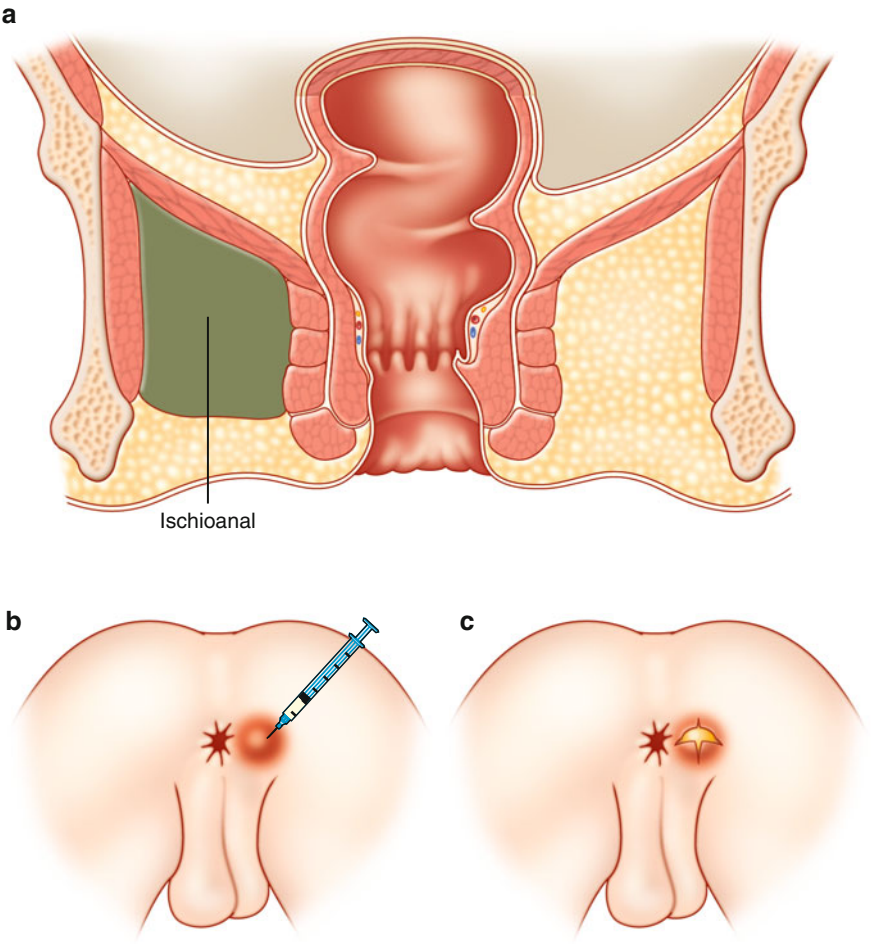

Fig. 4.3 (**a**) Ischioanal abscess. (**b** and **c**) Drainage of ischioanal abscess

4.3.3.4 Treatment

Exam under anesthesia is mandated for intersphincteric abscesses secondary to the lack of physical examination findings and the pain out of proportion to examination when evaluating the patient at the bedside. Under anesthesia, a digital rectal examination frequently reveals an area of fullness. The area of fluctuance in the intersphincteric plane should be opened with a knife. The internal sphincter muscle must be opened enough to express the pus in the intersphincteric space. The wound can then be marsupialized for better healing and to keep the tract open. A low intersphincteric abscess can typically be treated with drainage, division of the internal sphincter, and marsupialization. High intersphincteric abscesses, although uncommon, typically require placement of a mushroom catheter for adequate drainage [19]. Figure 4.4 demonstrates the anatomic location and proper drainage technique of an intersphincteric abscess.

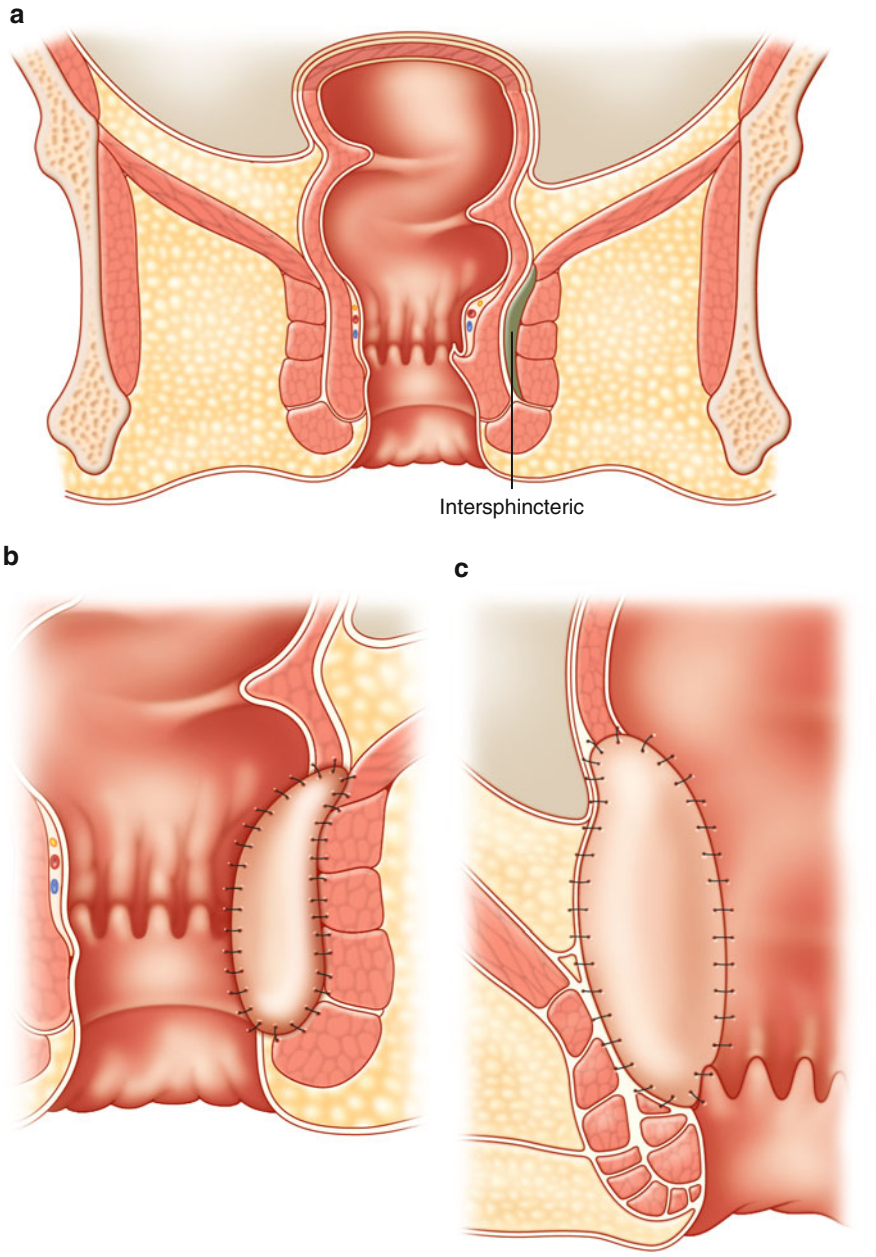

Fig. 4.4 (**a**) Intersphincteric abscess. (**b** and **c**) Drainage of intersphincteric abscess

4.3.4 Supralevator Abscess

4.3.4.1 Incidence
Supralevator abscesses have been estimated to represent 9–42 % of abscesses in the literature [6, 12].

4.3.4.2 Symptoms
Patients typically present with perianal pain, pelvic pain, rectal bleeding, ileus, and/or urinary retention [3, 8, 12].

4.3.4.3 Evaluation
Supralevator abscesses can arise from ischiorectal or intersphincteric abscesses extending upward or from pelvic abscesses secondary to diverticulitis, appendicitis, or tubo-ovarian abscess draining downward. Because of the varied treatment based on origin of infection, supralevator abscesses are often evaluated with imaging (CT or MRI) [8, 20].

4.3.4.4 Treatment
If the abscess is arising from an ischiorectal abscess, it can be drained through the perianal skin. However, if it is arising from an intersphincteric abscess, it should be drained through the internal sphincter and into the rectum to avoid the creation of a suprasphincteric fistula. If the abscess arises in the pelvis, it can be drained through the rectum, through the perianal skin, or percutaneously under imaging guidance depending on the size and position of the abscess [8]. In addition, if the abscess is associated with perforated viscus or inflammatory condition, the abscess should be treated according to treatment principles for these conditions and may require operative intervention [21]. Figure 4.5 demonstrates the location and proper drainage technique for supralevator abscesses arising from either an ischiorectal abscess or an intra-abdominal process.

4.3.5 Deep Posterior Anal Space (Horseshoe) Abscess

4.3.5.1 Overview
The deep postanal space is the potential space between the external sphincter complex anteriorly, the coccyx and anococcygeal ligament inferiorly and posteriorly, and the levator plates superiorly. Purulent material can track to this space, and when it extends laterally into the ischioanal fossa, the abscess is termed a horseshoe abscess [22].

4.3.5.2 Symptoms
Patients typically present with perianal pain, pelvic pain, rectal bleeding, and/or urinary retention [3, 8, 12].

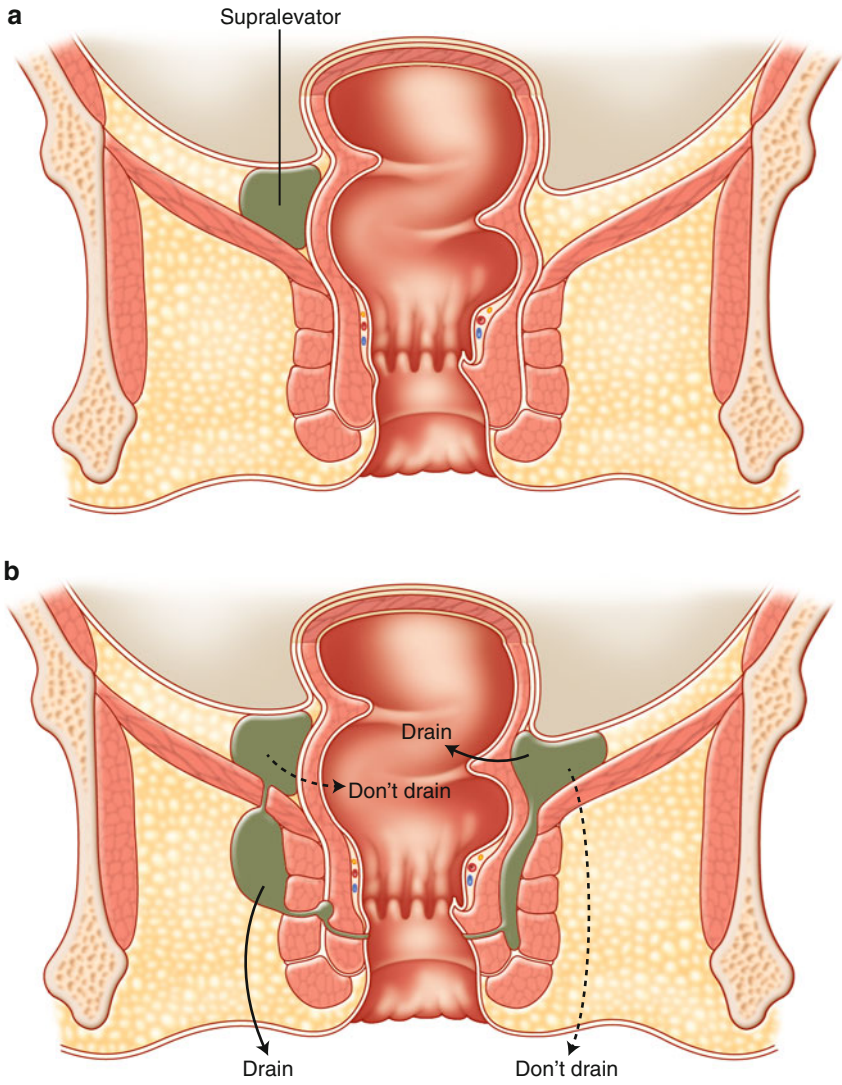

Fig. 4.5 (**a**) Supralevator abscess. (**b**) Drainage of supralevator abscess

4.3.5.3 Evaluation

Physical examination typically reveals tenderness, erythema, induration, and/or fluctuance. In addition, patients will typically have pain and/or fullness palpated on digital rectal examination. Tan et al. showed that preoperative MRI is sensitive in

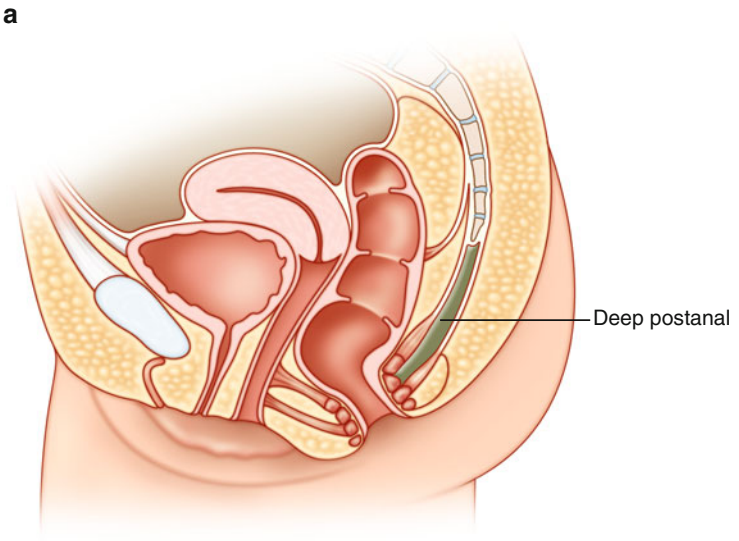

Fig. 4.6 Deep postanal space abscess

detecting fistula tracts and horseshoe fistulas (100 % sensitivity and specificity). Additionally, ultrasound has been shown to aid in identifying fistulas causing horseshoe abscesses [23]. Ratto et al. showed that hydrogen peroxide-enhanced ultrasound increased the accuracy of detecting horseshoe fistulas from 81 to 92 % [24].

4.3.5.4 Treatment

Multiple approaches have been described to treat the complicated deep postanal space abscess (Fig. 4.6). The most invasive procedure is the Hanley procedure in which a midline incision is made between the anus and the coccyx and the external sphincter is spread. The lower half of the internal sphincter muscle is divided to facilitate drainage. Counter incisions are then made over each ischioanal fossa [25, 26]. Inceoglu and Gencosmanoglu showed complete healing in 12 ± 3 weeks, no recurrence in a median follow-up period of 35 months, and no morbidity of mortality [25]. A modified Hanley procedure has been described using setons and drains to avoid cutting the sphincter muscle [15, 16]. Leventoglu et al. showed complete healing in 8 weeks in all of their 21 patients with one recurrence noted after a mean follow-up of 20 months. In addition, they reported no change from the preoperative Cleveland Clinic incontinence score [16]. Tan et al. showed that patients whose internal opening was identified at the initial operation and who had a seton successfully placed had fewer operations and shorter interval to final operation (median 5 vs. 14 months) [22]. Alternatively, Tan et al. describe a one-stage intersphincteric approach, which involves draining the abscess, removing the septic source, and ligating the intersphincteric fistula tract without division of the sphincter muscles. They showed an overall success rate of 70.6 % at 8 months, and the failures were treated with advancement flaps [27].

4.4 Postoperative Management

Patients are instructed to take sitz baths daily and after each bowel movement. They are discharged on a regular diet with oral narcotic pain medications as needed and a stool softener. They are seen in the office in 4–6 weeks to assess healing and evaluate for a fistula.

4.5 Complications

4.5.1 Recurrence

Recurrent abscesses have been described 11–89 % of patients in several series, while the presence of fistulae has been reported in 37–50 % [3, 8, 13, 28, 29]. Reasons for recurrence include missed infection in adjacent spaces, undiagnosed fistula, and failure to completely drain the abscess [6–8, 11, 12].

4.5.2 Incontinence

Incontinence can occur secondary to anorectal abscess drainage due to two mechanisms: division of the sphincter during incision and drainage and development of granulation tissue secondary to prolonged packing [8].

When evaluating rates of incontinence at 1 year, various studies have widely different results. The heterogeneity in the data is likely due to the wide variations in types of abscesses drained, drainage technique performed, and definition of type of incontinence. In addition, higher rates of incontinence have been reported with fistulotomy at the time of primary abscess drainage. Schouten and van Vroonhoven showed a 39 % incontinence rate with primary fistulotomy [10, 28]. However, other studies have shown a rate of incontinence to liquid stool or flatus rate at 1 year ranging from 0 to 18 % in patients who underwent drainage alone and 0–40 % in those who underwent fistulotomy [30].

4.6 Special Considerations

4.6.1 Recurrent Abscess

Yano et al. studied 205 patients with anorectal abscess and found a 36 % recurrence rate. They found that time from onset of symptoms to incision and drainage was the only statistically significant factor predicting recurrence. The type of anesthesia used, location of abscess, anatomic classification of abscess, presence or absence of drain, and presence or absence of diabetes mellitus were not associated with increased recurrence rates [31]. Hamadani et al. showed that age less than 40 years was the only factor associated with increased recurrence risk. Interestingly,

they showed that diabetics may have a decreased risk of recurrence compared to nondiabetics. They did not show an increased recurrence risk with gender, history of smoking, HIV status, or use of antibiotics [32]. With recurrent abscesses, one must determine if a rectal abscess was incorrectly diagnosed on initial drainage. A common diagnosis misdiagnosed as anorectal abscess is hidradenitis suppurativa. Chrabot et al. showed that in 100 recurrent anorectal abscesses, 32 were due to incorrect diagnosis secondary to missed hidradenitis suppurativa [33].

4.6.2 Necrotizing Infection

Improper, inadequate, or delayed drainage of perirectal abscesses can lead to Fournier's gangrene and account to 30–40 % of cases [34–36]. In fact, perianal abscess was the most common etiology of Fournier' gangrene in two recent studies [35, 36]. Czymek et al. showed that diabetes mellitus, chronic alcoholism, immunosuppression, and prolonged immobilization were risk factors for Fournier's gangrene [35]. Fournier's gangrene is associated with a mortality rate of up to 40 %. It is characterized by anaerobic and aerobic bacteria causing thrombosis and subsequent necrosis of subcutaneous tissues [37]. Early diagnosis is crucial for early treatment and improved survival [38]. To aid early diagnosis, Wong et al. have described the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score using variables of white blood cell count, hemoglobin, sodium, glucose, creatinine, and C-reactive protein. A score greater than or equal to 6 correlates increased suspicion for necrotizing infection and a score greater than 8 strongly predicts presence of necrotizing infection [39]. Treatment is based on broad-spectrum antibiotics and wide debridement to healthy tissue. Multiple debridements are typically required over multiple days [38]. Many choices for local wound therapy exist including, at the most basic, simple dressings to, at the most complex, negative-pressure wound therapy (NPWT). In patients with Fournier's gangrene associated with the perianal disease, fecal diversion with ileostomy or colostomy is frequently necessary [38].

4.6.3 Immunocompromised Patients

Many series have reported varying rates of recovery from anorectal abscess treated with conservative management and healing after incision and drainage [40–44]. Shaked et al. showed that patients with agranulocytosis (polymorphonuclear neutrophil [PMN] count less than 500 cells/mm^3) fared better with conservative management of perirectal abscesses than with incision and drainage. They showed that if incision and drainage is to be undertaken, it is best to do so after resolution of agranulocytosis and improvement in the PMN count [40]. However, in a separate study of 202 patients with acute leukemia, Barnes et al. showed that patients had increased rates of survival with early incision and drainage compared to other studies [41]. North et al. showed that patients in their series who were treated with chemotherapy for leukemia did not have a significantly different rate of nonhealing

than the general population and that the duration of neutropenia did not affect the healing rates in these patients [42]. Cohen et al. examined patients who underwent bone marrow transplantation, which typically causes neutropenia. They showed that their patient population had similar rates of healing as the general population as well as similar bacterial cultures [43]. Finally, most recently, Munoz-Vilasmil et al. examined immunocompromised patients with HIV, inflammatory bowel disease, malignancies, and diabetes and showed no difference in rates of healing or complication rates when compared to the general population [44]. Therefore, management of anorectal abscess in immunocompromised patients should be patient centered and based on the degree of sepsis, PMN count, and overall patient health. In addition, a low threshold should be used to undergo surgical treatment when conservative management is chosen initially.

4.6.4 Inflammatory Bowel Disease

Patients with inflammatory bowel disease pose an increased challenge in treating anorectal abscesses. Challenges include immunosuppression with steroid treatment, frequent recurrences, and diarrhea secondary to bowel disease. Secondary to these factors, multiple studies have demonstrated the need for fecal diversion in 40–80 % of patients with Crohn's disease. Causey et al. analyzed >7000 patients using the American College of Surgeons National Surgical Quality Improvement Program database (ACS-NSQIP). They showed that 4.8 % of patients had underlying Crohn's disease and that they were more likely to have a seton placed and be treated with steroids. Alternatively, primary fistulotomy was more common in patients without Crohn's disease (16 vs. 11 %, p <0.001). There was no difference in the overall complication rates between groups, but emergency procedures had higher complication rates in patients with Crohn's disease. Procedure-type breakdown for patients with Crohn's disease included 37 % local procedures, 46 % proctectomy, and 8 % fecal diversion. In contrast, patients without Crohn's disease underwent local procedures 96 % of the time, proctectomy 1 % of the time, and fecal diversion 2 % of the time. Steroid use was associated with an independent 1.7 times increased risk of complications [45].

4.6.5 Primary Fistulotomy

Advocates for primary fistulotomy suggest that if a superficial fistula tract can be identified at the time of abscess drainage and fistulotomy performed, one could save the patient a second operation (i.e., decreased recurrence). Opponents of this strategy cite increased incontinence rates with primary fistulotomy [18]. Tang et al. performed a small prospective randomized study (21 patients without fistulotomy and 24 patients with fistulotomy) and showed a decreased trend in recurrence in the fistulotomy group, but this did not reach statistical significance [46]. Benjelloun et al. showed that primary fistulotomy was associated with a lower recurrence rate

than abscess drainage alone (8 vs. 88 %, $p<0.0001$). They also noted a higher incidence of fecal incontinence in the patients treated with fistulotomy (10 vs. 2 %, $p=0.27$). They showed that the recurrence and incontinence rates were particularly high in patients with high fistula tracts (involved more than 40–50 % of the thickness of the external anal sphincter) when compared to low fistula tracts (recurrence 18.1 vs. 5.1 %, $p=0.043$; incontinence 36.3 vs. 2.5 %, $p=0.008$) [47]. Oliver et al. showed such high rates of recurrence and incontinence in treatment of high intersphincteric and transsphincteric fistulas (18.2, 36.4 %); they recommended drainage only in this group [7]. A 2005 meta-analysis of five trials and 405 patients showed a statistically significant 83 % risk reduction in recurrence rate with fistulotomy. However, they also showed a relative risk of 2.46 for incontinence to flatus and soiling [48]. A 2010 Cochrane review evaluated six trials including 479 patients and showed that performing fistulotomy at time of abscess drainage reduced recurrence rates (RR = 0.13, 95 % confidence interval = 0.07–0.24). They showed no statistically significant difference in incontinence rates at 1 year in patients with and without fistulotomy for low fistulae [30]. If one is to perform primary fistulotomy at the present time, it should be reserved for superficial, low fistulas with a clear internal opening.

4.7 Conclusion

Anorectal abscesses are common, of varying complexity, and are cared for in a variety of clinical settings. Therefore, it is imperative that the surgeon is aware of the anatomy of the region and the drainage techniques for the various types of abscesses to ensure successful treatment of the abscess and to minimize complications. In addition, patients with recurrent abscesses, inflammatory bowel disease, and necrotizing infection and those who are immunocompromised require a specialized approach to treatment of anorectal abscesses and the associated clinical conditions.

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Anal Fissure

5

Glenn Hall Jr. and Brian R. Kann

An anal fissure (or fissure in ano) is a longitudinal or elliptical tear in the anoderm distal to the dentate line, typically just proximal to or at the level of the anal verge. Anal fissures cause severe pain with defecation, are associated with varying degrees of rectal bleeding, and can negatively impact the quality of life of those afflicted in a tremendous manner. Anal fissures have been acknowledged as a source of anal pathology dating back to the early 1800s, when anal dilation was first described by Recamier as a means of treatment [1].

While anal fissures are commonly encountered by the practicing clinician, their exact prevalence is difficult to determine, given that many afflicted individuals may never consult a physician [2]. In a population-based cohort study, Mapel et al. reported an overall annual incidence of 0.11 % (1.1 cases per 1000 person-years) [3]. Anal fissures appear to affect both males and females with equal incidence [4]. While they can occur in any age group, they are more frequently diagnosed in patients under the age of 50, with a mean age at presentation of 40.9 years in women and 46.6 years in men [3].

Anal fissures can be classified as acute, chronic, or associated with an underlying disease process. Acute fissures are those that have been present for less than 6–8 weeks and typically appear as a simple tear in the anoderm (Fig. 5.1). In contrast, chronic anal fissures are those that persist for longer periods of time and are often associated with inflammatory features, such as an external skin tag ("sentinel tag") or a hypertrophied anal papilla adjacent to the fissure. Additionally, the mucosal edges of chronic fissures tend to be raised (Fig. 5.2), and exposed fibers of the internal anal sphincter may be visible at the base. The majority of anal fissures are

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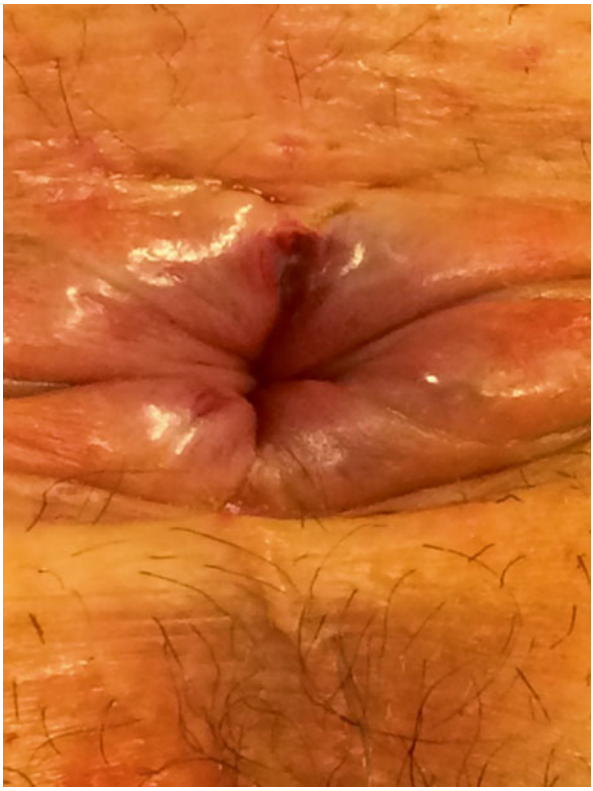

Fig. 5.1 Acute anal fissure

located in the midline; while the posterior midline is the most common location, anterior midline fissures may be seen in up to 25 % of affected women and 8 % of affected men [5]. Up to 3 % of afflicted patients have both anterior and posterior fissures. Anal fissures occurring in females during the postpartum period are more frequently located in the anterior midline. In patients with anal fissures identified in atypical locations (other than the anterior or posterior midline) or those with multiple fissures, the clinician should evaluate the patient further to rule out other underlying conditions, such as cryptoglandular disease, inflammatory bowel disease, HIV, cancer, trauma, sexually transmitted diseases, or tuberculosis.

5.1 Etiology

The precise etiology of anal fissures is likely multifactorial. Most would agree that trauma to the mucosa of the distal anal canal and anoderm likely plays an instrumental role in the pathophysiology of anal fissures. However, while fissures may often result from passage of a large, firm stool bolus commonly associated with constipation, many patients develop fissures after episodes of intractable diarrhea.

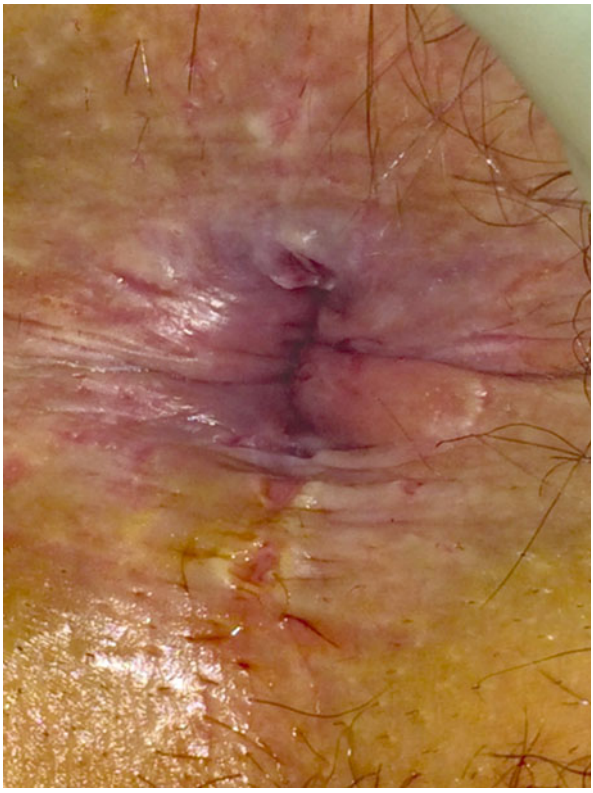

Fig. 5.2 Chronic anal fissure

Trauma from anoreceptive instrumentation or intercourse may also play a role. However, despite the proposed role of trauma as a precursor in the pathogenesis of anal fissures, many patients present without a history of antecedent trauma. Additionally, some patients who develop an acute fissure will heal very quickly without any specific treatment, while others will have persisting symptoms even after prolonged efforts at conservative management. Clearly, there seem to be factors besides local trauma that play a role in the development and persistence of anal fissures.

One of the most widely accepted contributing factors to the development of anal fissures, besides trauma, is elevated resting hypertonia of the internal anal sphincter (IAS). Resting anal pressure is maintained by tonic contraction of the IAS, which is mediated by both α-adrenergic innervation and inherent myotonic tone [6, 7]. Patients with both acute and chronic anal fissures have been shown to have higher maximal and mean resting anal pressures (MRAP) than normal control subjects [8, 9]. It has been proposed that IAS hypertonia may contribute to the persistence or nonhealing of anal fissures by two mechanisms: (1) spasm or lack of relaxation of the IAS during defecation, leading to continued trauma to the fissure, and (2) reduced blood flow to the fissure, leading to decreased tissue perfusion and poor healing.

The role of ischemia in the persistence of anal fissures was first proposed by Gibbons and Read in 1986 [10]. Normal resting anal canal pressure in healthy volunteers ranges from 80 to 100 mmHg, which may approach the intra-arterial systolic pressure in the inferior mesenteric artery. With increased IAS tone, IAS pressure may exceed systolic pressure and blood flow may be impeded, resulting in an area of relative ischemia and a superficial ischemic ulcer [11, 12]. In addition to increased IAS tone, the inherent microvascular anatomy of the anus may play a role in chronic fissures. Angiography performed postmortem has been shown to demonstrate decreased perfusion in the posterior midline of the distal anal canal, where a large proportion of fissures are located [13]; this has also been corroborated using Doppler laser flowmetric studies [12]. Additionally, an inverse relationship has been shown to exist between posterior midline anodermal blood flow and maximum resting anal pressure [12]; this mechanism may be responsible for delaying or preventing healing of anal fissures.

Other factors that may contribute to the development of anal fissures include reduced support of the anoderm by the underlying sphincter complex (leading to shear injury), diets lacking adequate fiber, and trauma during childbirth. Anal fissures that occur postpartum and atypical fissures associated with other disease processes typically are not associated with elevated resting IAS pressures. The presence of an anal fissure in a child without a history of constipation should alert the clinician to the possibility of sexual abuse.

5.2 Symptoms and Diagnosis

The diagnosis of anal fissure is usually suggested by the patient's history. Patients often present either with a self-diagnosis of "hemorrhoids" or are diagnosed by their primary care provider as having hemorrhoids based simply on the presence of anal pain and bleeding, when they actually have an anal fissure. The "classic" description of symptoms includes sharp pain during and immediately after defecation. Patients usually describe the pain with defecation as a sensation of passing "broken glass" or "razor blades." Pain after defecation often transitions to a dull, throbbing pain that is intense and may last for several hours after a bowel movement; in some patients this post-defecatory pain can last for up to 24 h. Patients may also complain of rectal bleeding with bowel movements. While this usually consists of a minimal amount of bright red blood seen on the toilet tissue, occasionally patients will report more significant bleeding. Blood mixed with the stool is not typical for patients with anal fissures and should be further evaluated to rule out other conditions. There is often an antecedent history from the patient of passage of a large, firm bowel movement or an episode of constipation and straining prior to the initial onset of symptoms.

The pain experienced by patients afflicted with an anal fissure during bowel movements often creates significant anxiety surrounding the act. This can lead to failure of the sphincter muscles to relax appropriately or spasms in the sphincter muscles with attempts to defecate. In turn, this may lead to "self-imposed"

constipation, as the patient learns all too well the pain he/she can expect during bowel movements. These factors often initiate a cascade or self-perpetuating cycle of worsening symptoms due to failure to heed the call to defecate, leading to larger and more traumatic bowel movements that exacerbate the fissure and prevent appropriate healing.

Diagnosis of anal fissure is usually made by simple visual inspection. Proper positioning (either kneeling or Sims' position) and lighting are critical. Gentle bimanual retraction of the buttocks and effacement of the anal verge will usually reveal the fissure in the distal anal canal, often just crossing over the anal verge. A sentinel skin tag or hypertrophied papilla may be visualized in close approximation with the fissure. Once the diagnosis has been confirmed, there is no need to exacerbate symptoms further by performing a digital rectal examination or anoscopy during the initial evaluation. It is critical to evaluate the anal canal at some point, either after treatment commences and symptoms resolve or at the time of surgical intervention if conservative measures ultimately fail. When dealing with atypical fissures that are either multiple, painless, or located off the midline, an exam under anesthesia should be strongly considered to exclude other pathology.

5.3 Nonsurgical Management

5.3.1 Fiber, Diet, and Anti-inflammatory Agents

More than half of acute anal fissures will heal, either with no specific measures or with increased fiber and fluid intake in order to create softer, bulkier stool; however, up to one-third of these can be expected to recur. The addition of sitz baths or warm soaks along with topical agents, such as anti-inflammatory agents or local anesthetics, may offer some contribution to healing as well. In a randomized trial comparing topical lignocaine, topical hydrocortisone, and sitz baths in combination with unprocessed bran, Jensen reported no significant differences in symptomatic relief amongst the three groups [14]. Furthermore, at 1-year follow-up, fissure recurrence was experienced by 16 % of patients receiving 15 g of unprocessed bran daily, compared with 60 % of patients receiving 7.5 g daily and 68 % of those receiving placebo [15]. Shub et al. also demonstrated a 44 % healing rate in patients with anal fissures treated with psyllium and sitz baths, though the recurrence rate during a 5-year follow-up period was 27 % [16]. Hanahel and Gordon reported initial healing in 44 % of patients with anal fissures treated with bulking agents and sitz baths, though recurrences were seen in 18.6 % [5].

The advantages of utilizing increased fiber/fluid intake and soaks/sitz baths as an initial management strategy for acute anal fissures are that it is inexpensive and moderately effective and there is essentially no risk of adverse effects. Despite the widespread availability and use of a number of hydrocortisone or other anti-inflammatory preparations, either alone or with the addition of topical anesthetics, there is little convincing evidence to suggest that they contribute significantly to the healing of anal fissures.

5.4 Case 1

5.4.1 Acute Fissure

A 45-year-old female presents with a 2-week history of severe anal pain with defecation as well as bright red blood on the toilet tissue after bowel movements. She describes the pain as sharp and stabbing during defecation, transitioning to a dull, achy discomfort that lasts for a few hours afterwards. She reports having had a very large, painful bowel movement prior to the onset of symptoms. Her primary care physician diagnosed her as having hemorrhoids and prescribed topical hydrocortisone 2.5 %, which has not improved her symptoms.

On examination, she has an acute-appearing posterior midline fissure in ano. She is counseled regarding increased fiber intake (20–25 g/day), increased fluid intake, and warm soaks/sitz baths. She is also prescribed 0.2 % NTG for topical use three times daily. After a few days, she calls complaining of severe headaches; NTG is discontinued and she is instead prescribed 5 % diltiazem for topical use three times daily.

At 6-week follow-up, her symptoms have improved significantly, though on examination, the fissure has not fully healed. She is instructed to continue with the current regimen. Two weeks later she returns to the office with worsening symptoms and on examination, the fissure appears worse. She subsequently undergoes BTX injection, and 6 weeks later she is pain-free. Examination at that time reveals that the fissure has completely healed; digital rectal examination and anoscopy reveal no other abnormalities. Her continence is normal.

5.4.2 Topical Nitrates

The main goal of therapy in patients afflicted with an acute fissure that has failed to heal with initial attempts at conservative measures is centered around the principles of managing IAS hypertonia, reducing resting anal pressure, and increasing blood flow to the fissure to facilitate healing. While the "gold standard" in the operative management of chronic anal fissures has long been considered internal anal sphincterotomy, a multitude of oral, topical, and injectable agents are often utilized to effect a "chemical sphincterotomy" and avoid surgery along with the inherent risk of altered postoperative continence.

The first class of pharmacologic agents to be used in this regard was topical nitrates, including nitroglycerin [NTG], glyceryl trinitrate [GTN], and isosorbide dinitrate [ISDN]. Nitric oxide (NO) is the predominant non-adrenergic, non-cholinergic neurotransmitter in the IAS. It stimulates guanylate cyclase, leading to the formation of cGMP, which then activates protein kinases that dephosphorylate myosin light chains, resulting in muscle fiber relaxation [17]. The use of exogenous nitrates has been shown to release nitric oxide in vivo, thus serving as nitric oxide donors and resulting in reduced resting anal pressure.

Guillemot et al. first studied the effect of topical application of perianal NTG in patients with constipation, both with and without anal sphincter hypertonicity, as

well as in a control group, and found that topical application of NTG resulted in a significant reduction in MRAP in all three groups [18]. Loder et al. also investigated the effect of topical nitrates on anal sphincter function, reporting a 27 % reduction in MRAP after topical application of 0.2 % GTN [19]. Shortly thereafter, Gorfine published one of the first case series utilizing topical nitrates in the clinical management of anal fissure, in which he reported healing in 77 % of patients after 8 weeks of therapy with topical 0.3 % NTG ointment [20].

A number of randomized trials investigating the use of topical nitrates in the management of anal fissures soon followed. In a randomized, prospective placebo-controlled trial, Lund and Scholefield showed healing rates of 68 % after 8 weeks with the use of topical 0.2 % GTN compared with 8 % using placebo. They also demonstrated increased anodermal blood flow via laser Doppler flowmetry after application of GTN [21]. Bacher et al. reported healing rates of 80 % after 1 month of treatment using 0.2 % NTG compared with 40 % using 2 % lidocaine; manometric studies after 1 month of treatment also showed a 20 % reduction in MRAP in patients treated with 0.2 % NTG [22]. Carapeti et al. similarly published a randomized controlled trial that showed a healing rate of 67 % in patients treated with topical GTN compared with 32 % in those treated with placebo, though they found a significant recurrence rate [23]. Additional randomized controlled trials published by Kennedy et al. and Chaudhuri et al. reported similar trends [24, 25]. A Cochrane Database review found that GTN was significantly better than placebo in terms of healing rates (48.9 % vs. 35.5 %, $p<0.0009$), though late recurrences were seen in 50 % [26]. More recently, Berry et al. compared the use of 0.4 % NTG with placebo for the treatment of chronic anal fissures, also administering acetaminophen to patients in both treatment groups prior to NTG application in order to control for the confounding effects of analgesics; they reported that pain was significantly reduced in the NTG group compared with placebo [27].

Other studies investigating the utility of topical nitrates for the treatment of anal fissures have reported contradictory results. Altomare et al. randomized patients with anal fissure to receive either 0.2 % GTN or placebo and found no difference in pain reduction or healing, despite demonstrating improved anodermal blood flow with GTN treatment [28]. Another multicenter, prospective, double-blinded study of 304 patients randomized to receive either placebo or NTG at concentrations of 0.1, 0.2, and 0.4 % found healing rates of 50 % in all groups, though 0.4 % NTG was associated with a more significant reduction in average pain intensity than other treatment arms [29].

The most widely reported adverse effect encountered with the use of topical nitrates is headache, occurring in as many as 90 % of patients. These headaches tend to be transient and often subside within 15 min of application. Starting with a lower dose and gradually escalating therapy over a 4–5-day period can often mitigate the occurrence and severity of headaches. The use of gloves or finger cots to limit systemic absorption, application in a recumbent position, and remaining recumbent for 15 min after application have also been reported to minimize headache severity [30, 31]. Despite these measures, in 10–15 % of patients, the headache associated with topical nitrate use is disabling enough to result in cessation of treatment

[32–34]. Perez-Legaz et al. found a lower incidence of headaches in patients randomized to receive endoanal as opposed to perianal application of 0.4 % GTN (23 vs. 54 %, $p=0.003$); they also reported an improved healing rate at 24 weeks with endoanal application compared with perianal application (77 % vs. 62 %, $p<0.05$) [35]. Orthostatic hypotension is also a reported adverse effect associated with the use of topical nitrates, due to the potential for vasodilation if systemic absorption occurs.

Other studies have investigated the use of higher concentrations of topical nitrates. In the study by Carapeti et al. previously mentioned, the authors investigated the use of an escalating dose of GTN, starting with 0.2 % and increasing the dose by 0.1 % weekly to a maximum of 0.6 %; they found no difference in healing rates after 8 weeks of treatment when compared with a standard dose of 0.2 % [23]. In a randomized controlled trial comparing placebo to 0.1, 0.2, and 0.4 % GTN, Scholefield et al. found no difference in any of the GTN groups compared with placebo. However, a secondary analysis excluding fissures without secondary criteria for chronicity found statistically higher healing rates for the 0.1 % GTN, 0.4 % GTN, and GTN group as a whole compared with placebo, suggesting that the use of higher concentrations of topical GTN may be more beneficial for patients with chronic fissures [36]. Unfortunately, the use of higher concentrations of topical nitrates is associated with more frequent and severe headaches, as well as a higher incidence of orthostatic hypotension.

The length of treatment has also been studied as a predictor for successful treatment with topical nitrates. Gaglairdi et al. randomized patients to either 40 days or 80 days of treatment with 0.4 % GTN and found that both pain at defecation and healing improved significantly until 40 days ($p<0.001$), while the difference between 40 and 80 days was not significant [32]. In contrast, Lund and Scholefield reported that extending the use of 0.2 % GTN from 4 to 6 weeks increased healing rates from 36 to 85 % [37].

More recent studies have also examined the efficacy of L-arginine, an endogenous nitric oxide donor, in the treatment of anal fissure. L-arginine has been shown to lower MRAP and improve anodermal blood flow [38, 39], and in a phase II clinical trial, topical L-arginine was found to have a 62 % healing rate for anal fissure after 18 weeks, with no patients experiencing headache as a side effect [40].

Besides the increased incidence of headaches, the other major drawback to the use of topical nitrates is the rate of fissure recurrence, which has been reported to be as high as 67 % [41]. The reduction in MRAP induced by topical nitrate application is transient, meaning that IAS pressure may return to pretreatment levels with cessation of treatment, which can predispose to a relapse.

5.4.3 Calcium Channel Blockers

Calcium channel blockers (CCBs), such as nifedipine and diltiazem, act by inhibiting voltage-dependent calcium channels in the cell membranes of smooth muscle cells, thus decreasing intracellular calcium concentrations and interfering with

calcium-mediated signal transduction and phosphorylation; this ultimately results in decreased muscle contraction and subsequent smooth muscle relaxation [17]. Chyrsos et al. demonstrated a reduction in MRAP by approximately 30 % after administration of sublingual nifedipine, establishing a basis for the potential therapeutic effect of CCBs in the management of anal fissures [42]. Factors that often limit the use of topical nitrates, such as severe headaches and systemic hypotension, are seen infrequently with CCBs, often making them a more attractive alternative.

Early reports established the clinical efficacy of both topical and oral nifedipine in the management of anal fissures. Antropoli published a series of 283 patients randomized to receive either topical 0.2 % nifedipine gel or placebo twice daily for 3 weeks; healing was seen in 95 % of the nifedipine-treated patients compared with 50 % of controls ($p<0.01$) [43]. In another prospective randomized trial, Perrotti randomized patients to receive either topical 0.3 % nifedipine ointment or 1 % hydrocortisone (both groups also received 1.5 % lidocaine) and found healing in 94.5 % of the nifedipine-treated patients compared with 16.4 % of controls ($p<0.001$) [44]. Another study by Cook et al. found that 20 mg of nifedipine taken orally twice daily reduced MRAP in patients with anal fissure by 36 %; this resulted in healing in 60 % and resolution of symptoms in 80 % of patients [45]. Agaoglu et al. also reported healing rates of 60 % with the use of 20 mg of oral nifedipine taken twice daily [46]. Agrawal randomized 90 patients to conventional treatment (psyllium, stool softeners, sitz baths, lidocaine ointment), oral nifedipine, or topical nifedipine and found that pain relief was significantly better in the group treated with topical nifedipine than in the other two groups, while the use of oral and topical nifedipine was found to result in comparable healing rates [47].

Further studies demonstrated similar findings with diltiazem. Carapeti et al. treated patients suffering from chronic anal fissure with topical 2 % diltiazem gel and found significant reductions in pain scores and MRAP, with a 67 % healing rate [48]. Knight et al. reported a 75 % healing rate with the use of 2 % diltiazem topical gel for 3 months; 47 % of the patients that did not heal after 3 months of treatment healed after an additional 8-week course of treatment [49]. In a randomized, controlled trial comparing the effectiveness of both oral (60 mg) and topical 2 % diltiazem, Jonas et al. reported that, after 8 weeks of treatment, healing was seen in 38 % of the patients treated via the oral route, compared with 65 % in those treated topically. Additionally, side effects (including rash, headache, nausea, vomiting, reduced smell and taste) were seen in 33 % of those treated orally, while those treated topically experienced no adverse reactions [50]. In a separate study, the same authors reported that the use of topical 2 % diltiazem resulted in healing of fissures in 49 % of patients that had failed to previously respond to a complete course of topical GTN [51].

As with topical nitrates, the major concerns regarding the use of CCBs center on long-term efficacy and recurrence once treatment is stopped and MRAP returns to baseline. Nash et al. followed 112 patients treated with topical diltiazem for an average of 2 years and found that, while more than two-thirds reported initial success, 59 % required further treatment (either medical or surgical) during the follow-up period [52].

5.4.4 Botulinum Toxin

Botulinum toxin (BTX) is an endopeptidase exotoxin synthesized by *Clostridium botulinum* that binds to the presynaptic nerve terminals at the neuromuscular junction of α-motor neurons, γ-neurons in muscle spindles, and all parasympathetic and cholinergic postganglionic sympathetic neurons, thus blocking acetylcholine release and causing temporary paralysis [17]. This effect can persist for as long as 3–4 months, until axonal regeneration occurs with the formation of new nerve terminals [53]. The exact mechanism of BTX in smooth muscle has not been fully elucidated, as smooth muscle fibers, unlike skeletal muscle fibers, lack neuromuscular synapses. However, injection of BTX into both the external anal sphincter (skeletal muscle) and IAS (smooth muscle) has been shown to produce sphincter relaxation [54, 55]. This temporary chemodenervation produces a "chemical sphincterotomy" without the risk of possible long-term alterations in fecal continence as can be seen with surgical sphincterotomy.

Early studies by Jones et al. using a porcine model demonstrated decreased MRAP after localized intrasphincteric injection of BTX; examination of strips of treated sphincter muscle found that the mostly likely mechanism of action on the IAS is via sympathetic blockade [56]. One of the earliest clinical studies evaluating the use of BTX in the treatment of anal fissures was reported by Gui et al., who prospectively studied the effect of injection of a total of 15 U of BTX into the IAS of ten patients with chronic anal fissure (two lateral injections and one posterior injection, five U each) and found healing of the fissure in seven patients at 2 months' follow-up [57].

A number of subsequent studies further evaluated the safety and efficacy of BTX in the management of anal fissures. Maria et al. [58] conducted a double-blind, placebo-controlled study of BTX injection (20 U) for the treatment of chronic anal fissure and reported 73.3 % (11 of 15) healing at 2 months in the BTX group, compared with 13.3 % (2 of 15) in the control (saline injection) group ($p=0.003$). The four patients in the BTX group with a persistent fissure at 2 months were retreated with another injection of BTX (25 U), and all had healed by 2 months after reinjection, with no relapses during an average follow-up of 16 months. Colak et al. demonstrated the superiority of BTX to topical lidocaine, reporting healing in 70.6 % of patients treated with BTX compared with 21.4 % in patients treated with lidocaine ($p=0.006$) [59]. Lindsey et al. performed BTX injection (20 U) in 40 patients with chronic anal fissures who had failed prior treatment with 0.2 % GTN; they reported healing in 43 % and symptomatic improvement in 73 %, while 18 % experienced symptoms of mild, transient incontinence [60]. Jost and Shrank reported that a repeat injection of BTX in patients who did not heal after an initial BTX injection was effective in 63 % of patients [61].

A number of studies have sought to determine the optimal dose for BTX injection. Minguez et al. compared groups treated with 10 U (5 U on each side of the IAS), 15 U (5 U on each side of the IAS and 5 U beneath the fissure), and 21 U (7 U on each side of the IAS and 7 U beneath the fissure); they found that the groups treated with a higher dose demonstrated better pain relief, a more significant

reduction in MRAP, and a lower likelihood to require reinjection for persistent symptoms. The need for surgery was similar in the first 2 groups (17 and 19 %) but significantly lower in the third group (5 %) [62]. Brisinda et al. randomized patients to receive BTX injections of 20 U (and retreatment with 30 U for persistent symptoms) or 30 U (and retreatment with 50 U for persistent symptoms), and they found that the higher dose resulted in a higher rate of healing (87 % vs. 73 %), though the higher dose was associated with a higher incidence of mild, transient incontinence to flatus [63].

Other studies have sought to determine the most effective injection technique or location(s). Maria et al. found that injection of the IAS in the anterior midline resulted in improved lowering of MRAP and produced an earlier healing scar, compared with injection in the posterior midline [64]. Othman compared two separate BTX injections of 20 U each into each side of the IAS with a single posterior midline injection of 25 U and found equivalent outcomes in terms of healing and time to pain relief [65].

Some investigators have combined BTX injection with other modalities in the management of anal fissures in an attempt to improve rates of healing. Lysy et al. reported that daily application of ISDN after BTX injection was more effective than BTX alone [66]. Jones et al. randomized patients to receive either BTX injection plus topical GTN paste or BTX injection plus placebo paste; there was a non-statistically significant trend towards better outcomes in the group treated with GTN, though healing rates in both groups were poor (47 % vs. 27 %) [67]. Two small case series describing BTX injection in combination with fissurectomy have been reported by Patti et al. [68] and Witte et al. [69], demonstrating healing in 10/10 and 19/21 patients, respectively.

The commercial availability of BTX and the ability to perform injection in the office setting has made its use commonplace. Complications of BTX injection include local discomfort at the site of injection, hematoma or hemorrhoidal thrombosis, local infection, and disturbances in continence of varying severity and duration. Recurrences rates have been reported to be as many as 41.5 % [62]. Contraindications to the use of BTX include known hypersensitivity, pregnancy, myasthenia gravis, Lambert-Eaton syndrome, and amyotrophic lateral sclerosis. Injection of BTX in patients using aminoglycosides should also be avoided due to potential enhancement of the effect of BTX [70]. In 1999, the US Food and Drug Administration issued a warning regarding overdosing with resultant respiratory failure and death [71].

5.4.5 Other Sphincter Relaxing Agents

Other pharmacologic agents have been shown to demonstrate potential in the management of anal fissures by reducing IAS pressure. Pitt et al. found that oral administration of indoramin (an alpha-1 adrenergic antagonist) reduced anal pressure in both patients with chronic anal fissure as well as in healthy controls [72]. However, in a placebo-controlled trial, the same authors found that, despite a 29.8 % reduction

in MRAP, healing occurred in only 7 % of the treatment group compared with 22 % in the placebo group [73].

Bethanechol, a cholinergic agonist, has also been shown to lower anal sphincter pressure when applied topically [74]. Carpeti et al. reported healing of fissures in 60 % of patients treated with topical 0.1 % bethanechol gel with no side effects [48]. In a non-randomized trial comparing the efficacy of DTZ with bethanechol in the treatment of fissures, Araujo et al. found similar healing rates (53 % vs. 50 %, $p = 0.8$) after 8 weeks [75].

Jones et al. [76] have demonstrated that there are several functionally important phosphodiesterases in the IAS and rectal circular smooth muscle. Both adenosine 3′,5′-cyclic monophosphate and guanosine 3′,5′-cyclic monophosphate appear to be important in the myogenic tone of the IAS. Sildenafil, a phosphodiesterase inhibitor and nitric oxide donor, has been shown to decrease internal anal sphincter tone in vitro [77]. Torrabadella et al. reported that sildenafil significantly reduced anal sphincter pressure in a series of 19 patients with chronic anal fissures [78]. Tadalafil, another phosphodiesterase inhibitor, has also been shown to improve symptoms related to anal fissures [79].

More recently, topical application of 0.28 % captopril (an ACE inhibitor) has also been shown to result in reductions in MRAP in healthy volunteers [80]. Further studies are needed to clarify its clinical efficacy in treating anal fissures.

5.4.6 Surgical Management

While initial management of acute anal fissures is typically via conservative measures, failure of these means to resolve fissure-related symptoms after a period of 6–12 weeks warrants discussion with the patient regarding surgical management. Surgical treatment of anal fissures is targeted towards the goals of medical treatment, namely, addressing IAS hypertonia and enhancing mucosal blood flow to improve healing. Options include anal dilation, LIAS, and advancement flaps.

5.5 Case 2

5.5.1 Chronic Fissure

A 32-year-old male has been treated for the past several months for a refractory anal fissure. Prior to the onset of symptoms, his diet consisted mainly of fast food and soda, and he suffered from chronic constipation. He has increased his fiber and fluid intake and has been treated with prolonged courses of both topical 2.5 % hydrocortisone and 5 % diltiazem with no improvement in pain or bleeding. On examination he has a chronic-appearing anterior midline fissure with raised mucosal edges, visible IAS fibers at the base of the fissure, and a small sentinel skin tag at the apex of the fissure.

After discussing the options of undergoing BTX injection or LIAS, he opts for the latter. A closed LIAS and excision of the tag is performed in the operating room under monitored anesthesia care with injection of local anesthetic. At the time of surgery, a prominent IAS "band" is noted on palpation of the intersphincteric groove; this disappears after performing the sphincterotomy. At 6-week follow-up, he reports no pain or bleeding with bowel movements and has no alterations in continence. On examination, the fissure has healed, and anoscopy is unremarkable. He is instructed to maintain a high-fiber diet.

5.5.2 Anal Dilation

Anal dilation, or sphincter stretch, was first described in the early 1800s [1] and for a long period was the most widely practiced means of treating anal fissure. Its use in the current era is limited and it is mentioned herein mainly for historical completeness. The procedure involves a slow, controlled dilation of the anal canal, using up to four fingers. Healing rates range from 40 to 70 %, and recurrence rates range from 2 to 55 % [4]. However, the major limiting complication is damage to the anal sphincter with resultant alterations in continence, which includes incontinence to flatus or fecal soiling in up to 40 % of patients and true fecal incontinence in as many as 16 % [4]. A Cochrane Database review of operative procedures for anal fissures in 2011 suggested abandonment of manual dilation due to the significant risk of nonhealing and incontinence [81].

5.5.3 Lateral Internal Anal Sphincterotomy

Lateral internal anal sphincterotomy (LIAS) is recommended as the surgical treatment of choice for anal fissures refractory to medical management [82]. The procedure involves dividing the distal portion of the internal anal sphincter to reduce MRAP and facilitate healing. As initially described by Eisenhammer [83], internal anal sphincterotomy for chronic anal fissure was performed at the site of the fissure itself, typically though the posterior midline. However, this was later found to be associated with development of a scarred groove, or "keyhole deformity," in as many as 28 % of patients, leading to trapping of fecal matter and subsequent soiling [84]. As a result, the procedure was modified and is currently performed in a lateral location.

LIAS can be performed using either an open or a closed technique. The open technique utilizes an incision made over the intersphincteric groove with isolation and division of the distal internal anal sphincter under direct visualization (Fig. 5.3). The closed technique is performed by insertion of a beaver blade or #11 blade into the intersphincteric groove parallel to the muscles, then rotating the blade medially 90°, and withdrawing the blade, thus dividing the distal internal anal sphincter in a lateral to medial direction (Fig. 5.4). Alternatively, the blade can be inserted into the

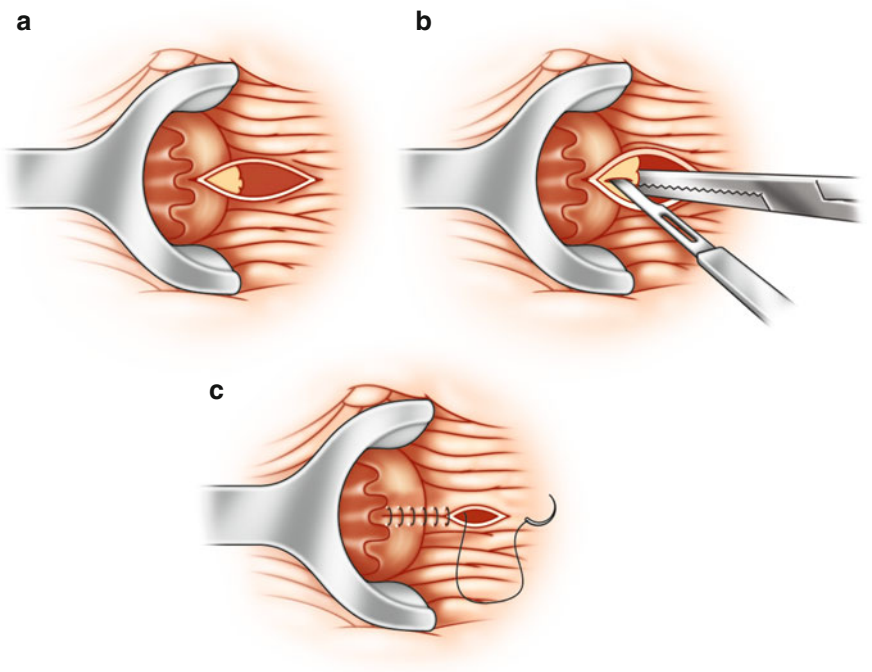

Fig. 5.3 Open lateral internal anal sphincterotomy. (**a**) Lateral incision to expose IAS. (**b**) Division of IAS under direct visualization. (**c**) Closure of incision

submucosal space instead of the intersphincteric space and rotated laterally, dividing the muscle in a medial to lateral direction.

Reported rates of fissure healing after LIAS are generally in the range of 90–100 % [85–99]. The major drawback to the procedure is the potential for altered continence postoperatively. These disturbances are typically mild and may involve fecal seepage/soiling, impaired control of flatus, or stress incontinence to liquid stool. While most of these disturbances are transient, some can persist long-term effect. The general mindset of many practicing clinicians is that altered continence after LIAS occurs infrequently, though careful review of the literature reveals that it may be seen in more than 35 % of patients postoperatively [90]. Part of the problem with determining the true incidence lies in the variability of what investigators define as "altered continence" as well as inconsistencies in follow-up.

A recent meta-analysis that included 22 studies reported continence disturbances in 14 % of patients undergoing LIAS, with weighted analysis revealing incontinence to flatus in 9 %, soilage/seepage in 6 %, accidental defecation in 0.91 %, and incontinence to liquid stool in 0.67 % [100]. Levin et al. found that in patients who developed delayed incontinence after surgery for anal fissure, the onset of incontinence was 8 years younger than patients with incontinence who had not undergone prior fissure surgery and 15 years sooner than in patients with incontinence related

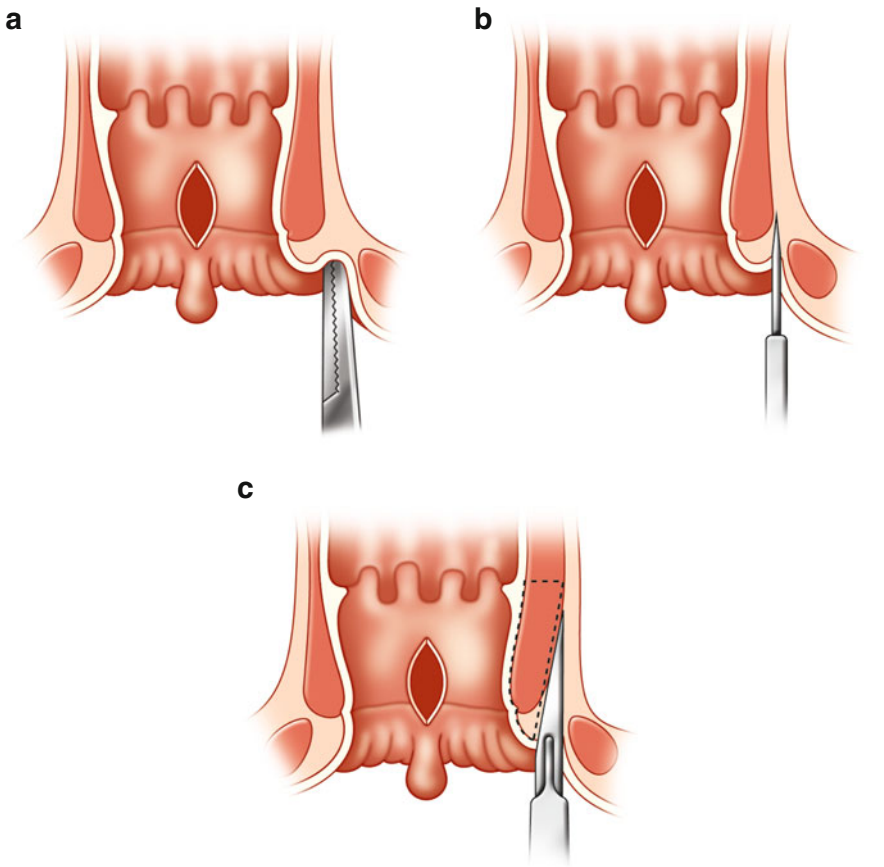

Fig. 5.4 Closed lateral internal anal sphincterotomy. (**a**) Identficaton of intersphincteric groove in lateral position. (**b**) Insertion of scalpel into intersphincteric groove parallel to direction of sphincters. (**c**) Medial rotation (90 degrees) and withdrawal of scalpel, dividing the distal IAS

to post-obstetric trauma [101]. In a study designed specifically to define the risk of postoperative incontinence after LIAS, Hyman followed 34 patients prospectively and found that only three had post-op deterioration in continence scores and only one reported deterioration in quality of life [102].

Certain factors, such as prior obstetric injury or previous anorectal surgery, may predispose a patient to continence disturbances after LIAS. Kement et al. reported an 11.7 % incontinence rate after LIAS and found that prior vaginal delivery was associated with a higher incidence of "severe" incontinence [103]. This highlights the importance of taking a detailed history when considering LIAS.

A number of studies have compared the open and closed techniques to attempt to identify differences in rates of healing and postoperative incontinence. In a retrospective review reported by Garcia-Aguilar et al., patients undergoing open LIAS

experienced a higher incidence of postoperative difficulties with soiling and incontinence to both flatus and stool compared with those undergoing closed LIAS [90]. Gupta et al. also reported more complications with the open technique [104]. Patel et al. found that open LIAS compared with closed LIAS was associated with a higher incidence of wound infections (10.3 % vs. 4.2 %), temporary incontinence to flatus (8.3 % vs. 3.4 %), and temporary incontinence to stool (3.4 % vs. 0 %) [105]. In contrast, other studies have shown no difference in the incidence of incontinence rates comparing the open and closed techniques [88, 94]. Yurko et al. compared 387 patients undergoing open LIAS, closed LIAS, and fissurectomy and found no differences in time to healing, incontinence, or recurrence [106]. A Cochrane Database review found no difference between open and closed LIAS in terms of persistence and postoperative incontinence [107].

Variations in LIAS technique have also been described. Lasheen et al. have described a "segmental internal sphincterotomy," in which the IAS is divided with two separate incisions (one proximally and the other distally) in different radial planes within the anal canal; in their series of 50 patients, all fissures had healed at a mean follow-up of 18.5 months, with no reported incontinence [108]. Kang et al. described making circumferential incisions instead of radial incisions for open LIAS and found that this reduced time to wound healing significantly [109]. Bilateral LIAS has also been reported and was found to be more likely to result in healing than unilateral LIAS, with no difference in incontinence rates [81].

5.5.4 Advancement Flap

In patients that have low-pressure fissures or hypertonic fissures with risk factors for postoperative incontinence, another option is to perform an anodermal advancement flap (AAF), which is often performed in conjunction with a fissurectomy. Leong et al. reported the results of a prospective controlled trial in which 40 patients were randomized to undergo either LIAS or AAF; they found no difference between the two groups in terms of healing rates and reported no postoperative incontinence in either group [110]. Chambers et al. reported a series of 54 consecutive patients undergoing V-Y AAF and reported healing in all but one patient at 6-month follow-up and suggested that AAF be considered as first-line treatment for chronic fissures [111].

Patel et al. compared the results of 50 patients undergoing AAF to a matched cohort of patients undergoing LIAS and found that, while there was no difference in incontinence rates or healing, AAF was associated with a higher incidence of resolution of symptoms [112]. Hancke et al. also compared AAF to LIAS and found no difference in terms of healing rates, though the incidence of both short-term and long-term mild incontinence was higher in patients undergoing LIAS (short term, 20.0 % vs. 0 %, $p<0.05$; long term, 47.6 % vs. 5.8 %, $p<0.05$) [113].

Madgy et al. compared conventional LIAS, V-Y AAF, and a "tailored" LIAS combined with a V-Y AAF and reported healing rates of 84, 48, and 94 %, respectively. The combined LIAS/AAF group had the lowest recurrence rate (2 %), and

the incontinence rate was lower in the combined LIAS/AAF group compared with conventional LIAS alone (2 % vs. 14 %) [114]. Theodoropoulos et al. also compared a "tailored" LIAS, which was extended to the apex of the fissure, combined with a V-Y AAF to conventional LIAS alone and reported faster healing, less postoperative soiling, and decreased postoperative use of analgesics in the combined LIAS/AAF group [115]. Patti et al. studied the effect of combined BTX injection along with fissurectomy and AAF in 22 patients; they reported a 100 % initial healing rate, with recurrences in 8 % at a mean 24-month follow-up. No changes in continence from baseline were reported [116].

5.5.5 Comparison of Treatment Modalities

5.5.5.1 Topical Nitrates vs. Calcium Channel Blockers

There have been a number of randomized controlled trials comparing the efficacy of topical nitrates in the treatment of anal fissures to CCBs (Table 5.1) [117–132]. The majority of studies have found that CCBs are either equally or more effective than topical nitrates in healing anal fissures, with a preferable side effect profile. Most importantly, the incidence of headache, which is often the limiting factor preventing continued therapy with nitrates, is significantly reduced with the use of topical CCBs.

Table 5.1 Trials comparing topical nitrates and calcium channel blockers

Year	Author	*N*	Treatment	Healing (%)	Side effects (%)
2000	Carapeti [48]	15	GTN	60	
		15	DTZ	67[a]	
2002	Kocher [117]	29	GTN	86.2	72.4
		31	DTZ	77.4[a]	41.9[b]
2003	Bielecki [118]	21	GTN	85.7	33.3
		22	DTZ	86.3[a]	0[b]
2003	Ezri [119]	26	GTN	58	40
		26	NFD	89[b]	5[b]
2007	Shrivastava [120]	30	GTN	73	67
		31	DTZ	80[b]	0[b]
		30	Placebo	33	0
2009	Sanei [121]	51	GTN	54.9	
		51	DTZ	66.7[a]	
2009	Jawaid [122]	40	GTN	82.5	72.5
		40	DTZ	77.5[a]	32.5[b]
2012	Ala [123]	25	GTN	60	100
		36	DTZ	91.66[b]	0[b]

CCB calcium channel blocker, *GTN* glyceryl trinitrate, *DTZ* diltiazem, *NFD* nifedipine
[a]Not statistically significant
[b]Statistically significant

A recent systematic review published by Sajid et al. included seven randomized trials comparing DTZ and GTN and confirmed that they are equally effective in terms of fissure healing, but DTZ is associated with a significantly lower incidence of headache and recurrence [124]. These results are similar to those previously published in a Cochrane review [125] and an earlier meta-analysis [126]. Unfortunately, trials with long-term follow-up comparing the two modalities are lacking.

5.5.5.2 Topical Nitrates vs. Botulinum Toxin

Table 5.2 summarizes the trials comparing the efficacy of topical nitrates compared with BTX in the management of anal fissures [127–132]. The majority of reported trials either favors BTX or shows no statistical difference between the two modalities. Fruehauf et al. reported superior healing rates with NTG over BTX, though patients were assessed only after 2 weeks of therapy [129]. Asim et al. studied the effect of GTN treatment after BTX injection and found that it did not improve healing rates [132].

5.5.5.3 Topical Nitrates vs. LIAS

Table 5.3 summarizes the trials comparing topical nitrates to LIAS in the management of anal fissures. Most studies show improved rates of healing with LIAS, though one must balance the risk of postoperative incontinence [133–141].

5.5.5.4 Calcium Channel Blockers vs. Botulinum Toxin

Randomized prospective trials directly comparing topical calcium channel blockers with BTX injection for refractory anal fissure are relatively lacking. Samin et al. randomized 134 patients to receive either DTZ and placebo injection or BTX injection and placebo cream and observed healing in 43 % of both groups. Reduction in

Table 5.2 Trials comparing topical nitrates and botulinum toxin

Year	Author	*N*	Treatment	Follow-up	Healing (%)
1999	Brisinda [127]	25	NTG	2 months	60
		25	BTX		96[a]
2006	DeNardi [128]	15	GTN	3 months	66.7
		15	BTX		57.1[b]
2006	Fruehauf [129]	25	NTG	2 weeks	52
		25	BTX		24[a]
2007	Brisinda [130]	50	NTG	2 months	70
		50	BTX		92[a]
2009	Festen [131]	36	ISDN	4 months	58.3
		37	BTX		37.8[b]
2014	Asim [132]	21	BTX	12 weeks	50
		20	BTX + GTN		57[b]

NTG nitroglycerin, *GTN* glyceryl trinitrate, *ISDN* isosorbide dinitrate, *BTX* botulinum toxin
[a]Statistically significant
[b]Not statistically significant

Table 5.3 Trials comparing topical nitrates and LIAS

Year	Author	*N*	Treatment	Follow-up	Healing (%)
1997	Oettle [133]	12	GTN	22 months	83.3
		12	LIAS		100[a]
2000	Zuberi [134]	21	GTN	8 weeks	66.7
		21	NTG patch		63.2
		12	LIAS		91.7[a]
2000	Richard [135]	44	NTG	6 months	27.1
		38	LIAS		97.1[b]
2001	Evans [136]	34	GTN	8 weeks	60.6
		31	LIAS		97[b]
2002	Libertiny [137]	35	GTN	2 years	45.7
		35	LIAS		97.1[b]
2005	Mishra [138]	20	GTN	6 weeks	90
		20	LIAS		85[a]
2010	Rather [139]	340	NTG	28 months	56.9
			SILS		100[b]
2010	Karamanlis [140]	30	NTG	2 months	60
		30	LIAS		93[b]
		30	XYL		16.6
2013	Arslan [141]	105	ISDN	6 months	77.1
		102	LIAS		97.1[b]

NTG nitroglycerin, *GTN* glyceryl trinitrate, *ISDN* isosorbide dinitrate, *LIAS* lateral internal anal sphincterotomy, *XYL* xylocaine
[a]Not statistically significant
[b]Statistically significant

pain was also similar between the two treatment arms, noted in 78 % of patients in the DTZ group and 82 % of patients in the BTX group [142].

5.5.5.5 Calcium Channel Blockers vs. LIAS

Prospective randomized trials comparing the effectiveness of CCBs to LIAS in the treatment of anal fissures are also lacking. In one prospective trial, Ho and Ho randomized 132 patients to receive either LIAS or oral nifedipine plus a "tailored" sphincterotomy. At 4-month follow-up, it was noted that LIAS was more effective in terms of healing rates, recurrence, and patient satisfaction [143]. In another study directly comparing the efficacy of 0.5 % nifedipine ointment to that of LIAS, Katsinelos et al. described complete healing at 8 weeks in 96.7 % of the nifedipine-treated group and 100 % in the LIAS group ($p = 0.49$). The incidence of side effects was significantly higher in the nifedipine-treated group (50 % vs.18.7 %) [144]. A study of 60 patients from India comparing topical DTZ to LIAS found healing rates of 88.46 % in patients treated with DTZ compared with 100 % in those who underwent LIAS at 3 months; the average time to fissure resolution was 3.6 weeks for LIAS and 5.04 weeks in those treated with DTZ [145].

Table 5.4 Trials comparing botulinum toxin and LIAS

Year	Author	*N*	Treatment	Follow-up	Healing (%)
2003	Mentes [146]	61	BTX	2 months	73.8
		50	LIAS		98[a]
2005	Arroyo [147]	40	BTX	12 months	45
		40	LIAS		92.5[a]
2005	Iswariah [148]	17	BTX	26 weeks	41
		21	LIAS		90[a]
2010	Nasr [149]	40	BTX	18 weeks	62.5
		40	LIAS		90[a]
2012	Valizadeh [150]	25	BTX	2 months	44
		25	LIAS		88[a]
2015	Gamdomkar [151]	49	BTX + DTZ	1 year	65
		50	LIAS		94[a]

BTX botulinum toxin, *LIAS* lateral internal anal sphincterotomy, *DTZ* diltiazem
[a]Statistically significant
[b]Not statistically significant

5.5.5.6 Botulinum Toxin vs. LIAS

A number of clinical trials have compared BTX injection to LIAS in the management of chronic anal fissures; these are summarized in Table 5.4. Most studies point to a higher rate of healing and lower recurrence rates with LIAS, but lower incontinence rates with BTX injection. Valizadeh et al. reported that at 2 months after treatment, healing was seen in 88 % of patients undergoing LIAS compared with 44 % patients undergoing BTX injection, though no difference in healing was observed at 3-month follow-up; recurrences were higher with BTX group, but altered continence occurred more frequently with LIAS [150]. A recent meta-analysis that included 489 patients from seven trials found that LIAS was associated with higher healing rates, lower recurrence rates, and higher incontinence rates compared with BTX, though no statistically significant difference was seen in total complications [152].

Gandomkar et al. published a study of 99 patients randomized to either LIAS or a regimen of BTX injection followed by a 6 weeks course of topical DTZ and found that healing was noted in 94 % of patients in the LIAS group compared to 65 % in BTX/DTZ group ($p<0.001$), though higher incontinence scores were seen in the LIAS group ($p=0.04$). Interestingly, in the subgroup of patients whose fissure had been present for less than 12 months, all fissures healed in both groups, but if the fissure had been present for more than 12 months, healing was found to be superior with LIAS (86 % vs. 23 %, $p<0.001$) [151].

5.5.5.7 Systematic Reviews

The most recent Cochrane review assessing the efficacy and morbidity of various medical therapies included 5031 patients in 75 randomized, controlled trials

[125]. GTN was found to be marginally but significantly superior to placebo in healing anal fissures (48.9 % vs. 35.5 %, $p<0.009$), but late recurrences with GTN treatment were seen in approximately 50 % of patients. BTX and CCBs were found to be equivalent to GTN but were associated with significantly fewer adverse effects. No modality of medical therapy came close to equaling the efficacy of LIAS, though none of the medical modalities were associated with a risk of incontinence.

The most recent Cochrane review comparing the various surgical techniques utilized for management of anal fissures included 2056 patients in 27 randomized controlled trials [81]. Manual stretch was found to have a higher incidence of minor incontinence and fissure persistence than LIAS. Little difference was seen in healing and risk of incontinence when comparing open and closed techniques for LIAS. Fissurectomy and LIAS were found to have equal risk of incontinence, though fissurectomy was more likely to result in treatment failure. Bilateral sphincterotomy, a newer technique, was found to be less likely to result in treatment failure than unilateral sphincterotomy.

5.5.6 Atypical Fissures

5.5.6.1 Low-Pressure Fissures

There is a subset of patients who may present for evaluation of anorectal complaints and are found to have a low-pressure fissure without IAS hypertonia; these patients typically lack the classic symptoms of painful defecation. Fissures of this type are often found in the anterior midline location. LIAS should be performed with extreme caution in this particular subset of patients to minimize the risk of postoperative incontinence.

Patients with fissures identified during evaluation of postpartum incontinence often suffer from low-pressure fissures. Corby et al. followed 209 primigravid women with no pre-existing history of anorectal disease who underwent anal manometry 6 weeks before and after delivery. They found that 9 % of patients developed postpartum anal fissure, and both resting and squeeze anal pressures were decreased in the postpartum period. Based on this the authors suggested that there is no role for LIAS in this setting, and treatment should be based on medical management [153].

If medical management of a low-pressure fissure fails, a number of other viable options exist. Nyam et al. evaluated 21 patients with recurrent and low-pressure fissures treated with island advancement flap and found complete healing without postoperative incontinence in all patients [154]. Lindsey et al. found that BTX injection may actually have an atypical effect on the IAS in low-pressure fissures, causing contraction rather than relaxation, which suggests that low-pressure fissures may exhibit a different pathophysiology than hypertonic fissures [155]. Chemical cauterization of low-pressure anal fissures using topical silver nitrate has also been described.

5.6 Case 3

A 35-year-old female presents with complaints of bright red blood on the toilet tissue after bowel movements and mild discomfort during defecation. She has had three vaginal deliveries, the last of which was 8 years ago and complicated by a fourth-degree perineal laceration. On examination, she has an anterior midline fissure in ano. On further questioning, she reports occasional fecal seepage and soiling, especially when her stool is looser.

She is prescribed topical 5 % diltiazem and counseled regarding increased fiber and fluid intake as well as soaks/sitz baths. After 8 weeks, her symptoms have persisted, and on physical examination the fissure appears unchanged. Digital rectal exam reveals somewhat diminished sphincter tone. After discussing further options, she elects to undergo an anodermal advancement flap. Six weeks postoperatively, her operative wounds have healed, her continence remains at baseline, and she is pain-free.

5.6.1 Crohn's Disease

Perianal Crohn's disease can manifest with a multitude of presentations, including anal fissure. Anal fissures in the setting of Crohn's disease may arise due to the same mechanism as idiopathic fissures but can also be a direct result of ulceration caused by the disease process. Crohn's-related fissures are often multiple and located in locations other than the midline; they often present with atypical symptoms or, alternatively, may be completely asymptomatic. Other findings, such as abscess/fistula and large inflammatory skin tags are often found to be coexistent (Fig. 5.5).

While unhealed fissures in the setting of Crohn's disease have been found to progress to abscess or fistula in as many as 26 % of patients [156], the classic teaching has been to treat Crohn's-related anal fissures with aggressive medical management and local wound care, with the main goals being reduction of pain, improvement of stool consistency and frequency, and avoidance of local sepsis. Aggressive surgical management frequently results in significant complications, including nonhealing wounds, incontinence, abscess/fistula, and the eventual need for proctectomy. Failure of anal fissures in the setting of Crohn's disease to heal with aggressive medical management should be further evaluated by examination under anesthesia with possible biopsies to exclude other pathology before contemplating surgical management.

Isbister and Prasad have reported successful healing of Crohn's-related fissures with the use of anal dilation [157], while others have reported the development of incontinence using the same technique. Wolkomir and Luchtefeld reported healing in 22 of 25 patients with anal fissure in the setting of Crohn's disease undergoing LIAS; at a mean follow-up of 7.5 years, none of these patients had required proctectomy as a direct result of undergoing LIAS [158]. In a retrospective review of 49 patients with Crohn's disease and symptomatic fissures published by Fleshner at al. [156], fissures in one-half of the patients healed with medical management. Factors

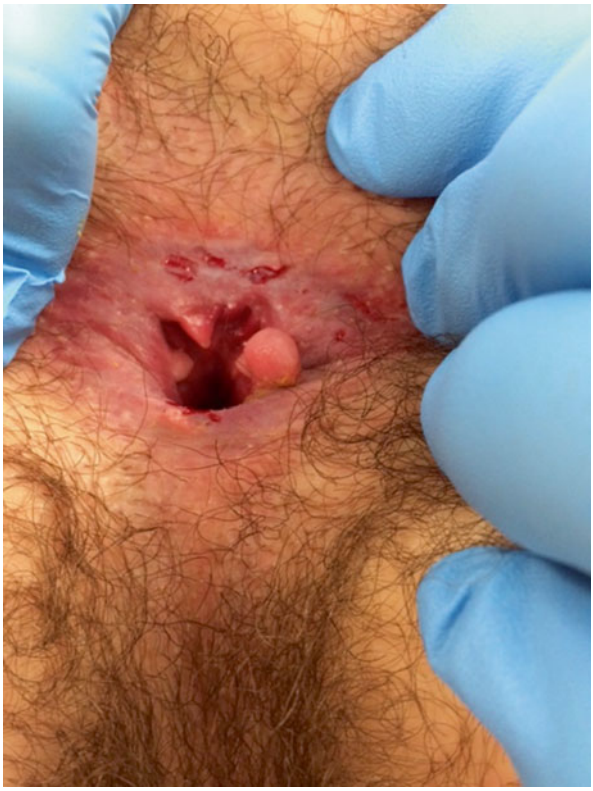

Fig. 5.5 Atypical anal fissures associated with perianal Crohn's disease

predictive of successful medical treatment included male sex, absence of pain, and acute presentation. Of 15 patients who ultimately required surgery, two-thirds healed. Anorectal procedures (LIAS, fissurectomy, or a combination of both) were associated with healing in 88 %, while proximal intestinal resection resulting in healing in only 43 %. D'Ugo et al. reviewed 41 patients with anal fissures in the context of Crohn's disease, all of who were initially managed conservatively. Of these, 14 ultimately required surgery (BTX + fissurectomy in 8 and LIAS in 6) with a 57.1 % complication rate [159].

5.6.2 Human Immunodeficiency Virus (HIV)

Perianal disease commonly affects patients infected with HIV and the differential diagnosis in this patient population can be vast. Severe anal pain, in particular with defecation, in the setting of HIV should raise concern regarding the presence of an anal fissure. While classic-appearing posterior midline fissures can be seen in HIV patients, HIV-associated fissures tend to appear wider and deeper. Though the classic teaching is that HIV-associated fissures often occur in atypical locations, Abramowitz et al. found that 94 % were located posteriorly [160].

HIV-associated fissures with classic features may be treated in a similar fashion to HIV-negative patients, while atypical-appearing fissures often necessitate evaluation under anesthesia with biopsy, culture, and/or debridement; further therapy should be directed against any neoplastic process or infectious etiologies identified. Those patients with no identifiable agents may be helped with aggressive debridement or intralesional steroid therapy, allowing for safe and effective treatment in most patients. The efficacy of topical agents, such as nitrates and CCBs, or BTX has not been well studied in this specific patient population, though they are frequently used. LIAS has also been described to successfully treat anal fissures in over 90 % of HIV patients [161].

5.7 Conclusions

Anal fissure is a common cause of anorectal complaints. Symptoms typically include severe pain with defecation and post-defecatory bleeding. Diagnosis is usually made very easily based on history and simple examination of the anorectum. Acute fissures will often heal with conservative measures, including increased fiber and fluid intake, soaks/sitz baths, analgesics, and topical anti-inflammatory agents. For more refractory or chronic fissures, a number of medical options are available that are tailored towards reducing resting anal pressure and improving anodermal blood flow, including topical nitrate compounds, topical calcium channel blockers, and injection of botulinum toxin. Surgical treatment is reserved for patients that fail conservative measures. While the gold standard for surgical management is lateral internal anal sphincterotomy, one must keep in mind the potential for postsurgical alterations in continence. Low-pressure fissures (those without internal anal sphincter hypertonia) that fail to heal with conservative can be managed surgically via an advancement flap. Fissures that occur in the setting of Crohn's disease and HIV infection should be approached conservatively, keeping in mind the increased risk for postsurgical complications.

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Anal Fistula

6

Martin Luchtefeld and Tarek Jalouta

6.1 Definition

A fistula is defined as an abnormal communication between two epithelium-lined surfaces. A fistula-in-ano is an abnormal tract or cavity communicating with the rectum or anal canal by an identifiable internal opening.

6.2 Etiology

The most common origin of fistulas is from cryptoglandular infections. Crohn's disease is another common etiology, but fistulas may also develop secondary to trauma, anal fissures, radiation therapy, tuberculosis, chlamydial infections, and carcinomas.

6.3 Classifications

In the setting of cryptoglandular disease, the anal gland infection progresses into the muscular wall of the anal sphincter to cause an abscess which subsequently gives rise to the development of a fistula tract. The relationship of the primary tract to the sphincter mechanism will dictate the class of fistula and future management.

The most practical classification used today is Parks classification [1]. The classification is divided into four groups (Fig. 6.1):

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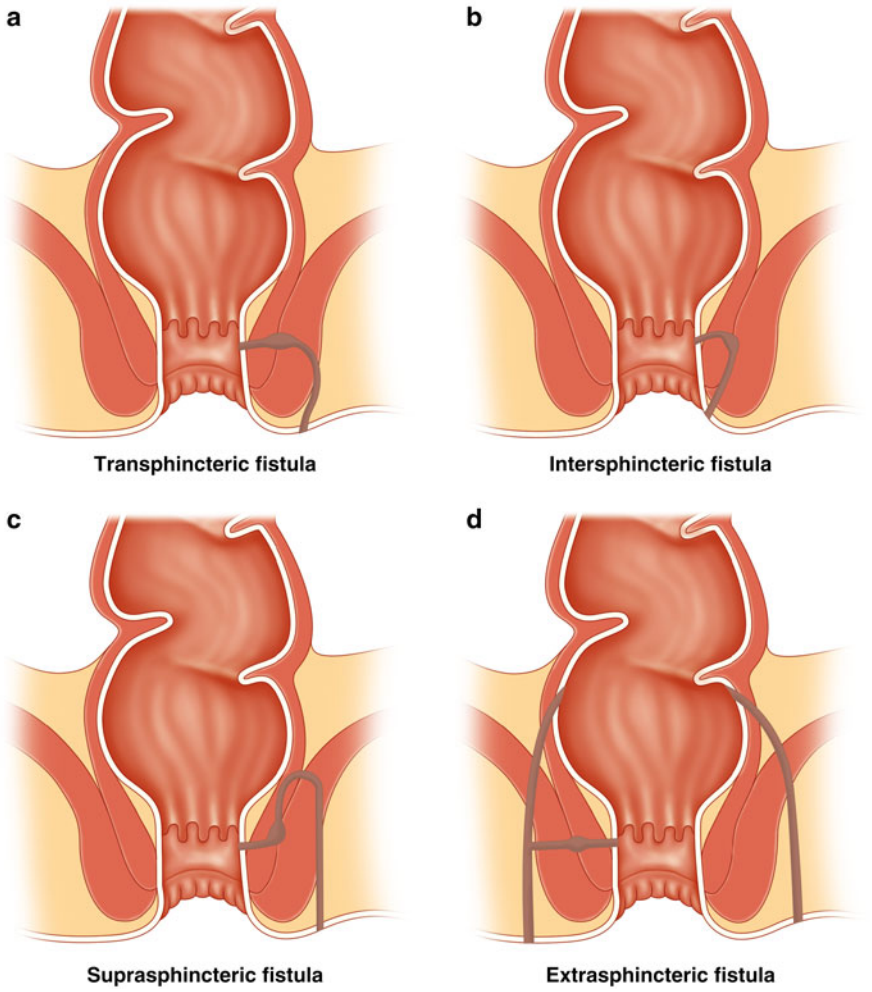

Fig. 6.1 (**a**) Transsphincteric fistula. (**b**) Intersphincteric fistula. (**c**) Suprasphincteric fistula. (**d**) Extrasphincteric fistula

(a) Transsphincteric
(b) Intersphincteric
(c) Suprasphincteric
(d) Extrasphincteric

Horseshoe fistulas deserve special mention but are actually variations of transsphincteric or intersphincteric fistulas. The intersphincteric fistulas are the commonest type of fistula (70 %). They are typically a simple low tract that traverses only the internal sphincter but can be complicated by secondary tracts.

Transsphincteric fistulas (20–25 %) pass through both internal and external sphincter before exiting to the skin. A supralevator extension of a transsphincteric fistula may also occur.

Suprasphincteric fistula are unusual fistulas (even though Parks and colleagues reported them to comprise 20 % of their series, other series have reported that this type of fistula is very rare), approximately 1–3 % of fistulas [1]. The fistula pathway starts as an intersphincteric fistula and tracks superiorly between puborectalis and the levator ani muscles. It then traverses downward through the ischiorectal fossa to the skin.

Extrasphincteric fistulas are rare (1–2 %). This fistula is generally associated with an unusual etiology such as trauma, Crohn's disease, pelvic inflammatory disease, or carcinoma. It can also result from a supralevator abscess (or a transsphincteric fistula with supralevator extension) that spontaneously drains into the rectum.

6.4 Preoperative Assessment

6.4.1 Physical Examination

An examination in the office may identify any potential external fistulous openings. Palpation may reveal a thick tract proceeding towards the anal canal. Intersphincteric fistulas are the most likely to be identified in this fashion. Transsphincteric fistulas are deeper and less likely to be able to be felt. A careful digital rectal exam can also sometimes identify the internal opening in more chronic fistulas. An anoscopy should be done in the office as well. The yield for identifying internal openings is rather low but it allows for evaluation of any other coexisting pathology. Tell-tale signs of perianal Crohn's (edematous skin tags, multiple unusual fissures) can be seen at this time and give insight to the etiology of the fistula.

6.4.2 Goodsall's Rule

This rule is designed to help identify the internal opening and the course of the primary tract of a fistula-in-ano (Fig. 6.2). When the external opening lies anterior to the transverse anal line drawn across the tuberosities transecting the anal verge, the internal opening tends to be located in a straight radial tract into the anal canal. If the opening is posterior to the transverse anal line, the internal opening is usually located in the posterior midline.

Cirocco and Reilly analyzed the predictive accuracy of this rule by reviewing 216 patients who underwent fistula surgery. While only 49 % of those who had an external opening anterior to the traverse plane had radially directed fistulas, the accuracy rate of Goodsall's rule regarding posterior secondary openings was much greater [2].

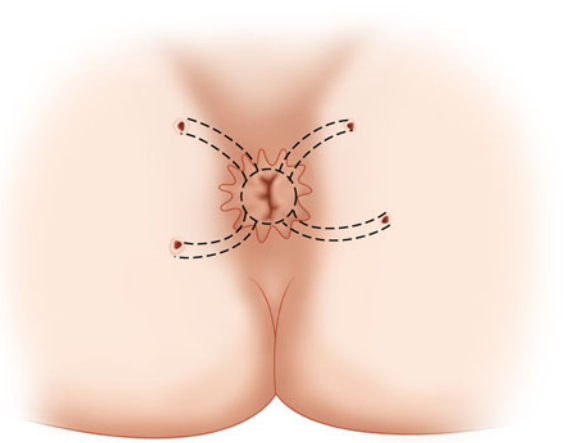

Fig. 6.2 Goodsall's rule: anterior fistulas track radially; posterior fistulas track to the midline

6.4.3 Fistula Probes

One can attempt passage of a probe gently from the external opening to the internal opening. However, this maneuver is best left for the operating room due to patient discomfort. The probing should be done gently to avoid creating another tract.

6.4.4 Injection of the Fistula Tract

Various products have been described to inject into the fistula tract in order to help identify the internal opening and any unusual secondary tracts or extensions. Milk, methylene blue, and hydrogen peroxide are examples used by various authors. Usually these are adjuncts used in the operating room rather than in the office setting.

6.4.5 Imaging Studies

Imaging studies are not used routinely for all fistulas or in all practices; these modalities are most useful for complex or recurrent fistulas, especially in the setting of multiple previous surgeries and significant scar.

6.4.5.1 Fistulography

Fistulography consists of the radiologic delineation of a fistula tract with a water-soluble contrast agent. It has been replaced in most cases with newer technologies such as CT scan, MRI, and endoluminal sonography [3]. In unusual cases, fistulography may help delineate an extrasphincteric fistula of pelvic origin or may help evaluate patients with recurrent fistula [4] However, previous studies have found fistulograms to be inaccurate in many cases when compared to surgical findings.

6.4.5.2 Endoanal Ultrasound (EAUS)

This technique is simple to perform, noninvasive, inexpensive, and well tolerated and provides excellent definition of anatomy. However, it does depend to a large degree on the examiner's experience. 3D imaging has been available since the late 1990s [5] and has further enhanced the accuracy of ultrasound examination.

The ultrasound probe may be used with two frequency settings: 7 or 10 MHz. The higher frequency (e.g., 10 MHz) does not penetrate as deeply, but gives higher-resolution images close to the probe. For this reason, it is ideally suited for ultrasound within the anal canal, but may not be as well suited for deeper fistula tracks passing at some distance from the rectum [6].

One report noted that the surgical procedure was influenced by ultrasonographic finding in up to 38 % of cases [7]. In another study that compared digital examination with ultrasound, the two were equally able to identify intersphincteric and transsphincteric tracts, but the ultrasound was unable to assess superficial, suprasphincteric, extrasphincteric, and supralevator or infralevator tracts [7].

Cataldo et al. evaluated their experience with intrarectal ultrasonography (IRUS) in 24 patients with suspected perianal abscess and fistula. At operation, 19 of 24 patients were found to have perirectal abscesses, with all 19 cases correctly identified preoperatively by IRUS [8].

Fistula tract enhancement using hydrogen peroxide provides excellent definition of the fistula tract anatomy. Cheong et al. reported that hydrogen peroxide enhancement of fistula tract is simple, effective, and safe method of improving the accuracy of endoanal ultrasonographic assessment of recurrent anal fistula [9]. There are several "tricks" to properly perform injection of hydrogen peroxide at the time of EUS. Gas bubbles can create artifact and obscure anatomy. Therefore, a minimum amount of hydrogen peroxide should be used during the examination. The authors prefer to use 12 mL of 1.5 % hydrogen peroxide injected after first clearing the fistula tract of any debris by flushing with saline. Pressure must be applied to the external opening at the time of injection to prevent retrograde extravasation and increased bubbling. This maneuver may require help by an assistant. The fistula probe is then passed into and out of the fistulous trajectory following the tract. If 3D ultrasound is used, it may be cycled at this point. The internal opening of a fistula tract is defined by the presence of a hyperechoic breach at the level of the internal sphincter [10]. The inability to identify all extensions of complex fistulas or even primary tracts when they are beyond the reach of the instruments is a limitation of this technique [11]. Scar or inflammatory tissue and presence of abscess may limit the ability to distinguish the anatomic structure that otherwise is usually seen on endoanal ultrasound. Abscess, in particular, can appear similar to adipose tissue seen in the ischiorectal fossa. It has also typically been difficult to identify the internal opening of a fistula in the mucosa.

6.4.5.3 Magnetic Resonance Imaging

MRI appears to have the greatest concordance with clinical and surgical finding when compared with EAUS or CT, with reported accuracy rates of 85 % or greater [12, 13]. It has the advantage of not being user dependent for interpretation, as well

as the ability to evaluate fistula tracts that course distant from the anus [14]. It may be performed with or without contrast medium and/or using an endorectal coil. One problem with the endorectal coil is that it requires transanal insertion [14]. Specific characteristics that may be seen were outlined by Buchanan et al. who showed that acute angulation from the internal opening tended to be found in high transsphincteric tracts, whereas those exhibiting obtuse angulation tended to be lower fistulas [15].

Buchanan found that disease recurrence after surgery in patients with fistula-in-ano was decreased by 75 % in those who underwent preoperative MRI. Sahni et al. [16] found MRI to be superior to EUS with regard to specificity and sensitivity (97 % and 96 % vs. 92 % and 85 %,respectively). EUS is less accurate in detecting disease extending into the pelvis or ischiorectal fossa [17]. In the setting of Crohn's disease, Schwartz prospectively demonstrated equivalent accuracy between MRI, EUS, and EUA (87, 91, and 91 %, respectively) for determining fistula anatomy.

6.5 Surgical Treatment

Despite advances in technology and new options for surgery, the goal of curing fistulas while maintaining continence and minimizing recurrence can be challenging. Most surgical options for treatment of an anal fistula are performed on an outpatient basis. Following the induction of adequate anesthesia, the patient is placed in position of surgeon's choice. A thorough examination of the anorectal region is always the first step. As mentioned earlier in the evaluation section, simple examination and digital rectal exam are an invaluable part of determining the course of the fistula and location of the internal opening. A fistula probe can then be utilized to identify the tract. The probe is usually placed through the external opening, but it can also be used retrograde in the anal canal to help identify the involved crypt. If the fistula tract cannot be delineated in this way, the next step is to use hydrogen peroxide (the author's favorite) or other dye to help find the internal opening. While examining the anal canal with a Hill-Ferguson retractor, a syringe with an 18-gauge catheter is used to infuse hydrogen peroxide through the external opening until it can be seen emanating from an internal opening.

If the tract and the internal opening cannot be defined after all these maneuvers, the best option is to stop at this point and reevaluate the patient at a later date. If imaging (MRI, ERUS) had not been done preoperatively, this would be an opportune time to obtain one of these studies.

The surgical treatment of fistula-in-ano is very dependent on the classification of the fistula. In the following section on the treatment of intersphincteric and transsphincteric fistulas, it is assumed that the underlying etiology is due to cryptoglandular disease.

6.5.1 Intersphincteric Fistulas

For an intersphincteric fistula, the most common choice is a fistulotomy. In the setting of an intersphincteric fistula, the cure rates are high. Because there is a relatively limited amount of muscle divided, the most feared complication (incontinence) is not often seen. However, if there is already impaired anal function, one can still consider the muscle-sparing techniques discussed below.

6.5.2 Fistulotomy

Performing a fistulotomy is a straightforward procedure once the tract has been defined and the internal opening found. A fistula probe is passed along the entire length of the fistula tract. The tract is opened down to the fistula probe using electrocautery or a scalpel. The tract can then be curetted and packed. Any unusual tissue can be sent for histologic evaluation.

6.5.3 Transsphincteric Fistulas

There are many treatment choices and considerable controversy surrounding transsphincteric fistulas. Much of the difficulty in making a decision for transsphincteric fistulas revolves around the issue of incontinence.

6.5.4 Fistulotomy

Fistulotomy, described above, can still be a good choice for treatment of a transsphincteric fistula. For a relatively low transsphincteric fistula in the posterior midline of a healthy young male, fistulotomy can result in high cure rates with little risk of incontinence. However, the same procedure done for the same fistula in the anterior midline of a woman with the sphincter already compromised by a difficult vaginal delivery could result in debilitating incontinence.

6.5.5 Fistulectomy

There is little reason to consider doing a fistulectomy rather than a fistulotomy. Although recurrence rates may be similar, healing times are longer and there is more incontinence associated with fistulectomy. One could consider an excision of a small section of the tract for biopsy purposes in the case of suspected Crohn's disease or malignancy in a long-standing fistula [18].

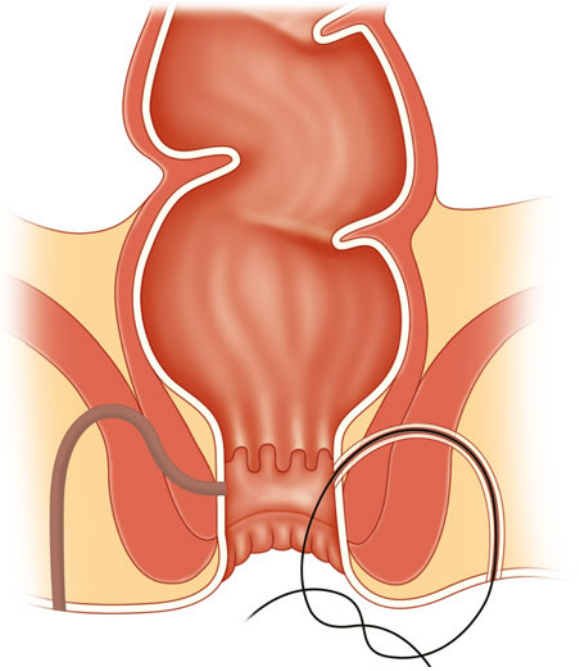

Fig. 6.3 Seton placement in transsphincteric fistula

6.5.6 Setons

Setons can be used in primarily two ways: a marking (non-cutting seton) or a cutting seton (Fig. 6.3a, b).

1. *Marking* (*non-cutting*) *seton*

   The marking seton will not damage or cut the sphincter, and as the name implies it is placed in the tract and tied loosely. The purpose of the marking seton is to control local sepsis by providing a drainage channel and ensuring that the tract does not temporarily close and lead to an abscess. It is used to either set the stage for a second more definitive procedure (including all the muscle-sparing techniques discussed below) or in the setting of Crohn's it can be used as a definitive treatment.
2. *Cutting seton*

   The cutting seton is used for a controlled division of the sphincter to aid in healing of the fistula. Inflammatory reaction and fibrosis of the transection site are thought to prevent retraction of the sphincter complex during the cutting process [19]. This mechanism is supposed to minimize risks of incontinence. The analogy used to describe this technique is that of pulling a wire through an ice block. As the wire passes through, the ice reforms behind the wire.

   The technical aspects of placing a seton are straightforward. The procedure starts in the usual fashion: after anesthesia is induced, exam is carried out to

identify the pathway of the tract and the internal opening. Once this is accomplished, the seton can be passed through the tract and tied to itself. A marking (non-cutting) seton is tied loosely. For a cutting seton, the skin and anal canal mucosa between the openings must be initially incised and then seton tied down firmly in place around the muscle encompassed by the fistula tract. Multiple alternatives for the seton exist such as double no. 2 silk, elastic bands, vessel loops, or a ¼-in. Penrose drain [20], and the commercially available silastic Comfort Drain™ (AMI).

The cutting seton must be sequentially tightened to gradually cut through the muscle. There are alternatives such as a rubber ring ligator to tighten the ligature [21], use of hangman's knot [22], or inserting multiple setons initially, securing only one .

Cutting setons do not eliminate the risk of incontinence. Parks and Stitz assessed function in 68 patients in whom a seton was used. Of those patients who had a seton inserted but removed without further division of muscle, 17 % complained of partial loss of control, whereas 39 % of patients who later had division of the seton-contained muscle experienced problems with control [23]. William and colleagues reviewed their experience with 74 patients who underwent seton division of high anal fistulas by four techniques: staged fistulotomy, cutting seton, short-term drainage, and long-term drainage for Crohn's disease [24]. None of the patients treated with a cutting seton ($n=13$) developed a recurrence. Minor instances of incontinence developed in 54 % of those treated by two-staged fistulotomy or by a cutting seton. Kuypers reported his experience with the use of the seton in the treatment of extrasphincteric fistula [25]. No recurrences were observed in his ten patients; six experienced slight soiling, and one was incontinent. A meta-analysis of 37 different studies that examined the incidence of incontinence following cutting seton use reported a rate of 12 %, increasing proportionally with the height of the internal opening [26]. Van Tets and Kuijpers cautioned against the use of setons for fistulas with high anal or rectal openings. In a review of 34 patients with a two-stage seton procedure (16 extrasphincteric and 18 transsphincteric), there were two recurrences but all transsphincteric fistulas healed. Of 29 patients with preoperative normal fecal control who were available for follow-up, postoperative continence was normal in 12 patients (category A according to Browning and Parks classification [27]), 5 patients had no control over flatus (category B), 11 were incontinent for liquid stool or flatus (category C), and 1 had continued fecal leakage (category D).

6.5.7 Muscle Sparing Approaches to Treat Transsphincteric Fistulas

There are several surgical techniques for the treatment of fistulas that do not involve dividing any muscle: advancement flaps, fibrin glue, fistula plugs, and LIFT (ligation of the intersphincteric fistula tract) procedure.

6.5.7.1 Fibrin Glue

The efficacy of fibrin sealant was markedly improved through the addition of bovine thrombin to fibrinogen in 1944 [28]. Instilling fibrin glue in the presence of local sepsis or active inflammation is not recommended. A marking seton should be placed for 6–8 weeks prior to the fibrin glue treatment.

As in all surgery involving treatment of an anal fistula, the procedure is started by identifying the internal and external opening of the fistula. The tract is debrided and cleaned using a curette. Fibrin glue is then injected into the external opening using a syringe and 18-gauge angiocath until the fibrin glue can be seen coming out of the internal opening in the anal canal.

Initial reports were impressive, with a 75 % healing rate without loss of continence. More recent studies have been less promising (Table 6.1) with only one recent study, by Maralcan et al. in 2006 demonstrating a strong healing rate of 78 % [44].

Healing rates have been reported in the range of 14–80 % [31, 45, 46]. When compared with other techniques that do not cut the sphincter, fibrin glue was better only than seton drainage alone. The healing rate with glue was 39.1 %, whereas the fistula plug, advancement flap, and seton drainage had healing rates of 59.3, 60.4, and 32.6 % at 12 weeks of follow-up, respectively [47]. Several recent meta-analyses of the literature have been published and demonstrate no advantage for the use of fibrin glue over conventional surgical therapies (Table 6.1).

Table 6.1 Results of fibrin glue repair

Author	*N*	Etiology	% success
Hjortrup et al. [29]	23	Crypto, postoperative	74
Venkatash et al. [30]	30	Crypto, RVF, HIV, Crohn's, urethro-vesicorectal	60
Cintron et al. [31]	26	Crypto, Crohn's	85
Cintron et al. [32]	79	Crypto, HIV, Crohn's RVF	54
			64
Sentovich [33]	48	Crypto, Crohn's	69
Lindsey et al. [34]	19	Crypto, Crohn's	63
Chan et al. [35]	10	Crypto	60
Sentovich et al. [36]	48	Crypto, Crohn's	69
Buchanan et al. [37]	22	Crypto	14
Vitton et al. [38]	14	Crohn's	57
Witte et al. [39]	34	Crypto, IBD, HIV	55
Hammond et al. [40]	16	Crypto	80
Maralcan et al. [41]	46	Crypto	87
de Oca et al. [42]	28	Crypto	68
Herreros et al. [43]	59	Crypto	37
	60		52

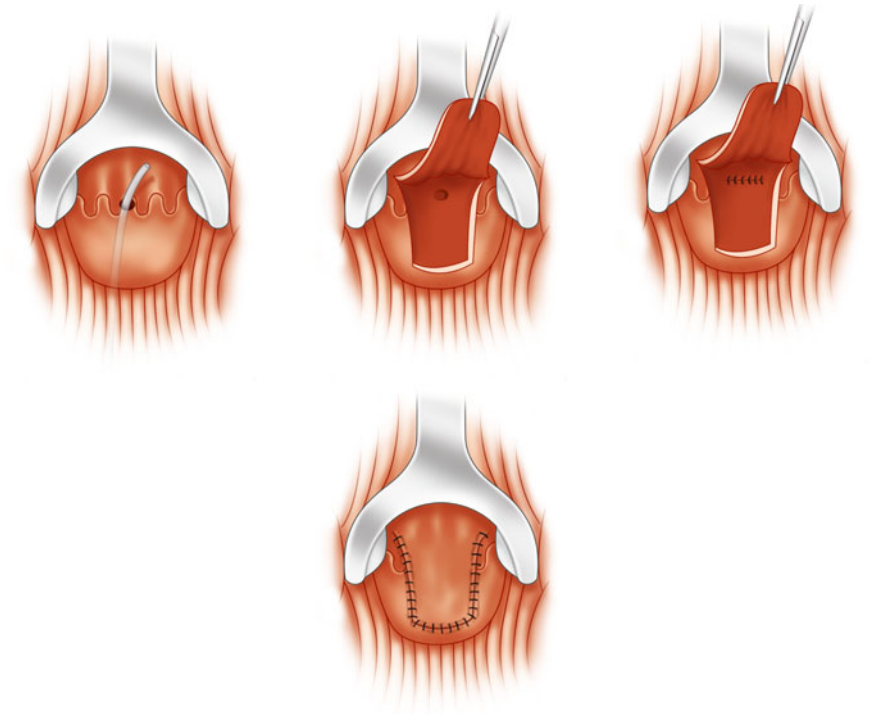

Fig. 6.4 Advancement flap repair: fistula is identified, a wide-based flap raised, the fistula closed, and the flap advanced over the closure

6.5.7.2 Advancement Flap

The advancement flap was first described by Elting in 1912 [29]. The procedure usually is done after first minimizing local sepsis by use of a marking seton. Following induction of anesthesia, an examination confirms the location of the internal opening. The most common flap is a widely based anorectal mucosa flap that is developed starting just below the internal opening. The epithelialized internal opening is excised, the tract is excised or curetted, the internal opening closed, and then the flap mobilized over the internal opening and sutured in place (Fig. 6.4).

Because the advancement flap has been in use for so long, considerable experience has been gained using the technique of advancement flap. Success rates range from 60 to 80 % (Table 6.2). One advantage of advancement flap repairs is that they are quite versatile and can be used in the presence of Crohn's disease and for other fistulas such as rectovaginal and rectourethral fistulas. However, it should be noted that even though the sphincter muscle is not directly divided, Soltani et al. reported that the success and incontinence rates were 80.8 %/13.2 % for cryptoglandular and 64 %/9.4 % for Crohn's fistulas. Mizrahi et al. found an increased risk in the presence of prior attempts at repair [62]. Schouten et al. found no difference in risk of incontinence based on age, sex, or the number of prior repairs [56]. Abbas et al.

Table 6.2 Results of advancement flap repairs

Author	*N*	% success
Chung et al. [47]	96	60
Dubsky et al. [48]	54	76
Golub et al. [49]	164	97
Zbar et al. [50]	11	81.8
Mitalas et al. [51]	162	59
Mitalas et al. [52]	80	68
Ortiz et al. [53]	91	82
Ortiz et al. [54]	16	88
Perez et al. [55]	30	93
Schouten et al. [56]	44	75
van Koperen et al. [57]	54	83
Wang et al. [58]	26	64
Christoforidis et al. [59]	43	63
Uribe et al. [60]	56	92.9
Abbas et al. [61]	36	76

found an increased risk of incontinence with older age and high transsphincteric fistulas; however, the majority of the patients in this study had a fistulotomy, with only 10.6 % of patients having advancement flaps [63].

6.5.7.3 Anal Fistula Plug

The first anal fistula plug developed was the Cook Surgisis Biodesign fistula plug. Made from lyophilized porcine intestinal submucosa, this device has an inherent resistance to infection, does not initiate immune response, and becomes repopulated with host cell tissue during a period of 3 months [64]. The surgical technique for placing the fistula plug is straightforward but certain steps must be rigidly adhered to in order to minimize the risk of early technical failure.

As with the other techniques described in this section, it is recommended that this procedure should not be done in a field of ongoing sepsis. Most authors suggest placement of a seton prior to proceeding with a fistula plug. Once in the operating room, the fistula plug is pulled into the fistula tract through the internal opening (using a hemostat or suture to guide it) until the larger caliber fistula plug has been wedged into the internal opening of the fistula. Once in place, the proximal end of the fistula plug is anchored into the internal sphincter at the level of the internal opening using an absorbable suture. A common cause of early failure is that of plug dislodgment and migration out of the fistula tract. Although initial reported success rates were very promising, subsequent experience has not been as good with healing rates range between 13.9 and 87 % [65].

A second option for a fistula plug is the Gore BIO-A Fistula Plug, *which was also* approved in 2009. It is a porous, fibrous polymer composed of 67 % polyglycolide and 33 % trimethylene carbonate. It is nonantigenic and biocompatible because it is degraded via a combination of hydrolytic and enzymatic pathways. The device consists of a disk 16 mm in diameter, attached to six tubes, each 9 cm in length. The size of the plug can be tailored by changing the number and length of the tubes so that it

Table 6.3 Results of fistula plug

Author	*N*	%
Ratto et al. [68]	11	72.7
Ommer et al. [69]	40	57.5
De la Portilla et al. [66]	19	15.7
Johnson et al. [70]	25	87
Champagne et al. [71]	46	83
O'Connor et al. [72]	20	80
Ellis et al. [73]	18	78
Safar et al. [74]	35	14
Lawes et al. [75]	20	24
El-Gazzaz et al. [76]	33	25

occupies the fistula tract until the bioabsorbable nature of the material allows the body to fill the defect with native tissue [66]. Similar to the Cook Surgisis product, the BIO-A has had some success in healing fistulas with healing rates ranging from 14 to 88 % [65, 67]. In a study directly comparing the Cook Surgisis Biodesign and Gore BIO-A products over a 28-month period [65], Buchbery and colleagues found that the healing time was similar. However, the overall success rates were 12.5 % with the BIO-A, compared with 54.5 % for the Cook Surgisis plug (Table 6.3).

6.5.7.4 Ligation of Intersphincteric Fistula Tract (LIFT)

The LIFT procedure is a relatively recent addition to the options for treatment of anal fistulas.

The LIFT procedure was initially described by Rojanasakul in 2007 [77]. The operation is appropriate for transsphincteric fistulas with length sufficient enough to perform the procedure.

Once the patient is appropriately anesthetized and positioned, a curvilinear incision is made in the perianal region just outside of the intersphincteric groove. Dissection is carried out in the intersphincteric plane until the fistula tract is identified and isolated. The tract is ligated with absorbable suture and divided. The incision is loosely closed to facilitate the drainage of any infected material.

In Rojanasakul's initial paper, the LIFT technique is impressive in its simplicity [78]. The original series in 2007 was a prospective observational study of 18 patients with fistula-in-ano. He reported 94.4 % (17/18) healing at 4 weeks of follow-up. There was no reported incontinence [77] (Table 6.4).

Subsequent series have not been as optimistic as Rojanasakul's original work; other authors have reported healing rates of 57–82 %. Pooled results of LIFT procedures were reviewed by Omar Vergara and his group, a total of 18 papers: eleven were retrospective, two were retrospective and prospective, four were prospective, and one was a randomized controlled trial. The total number of patients was 592, and 385 were male (65 %). The average age reported was 42.82 years. Only a few studies included patients with the following characteristics: rectovaginal fistula, three studies with six patients in total; cigarette smoking, two studies with 21

Table 6.4 Results of LIFT procedure

Author	*N*	%
Liu et al. [79]	38	61
van Onkelen et al. [80]	22	82
Ooi et al. [81]	25	68
Aboulian et al. [82]	25	68
Shanwani et al. [83]	45	82
Rojanasakul et al. [77]	18	94

patients; inflammatory bowel disease, two studies; diabetes, three studies; HIV, one study; and using corticosteroids, one study. Other special characteristics mentioned were the presence of obesity, ischemic heart disease, rheumatoid arthritis, and cancer. The most common type of fistula included was transsphincteric (73.3 %). The percentage of "low" transsphincteric fistulas was 13.5 %. The remaining fistulas were classified as horseshoe or hemi horseshoe, intersphincteric, suprasphincteric, and rectovaginal. In addition, 34.4 % of the population had been previously operated using the same or another surgical technique. The mean operative time reported was 36.16 min. Only two studies reported the length of hospital stay (2.5 and 1.4 days, respectively), but most of the surgeries were performed on an outpatient basis. The mean healing rate was 74.6 % (range 40–95 %), and the mean healing time was 5.5 weeks [84]. One unique advantage of the LIFT procedure is that at times the result of a "failed" case is an intersphincteric fistula that can be treated with a fistulotomy (Fig. 6.5).

6.6 Treatment of a Transsphincteric Anal Fistula: Choosing a Surgical Option

There is a paucity of good data available to help drive a decision for which procedure to use. A Cochrane review in 2010 concluded that at the time there was no significant difference between the methods. The authors of the review did note that the use of fibrin glue was associated with minimal incontinence. Additional studies since the 2010 review have remained inconclusive. A recent meta-analysis was done of randomized trials comparing fistula plug vs. advancement flaps and concluded that there was no significant difference between the two procedures (although in each individual study, the success was higher in the advancement flap group). Six studies involving 408 patients (anal fistula plug = 167, mucosa advancement flap = 241) were included in this meta-analysis. The postoperative quality of life, for patients treated using the AFP, was superior to that of the MAF patients. Patients treated with the AFP had less persistent pain of a shorter duration and the healing time of the fistula and hospital stay were also reduced [85]. Mushaya et al. run a randomized study comparing the LIFT procedure to the advancement flap. Both trials demonstrated better short-term outcomes (shorter operative times and earlier return to normal activities) for the LIFT procedure but no difference in recurrence rates. LIFT was 32.5 min shorter than anorectal advancement flap ($P = 0.001$). Complications were similar, with no hospital readmissions. Return to normal

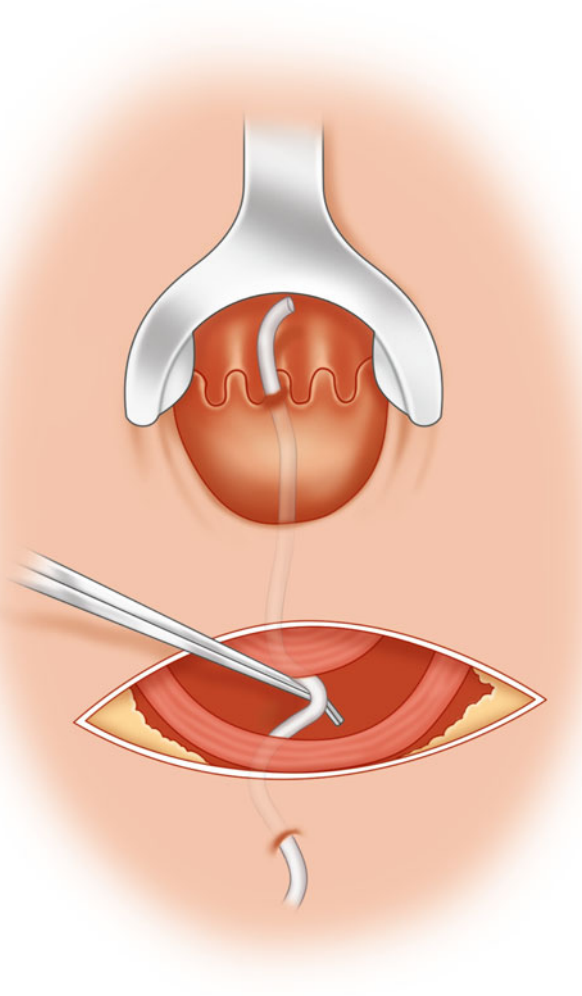

Fig. 6.5 Dissection done deep to fistula, with vessel loops around the tract

activities was 1 week for LIFT patients and 2 weeks for anorectal advancement flap patients ($P=0.016$). At 19 months there were three recurrences (two in the LIFT group). One ARAF patient had minor incontinence [86].

6.6.1 Suprasphincteric Fistula

Fistulotomy performed for a suprasphincteric fistula would result in division of all of the external sphincter and the puborectalis. Almost certainly the patient would be

rendered incontinent. Much like transsphincteric fistulas, there is not much information on which to choose an optimal procedure. However, advancement flaps, fibrin glue, and fistula plugs could all potentially be used. The LIFT procedure has been mostly used for high transsphincteric fistulas rather than suprasphincteric fistulas. Other unique approaches have been described. One technique involves dividing the distal portion of the internal and external sphincter and placing a seton around the remaining portion of the sphincter involved with the fistula. A modification of this technique describes dividing just the distal portion of the internal sphincter and placing a seton around the remainder of the muscle involved.

6.6.2 Extrasphincteric Fistula

As mentioned previously, extrasphincteric fistulas can have unusual etiologies including diverticulitis and pelvic inflammatory disease. Any source of the fistula such as an infectious/inflammatory condition in the pelvis must be addressed first. Eliminating the source of the fistula may be all that is required.

For an extrasphincteric fistula of a more ordinary nature, the muscle-sparing techniques (other than the LIFT procedure) discussed earlier can be used. If the internal opening is low enough to allow an endorectal advancement flap, this technique may be employed.

6.6.3 Horseshoe Fistula

Most horseshoe fistulas will be the transsphincteric variety. The most common variation consists of an internal opening in the posterior midline with extensions going anteriorly on both sides of the rectum (Fig. 6.6). The classic treatment of primary posterior fistulotomy and laying open both arms of the horseshoe led to a large open, gaping wound, which required a prolonged healing time. In 1965 Hanley described a more conservative technique. A key portion of this technique is to unroof the deep postanal space by doing a fistulotomy in the posterior midline. The horseshoe tracts are curetted and drained with more limited incisions [87]. Hanley and colleagues reported the long-term results of 41 horseshoe fistulas treated in this manner with no recurrence or incontinence [88]. Other authors have reported similar excellent results using this technique for these difficult fistulas.

6.7 Anal Incontinence After Surgery for an Anal Fistula

Anal incontinence following fistulotomy is a feared complication and is the primary motivation for the development of muscle-sparing techniques for the treatment of anal fistulas. Incontinence has been reported to be anywhere between 3 and 50 % following fistulotomy. Even though advancement flap repairs are considered to be "muscle sparing," incontinence is sometimes reported after this procedure with a

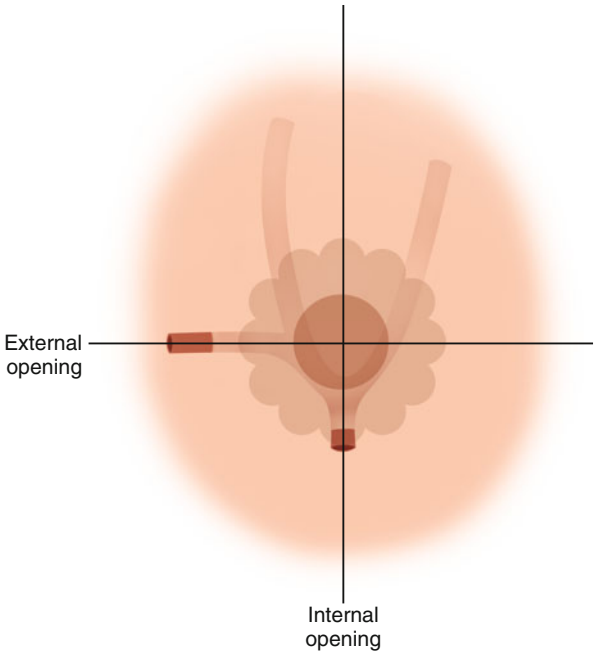

Fig. 6.6 Horseshoe fistula

Table 6.5 Vaizey incontinence score (Modified from the Wexner incontinence score)

	Never	Rarely	Sometimes	Weekly	Daily
Incontinence for solid stool	0	1	2	3	4
Incontinence for liquid stool	0	1	2	3	4
Incontinence for gas	0	1	2	3	4
Alteration in lifestyle	0	1	2	3	4
				No	Yes
Need to wear a pad or plug				0	2
Taking constipating medicines				0	2
Lack of ability to defer defecation for 15 min				0	4

range of 33–50 % [89, 90]. The mechanism of this could be due to either stretching of the sphincter from retractors or if the flap itself contains some muscle fibers.

Scoring systems for assessing continence exist and can be used to assess and describe the degree of impairment of continence a patient experiences. The most commonly used is the Wexner [91] incontinence grading systems; Vaizey [92] also developed a system based on the former and included three modifications (Table 6.5).

Lunniss et al. [93] used manometry assessment to study factors affecting continence after operation for anal fistula. They determined that functional deficits are related to low resting pressures, reflecting the change in internal sphincter integrity by its division. The sphincter mechanism in elderly patients is already weakened by age and less likely to tolerate division of even small amounts of muscle. Similar findings in 148

patients who underwent fistulotomy for intersphincteric fistulas (and therefore IAS division alone) were published by Toyonaga et al. in 2007. They found that resting tone and length of the high pressure zone were reduced following fistulotomy but voluntary contraction was not affected, and of the 30 patients (21 %) who suffered impairment of continence, only four suffered a higher degree than flatus incontinence [94].

6.8 Special Circumstances

6.8.1 Crohn's Disease Fistula

Perianal fistula and anovaginal fistulas are seen in 20–30 % of patients with Crohn's disease. Even in a patient with no known history of Crohn's, this diagnosis needs to be considered with the finding of multiple fistulas that are complex and/or in association with skin tags and fissures. Fistulas which develop in an atypical location or do not heal regardless of multiple attempts with medical and surgical treatment also point to Crohn's disease as an etiology. The pathogenesis of Crohn's fistula is poorly understood. Crohn's fistulas may be more complex and do not always follow the typical pattern of cryptoglandular disease or Goodsall's rule. Patients may present with constant anal pain or pain with defecation, but they are often painless unless an abscess is present [95]. Alexandar Williams report that one-half of these patients with anal fistula and Crohn's disease had no symptoms [25]. The operative approach to anal fistulas in Crohn's disease is more conservative than for cryptoglandular disease: the goal is to control symptoms rather than bringing about complete resolution of the fistula. As mentioned earlier, some Crohn's anal fistulas are relatively asymptomatic. In this situation and especially if there is active untreated Crohn's disease, the emphasis should be on medical management of the Crohn's disease.

6.8.1.1 Medical Management of Crohn's Related Fistula-in-Ano: Biologic Modifiers

The effects of TNF-α in the intestine include disruption of the epithelial barrier, induction of apoptosis of villous epithelial cells, and secretion of chemokines from intestinal epithelial cells [96]. Inhibition of TNF-α has been an important therapeutic target in CD patients with or without perianal disease for the last decade. In perianal CD, in particular, the use of biologic agents added a new therapeutic tool for an extremely difficult-to-treat situation, optimizing the need for surgery and improving quality of life [97, 98]. Several TNF inhibitors, classified to synthetic or endogenous (biologics), have been described or developed, showing interference either with the biosynthesis of the cytokine or blocking its effect once released from the cell [99]. Among the synthetic agents, pentoxifylline and rolipram can block secretion of TNF from macrophages increasing intracellular c-AMP levels, but unfortunately a therapeutic trial of pentoxifylline in Crohn's disease was ineffective [100].

Infliximab is a monoclonal antibody with mouse origin against TNF-α which was initially approved for the treatment of intestinal Crohn's disease in 1998

[101]. The use of infliximab is safe and well tolerated, but adverse events, such as infusion reactions, increased rate of infections including tuberculosis, delayed hypersensitivity reactions, formation of antibodies to infliximab, formation of anti-double-stranded DNA antibodies, and, in rare cases, drug-induced lupus, have been reported [102].

The first randomized, double-blind, placebo-controlled trial of infliximab for the treatment of Crohn's fistulas was done in 1999 by Present and associates [103]. This study included 94 patients with both intra-abdominal and perianal fistulas. At a dose of 5 mg/kg, there was a complete response with fistula closure in 55 % of the patients treated with infliximab vs. 13 % of patients receiving placebo. Subsequent studies have also shown adalimumab to be effective for the treatment of Crohn's related fistula-in-ano.

Adalimumab is a recombinant fully human IgG1 human monoclonal antibody that binds with high affinity and specificity. The use of adalimumab is safe and well tolerated, but adverse events more or the less similar of those reported for infliximab (see above) have been reported [102]. It is administered subcutaneously by a simple self-injection and thus patient hospitalization is not required. Its efficacy in anti-TNF-naive or previously treated patients with infliximab with moderate to severe CD has been proven. An induction period of subcutaneous infusions of 160 mg at week 0, 80 mg at week 2, and 40 mg at week 4 has shown best efficacy followed by infusions of 40 mg every other week, as maintenance treatment, with shortening of the intervals to 1 week or increasing dosage up to 80 mg every other week, in case of insufficient response, is the current clinical practice. Adalimumab has shown significant efficacy in perianal fistulizing CD in large randomized trials [104]. In the first randomized multicenter 4-week placebo-controlled trial (the CLASSIC-I), including 32 patients with fistulizing/perianal disease naive to anti-TNF agents, the rates of fistula improvement and remission for the adalimumab-treated patients and those receiving placebo were not significantly different [105]. A recent single-center 24-week open-label study, including 46 patients with perianal CD naive or not to anti-TNFs, adalimumab showed significant efficacy in controlling perianal disease; 24 % of patients had a complete closure of the fistula, assessed under anesthesia, while 55 % had a lack of drainage of purulent material at surgical evaluation under anesthesia. Of note, as in ADHERE, clinical response was independent of the past use of infliximab [106].

6.8.1.2 Immunosuppressants

6-Mercaptopurine (6-MP) and azathioprine (AZT) have been used frequently in the treatment of intestinal Crohn's disease for many years, but the benefit is often not realized for several months. In a long-term randomized double-blind study of 6-MP, Present et al. [107] demonstrated that 67 % of subject with Crohn's disease who were talking 6-MP improved in comparison with only 8 % for those receiving placebo. In this study the mean time for response to 6-MP was 3.1 months, and 20 % of the subjects required more than 4 months of treatment before improving. They also reported that 75 % of the subjects receiving 6-MP were able to decrease concomitant corticosteroid therapy. Ochsenkühn et al. combined azathioprine, 6-MP,

and infliximab in patients with Crohn's fistulas refractory to conventional management [108]. The 14 patients with perianal fistulas received 3–4 infusions of infliximab followed by long-term therapy with 6-MP and azathioprine. Complete closure of the fistula occurred in 13 patients for more than 6 months. They concluded that 6-MP and azathioprine may prolong the fistula closure achieved with infliximab. A meta-analysis by Pearson et al. [109] conducted nine randomized placebo-controlled trials. The authors found that azathioprine and 6-MP benefit those with active disease but steroids should be maintained and tapered while waiting for these agents to take effect. Therapy should be continued for at least 17 weeks and preferably for 26–52 weeks. Benefit was accrued to patients with quiescent and fistulous disease and steroid-sparing effects are near 10 %. Azathioprine and 6-MP remain the second-line immunosuppressive drugs.

6.8.1.3 Ciprofloxacin and Metronidazole

The use of antibiotics is based on their effect on decreasing luminal bacterial concentration, secondary tissue invasion, and microabscesses which complicate Crohn's disease and bacterial dissemination that is responsible for systemic complications [110]. West prospectively compared ciprofloxacin in conjunction with infliximab vs. infliximab alone and found that the response rate (50 % reduction in the number of draining fistulas) was 8 of 11 (73 %) in the combination therapy group vs. 5 of 13 (39 %) with infliximab alone [111]. Prantera et al. investigated the efficacy and the safety of combination of metronidazole and ciprofloxacin compared with methylprednisolone in treating 41 consecutive patients with active Crohn's disease. Patients were 500 mg twice daily, plus metronidazole, 250 mg four times daily, or methylprednisolone, 0.7–1 mg/kg/day, with variable tapering to 40 mg, followed by tapering of 4 mg weekly. Ten of the 22 antibiotic patients (45.5 %) and 12 of 19 steroid patients (63 %) obtained clinical remission at the end of the 12-week study. The authors suggested that metronidazole and ciprofloxacin could be an alternative to steroids in treating the acute phase of Crohn's disease. Bernstein found that, in a series of 21 patients treated with metronidazole 20 mg/kg/day for 6–8 weeks, all patients noticed less discomfort, and 56 % had complete healing. However, the fistulas recurred in 75 % of patients on stopping the drug [112].

6.8.2 Surgical Management of Crohn's Related Fistula-in-Ano

Prior to making any decisions regarding the best surgery for a fistula, the activity of the Crohn's disease needs to be assessed. If the patient is found to have active inflammation in the rectum, there is no role for attempts at curative fistula surgery. In this setting, placing loose (non-cutting) setons is the best choice. Fistulotomy rarely has a role unless the fistula is subcutaneous only. The other sphincter-sparing procedures have little chance of healing when there is active inflammation in the rectum. Even when the Crohn's disease is quiescent, the decision-making is more conservative. There is recognition of the fact that a patient with Crohn's can have a typical cryptoglandular disease. Even in this circumstance, these patients can

sometimes develop more typical Crohn's fistula in the future. Overly aggressive treatment of fistulas with repeated injury to the sphincter will lead to incontinence. Again, the emphasis is on relieving symptoms, not complete cure of the fistula. For a symptomatic fistula, placing a seton can be a good choice. The ideal setting for attempts at cure is fistulas that are either intersphincteric or low transsphincteric fistulas. The Crohn's disease should be well controlled and ideally not located in the anal canal or rectum. Once a decision has been made to attempt a curative surgery, all of the options for fistulas are viable. There is no high-level evidence to help separate out the various options.

6.8.3 Anal Fistula and Carcinoma

Long-standing chronic inflammation in the region of the anal glands is believed by some to lead to malignant degeneration. Immunohistochemical staining has revealed that the origin of these cancers may be from the rectal mucosa rather than the anal glands in one small series [113]. The presence of tumor mass, bloody discharge, and mucin secretion is suggestive of the presence of an underlying tumor [114]. A nationwide pathology database in the Netherlands identified only four cases of malignant transformation of a fistula, and all occurred in individuals with Crohn's disease [115]. Both adenocarcinoma and squamous cell carcinomas have been reported. Ky and coworkers related 7 patients with carcinoma arising in anorectal fistulas associated with Crohn's disease and identified 33 more in the literature [116]. Millar described three cases of villous tumors arising in anal fistula [117]. Differential diagnosis includes anal canal carcinoma with fistula, carcinoma of the rectum with fistula, hidradenitis suppurativa with malignant degeneration, and carcinoma arising in an anal canal duct [118, 119].

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Pruritus Ani

7

Ursula M. Szmulowicz

Derived from Latin, *pruritus ani* refers to perianal and anal itching. Itching is a sensation that causes an impulsion to scratch. Primarily mediated by histamine, itch results from irritation of the unmyelinated C fibers that end in the dermal-epidermal junction [1]. The incidence of pruritus ani ranges from 1 to 5 % [2, 3]. In a population study in Joliet, Illinois, of 102 randomly selected participants, 6 % reported anal itching in the past year [4]. In contrast, Keighley and Williams reported a 45 % incidence of pruritus ani within the past 5 years when surveying patients without gastrointestinal complaints seen in a hospital outpatient department [5, 6]. Due to the embarrassing nature of the complaint, the incidence may be greater than stated. Males suffer from pruritus ani more frequently than females, with a ratio of 2:1 to 4:1 [2, 7, 8]. Although the symptom may arise at any age, it is most common in the 40s to 60s [2]. In the series of 200 patients with pruritus ani from Bowyer and McColl, the majority of their patients presented in their middle 40s, with a range of 12–76 years old [7]. Perianal itching usually is a transient, self-limited symptom, resolving without any medical intervention. However, in a subset of patients, pruritus ani may be chronic, even becoming debilitating. Bowyer and McColl reported that 40 % of their patients had experienced perianal itching for 5 years or longer [7]. Five patients (7 %) in the series from Smith and colleagues experienced pruritus ani for more than 30 years [9].

Perianal itching arises from a myriad of etiologies (Table 7.1). Siddiqui and colleagues comment that there are almost 100 discrete causes of pruritus ani [2]. Pruritus ani usually is due to a benign condition. The majority of patients are categorized with idiopathic pruritus ani, in which, after a suitable assessment, no evident cause for itching is found. The incidence of idiopathic pruritus ani varies among studies, from 25 to 75–95 % [8, 10, 11]. The secondary causes of pruritus ani

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Table 7.1 Etiologies of pruritus ani

Idiopathic	Fecal soilage
	Dietary factors
Anorectal disease	Abnormal anorectal morphology (congenital or postsurgical)
	Anal fissure
	Fistula in ano
	Hypertrophic anal papilla
	Internal hemorrhoidal disease
	Perianal Crohn's disease
	Rectal prolapse
Dermatologic conditions	Acanthosis nigricans
	Atopic dermatitis
	Benign familial chronic pemphigus (Hailey-Hailey disease)
	Contact dermatitis
	Lichen planus
	Lichen sclerosus
	Lichen simplex chronicus
	Psoriasis
	Seborrheic dermatitis
	Vitiligo
Infection	Bacterial: erythrasma and streptococcal and staphylococcal dermatitis
	Fungal: candidiasis, dermatophytosis
	Parasitic: pediculosis, pinworms, scabies
	Sexually transmitted: chlamydia, condyloma (HPV), gonorrhea, herpes, molluscum contagiosum, syphilis
Neoplasia	Anal cancer
	Bowen's disease (high-grade anal intra-epithelial neoplasia)
	Colon and rectal polyps and cancer
	Leukemia
	Lymphoma
	Perianal Paget's disease
Psychiatric disorders	Anxiety
	Depression
	Ekbom's syndrome (parasitosis)
	Personality disorders
Systemic disease	Celiac disease
	Diabetes mellitus
	Hyperthyroidism
	Inflammatory bowel disease
	Iron-deficiency anemia
	Liver disease
	Pellagra
	Polycythemia vera
	Renal disease/failure
	Vitamin A and D deficiencies

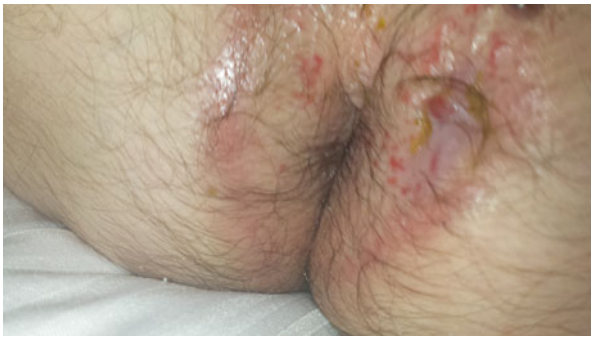

Fig. 7.1 Skin erythema and excoriation due to moisture/excessive wiping

include infectious, neoplastic, anal or colorectal, dermatologic, and psychiatric. A colonic or anorectal pathology is identified in 75 % of patients with this complaint, including malignancies: rectal cancer (11 %), anal cancer (6 %), and colon cancer (2 %) in the review from Daniel and colleagues [2, 8]. Anorectal disease, particularly internal hemorrhoidal disease, is present in as many as 52 % of patients with pruritus ani [2] (Fig. 7.1). Also, multiple pathologies may be present in a single patient: Bowyer and McColl diagnosed 257 conditions causing pruritus ani in their 200 patients, with one patient demonstrating five discrete pathologies, all of which required treatment in order to effect a cure [7].

The nature of the disorder makes treatment challenging. Patients are reluctant to present to a physician with this sensitive, socially embarrassing complaint as well as to engage in a thorough discussion of the problem. Since, in many cases, treatment relies on lifestyle alterations such as diet and cleansing changes, patients may be disinclined to adhere to the physician's recommendations. Moreover, pruritus ani may require the input of multiple specialists, primarily a colon and rectal surgeon and a dermatologist, for effective management. Surgeons, in particular, are often not interested in this chronic condition that often does not require surgical intervention and tends to feature multiple recurrences. Additionally, there are few studies to provide appropriate evidence-based strategies for treatment of the condition.

The following cases are presented to highlight the assessment and management of idiopathic pruritus ani as well as selected secondary causes of perianal itching (Fig. 7.2). Despite the source of the perianal pruritus, the goal of management is the resolution of itching and the reversal of any associated skin changes.

7.1 Case 1

The patient is a 45-year-old female who presents to your office with the complaint of perianal itching. The assessment of the complaint of pruritus ani begins with a thorough history. The eventual successful treatment of the condition will be facilitated by carefully listening to the patient at the initial visit to investigate his or her symptomology. When did the condition arise? Patients with pruritus ani due to a

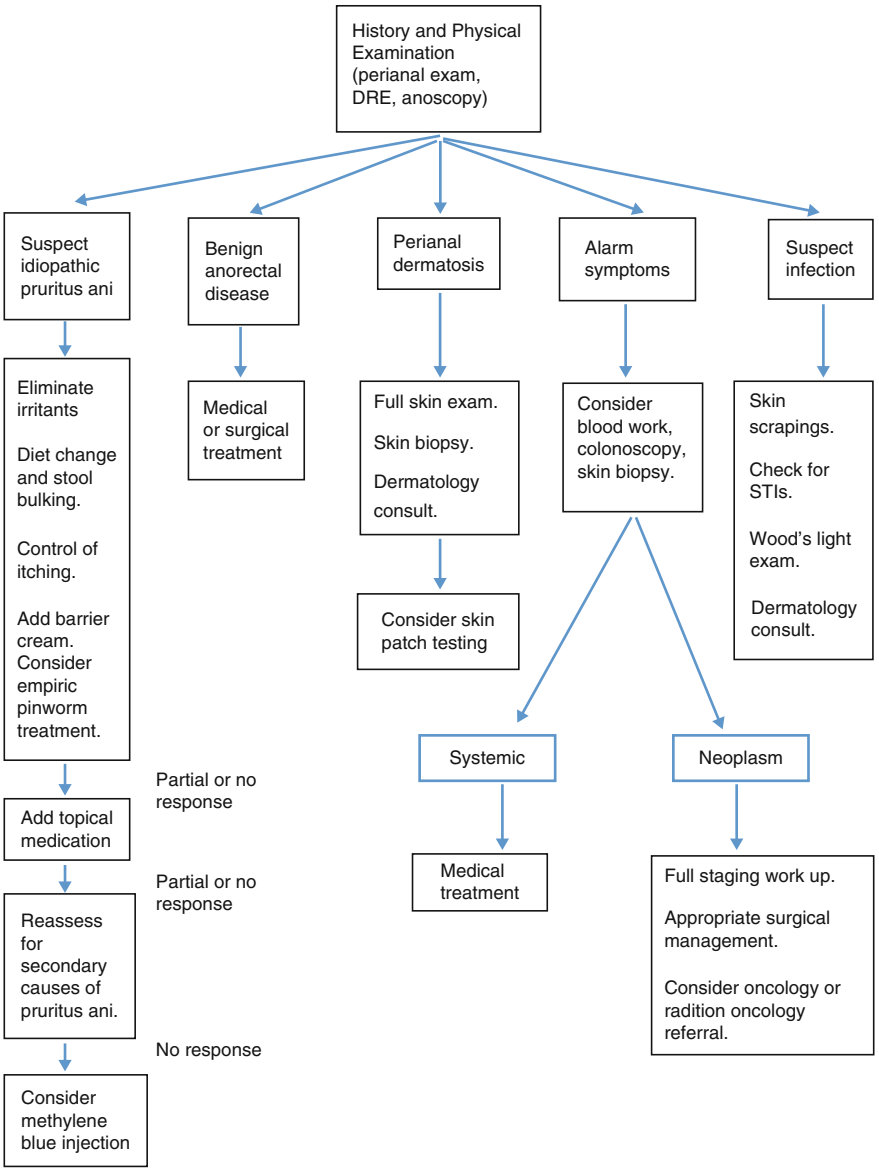

Fig. 7.2 Algorithm for the management of pruritus ani

dermatosis or neoplasia often experience symptoms for longer than those with idiopathic pruritus ani [8]. How often does the patient feel the perianal itching? Is it constantly present or does it ultimately subside? The precipitating and/or exacerbating factors—especially the initial inciting event—for pruritus should be explored. In general, perianal itching usually develops following a bowel movement, particularly if it has a liquid consistency, or at bedtime [12]. Does the itching wake the

patient from sleep? Is the area being traumatized: Does the patient scratch or vigorously rub the perianal skin? Alternatively, does the patient engage in perianal grooming—by waxing, shaving, or depilatory—that may damage the skin? Does the perianal skin seem moist or sweaty or is there drainage noted? Do any members of the same household have a similar complaint of perianal itching, suggestive of an infectious etiology such as pinworms? Prior and current prescription and over-the-counter medications, especially used by the patient for the treatment of the condition, should be reviewed. The bowel habits—the stool frequency and consistency—and the perianal cleansing methods of the patient should be elucidated. Has the patient added or changed any cleansing products such as soap, detergent, toilet paper, or wet wipes recently? The patient should be questioned about the presence of rectal bleeding. Such bleeding, however, may emanate from fissuring or excoriation of the perianal skin. Other alarm symptoms—such as unintentional weight loss, melanotic stools, unusual fatigue, and changes in bowel habits or stool caliber—should be sought. Is there itching or a rash elsewhere on the patient's skin surface that might point to a dermatologic condition? Any recent illnesses and their treatment, particularly with antibiotics and steroids, should be explored. As part of the inquiries regarding the medical history, the patient should be asked about skin diseases, allergies, atopy, urticaria, and previous skin patch testing that might signal a contact dermatitis [2]. Systemic diseases such as diabetes mellitus, liver disease, renal failure, hyperthyroidism, iron-deficiency anemia, leukemia, and lymphoma may be associated with pruritus ani, although the itching usually is more generalized; diabetic patients have a greater propensity to infection and to low resting sphincter pressures [13]. In females, details of previous child bearing should be elicited. The patient should be surveyed about previous sexually transmitted diseases and anoreceptive intercourse; MacLean and Russell comment that latex condoms or lubricant may produce a contact dermatitis [13]. Has the patient underwent previous anorectal procedures that may have altered the anal morphology or weakened the anal sphincters? Mazier emphasizes the importance of a dietary history, particularly focusing on caffeine, chocolate, citrus products, and tomatoes and tomato products [12]. The patient should be asked about fluid intake, which, if excessive, could lead to liquid stools as well as about laxative use [11, 14]. Mazier also advises that a social history be obtained to identify familial, work, and financial stressors that may contribute to pruritus ani [12]. Twenty percent of the patients with pruritus ani in the series from Smith and colleagues observed that stress worsened their symptoms [9]. Pruritus ani has also been cited as a manifestation of a psychiatric disorder. However, Dasan et al. identified only 13.5 % of their patients with pruritus ani who scored above the threshold of 7/8 on a general health questionnaire (GHQ 28) inquiring about psychiatric issues [15]. Also, there were no statistically significant deviations from the validity scales noted on the Minnesota Multiphasic Personality Inventory in the study from Smith and colleagues [9]. The family history should be directed to inflammatory bowel diseases, gastrointestinal malignancies, and skin disorders [13].

A general physical examination should be performed. In addition, the presence of a dermatologic condition should be assessed by examining the entire skin surface of the disrobed patient, particularly the flexor and extensor surfaces of the limbs, the

inguinal creases, scalp, and the interdigital toe spaces. The classic findings of various dermatologic diseases often are not exhibited in the perianal area; the diagnosis thus may be better determined based upon skin lesions elsewhere on the body [11]. If a dermatosis is identified, a referral to a dermatologist should be considered. Dasan and colleagues suggest that, based upon the high incidence of a dermatosis as the cause of pruritus ani in their combined colorectal-dermatological clinic—85 %—a dermatologist should actually be the first referral [15]. Also a patient with a significant dermatosis might benefit from the input of a wound ostomy nurse. Enlargement of the inguinal lymph nodes may indicate neoplasia or a sexually transmitted disease [2].

The perianal skin is included in the physical examination. In some patients, there may be no evident abnormalities, although most will have an associated dermatosis [5]. Daniel et al. offered descriptions of the various stages of the perianal skin changes [8] (Table 7.2). The degree of the perianal skin changes often are correlated with the intensity and duration of pruritus ani [12]. Perianal erythema may be noted in mild cases of pruritus ani [12] (Fig. 7.5). A brightly hued erythema may signal a fungal infection [2]. More severe or chronic perianal itching may produce lichenification—a nonspecific whitening and thickening of the skin with pronounced skin folds—or fissuring, in which cracks appear in the skin [12]. Chronic inflammation is frequently associated with hyperpigmentation [2] (Fig. 7.3). Excoriation indicates that the patient has been scratching or vigorously rubbing the perianal skin. A skin lesion with a distinct margin may point to psoriasis, tinea, or a neoplasm [2]. Multiple perianal vesicles are consistent with herpes [2]. A dermatitis with an indistinct border is more commonly seen with idiopathic pruritus ani [2]. Significant inflammation may lead to "weeping" of the perianal skin or maceration. In addition to the perianal region, pruritus may ultimately include the buttocks and genital area, both of which should also be examined [12] (Fig. 7.4). A *Corynebacterium minutissimum* cutaneous infection—erythrasma—is characterized by the fluorescence of the perianal skin under Wood's light.

The digital rectal examination (DRE) and anoscopy/rigid proctoscopy are performed to identify any anorectal sources for pruritus ani. In particular, the patient should be assessed for internal hemorrhoidal disease, anal fistula, anal fissure, and anal neoplasia. Straining during the anoscopy may disclose hemorrhoidal or mucosal prolapse. The anal sphincters should be assessed with anal manometry and endoanal ultrasound if the patient reports fecal soilage. A flexible sigmoidoscopy or colonoscopy may be considered based upon the patient's associated symptoms, age, and personal or family history of colon and rectal cancer and adenomatous polyps.

Table 7.2 Staging of perianal skin changes

Grade	Definition
Mild	Normal-appearing or erythematous perianal skin
Moderate	Erythematous perianal skin with mild maceration and/or excoriations or fissures
Severe	Erythematous, macerated, excoriated skin with ulcerations
Chronic	Pale white, thickened, dry skin without hair (lichenification)

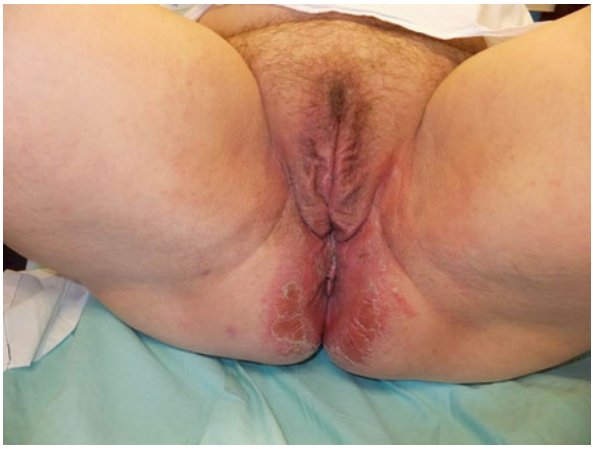

Fig. 7.3 Changes in the skin color with hyperpigmentation

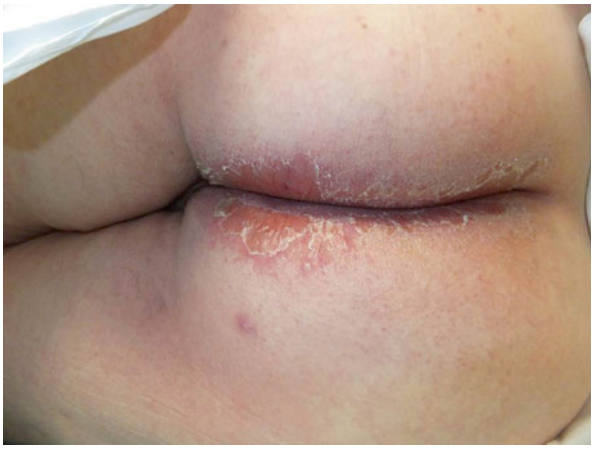

Fig. 7.4 Erythematous plaques of the perianum and gluteal cleft due to chronic pruritus ani

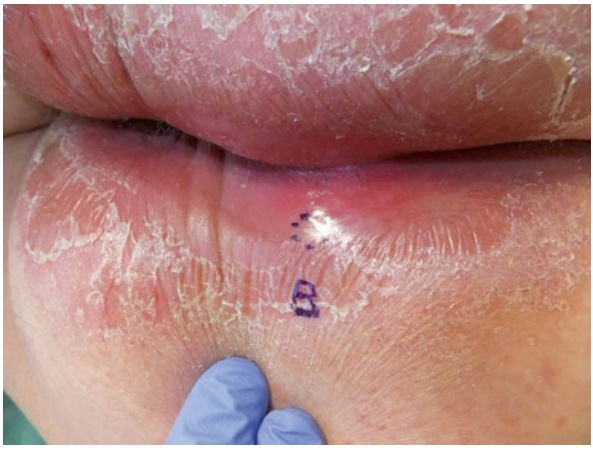

Fig. 7.5 Erythematous perianal skin

Daniel et al. urge that a colonoscopy be performed particularly in patients older than 50 years old with long-standing pruritus ani due to a significantly higher risk of colon and anorectal cancer [8]. A vaginal examination may be indicated in certain patients if vaginal drainage appears to be the source of the perianal pruritus.

The inclusion of additional investigations should be guided by the patient's symptomology and physical findings. Markell and Billingham comment that, as a majority of patients are diagnosed with idiopathic pruritus ani, in the absence of specific findings at the initial evaluation, the exclusion of secondary causes of pruritus ani may be instituted if a 4–8-week trial of generic management is unsuccessful [11]. Alarm symptoms that may instigate further evaluation include rectal bleeding, melanotic stools, a change in bowel habits or stool caliber, malaise, unusual fatigue, and unintentional weight loss. A perianal mass and significant skin changes/dermatosis also signal an etiology other than idiopathic pruritus ani. Among the blood work that may add to the diagnostic process are a complete blood count, immunoglobulin E, blood glucose, celiac screen, renal and liver function panels, and syphilis serology [13]. Skin patch testing by an allergist should be considered, particularly if a contact dermatitis is suspected [2].

A skin biopsy should be obtained if a suspicious lesion is noted or if conservative measures are not successful. A 3–6 mm punch biopsy may be used. Both the affected skin—the most abnormal site—and the adjacent normal-appearing skin should be biopsied [2, 13]. In the absence of such a finding, a skin biopsy for patients with idiopathic pruritus ani usually demonstrates normal skin or nonspecific changes consistent with chronic inflammation, fibrosis, and skin hypertrophy [12, 16].

The presence of an infectious process may be investigated. However, due to difficulties with specimen collection and transportation, such testing is often plagued by a high false-negative rate [2]. The swabs should be obtained prior to the digital rectal examination, as the lubricant contains a bactericide [2]. The appropriate medium and storage temperature should be used [2]. The more common bacteria infecting the perianal skin include the *Streptococcus* species, *Staphylococcus* species, and *Corynebacterium minutissimum*. A rapid streptococcus test can diagnose streptococcal dermatitis. A fungal infection may also be identified via skin scrapings [2]. The exudate from unroofed vesicles such as found with an active herpes simplex infection may be sent to the microbiology laboratory on a slide or in a viral culture medium [2]. Testing for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* may be performed by polymerase chain reaction (PCR) swabs in high-risk individuals [13].

7.2 Case 2

The patient is a 41-year-old male with no significant medical history who presents to your office with the complaint of perianal itching, occurring 30 min after a bowel movement, for the past 6 weeks. He also makes note of spots of bright red blood on the toilet paper when wiping following a bowel movement. Wiping the perianum when the itching arises results in symptomatic relief. He has approximately four

loose bowel movements per day. The patient has attempted no treatment other than more vigorous cleansing. A thorough evaluation identifies no perianal or anorectal pathology as a cause of his symptoms. The perianal skin demonstrates mild circumferential erythema and minimal excoriation. He is given the diagnosis of idiopathic pruritus ani.

The majority of patients with the complaint of perianal itching, as with this patient, will be ultimately categorized with idiopathic pruritus ani. Few studies have explored the underlying cause of idiopathic pruritus ani. One hypothesis suggests that the "self-sterilizing" function of the perianal skin is impaired [17]. Smith and colleagues note that the consistency of the stool also impacts the perianal itching: 48 % of patients with this condition reported loose or watery stools [18]. Certain foods or medications may add to the loose stool consistency. In contrast, the fecal microflora has not been shown to contribute to itching: Silverman et al. determined that there is no significant difference in the microbiology of stool from patients with and without pruritus ani [19]. Moreover, Caplan found no association between the stool pH and perianal itching [20].

Fecal soiling has also been suggested as a culprit for provoking or perpetuating perianal itching. Although the fecal soiling may be obvious, as with patients suffering from gross fecal incontinence, in others, as with this patient, it may be imperceptible yet sufficient to incite itching [2]. In a study from Smith and colleagues, 41 % of patients with pruritus ani experienced fecal incontinence daily to three times per week; 33 % of this group reported the episode within 1 h of the bowel movement [9]. Caplan also pointed to cutaneous secretions and other rectal discharges as factors in precipitating or promoting perianal itching [20]. The soiling may be a consequence of poor perianal hygiene, particularly in patients with obesity, deep buttocks, hirsutism, or pronounced perianal skin folds; incomplete rectal emptying; altered postsurgical anal or rectal morphology; anorectal disease such as internal hemorrhoidal disease or fistula in ano; an irregular stool consistency and/or frequency; and/or abnormal sphincter function or reflexes [2, 13, 21]. Thirty-nine percent of the patients with pruritus ani in the series from Smith et al. complained of a sensation of incomplete emptying [9]. Inciting the rectoanal inhibitory reflex (RAIR) resulted in a significantly more pronounced percentage decline in the anal pressures of patients with idiopathic pruritus ani than of controls (57 vs 40 %, $p<0.05$), despite normal resting and squeeze pressures, in the study from Allan and colleagues [22]. Moreover, Eyers and Thomson showed that patients with idiopathic pruritus ani demonstrated a significantly more exaggerated RAIR in response to rectal distention with 50, 100, and 150 mL of air than patients with pruritus due to anal disease ($p<0.01$, $p<0.01$, and $p<0.001$, respectively) [23]. Farouk et al. identified a significantly greater degree ($p<0.01$) and duration ($p<0.001$) of transient internal anal sphincter relaxation in patients with idiopathic pruritus ani as compared to controls during ambulatory anal manometry; at the same time, the symptomatic patients generated a more significant increase in rectal pressure than the control group ($p<0.01$) [24]. In the same study, fourteen (61 %) of the patients with idiopathic pruritus ani reported staining of their underwear within 30 min of an episode of transient internal anal sphincter relaxation, while 17 (74 %) and 23

(100 %) noted perianal itching within 1 and 2 h, respectively [24]. A saline infusion test detected leakage at a significantly lower volume in patients with idiopathic pruritus ani than in controls (600 vs 1300 mL, $p<0.001$); patients with more severe symptoms exhibited leakage at significantly lower volumes than those with milder complaints ($p<0.02$) [22].

The perianal skin, in particular, is sensitive to the presence of fecal material. Fecal material, mucus drainage, and moisture in the perianal area impair the normal barrier function of the bilayered stratum corneum and alter the pH (normally 5.0 to 5.9) of its protective acid mantle, permitting disruption of the epithelium—particularly in the presence of friction from apposing surfaces or of fragile aging skin—and entry of irritants and colonizing microorganisms such as the *Candida* species into the dermis [25, 26]. Consequentially, an inflammatory reaction is incited, provoking further itching [27]. In a seminal 1966 study, Caplan explored the effect of feces upon the skin, performing patch testing on the perianal skin and on the arms of 27 healthy male subjects, using their own feces, and on 10 healthy males as controls [20]. The inner arms of each subject were treated with fresh moist feces, feces with a pH of 5.0 and of 8.0, a control solution with a pH of 5.0 and of 8.0, and a plain piece of gauze [20]. Twelve of the 27 study patients (44 %)—only four of whom had previous histories of perianal itching—reported perianal irritation, itching, or burning following the application of the feces to the perianal skin, with the symptoms occurring either immediately ($n=1$), within 1 h ($n=7$), or at 3, 4, 6, or 24 h; the control subjects were free of pruritic symptoms. While two test subjects noted that pruritic symptoms persisted for 1 h but then resolved spontaneously, the remaining ten patients suffered the symptoms for 15 min to 6 h, with relief only obtained immediately after removing the feces. There were no objective findings when examining the perianal skin. In contrast, none of the inner arm patch tests precipitated pruritic symptoms, although mild skin reactions were observed in some subjects [20]. The author concluded that fecal matter produces an irritant, not an allergic effect [20]. Moreover, the perianal skin is more susceptible to the irritant nature of feces than is skin elsewhere on the body [20]. The fecal components that may serve as irritants include bacterial endopeptidases such as trypsin and kinase and exotoxins as well as intestinal lysozymes [19, 23, 28, 29].

The treatment of idiopathic pruritus ani begins with conservative measures: the removal of irritants and the control of itching (Table 7.3). These recommendations should be reviewed in great detail with the patient in order to ensure better compliance. The perianal skin should neither be scratched nor vigorously rubbed, even in the course of cleansing after a bowel movement. In the event that the patient scratches the area unconsciously while sleeping, socks or mittens may be worn over the hands. The fingernails should be kept short [2]. Scratching traumatizes the perianal skin, exacerbating the inflammatory process and enhancing itching; the resulting itch-scratch cycle becomes difficult to halt in the face of continued injury to the perianal skin [25, 30]. No soaps or cleansing creams—which dry and alkalinize the skin—should be applied to the perianal skin, even in the shower or bath [26]. In the bath tub, bubble baths and perfumed shampoos and conditioners should be eschewed. Washcloths, loofahs, and other cleansing accessories should be avoided

Table 7.3 Perianal skin irritants to avoid

Scratching or rubbing
Scented toilet paper
Wet wipes
Perfumed soaps, cleansers, shampoos, and conditioners
Washcloths, loofahs, and other cleaning accessories
Perianal waxing, shaving, or depilatories
Fragranced detergents and fabric softeners
Over-the-counter and prescription topical preparations (ointments, creams, gels, suppositories)

Table 7.4 Foods associated with pruritus ani

More common	Alcohol, including beer
	Chocolate
	Coffee and tea (decaffeinated and caffeinated)
	Soda (decaffeinated and caffeinated)
	Tomatoes and tomato products
Less common	Citrus and citrus products
	Milk and milk products
	Peanuts and other nuts
	Figs
	Grapes
	Popcorn
	Pork
	Prunes
	Spices
	Spicy foods
	Tobacco

when cleansing in the shower or bath, instead relying upon water and the patient's hand; 65 % of the oil and dirt is effectively removed with water alone [26]. If necessary, a physician-sanctioned fragrance-free, hypoallergenic beauty bar or unscented pH neutral (pH 4–7) soap may be used [26]. Prior to leaving the bath or shower, any product residue, which may be an irritant, should be rinsed from the perianal skin [2]. Perfumed toilet paper as well as wet wipes should be replaced with gentle, unscented, undyed toilet paper [31]. The patient's current regimen of topical medications—both by prescription and over the counter—should be stopped, as the patient could have become sensitized to the medication or one of its excipients. Perianal grooming—via waxing, shaving, or depilatory—should be stopped [13]. Moreover, detergents and fabric softeners should be substituted with fragrance-free versions [2].

The contribution of certain foods to perianal itching has been debated (Table 7.4). Specific foods may directly have an irritant effect upon the perianal skin. Tomatoes and tomato products may promote perianal pruritus via histamine release [13]. Alternatively, bowel consistency and/or frequency is altered by various foods, leading to the seepage of stool. Certain foods impact the internal anal sphincter: a

decline in resting anal canal pressures was observed by Smith et al. in eight patients (73 %) 1 h following the ingestion of three cups of coffee ($p=0.03$) [9, 13]. In their patients with idiopathic pruritus ani, Daniel and colleagues found that the volume of coffee significantly influenced the severity of the perianal itching ($p<0.0001$); a similar correlation was not identified for alcohol or tobacco use [8]. The common foods that may be associated with pruritus ani should ideally be removed from the diet; once itching subsides, each item can be sequentially reintroduced into the diet. To track the success of the dietary changes, a symptom diary should be kept. There is a 24- to 48-h delay between eating a certain food and developing perianal itching [14]. Friend notes that the perianal itching subsided within 2 weeks due to this elimination diet, although no systematic study has verified its efficacy [2, 14]. If a certain food is determined to be a causative agent for the perianal itching, it should be avoided. Alternatively, the patient may be able to ingest it up to a threshold amount before symptoms occur: usually two to three cups of coffee, four cups of tea, and less than two cans of beer per day, in the experience of Friend [14]. As with certain foods, some medications such as laxatives, antibiotics, and colchicine may incite or aggravate pruritus ani either by producing an irritant effect upon the skin, causing fecal leakage (e.g., mineral oil), or by loosening the stool [2, 21] (Table 7.5).

The recommendations for the control of itching focus upon maintaining a clean, dry perianal skin without inflicting any trauma (Table 7.6). However, no systematic studies have proven the benefit of careful anal hygiene in treating pruritus ani, although the majority of groups advocate these methods [2]. After a bowel movement, the perianal skin should ideally be washed while in a squatting position in the shower with a shower head or with a bidet, without employing soap [2]. It is possible to install a bidet attachment to an existing toilet (called a washlet), if a bidet is not available. If neither method is practicable, then moistened, unscented toilet paper can be used. Alternatively, especially when outside the home, the site may be

Table 7.5 Medications and preparations associated with pruritus ani

Balsam of Peru
Bacitracin
Colchicine
Colpermin
Fragrance
Lanolin
Laxatives
Mineral oil
Neomycin
Parabens
Peppermint oil
Propylene glycol
Quinidine
Thimerosal
Topical anesthetics (“-caine” group)
Topical antihistamines

Table 7.6 Management of perianal itching

Avoid scratching and vigorous rubbing of the perianal skin
Wear mittens or socks on your hands if you unconsciously scratch while asleep
Use your hand and water to cleanse the perianal skin. Do not use soap—especially perfumed soaps—or other cleansers while showering or bathing the perianal skin. Avoid washcloths, loofahs, and other cleansing accessories
Employ moistened undyed, unscented soft toilet paper or tissue for cleansing after bowel movements. Avoid wet wipes. Alternatively, shower, bathe, or use a bidet or bidet attachment for cleansing
Cleanse the perianal skin if itching arises in the absence of a bowel movement
Immediately dry the moist perianal skin by gentle patting. If at home, use a hair dryer on the cool setting
Apply a barrier cream once the perianal skin is dry
Wear a thin cotton strip, dusted with unscented baby powder or cornstarch, between the buttocks. Change the strip frequently throughout the day
Wear loose cotton underwear, which should be changed at least daily
Increase your dietary fiber intake
Avoid the foods associated with perianal itching. Keep a symptom diary
Add rectal irrigation—lukewarm water in a 3–4 oz. enema bulb—following bowel movements if bulking up the stool does not improve leakage per anus

cleansed with mineral oil or another oil-based cleanser such as Balneol® (Meda Consumer Healthcare, Marietta, GA) or with an aqueous cream, applied with a cotton ball. Immediate cleansing should also take place if itching arises spontaneously in the absence of a bowel movement, even at night, as it may represent the occult leakage of stool [2]. Following cleansing, the moist perianal skin should be gently patted dry, after which, if at home, the area should be further dried with a hairdryer on the cool setting. A barrier cream such as zinc oxide or Calmoseptine® (Calmoseptine, Inc., Huntington Beach, CA) can then be applied as a skin protectant after cleansing. Siddiqui and colleagues suggest that petroleum jelly be placed on the perianal skin after washing [2]. In contrast, Rohde recommends that water—as well as ointments, creams, gels, and suppositories—not at all be applied to the perianal skin, using only a "smooth dry article" to wipe, possibly along with a few drops of oil, such as olive oil [32]. He found that the 19 patients (100 %) who exactly followed his guidelines but only 8 (33 %) who did not or partially adhered to the plan experienced a resolution of their symptoms ($p < 0.001$) [32].

The impact of clothing upon pruritus ani has not been studied. However, it is agreed that, since heat and moisture worsen perianal itching, clothing that promote dryness should be favored [2]. However, Smith and colleagues found an equal incidence of pruritus ani in male Navy personnel working in hot (5 %) and cool (7 %) areas on a ship [9]. Yet, most groups advocate loose, cotton clothing. Clothing to avoid include pantyhose, jeans or other tight pants, swimsuits, leotards, and Lycra clothing. Underwear—cotton, not nylon or acrylic—should be put on only after the perianal skin is dry and changed at least once a day [2, 10]. Also, patients who wear incontinence protection should avoid products with a plastic backing [26].

MacLean and Russell recommend that prolonged sitting be avoided [13]. The patient should wear a strip of cotton, dusted with unscented baby powder or cornstarch, against the perianal skin, changing it on multiple occasions throughout the day, to collect any moisture or drainage; Alexander-Williams describes the cotton strip as measuring twice as long as a 50 pence piece (60 mm) [25]. Powders both absorb moisture and reduce friction [26]. A sanitary napkin is not a replacement for a cotton strip and may in fact prove an irritant.

Treatment also involves eliminating any occult fecal soiling. To improve the consistency of watery to loose stools, the patient should concentrate on eating a diet high in fiber and avoiding overhydration. A fiber supplement may be added for further stool bulk, which may aid in completely emptying the rectum of feces. In the case of watery stools, antidiarrheal medications such as loperamide, diphenoxylate/atropine, and codeine may be considered. Rectal irrigation using lukewarm water in a 3–4 oz bulb syringe may be used immediately following a bowel movement to evacuate any residue that may later leak onto the perianal skin.

The patient should follow up in the office in 4–6 weeks to confirm that the symptoms and perianal skin changes have resolved. This treatment yields a more than 90 % success rate [11]. In contrast, Smith and colleagues encountered a 27 % rate of cure after a 2-year observation period, with the greater success in patients who suffered from pruritus ani for less than 2 years; the patients who had the complaint for greater than 2 years did improve symptomatically but had frequent recurrences [9]. Even after becoming asymptomatic, the patient should generally adhere to the precepts of maintaining a clean, dry perianal skin without inflicting any trauma [25]. The patient should be advised that recurrences of pruritus ani are commonly experienced, in which case the full regimen of treatment should be reintroduced. Daniel et al. found that, despite initial good responses to treatment in all their patients with idiopathic pruritus ani, the condition was associated with a 22 % recurrence rate within 9 months, which was twice as high as that for pruritus due to anorectal disease ($p < 0.0001$) [8].

The same patient returns for a 4-week follow-up visit, stating that he is significantly improved. He has been meticulously adhering to your instructions for treatment. However, he still notices mild perianal itching several times per week. The perianal excoriation has resolved, although the mild circumferential perianal erythema remains. The examination is otherwise unremarkable.

Topical medications, in conjunction with proper anal hygiene, are an important part of the treatment armamentarium for idiopathic pruritus ani. A topical steroid assists in stopping the itch-scratch cycle by reducing inflammation [9]. The majority of patients with mild to moderate symptoms and minor changes in skin morphology are successfully managed with a low-potency steroid preparation such as a 1 % hydrocortisone ointment, applied twice a day, for a short course. Some groups suggest that the 1 % hydrocortisone be alternated with a barrier cream such as zinc oxide or Calmoseptine® (Calmoseptine, Inc., Huntington Beach, CA) every 2 weeks to minimize the side effects of the steroid. In a randomized, double-blind, placebo-controlled, crossover study, Al-Ghnaniem and colleagues treated ten patients with moderate idiopathic pruritus ani for a mean of 50.2 months topically

with 1 % hydrocortisone (in white soft paraffin) and with a placebo (white soft paraffin), both for 2 weeks, with the study intervals preceded and separated by 2-week "washout" periods without any topical medication; the authors found significant improvements in the visual analog score (VAS) for perianal itching ($p=0.019$) and in the eczema area and severity index (EASI, $p<0.01$) with the steroid [5]. The dermatology life quality index (DLQI) did not significantly change ($p=0.065$), possibly due to the small sample size and the minimal impact that the itching had on the patients' lives prior to treatment [5]. In contrast, Öztaş and colleagues determined that Protex liquid cleanser—chosen to reduce perianal fecal contamination—applied twice daily in 32 patients with idiopathic pruritus ani for 2 weeks, yielded no statistically significant difference in symptom relief as compared to a topical steroid cream, Advantan (methylprednisolone aceponate 0.1 %), used by 28 patients: 90.6 vs 92.3 %, $p>0.05$ [33]. Low-potency topical steroid preparations containing an anesthetic afford brief relief of itching; however, the perianal skin may become sensitized to the topical anesthetic, leading to a worsening of the symptoms and skin changes. There has been no recommendation made for the longest safe duration for treatment with the low-potency topical steroids [2]. A higher potency topical steroid may be necessitated by more severe symptoms or skin changes, with the course lasting for no longer than 8 weeks; if required, the high-potency steroid can then be replaced with a lower potency steroid until the symptoms and skin changes completely resolve [2]. Ultimately, once the symptoms resolve, only a barrier cream should be used on the perianal skin, employing the topical steroid for brief, as needed treatment [5]. There is no role for oral steroids for idiopathic pruritus ani. Steroid injections have been described for this condition. Tunuguntla and Sullivan presented a case study in which a 48-year-old female with intermittent rectal pain and itching was successfully treated with a single injection of 80 mg of methylprednisone acetate into the excoriated perianal skin, with no recurrence by the 1 year follow-up visit [27]. Similarly, 73.6 % of the 19 patients injected with the long-acting triamcinolone hexacetonide for perianal itching obtained "good" or "excellent" symptomatic relief in the series from Minvielle and Hernandez over a 1–9-month observation period [34].

Topical steroid preparations should be used with caution when treating idiopathic pruritus ani. Patients must be advised against prolonged use of these medications due to the association with skin atrophy. Intertriginous sites such as the perianal skin are particularly susceptible to skin atrophy [35]. The higher potency topical steroids, which are 1000-fold stronger than the lowest potency topical steroids, carry a greater risk of skin atrophy [2]. Also, as compared to steroid creams, steroid ointments are less likely to result in skin atrophy [2]. Topical steroid use may promote bacterial or fungal infections at the treatment site [33]. With chronic use, the perianal skin may appear intensely erythematous or develop telangiectasias, purpura, striae, or scar [2, 33]. Moreover, once the steroid medication is stopped, some patients suffer from a "rebound itch" (steroid addiction) that requires a gradual reduction in the dosage and concentration of the medication [2, 36].

Tacrolimus has been offered as an alternative topical medication, used off-label, for idiopathic pruritus ani. Suys conducted a randomized double-blind crossover

study using topical 0.1 % tacrolimus and a placebo (petrolatum) in 21 patients with idiopathic pruritus ani [37]. Each patient was treated with the study medication and the placebo for 4-week intervals, with a 1 week washout period in between the two phases [37]. The author recorded a significant improvement in the itch intensity ($p=0.044$) and frequency ($p=0.019$) as a result of the treatment with topical tacrolimus; within 2 weeks of starting the medication, a 68 % symptom reduction was noted [37]. Although there was a positive trend in the DLQI during the tacrolimus treatment, it did not reach statistical significance when compared to that of the placebo phase [37]. The only reported side effect was a minimal burning sensation in one patient [37]. There was no long-term follow-up of these patients. Similarly, in a 4-week randomized study of patients with pruritus ani due to atopic dermatitis, Ucak and colleagues found that topical 0.03 % tacrolimus ointment yielded significantly improved EASI, DLQI, and itching scores as compared to placebo at weeks 4 and 6 ($p<0.05$), with 12.5 % of the study subjects reporting the side effect of burning; however, 8 weeks after the conclusion of the study, recurrent symptoms were noted in 81.25 % of the tacrolimus and in 68.75 % of the placebo group [1]. Unlike the topical steroid preparations, topical tacrolimus avoids the side effect of skin atrophy. Yet this immunosuppressive medication, a calcineurin inhibitor, is associated with potential significant side effects of which the patient should be advised. Twenty percent or more of patients treated with topical tacrolimus experience burning or pruritus, flu-like symptoms, skin erythema, and headache [38]. Ali and Lyon described a 23-year-old female patient treated with 1 g of once daily 0.1 % tacrolimus applied to the perianal skin for perianal Crohn's disease, who developed tacrolimus toxicity after 4 weeks, complaining of nausea, paresthesias, and light-headedness; tacrolimus toxicity may be accompanied by renal failure, hypertension, and gastrointestinal and central nervous system symptoms [39]. Additional rare side effects of topical tacrolimus include an increased risk of malignancy, especially lymphoma and non-melanoma skin cancer; acute renal failure; and infections with varicella-zoster, herpes simplex virus, and eczema herpeticum [38, 39]. As such, no more than the minimum amount of medication needed for symptom control should be applied to only the affected areas [38]. Systemic absorption is more likely if the topical medication is applied to injured skin [38]. Moreover, topical tacrolimus is not meant for continuous, long-term use, due to the greater risk of side effects [38]. It should be avoided if a perianal skin infection is present [38]. Also the treatment should not be employed in patients who are immunocompromised or have renal impairment [38].

Capsaicin has also been used for the treatment of idiopathic pruritus ani. This product, a natural alkaloid obtained from red chili peppers, is thought to impede the production, storage, and release of substance P, a neuropeptide that mediates itching and pain sensation [10]. Capsaicin acts upon the C fiber afferent neurons that contain substance P, binding to the capsaicin receptors; the neurons become increasingly desensitized with a longer duration of treatment [10]. The medication has been used for the treatment of pain due to rheumatoid arthritis and post-herpetic neuralgia and of itching resulting from conditions such as uremia and post-mastectomy syndrome [10]. When applied topically to the perianal skin, capsaicin

produces a brief burning sensation that inhibits the urge to scratch. Lysy and colleagues conducted a double-blind, random order, placebo-controlled, crossover study of topical capsaicin (0.006 %) and a placebo (1 % menthol) in 44 patients with severe intractable idiopathic pruritus ani for an at least 3-month duration, in which all patients received the study medication and the placebo three times a day for 4 weeks each, with the two study periods separated by a 1 week "washout" interval. Thirty-one (70 %) patients obtained symptom relief only from the capsaicin, not the placebo; in these patients, the itching score significantly decreased following treatment with capsaicin ($p<0.001$) [10]. Notably, 24 of the patients who responded to capsaicin did so immediately, while the remaining seven patients experienced the benefit within 3 days of instituting the medication [10]. Of the 13 nonresponders to capsaicin, 4 left the study due to side effects—moderate to severe perianal burning ($n=3$) and urticaria ($n=1$)—and one experienced an equal response to both medications [10]. However, the authors note that all of the patients developed at least mild perianal burning as a consequence of applying the capsaicin, significantly more so than after using the 1 % menthol ($p<0.001$); the subjects reported a significant decrease in the capsaicin-induced perianal burning over the 4 weeks ($p<0.001$) [10]. For the 18 capsaicin-responsive patients who were followed for more than 8 months (range, 10–20 months), 4 were asymptomatic and 14 "nearly asymptomatic" on a maintenance regimen of once daily capsaicin every 1.97 days (range, 0.5–7 days) [10]. With longer follow-up, two patients required a stronger concentration of capsaicin (0.012 %) and two patients, an escalation in maintenance dosing to once every day to remain symptom-free [10].

Alternative treatment measures have been reported in the literature on idiopathic pruritus ani. Oral antihistamines have been used, although their efficacy may arise from their sedating effect, allowing sleep, as opposed to a direct inhibition of perianal itch [2]. Topical antihistamines do not prevent perianal itching but may instead serve as an irritant [2]. Siddiqui and colleagues comment that hypnosis has been employed but cannot be recommended due to a lack of study [2].

7.3 Case 3

The patient is a 26-year-old female with a history of asthma who presents to your office, complaining of perianal itching for the past 4 weeks. The itching begins after her once-a-day bowel movement and continues until she goes to sleep at night. She applies an over-the-counter "hemorrhoid" cream, which initially seemed to relieve her symptoms, twice a day; the itching has instead been steadily worsening, encompassing more of the perianal skin and even preventing sleep. She scratches frequently. She reports no other symptoms. On examination, the perianal skin is circumferentially erythematous, with excoriation, maceration, and vesicles noted. She has no other skin lesions or anorectal findings.

This patient has pruritus ani due to an allergic contact dermatitis arising from her topical "hemorrhoid" cream. Most individuals regard these over-the-counter medications as innocuous; however, these preparations may induce or exacerbate

pruritus ani, even producing an alternation in the appearance of the treated area. In susceptible patients, although the perianal itching seems to improve when first using the topical medication, the symptom then is intensified by an allergic reaction to one of its components. A more exuberant application of the same medication to a greater area then causes itching to spread beyond the initial affected site. Inadvertent transfer or even systemic use of an unknown allergic agent can precipitate a contact dermatitis on the perianal skin [40]. Contact dermatitis was the etiology for pruritus ani in 20 % of the patients in the series from Bowyer and McColl; the primary culprit in the majority of these cases was a topical anesthetic [7]. In a study from Harrington and colleagues, 69 % of patients with pruritus ani were found to have a positive skin patch test, 75 % of whom improved after eliminating the allergen; 38 of these patients reacted to therapeutic agents [31]. Additionally, the North American Contact Dermatitis Group identified 73 patients (21 %) with anogenital dermatitis who had at least one contributory positive reaction on patch testing—most commonly to cosmetics, steroids, or other medications [41]. Sensitizing agents are commonly used in cleaning products such as soaps, wet wipes, and toilet paper and in various topical preparations [2]. Even certain steroid preparations—meant for treatment of pruritus ani—may instead escalate the symptoms if a sensitizing agent is present. As compared to creams, ointments generally are composed of fewer ingredients and preservatives and are thus less likely to incite an allergic reaction [2]. The perianal skin in patients with contact dermatitis often demonstrates bright erythema, scale, maceration, and vesicle formation [2, 11]. The patient should stop using all topical products, assuming that the agent has perpetuated the problem [11]. Skin patch testing may be conducted to better establish the causative agent(s), ensuring better results by including the specific products used by the patient in the test panel [42]. A topical steroid ointment that contains none of the agents to which the patient is allergic should be prescribed, for instance, a 1 % hydrocortisone ointment for three 2-week courses, alternating with a barrier ointment such as zinc oxide every 2 weeks. Additionally, the patient should be instructed to eliminate irritants such as soaps, wet wipes, and scented toilet paper as well as to institute measures to keep the skin dry and to avoid itching.

7.4 Case 4

The patient is a 60-year-old healthy male with a 5-year history of chronic pruritus ani, previously treated with conservative measures, various topical steroid preparations, and rubber band ligation, who presents with persistence of the perianal itching. A thorough investigation by his colorectal surgeon and dermatologist has uncovered no further anorectal pathology or perianal skin disorder. His recent colonoscopy revealed only mild sigmoid diverticulosis. He seeks further treatment for the near-debilitating itching.

Idiopathic pruritus ani that is intractable to treatment with proper perianal hygiene, diet change, and topical preparations is a difficult and frustrating condition for the sufferer as well as the physician. Previously reported interventions such as

cryotherapy with liquid nitrogen spray; ultraviolet phototherapy; irradiation; surgical denervation or excision (Clover Leaf procedure) of the perianal skin; and the injection of anesthetic agents, mercury sulfide, phenol, or alcohol into the affected site have proven ineffective, too invasive, and/or too fraught with complications to be accepted into common practice [17, 21, 43, 44]. First introduced in 1968, the injection of methylene blue has been demonstrated in small series to produce some benefit in this difficult population of patients [45]. The treatment should be considered in patients who are refractory to other measures, have become steroid dependent, or who have a poor quality of life due to the perianal pruritus. However, the patient should complain specifically of itching to profit from the procedure: Eusebio and colleagues reported that their two patients with perianal burning or "irritation"—not itching—showed no response to the injection [45]. Also methylene blue is contraindicated in patients with glucose-6-phosphate dehydrogenase deficiency due to the association with hemolytic anemia [46]. The methylene blue is thought to destroy nerve endings, a finding that was confirmed by electron microscopy of punch biopsy specimens taken 1 and 7 years after treatment [45]. In order to verify the therapeutic effect of the methylene blue, Mentes et al. treated six patients only with 0.5 % lidocaine, omitting the methylene blue; all of these patients experienced a recurrence of pruritus ani within a few days of the injection [17]. The protocols for the procedure vary among groups (Table 7.7). Most groups use a 22 or 25 gauge needle to inject 10–30 mL of 0.5–1 % methylene blue, producing a final concentration of 0.25–1 %, along with additives such as a local anesthetic (0.25 % Marcaine with 1:200,000 epinephrine, 2 % procaine, or 0.5 % Xylocaine) and steroid (methylprednisolone or hydrocortisone). The medication was injected either subcutaneously, intracutaneously, or intradermally. Sutherland and colleagues specified their technique: "aliquots were injected intradermally to raise 10–15 mm blebs abutting each other." [16] The procedure is usually outpatient, although Sutherland et al. admitted their patients for an overnight stay for patient-controlled analgesia. The short-term cure rates range from 65 to 100 % (Table 7.8). Some authors have retreated their patients shortly after their initial injection in the event of a partial or no response, with good results in 88 %. Mentes and colleagues increased the percentage of symptom-free patients from 80 to 93.3 % by reinjecting the five patients who were partial responders at 1 month postinjection; four patients had a complete response afterward. The success rate of the procedure has been shown to decrease with longer follow-up: Mentes et al. recorded that 93.3, 83.3, and 76.6 % of their patients were symptom-free at 1, 6, and 12 months after the procedure, respectively. After a median of 47 months of follow-up, only 20 % of the patients in the series from Samalavicius and colleagues were symptom-free [47]. Botterill and Sagar correlate the efficacy of the procedure with persistence of the perianal tattoo for 2–6 weeks: the three patients who had no response lost the blue discoloration prior to 2 weeks, indicating that the dye was injected too deep [48]. Notably, Mentes et al. comment that three of the five patients who developed recurrent symptoms at the 1 year follow-up were those who had required a second injection of methylene blue for symptom relief [17]. The authors speculate that patients who experience a much later recurrence may benefit from reinjection of methylene blue [17]. In the series

Table 7.7 Methods for injection of methylene blue

	Anesthesia	Antibiotic	Position	Methylene blue	Additives	Injection site
Wolloch and Dintsman (1979) [46]	NR	No	Lithotomy	15–20 mL 1 %	2 % Procaine	Subcutaneous
Eusebio et al. (1990) [45]	IV sedation	No	NR	30 mL 0.5 %	0.25 % Marcaine with 1:200,000 epi, 0.5 % Xylocaine	Intracutaneous, subcutaneous in anodermal and perianal area
Eusebio (1991) [73]	IV sedation	NR	Prone jackknife	10 mL 1 %	NS, 0.25 % Marcaine with 1:200,000 epi, 0.5 % Xylocaine	Intracutaneous, subcutaneous in anodermal and perianal area
Farouk and Lee (1997) [43]	General	Yes	Lithotomy	10 mL 1 %	0.25 % Marcaine with 1:200,000 epi, 0.5 % Marcaine with 0.9 % NaCl	Intradermal along skin furrows
Botterill and Sagar (2002) [48]	General (23) IV sedation (2)	No	Lithotomy	5 mL 1 %	1 % lignocaine, hydrocortisone	Intradermal
Mentes et al. (2004) [17]	None	No	Prone jackknife	15 mL 1 %	7–8 mL 0.5 % lidocaine	Intracutaneous, subcutaneous
Sutherland et al. (2009) [16]	General	No	NR	10 mL 1 %	0.5 % Marcaine with 1:200,000 epi steroid[a]	Intradermal
Samalavicius et al. (2012) [47]	None	Yes	Prone jackknife	15 mL 1 %	2 % Lidocaine, NS	Intradermal, up to the level of the dentate line

NR not reported, *epi* epinephrine, *NS* normal saline
[a]Methylprednisolone

Table 7.8 Outcomes of injecting methylene blue

	N (male)	Median age (years)	Success (%)	Reinjection (*n*)	Median follow-up	Complications
Wolloch and Dintsman (1979) [46]	Nine (nine males)	46 (29–68)	100 % at 3–15 months	One (one successful)	NR (3–15 months)	Pyrexia (1)
Eusebio et al. (1990) [45]	23 (15 males)	NR (25–71)	43 % "Complete relief" at 9.5 years	0	NR	Cellulitis (4); skin necrosis (3)
Eusebio (1991)	11 (NR)	NR	"Dramatically efficacious"	NR	NR	"Virtually non-existent"
Farouk and Lee (1997) [43]	Six (five males)	56 (25–76)	83 % "Substantial reduction" in symptoms	Three (three successful)	Three (2–5 years)	Urinary retention (1); superficial abscess (1); transient FI (1)
Botterill and Sagar (2002) [48]	25 (15 males)	49 (28–85)	88 % at 6 weeks	Eight (six successful)	11 (2–25 months)	FI (1)
Mentes et al. (2004) [17]	30 (13 males)	39 (22–70)	76.6 % at 1 year	Five (four successful)	NR (1–2 years)	Cellulitis (2)
Sutherland et al. (2009) [16]	49 (19 males)	43 (19–67)	65 % at 8 weeks	Four (four successful)	8 weeks	FI (3); flatus incontinence (4)
Samalavicius et al. (2012) [47]	Ten (four males)	43 (30–63)	100 % at 4 weeks, 20 % within 60 months	0	47 (29–60 months)	None

FI fecal incontinence, *NR* not reported

from Farouk and Lee, three patients successfully underwent reinjection at 1, 3, and 5 years due to recurrent symptoms [43].

The injection of methylene blue is associated with possible side effects that should be reviewed with the patient. The urine may briefly appear blue-green due to excretion via the kidneys. The perianal area usually becomes hypoesthetic, which may persist from 4 weeks to 5 years. Patients may be insensate to pinprick for a longer period. The blue tattooing of the perianal skin may remain for 2–6 weeks. Urinary retention is a rare complication. Transient fecal incontinence has been reported. In the series from Sutherland and colleagues, 14 % of the patients experienced an impairment in continence, four to flatus and three to stool, which resolved by 4–6 weeks and 10 days to 2 weeks, respectively; the authors attributed this complication to the migration of the dye to the anal canal, where it impacted sensation and, thus, continence [16]. However, Samalavicius et al., who purposefully directed the injection up to the level of the dentate line, recorded no changes in continence.

Infectious complications have also been reported following the injection of methylene blue. Farouk and Lee diagnosed a superficial abscess in one patient (20 %), while four subjects (17 %) in the series from Eusebio et al. developed a self-limited cellulitis [43, 45]. Mentes and colleagues emphasize the importance of maintaining the sterility of the injected solutions and of the perianal skin preparation, for which they used chlorhexidine and 10 % povidone iodine [17]. Only two groups advocate the addition of antibiotics. The injection should not be made too deep, beyond the dermal layer, so as to avoid pelvic sepsis [17]. Moreover, Mentes et al. recommend that a minimal number of needle punctures be made in the perianal skin [17].

Skin necrosis was also identified as a complication of the injection of methylene blue into the perianal skin. In the series from Eusebio and colleagues, 13 % of their patients developed full-thickness skin necrosis of up to 3 cm in diameter; after debridement, the sites healed within 8 weeks [45]. The authors comment that using the full concentration of methylene blue may have been the source of this complication [45]. Others have pointed to the high volume of the injected fluid—20 to 40 mL—as a source of the skin necrosis. Later studies, including a follow-up study from Eusebio, in which smaller volumes and a lower concentration were utilized, have not produced this same complication. Mentes et al. suggest that, even if a smaller volume risks not addressing the entirety of the affected perianal skin, it is more prudent to plan a second injection on a separate occasion [17]. Also, a too-shallow injection performed may risk skin ulceration [17].

7.5 Case 5

The patient is a 35-year-old G2P2 female with a history of rubber band ligation due to grade I internal hemorrhoids following the birth of her first child, who presents with a 4-month history of bright red blood on the toilet paper, discomfort and swelling of the anus, and perianal itching after bowel movements. A thorough history and physical examination are performed. The anoscopy demonstrates internal

hemorrhoids that prolapse but spontaneously reduce (grade II) and perianal excoriation with mild erythema.

Internal hemorrhoidal disease is commonly identified in patients with the complaint of pruritus ani. Hemorrhoidal disease was associated with perianal pruritus in 22 % of the patients in the series from Bowyer and McColl; in 16 of those patients, it was the only pathology [7]. In a review of 500 patients with hemorrhoids from Mazier, 29 % named "itching (pruritus)" as their chief complaint [12]. However, the author comments that, despite the belief of most patients with perianal itching, pruritus ani is not a primary symptom of internal hemorrhoidal disease; instead, the mucus drainage and fecal soiling arising from prolapsing internal hemorrhoids may secondarily produce perianal itching [11, 12, 49, 50]. Pruritus ani was reported by 50 % of the patients with hemorrhoids in the review from Murie et al., while 67 % noted fecal soiling [49]. Patients with symptomatic internal hemorrhoidal disease may benefit from procedures such as rubber band ligation, Doppler-guided hemorrhoidal artery ligation, stapled hemorrhoidopexy, and hemorrhoidectomy. Murie and colleagues determined that both rubber band ligation and excisional hemorrhoidectomy significantly decreased the incidence of pruritus ani [49]. However, in the series from Smith et al., 88 % of the patients with pruritus ani due to internal hemorrhoidal disease had persistent symptoms despite rubber band ligation or hemorrhoidectomy [9].

Various anorectal conditions are similarly associated with pruritus ani. Bowyer and McColl diagnosed anal fissure, anal spasm, perianal skin tags, hypertrophied anal papilla, and anal fistula as causes of pruritus ani in 2.5, 2, 2.5, 1, and 0.5 % of their patients, respectively [7]. Siddiqui and colleagues recommend that all anorectal abnormalities be treated in patients with pruritus ani, commenting that even small skin tags may trap fecal residue and cause skin irritation [2]. Yet no study has confirmed any benefit of perianal skin tag excision for treating pruritus ani. In the review from Bowyer and McColl, five patients underwent excision of their perianal skin tags with resolution of itching [7]. The authors noted that while skin tags were a very common finding among their 200 patients, they were deemed to be contributory factors only if the patient specifically pointed to the tag as the site of itching [7, 51]. In contrast, Murie et al. stated that hemorrhoidectomy, which concurrently excised the perianal skin tags, did not result in an improved outcome in treating pruritus ani as compared to rubber band ligation, which did not impact the external tissue, possibly due to a consequent impairment in continence after the surgery [49]. Similarly, excision of hypertrophied anal papillae is of dubious benefit for relieving pruritus ani. The two patients with hypertrophied anal papillae and pruritus ani in the same series from Bowyer and McColl experienced symptomatic relief after excision [7]. However, in a randomized study of the impact of the excision of nonprolapsing hypertrophied anal papillae upon chronic pruritus ani, Jensen found no significant benefit as compared to expectant management ($p > 0.05$), with 67 and 55 % symptom-free at 1 year; 42 % of the patients who underwent surgery developed anal pain secondary to a postoperative anal fissure, sphincter spasms, or infection [52]. The author discourages the practice of excising hypertrophied anal papillae for the treatment of pruritus ani, suggesting that it be only considered for prolapse of the lesion [52].

7.6 Case 6

A 58-year-old male with type II diabetes mellitus and with a recent diagnosis of sinusitis presents to your office with the complaint of constant, severe perianal itching and pain for the past 2 weeks. He had been treated with oral antibiotics for his sinus infection with good results, shortly after which pruritus ani developed. He has attempted no specific treatment for the perianal itching. He reports no other symptoms. On examination, he has a diffuse, well-marginated, macerated erythematous perianal plaque. Skin scrapings from the perianal skin reveal *Candida albicans*.

Fungal infections are an uncommon etiology for pruritus ani. Approximately 10–15 % of patients with pruritus ani have a fungal infection [28]. *Candida albicans* is usually a commensal organism, found in 23.4 % of the control patients in the series from Dodi et al [53]. In the series from Bowyer and McColl, perianal candidiasis occurred in 14 % of their patients with itching [7]. Treatment is only required when *Candida* is identified in an immunocompromised patient—such as a diabetic—who had previously taken systemic antibiotics or steroids [2, 7, 53]. Other factors that predispose to an infection with *Candida* species include advanced age, excessive sweating, obesity, occlusive clothing, and concurrent genital candidiasis [42]. Itching associated with perianal candidiasis is usually severe and may be accompanied by pain [28]. A *Candida* dermatitis appears as a diffuse, well-marginated erythematous macerated plaque, often with pustules [28, 36]. Skin scrapings reveal mycelial forms and spores [36]. For the majority of these superficial skin infections, a topical preparation such as clotrimazole, miconazole, or nystatin is very effective [54]. Systemic medications such as ketoconazole and fluconazole may be considered in immunocompromised patients, due a higher rate of relapse with topical applications in this group; in the case of bacterial superinfection; or in individuals with multiple recurrences [54].

Dermatophyte infections, also known as ringworm or tinea, are widespread. In contrast to the *Candida* species, dermatophytes—most commonly *Trichophyton mentagrophytes and Trichophyton rubrum*—are always pathologic and should be treated [21, 53]. This superficial skin infection is more common in immunosuppressed patients, athletes who engage in contact sports, people who attend communal baths, and those who work or live with animals [55]. Transmission is by direct contact with an infected individual or pet or via fomites such as clothing, towels, or linens. The common symptom is itching. The perianal exam demonstrates multiple well-demarcated, ring-shaped, scaly erythematous plaques, often with vesicles or pustules [2, 28, 36]. Skin scrapings demonstrate hyphae [36]. The infection is treated with topical antifungal medications such as clotrimazole, econazole, and miconazole, which yield a cure rate of greater than 80 % [54]. Prevention involves aggressive hand cleansing and avoidance of sharing articles of clothing or linens with infected individuals [55].

7.7 Case 7

A 30-year-old healthy HIV-negative male patient appears in your office with the complaint of perianal itching and hemorrhoids. On examination, he has scattered perianal warts. The digital rectal examination and anoscopy reveal no pathology, including no warts. An anal cytology and HPV (human papillomavirus) DNA assay are negative for dysplastic cells and high-risk HPV, respectively.

The patient has perianal condyloma acuminata (Fig. 7.6). This sexually transmitted disease occurs due to infection with the human papillomavirus (HPV). Anogenital HPV include the low-risk subtypes 6 and 11, associated with condyloma, and the high-risk subtypes 16 and 18, seen with high-grade anal intraepithelial neoplasia (AIN) and anal cancer. The condyloma may be asymptomatic or accompanied by itching, pain, burning, drainage, or bleeding [50]. The lesions appear pink, flesh-colored, or white and are papillary or flat. The warts are variable in size as well as extent. In the perianal area, condyloma exhibit a radial growth pattern [50]. A digital rectal examination and anoscopy are required to exclude intra-anal condyloma. A biopsy may be performed to confirm the diagnosis or to evaluate any suspicious areas. The presence of anal intra-epithelial neoplasia (AIN) should be particularly assessed in high-risk populations with an anal cytology, HPV DNA assay, and, if appropriate, a high-resolution anoscopy. Small perianal condyloma may be treated in the office with topical agents such as podophyllum resin or trichloroacetic acid or with cryotherapy. Topical imiquimod cream, sinecatechins, or podophyllotoxin can be considered for patient-administered treatment of small perianal lesions. More extensive disease or disease involving the anus should be addressed by surgical excision and/or ablation with a CO_2 laser, Bovie electrocautery, or infrared coagulator. Recurrences are common, ranging from 30 to 70 %

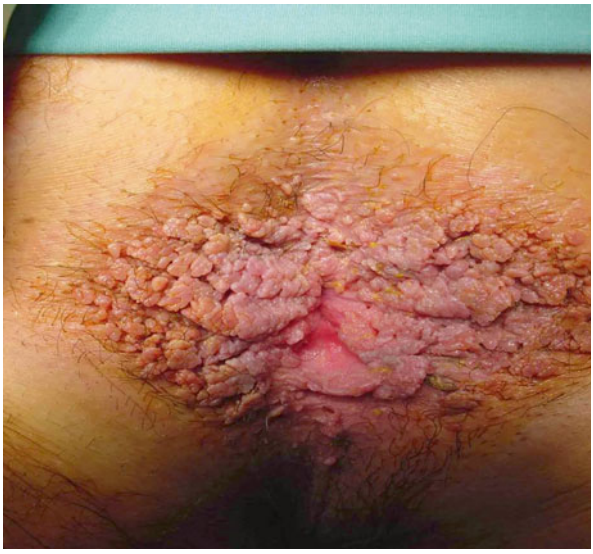

Fig. 7.6 Perianal condyloma

within 6 months of treatment, particularly if an intra-anal component is not recognized and treated [56]. However, postsurgical treatment of the perianal skin with topical imiquimod cream may decrease the incidence of recurrence.

Perianal pruritus may also arise from other sexually transmitted diseases. An active herpes simplex infection is characterized by an often intense itching [28]. Gonococcal proctitis may lead to pruritus ani as a consequence of the anal secretions [28]. Similarly, vaginal secretions due to a sexually transmitted infection may cause perianal irritation and itching [13]. The chancre or flat, velvety condylomata lata seen with primary and secondary syphilis infections may produce perianal itching. When located at the anal verge, the chancre may mimic an anal fissure in appearance; however, the chancre is less likely to be associated with pain [28]. Itching associated with *Sarcoptes scabiei* begins in the anogenital area but usually becomes generalized [21].

7.8 Case 8

The patient is a 32-year-old G3P3 healthy female with no history of anorectal surgery who presents with perianal itching. She reports that the itching wakes her from sleep. The perianal skin appears excoriated. There is no other anorectal pathology.

This patient has pruritus ani secondary to an infection with the nematode *Enterobius vermicularis* or pinworms. Enterobiasis is the most common parasitic infection in the United States and Western Europe, found in all socioeconomic levels. Humans, especially children, are the only host for *Enterobius*. The highly infectious eggs are able to persist in both cool and humid climates. Infection occurs via ingestion of the eggs by a direct fecal-oral route, via contaminated foods, or by fomites, including clothing, linen, and toilet seats [57]. Eggs that have become airborne may be unknowingly swallowed [58]. The eggs mature into the adult worms within the small intestine over 1–2 months, after which the worms travel to the colon, with the cecum and appendix serving as the primary reservoirs [58]. The worm burden varies among individuals from a few to hundreds [59]. About one-third of infected patients are asymptomatic [59]. The most common symptom, itching, typically arises at night as the adult female worms deposit their eggs—up to 10,000—in the folds of the perianal skin, waking the patient from sleep [57, 59]. Pruritus—an inflammatory reaction to the eggs and worms—begins in the perianal area but may ultimately extend to the buttocks, perineum, and genitals [28]. Scratching the perianal skin may produce a secondary bacterial infection [58]. Rarely, patients with a severe infection may complain of nausea, vomiting, and abdominal pain [57]. Very unusual presentations of a pinworm infection include pelvic peritonitis, vaginitis, urethritis, and salpingitis [57]. The findings on examination of the perianal skin are nonspecific, including erythema, excoriation, and maceration. The infection is diagnosed by a cellophane test, in which the tape is applied to the perianal skin at night or prior to arising from bed in the morning in order to collect the adult worms and eggs; the specimen is then examined under light microscopy [28]. Multiple samples improve the diagnostic yield: a 50, 90, and

100 % detection rate for 1, 3, and 5 samples, respectively [58, 59]. On occasion, a diagnosis is made after seeing the 8–13 mm, white, threadlike female worms on the perianal skin, usually in the morning [58]. For patients who scratch, eggs may be identified from scrapings taken from under the fingernails [58]. Treatment involves eradicating the adult worms with mebendazole (100 mg), pyrantel pamoate (11 mg/kg, up to 1 g), or albendazole (400 mg), all of which are given orally in a single dose that is followed 2 weeks later by a second dose [38]. Mebendazole and albendazole- are associated with an approximately 100 % cure rate after the second dose [38]. Pyrantel pamoate, which is available over the counter, yields a 90–100 % eradication of the infection [38]. Empiric treatment of a presumed pinworm infection may be considered in some patients, particularly if their itching occurs at night [16]. Among the preventative measures are scrupulous hand cleansing, morning bathing, avoidance of scratching, regular trimming of the fingernails, and frequent changing of the underwear, clothing, bed linens, and towels [57, 59]. Although the anthelmintic medications are effective, the recurrence rate due to reinfection is high. It is common for other members of the household to harbor the same infection, even in the absence of symptoms. As such, treatment of even asymptomatic family members, particularly if the patient suffers from multiple symptomatic recurrences, may be advisable.

7.9 Case 9

A 60-year-old female presents to your office with the complaint of perianal itching for the past 2 years. On examination, the perianal skin demonstrates brown–red scaling lesions, which are also noted in the inguinal creases. Under a Wood's lamp, the lesions reveal an intense coral red fluorescence.

This patient has erythrasma, a superficial infection of the perianal skin with the gram-positive bacillus *Corynebacterium minutissimum*. This condition accounts for 1–18 % of cases of pruritus ani in various series [2, 7]. The incidence increases with greater age [60]. It is not unusual for itching, which can be very intense, to persist for longer than 1 year, due to delays in presentation and in diagnosis [2]. In the series from Bowyer and McColl, the average duration of symptoms was 7.5 years, with a range of 3 months to over 40 years [7]. Among the predisposing conditions for the disease are diabetes, obesity, and perianal moisture [60]. The infection also appears in other sites, including the inguinal, gluteal, and inframammary creases; the axillae; the umbilicus; the scrotum; and the interdigital toe spaces, all of which should be examined [7]. The perianal skin often demonstrates multiple scaly, wrinkled, well-demarcated, irregular red or pink patches that gradually become brown in color [60]. However, there is no pathognomonic appearance to the perianal skin in this condition [61]. The characteristic feature of erythrasma is its coral red fluorescence under an ultraviolet Wood's light, due to the presence of porphyrin; however, if the site has been washed prior to the exam, the fluorescence of the water-soluble porphyrin may not be detectable [11, 60]. Also, in the series from Bowyer and McColl, only 9 of the 15 patients with erythrasma and pruritus ani had fluorescence in the perianal area,

although all 15 exhibited fluorescence in the inguinal creases, thighs, and toe web spaces [61]. The condition responds well to erythromycin (1 g by mouth daily in four divided doses for 10 days), with clarithromycin as the alternative oral antibiotic [60]. Among the topical preparations are clindamycin, an azole antifungal, and benzoyl peroxide. Bowyer and McColl report that their 15 patients gained symptomatic relief within 2–4 days of starting oral antibiotics and a topical betamethasone lotion [61]. However, recurrences are common: during the 3-month to 3-year observation period, seven of their patients (45 %) experienced a recurrence, all of which responded well to retreatment with erythromycin [61].

The perianal skin may also become superficially infected by *Staphylococcus aureus* or beta-hemolytic streptococci (groups A, B, and G). Both infections are more common in the pediatric population. However, Kahlke and colleagues identified 53 adult patients with perianal streptococcal dermatitis over a 4-year period; the authors also noted that 34 % of their adult control patients were colonized with beta-hemolytic streptococcus [62]. In children, unlike in adults, the pharynx serves as the reservoir for the perianal skin infection, even in the absence of pharyngitis [63, 64]. As with *C. minutissimum*, a perianal skin infection with *Staphylococcus aureus* or beta-hemolytic streptococci produces an often pronounced itching that may persist for over 1 year [2, 28]. With streptococcal dermatitis, the involved skin demonstrates sharply bordered, moist, bright erythema with edema, maceration, lichenification, and scale but no satellite lesions; there may be an associated mucoid or serosanguinous drainage [2, 11, 28, 63]. The diagnosis may be suspected after the patient fails to respond to a topical steroid and confirmed with a rapid streptococcal test or culture [11, 64]. Clinical improvement of the beta-hemolytic streptococcal-perianal dermatitis is rapid after starting oral antibiotics, usually amoxicillin, although relapses are frequent, seen in 39 % of patients [11, 64]. In a series of 19 adult patients with severe chronic pruritus ani with a mean duration of 6 years (range, 1–20 years) due to a beta-hemolytic streptococcus infection, Weismann et al. successfully treated eight (42 %) with various antibiotics—penicillin V/dicloxacillin, erythromycin, and clindamycin—in conjunction with topical betamethasone and fucidin; the remaining patients experienced a transient improvement in itching and in the skin changes [63]. The authors found that the condition was difficult to eliminate with a single course of antibiotics [63]. In the series from Kahlke and colleagues, 42 % experienced a resolution of their symptoms after a single 10- to 14-day course of an antibiotic, primarily amoxicillin (1 g three times daily), although 6 % had a recurrence in the short term; also, 58 % of their patients needed additional treatment for other anorectal pathologies for complete relief of pruritus [62].

7.10 Case 10

The patient is a 32-year-old healthy male with no previous anorectal complaints who presents to the office with constant perianal itching for the past 4 months. He applies a diaper rash ointment without much change in his itching. He has no

other symptoms. He has noticed no similar itching and no rash elsewhere on his body. The examination reveals a palely erythematous, poorly demarcated perianal plaque, extending to the gluteal cleft. Additionally, there is a brightly erythematous, scaly plaque on his scalp.

This patient suffers from psoriasis. Psoriasis may rarely appear solely in the perianal location but more commonly affects the elbows, knees, penis, and scalp. Yet, in a series of 3000 patients with psoriasis, 44 % demonstrated perianal disease [35]. Pruritus ani is due to psoriasis in 5–55 % of patients [2, 7, 15]. Itching in the perianal area may be exacerbated by moisture and friction [35]. As with other dermatologic conditions, the findings typical of psoriasis—brightly erythematous, macerated, scaled, sharply demarcated plaques—are often not evident in the perianum, possibly due to trauma from scratching, vigorous rubbing, or friction from the apposed skin surfaces or to prior medications [2, 11]. The psoriasis of intertriginous sites such as the perianal skin (inverse psoriasis) exhibits paler, poorly bordered plaques without scale [2, 28]. For the appropriate treatment, the patient should be referred to a dermatologist. First-line management of the condition usually involves a low- to midpotency topical steroid for short-term use, followed by either calcipotriene or a topical immunomodulator such as pimecrolimus or tacrolimus for chronic administration [11, 35]. The chronic nature of this skin disorder should be explained to avoid unrealistic expectations of a cure and to improve compliance.

7.11 Case 11

A 70-year-old G1P1 female with rheumatoid arthritis is sent to your office by her primary care physician due to her complaints of intense vulvar and perianal itching. Her symptoms began 8 months ago. On examination, the vulva and perianal skin appear white, wrinkled, and atrophic.

This patient is diagnosed with lichen sclerosus. This condition primarily affects women, especially following menopause, with a 5:1 to 6:1 female to male ratio [11, 28]. The exact incidence is unknown. Possible etiologies for lichen sclerosus include an autoimmune disorder, hormonal imbalance, or genetic disease, as there is a familial predisposition. Lesions often form on previously traumatized skin [65, 66]. Most cases involve the labia, clitoris, and perianal skin, although lesions may develop on any skin surface. Both the vulvar and perianal skin are involved in 60 % of females with the disease [28]. The majority of patients with perianal disease complain of severe itching, pain or discomfort, and bleeding, although some individuals may be asymptomatic. Typically the affected skin initially exhibits ivory-colored atrophic papules that later uncover erythematous tissue; as the acutely inflamed skin heals, it becomes a white, atrophic, and wrinkled patch with areas of ecchymosis [11, 28, 65]. Around the anus, the fragile skin may form painful fissures that readily bleed. The patient may experience flattening of the clitoris and labia [11]. The diagnosis is usually evident by examination but may be confirmed by tissue biopsy, which shows epidermal atrophy with subepidermal edema [67].

Treatment of lichen sclerosus involves a short course of a high-potency topical steroid ointment such as clobetasol propionate, followed by a less potent topical steroid, which usually resolves the symptoms, although the skin morphology will not revert to its baseline [11, 65]. Other treatment options include steroid injections, tacrolimus, retinoids, oral or topical tricyclic antidepressants, and UV light [11, 66]. Surgery, which is not curative and may worsen the scarring, is not indicated for perianal lichen sclerosus, only for complications of genital disease or for neoplasia [65]. Even in the absence of symptoms, patients should be medically treated to halt the progression of the skin changes as well as to prevent an eventual squamous cell carcinoma [65]. In the event of a recurrence or incomplete response to the treatment, the area should be biopsied to rule out a squamous cell carcinoma, which involves approximately 5 % of patients [2]. Patients should follow up with their physician regularly for reexaminations every 6–12 months [66]. Between such visits, patients should be vigilant for ulcerations, masses, or other skin changes that may signal a malignancy [65].

7.12 Case 12

The patient is a 71-year-old white female with a personal history of adenomatous colon polyps, status post surveillance colonoscopy 1 week ago, who is referred to your office with severe, constant left-sided perianal itching for 8 months. The examination demonstrates an erythematous, eczematous left-sided perianal lesion, concerning for a neoplasm. A punch biopsy identifies extramammary Paget's disease.

Extramammary Paget's disease—cutaneous adenocarcinoma in situ arising from the apocrine sweat glands—of the perianal skin is a rare condition. The perianal location (Fig. 7.7) represents 20 % of cases of extramammary Paget's disease [68]. From 1893 to 2011, approximately 200 cases of perianal Paget's disease have been reported [69]. It is most commonly diagnosed in 50–80-year-olds, particularly Caucasian women [11, 68]. Typically, patients present with intense pruritus and/or pain, which may be accompanied by bleeding or burning. The diagnosis is often delayed for as long as 2–8 years as a presumed "dermatitis" is unsuccessfully medically treated [69]. The characteristic slow-growing perianal lesions are well-bordered erythematous plaques that feature eczema, maceration, scale, or ulcerations; a mass may signal invasive disease [70]. The diagnosis is based upon a skin biopsy. Immunohistochemical stains—cytokeratin 7 (CK7), cytokeratin 20 (CK20), gross cystic disease fluid protein-15 (GCDFP-15), carcinoembryonic antigen (CEA), and S-100 protein—confirm the diagnosis. A colonoscopy, cystoscopy, mammogram, and colposcopy should be considered in these patients due to an up to 33–86 % association with other malignancies, especially colorectal and tubo-ovarian [67, 69]. Goldblum and colleagues recorded a 45 % incidence of synchronous or metachronous rectal adenocarcinoma among 11 patients with perianal Paget's disease [71]. An immunohistochemical analysis that is CK20(−)/GCDFP-15(+) indicates primary perianal Paget's disease, while CK20(+)/GCDFP-15(−) suggests an underlying malignancy (secondary perianal Paget's disease) [70, 71]. Due to the rarity of this

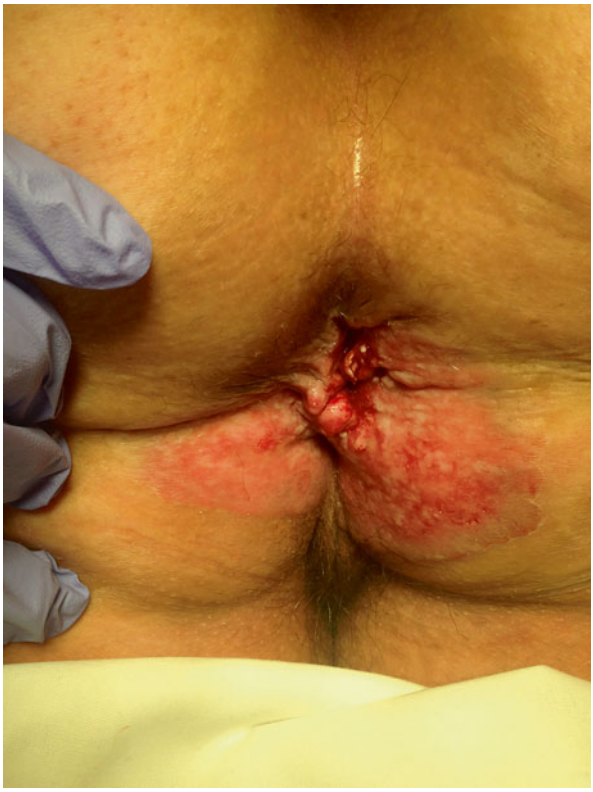

Fig. 7.7 Paget's disease

condition, no large, randomized studies have been conducted to determine the most effective treatment modality. A wide local excision with preservation of the anal sphincters has long been the standard treatment of perianal Paget's disease, possibly in conjunction with advancement flaps or split-thickness skin grafts for coverage of the often large defect. Preoperative skin mapping biopsies may guide the lines of excision; however, the margin of the lesion is often irregular and the skin that appears normal may be involved. The ideal width of the macroscopic margin is debatable; wider margins, however, do not decrease the recurrence rate but do produce a distorted anatomy, possible anal stricture, and prolonged wound healing. The efficacy of frozen sections to confirm microscopically clear margins is dubious due to false-negative results secondary to the multicentric nature of the disease (skip lesions) [69]. In the series from McCarter et al., 30% of patients experienced a local recurrence after wide local excision [72]. Patients with a synchronous distal rectal or anal cancer should undergo a concurrent abdominoperineal resection (APR); in the event of lymph node metastases, an inguinal lymph node dissection should be added to a wide local excision or APR [69]. Palliative chemotherapy and radiation therapy are used for metastatic disease to the liver, bone, lung, or adrenal glands. Less invasive options for primary perianal Paget's disease are Mohs' surgery, photodynamic

therapy, 5 % imiquimod cream, and radiotherapy. Perianal Paget's disease has a 50 % overall recurrence rate [69]. As recurrences are frequent and can occur even decades after the initial treatment, long-term follow-up of the perianal skin as well as of potential sites of metachronous malignancies is mandatory [11]. The overall survival and disease-free survival reported by McCarter and colleagues was 59 and 64 %, respectively, at 5 years and 33 and 39 %, respectively, at 10 years [72].

7.13 Conclusion

Pruritus ani is a difficult and frustrating condition for which patients are hesitant to seek medical attention. The incidence likely is greater than reported. Although usually a transient symptom, perianal pruritus can produce significant distress for the patient, which should not be minimized by the physician. The causes of pruritus ani include primary (idiopathic) pruritus ani and a wide range of secondary diseases, grouped as infectious, dermatologic, neoplastic, systemic, anorectal, and psychiatric etiologies. The management of the patient begins with a careful history and physical examination, focusing on the perianal and anal assessment. The search for a secondary cause for pruritus ani is guided by the patient's symptoms and exam findings. Treatment of idiopathic pruritus ani rests upon the elimination of irritants, the maintenance of anal hygiene in the absence of trauma, and the addition of the appropriate topical agents. The options for intractable cases are limited. Overall, the dogmatic protocols with which physicians address idiopathic pruritus ani are derived from small studies or even anecdote. Further study of the condition is warranted to improve outcomes. Secondary pruritus ani is addressed according to the particular pathology. Patients with nonsurgical conditions may benefit from the input of dermatologists, allergists, or wound care nurses.

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Anal Condyloma Acuminata and Anal Dysplasia

8

Michelle D. Inkster, Ursula M. Szmulowicz, Homer O. Wiland, and James S. Wu

Anal condyloma acuminata and anal dysplasia are human papillomavirus-related intraepithelial lesions that are precursors of anal squamous cell cancer. Risk factors include immunosuppression for patients who have inflammatory bowel disease, cervical cancer, human immunodeficiency virus, a history of solid organ transplantation, as well as viral transmission by person-to-person contact. Assessment includes disease-specific history and physical examination, selected tests, and biopsy of suspicious lesions. Treatment includes antiviral agents, anticytotics, strong acid, or ablation using a variety of techniques. Vaccine prophylaxis against four types of human papillomavirus is available. This chapter discusses infection, diagnosis, and treatment of condyloma acuminata and anal dysplasia.

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8.1 Pioneering Work

HPV is thought to be at least 350 million years old [1]. Infection with human papillomavirus (HPV) is associated with the development of cervical, vulvar, vaginal, anal, penile, and oropharyngeal cancers [2, 3]. Condyloma acuminata and anal dysplasia are preinvasive lesions that may progress to anal squamous cell carcinoma [4, 5]. Treatment for warts has been known since at least the time of Hippocrates who recommended treatment of condyloma with "alum, chalcitis, a little crude Melian alum[?]; sprinkle a little dried elaterium, and a little dried pomegranate rind in like manner [6]." That warts are infectious was shown by Macfadyean and Hobday in 1898 [7] when they excised warts from the warty buccal membrane of one dog and rubbed the cut surface of the wart onto the lightly scarified buccal surface of a second dog. About a month later, there was growth at the point of inoculation of the second dog's mouth. The warts grew in size for a short time and then regressed. In a similar experiment, they removed the new wart, ground it up with a pestle and mortar, and injected the suspension into the skin of the thigh of a dog from whom a wart had been removed. There was no growth observed at the site of injection. They surmised that there may have been some protection from prior infection. In 1910, Rous made the observation that cancer, a sarcoma, could be transmitted by a virus [8, 9]. He was awarded the Nobel Prize in Physiology and Medicine in 1966. Wild cottontail rabbits that lived in Iowa were called "warty" or "horny" because they had cutaneous warts that grew on the skin of the stomach naturally and caused no symptoms. In 1932, Shope described the inoculation of domestic rabbits with pieces of these warty tumors and showed that there was a transmissible factor present in the lesions [10].

Although there is reference to cancer of the uterus in the Ebers Papyrus, the first written description of uterine cancer was by Aretaeus Cappadox (AD 81–138) who described two distinct forms—firm and non-ulcerated and foul smelling and ulcerated. Both were associated with swelling in the groin, were chronic and deadly, and, if uterine bleeding was present, were considered incurable [11]. It was not until 1907 that Ciuffo [12] showed the warts contained a filterable infectious agent. In 1949, Strauss showed that human warts had papillomavirus DNA present by using electron microscopy [13]. In 1971, Oriel and Whimster described a case of a homosexual male with anal warts. Pathology showed carcinoma in situ; papillomavirus particles were found on electron microscopy [14]. The authors concluded that malignant transformation of viral warts might be a cause of perianal and perigenital carcinomata.

In 1974, Harald zur Hausen went to a conference in Florida where he was to present his work showing that HSV was not the cause of cervical cancer only to have the preceding presenter state that 40 % of the HSV genome had been found in one specimen. This was later shown to be incorrect, but zur Hausen's work was received in silence. In 1976, he and his coworkers reported finding HPV DNA in cervical cancer and warts [15]. He extracted HPV DNA from plantar warts and showed that they did not react with genital warts or other skin warts and concluded that papillomavirus was not a single virus but many different viruses. In 1983 and 1984, zur Hausen and his colleagues described the initial isolation of HPV 16 and 18 DNA from genital cancer [16, 17]. For his body of work, he was awarded the Nobel Prize for Physiology and Medicine in 2008.

HPV is so common that nearly all sexually active men and women are infected at some point in their lives [18]. HPV-related cancer is thought to be slow growing, but there is no strong evidence-based data to confirm this. The exact time and date that a person is infected is mostly unknown. This makes it difficult to propose a timeline for conversion of an infection from a benign condition to a cancerous one. It also makes it difficult to propose an adequate screening protocol for the anus for those who have a precancerous condition. There is no uniform agreement that any screening is justified. There are some who advocate that screening alone is adequate, whereas other workers in this field advocate either no screening or screening and destruction of lesions that are seen [19, 20].

8.2 Anal Embryology

The embryologic origins of the anorectum and of the cervix, vagina, and penis help to explain their susceptibility to infection with HPV, dysplasia, and cancer. These structures have in common a stratified squamous epithelium that predisposes to HPV infection.

In the fourth week of gestation, the foregut, midgut, and hindgut arise from the gut tube, an endodermal derivative [21]. The hindgut differentiates into the distal one-third of the transverse colon, the descending and sigmoid colon, the rectum, and the anal canal above the dentate line. The most distal segment of the hindgut fuses with the allantois and mesonephric ducts, creating the cloaca ("sewer"), a cul-de-sac that terminates blindly at the cloacal membrane [22]. At the cloacal membrane, the endoderm and the ectoderm are in direct juxtaposition [23, 24]. Between the fourth and sixth weeks of gestation, the urorectal septum partitions the cloaca into the ventral urogenital sinus and the dorsal anorectum [23, 25, 26]. Similarly, the cloacal membrane is divided by the urorectal septum anteriorly into the urogenital membrane and posteriorly into the anal membrane [22]. While the proximal anal canal develops from the caudal portion of the endodermal cloaca, the distal anal canal is an ectodermal derivative. The lateral protuberances of the anal folds form the proctodeum, or anal pit, which becomes the distal anal canal after the anal membrane regresses in the eighth week of gestation (Fig. 8.1) [22, 27]. The former site of the anal membrane becomes the dentate (pectineal) line, superior to which is located the 6 to 12 mm anal transition zone (ATZ). Proximal to the ATZ, the rectum is lined with columnar epithelium.

8.3 Anal Anatomy

The anal canal is divided into three zones: colorectal, anal transitional zone and squamous (Fig. 8.2). The proximal anal canal is lined by columnar epithelium. Distal to the columnar epithelium is the anal transitional zone (ATZ).

The ATZ is particularly important because, as stated by Nigro, most cancers of the anal canal arise in or just below the tissue that lines the anal canal immediately above the dentate line and are often described as either cloacogenic, transitional cell, basaloid, epidermoid, or squamous cell cancers. All are considered variants of squamous cell cancer [30].

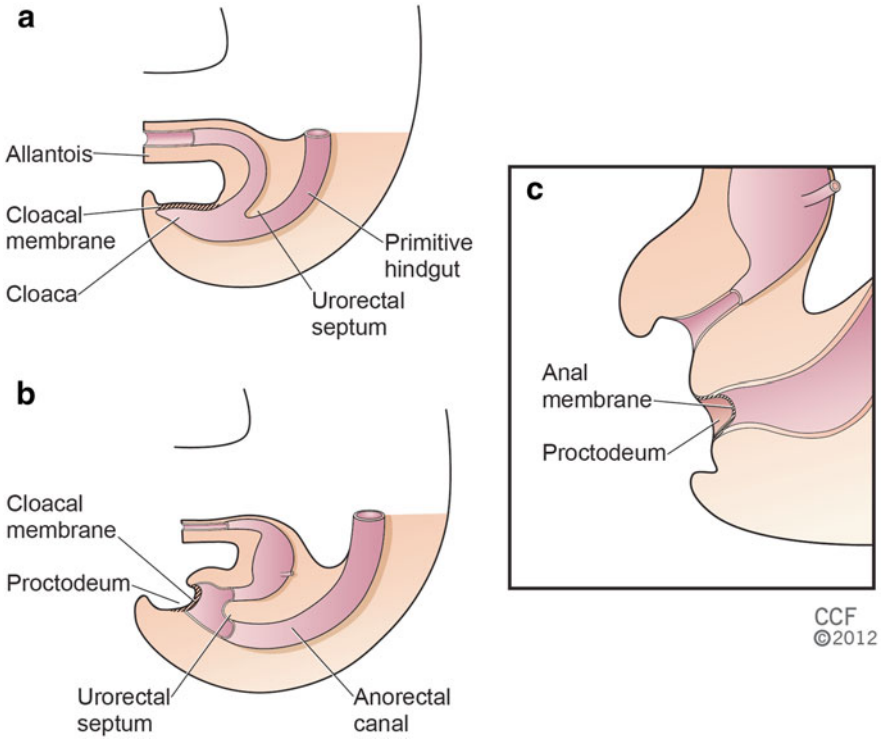

Fig. 8.1 Embryology of the anorectum. (**a**) The cloaca—the fusion of the hindgut with the allantois and mesonephric ducts—is partitioned by the urorectal septum, creating (**b**) the urogenital sinus anteriorly and the anorectum posteriorly. The once common chamber terminates blindly at the cloacal membrane, which similarly is divided into the anterior urogenital membrane and posterior anal membrane. (**c**) The ectodermal layer of the anal membrane gives rise to the surrounding protuberances—the anal folds—that create a central depression, the proctodeum, which ultimately develops into the distal anal canal (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015. All Rights Reserved)

8.4 Risk Factors for Anal Squamous Neoplasia

Squamous dysplasia of the anus is associated with risk factors that include HPV infection, anoreceptive intercourse, immunosuppression, genital carcinoma or dysplasia, smoking, and anal coinfection with agents other than HPV (Table 8.1).

8.4.1 Human Papillomavirus Infection

HPVs are double-stranded DNA viruses that are host and tissue specific—canine virus infects dogs, bovine virus infects cows, human virus infects humans, and rabbit virus infects rabbits. Greater than 200 HPV serotypes have been identified.

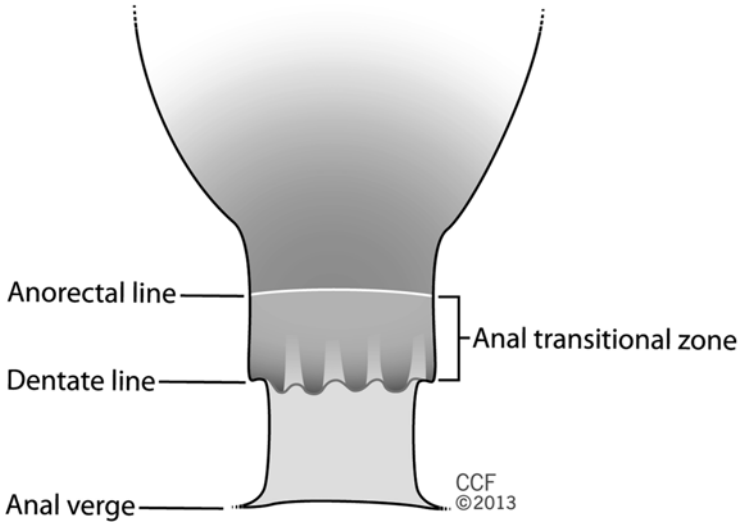

Fig. 8.2 The anorectal line defines the junction between the columnar epithelium of the colorectal zone and the epithelium of the anal transitional zone. The dentate line marks the distal border of the anal transitional zone. Distal to the dentate line is non-keratinized squamous epithelium without skin appendages. The anal verge marks the palpable junction between the internal and external anal sphincters. The perianal skin is keratinized squamous epithelium with skin appendages (apocrine glands, sweat glands, and hair follicles). On digital rectal examination, the anal canal is defined by the boundaries of the internal anal sphincter muscle that extends from the anorectal ring to the anal verge [27–29] (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015. All Rights Reserved)

Table 8.1 Risk factors for anal cancer

Human papillomavirus
Anoreceptive intercourse
Genital dysplasia
Anal condyloma acuminata
Tobacco consumption
Immunosuppression
Human immunodeficiency virus
Transplantation

These are separated into two large groups based on location: skin versus internal wet-squamous mucosa. Further, subclassification is based on oncogenic potential (low risk vs. high risk) as shown in Table 8.2 [31].

HPV is associated with cancers of the cervix, penis, vulva, vagina, anus, and oropharynx [32]. High-risk HPVs, most notably HPV-16 and 18, are found in the majority of anal cancers [33–36]. HPV 6 and 11 are associated with genital warts [31].

Table 8.2 HPV serotypes and cancer risk [31]

Group	HPV types
High risk	**16, 18**, 31, 35, 39, 45, 51, 52, 56, 58, 59
Probably high risk	26, 53, 66, 68, 73, 82
Low risk	**6, 11**, 40, 42, 43, 44, 54, 61, 70, 72, 81

8.4.2 Immunosuppression

Increased risk for anal neoplasm is seen in patients who are immunosuppressed because of HIV infection, solid organ transplantation, hematologic malignancy, and autoimmune diseases. In 1990, Svenson and coworkers [37] described carcinoma of the anal canal in a 40-year old homosexual man with AIDS. The patient presented with an anal abscess that became a fistula. Histology of the resected fistula showed extensive, poorly differentiated squamous cell carcinoma. In 2000, Frisch et al. [38] reported the incidence of invasive and in situ HPV-associated cancers (cervix, vulva, vagina, anus, and penis) among 309,365 US patients with HIV infection/AIDS. HPV-associated cancers in AIDS patients occurred in statistically significant excess; the relative risk for anal cancer was increased to 6.8 in females and to 37.9 in males.

Chronic immunosuppression from solid organ transplant also is associated with increased incidence of anal cancer [39, 40]. Penn and Starzl reported *de novo* tumors in 75 survivors of organ transplantation, the incidence being approximately 80 times greater than in the average population in a comparable age range [41]. The authors felt that there was strong evidence for an association between immunosuppression and tumor growth. In 2000, Penn, who was then in charge of the transplant registry at the University of Cincinnati, reported that skin cancers were the most common tumors being 38 % of all de novo malignancies [42]. Anogenital carcinoma was found on the vulva, perineum, scrotum, penis, perianal skin, and the anus. These patients were much younger and had in situ lesions. More than 40 % of these patients had a history of condyloma acuminata secondary to infection with HPV types 16 and 18. There have been many studies that have assessed the *de novo* cancer incidence in transplant patients, but, unfortunately, when the studies were initiated, the registry developed, and data collected, anal dysplasia and anal cancer were not in the data set although cervical and vulvar cancer may have been assessed.

8.4.3 Genital Dysplasia

An association between anal cancer and genital dysplasia/cancer has been recognized since the mid-part of the last century. In 1940, Gabriel reported that 3 of 29 women with anal cancer had associated malignancy of the uterine cervix [43]. Gabriel proposed that this finding was “suggestive of a similar tendency to

carcinoma in the epithelium of the cervix uteri and the anal region." In 1966, Cabrera et al. [44] presented a series of 64 anal carcinomas in the female; 11 had multiple primaries in the anogenital tract. The authors suggested "a more than casual relationship." In 1989, Scholefield et al. [45] prospectively studied the use of an endoscope in examination of the anal canal for the detection of premalignant lesions. The authors noted that the etiology of anal cancer and its association with a sexually transmissible agent bear strong similarities to the etiology of cervical cancer and that these similarities may reflect the common embryological origins of the anal and endocervical canals noting that "both are derived from the cloacogenic membrane." In 2003, Evans et al. [46] found that second primary cancers of the anus, vulva, and vagina were significantly increased after a diagnosis of either cervical intraepithelial neoplasia III or invasive cervical cancer. For anal cancer, the standardized incidence rates were 5.9 and 6.3 after a diagnosis of CINIII and cervical cancer, respectively. They concluded that these results supported the hypothesis that cancers of the cervix, anus, vulva, and vagina share common risk factors such as HPV.

8.4.4 Sexual Contact

Anoreceptive intercourse has been implicated in the pathogenesis of anal cancer. In 1979, Cooper and coworkers [47] described cloacogenic carcinoma of the anorectum in homosexual men. Reasoning (1) that cloacogenic carcinoma arises from the transitional zone epithelium and (2) that transitional zone epithelium is derived from the embryologic cloacogenic membrane as is the uterine cervix and vagina in the female, the authors questioned if there is an etiologic potential of receptive intercourse in the development of cloacogenic carcinoma. In 1989, Holly et al. [48] conducted a study of 126 patients with anal and rectal squamous cell carcinoma and 372 randomly selected control subjects. They found that the relative risk for cancer was elevated for men with a history of homosexual activity (RR = 12.4). In 1987, Daling and coworkers [49] found that in men, history of receptive anal intercourse was associated with the occurrence of anal cancer with a relative risk of 33:1. In 1997, Frisch et al. [35] conducted telephone interviews with women and men in whom invasive or in situ anal cancer was diagnosed. Multivariate analysis revealed statistically significant associations between measures of sexual promiscuity and the risk of anal cancer in both men and women. In women, receptive anal intercourse and venereal infections in the partner were associated with increased risk. Fifteen percent of men with anal cancer reported having homosexual contact.

8.4.5 Smoking

An association between anal cancer and smoking has been found. In 1999, Frisch et al. [50] compared patients with anal cancer in Denmark and Sweden with two control groups: subjects drawn at random from the central population and patients with adenocarcinoma of the rectum. They found that the risk of anal cancer was

high among premenopausal women who smoke tobacco compared with the risk for lifetime nonsmokers. The authors noted that the mucosa of the anal canal and the vagina derive from the cloaca. In a 2004 population-based case-control study of anal cancer, Daling et al. [51] found that current smokers among men and women were at particularly high risk for anal cancer independent of other risk factors. The authors proposed that current smoking likely has a promotional effect at late stages of disease progression.

8.4.6 Other Infections

In 2004, Sobhani et al. [52] studied patients with anal canal condyloma after curing their lesions. They checked for HIV and anal coinfection with syphilis, gonococci, Epstein–Barr virus, cytomegalovirus, herpes simplex, and HPV types and determined the incidence and effect of cumulative infections on anal carcinoma. They found that the risk of invasive carcinoma in HPV-infected patients is increased by HIV and anal coinfection.

8.5 HPV Pathogenesis

There is strong evidence that squamous intraepithelial neoplastic lesions precede the development of squamous cell carcinoma and that high-risk type HPV provides an environment that allows the development of dysplasia and cancer. In 1988, Fenger and Nielsen defined three grades based upon the extent of nuclear abnormalities following the system used to describe cervical intraepithelial neoplasia (Table 8.3) [53].

Figure 8.3 illustrates HPV pathogenesis. Following injury to the epithelial surface, the virus can infect the basal stem cell layer; a dysplastic cell population then expands from the basal layer to the surface. This figure includes synonymous nomenclatures reported in the literature.

Other terms used to describe dysplasia include high-grade and low-grade squamous intraepithelial lesions (HSIL/LSIL) and mild to severe dysplasia/carcinoma in situ. Condyloma acuminata or warts are graded at least low-grade dysplasia. Invasion through the basement membrane defines carcinoma [54, 55].

Table 8.3 Anal intraepithelial neoplasia grading according to Fenger and Nielsen

AIN1: nuclear abnormalities confined to the lower third of the epithelium
AIN2: nuclear abnormalities in the lower two thirds
AIN3: full thickness nuclear abnormalities

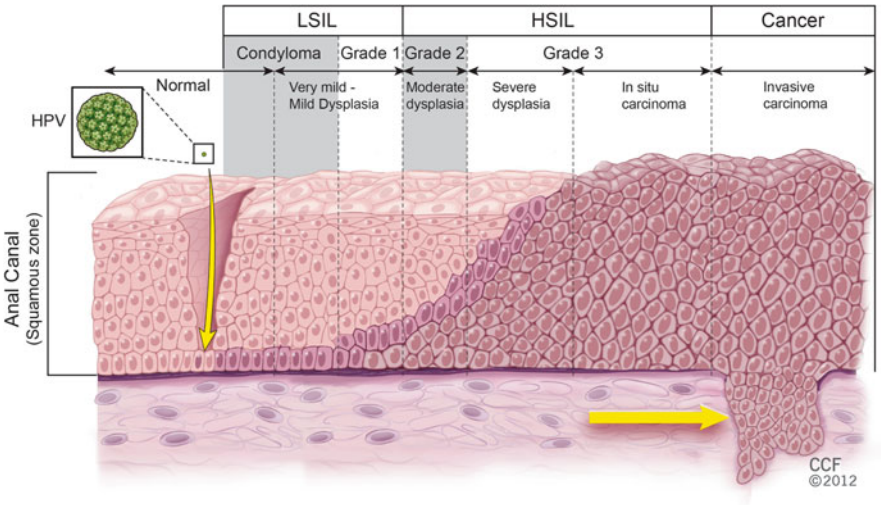

Fig. 8.3 Following HPV introduction into the basal layer of the squamous anoderm (*yellow arrow*), virally infected dysplastic cells migrate to the surface of the epithelium. Extension beneath the basement membrane (*horizontal arrow*) defines carcinoma (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2015. All Rights Reserved)

Table 8.4 The malignant transformation of anal dysplasia

Study	Year	*N* (type)	SCC	References
Scholefield	1994	27 AIN III	8/27 (29 %)	[56]
Sobhani	2004	199 HGD	7/199 (3.5 %)	[52]
Scholefield	2005	35 AIN III	3/35 (8.6 %)	[57]
Watson	2006	72 (AIN I-III)	8/72 (11.1 %)	[58]

AIN anal intraepithelial neoplasia, *HGD* high-grade dysplasia, *HGAIN* high-grade AIN

8.5.1 Risk of Malignant Transformation

Malignant transformation of high-grade anal dysplasia has been reported to be between 3.5 % and 29 % as seen in Table 8.4.

8.6 Clinical Practice

The management of anal warts and anal dysplasia begins with a disease-specific history and physical examination. Risk factors including history of HIV infection, anoreceptive intercourse, genital dysplasia, warts at other bodily locations, immunosuppression, sexually transmitted diseases, and smoking are documented.

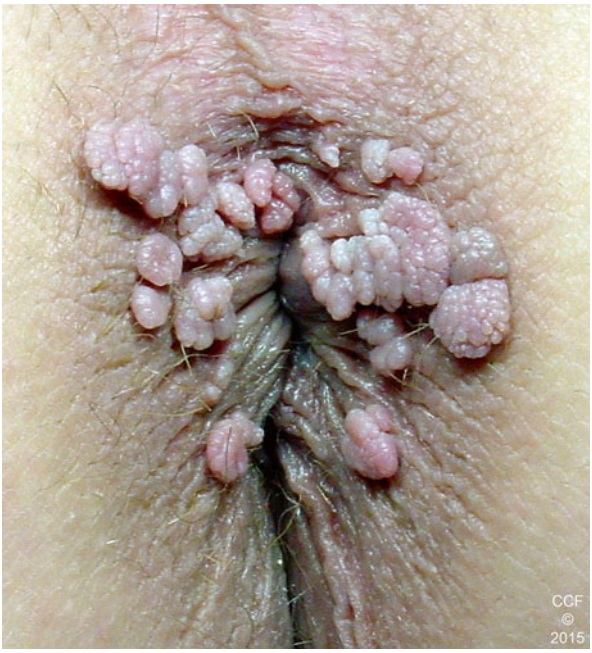

Fig. 8.4 Anal condyloma acuminata in the region of the corrugator cutis

Although examination is focused on the anus, the presence of condyloma in the oropharynx, skin, and genitalia is noted. Anal examination includes inspection and palpation of the perianal skin, circumferential palpation of the anal canal and rectal vault, and anoscopy. We routinely obtain specimens for anal HPV serotyping and anal cytology at the first visit. A typical example of perianal condyloma is shown in Fig. 8.4.

8.6.1 Human Papillomavirus Serotyping

Anal HPV serotyping is done using the *digene* HC2 High-Risk HPV DNA test, Qiagen™. The HC2 High-Risk HPV DNA test is an in vitro nucleic acid hybridization assay for the qualitative detection of thirteen high-risk types of human papillomavirus (HPV) DNA. The HPV types detected by the assay are the high-risk HPV types 16/18/31/33/35/39/45/51/52/56/58/59/68. The test does not determine the specific HPV type present [59].

8.6.2 Anal Cytology/Pap Smear

Anal cytology is interpreted according to the terminology proposed by the Bethesda system [60]. In 1997, Palefsky et al. [61] examined a total of 2958 anal examinations assessing anal cytology as a screening tool for anal SIL. The authors found

that the grade of disease on anal cytology did not always correspond to the histologic grade and concluded that anal cytology should be used in conjunction with histopathologic confirmation. A report by Scholefield et al. in 1998 [62] supported the use of anal cytology for diagnosis and follow-up of at risk individuals. In 2003, Friedlander et al. [63] blindly reviewed anorectal cytology specimens from 51 patients. Of these, 32 patients had anoscopic evaluation and 30 had histologic correlation. A 2005 report by Arain et al. [64] reported the cytomorphological features of 200 consecutive anal smears collected in liquid medium. Findings were correlated with results of surgical biopsies and/or repeat smears. The authors found that anal smears had a high sensitivity (98 %) for anal squamous intraepithelial lesions but a low specificity (50 %) for predicting the severity of the abnormality in a subsequent biopsy. A review of anorectal cytology by Bean and Chhieng in 2009 [65] found that sensitivity and specificity of a single anal–rectal cytology specimen are comparable with that of a single cervical cytology test, but that cytological interpretations do not always correlate with lesion severity.

8.6.3 Treatment of External Condyloma Acuminata

According to the 2010 Sexually Transmitted Diseases Treatment Guidelines [66], treatment is directed to the macroscopic (i.e., genital warts) or pathologic (i.e., precancerous) lesions caused by infection. As shown in Table 8.5, choice of therapy is based on lesion characteristics, patient preference, cost, convenience, adverse effects, and clinician experience [67].

8.6.3.1 Podophyllotoxin

Podophyllotoxin, also known as podofilox, is a natural product extracted from the rhizomes of Podophyllum plants [68]. The medication is self-applied twice a day for 3 days followed by 4 days without treatment. This be repeated for up to four cycles.

Table 8.5 CDC Recommended regimens for external genital warts

Patient applied
Podofilox 0.5 % solution or gel
Imiquimod 5 % cream
Sinecatechins 15 % ointment
Provider applied
Cryotherapy with liquid nitrogen or cryoprobe
Repeat applications every 1–2 weeks
Podophyllin resin 10–25 % in a compound tincture of benzoin
Trichloroacetic acid (TCA) or bichloroacetic acid (BCA) 80–90 %
Surgical removal either by tangential scissor excision, tangential shave excision, curettage, or electrosurgery

Centers for Disease Control and Prevention, Atlanta [71]. Genital warts. www.cdc.gov/std/treatment/2010/genital-warts.htm

8.6.3.2 Imiquimod

Imiquimod is an imidazoquinoline that possesses immunomodulating and antiviral activity [69]. Typically, imiquimod is applied once daily at bedtime, three times a week for up to 16 weeks [70]. The treatment area should be washed with soap and water 6–10 h after application [71].

8.6.3.3 Sinecatechins

Topical sinecatechins, extracted from green tea, have been used to treat external anogenital warts. In a randomized, double blind trial involving 502 patients, patients applied sinecatechins ointment three times daily for a maximum of 16 weeks [72].

8.6.3.4 Cryotherapy

Cryotherapy destroys warts by freezing. The procedure is usually done in the office setting using liquid nitrogen. Repeat applications may be done every 1–2 weeks. The technique has the advantage of being applicable to the treatment of warts in the pregnant female [73].

8.6.3.5 Trichloroacetic Acid

Trichloroacetic acid (TCA) is a strong acid [74] that precipitates protein. Topical application of TCA to genital warts can result in wart ablation [75].

8.6.3.6 Topical 5-FU

5-Fluorouracil is a pyrimidine analog that cases irreversible inhibition of thymidylate synthetase. It has been used topically to treat squamous cell carcinoma in situ (Bowen's disease) [76–78].

8.6.3.7 Side Effects

All treatment methods can cause pain, erythema, ulceration, and scarring. Sitz baths and anti-inflammatory analgesic medications are beneficial during the postoperative period. None of the above treatments are so effective that any one supercedes all others.

8.6.4 Surgical Ablation

Lesion identification and destruction has been achieved with a variety of methods. As shown in Figs. 8.5a–c, large lesions that are visible with the naked eye are most easily removed by excision.

Small lesions are detected either with magnification or by blind biopsy. In 1936, Hinselmann examined cervical tumors with magnification using a technique he named "Kolposcopie" [79]. In 1979, Strauss and Fazio [80] described the technique of "anal mapping" to determine the extent of Bowen's disease of the anal and perianal area. In 1989, Scholefield et al. [45] prospectively studied the use of an

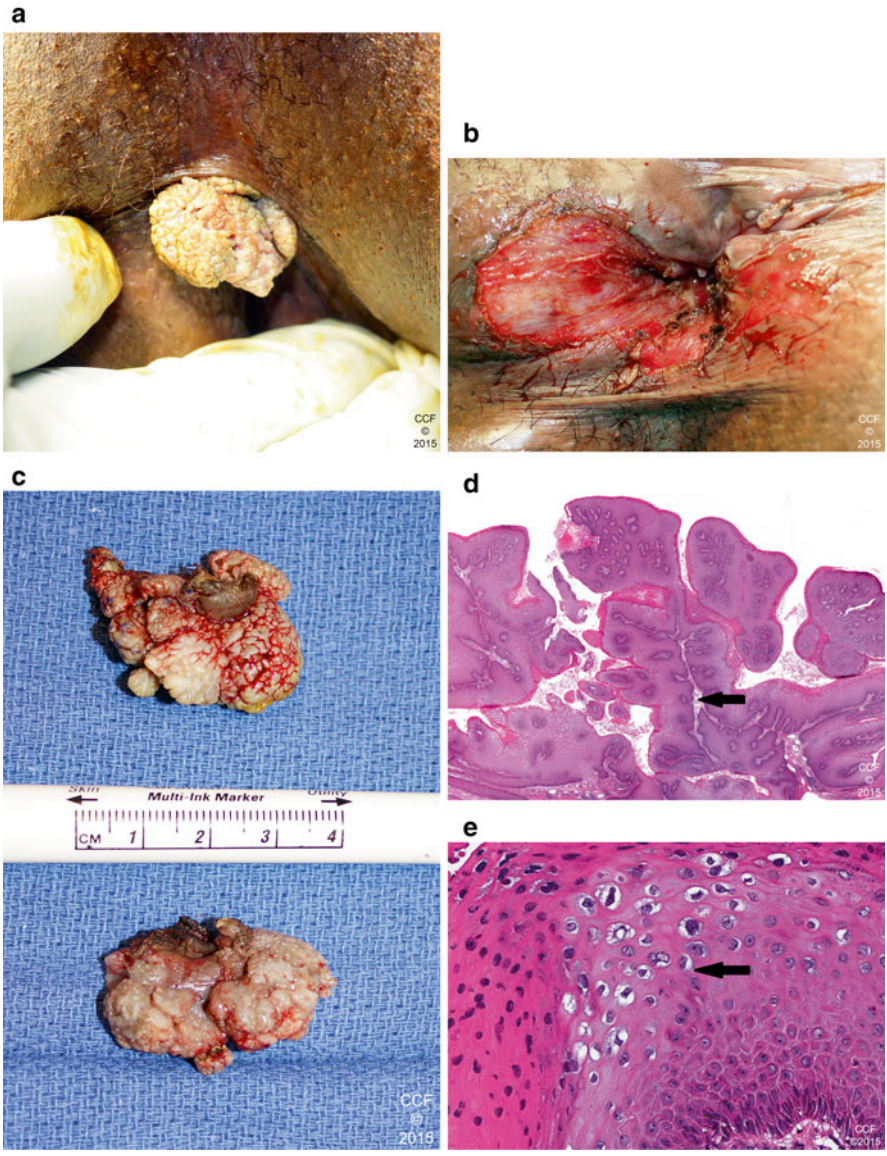

Fig. 8.5 (**a**) Large perianal condyloma. (**b**) Perianal skin following condyloma excision. The lesion is excised down to the dermis. Residual minute condyloma was ablated by electrocautery in this case. (**c**) Perianal condyloma following excision. (**d**) Low power views show a papillary squamous proliferation characterized by hyperplastic squamous epithelium with prominent fibrovascular cores (*arrow*) (H–E; original magnification ×10); (**e**) At high power, the surface epithelium shows areas of parakeratosis as well as a superficial layer of koilocytes (*arrow*; squamous cells with nuclear enlargement, hyperchromasia, irregular nuclear contours, and occasional binucleated forms) (H–E, original magnification ×200). The overall morphology is diagnostic of a condyloma

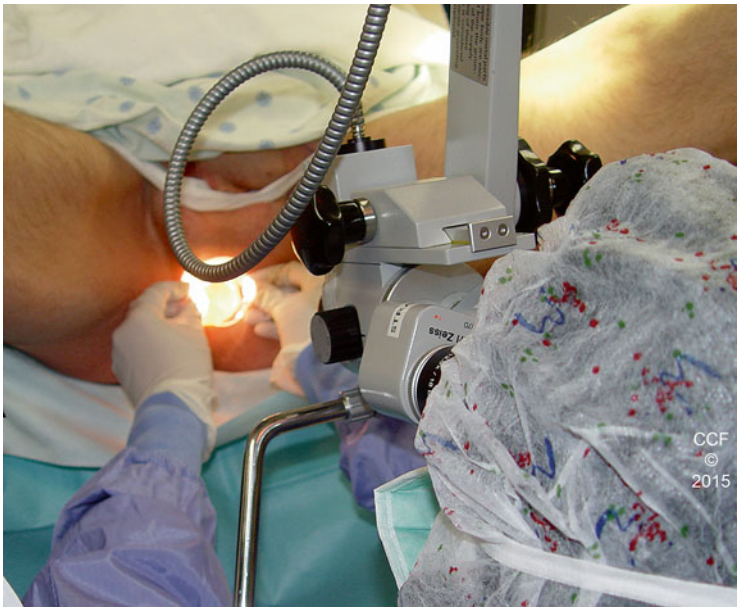

Fig. 8.6 High-resolution anoscopy: the anoderm is inspected with magnification using an operating colposcope through an anoscope with white light and green light following anoderm preparation with acetic acid and Lugol's iodine

"endoscope" (colposcope) to examine the anal canal for the detection of premalignant lesions. In 1997, Jay et al. [81] used a colposcope in conjunction with an anoscope to describe the appearance of anal squamous intraepithelial lesions and their relationship to histopathology. Anal colposcopy/high-resolution anoscopy (HRA) now is used widely for the detection of precancerous anal lesions (Fig. 8.6).

Figure 8.7 shows multiple raised lesions in the anal canal of a renal transplant patient. In Fig. 8.8a, a serpiginous lesion is seen with green light after anoderm treatment with dilute acetic acid and Lugol's iodine in an HIV-positive male. Lesion destruction by electrocautery is shown in Fig. 8.8b. Pathology showed HSIL (Fig. 8.8c, d). Figure 8.9 shows an ulcerated squamous cell carcinoma. Alternate energy sources used for lesion ablation include cryotherapy, infrared coagulation (IRC), and laser [82–84].

8.6.5 Photodynamic Therapy

Photodynamic therapy (PDT) is a two-step process involving the topical or systemic application of a photosensitizer followed by illumination of the treatment area with a nonthermal laser or non-laser light of a specific wavelength. The interaction of light with the drug results in the generation of singlet oxygen which leads to a local

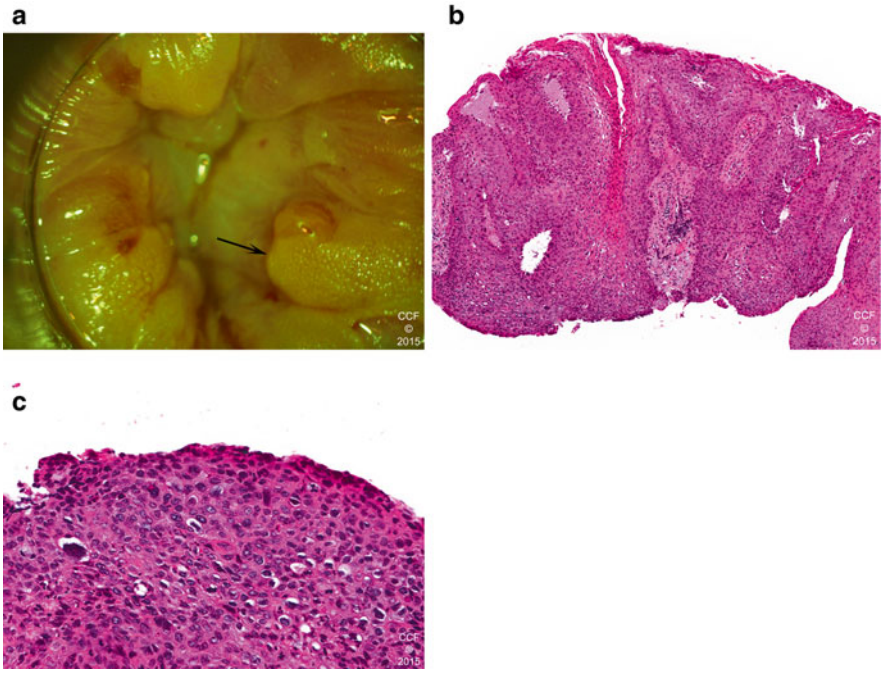

Fig. 8.7 (**a**) HRA: Multiple raised lesions seen under green light after treatment with acetic acid and iodine in a renal transplant recipient. Targeted biopsy of the 5 o'clock (*arrow*) lesion showed HSIL. (**b**) Biopsies of the left posterior anus show fragments of anal squamous mucosa with significant atypia involving the full thickness of the epithelium (H–E, original magnification ×40). (**c**) At higher power, there is overall loss of nuclear polarity (i.e., nuclei oriented in different directions) and significant nuclear atypia characterized by nuclear enlargement, hyperchromasia, and pleomorphism (H–E, original magnification ×200)

cytotoxic effect [85, 86]. Aminolevulinic acid is metabolized to protoporphyrin IX (PpIX) which tends to accumulate in malignant and premalignant cells [87]. The application of photodynamic therapy to treat anal dysplasia has been reported by Hamdan et al. [88].

8.6.6 Vaccines

A prerequisite for making vaccines is to know the structure of the molecule that is involved with immunity, that is, which epitopes can provoke the production of antibodies. There have been binding sites determined for the neutralizing antibody sites for HPV 6, 11, 16, 31, and 52. To date, the virus can be extracted from native tissue, but the whole virus has not been grown in tissue culture. Frazer and Zhou [89] developed an entity called VLPs-these are virus-like particles that are produced in plasmids and are able to self-assemble into a structure that is similar to native virion. The VLPs are composed of 72 pentamers of the L1 protein in association with 12 or

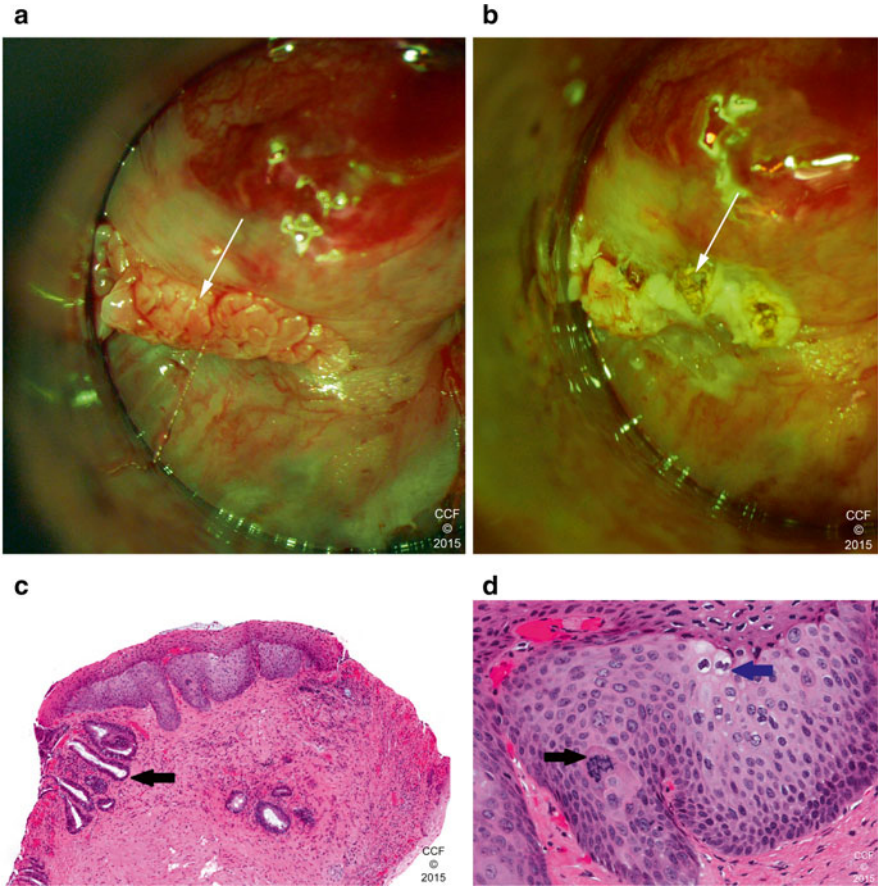

Fig. 8.8 (**a**) Raised anal lesion seen by HRA (*arrow*). (**b**) Lesion ablation with electrocautery. (**c**) The right lateral anal biopsies show fragments of anorectal mucosa (*black arrow* denotes adjacent colonic epithelium) with areas of parakeratosis along the superficial aspect of anal squamous mucosa (H–E, original magnification ×40); (**d**) HSIL. There is significant atypia along the basal aspects of the anal squamous mucosa, and several suprabasal mitotic figures are seen (*black arrow*). There does appear to be partial squamous maturation towards the surface, and scattered koilocytes are identified (*blue arrow*) (H–E, original magnification ×200)

more copies of the L2 protein. They can bind to conformation-dependent monoclonal antibodies. The VLPs also contain a minority population of unknown viral or cellular proteins/factors such as molecular chaperones and karyopherins that may influence the final structure. Papilloma-based gene transfer vectors are called pseudovirions (PsV) and these are self-assembled within transfected cells allowing the production of several billion units of virus per milliliter. Native virions are produced only in stratified and differentiated epithelia and are synthesized only during a natural infection or in a type of culture system called organotypic. The organotypic culture process uses "rafts" which allow for completion of the HPV life cycle. PsVs,

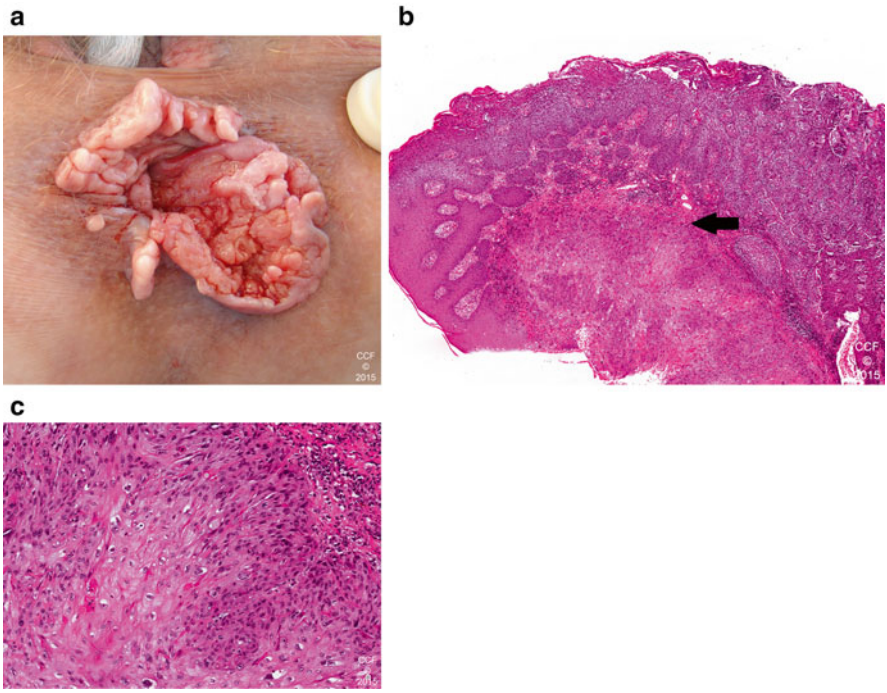

Fig. 8.9 (**a**) Gross appearance of the squamous cell carcinoma. (**b**) Low power view shows a polypoid squamous proliferation. At the arrow, there is an irregular, infiltrative appearing nest of squamous epithelium within the core of the biopsy (H–E, original magnification ×20). (**c**) At higher power, the infiltrative appearing area shows nests of squamous epithelium with prominent eosinophilia and an overall "glassy appearance," characteristic of the "paradoxical maturation" seen within areas of well-differentiated squamous cell carcinoma (H–E, original magnification ×200)

therefore, bypass the need for differentiating host tissue for viral assembly. A major problem in defining the structure of the virion was that insufficient virus was produced in organotypic culture; however, polymerase chain reaction and purification have made it possible to examine the viral life cycle.

VLPs are noninfectious and non-oncogenic, making them ideal candidates for use in HPV vaccine production. Suzich in 1995 [90] reported success with a canine model for L1 canine oral papillomavirus (COPV) grown in Sf9 insect cells in developing protection that was resistant to experimental challenge with COPV. The canine model showed that VLPs not only produced protection but that the IgG fraction of serum transferred this immunity to another animal. A vaccine called Gardasil developed by Merck was later approved by the Food and Drug Administration for use in women ages 9 to 26-this was the first vaccine designed to prevent cervical cancer. Cervarix was later produced by GlaxoSmithKline. These are now considered part of the routine vaccinations that are administered to women in the age group 9 to 26 and also to young men in the same age group.

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Anovaginal and Rectovaginal Fistula

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Evie Carchman and Brooke Gurland

Rectovaginal and anovaginal fistulas are abnormal epithelized connections between the vagina and either the rectum or the anus. This disease also includes fistulas that extend from the anal canal to the perineum. These fistulas account for approximately 5 % of anorectal fistulas. An accurate incidence of this disease process, which is directly related to socioeconomic status of the affected patient, is unknown [1]. This condition is horribly debilitating due to the uncontrolled passage of gas and stool through the vagina that leads to irritation, inflammation, dyspareunia, and increased risk of urinary tract infections and vaginal infections. As a consequence of the symptoms, there is a significant decrease in the patient's quality of life, with psychosocial and sexual dysfunction [2].

The main etiology of RVFs is obstetrical trauma (88 %) due to poor healing of the primary repair of a third- or fourth-degree perineal tear. This poor healing can be a consequence of inadequate repair, breakdown of repair, or infection. Beyond poor healing of repaired perineal tears, prolonged labor with necrosis of the rectovaginal spectrum can occur and lead to a rectovaginal fistula (RVF). Only 0.1 % of vaginal deliveries result in RVFs [3]. Other etiologies include congenital infection (tuberculosis and lymphogranuloma venereum), postoperative surgical complications (from complicated rectal or gynecologic surgery), inflammatory disease (i.e., Crohn's disease, Bartholin gland infection, cryptoglandular disease, and diverticular disease in the setting of previous hysterectomy), trauma, and rectal or gynecologic malignancies (especially if significant local extension or treated with radiotherapy). Rectovaginal fistulas occur in 0.2–2.1 % of patients with inflammatory bowel

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disease (especially Crohn's disease) and 10 % of patients undergoing low anterior resection with or without pouch [4]. Fistulas after low-stapled colorectal anastomoses are a consequence of either the vaginal wall becoming incorporated in the stapler or if an anastomotic leak leads to abscess formation that then drains into the vagina. Over the last decade, there has been an increase in RVFs that has been noted after hemorrhoid or pelvic floor surgery, especially in cases where staplers or foreign materials were used.

RVFs are classified according to their cause, location, and size. There is however no uniform classification system. This lack of standardized classification makes comparisons between treatment options inaccurate and difficult [5]. Using a size as criteria categorizes fistulas less than 2.5 cm in diameter as being considered small, while those greater than 2.5 cm are categorized as large. The location of the rectovaginal fistula can be described as it relates to rectum, vagina, and rectovaginal septum. In low fistulas, the rectal defect is at or below the dentate line. In high fistulas, the vaginal opening is at the level of the cervix. The location is important in determining the appropriate surgical approach as high fistulas are more easily accessed through an abdominal approach, where, on the other hand, mid to low fistulas are easily approached via the perineum [6]. RVFs are classified as simple if the fistula tract is low, secondary to infection or trauma, and can be repaired by local techniques. RVFs are considered complex if large, recurrent, high, or caused by inflammatory bowel disease. Complex RVFs usually have decreased blood supply, and therefore to provide the best chance for a successful repair, usually well-vascularized tissue needs to be transposed.

Surgical options include local repair (transanal, transvaginal, or transperineal), tissue transposition procedures (gracilis muscle or labial fat), and transabdominal repair. There is no standard of care treatment option for patients with a RVF. This makes patient selection a major key factor in achieving operative success. The choice of surgical option varies according to the location of the fistula, the etiology, the experience of the surgeon, and the presence of a sphincter defect. The timing of the repair is also important along with appropriate anatomic dissection and repair, a total excision of the fistula tract, and adequate tissue approximation without significant tension.

There have been several factors that have been identified to increase the risk of poor healing after RVF repair. The reasons for postoperative complications are infection, tension, local fibrosis/scarring, and ischemia. On multivariate analysis in one study, obesity was associated with significant lower healing rates for repairs in patients with obstetric and cryptoglandular RVFs [2]. The number of previous repairs is also associated with decrease healing in several studies [2, 7–9]. Lowry et al. report a success rate of 88 % in patient who underwent a primary repair of an RVF, which declined after two previous repairs to 55 % [8]. This decrease in healing is likely a consequence of poor blood supply due to scarring and inflammation. Smoking and the presence of Crohn's disease are also associated with a higher chance of failure [10]. The recurrence rates published by Watson et al. for the various surgical approaches were 12 % for transanal advancement flap, 11 % for transvaginal repair, 3 % for perineoproctomy, and 0 % for overlapping sphincteroplasty [11].

9.1 History and Physical

Taking a good history is important in diagnosis of a RVF and also to determine the etiology of the fistula. Symptom severity depends on the size and the location of the fistula. The most common presenting symptoms are the passage of flatus or stool through the vagina. Patients may also complain of recurrent urinary tract infections or vaginitis. Symptoms common to abscesses due to cryptoglandular disease include slow, gradual onset of pain/pressure, fevers, intermittent or persistent purulent drainage, pain on defecation, and urinary retention. About 20–30 % of patients with a RVF will give a history of previous anorectal abscess [12]. Questions regarding intestinal symptoms are important to determine the presence of inflammatory bowel disease. History of anorectal procedures and fecal incontinence should be obtained. Finally, a full gynecologic and obstetric history should be documented including history of malignancy, radiation, pelvic surgery, number and methods of deliveries, prolonged labor, episiotomy, tears/repairs, and use of forceps.

A thorough physical examination with a focus on the anorectal and genital exam is also very important in terms of diagnosis and plans for treatment. Using anoscopy, inspection, and palpation, one can define most of the characteristics of the fistula and the integrity of the surrounding tissue. On vaginal examination, there may be visible stool or signs of inflammation. One may gently probe the fistula with a fistula probe making sure not to create a false passage. If suspected undiagnosed malignancy is present, biopsy of the fistula should be performed. Assessment of the anal sphincter integrity should also be performed to help with surgical planning. The presence of perineal descent and internal intussusception should be determined which is useful when considering a rectal advancement flap.

Sigmoidoscopy should be carried out on all patients with anorectal and rectovaginal fistulas to identify the presence of associated pathology such as neoplasm, inflammatory bowel disease, or associated secondary tracts. Findings on sigmoidoscopy may indicate the need for a full colonoscopy. Anorectal manometry may be desired in select cases to obtain an objective assessment of the anorectal sphincter. Manometry can identify patients who are at high risk for postoperative incontinence. It can also be useful in patients with a suspected or known sphincter defect when it is suspected that the patient will need a substantial portion of their external sphincter divided for fistula care.

In view of the multiple surgical options, it is important to distinguish between high and low fistulas. Low fistulas can be repaired via an anal, perineal, or vaginal approach. Therefore, it is very important to delineate the anatomy, which can be assisted with the use of certain diagnostic tests. Some diagnostic tests that may be desired are a fistulogram, anorectal ultrasound, or magnetic resonance imaging (MRI). Evaluating the tract using a fistulogram involves cannulating the external opening with a small catheter and injecting contrast material under pressure, while X-rays are taken from several different angles. Fistulograms may be helpful in complex fistulas to define the anatomic relationships and guide surgical management. A fistulogram may be indicated in patients with recurrent fistulas or when prior procedures have failed to identify the internal opening [13]. However, one study

done by Kuijpers et al. demonstrated that the results from fistulograms were unreliable compared to operative findings and a high incidence of false positive results [14]. A simpler test that just confirms the diagnosis of RVF without delineation of anatomy is a test when a tampon is placed in the vagina, and then a methylene blue enema is given. The tampon is removed 15–20 min later. If there is no staining of the tampon, the diagnosis of RVF is unlikely.

For more proximal or high fistulas, a barium enema may be helpful. Anorectal ultrasound is another diagnostic test that may be helpful to define muscular anatomy of the anal sphincters in relation to the fistula and also to determine if a sphincter defect is present and the magnitude of the defect. Obstetric injury-related RVFs are often found in conjunction with sphincter defects and fecal incontinence. On ultrasound, the fistula tract appears as a hypoechoic defect. The use of hydrogen peroxide injection into the fistula can enhance the imaging of the fistula and is more accurate than conventional transanal ultrasound [15]. MRI using surface and body coils is useful in the evaluation of recto and anovaginal fistulas. The use of a gadolinium enema greatly enhances the T2-weighted images and improves lesion identification [16]. Several studies have demonstrated a high concordance (85 %) between MRI results and operative findings compared to only 65 % concordance between endosonography and operative findings [17, 18].

9.2 Treatment

Treatment options include medical therapy, advancement flaps, overlapping sphincteroplasty, episoproctomy, sleeve or ileal pouch advancement, plugs, pull-through coloanal anastomosis, rectal resection with anastomosis (laparoscopic or open), and the interposition of tissue (omentum or muscle flap).

A small group of patients with RVFs respond to medical optimization. This is usually accomplished with regulating stool consistency (minimizing diarrhea). This makes the fistula less symptomatic and in some patients with RVFs related to obstetric origin may allow time for the fistula to heal without surgical intervention.

For those who fail conservative management, timing for operative intervention is extremely important in terms of improving odds for surgical success. The timing of surgical intervention is dictated by the resolution of inflammation and/or infection. Many would recommend waiting 3–6 months after the inflammatory response has resolved.

For simple rectovaginal fistulas, transanal or transvaginal advancement flaps may be performed. This is the most commonly reported and utilized technique for repair. During this procedure, the fistula is debrided and the rectovaginal septum is reapproximated, which covers the defect with a vascularized mucosal flap either in the vagina or rectal wall. A systematic review found little difference in the healing rates after either transanal or transvaginal approaches [19]. The transvaginal approach is likely preferable in patients with Crohn's disease where they have disease in the rectum. For a transanal approach, a flap is created that includes mucosa, submucosa, and some circular muscle. This flap is placed over the reapproximated

rectovaginal septum. In constructing the flap, the base should be at least 2–3 times the width of the apex to maintain a well-vascularized flap that should be mobilized 4–5 cm proximal to the fistula defect to prevent tension. Success rates with this technique range from 29 % to 100 %. The large range of success is likely a consequence of surgical technique and appropriate patient selection [20]. There have been some series that have looked at the efficacy of this procedure in patients with complex anorectal fistulas. In one small series, they concluded that endorectal advancement flap closed most complex anorectal fistulas with a low recurrence rate. However, they noted that recurrent rectovaginal fistulas were associated with a lower closure rate [21]. With improvements in medical management, these local flaps have improved success in difficult cases such as Crohn's fistulas. For patients with pouch vaginal fistulas, an ileal pouch mucosal advancement flap is also a reasonable option. There does not appear to be any advantage for diversion surgically after such repairs [10, 22].

Overlapping sphincteroplasty is a well-established transperineal approach for the treatment of rectovaginal fistulas in patients with a sphincter defect (usually from obstetric injuries) (Fig. 9.1). The technique involves placing the patient in Kraske position and making a curvilinear incision in the rectovaginal septum (Fig. 9.2). The two ends of the sphincter muscle are identified and divided. The rectovaginal fistula is debrided (Figs. 9.3 and 9.4). The two ends of the sphincter muscles are then overlapped and sutured in place with 3.0 PDS in a mattress fashion (Figs. 9.5, 9.6, and 9.7). The vaginal and the rectal sides of the fistula are closed with absorbable sutures, and then the skin is closed partially leaving an area open for drainage (Fig. 9.8). The advantages of this procedure are that it is straightforward, improves continence, and has good healing rates [23]. Depending on the complexity of the repair and concerns for healing, some surgeons will divert these patients with a temporary stoma to prevent the passage of stool over the repair. There has been no data to date that demonstrates that this improves healing rates after a sphincteroplasty.

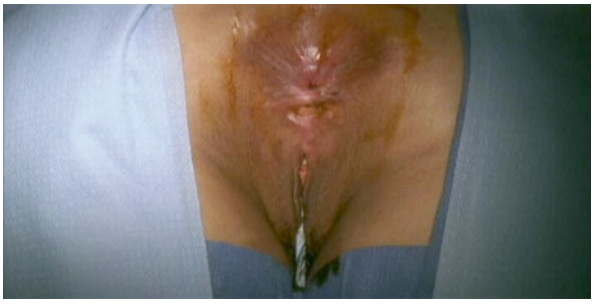

Fig. 9.1 This is an image of the patient in the prone position with a foley catheter in place. In this picture you can see the perineal fistula between the vagina inferiorly and the anus superiorly. On digital rectal examination, one is also able to identify a low rectovaginal fistula that connects directly to the visible perineal fistula

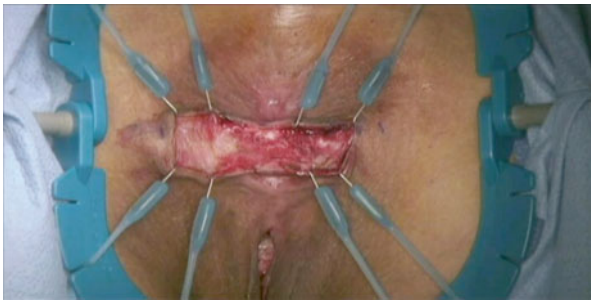

Fig. 9.2 This image demonstrates the Lone-star retractor in place with a curvilinear incision made in the perineal body posterior to the perineal fistula

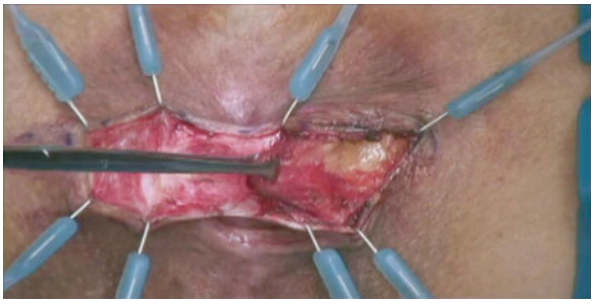

Fig. 9.3 The edges of the external sphincter muscle are identified and Alice clamps placed on the muscle to help apply appropriate counter traction to aid in the mobilization of the muscle. This mobilization allows for a tension-free repair. You can see in this picture that the right external sphincter muscle is being mobilized with evidence of ischiorectal fat laterally

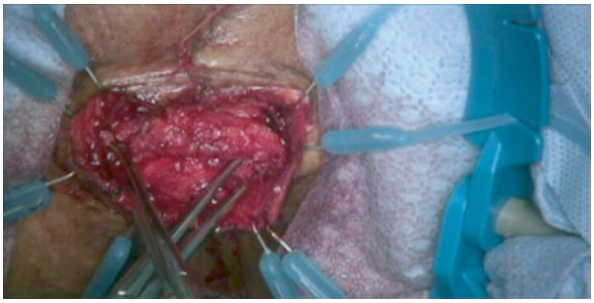

Fig. 9.4 In this image both edges of the sphincter muscle have been completely mobilized and the intervening scar tissue that was connecting the two edges of muscle has been sharply transected (but not excised). Superiorly the rectal side of the rectovaginal fistula is now closed with two layers of 3-0 vicryl

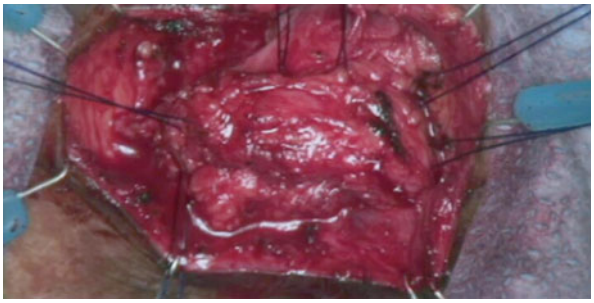

Fig. 9.5 In this image the Alice clamps are seen on the ends of the mobilized external sphincter muscle, the amount of overlap that can be obtained with appropriate mobilization is seen

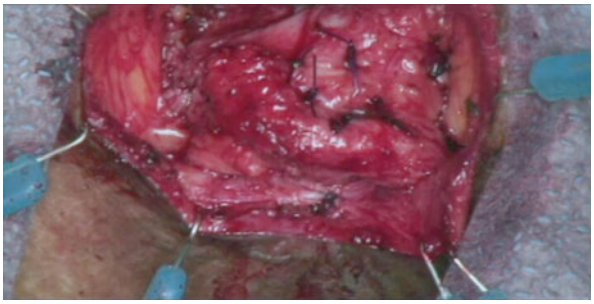

Fig. 9.6 Interrupted sutures are utilized in a vertical mattress fashion to fix the two freed edges of external sphincter muscle in their overlapped orientation

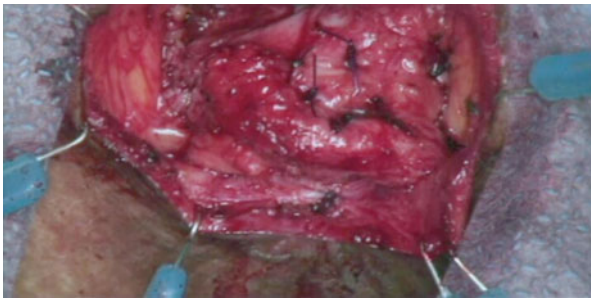

Fig. 9.7 Demonstration of the final overlap of external sphincter with the sutures in place. After tying down the sutures, it is essential to make sure that the closure is not too tight by placing either a finger or a small Hill-Ferguson retractor within the anus

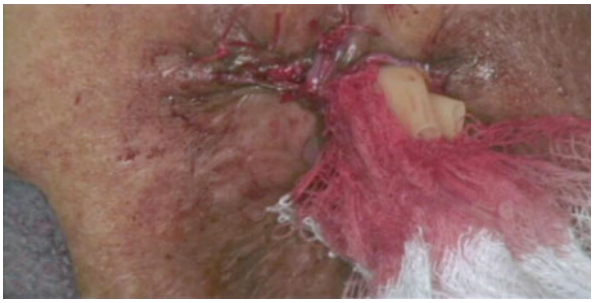

Fig. 9.8 After completion of the sphincteroplasty, the skin is closed with vertical mattress sutures. The middle of the wound is left open and a small non suction drain placed to prevent fluid accumulation. In this picture a 4×4 gauze has been sutured to the drain to help with drain removal

9.3 Case 1

A 54-year-old female suffered from a rectovaginal fistula after an obstetric injury. She had already undergone a transanal and a transvaginal fistula repair; both failed. She currently had a complex rectovaginal fistula with also a fistula in the perineum that connects to the rectovaginal fistula (Fig. 9.1). On exam she had a sphincter defect that was confirmed on endoanal ultrasound. She also had preoperative manometry that demonstrated good resting and squeeze pressures.

The patient underwent preoperative bowel preparation and received preoperative antibiotics. A Foley was placed in the operating room. She was placed in a prone position and her buttocks were taped apart. A curvilinear incision was made in rectovaginal septum posterior to the perineal fistula. The lone star retractor was utilized for exposure (Fig. 9.2).

The sphincter complex was dissected bilaterally; again, a large anterior sphincter defect was identified. An Alice clamp grasped the right side of the sphincter complex to facilitate retract to allow for adequate mobilization of the sphincter muscles (Fig. 9.3).

The sphincter muscles were dissected and mobilized bilaterally, and the central scar was divided sharply. Both ends of the sphincter muscles are grasped with Alice clamps. The rectal side of the rectovaginal fistula has been closed in two layers with 3-0 Vicryl in an interrupted fashion (Fig. 9.4).

The gynecologist preferred the patient in lithotomy position and performed a vaginoplasty, excised the perineal and vaginal fistula, and then did a two-layered closure of the vagina and reconstructed the perineal body. Using the Alice clamps, the ends of the sphincter muscles are overlapped. This overlap provides a tissue barrier between the vaginal and rectal repair and provides bulk to the perineal body (Fig. 9.5).

The two overlapped sphincter muscles are then sutured together with interrupted 3-0 PDS in a mattress fashion (Fig. 9.6).

The completed overlapping sphincteroplasty is seen in Fig. 9.7. A small Hill-Ferguson retractor is placed in the anus to confirm that the repair is not too tight.

The skin is then closed with vertical mattress 3-0 Vicryl sutures (Fig. 9.8). The middle of the wound is left open with a Penrose drain placed and in this case is sutured to a 4×4 gauze to facilitate its removal. The patient also had vaginal packing placed by the gynecologist for their repair. The patient was admitted overnight and given oral pain medications and a regular diet. The following day, the vaginal packing and the Penrose were removed. After the removal of the packing, the patient's Foley was removed and she was able to void and she was discharged to home.

Others have described surgical repair of obstetric injuries as an episioproctotomy or perineoproctectomy with layered closure. This surgical procedure, like the overlapping sphincteroplasty, offers a simultaneous repair of the sphincter complex. This procedure is more extensive than an advancement flap and requires the division of the perineal tissue. This procedure is indicated when there is a significant anterior sphincter defect, when there is a substantial injury to the perineal body, or when a large rectovaginal septum defect exists. Patients are placed in the Kraske position, and a probe is placed through the fistula. The tissue overlying the fistula is divided creating a fourth-degree perineal laceration. The sphincter edges are then dissected free. The rectal mucosa is closed, followed by an overlapping sphincter repair. Finally, the vaginal mucosa and the perineal skin are closed. The healing rates are equivalent to a rectal advancement flap and allow for improvement in continence [24]. Some surgeons feel that episioproctotomy should be considered first-line treatment in patients with a fistula and compromise of the anterior sphincter complex [25]. Just as with an overlapping sphincter repair, a diverting stoma should be considered in select cases with no data to support their use.

Simple fistulotomy is a surgical option in very low anovaginal fistulas. But extensive consideration needs to be given to the risk of incontinence. For any anovaginal fistula that is not superficial in nature, the risk of significant incontinence makes this procedure undesirable.

Other treatment options for simple rectovaginal fistulas include the use of a bioabsorbable fistula plugs and fibrin glue. These techniques are used to attempt to prevent radical surgery. With regard to fistula plugs based on experience, the outcomes are similar to advancement flap repair [26]. However, in cases of complex fistulas, the success rate is only moderate—44 % in one series [27]. Just as any other fistula repair procedure, a fistula plug is performed after local sepsis has been controlled. Currently, two different bioabsorbable plugs are commercially available. One is of xenogeneic origin (Cook Biodesign™) and the other is a synthetic absorbable plug which has a disc and 6 tails (Gore fistula plug™). For the procedure itself, the plug is placed through the fistula tract and excess plug is excised. The head or disc of the plug is then sutured in place with absorbable suture on the rectal side in figure-of-eight fashion, and the vaginal side is left open to allow for drainage. Similarly, the use of fibrin glue can be used. There are only a couple of small case series examining the use of fibrin glue, some of these demonstrating promising results, while others demonstrate low success rates [28, 29]. These local procedures

tend to work best in fistula tracts that are long (which is usually not the case in rectovaginal fistula). However, given the low morbidity and the ease of the procedure, it is not an unreasonable first-line treatment for patients with rectovaginal fistulas.

Like the fistula plug, another procedure that was designed for anal fistulas and then trialed in patients with rectovaginal fistulas is the ligation of intersphincteric fistula tract (LIFT) procedure [6]. This procedure entails dissecting in the intersphincteric plane around the fistula, which is isolated and then ligated. The rectal opening is then closed, and the vaginal opening may be closed or left open to drain. No muscle is cut during this procedure, so there is little to no risk of incontinence. There are several studies on the use of this sphincter-sparing technique for anal fistulas but just case reports for rectovaginal fistulas, so there are no studies to compare the LIFT procedure to other surgical procedures in this disease process.

Sleeve advancement flap may be a useful treatment in patients with severe perianal Crohn's disease. There is a small published case series from the Cleveland Clinic where they performed advancement sleeve flap in 13 Crohn's patients for severe fistulas disease, several with rectovaginal fistulas. In these 13 patients, they achieved successful healing in eight of the patients [30]. Another series from the Cleveland Clinic on patients with recurrent rectovaginal fistulas performed several different types of repairs from local repairs to pull-through coloanal anastomoses. The rectal sleeve advancement flap was performed in three patients. They state that the procedure is suitable for patients with more extensive scarring or anal stenosis. For this procedure, the mucosa and the submucosa are mobilized circumferentially from the dentate line to several centimeters proximally. Then, the dissection becomes full thickness up to the levator space. This extensive mobilization allows for the rectum to be advanced past the fistula to the anal canal without undue tension [31]. Ileal pouch advancement is the equivalent procedure for those patients with ileal pouches and pouch vaginal fistulas. Diversion with a stoma should be considered in these cases given that this is an anastomosis and with that comes a risk of anastomotic leak complications. Diversion should be used selectively based on patient comorbidities and the quality of the tissue that is being approximated.

Turnbull-Cutait proctectomy with coloanal anastomosis is another option for repair of complex rectovaginal fistulas. This two-stage procedure includes a proctectomy, excision of fistula, mobilization of the abdominal colon, and pull-through of the colon through the anus during the first stage. Some suggest rotating the colon slightly when you are pulling it through the anus so that the mesentery lays over the vaginal defect. Before pulling the colon through the anus, sutures are placed to allow for the anastomosis to be completed at a later date (making sure to take a bite of the internal sphincter). A drain is left in the pelvis, a loop ileostomy is created, and the colon is left unanastomosed externally for 5 days. This delay allows for adherence between the colon and the anal canal. The patient is taken back to the operating room, the exteriorized colon excised, and cut end checked for viability. The coloanal anastomosis is completed with the already placed sutures. This procedure is preferred over an immediate anastomosis in patients with a reoperated, irradiated pelvis with chronic inflammation or infection, persistent rectovaginal or rectourethral fistula, and complex perianal fistula [32]. This is obviously an

extensive procedure for the treatment of rectovaginal fistula, but in some patients is the only option available besides permanent diversion. Functional outcomes after this procedure are the same compared to other coloanal anastomoses.

For complex rectovaginal fistulas, attempts at local repair, as described above, are associated with significant rate of failure and for high rectovaginal fistulas are technically difficult. For these fistulas, long-term success usually requires abdominal resection and/or the interposition of healthy tissue. For abdominal procedures, a low anterior resection allows for excision of the diseased segment that contains the fistula (this can be done laparoscopically or open). If the tissues surrounding the rectum and the vagina are normal, then one may dissect in the rectovaginal septum and perform a simple closure of the fistula in several layers instead of performing a bowel resection. In those cases where one decides to primarily close the fistula, it is recommended to perform an omentoplasty to provide a healthy tissue barrier between the repair vagina and rectum. There are only a couple studies examining laparoscopic resection of high rectovaginal fistulas with the use of a pedicle of omentum between the anastomosis and the vaginal repair demonstrating high healing rates and minimal complications [33–36]. This well-vascularized interposed tissue decreases the risk of fistula recurrence. For those patient undergoing a resection for repair of the fistula, indications for diversion with stoma are the same as those patients undergoing any elective rectal resection—patient comorbidities, tissue quality and confidence in good vascularity, and lack of tension in the colon that is being brought down for the anastomosis.

However, one must examine the risk benefit ratio of utilizing an extensive abdominal procedure in a high-risk patient. For those high-risk patients, a perineal approach and the interposition of healthy tissue may decrease the risks of the surgical intervention. There are several tissue options for tissue interposition such as omentum, labial fat pad, bulbocavernosus muscle, rectus flap, sartorius flap, gracilis flap, gluteal muscle flap, or bioprosthetic material. There have been several studies looking at the use of gracilis muscle flaps in complex fistulas. A study by Troja et al. found that with complicated recurrent rectovaginal fistulas, the use of a gracilis flap resulted in 70 % success rate; however, the recurrence rate was noted to be 40 % [37]. Sartorius, gluteal, and rectus flaps work in a similar fashion, providing well-vascularized tissue in the rectovaginal septum to decrease recurrence of the fistula.

The Martius or bulbocavernosus muscle flap is another local muscle flap. For this procedure, the rectum is closed in layers, and then a longitudinal incision is made in the labia majora to dissect out the bulbocavernosus muscle and its adjacent labial fat pad. The muscle as its associated fat is then tunneled underneath the labia minora and sutured over the repaired fistula defect (Fig. 9.9). There are several series that have examined the healing rates after a Martius flap and have found healing rates greater than 90 % [38, 39]. In terms of the use of bioprosthetics, there are some institutions that have used a collagen matrix in the rectovaginal septum for tissue interposition. One small case series by Gottegens et al. utilized the collagen matrix in patients with history of previous RVF repair and found that in 9 of their 12 patients, they were able to obtain healing at 3 months [40]. Larger studies, comparison studies, and long-term results are needed with this new technique.

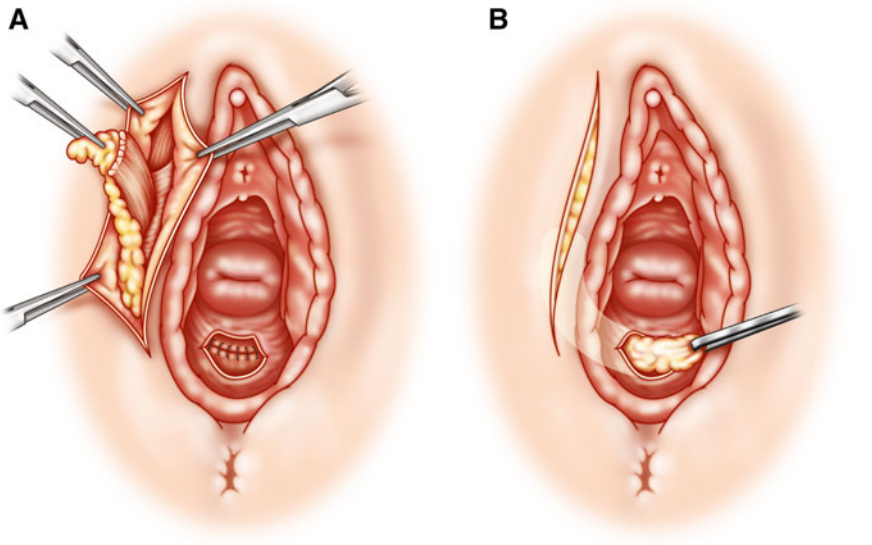

Fig. 9.9 The Martius or bulbocavernosus muscle flap is a local muscle flap in which the rectum in closed in layers and then a longitudinal incision is made in the labia majora to dissect out the bulbocavernosus muscle and its adjacent labial fat pad

The creation of a stoma (either end or loop colostomy or ileostomy) decreases the symptoms related to the fistula without definitive repair of the fistula. This can be utilized as a temporizing measure to allow for time for the inflammation of the fistula to resolve prior to performing a repair under more ideal circumstances. On the other hand, this can be the only planned surgical intervention in patients with significant comorbidities who are requesting the resolution of their symptoms.

Proctectomy is the most extreme surgical treatment for rectovaginal fistulas. Here, the patient has his/her rectum and anus removed and a permanent stoma created. This procedure is usually indicated in refractory rectovaginal fistulas related to Crohn's disease. This procedure is only appropriate if the patient can tolerate a large operation physiologically.

9.4 Conclusion

Rectovaginal fistula is a debilitating problem for the women that it affects. It is also a complex problem for the surgeons that treat these patients. The large number of surgical techniques that are described to treat this disease points to the fact that there is no one standard of care operation for this problem. To achieve optimal results, one needs to tailor the operative plan to each individual patient, their specific fistula, their anatomy, and the underlying disease process. Because of the multiple factors that come into play in the surgical treatment of rectovaginal fistulas, there still

remains a fairly high recurrence rate. Recurrence rates can be minimized with good patient selection, careful consideration of surgical options, good surgical technique, and patience on the part of both the patient and the treating surgeon.

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Hemorrhoids: Anatomy, Physiology, Concerns, and Treatments

10

Ohmar Coughlin and Michael Page

Hemorrhoids are one of the most common ailments affecting civilization throughout history. It is reported that Hippocrates may have used the Greek words *haema* meaning blood and *rhoos* meaning flowing to first define the term "hemorrhoid" around 400 BC. St. Fiacre, the patron saint of hemorrhoids, was reportedly named so after his hemorrhoids were cured while sitting on a stone in deep prayer during the seventh century [1]. The emperor Napoleon was also affected by hemorrhoids during the battle of Waterloo, and US President Jimmie Carter took time away from the presidency with a hemorrhoidal flare. Currently, the reported prevalence of hemorrhoids in the United States is 4.4 % and appears to peak between the ages of 45 and 65. Previous publications have suggested that Caucasians of higher socioeconomic class exhibit a higher incidence of hemorrhoidal complaints. This is thought to be related to dietary practices [2]. In reality, most patients who experience anal pain, itching, or bleeding are referred for treatment for "hemorrhoids" although they are often found not to be the case.

Multiple factors can contribute to hemorrhoidal disease including: constipation, increased intra-abdominal pressure, prolonged sitting on the toilet, and a weakened pelvic floor. It is important to understand that in the normal state, hemorrhoids are normal structures in the anal canal. They serve to aid in continence as well as protection of the underlying anal sphincter. Hemorrhoids are vascular cushions within the submucosa of the anal canal. These cushions contain blood vessels, elastic and connective tissues, and smooth muscle. The arterial supply to the distal rectum and hemorrhoids is derived from the terminal branches of the superior rectal (hemorrhoidal) artery. Anatomically, the rectal arteries bifurcate around the distal rectum

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and enter the submucosa above the dentate line where they begin their course along the anal canal. The right hemorrhoidal artery will typically divide again providing the classic description of three hemorrhoidal complexes—left lateral, right anterior, and right posterior.

The blood vessels within the hemorrhoid are more sinusoidal and typically lack a muscular wall—this makes them relatively weak. With time and repeated engorgement, they can become thin and subject to tearing with resulting bleeding. Arterial hemorrhoid bleeding is the most common presenting symptom. Both pH studies and the complaints of "bright red blood" filling the toilet have proven this to be the case. Hemorrhoid cushions are supported in place by the muscles of Treitz. These small muscles arising within the inter-sphincteric space are derived from fibers of both the bowel wall and the levator ani muscle. These supporting muscle fibers cross the internal sphincter to support the hemorrhoidal complex. During defecation, increased intra-abdominal pressure engorges the hemorrhoidal vessels. As they enlarge they are held in place by the muscles of Treitz to prevent prolapse and allow return to their normal configuration after defecation. It is thought that repeated increases in intra-abdominal pressure lead to stretch damage of the muscle and result in prolapse and enlargement of the vascular cushion [3, 4].

Hemorrhoids can be internal, external, or mixed. Internal hemorrhoids are typically associated with a history of constipation, sitting, and straining on the toilet. Most patients present with painless bleeding either into the toilet or on the toilet paper. As internal hemorrhoids progress, they can prolapse and cause perianal irritation and itching. Classic staging for internal hemorrhoids is described below. Treatment options vary according to hemorrhoid stage.

- Stage 1—Bleeding, no prolapse
- Stage 2—Bleeding with prolapse but spontaneous reduction
- Stage 3—Bleeding with prolapse requiring manual reduction
- Stage 4—Bleeding with inability to reduce the prolapse

External hemorrhoids are usually asymptomatic and often confused with external skin tags (Fig. 10.1). Patients will frequently present with complaints of perianal irritation or itching usually associated with difficulty cleaning their backside. Additionally, patients can develop a thrombosed external hemorrhoid presenting as an acute, painful lump in the perianal area. This typically occurs in the setting of prolonged sitting with travel, on the toilet, or on pregnancy. There is no definitive evidence to suggest that the presence of external hemorrhoids or skin tags increases the risk of developing an acute thrombosed hemorrhoid.

Mixed hemorrhoids are both internal and external hemorrhoids within the same presentation (Fig. 10.2). Patients will experience symptoms involving both components that can include prolapse, bleeding, pruritus, and leakage. It should be noted that hemorrhoids are neither precursors nor risk factors for cancer. Additionally, spicy foods will not exacerbate hemorrhoidal symptoms or irritation.

By combining a simple understanding of the pathophysiology of hemorrhoid disease with a clear knowledge of the anatomy and physiology of the anal canal, we will find that hemorrhoids of all types can be treated with relative success.

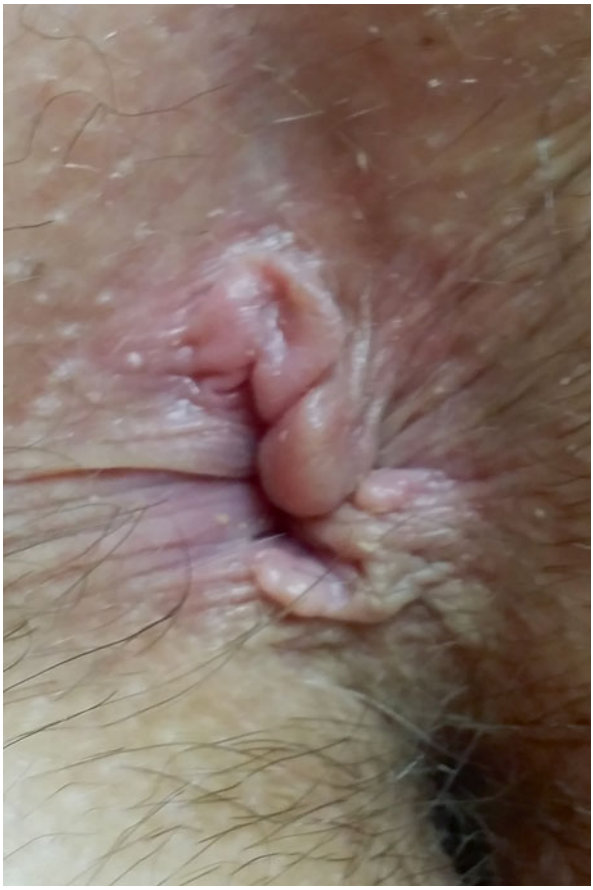

Fig. 10.1 External hemorrhoid and skin tag

10.1 Case 1: Grade 1 Internal Hemorrhoids

10.1.1 Presentation

A 30-year-old man presents with complaint of intermittent anal bleeding. He relates occasional bright red blood staining his toilet paper after wiping. He denies pain or tenderness. He denies any change in his bowel habits. When asked about his diet, he describes fast-food meals and snacks. He admits to playing games on his iPad during bowel movements.

10.1.2 Examination

He presents with a normal external anal opening. Upon rectal examination, columnar fullness is appreciated in the left lateral position. Anoscopy reveals prominent columnar engorgement above the dentate line circumferentially. No evidence of

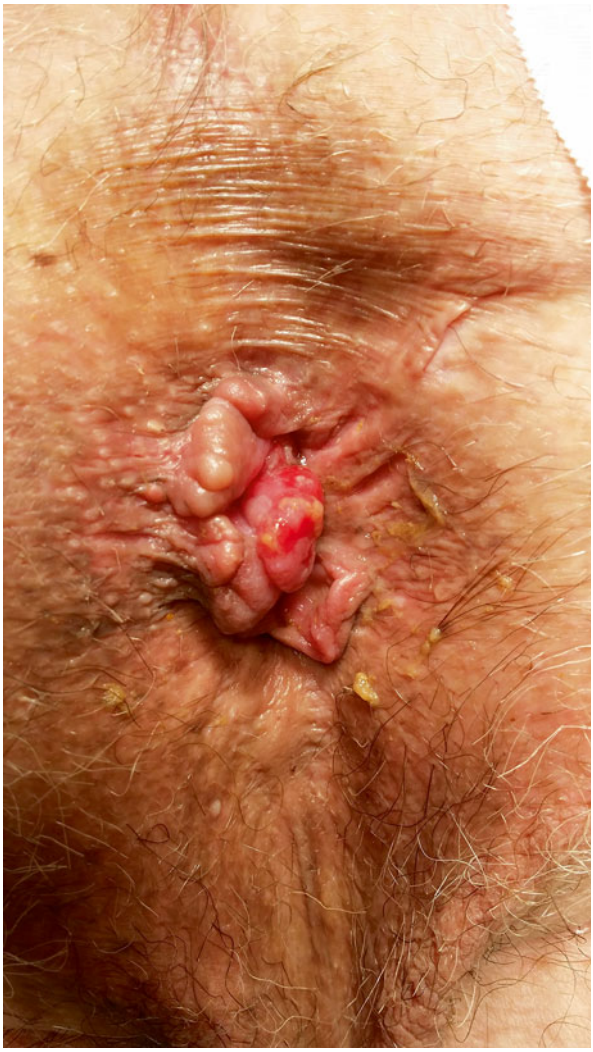

Fig. 10.2 Mixed prolapsed internal and external hemorrhoid

ongoing bleeding. No significant tenderness with examination. After withdrawing the anoscope, he is asked to bear down—no protrusion of tissue from within the anal canal.

10.1.3 Diagnosis

Grade 1 internal hemorrhoids

10.1.4 Discussion

Early hemorrhoid disease will frequently present as painless bleeding noted as streaking on toilet paper. It is important to differentiate hemorrhoids from other pathological conditions including fissure, polyps, IBD, or cancer. It is uncommon for bleeding hemorrhoids to present with anemia and all other conditions should be ruled out prior to treating the hemorrhoids. As stated earlier, hemorrhoidal grading is determined by protrusion. Enlarged hemorrhoids that do not protrude below the dentate line are considered grade 1. Factors leading to development of hemorrhoids include hard stools from a low-fiber diet, limited fluid intake, straining to pass bowel movements, and prolonged sitting during bowel movements. With distention of the hemorrhoid vessels within the anal canal, irritation from passage of stool and wiping can lead to excoriation and bleeding. As the anoderm above the dentate line is largely insensate, patients will not present with pain as an initial symptom.

10.1.5 Treatment

Initial treatment of grade 1 hemorrhoids consists of lifestyle modification focused upon the causative factors identified above. Patients are encouraged to increase dietary fiber and fluid intake either through meal selection or supplements. This will improve stool bulk to provide softer bowel movements and limit straining. Behavior modification focuses upon time spent sitting in the bathroom. If unable to pass a bowel movement after 2 min on the toilet, patients should be encouraged to leave the bathroom and reattempt at a later time. Additionally, the use of hydrocortisone either topically or in suppository form may result in decreased swelling, while behavior modification is implemented. These conservative measures are successful in the majority of patients and prevent progression of hemorrhoid disease. For patients who continue to have bleeding despite these changes when all other causes have been eliminated, interventions such as rubber band ligation, sclerotherapy, and infrared photocoagulation can be used.

10.2 Case 2: Grade 2/3 Internal Hemorrhoids

10.2.1 Presentation

A 52-year-old male presents with a history of bright red blood per rectum. The patient reports blood dripping in the toilet as well as on the toilet paper with bowel movements. He can feel swelling at his backside that subsides about 30 min after defecation; he occasionally will need to push on the swelling to achieve resolution. He has a history of congestive heart failure treated with diuretics and seasonal allergies treated with intermittent antihistamines. He reports regular bowel movements and does not strain on the toilet. His wife reports that he will sometimes spend 15–20 min in the bathroom.

10.2.2 Diagnosis

Grade 2/3 internal hemorrhoids

10.2.3 Discussion

Progression of hemorrhoid disease to grade 2 or 3 is defined by protrusion of internal hemorrhoids below the dentate line with spontaneous reduction in grade 2 or manual reduction in grade 3 (Fig. 10.3). Again, painless bleeding will frequently be

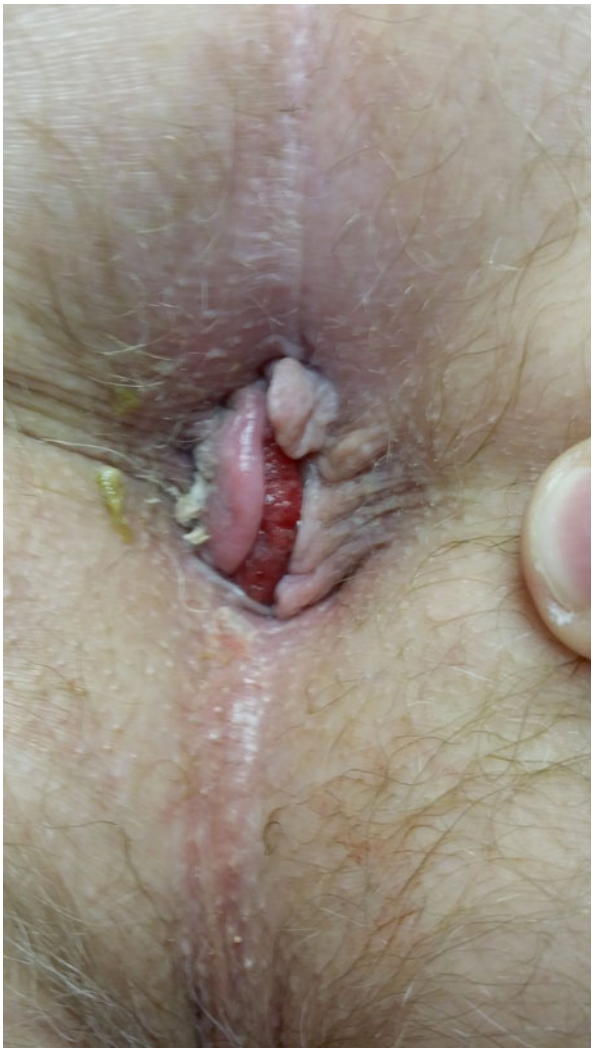

Fig. 10.3 Grade 3 internal mixed hemorrhoid

a patient's presenting complaint, but with advance hemorrhoids the feeling of a mass or swelling is common. For some patients, pruritus ani will develop when protrusion of hemorrhoid tissue allows seepage of rectal contents through the anal sphincters leading to irritation and inflammation of the sensate squamous epithelium below the dentate line.

10.2.4 Treatment

Initial treatment of grade 2 internal hemorrhoids follows the dietary and behavioral modification outline for grade 1 disease. Additionally, patients with grade 2 or 3 hemorrhoids are encouraged to soak in a warm tub or even apply ice packs to their perianal area. There is no strong evidence to support this practice, but many patients report significant relief of their symptoms with this treatment option. For patients refractory to dietary and behavioral modification, rubber band ligation of the internal hemorrhoids in the clinic setting provides a simple and elegant solution.

First described in 1963 by Barron, banding is performed during anoscopy [5]. Conventional banding uses an atraumatic clamp and a bander to deploy a rubber band gathering redundant mucosa above the hemorrhoidal column. A purpose-built suction bander serves a similar function and can be operated with one hand. The bander is placed within the anal canal above the prominent hemorrhoid column. The anorectal mucosa is drawn into the device. A trigger deploys the rubber band to permanently gather this tissue. Banding proximally tethers the hemorrhoid columns within the anal canal preventing protrusion. Over the following 3–5 days, the banded tissue will strangulate, necrose, and pass with a bowel movement occasionally heralded by a brief episode of self-limited bleeding. Most patients can achieve cure with this intervention at success rates of 75% [6] (Figs. 10.4 and 10.5). Some patients may require repeat banding depending on the severity of their hemorrhoids. Recurrence is prevented by continued adherence to dietary and behavioral modifications. Complications of rubber band ligation include pain, thrombosis, bleeding, and potential life-threatening pelvic sepsis. In our experience, most patients will experience a dull ache for 24–48 h. Symptomatic relief is provided by Tylenol or ibuprofen and sitting in a warm tub. Any patient who develops urinary retention with severe pelvic pain and fever should be promptly evaluated for pelvic sepsis. Early intervention with possible removal of the band, IV antibiotics, and careful observation are important steps to prevent further complications.

Another option for treatment of grade 2 or 3 hemorrhoids is sclerotherapy. Historically, this was performed prior to the advent of rubber band ligation. This process involves injection of a caustic agent to decrease the blood flow and induce fibrosis. Many different solutions have been used for sclerotherapy, but most clinicians now use a commercially available 5–10 % phenol solution with oil. Using a 25-gauge needle, the submucosa 1 cm above the dentate line is infiltrated with 1–2 mL of solution. Long-term results are very similar to banding in grade 1 and 2 hemorrhoid patients [7].

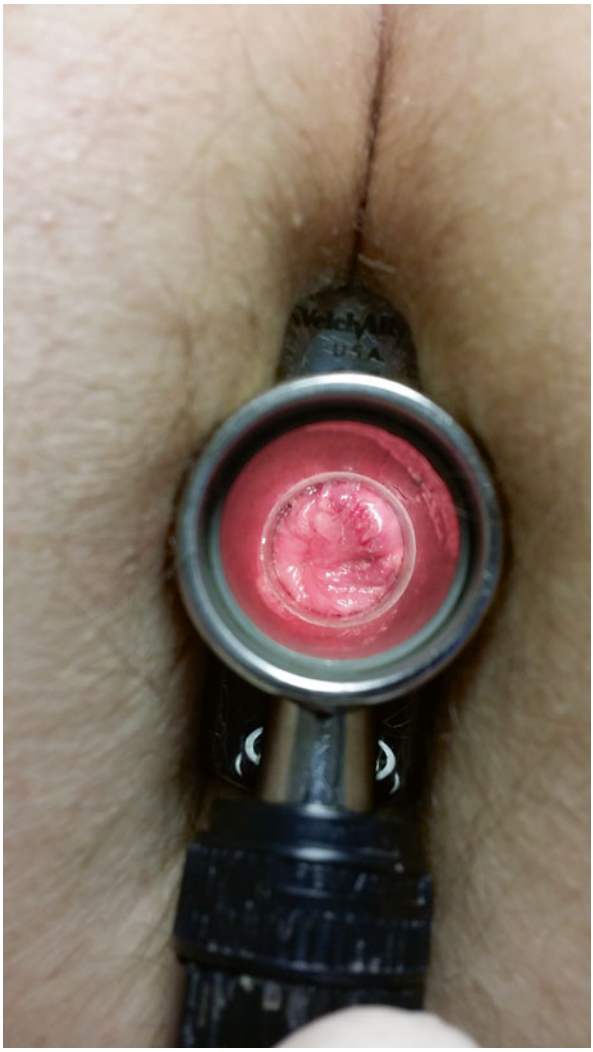

Fig. 10.4 Grade 3 internal hemorrhoid prior to banding

Infrared photocoagulation (IRC) is another less frequently used option for the treatment of hemorrhoids. IRC uses infrared light to generate heat which coagulates tissue proteins and evaporates water from cells. This leads to inflammation and scarring providing fixation of the hemorrhoid and treating the prolapse. IRC has been shown to work best with grade 1 and 2 hemorrhoids [7].

For 5–10 % of patients, failure of medical and noninvasive treatment will require a formal excisional hemorrhoidectomy. Indications for hemorrhoidectomy include grade 3 or 4 hemorrhoids with severe symptoms, concomitant anorectal disease requiring surgery, or patient preference. The two most described surgical procedures are the open Milligan-Morgan hemorrhoidectomy and the closed Ferguson hemorrhoidectomy. A multitude of descriptions and modalities for these procedures

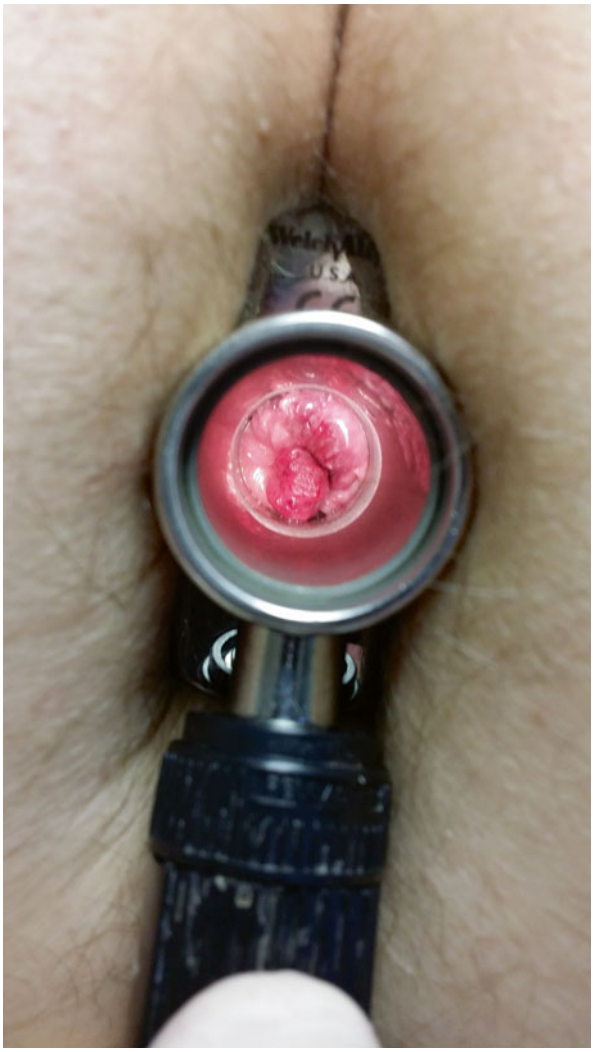

Fig. 10.5 Internal hemorrhoid post banding

exist—each with similar outcomes. Briefly, tenants of the procedures will include ligation of the vascular pedicle above the hemorrhoid column, excision of the hemorrhoid tissue, and either closure of the anal mucosa defect or healing by secondary intention [8]. Classically, this procedure has been performed with either scalpel or electrocautery, but some clinicians prefer to use either the harmonic scalpel (Ethicon Endo-Surgery, Cincinnati, OH) or the LigaSure (Covidien, Boulder, CO). Most studies have shown no difference in healing rates or pain ratings with these newer devices. As a benefit, they can reduce operating room time and have less bleeding associated with their use [9]. Complications of surgical hemorrhoidectomy include pain, bleeding (0.3–6 %), anal stenosis (0–6 %), urinary retention (2–36 %), and incontinence (2–12 %).

Because pain is the largest barrier to hemorrhoid surgery, many new devices have come to market which purport to give the same long-term improvement in symptoms with less post-procedural pain. These include Doppler-guided transanal hemorrhoid devascularization (THD™, AMI™), stapled hemorrhoidectomy or procedure for prolapsed hemorrhoids (PPH), and the hemorrhoid energy therapy (HET™) bipolar system.

The transanal hemorrhoid devascularization technique first described by Morinaga et al. in 1995 involves ligation of each of the six feeding vessels of the hemorrhoidal columns. The vessels are identified with a Doppler probe and ligated with an absorbable suture like Vicryl. A prolapsed hemorrhoid is then reposited to its formal location by pulling it up with a similar suture which starts at or above the ligation site and ends just above the dentate line. Results with the procedure are favorable with recurrence rates at 1 year around 10–15 % [10].

The stapled hemorrhoidectomy was introduced for hemorrhoids in 1998. First, an anal dilator is used to secure a circumferential purse-string stitch 2–4 cm above the dentate line. A modified EEA stapler is then inserted into the anal canal and the purse-string stitch draws redundant mucosa into the head of the stapler. The stapler is then fired excising a ring of redundant tissue and creating a circumferential staple line above the dentate line. Most long-term studies show no difference in pain when compared to conventional hemorrhoidectomy, but recurrence rates appear to be higher. Additionally, there are several unique complications associated with stapled hemorrhoidectomy including fistula, staple-line bleeding, and chronic pain [11].

The HET bipolar system represents the newest procedure to be employed for hemorrhoidal disease. Introduced in 2014, hemorrhoid energy therapy involves a patented anoscope with a window through which the hemorrhoidal tissue is isolated. Closing and activating the device around the hemorrhoid heats the submucosal vessels to induce coagulation and decreased blood flow. Early reports are encouraging with minimal pain and good short-term results, but to date no long-term studies have been performed.

There are a variety of nonoperative and operative treatment options for hemorrhoidal disease. It is important to exclude other entities that may mimic hemorrhoids. Each treatment options has its own set of advantages and disadvantages so it is important to be familiar with all the available treatment options so that patients may have the best long-term outcomes.

10.3 Case 3: Grade 4 Internal Hemorrhoids

10.3.1 Presentation

A 50-year-old woman presents to the emergency department with painful anal mass. She describes a history of progressively worsening hemorrhoids requiring manual reduction after bowel movements for the past 4 months. Today, she was unable to reduce her hemorrhoid tissue. She has subsequently developed increasing pain and tenderness prompting presentation.

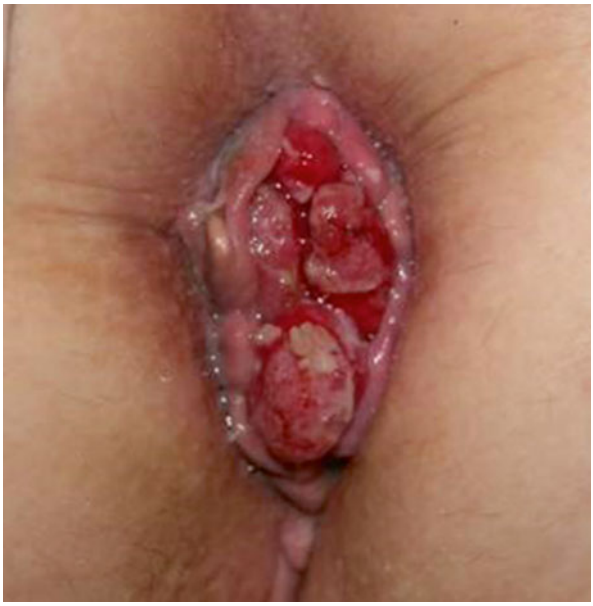

Fig. 10.6 Grade 4 prolapsed hemorrhoids

10.3.2 Examination

Swollen, engorged, prolapsed internal hemorrhoid tissue with bluish, black appearance (Fig. 10.6). Manipulation of the hemorrhoid tissue is painful. Surrounding perianal skin exhibits erythema and warmth.

10.3.3 Diagnosis

Grade 4 internal hemorrhoids

10.3.4 Discussion

The findings of grade 4 hemorrhoids are characterized by incarceration of the prolapsed hemorrhoids. This alarming finding should cause concern in the astute provider as the natural history of this disease is progressive swelling, strangulation, and necrosis of the hemorrhoid tissue. Urgent surgical consultation should be requested as delay in treatment can lead to progressive necrosis and potentially systemic infection.

10.3.5 Treatment

Treatment of incarcerated internal hemorrhoids typically requires emergent hemorrhoidectomy. In the instance of multiple herniated columns, the greatest and most threated hemorrhoids are selected for excision with planned elective return to

address the lesser hemorrhoids. This staged approach limits the incidence of stenosis following circumferential excision. In select patients, an alternative to surgery is a local block and direct injection of the hemorrhoids with a mixture of 0.25 % bupivacaine, 1:100,000 epinephrine, and hyaluronidase. This solution greatly reduces tissue edema and swelling allowing for reduction and ligation of the prolapsing hemorrhoid. The external thrombosis can then be excised. The results of this method have shown it to be safe and effective when compared to surgical hemorrhoidectomy with the added benefit of an earlier recovery and less pain [12].

10.4 Case 4: Thrombosed External Hemorrhoids

10.4.1 Presentation

A 45-year-old man presents to the emergency department with new onset of perianal pain and pressure. He describes 12 h of constant throbbing at the anal opening worsened by sitting, palpation, or bowel movements and improved when lying on his side.

10.4.2 Examination

Rectal examination reveals swollen, exquisitely tender, purple mass with attenuated skin below the anal verge protruding into the anal canal (Fig. 10.7). No evidence of surrounding erythema. No evidence or expression of purulent drainage.

10.4.3 Diagnosis

Thrombosed external hemorrhoids

10.4.4 Treatment

Treatment of thrombosed external hemorrhoids is dictated by the time between onset of symptoms and the patient's presentation to the outpatient clinic or emergency department. If diagnosed and treated within 48–72 h of onset, then an elliptical excision of overlying skin with evacuation of the thrombosed clot can provide significant symptomatic relief from pain and pressure. Topical or injectable 1 % lidocaine with 1:100,000 epinephrine can provide procedural analgesia and assist with hemostasis. Care must be taken to fully unroof the overlying skin to prevent re-closure and potential abscess formation. Post-procedural sitz baths three times daily and with soiling will allow for healing by secondary intention and a low incidence of postoperative abscess formation. If diagnosed beyond 72 h, treatment is conservative with warm packs and appropriate hygiene as pain and tenderness resolve over the following 5–7 days. Topical and systemic analgesics are appropriate for symptomatic relief during this period [13].

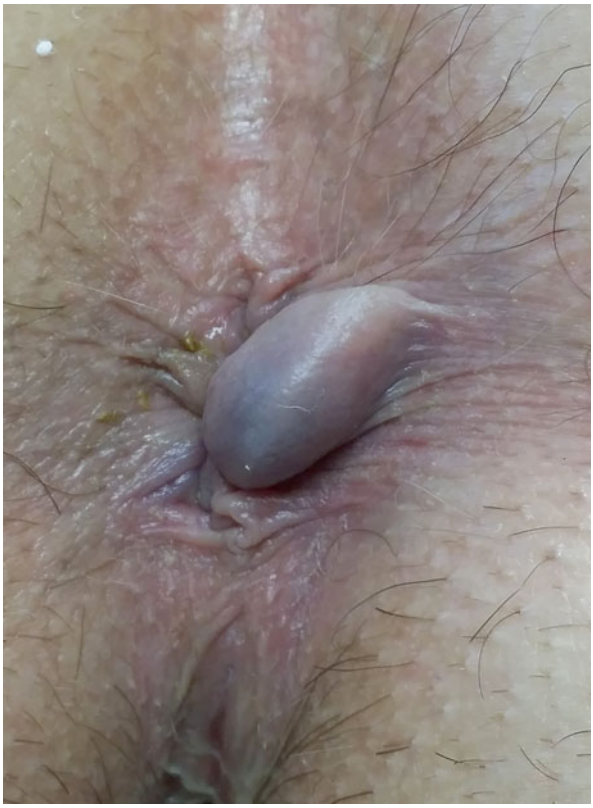

Fig. 10.7 Thrombosed external hemorrhoid

10.5 Case 5: Bleeding Hemorrhoids

10.5.1 Presentation

A 65-year-old man with atrial fibrillation on therapeutic anticoagulation presents to the emergency department with complaint of lower gastrointestinal bleeding. He relates a history of hemorrhoids with a mass occasionally palpable at his anal opening. His current bleeding started 2 h prior to presentation. He describes passing a number of bowel movements with a large amount of blood each time. He denies hematemesis.

10.5.2 Examination

The patient has a normal external anal exam. A digital rectal exam reveals a combination of clotted and bright red blood. He has large internal hemorrhoids that prolapse with removal of examining finger and then spontaneously reduce. While prolapsed, his hemorrhoid tissue demonstrates visible bright red bleeding (Fig. 10.8).

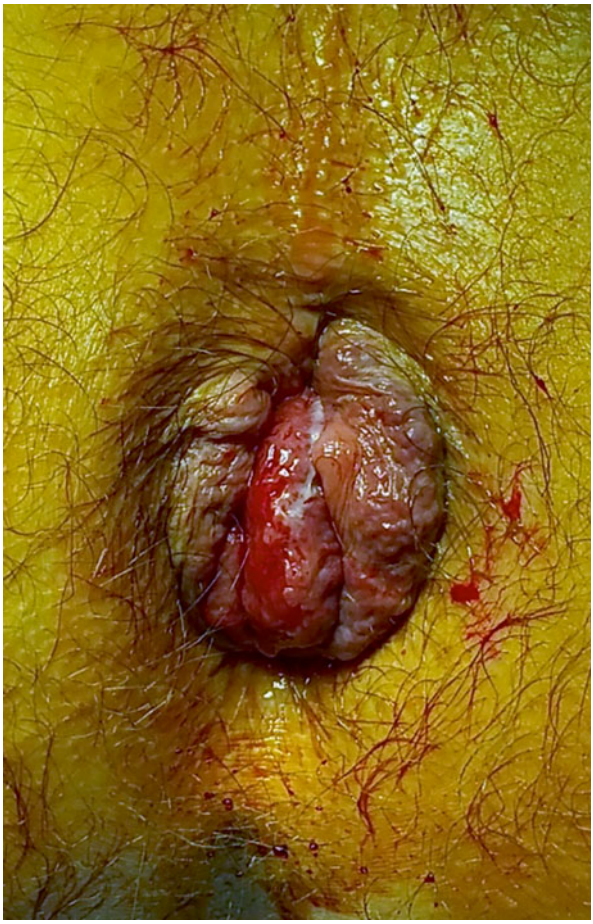

Fig. 10.8 Prolapsed internal hemorrhoid

10.5.3 Diagnosis

Bleeding internal hemorrhoids

10.5.4 Discussion

Presentation of bloody bowel movements warrants a full workup and assessment for upper and lower GI bleeding that is beyond the scope of this case. Bleeding hemorrhoids may represent up to 10 % of lower GI bleeds. Although hepatic cirrhosis is commonly associated with bleeding hemorrhoids, portal hypertension does not lead to development of hemorrhoids, and hemorrhoidal disease in cirrhotic patients is no different than that of the general population. Portal venous hypertension predisposes to anorectal varices, but these cause massive bleeding less than 1 % of the

time. Cirrhosis can contribute to hemorrhoid bleeding through coagulopathy mirroring the medical anticoagulation seen in the patient described above.

10.5.5 Treatment

Treatment of bleeding hemorrhoids begins first with resuscitation and reestablishment of hemodynamic stability through a combination of crystalloid administration and blood transfusion if indicated. Coagulopathy should be corrected. Control of anorectal bleeding begins with a local analgesia using 0.25 % bupivacaine containing 1:200,000 epinephrine. This can be injected in the tissues surrounding the bleeding hemorrhoid. Next, a 3–0 absorbable suture ligature can be placed to encompass the mucosa, submucosa, and internal sphincters in an attempt to achieve hemostasis. Finally, topical epinephrine in a concentration of 1:200,000 can be applied over rolled gauze in the anal canal in an attempt to provide medical and compressive hemostasis [12].

10.6 Case 6: Comorbid Illness and Hemorrhoid Disease

10.6.1 Presentation

A 35-year-old pregnant woman at 30 weeks gestation presents with complaint of anal mass noted during a routine prenatal check. She denies pain, but admits to perianal pruritus. Her bowel movements have been soft and brown. She has seen some bright red staining of the water in her toilet bowl after defecation as well as red streaks on her toilet paper.

10.6.2 Examination

Initial examination reveals no obvious mass at the anal opening. Mild perianal redness and irritation is noted. Anoscopy reveals prominent hemorrhoid engorgement. With Valsalva, these columns are seen to protrude below the dentate line, but spontaneously reduce with relaxation. Rectal exam is without significant tenderness.

10.6.3 Treatment

Patients who develop hemorrhoids during pregnancy will frequently experience resolution after delivery when their intra-abdominal pressure returns to normal. Symptoms can present at any time but are most frequent during the third trimester when uterine venous compression and constipation are more common. Conservative therapy is recommended with stool softeners, topical ointments, and excision of thrombosis if needed. When performing office procedures, it should be remembered

that left lateral decubitus positioning will help to shift the gravid uterus and alleviate compression of the inferior vena cava.

Additionally, patients with Crohn's disease or who are immunocompromised can also present with hemorrhoidal disease. Studies in these patient groups are limited, but in general those with active perianal Crohn's or proctitis should avoid surgical treatment until their disease is brought under control. Patients who are HIV+ or who take solid organ transplant immunosuppression medications should receive conservative treatments because of their increased risk for infection and poor wound healing [14].

10.7 Case 7: Postoperative Complications

10.7.1 Presentation

A 35-year-old woman undergoes elective, outpatient surgical hemorrhoidectomy. Three days following her procedure, she presents to the emergency department with increasing pain and rectal bleeding.

10.7.2 Examination

Perineal examination reveals exquisite perianal tenderness, no evidence of infection, and a large amount of bright red blood.

10.7.3 Diagnosis

Postoperative pain and bleeding

10.7.4 Discussion

Although safe and widely performed, hemorrhoid surgery of any form carries the risk of significant morbidity and mortality.

Pain is the most common complication following surgery. Multimodal pain management has become the mainstay of treatment. Successful regimens include long-acting local anesthetics, oral narcotics, nonnarcotic pain medications, and the use of compounded topical analgesic creams.

Bleeding, both early and late, occurs infrequently and has reported incidence of 0–31 % in different studies. Treatment options include rectal packing with epinephrine soaked gauze or Foley catheter balloon tamponade. When these methods fail, over-sewing with an absorbable suture in a figure-of-eight fashion may be required. Severe hemorrhage after hemorrhoidectomy is rare with reported incidence around 2 %. This potentially life-threatening complication often requires immediate surgical intervention [15].

Urinary retention, another common potential complication following hemorrhoid surgery, occurs most often in males. Limited use of IV fluids during surgery has been shown to reduce this complication. When retention occurs, urinary catheter drainage is often needed. If patients fail a short course of catheter drainage, then a urologic consult should be obtained and a short course of tamsulosin started.

Anal stricture can develop when excess anal canal tissue is removed. Proper surgical technique allows for adequate residual skin bridges between hemorrhoid excision sites. Treatment of mild strictures can he managed conservatively with dilation and stool-bulking agents. With severe stricture or failure of conservative management, an advancement flap using the Y-V configuration or an island-type flap has been shown to be effective (e.g., house, diamond, rectangular configurations) [12].

Incontinence after hemorrhoid surgery is extremely rare when proper surgical technique and avoidance of sphincter muscles are maintained. When incontinence does occur, assessment of the sphincter muscles with either anorectal manometry or endorectal ultrasound should be undertaken.

10.8 Summary

Hemorrhoidal disease is a common condition with a multitude of presenting symptoms and varied treatment options. A careful examination to exclude other more serious conditions is often needed. Treatment options should be tailored based upon each patient's individual complaint and comorbid medical conditions. A proper understanding of the anorectal anatomy and sound surgical technique will ensure good outcomes with very few complications.

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Chronic Anal Pain

11

Alexander T. Hawkins and Liliana Bordeianou

Chronic anal pain is the endpoint for a wide range of pathologies. It affects as much as 6.6 % of the population, though only about a third of those afflicted consult a physician [1]. It can be a disabling condition, with significant decrease in quality of life, psychological distress, and inability to work. Compounding the issue is the relatively sparse data available to aid clinicians treating the condition. Treatment depends on the etiology of the condition and generally requires thoughtful investigation, in several stages. The first stage involves consideration of organic, nonfunctional causes, which can be identified in about 15 % of patients [2]. The next stage looks for functional causes of pain. Rome III criteria divide such functional pains into proctalgia fugax, which is typified by short-lasting episodes of severe pain, and levator ani syndrome (chronic idiopathic anal pain) in which the pain lasts for periods of more than 20 min at a time or is permanent [3]. This chapter provides a structural, stepwise framework for the assessment and treatment of chronic anal pain to ensure that all diagnoses are considered.

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11.1 Evaluation and Treatment of Common Nonfunctional Causes of Anal Pain

11.1.1 Diagnostic Algorithm

When a patient presents with a suspected nonfunctional cause of chronic anal pain, a stepwise approach is essential to ensure that no possible diagnosis is overlooked (Fig. 11.1). The first step, of course, is a through history, including known anorectal problems, radiation exposure, inflammatory bowel disease, and anal trauma. After this, the next step is a detailed visual inspection and digital rectal exam. Many common anorectal maladies can be identified with this simple step. Visual inspection and digital rectal exam of the anorectum can exclude anal fissures, anal stricture, and other infections such as condyloma or herpes. In women, a bimanual exam can reveal gynecologic pathology, which may include endometriosis, vulvodynia, prolapse, or mesh erosion.

Should initial physical exam fail to provide the diagnosis, ancillary tests may be performed. An office test, anoscopy, can rule out anal cancer and distal rectal cancer or rectal stricture. A flexible sigmoidoscopy or full colonoscopy can identify proximal rectal cancer proctitis or a solitary rectal ulcer (Fig. 11.2). An MRI of the pelvis and rectum can reveal retrorectal pathology and cryptic perianal fistulae. An MRI of the spine can exclude herniated disc and neurologic syndromes.

11.1.1.1 Anal Fissure

An anal fissure is an oval-shaped tear in the anus distal to the dentate line. Also known as fissures in ano, these are mostly found in the posterior midline but can also be found in the anterior midline. The initial inciting event is thought to be from the passage of hard stool through the anal canal. This is then propagated by an elevated internal sphincter tone [4].

The classic symptom is acute, sharp pain on defecation. Rectal bleeding can also be seen on toilet paper after defecation. The diagnosis can be confirmed with a gentle anal exam. Fissures will appear on the posterior or anterior anal canal. Acute fissures look like a tear, while chronic fissures can have edema, fibrosis, and exposed internal sphincter fibers. (For a full discussion of anal fissures, please see Chap. 5.)

When it can be tolerated, the first line of therapy for anal fissures is medical, with the goal of relaxing the internal anal sphincter. Nifedipine and nitroglycerin both can be applied topically. BOTOX® (onabotulinumtoxinA) can be injected in the office setting. Stool should be kept soft with adequate hydration and fiber therapy. While 50 % of anal fissures will heal with medical therapy, others will require surgery. Lateral internal sphincterotomy had become the initial procedure of choice due to exceptional healing and low recurrence rates [5]. Second-line treatment for patients with normal sphincter tone can include fissurectomy with cutaneous flap. The fibrotic edges are excised down to normal anodermal tissue. Any skin tag or papilla is then excised. Sharp dissection is used without diathermy. Healthy perianal skin is then mobilized and advanced to fill the defect [6].

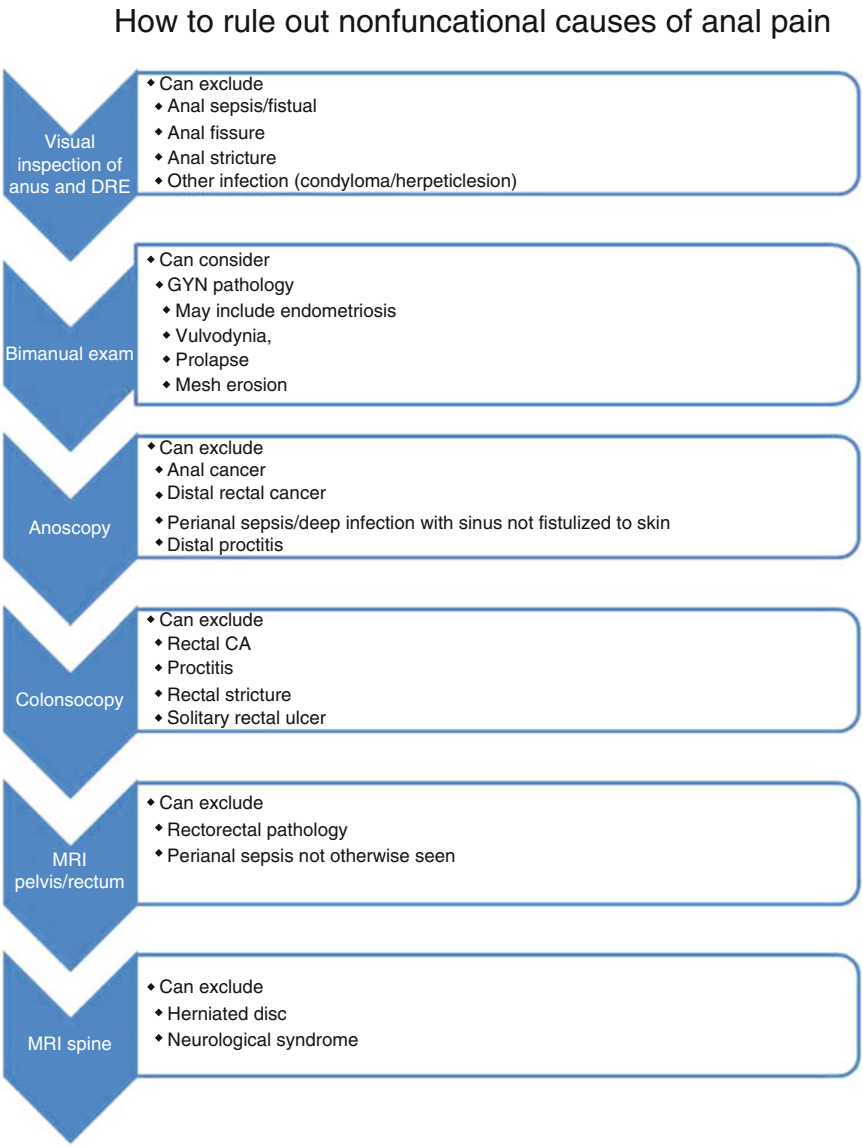

Fig. 11.1 Diagnostic algorithm in patients with suspected nonfunctional causes of anal pain

11.1.1.2 Anal Fistula

An anal fistula or fistula in ano is an abnormal tract or cavity connecting the skin with the anal canal or rectum. They are generally the result of a perianal abscess that fails to completely heal. Diagnosis is not always straightforward. Patients will usually have a history of an abscess that was drained either surgically or spontaneously. Often they will report purulent drainage and bleeding or pain on defecation, but sometimes they

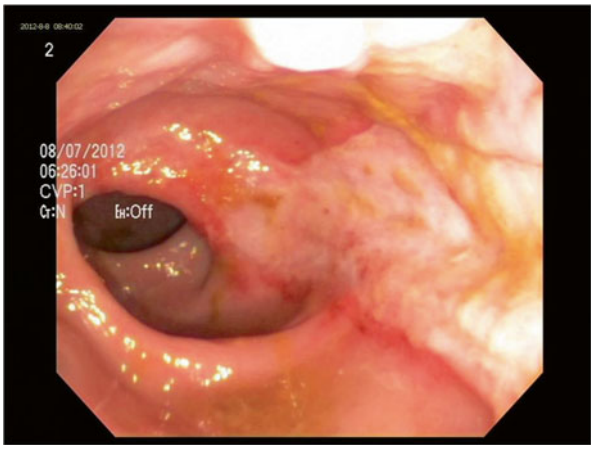

Fig. 11.2 Solitary rectal ulcer—another cryptic source of anorectal pain can be recognized on colonoscopy or flexible sigmoidoscopy. It is caused by obstructed defecation and paradoxical contractions of the puborectalis. It can sometimes coexist with levator ani syndrome (see further discussion later in chapter). Treatment is focused on treating functional constipation and levator ani syndrome, if present

will only report chronic rectal pain. On exam, the external opening can usually be identified as perianal granulation tissue that expresses pus on palpation. Anoscopy or an exam under anesthesia is usually necessary to identify the internal opening. MRI is a useful tool for defining high fistulae. Treatment depends greatly on the anatomic location. (For a full discussion on anal fistulae please see Chap. 6.)

For patients with chronic anal pain, it is also important to consider the possibility of an unrecognized deep postanal space fistula after a horseshoe abscess, resulting in an internal sinus tract that does not rupture outside of skin. These fistulae are not easily recognized on physical exam. Signs include pain between the posterior anus and coccyx. They can frequently be confused with puborectalis spasm that also produces tenderness with posterior pressure. One way to differentiate between the two is that deep postanal fistulae hurt more with defecation, whereas puborectalis spasms sometimes improve with defecation. When unsure, endoanal US or MRI may help rule out deep unrecognized sepsis.

11.1.1.3 Anal Stricture

Anal stricture is an uncommon (but severely disabling) condition defined as narrowing of the anal canal (Fig. 11.3). Ninety percent of cases are the result of aggressive hemorrhoidectomy [7], but the condition may also be caused by any condition that leads to scarring of the anoderm: anal trauma, inflammatory bowel disease, chronic laxative abuse, radiation, and venereal disease.

Anal stricture produces an anatomic change to the anal canal which results in painful and/or difficult bowel movements and a marked decrease in quality of life. Patients will usually report painful or difficult bowel movements along with rectal bleeding or narrowing of stools. A history of hemorrhoidectomy, radiation therapy, or inflammatory bowel disease can usually be elicited. A digital rectal exam is usually sufficient to confirm the diagnosis, and anorectal manometry can

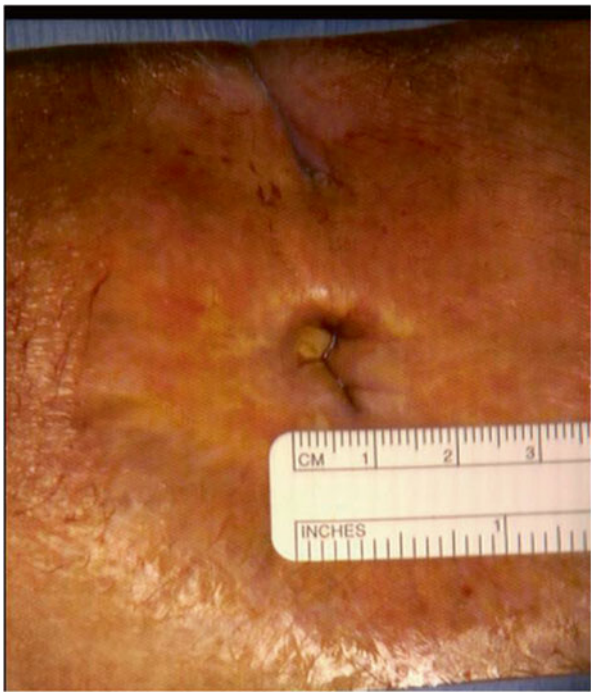

Fig. 11.3 Anal stenosis—patient has severe anal stenosis after an aggressive hemorrhoidectomy, where the anus is less than 1 cm and cannot accommodate even the little finger of the surgeon (patient in prone position)

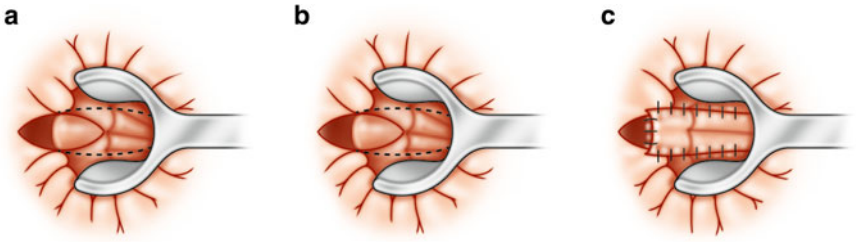

Fig. 11.4 Martin's anoplasty/lateral mucosal advancement flap. (**a**) Scar tissue is excised longitudinally. (**b**) The flap is tailored so as to have a wide base and to contain a few strands of the internal sphincter. (**c**) The flap is advanced to the edge of the internal sphincter near the anal verge and secured in place with absorbable sutures

provide an objective assessment of anorectal function. Patients with a mild stricture may achieve relief with fiber therapy, daily anal dilation, or sphincterotomy. For patients with more severe disease, treatment focuses on anoplasty with mucosal flaps or skin flaps [8, 9].

There are a number of possible flaps to employ. In patients with a short narrowing, a lateral mucosal advancement flap (Fig. 11.4a–c)—also known as a modified Martin's anoplasty—could be considered. This procedure involves a longitudinal excision of scar tissue (Fig. 11.4a) followed by transverse undermining of the proximal rectal mucosa. Taking care to preserve vascular supply, the surgeon tailors the

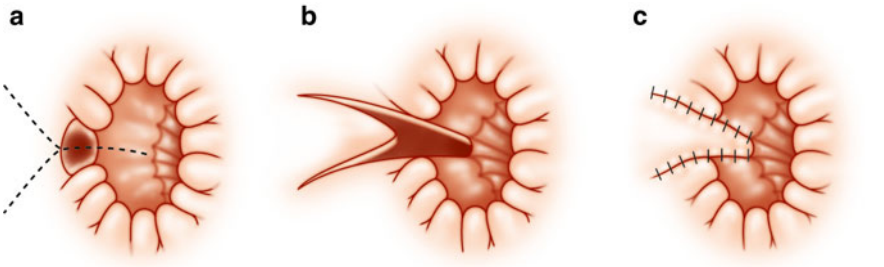

Fig. 11.5 Y–V advancement flap. (**a**) A longitudinal incision is made over the area of stenosis and extended on the perianal skin for 5–8 cm in either direction. (**b**) The flap is incised down to the fatty subdermal tissue to ensure good blood supply. (**c**) The flap is then advanced to the apex of the wound and sutured in place with absorbable sutures

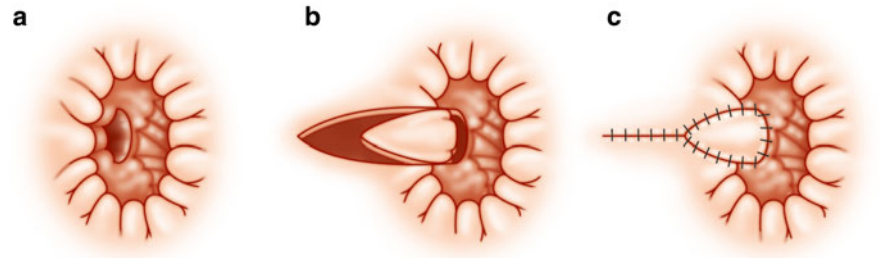

Fig. 11.6 V–Y anoplasty. (**a**) A V-shaped incision is made within the anal canal to release the stenosis. (**b**) A pedicled flap of skin and subcutaneous fat is then created by lifting the skin near the anus in the deep subcutaneous plane so as to preserve its blood supply. (**c**) The skin is then closed behind the area to create the "Y"

flap to have a wide base and to contain a few strands of the internal sphincter (Fig. 11.4b). If a functional component is present, an internal sphincterotomy is performed, though preferably not at the same spot as the flap. Once the flap is fully mobilized, it is advanced to the edge of the internal sphincter near the anal verge and secured in place with absorbable sutures (Fig. 11.4c). The external part of the wound is left open to minimize contracture. In properly selected patients, this simple intervention has a published success rate of 97 % [10].

A Y–V advancement flap (Fig. 11.5a–c) is another useful technique for addressing stenosis, though the technique is only effective when the surgeon needs to cover less than 25 % circumference of the anal canal (wider flaps tend to become necrotic) [11]. From the prone position, the surgeon makes a longitudinal incision over the area of stenosis. The incision is then extended on the perianal skin for 5–8 cm in either direction to form a V flap (Fig. 11.5a). The flap is incised down to the fatty subdermal tissue to ensure good blood supply (Fig. 11.5b). The flap is then advanced to the apex of the wound and sutured in place with absorbable sutures (Fig. 11.5c). Fiber supplementation and sitz baths are standard postoperative regimens. The Y–V flap has 90 % success rate in two published series [11, 12].

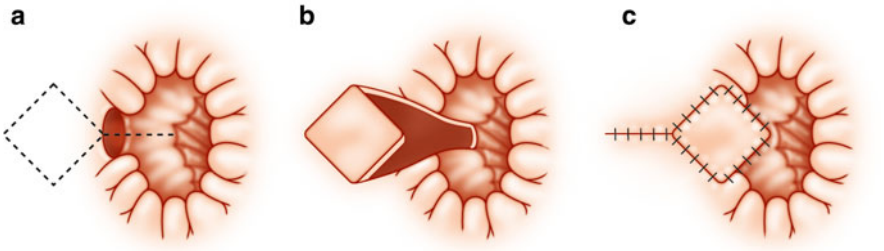

Fig. 11.7 Diamond-shaped flap. (**a**) Scar tissue is incised within the anus. (**b**) The skin and the subcutaneous tissue are mobilized on a diamond-shaped pedicle of skin. (**c**) The flap is sutured into place with absorbable sutures and the base closed primarily

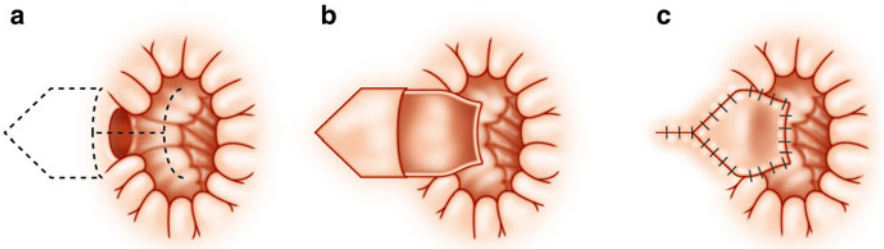

Fig. 11.8 House flap. (**a**) A longitudinal incision is made toward the perianal skin, from the dentate line to the area of stricture. (**b**) Proximal and distal incisions are centered on the longitudinal incision such that the flap is designed in the shape of a house with the flat base near the anus. (**c**) The flap is moved into the anus and sutured in place with absorbable sutures

The V–Y anoplasty (Fig. 11.6a–c) can also be considered as an alternative to V–Y flaps. This flap is created by making a V-shaped incision within the anal canal to release the stenosis (Fig. 11.6a). A pedicled flap of skin and subcutaneous fat is then created by lifting the skin near the anus in the deep subcutaneous plane so as to preserve its blood supply (Fig. 11.6b). The skin is then closed behind the area to create the "Y" (Fig. 11.6c). V–Y anoplasty is used with positive results in severe low anal stenosis.

A diamond-shaped flap (Fig. 11.7a–c) is similar to the V–Y flap, but it allows for a larger segment of tissue to be moved into the anus while still closing the donor site. Scar tissue is incised within the anus (Fig. 11.7a) and then the skin, and the subcutaneous tissue in its proximity is mobilized on a diamond-shaped pedicle of skin and subcutaneous tissue (Fig. 11.7b). A diamond-shaped flap is pedicalized and advanced such that it covers the intra-anal portion of the defect. It is then sutured into place with absorbable sutures and the base closed primarily (Fig. 11.7c). A diamond flap is useful for strictures above the dentate line or strictures associated with mucosal ectropion [13].

The house flap is an excellent choice that has the dual advantages of a wide flap that increases the anal canal diameter and allows for primary closure of the donor flap (Fig. 11.8a–c). After an enema the day of surgery, a Hill-Ferguson retractor is

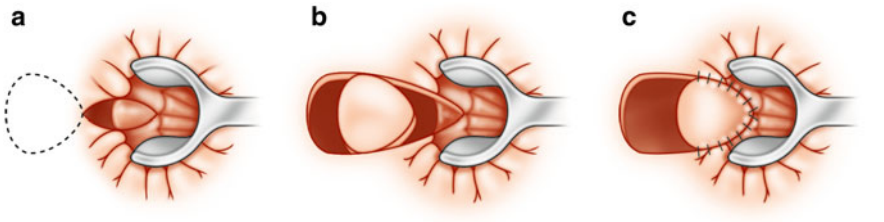

Fig. 11.9 U Flap. (**a**) A U-shaped incision is planned in the adjacent perianal skin. (**b**) The flap is then raised, with attention to preserving the fatty subcutaneous tissue with wide mobilization to ensure good vascular supply. (**c**) The flap is advanced and sutured in place with absorbable suture

used for exposure of the stricture. A longitudinal incision is made toward the perianal skin, from the dentate line to the area of stricture (Fig. 11.8a). Proximal and distal incisions are centered on the longitudinal incision such that the flap is designed in the shape of a house with the flat base near the anus (Fig. 11.8b). Care must be taken to preserve the subcutaneous vascular pedicle. Once the house-shaped skin, subcutaneous tissue is dissected, the flap is moved into the anus and sutured in place with absorbable sutures (Fig. 11.8c). High fiber diet is continued after the surgery, with some experts also advising sitz baths once wounds are noted to show some signs of unraveling—which they frequently do [9]. The house flap is a good choice if the stenosis is a long segment and extends all the way from the dentate line to the perianal skin.

A U flap is similar to the house flap except that the donor site is left open and allows to heal by secondary intention (Figs. 11.9a–c and 11.10a–d). This is considered when the perineal skin is woody and a longer incision with a primary closure is unlikely to hold. A U-shaped incision is planned in the adjacent perianal skin (Figs. 11.9a and 11.10a). The stenotic area is incised and a fissurectomy is performed if a patient has a concomitant unhealed chronic anal fissure (Fig. 11.10b). The flap is then raised, with attention to preserve the fatty subcutaneous tissue with wide mobilization to ensure good vascular supply (Figs. 11.9b and 11.10c). Finally, the flap is advanced and sutured in place with absorbable suture, and the donor side is covered with gauze (Figs. 11.9c and 11.10d).

Lastly, the rotational S flap (Fig. 11.11a–c) can be very helpful in patients presenting with a circumferential skin changes around the anus in association with mild anal stenosis. The flap is not very useful for significant stenosis, however. It involves a full-thickness S-shaped incision in the perineal skin with the size of the base equaling the length of the cut, starting from the dentate line (Fig. 11.11a). The flap is rotated and sutured to the normal mucosa (Fig. 11.11b), with the goal of bringing both wings of the S down to cover the anoderm and replace removed skin (Fig. 11.11c).

11.1.1.4 Others

A number of other conditions should be considered when evaluating the patient with chronic anal pain. Most are identifiable with a careful rectal exam. Hemorrhoids are often assumed to be the cause of chronic pain, but are usually painless unless

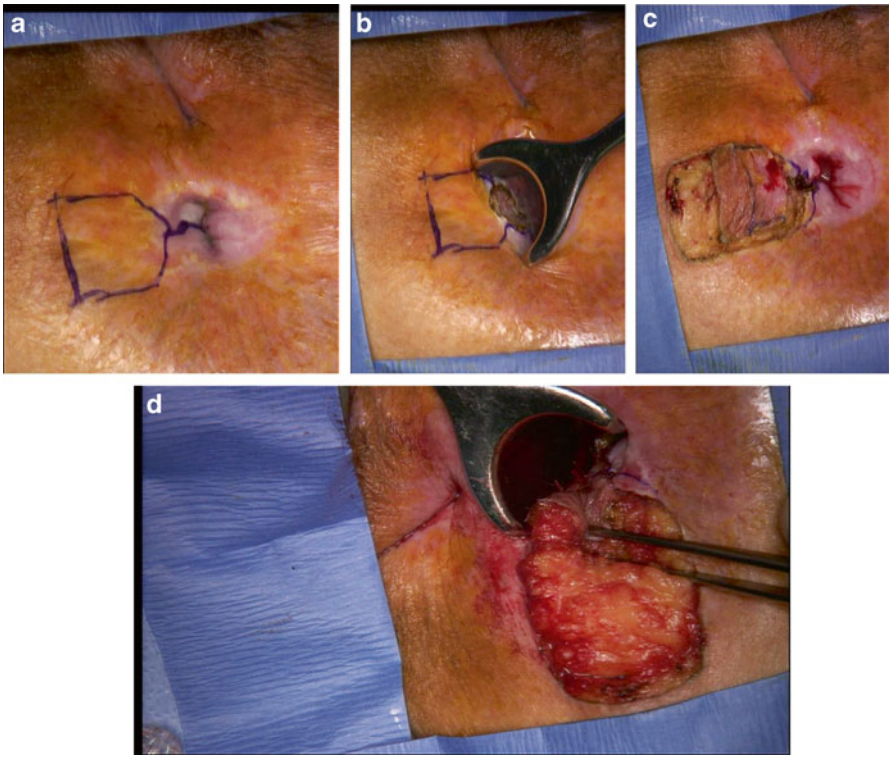

Fig. 11.10 (**a**) Decide on the size of skin you want to mobilize—needs to be big enough to be well vascularized on a mobile base. (**b**) Perform fissurectomy (if a fissure exists)—otherwise incise scar and if needed cut one-third of internal anal sphincter to give more stretch to the anus. (**c**) Free cutaneous flap—dissect deep enough to make flap mobile while still maintaining perfusion. (**d**) Cutaneous flap is advanced into the anus and secured with braided absorbable suture

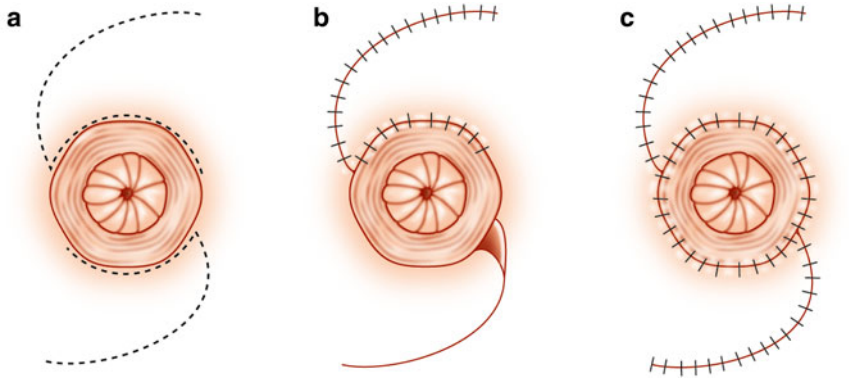

Fig. 11.11 Rotational S flap. (**a**) A full-thickness S-shaped incision is made in the perineal skin with the size of the base equaling the length of the cut, starting from the dentate line. (**b**) The flap is rotated and sutured to the normal mucosa. (**c**) With goal of bringing both wings of the S down to cover the anoderm and replace removed skin

thrombosed. A fungal infection may create prolonged pain that is less severe than an abscess. A tumor, such as cancer, can produce progressively worsening pain. A rectal sexually transmitted disease, such as gonorrhea, chlamydia, or herpes, can cause pain and discharge. Proctitis, either primary or secondary to inflammatory bowel disease, is also a cause of anal pain. Another cryptic source of anorectal pain, commonly recognized on colonoscopy, is a solitary rectal ulcer (see Fig. 11.2). It is caused by obstructed defecation and paradoxical contractions of the puborectalis. It can sometimes coexist with levator ani syndrome (see further discussion later in this chapter). In female patients, endometriosis, vulvodynia, prolapse, and mesh erosion all can present with anal pain. In male patients, chronic prostatitis should be considered. Finally, dermatologic pathology, such as psoriasis or dermatitis, can cause itching and pain.

11.2 Evaluation and Treatment of Common Functional Causes of Anal Pain

The so-called functional causes for anal pain are a diagnosis of exclusion. They may be considered only after all nonfunctional causes have first been ruled out and adequately managed (see Fig. 11.1). Again, as with any other medical condition, the evaluation of suspected nonfunctional causes of anal pain should start with a thorough history and a physical exam. It is not unusual to find situations where functional and nonfunctional causes of pain—occasionally with an acute or chronic component—may coexist, thus making the differentiation between these two pathways harder than it may seem.

11.2.1 Diagnostic Algorithm

In the presence of a normal exam and normal prior testing described earlier, the next step in the evaluation and in a rational treatment of a suspected functional disorder is anorectal physiology testing (Fig. 11.12). Anorectal physiology testing should begin with *anorectal manometry* measurements. This test is performed in an awake patient who is usually lying in the left lateral decubitus position. The test is performed by inserting a small catheter within the anus. This is then connected to a transducer that can measure the pressures generated within the anus at rest and squeeze. Depending on the catheter that may be used, these measurements can be obtained in 4–8 circumferential points along the anal canal. Pressures can also be measured at various heights within the anus, starting from the level of puborectalis and ending at the anal verge. In addition to anal pressure, rectal pressure can also be measured.

If the measured pressures are high, a physician should suspect anismus, proctalgia fugax, levator ani syndrome, or myofascial pain. The typical signs, symptoms, and treatments of these conditions are discussed below. Thereafter, a patient should undergo *electromyography* (*EMG) testing* to determine whether they are also

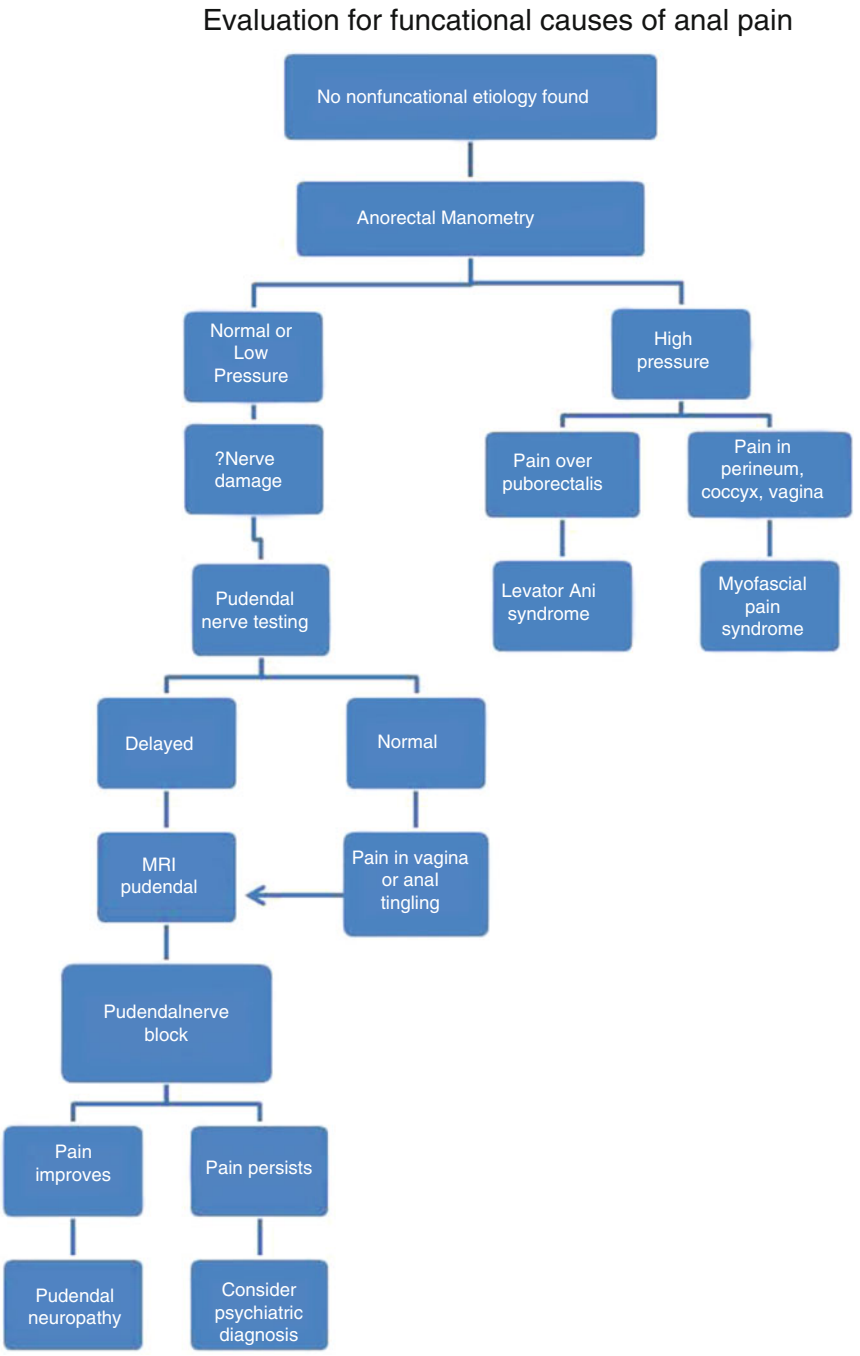

Fig. 11.12 Diagnostic algorithm in patients with suspected functional causes of anal pain

presenting with a paradoxical contraction of puborectalis. This determination may guide the first line of treatment. Patients with a coexisting paradoxical contraction of puborectalis would typically be offered EMG-guided biofeedback, but patients with normal EMG may need to start with physical therapy (PT). Other treatments offered for these conditions will be described below.

If anorectal manometry pressures are low, the diagnosis of functional anal pain is more elusive. In this situation, we recommend a measurement of *pudendal nerve terminal motor latencies (PNTMLs)*. PNTMLs are performed by gently stimulating the left and right pudendal nerves. The test measures the time elapsed between the stimulation of the nerve and the contraction of the anal sphincter following this stimulation. Normally this time is less than 0.2 ms. Patients with delayed PNTMLs should be evaluated to exclude neurological causes of pain and pudendal neuralgia. Patients with normal PNTMLs should be suspected to have atypical forms of anismus, proctalgia fugax, levator ani syndrome, or myofascial pain. In these situations, medical treatment of anal pain is more likely to be effective than biofeedback or PT.

11.2.1.1 Levator Ani Syndrome

Levator ani syndrome is known by many other names including anismus, levator spasm, paradoxical contraction of puborectalis, piriformis syndrome, chronic proctalgia, and pelvic tension myalgia. Patients suffering from levator ani syndrome usually report prolonged pain lasting for hours. The pain is constant or frequent and is typically dull. Physical exam is typically normal. The pain is often reproduced following posterior palpation of the puborectalis muscle on the digital rectal exam [14, 15]. On further probing, patients describe a vague, dull ache, or pressure sensation high in the rectum. It is often worse with sitting, and it sometimes improves with standing or lying down. Individual episodes of pain can last for 20 min or longer.

Patients presenting with pain secondary to the levator ani syndrome can sometimes recall an inciting event, though sometimes the event may be a psychological one. Many patients with the syndrome have additional psychological disturbances sometimes referred to as the "neurotic triad": they measure high on the hypochondriasis, depression, and hysteria scales of the Minnesota Multiphasic Personality Inventory [16]. Because of the convoluted overlay of physical and psychiatric issues, the treatment of the levator ani syndrome can be a very frustrating experience for both patients and their physicians, and patients are frequently passed from subspecialist to subspecialist [17]. The theoretical goal of the treatment of the levator ani syndrome is to relax the puborectalis spasm, which is postulated to cause or perpetuate the pain [3, 15, 18, 19].

This hypothesis is supported by the finding that many patients presenting with the levator ani syndrome-type pain are found to have elevated anal manometry pressures. In addition, patients frequently fail balloon expulsion testing and have paradoxical contractions of their puborectalis on EMG testing, suggesting a relationship between the levator ani syndrome and obstructed defecation syndrome [2, 3, 18, 19].

Data regarding many of the treatment modalities mentioned below is embarrassingly limited, and the quality of data is further handicapped by its retrospective

nature, small numbers, and selection bias. Still, there seems to be a consensus among all experts that the most important first line of treatment is patient reassurance, though it is unclear how many of these patients are satisfied with reassurance alone [18]. Physical therapy with vigorous digital massage of the puborectalis muscle may also be reasonable, though the number of massage sessions required (minimum of 50 visits) and the intensity of the needed massage (massage must be painful) is unclear [20]. Others suggested combining digital rectal massage of the puborectalis with oral diazepam or rectal diazepam, and one series reported a 68 % success rate by treating 316 patients with levator ani syndrome using this combination [21]. Many physical therapists also advocate a trial of *electrogalvanic stimulation (EGS),* which is thought to fatigue spastic muscles, thus leading to their eventual relaxation. Recommended treatment duration and pulse frequencies vary from group to group, though some argue that intervals between sessions must be small for the treatment to be effective: e.g., 1 h per day for 3 sessions in a 10-day period. One of the earliest studies using EGS reported a 91 % success rate utilizing this approach in the short term, although subsequent studies showed more modest results, with only approximately two-thirds of patients reporting some short-term pain relief [22] and only one-third having persistent pain improvement [23].

Biofeedback aimed at teaching patients how to relax the puborectalis muscle is another well-known treatment modality frequently considered in these patients—especially when the pain is found to be associated with obstructed defecation syndrome, as well as the findings of an inability to expel a balloon and/or paradoxical contraction of puborectalis on anorectal physiology testing. The goal of biofeedback is to retrain pelvic floor musculature to relax upon attempt to push. An initial report of 12 patients treated with biofeedback reported 100 % cure rates after 8 sessions [24]. Unfortunately, follow-up series were less enthusiastic and success rates varied from 30 to 90 % [17, 19, 25].

A well-conducted randomized controlled trial of 157 patients with clearly documented levator ani syndrome study compared the effectiveness of levator massage, biofeedback, and electrogalvanic stimulation. At 1-month follow-up, the study reported biofeedback to be significantly more effective than EGS and massage by intent-to-treat analysis, with adequate relief of pain reported by 59.6 vs. 32.7 vs 28.3 % for biofeedback, EGS, and massage, respectively. Benefits were maintained throughout 12 months of long-term follow-up and no side effects were reported with any treatment [2].

The options remaining for the patients who fail biofeedback, sitz baths, electrogalvanic stimulation, and massage are very limited. A referral to a pain management specialist for consideration of tailored nonnarcotic pain and combination pain regimens is appropriate. Similarly, a referral to a psychiatrist may be helpful. Finally, low-risk surgical interventions such as botulinum toxin A (Botox A) injections or sacral nerve stimulation could be considered on research protocol, since data regarding efficacy of these interventions is controversial and these treatments are not FDA approved in the USA.

Botox injections are a well-described treatment of anal pain secondary to anal fissures (see Chap. 5). Its efficacy in the treatment of levator ani syndrome, on the

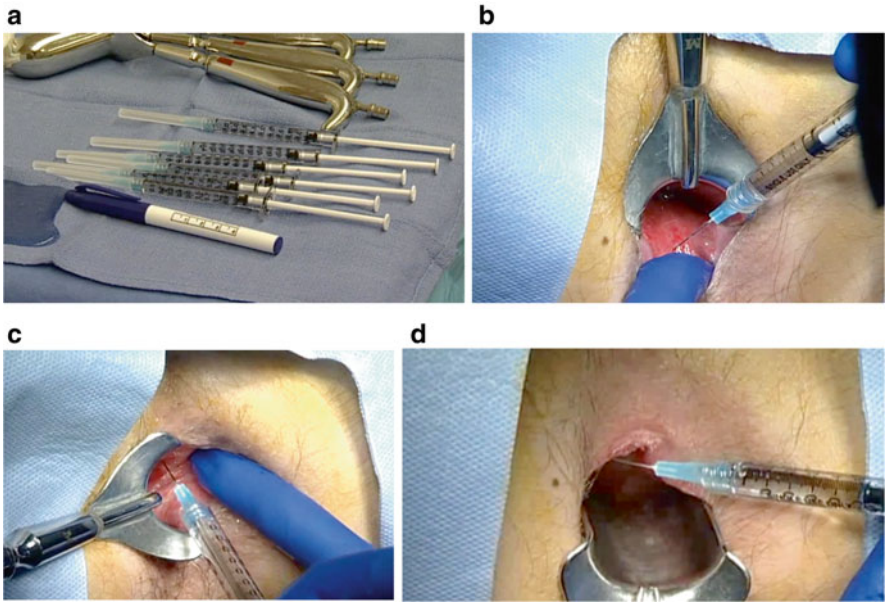

Fig. 11.13 Botox injection for levator ani syndrome. (**a**) Prepare 200 IU Botox in 6 cc NS (or 100 IU in 6 mL if a smaller dose is elected) and place in six tuberculin syringes. (**b**) In lithotomy, palpate the puborectalis and inject three syringes in the posterior puborectalis—spot of most pain in patients. (**c**) Inject two of the remaining syringes in the left and right side of puborectalis. (**d**) Inject last syringe in the anterior insertions of the puborectalis and then perform puborectalis massage for 15–20 min (mostly posterior)

other hand, is less documented. Furthermore, experts are unsure as to the appropriate dosage, ranging in descriptions from 20 to 200 IU. Botox injections are administered under general anesthesia, in the lithotomy position. We recommend diluting the Botox (20–200 IU) into 6 cc of NS and loading each cc into a separate tuberculin syringe (Fig. 11.13a). The puborectalis sling is digitally palpated and the drug is injected into it, starting posteriorly (Fig. 11.13b). Following this, further injections are performed laterally (Fig. 11.13c) and also at the site of the puborectalis insertion into the perineal body anteriorly (Fig. 11.13d). Following injections, a vigorous 15 min puborectalis massage is performed.

While utilization of Botox to relax the puborectalis muscle spasm makes a lot of intuitive sense, a randomized controlled trial of 12 patients treated with 100 IU of Botox versus placebo showed no difference in the rectal pain observed in the two treatment groups. The trial had several limitations, including the fact that only 7/12 randomized patients actually showed up for all of their injections and follow-up visits, while the original power calculation called for 24 study subjects [26]. Given the limitations, further studies on the potential use of Botox for this condition are warranted, with a focus on efficacy, dosage, and risks.

Borrowing from the treatment on myofascial pain (see below), some surgeons attempted to treat levator ani syndrome patients with steroid caudal block and

trigger point injections with of a mixture of triamcinolone, acetonide, and lidocaine: unfortunately results were not promising [17, 27]. Finally, sacral nerve stimulation (SNS) was also reported to be beneficial in an open study involving 27 patients [28]. However, another report from Oxford put the use of SNS for this indication in question, finding that only one out of ten patients treated within the study reported sustained improvement when the data was analyzed on an intent-to-treat basis [29].

11.2.1.2 Proctalgia Fugax

In proctalgia fugax, the pain is brief, intense, and sharp. Pain usually lasts seconds or minutes and occurs unexpectedly and infrequently (less than once a month). Many—but not all—patients with this condition are awoken from sleep because of the sudden onset of sharp anorectal discomfort, and earlier literature on the condition refers to it as "nocturnal proctalgia" [30].

Defecation and self-digitation of the anus are reported to help with pain resolution [31, 32]. Patients will deny anorectal pain between episodes. Despite the severity of the attacks, which can range from uncomfortable to unbearable, only approximately 20 % of patients experiencing proctalgia fugax do ultimately seek attention for this complaint [33].

Given the episodic nature of the pain, treatment for this condition is often impractical. Patients must be reassured that they do not have a malignancy or another dangerous condition. Patients with frequent symptoms can be given a trial of nitroglycerine or a calcium channel blockers such as nifedipine or diltiazem, though data on their efficacy is limited to case reports and anecdotes [34, 35]. One patient was reported to improve with clonidine, an alpha-2 adrenoceptor antagonist [36]. One randomized controlled trial evaluated the efficacy of the inhaled β2-adrenergic agonist salbutamol in 18 patients with proctalgia fugax. The study was initiated after a physician reported favorable results following self-treatment [37]. This 18-patient trial did show the inhalation of salbutamol to be more effective than placebo for shortening the duration of episodes of proctalgia [38].

11.2.1.3 Myofascial Pain Syndrome

Some women with anal (and vaginal pain) may be suffering from myofascial pain dysfunction syndrome, which—on the perineum—is characterized by severe chronic pain elicited by pressure over specific trigger spots other than the posterior puborectalis, with and without dyspareunia. The syndrome can also affect other body areas, where it is sometimes referred to as fibromyalgia. Some authors question the distinction between myofascial syndrome and levator ani syndrome, as well as the distinction between myofascial pain syndrome and pudendal neuralgia. Separating the two is very difficult indeed, though at times a matter of semantics. Patients suffering from this condition are frequently treated similarly to the patients suffering from levator ani syndrome, though treatment is usually transvaginal and it involves massage of the trigger point; trigger point injections with mixture of 10 cc of 0.25 % bupivacaine, 10 cc of 2 % lidocaine, and 1 cc (40 mg) of triamcinolone which can then be used for injection of 5 cc per trigger point; Botox injections

(20–100 IU); and physical therapy [39]. If EMG reveals paradoxical contractions of the puborectalis, patients are also offered EMG-guided biofeedback.

11.2.1.4 Coccydynia

Coccydynia is a rare condition involving pain upon pressure on the coccyx. This is different from the pain elicited on DRE exam following palpation of the puborectalis (levator ani syndrome), though the two conditions are sometimes confused [40]. Pain is more common in obese women, and it is usually triggered by sitting on hard surfaces [41]. Treatment involves patient education and advice to focus on avoiding sitting without a cushion, posture change, and anti-inflammatory drugs [42]. When these fail, some may benefit from physical therapy and intrarectal pelvic floor muscle manipulation, although a recent prospective randomized trial of 102 chronic coccydynia patients only showed a 22 % success rate in the manipulation arm [43]. A minority of patents (19 %) may be candidates for partial coccygectomy, and selected series report an 80 % satisfaction rate after recovering from a procedure that has complication rates nearing 50 % [44].

11.2.1.5 Pudendal Neuralgia

Pudendal neuralgia, which is also known as pudendal neuropathy, pudendal nerve entrapment, cyclist's syndrome, pudendal canal syndrome, or Alcock's syndrome, is a disorder of unknown frequency and of unclear relevance when it comes to the differential diagnosis of isolated chronic anal pain. The symptoms potentially attributable to pudendal neuralgia include a superficial burning sensation and numbness in the perianal and genital areas, with paresthesia—as opposed to a deeper rectal pain.

For years, the disease was thought to be rare and usually attributable to pelvic trauma, repetitive sitting injury (e.g., competitive bicycling), or pelvic radiation [15]. A more controversial theory states that pudendal neuralgia can be caused by a repetitive stretching injury of the pudendal nerve during its course in the Alcock's canal by perineal descent (Fig. 11.14). While this hypothesis has been met with enthusiasm by surgeons who then reported case reports of successful outcomes following pudendal nerve release, others have called the diagnosis into question [45].

Pudendal neuralgia is not clearly defined in the literature. It appears to be considered more frequently in certain urogynecological and pelvic floor practices with a heavy interest in the condition. The possibility of pudendal neuralgia is usually raised if and when a patient with chronic pain presents with a PNTML delay during their anorectal physiology testing [46]. However, some argue that even patients with normal PNTMLs can have nerve entrapment, with isolated sensory impairment. While the theory behind pudendal neuralgia is plausible, the literature pertaining to its treatment is controversial, especially given the suspect and potentially self-serving assertion by a limited group of pudendal neuralgia experts who state that the diagnosis of pudendal neuralgia in the end can only be reliably diagnosed and unequivocally confirmed at surgical exploration. Thus, a patient is asserted to have pudendal neuralgia if they are found to have an entrapped nerve at surgery and if their symptoms of pain are resolved following nerve release. Utilizing this liberal

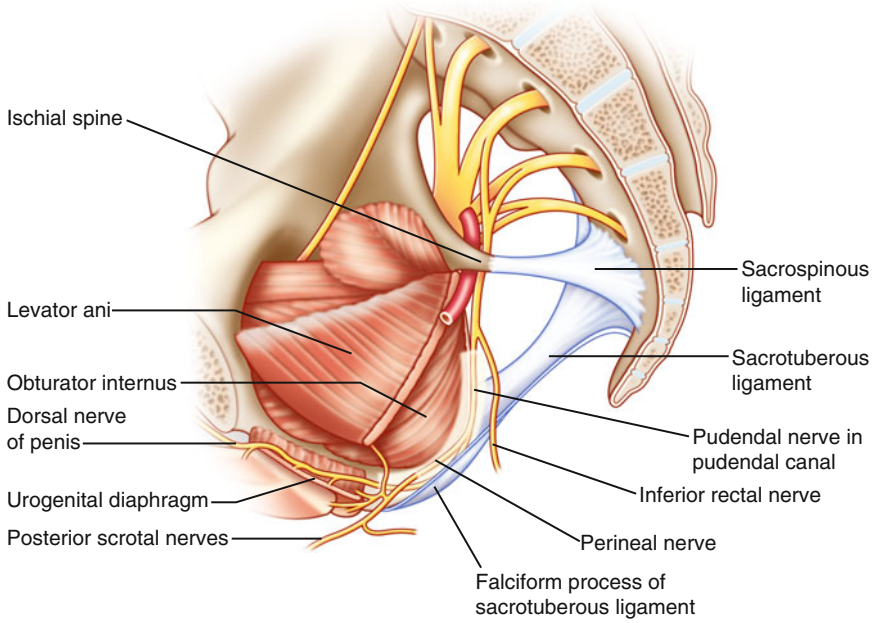

Fig. 11.14 Path of pudendal nerve through the Alcock's canal—the space between sacrospinous and sacrotuberous ligaments is tight so scarring, repetitive injury in a sitting position, and perineal descent can compress the nerve and cause pudendal neuralgia

approach, a randomized controlled trial of 32 patients randomized to surgery versus no care reported a much better improvement rate in the surgery group. Authors document a 50 % improvement in the symptoms of patients randomized to surgery group versus a 6.2 % improvement in the non-surgery group [47]. The study came from a group that has reported a series of over 400 patients treated with pudendal nerve releases over the course of 20 years, with authors admitting that many patients required further interventions following pudendal nerve releases, despite reporting satisfaction. Another smaller series of 12 patients undergoing pudendal nerve neurolysis and transposition of 19 nerves (7 bilaterally) reported a much lower long-term success, with successful resolution of pain in only 3 patients, raising the question of the placebo effect [48].

Given the controversial nature of the diagnosis and the need for better research using common criteria, arguments have been made for a clear definition of what constitutes pudendal neuralgia. A 2008 meeting of pudendal neuralgia experts stressed that the diagnosis cannot be made if the pain extends beyond the spots usually innervated by the pudendal nerve. Furthermore, they stressed that the pain is not nocturnal, and it usually gets worse with sitting (when nerve is put on stretch). The panel also agreed that a pudendal nerve entrapment is more likely if the pain is relieved by anesthetic infiltration along the path of the pudendal nerve.

Disappointingly, however, the ultimate conclusion of the panel is that the only way to confirm the disease is surgical exploration [49].

While the interest in pudendal neuralgia appears to be on the rise among pelvic floor disorder experts, there is still a paucity of high-quality data regarding the true incidence of this condition and—even less so—on how to treat it if one is convinced that the pudendal nerve is indeed to blame for a patient's chronic pain. Until high-quality, reliable data is available, we advocate that these patients be treated conservatively with biofeedback, physical therapy, myofascial/puborectalis massage, and trigger point injections and drugs. If all fail, possibility of pudendal nerve entrapment could be entertained and investigated with a pudendal nerve MRI. If the test suggests the possibility of a tight Alcock's canal, a CT or US-guided diagnostic pudendal nerve injection could be considered. We do not believe surgery to release the nerve should be considered at all except for very specific circumstances and following a multidisciplinary evaluation with a neurologist, physical therapist, colorectal surgeon, spine surgeon, pain medicine specialist, and a psychiatrist. Even then, pending good data, the procedure should have no place outside carefully scrutinized peer research trials.

11.3 Conclusions

Chronic anal pain can be a frustrating disorder for both patients and clinicians. Though prevalent, patients rarely seek care for it and instead suffer a great decrease in quality of life. Though high-quality data is sparse, this chapter presents a stepwise work-up to identify and treat the multiple causes of chronic anal pain. It is of great importance to diligently and thoroughly exclude all nonfunctional causes of the pain before starting a work-up of functional pain. Despite all that we know, much more work needs to be done to elucidate the causes of chronic intractable anal pain and to discover appropriate therapeutic options. Finally, these patients will likely do best in a multidisciplinary and customized approach to their care.

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Anal Cancer

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The incidence of anal cancer has increased in recent years in both the general population and particularly in high-risk groups. The commonest type is epidermoid which includes squamous cell carcinoma (SCC): keratinizing, nonkeratinizing, and basaloid. Other anal cancers include adenocarcinoma, malignant melanoma, lymphomas, etc. Many different cell types are found in the anal canal: all of which may give rise to an associated malignancy. Risk factors include human papillomavirus infection (HPV), anoreceptive intercourse, cigarette smoking, and immunosuppression. The HPV vaccine should theoretically reduce the incidence of HPV-associated malignancies [1]. Its efficacy in reducing progression to dysplasia was greatest when administered to a population free of HPV infection and has no effect against active infection or existing dysplasia [2]. Local staging of anal canal cancers is achieved by endoanal ultrasound and or magnetic resonance imaging (MRI) of the pelvis. Computerized tomography (CT) scanning is used for detection of distal disease. The anatomical location is critical, with true anal canal cancers having increased potential for spread and thus requiring aggressive treatment in comparison to perianal skin cancers which can be treated by local excision. There is debate but most consider the true anal canal extending from the anorectal junction/rectal mucosa to the anal verge. Some SCCs may be found above the dentate line in the transformation zone in which a transitional epithelium may be found instead of rectal columnar mucosa [3]. The perineal skin extends from the anal verge to a 5 cm radius. Early detection improves survival in most cancers but is of paramount importance with anal canal cancers, many of which have a premalignant phase. Patients presenting with anorectal symptoms require a careful digital rectal

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examination for underlying pathology, and if a diagnostic doubt exists, then a formal examination under anesthesia (EUA) or referral to a specialist is appropriate. Examination for inguinal lymphadenopathy is mandatory. Lesions above the dentate line drain to the inferior mesenteric nodes and lateral to internal iliac nodes. Below the dentate line, the drainage is to the inguinal and femoral nodes. The mainstay of treatment for SCC of the anal canal is a combination of chemotherapy and radiotherapy. The overall aim for all patients presenting with an anal canal cancer is cure with preservation of sphincter function. Surgery (in the form of abdominoperineal resection) for SCCs is generally reserved for refractory or recurrent disease, but benefit varies depending on the histological type. The potential for an underlying anal canal cancer should not be overlooked in patients with long-standing anal canal diseases such as Crohn's and fistula in ano especially if they develop a change in symptoms. Bowen's disease and Paget's disease are premalignant conditions with the potential to give rise to SCC and adenocarcinoma, respectively.

This chapter attempts to address some clinical conundrums associated with the management of malignant disease of the anal canal and explores common presentations and treatment options through clinical case presentations and discussion of associated learning points.

12.1 Incidence

Anal cancer is a relatively rare disease, but the incidence has been increasing over the last three decades. According to the SEER4 database (http://seer.cancer.gov/statfacts/html/anus.html), 7210 new cases will be diagnosed in the USA in 2014 representing 0.4 % of all cancers. There will be a total of 950 deaths from anal cancer in 2014 (representing 0.2 % of all cancer deaths). Risk factors include human papillomavirus (HPV) infection (particularly subtype 16), anoreceptive intercourse (male and female), cigarette smoking, and immunosuppression. While there appears to be an association between human immunodeficiency virus (HIV) and anal cancer, it is difficult to distinguish it as an independent risk factor because of concomitant immunosuppression and coinfection with human papillomavirus (HPV).

12.2 Presentation, Diagnosis, and Management

The anal canal extends from the anal verge to the rectal mucosa. The dentate line represents a zone of transition from squamous to non-squamous mucosa. Tumors arising in the anal canal are histologically classified as follows: squamous cell carcinoma, verrucous carcinoma/giant malignant condyloma of Buschke–Lowenstein, and adenocarcinoma—arising in the epithelium of the anal canal including the mucosal surface and anal glands, basal cell carcinoma (perianal skin), extramammary Paget's disease, and anal melanoma (1–3 % of all anal tumors). Squamous cell carcinoma represents the commonest tumor type. Previously (WHO 2002), they were classified into subtypes of large cell keratinizing, large cell nonkeratinizing,

and basaloid/cloacogenic carcinoma. It is now recognized that most squamous carcinomas show more than one histological subtype. The current WHO *Classification of Tumours of the Digestive System* (fourth edition, 2010) now groups these three subtypes under one heading of squamous cell carcinoma [4].

The majority of cases present with early-stage localized disease. The T stage of an anal cancer refers to the size of the lesion at its greatest dimension [5]. T1 tumors are 2 cm or less. T2 tumors are greater than 2 cm but less than 5 cm. T3 lesions measure greater than 5 cm, and T4 tumors are of any size with invasion into adjacent extradermal tissues such as the cartilage, skeletal muscle, or bone. With respect to nodal status, the TNM system recognizes the absence or presence of regional nodes, with N0 representing the absence of involved nodes and N1 representing the presence of involved nodes. The system is similar with respect to metastatic disease, with M1 referencing the presence of distant metastatic disease (Table 12.1). The diameter of the lesion and the absence or presence of involved lymph nodes are the most reliable predictors of survival and determinants of prognosis. Survival rates worsen significantly as the tumor diameter increases. It has been reported that 17.5 % of patients presented with T1 lesions and had 100 % 5-year survival; 66.6 % of patients presented with T2 lesions and had a 5-year survival rate of 61 %; and 15.8 % of patients presented with T3 lesions, with a survival rate of 12.5 %. As with most cancers, nodal involvement increases with tumor size [6–8]. With nodal metastases, survival rates decrease and prognosis deteriorates. In one study, 26 % of patients had inguinal nodal metastases at the time of presentation. Nodal

Table 12.1 The TNM staging system for perianal squamous cell cancer

Primary tumor (T)	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor 2 cm or less in greatest dimension
T2	Tumor more than 2 cm but not more than 5 cm in greatest dimension
T3	Tumor more than 5 cm in greatest dimension
T4	Tumor of any size that invades adjacent extradermal tissue(s): bone, cartilage, skeletal muscle
Regional lymph nodes (N)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Regional lymph node metastasis
Distant metastases (M)	
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

involvement was not seen with T1 tumors (less than 2 cm). In tumors between 2 and 5 cm (T2), nodes were involved in 23 % of cases, and in tumors greater than 5 cm (T3), nodes were involved in 67 % of cases. Other important tumor factors potentially affecting survival are the depth, presence of sphincter involvement, degree of differentiation, and the location of the primary. The presence of an inguinal lymphadenopathy should always lead to examination of the anal canal given the potential for tumors below the dentate line to metastasize.

Until 40 years ago, treatment of anal cancer usually consisted of abdominoperineal resection. The standard of care for epidermoid anal cancer is now concurrent chemoradiotherapy with surgery usually reserved for those with residual disease following systemic therapy or locoregional recurrence [9]. Even in patients with locally advanced anal cancer with infiltration of the prostate or vaginal fistulization, the first-line treatment is chemoradiotherapy. In those with a vaginal fistula and associated fecal incontinence, a defunctioning stoma may be necessary for symptomatic control. The timing of repeat biopsies of the anal canal lesion is important. We recommend waiting 10–12 weeks following final dose of radiotherapy before performing EUA and biopsy. In patients who have undergone chemoradiotherapy and are found to have persistent local disease or develop recurrent disease, then a salvage abdominoperineal resection is recommended. In this scenario an extralevator abdominoperineal resection is critical. We would perform the abdominal component of the procedure in the lithotomy position and the perineal part with the patient in the prone-jackknife position. In these cases we would consider the application of a myocutaneous flap to the dead space. These perineal wounds have a high potential for breakdown as a significant part of the perianal and or perineal skin often has to be removed leaving a dead space best filled by autologous tissue. Whether one used a gracilis, rectus abdominis of gluteal flap depends on patient factors and opinion/experience of the plastic reconstructive surgeon involved in the case.

Often following chemoradiotherapy, patients complain of significant anorectal dysfunction. This includes tenesmus, bowel frequency, and urge and true fecal incontinence. Radiation proctitis with associated rectal bleeding is often a nuisance reducing quality of life (Fig. 12.1). Treatment options consist of topical medications such as steroid and sucralfate enemas. Other treatments include the use of formalin solution or endoscopic argon plasma coagulation (APC) [10]. While APC has a limited depth of penetration, we would advise caution given potential for a devastating rectovesical or rectourethral fistula especially when applied in the prostatic region. In refractory cases we have used hyperbaric oxygen therapy, and on occasions, significantly symptomatic patients have resorted to colostomy. Infertility is also a significant risk in both sexes.

If a diagnosis of adenocarcinoma is histologically confirmed, it should be treated as a rectal cancer (neoadjuvant chemoradiotherapy or short-course radiotherapy and anterior resection/abdominoperineal resection depending on tumor location). If a perianal skin cancer can be safely removed with a clear margin without sphincter compromise, then this is appropriate with careful follow-up. If the perianal skin cancer is extensive or there is risk of sphincter damage with excision, then chemoradiotherapy is appropriate. However, there is still significant debate as to what

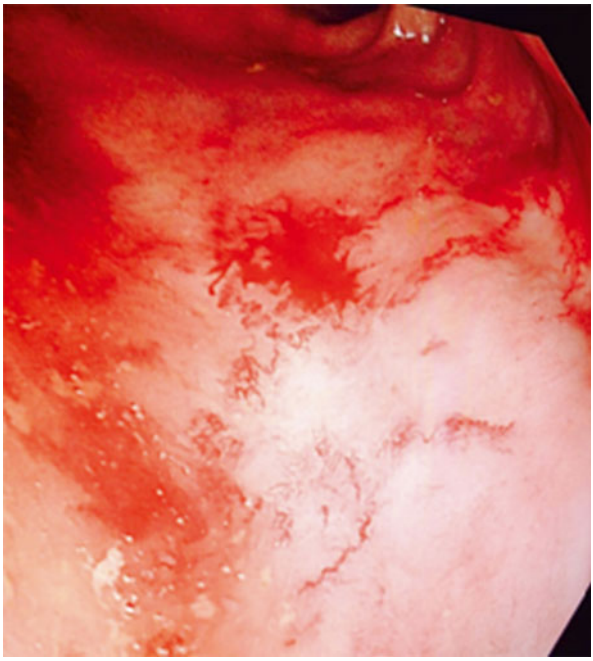

Fig. 12.1 Radiation proctitis with characteristic telangiectasia

represents a true perianal skin canal and what is a true anal canal cancer. If the perianal skin lesion encroaches on the anal verge, then we tend to treat it as a true anal canal lesion given potential for lymph node involvement.

In addition to endorectal ultrasound, MRI, and CT scans, there has been interest of late in 2-[18F]-fluoro-2-deoxy-D-glucose (FDG) positron emission tomography (PET). Its value, however, is questionable because most tumors demonstrate some element of uptake even following treatment, and the consensus is that PET tends to overstage anal cancer. Thus, its role in the detection of locoregional disease in patients with biopsy-proven anal canal caner is still evolving [11].

Common presentations of anal canal cancer are rectal bleeding (often attributed to hemorrhoids which may coexist), pain on defecation, palpable mass, or tenesmus. Almost a quarter of patients have no symptoms at the time of diagnosis, and anal cancer is an incidental finding. Irrespective of age, one should have a high index of suspicion in patients presenting with bleeding per rectum and avoid the presumption that it is due to hemorrhoids. Investigations should be performed in stepwise manner.

- History and clinical examination
- Full colonoscopy
- +/−Examination under anesthesia with biopsy
- +/−CT abdomen/pelvis

Surgeons and physicians dealing with anorectal pathology should be familiar with the potential differential diagnoses:

- Hemorrhoid
- Anal skin tag
- Squamous cell carcinoma of the anus
- Adenocarcinoma of the rectum
- Condylomata acuminata
- Malignant melanoma

The following cases highlight some of the diagnostic and management dilemmas that may be associated with management of anal cancer. They represent typical patients commonly presenting to any colorectal service. A short case history is followed by a brief description of learning points and discussion of evidence-based management options where applicable.

12.3 Case 1

A 43-year-old heterosexual man with no history of sexually transmitted infections presented to the colorectal department with a small verrucous lesion close to the anal canal. He complained of local pain, intermittent abscess formation, pruritus, bleeding, malodor, and altered bowel habits. He underwent full colonoscopy which was otherwise normal and was booked for wide local excision of the lesion. Unfortunately, he failed to attend for the operation. Three years later, he represented with a far larger lesion (14 × 9 cm) and a slightly smaller lesion on the contralateral anal canal. MRI scan confirmed that there was no deep invasion. He underwent EUA and biopsy. Histology confirmed verrucous carcinoma.

12.3.1 Learning Points

- Associated with HPV-6 and HPV-11, verrucous carcinomas or Buschke–Lowenstein tumors are large, soft, fleshy, painful, cauliflower-like cancer.
- They are slow growing but relentless.
- Although benign, they have potential for local erosion to the ischioanal fossa and perirectal tissue. They do not metastasize.
- Microscopically, verrucous carcinoma looks like condyloma acuminata. Wide local excision is the treatment of choice, with abdominoperineal resection (APR) performed in unusual cases of late-stage disease with sphincter invasion.
- Radical excision may be necessary in order to achieve a cure.
- Reports of radiotherapy, imiquimod treatment, and CO_2 laser treatment are available, but wide excision with postoperative vigilance looking for recurrences is the mainstay of therapy.

12.4 Case 2

A 39-year-old homosexual male presented with anal discomfort, intermittent bright red blood per rectum, tenesmus, and a palpable mass inside the anal verge. He had had unprotected anal intercourse with multiple partners over the preceding 10 years.

Examination under anesthesia (EUA) revealed a hard pedunculated mass below the dentate line. Multiple biopsies were taken and sent for urgent histopathology. Further examination demonstrated enlarged, hard, non-tender lymph nodes in the left inguinal canal.

Endoanal ultrasound was performed for evaluation of tumor size and extension and infiltration of the sphincter muscle complex. It confirmed a 4×2 cm lesion invading the anal sphincter (T3N1). Biopsies demonstrated invasive squamous cell carcinoma. He was found to have HPV p16 infection. P63 positivity confirmed the squamous origin of the tumor (Fig. 12.2a–c). Staging CT of thorax, abdomen, and pelvis was negative for distant metastases. Serology was positive for human immunodeficiency virus (HIV). CD4 count was 620.

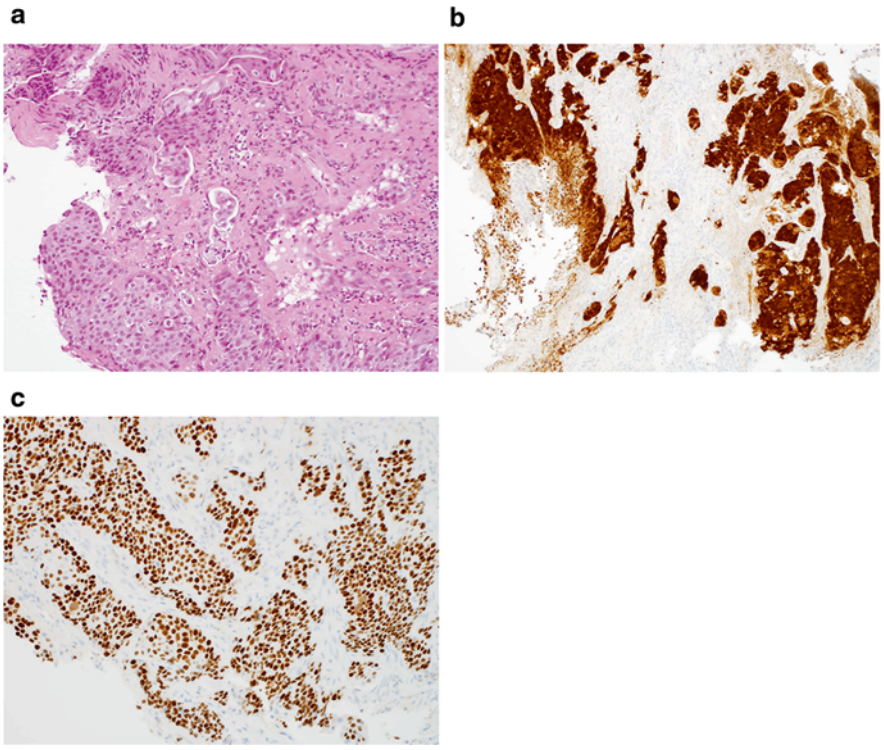

Fig. 12.2 (**a**) Invasive squamous cell carcinoma. (**b**) Immunohistochemistry with p16 showing diffuse staining in invasive squamous cell carcinoma indicating association with high-risk HPV. (**c**) Immunohistochemistry positivity with p63 nuclear stain confirming "squamous" origin of the carcinoma

Chemoradiotherapy and antiretroviral therapy were commenced. EUA was performed 12 weeks following completion of systemic treatment, and there was no visible or palpable lesion. Biopsies were taken and did not demonstrate any residual tumor cells. The patient was considered to have undergone a complete pathological response and was enrolled on a surveillance program to ensure early detection in the case of recurrent disease.

12.4.1 Learning Points

- The relation between anal cancer and receptive anal intercourse is similar in both sexes and is independent of immunosuppression [12].
- Anal cancer is much more frequent in HIV-positive homosexual males in comparison with HIV-seronegative persons [13]. All high-risk patients presenting with anal cancer should undergo HIV testing.
- Presentation of anal cancer in the HIV-positive population does not differ when compared to the general population. Anal pain, fissures, fistulae, diarrhea, bleeding, and exophytic verrucous anal lesions are the most common clinical manifestations [14].
- The combination of HAART and chemoradiotherapy is as safe and effective for immunodeficient and immunocompetent patients [12–15].
- Pretreatment CD4 count <200/mm^3 increases the likelihood of toxicity, and so these patients should be treated with caution, while patients with CD4 counts ≥200/mm^3 can be expected to tolerate combined modality therapy.

12.5 Case 3

A 55-year-old woman presented with perianal discomfort and a sensation of irregular skin while cleaning with intermittent "spotting" of bright red blood. She was previously fit and healthy apart from a hysterectomy 20 years earlier for cervical cancer. Local and distant staging confirmed a T3N1 squamous cell cancer of the anal canal, and she underwent chemoradiotherapy (45 Gy in 1.8-Gy fractions over 5 weeks) with 5-FU (1000 mg/m^2 per day on days 1–4 and 28–31) and bolus mitomycin (10 mg/m^2 on days 1 and 28, with a maximum of 20 mg per cycle) [16]. She had a good clinical response and tolerated therapy well. Examination under anesthesia was performed 12 weeks following completion of chemoradiotherapy. No abnormality was detected either clinically or histologically. At surveillance EUA 18 months later, she was found to have a lesion at the site of the previous tumor (Fig. 12.3a). Biopsy confirmed it to be a squamous cell carcinoma. Following discussion at the multidisciplinary meeting (MDM), the decision was taken to perform a salvage abdominoperineal resection with posterior vaginectomy. A gracilis flap was used. Final histology demonstrated a T3N0M0 tumor (Fig. 12.3b, c). She made an uneventful recovery and will have surveillance CT scans to monitor for distant metastases.

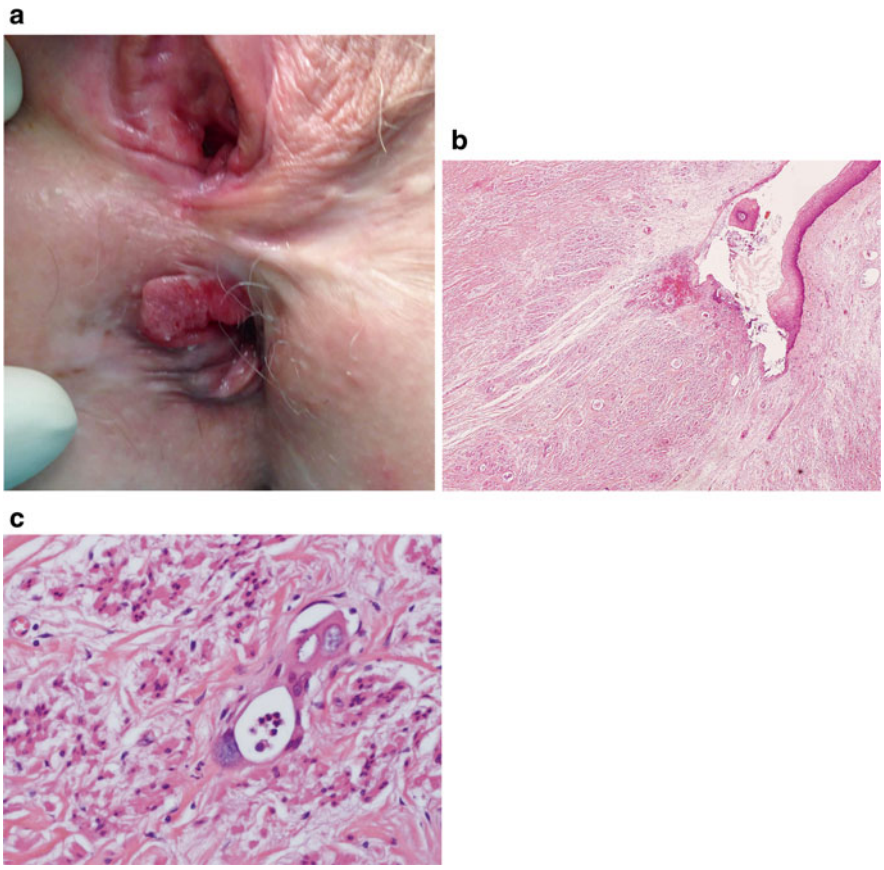

Fig. 12.3 (**a**) Recurrent anal canal cancer. (**b**) Low power of ulcerating residual tumor bed anal canal. (**c**) H&E section showing focal residual carcinoma where residual tumor cells show a glandular-type morphology (mucin globules and gland outline)—a well-recognized phenomenon in post-therapy changes. Near-complete response to neoadjuvant therapy (immunohistochemistry confirmed squamous immunophenotype as did review of pretreatment biopsy)

12.5.1 Learning Points

- There is no consensus as to whether physical examination alone is sufficient following treatment or whether biopsy is necessary in the presence of complete clinical response.
- Five-year local disease failure rates are different between those patients receiving radiation alone (52.5 %) and those receiving combined chemoradiation (35.3 %). In the radiation alone group, age, total radiation dose <50 Gy, and higher T stage predicted local failure. For patients receiving combined chemoradiation, no predictive factor was identified [17].

- The preferred treatment for persistent disease following combined modality therapy is APR. The main complications of this procedure are delayed wound healing, wound infection, and local failure [18]. Unfortunately wound complications are common in all previously irradiated skin.
- Salvage chemoradiotherapy has been described, but up to a third of these patients inevitably ultimately require APR [16].
- Any patient with a history of cervical cancer should be carefully evaluated for anal cancer because of the causative role of HPV in both [17].

12.6 Case 4

A 39-year-old man presented for day-case hemorrhoidal artery ligation (HAL) for treatment of hemorrhoids. He was a vague historian but complained of perianal itch, occasional mucus discharge, and intermittent bright red bleeding per rectum. He was a smoker with a previous history of genital warts. He was placed in the lithotomy position, and an examination under anesthesia was performed. The hemorrhoid at the 7 o'clock position appeared unusual. It was large, bulky, and polypoid in nature. The operating surgeon decided not to proceed with HAL but to take multiple biopsies of the unusual hemorrhoid. Histology confirmed a poorly differentiated squamous cell carcinoma of the anus (Fig. 12.4a, b). Local and distant staging were undertaken, and the patient underwent chemoradiotherapy for management of anal cancer. He had an excellent clinicopathological response.

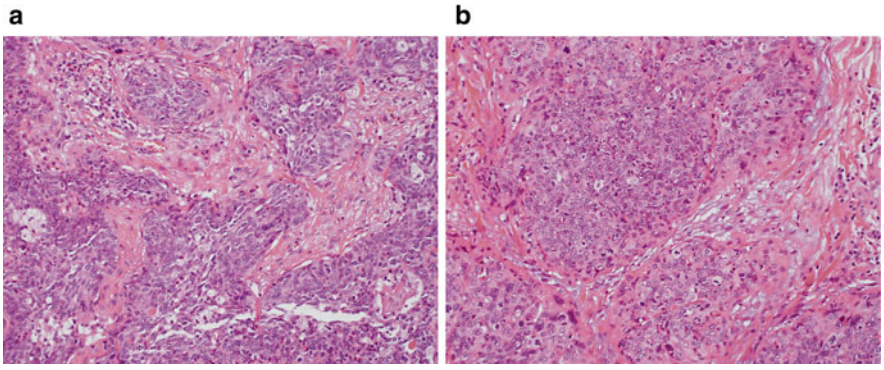

Fig. 12.4 (**a**) Invasive nonkeratinizing squamous cell carcinoma. (**b**) Abundant mitoses and cell pleomorphism indicating poorly differentiated tumor

12.6.1 Learning Points

- A low index of suspicion is essential when dealing with perianal pathology, and any unexpected findings should be thoroughly investigated to rule out neoplasia.
- Rectal bleeding should not be ascribed to hemorrhoids unless all other diagnoses have been definitively excluded.

12.7 Case 5

A 47-year-old gentleman presented with anal cancer. He had noticed a "lump" with associated bleeding some years earlier but due to fear of diagnosis decided not to present for medical attention. Anal canal biopsy confirmed an invasive nonkeratinizing SCC. Standardized staging demonstrated multiple bilobar liver metastases that were deemed unsuitable for surgical resection. Following multidisciplinary team discussion, the decision was taken to proceed to systemic therapy in the form of cisplatin and 5-fluorouracil as well as a targeted dose of 50 Gy radiotherapy. He tolerated treatment well but, unfortunately, 9 months following diagnosis, staging radiology demonstrated progression of disease. He underwent second-line chemotherapy but did not demonstrate any clinical response. Following institution of palliative management, he died 3 months later.

12.7.1 Learning Points

- Ten to 20 % of patients will develop distant metastases following combined modality treatment.
- The prognosis for patients with distant metastases is generally poor, although documented median survival rates vary from 8 to 34 months [19].
- The SEER database reports 5-year survival rates of 10 % in men and 20 % in women with distant metastases from anal cancer at presentation between 1973 and 2000 (http://seer.cancer.gov/statfacts/html/anus.html).
- The National Comprehensive Cancer Network (NCCN) Guidelines currently recommend cisplatin and 5-FU chemotherapy as first-line treatment of metastatic squamous cell carcinoma (http://www.nccn.org/professionals/physician_gls/f_guidelines.asp).
- Only six randomized trials relating to anal cancer have been performed over the last three decades (none examining treatment of metastatic disease). Therefore, available evidence consists of phase II trials, retrospective series, and case reports only [16, 19–24].
- The rare nature of metastatic anal cancer does not lend itself well to randomized control trial design—thus leaving a suboptimal evidence base from which to draw.

12.8 Case 6

A 68-year-old lady presented with a 6-month history of perianal discomfort and bright red blood per rectum. She had no family history of colorectal cancer, no weight loss, and no systemic symptoms. She had had banding of hemorrhoids 10 years previously with a good result and felt that the symptoms she was experiencing were consistent with hemorrhoids. Nonetheless, she underwent full colonoscopy which was normal to the cecum. Digital rectal examination demonstrated third-degree hemorrhoids at 5, 7, and 11 o'clock positions. Having discussed management options in detail with her, she opted for formal hemorrhoidectomy. All three hemorrhoids were excised, leaving adequate skin bridges. She had an uneventful perioperative course and made an excellent recovery. Histology of the excised specimen was consistent with hemorrhoidal tissue and showed a single focus of Bowen's disease within one hemorrhoid. This was completely excised. Perianal mapping with four quadrant biopsies revealed no further disease. The case was discussed at a multidisciplinary meeting, and the decision was taken to enroll the patient on a surveillance program of serial examinations under anesthesia and biopsies to monitor for recurrence.

12.8.1 Learning Points

- There is a lack of controlled data supporting an optimal treatment strategy for Bowen's disease or anal intraepithelial neoplasia serendipitously discovered in the hemorrhoidal tissue.
- It is considered reasonable by most surgeons to adopt a watch and wait approach and perform serial examinations under anesthesia to ensure early detection of recurrence.
- It may present as chronic dermatitis or raised erythematous area with associated fissures.

12.9 Case 7

A 45-year-old woman presented with a 6-month history of intermittent bright red rectal bleeding. She had not noticed any change in bowel habit, had not lost any weight, and had no family history of colorectal cancer. She underwent a full colonoscopy which was normal, apart from a deeply pigmented lesion at the anal verge. This was biopsied and histology confirmed malignant melanoma (Fig. 12.5a, b). Staging CT demonstrated multiple liver, spleen, and bone metastases throughout the spinal canal. Palliative chemotherapy was commenced and radiotherapy to the spine for management of bone pain. She died 6 weeks later.

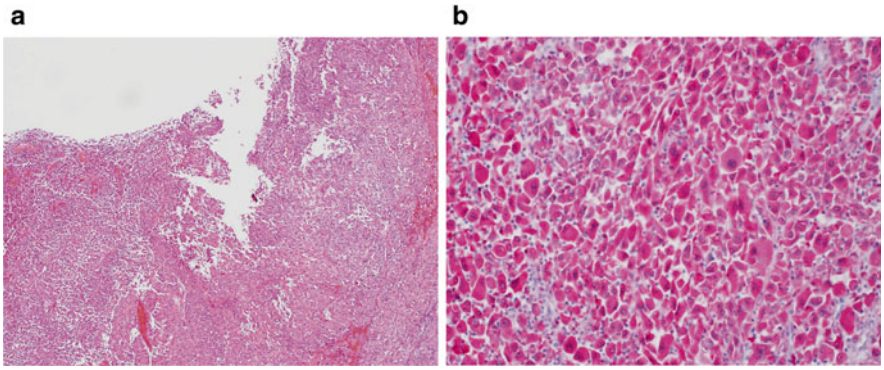

Fig. 12.5 (**a**) Low power view: ulcerating invasive melanoma. (**b**) Immunohistochemistry—positivity with mel A and S100

12.9.1 Learning Points

- Anal canal is the third most common site of melanoma after skin and eyes.
- It generally occurs adjacent to the dentate line from melanocytes.
- Bright red bleeding per rectum is the most common presentation.
- Most are highly pigmented lesions but diagnosis remains difficult—necessitating a high level of clinical suspicion.
- Tumors are highly aggressive and usually widely metastatic. For small symptomatic lesion, wide local excision may be considered if negative margins can be achieved. In the absence of distal disease, whether an abdominoperineal resection should be considered for locally invasive lesions is still very contentious with most studies showing no difference in long-term outcomes in patients who underwent local excision versus APR [25, 26].
- Tumors are usually radio- and chemoresistant.
- 5-year survival is <15 %.

12.10 Case 8

A 58-year-old lady with severe perineal Crohn's disease diagnosed 20 years earlier presented to the outpatient department with a painful, nonhealing fistula. This had been treated on several occasions with abscess drainage and with multiple setons to keep the patient free of sepsis and continent. She had been treated with azathioprine and infliximab for the past 17 months. She reported that one particular fistula was more painful and associated with increased mucus discharge that was atypical. Careful EUA revealed a small indurated area below the dentate line, and a punch biopsy was taken. This had been previously described on magnetic resonance imaging but was not deemed suspicious. Histology demonstrated a squamous cell carcinoma of the anal canal. Because of severe anorectal Crohn's disease, the option of

abdominoperineal resection (APR) was considered but the decision was taken that the inflamed perineum would be unlikely to heal. A diverting loop colostomy was performed and she was treated with chemoradiotherapy. Repeat biopsies of the inflamed area demonstrated inflammatory tissue only consistent with Crohn's disease. The anal cancer responded well to local radiotherapy. She was enrolled on a surveillance program with the aim of early detection of recurrence.

12.10.1 Learning Points

- Squamous cell carcinoma in perianal fistulae associated with Crohn's disease is rare, making diagnosis and management challenging [27–29].
- Anal cell carcinoma may present in an indolent fashion with little or no obvious external evidence of disease, and so a high index of suspicion is imperative.
- Management of complex perianal disease should be undertaken by personnel with ample experience in both Crohn's disease and anorectal cancer and should involve discussion at a multidisciplinary meeting involving gastroenterologists, surgeons, radiation oncologists, medical oncologists, pathologists, and radiologists.
- Because radiotherapy can induce tissue damage, especially in the skin that is already affected by severe Crohn's disease, the decision was taken to perform a diverting loop colostomy for the duration of treatment. In this case, it served dual purpose—to allow adequate irradiation for treatment of anal squamous cell carcinoma and also to facilitate healing of multiple Crohn's fistulae.
- If an abdominoperineal resection is indicated, most patients will require a myocutaneous flap given the extension of fistula tracts to anal margins that may be extensive.
- Clinical management should be patient centered and individualized.

12.11 Case 9

A 62-year-old previously fit and healthy woman presented to the colorectal service with a 3-year history of pruritus ani, an erythematous perianal skin rash with eczema, oozing and scaling, this was associated with constipation. Examination revealed a circumferential, slightly raised skin lesion extending proximally to the dentate line. Full physical examination was normal Colonoscopy was normal to cecum. CT of abdomen and pelvis did not demonstrate any sites suspicious for metastatic disease. Biopsy of the lesion confirmed anal Paget's disease (Fig. 12.6). There was no histological evidence of invasive cancer. She underwent wide local excision of the lesion surveillance examinations under anesthesia have been negative for 3 years.

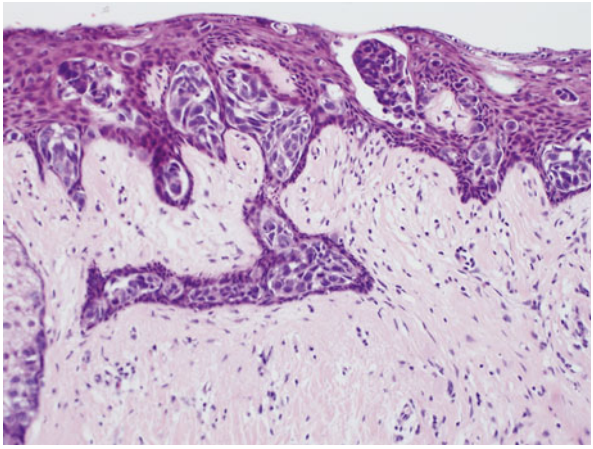

Fig. 12.6 Paget's cells—large, pale, clear cells singly and in clusters

12.11.1 Learning Points

- Anal Paget's disease is very rare, with less than 200 reported cases in the English language literature.
- It occurs in the seventh decade of life and affects men and women equally.
- Diagnosis is often delayed because of similarity to other benign anal skin conditions and physician unfamiliarity with the disease.
- For patients who do not have an invasive cancer, a wide local excision is the treatment of choice. With a noninvasive tumor, survival may approach 100 %.
- Patients initially presenting with invasive disease may be candidates for an abdominoperineal resection (APR), with an added inguinal lymphadenectomy in the presence of nodal disease.
- Recurrence rates are reported at 37–100 %. Most can be treated with repeat wide excision [30].
- A significant proportion of patients may have an underlying colorectal neoplasm.

12.12 Case 10

A 29-year-old woman presented with skin changes at the anal margin. Ten years previously she had been treated for cervical carcinoma in situ (CIS). We biopsied the area which reported anal intraepithelial neoplasia (AIN) with high-grade dysplasia (Fig. 12.7). We proceeded to anal mapping in which biopsies were taken in a circumferential manner from the dentate line downwards. Most of the biopsies reported AIN with high-grade dysplasia. Given the extensive area of involvement, we proceeded to a laparoscopic colostomy followed by removal of the involved perianal skin and anal margin and verge up to the dentate line. Great care was taken

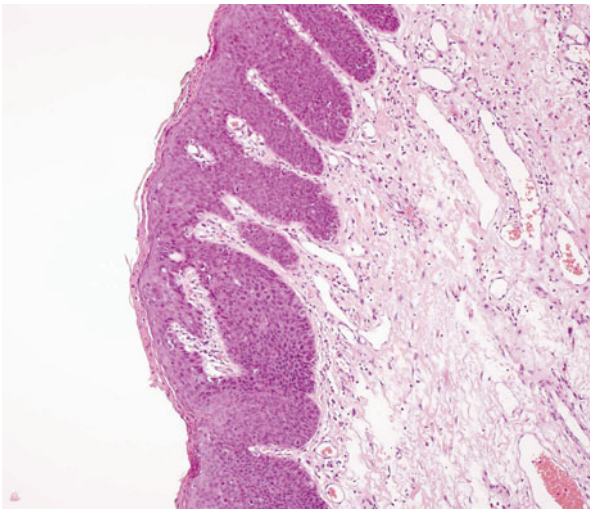

Fig. 12.7 Anal intraepithelial neoplasia III

to protect the underlying sphincter. This area was skin grafted and healed without fibrosis. The colostomy was closed at 6 months with no change in anorectal function.

- AIN is a precursor for anal cancer.
- Treatment consists of removal of macroscopic disease with margins.
- Multifocal involvement may necessitate more extensive surgery with potential for anal canal stenosis and fecal incontinence.
- Even with extensive surgery, there is still an inherent risk of further AIN or anal canal cancer.
- Other treatment options if the patient is not suitable for surgery include topical chemotherapy (5-FU), immunotherapy (imiquimod cream 5 % which slows the progression of disease but 80 % have a relapse after cessation of therapy), phototherapy, and there may be a role for radiotherapy [31].

12.13 Case 11

A 50-year-old man was referred by his general practitioner with an anal canal cancer. On examination he also had left inguinal lymphadenopathy. Biopsy of the anal canal region reported an anal canal adenocarcinoma (Fig. 12.8a). Biopsy of the inguinal node reported metastatic adenocarcinoma (Fig. 12.8b). He underwent chemoradiotherapy with radiotherapy to include the groin regions. Three months following neoadjuvant chemoradiotherapy, he then underwent an abdominoperineal resection with left groin lymphadenectomy.

- Histological confirmation of an anal canal lesion is critical given the potential for an atypical malignancy.

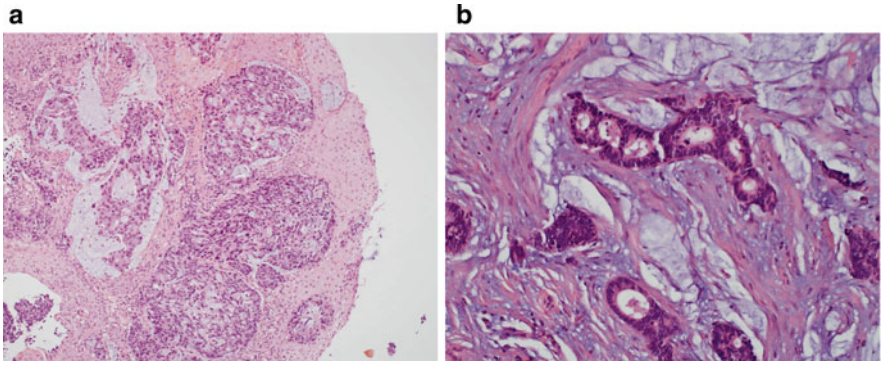

Fig. 12.8 (**a**) Adenocarcinoma of the anal canal. (**b**) H&E section of inguinal lymph node showing metastatic mucinous adenocarcinoma associated with known anal canal adenocarcinoma

- Anal canal adenocarcinoma is a rare malignancy with limited data on outcomes and consensus on treatment.
- The majority of tumors arise from anal glands or may be associated with fistula tracts.
- Outcome is poor with significant potential for distal disease [32, 33].

12.14 Case 12

A 32-year-old man was referred with a diagnosis of anal warts by his general practitioner. These lesions had been present for 5 years. He denied anoreceptive intercourse. At EUA he had extensive condyloma acuminatum affecting the perineum and anal canal. Several areas were removed and sent for histology. Histopathology reported anal condyloma with an associated squamous cell carcinoma (Fig. 12.9a, b). He was treated with chemoradiotherapy, achieving a complete clinical and pathological response.

- Condyloma acuminatum and HPV infection of the anal canal/perineum do occur in the absence of anoreceptive intercourse.
- Risk factors include the number of sexual partners and HPV infection in the genitals.
- Anal to genital self-inoculation of HPV has been documented. Hand transmission of HPV to anal canal may be a possibility.
- The two types of HPV that cause most cases of anal and genital warts are HPV-6 and HPV-11. These are low-risk subtypes and are generally not associated with

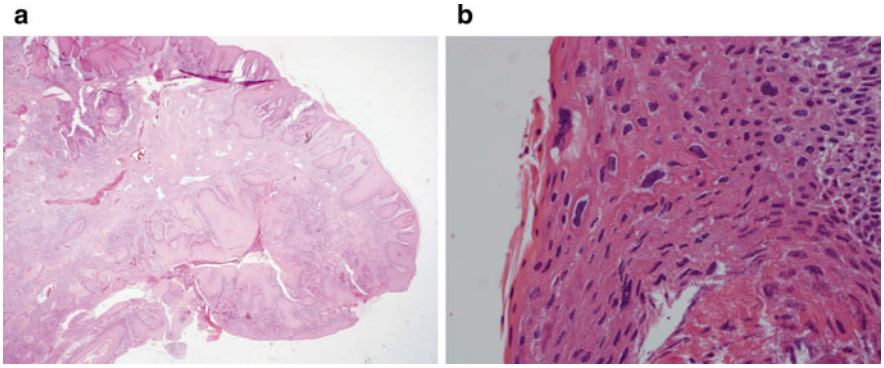

Fig. 12.9 (**a**) Low power view of condyloma acuminatum with squamous cell carcinoma. (**b**) Viral (HPV) cytopathic effect in overlying squamous epithelium: enlarged nuclei and vacuolated cells (koilocytes)

anal canal cancer. However, patients associated with low-risk types of HPV have a higher potential to be infected by high-risk types of HPV.

- The presence of anal and genital warts should raise an index of suspicion for an associated anal canal malignancy.

Because anal cancer is relatively rare, diagnosis can often be missed. A high index of suspicion in all patients presenting with perianal symptoms is imperative, and extensive investigation must be undertaken until the treating physician is satisfied that risk of neoplasia is acceptably close to zero. Like most disease processes, early detection leads to far better outcomes, and late presentation or recurrence of anal cancer carries a poor prognosis. The mainstay of treatment of squamous cell carcinoma of the anal canal is chemotherapy with mitomycin C and 5-fluorouracil in combination with local radiotherapy. In the case of residual or recurrent disease, abdominoperineal resection may be indicated. Physician and patient education are possibly the most important interventions in improving survival from these cancers. Increased awareness among the medical and general communities could lead to earlier detection and resultant improved outcomes. Delayed diagnosis has significant impact on patient well-being, quality, and quantity of life. Lack of quality trials investigating optimum management of metastatic squamous cell carcinoma renders management decision making difficult and leads to variations in care worldwide. It is imperative that all patients with anal cancer be managed by a multidisciplinary team and undergo adequate surveillance following initial treatment to ensure early detection of recurrent disease.

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Pilonidal Disease

13

Andrea Petrucci, Nancy Morin, and Marylise Boutros

13.1 Definitions and Risk Factors

The term "pilonidal" dates back to the year 1880 when R. M. Hodges coined the term which basically translates into "hair nest" [1]. A pilonidal sinus is a chronic subcutaneous tract in the natal cleft, which spontaneously drains through the skin openings [2].

Pilonidal disease is a common problem with an overall incidence of 26 per 100,000 individuals. This disease is most commonly seen in adolescents and young adults [3]. Pilonidal disease rarely occurs in individuals older than 40 years of age, and it is believed to be an acquired condition as opposed to a congenital one [4]. Patients with a deep natal cleft are prone to acquiring pilonidal disease because it is a favorable environment for sweating, maceration, bacterial contamination, and penetration of hairs [5]. Other predisposing factors include obesity, history of folliculitis or a furuncle on another body region, hirsutism, and family history. In a retrospective study published in 2009, a positive family history was found to also predispose patients to a higher recurrence rate after surgery [6]. It seems as though the familial predisposition is related to other family members having similar hair patterns and body habitus rather than an actual genetically transmitted origin of the disease. In addition, certain occupations such as hairdressers, military personnel, and sheep shearers were reported to be at increased risk of developing pilonidal disease [3].

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13.2 Pathogenesis of Pilonidal Disease

There is no objectified right answer as to how pilonidal sinuses form; however, there are two schools of thought about the pathogenesis of this disease. Bascom believed that the natal cleft was normal and that it was simply the result of a hair follicle filled with keratin that eventually becomes infected, very similar to a furuncle, extending its way into the subcutaneous fat (Fig. 13.1). A more common belief is that of Karydakis, who stated that a loose hair shaft finds its way into the gluteal cleft, burrowing into the skin, causing the formation of a pit which allows for other hair shafts to insert (Fig. 13.2). This loose hair eventually causes an inflammatory reaction that can either become chronic or develop into an abscess [7]. Though the latter theory is more widely taught and believed, there is no evidence to prove one theory over the other.

13.3 Clinical Presentation

How does one recognize pilonidal disease? Look for pits. These pits represent primary and secondary openings of the pilonidal sinus. The primary opening(s) is usually located at the base of the natal cleft, roughly 5 cm above the anus, and is the opening through which hair may be observed to protrude (Fig. 13.3). There is a subcutaneous tract that forms from this primary opening, creating a sinus. The sinus(es) can vary in length and number. The pit may form tracts that create a

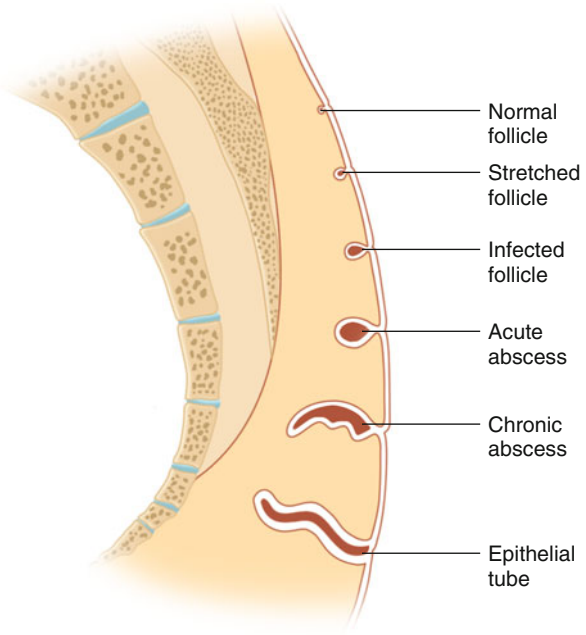

Fig. 13.1 Pathogenesis of pilonidal disease

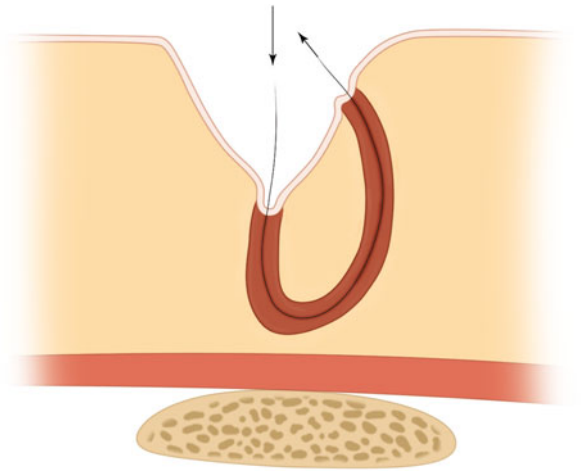

Fig. 13.2 Pathogenesis of lose hair inserting and burrowing under the skin, forming a sinus tract

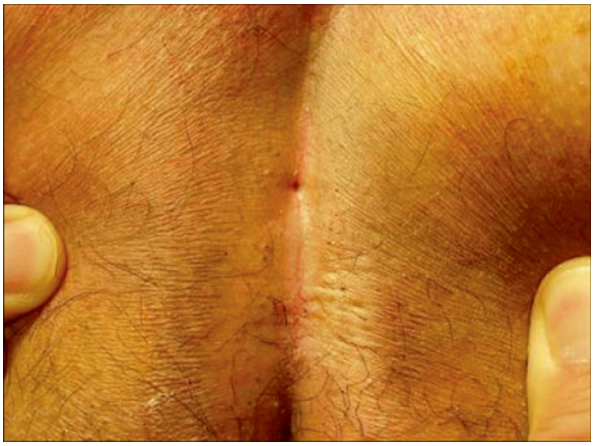

Fig. 13.3 Sinus opening in the natal cleft (adapted from Hong and Ryoo [7], with permission)

secondary opening off the midline. These secondary openings are where spontaneous drainage or incision and drainage of an abscess occur. The pilonidal tract along with its two openings, the primary and secondary sinuses, can be visualized on the sketch in Fig. 13.2. Patients can have a single or multiple secondary openings, depending on the chronicity and complexity of the disease.

Patients can present with either an acute pilonidal abscess, a single chronic draining sinus, or a complex or recurrent pilonidal sinus [3] which are treated in different ways as will be discussed later. A pilonidal abscess usually presents as a tender, fluctuant mass with overlying cellulitis (Fig. 13.4) as opposed to a chronic draining sinus, which shows no signs of infection. A chronic sinus presents with a primary pit located in the natal cleft often with possible hair sticking out of it's opening (Fig. 13.3).

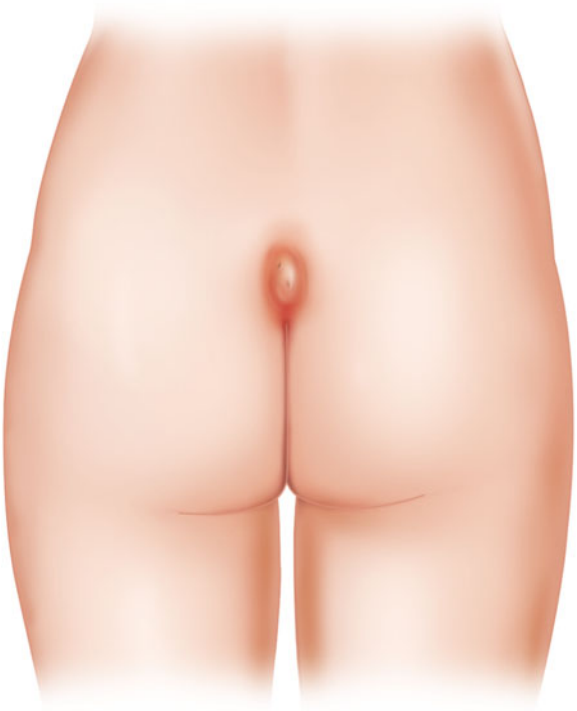

Fig. 13.4 Pilonidal abscess

Complex and recurrent pilonidal sinuses are usually the result of persistent sinuses or multiple abscess drainages that may have more than one opening to the skin. It is important to keep in mind that other diseases such as anorectal cryptoglandular abscesses, hidradenitis, and fistulas secondary to complex presentations of Crohn's disease can present similarly to pilonidal disease and need to be ruled out as possible differential diagnoses [8, 9]. Although pilonidal disease is not life threatening, it can be debilitating for the patient and poorly impact their quality of life. Regardless of the presentation of pilonidal disease, the ultimate goal for treatment is to decrease morbidity for the patient and to allow for quick recovery and return to daily activities.

13.4 Management of Pilonidal Abscesses

Case 1

A 24-year-old man presents to the emergency room complaining of "pain over their tailbone." This is the first time he has ever felt such pain. He recalls falling on his tailbone during his speed skating practice roughly 2 weeks ago. He also mentions that he had a fever yesterday with some chills over the last 2 days. He first noticed

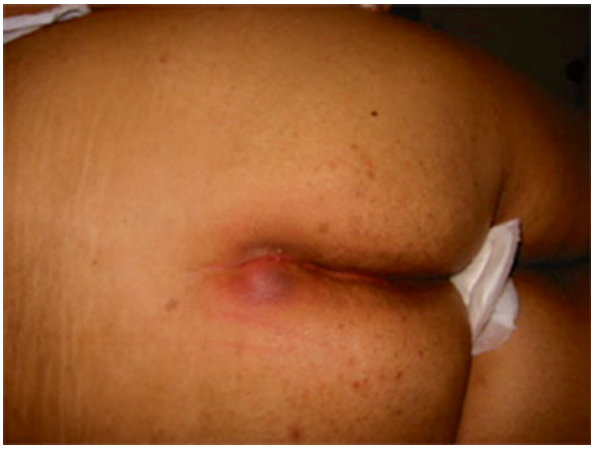

Fig. 13.5 Pilonidal abscess (from Slater [9] with permission)

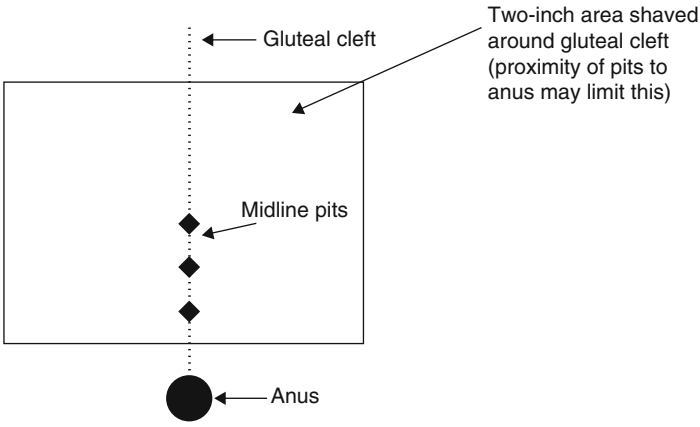

Fig. 13.6 Technique for shaving (adapted from Papaconstantinou and Thomas [3], with permission)

a "lump" about a week ago but came in today to see you because he felt that it increased in size and the pain was keeping him up at night. He denies any other lower gastrointestinal symptoms or abdominal pain.

On exam, he is afebrile and his vital signs are all within normal limits. Abdominal and digital rectal exam are unremarkable. You notice an inflamed, erythematous lump at the natal cleft with no spontaneous discharge (Fig. 13.5). It is very tender and fluctuant.

This is a typical presentation of a pilonidal abscess. Just as in any other clinical presentation of an abscess, this patient presents with the universal signs of erythema, pain, and cellulitis. In the case of a pilonidal abscess, the technique used to drain the abscess is important (Fig. 13.6).

When a patient presents with a pilonidal abscess, it is usually located lateral to the midline despite the initial sinuses being located in the midline, along the gluteal

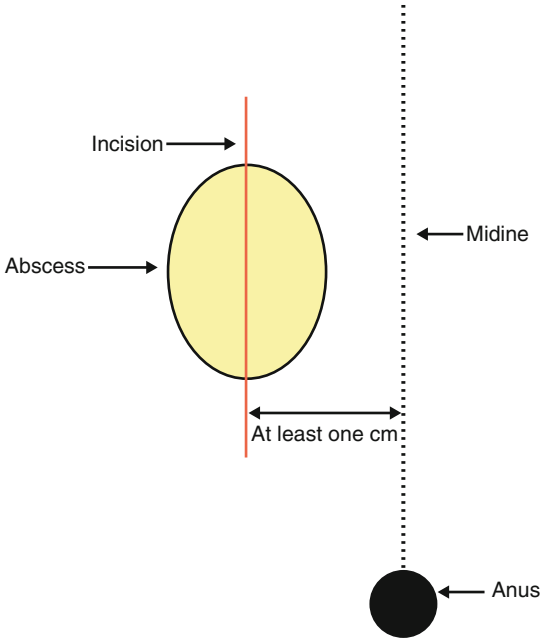

Fig. 13.7 Sketch of proper incision technique for incision and drainage of a pilonidal abscess (adapted from Papaconstantinou and Thomas [3], with permission)

cleft. Studies have shown that the best way to drain the abscess is to make the incision off the midline [2] because this leads to better healing. A midline wound is under constant traction and vacuum forces that allow surrounding hair and bacteria to enter the wound impair wound healing [10], whereas an off-midline incision may be less likely to create this traction force. The incision is ideally made about 1 cm lateral to the midline and deepened all the way down into the cavity, to ensure that the abscess cavity is opened and pus and any other material, such as hair, can be evacuated [3] (Fig. 13.7).

Once this is completed, the incision is converted to a cruciate or elliptical incision to ensure the skin and subcutaneous tissues overlying the abscess cavity do not close prematurely and lead to a recurrence of the abscess. The cavity is then copiously irrigated. A randomized control trial assessed the benefit of performing a curettage at the time of incision and drainage, and the authors found that there was a significant difference in healing at 10 weeks after the procedure and lower recurrence rates observed with curettage [11]. This is due to removal of all inflammatory debris that may impair healing and removal of all epithelialized surfaces to encourage quicker wound healing. As such, once the cavity is irrigated, a gentle curettage should be performed, followed by a light packing of the cavity (Fig. 13.8).

The act of packing a wound and removing the packing for cleansing at least once daily promotes healing; however, it can be quite painful and bothersome for the patient, which may lead to poor posttreatment compliance to wound care. For this reason some surgeons advocate that the packing be removed the following day by the patient and the cavity be washed with soap and water, preferably two to three times a day to accelerate healing [2, 3] and to help keep the area clean. If the

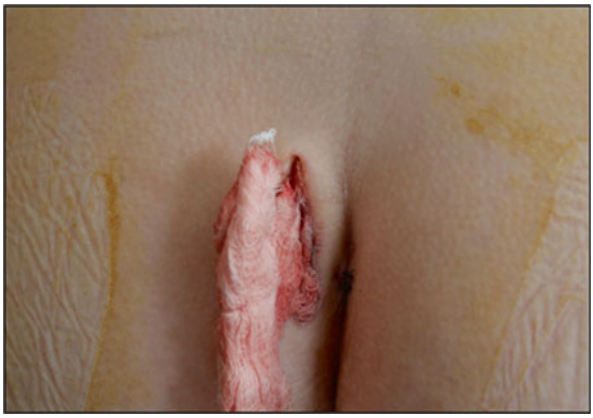

Fig. 13.8 Packing post incision and drainage

wound is packed daily, it should be lightly packed with saline gauze to allow a good balance between keeping the wound dry and promoting the formation of granulation tissue to ensure proper healing. Any hypertrophic granulations tissue should be cauterized with silver nitrate as this will allow for adequate epithelialization to occur [2].

One very important point for the promotion of healing and prevention of recurrent disease is to ensure that hair surrounding the diseased area is shaved regularly. There should be a close follow-up, with visits scheduled every 2 weeks in order to ensure that the wound is healing well and there are no signs of recurrence [3, 11].

Although this patient presented with a history of fever and chills, incision and drainage of the abscess is sufficient to treat the infection. The role of post-drainage antibiotics has been reviewed, and there is no strong evidence to consider treating patients after drainage with antibiotics as such treatment has not been shown to improve the risk of wound complications and healing rates [11]. The only patients for whom post-drainage antibiotics may be considered are those who are immunocompromised, have any prosthetic implants, are known diabetics, or have significant cellulitis [11].

Most pilonidal abscesses heal very well following incision and drainage [11]; however, some may require further incision and drainages or debridement because of the excess in granulation tissue that forms in the wound. All pilonidal sinuses, if symptomatic, will need further elective management for eradication.

13.5 Management of a Pilonidal Sinus

Case 2

The same 24-year-old patient, who presented with a pilonidal abscess earlier, now comes to your office, 3 months after having his abscess drained in the emergency room. He is feeling well and his wound has healed. He comes to see you because he is complaining of staining his undergarments regularly with light colored yellow

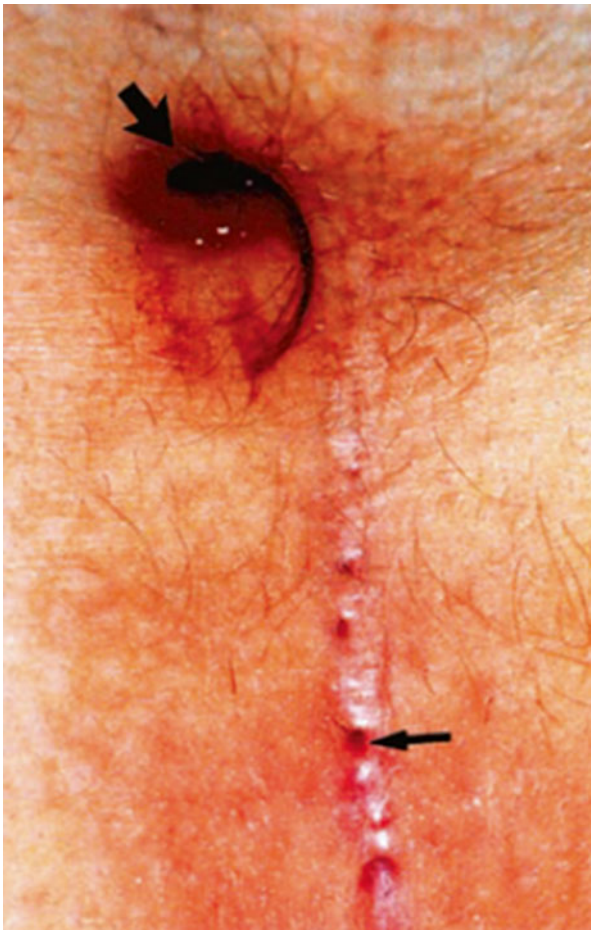

Fig. 13.9 Numerous non-inflamed midline pits, the primary source of the disease (*small arrow*). Hairs extrude from the secondary sinus (*large arrow*) (adapted from Nivatvongs [2], with permission)

fluid. On further examination, you notice that he has multiple pits in the natal cleft, with a secondary opening off the midline where his abscess was drained. There is no sign of recurrent abscess and there is no induration or tenderness on exam. You notice small little hair shafts sticking out of the pits and secondary opening (Fig. 13.9). How would you treat this young man?

13.5.1 Nonoperative Approaches

There is a role for nonoperative management following an initial episode of uncomplicated pilonidal disease. Thus, this patient may be offered conservative treatment. An important component of the nonoperative approach for the treatment of pilonidal disease is shaving and hygiene around the diseased area (see Fig. 13.1). This simple act in addition to a limited lateral incision for drainage of the index abscess

has been shown to decrease the number of hospital admission days, decrease the number of surgical procedures and is associated with an earlier return to work when compared to more invasive surgical techniques [11]. This conservative, noninvasive practice of meticulous hair control and perineal hygiene has been used for quite some time. In a study with military personnel in the mid-twentieth century, Armstrong and Barcia retrospectively reviewed outcomes of patients that were treated with a variety of surgical approaches and compared their outcomes to a prospective cohort of 101 patients who were solely treated using a conservative, nonoperative approach consisting of shaving 5 cm around the diseased area. In this pilot study, no patients who had undergone conservative treatment had any evidence of unhealed wounds and all were able to continue serving in the army during their treatment [12]. Their data strongly suggested that conservative treatment was superior to excisional therapies although they did not control for the different operative approaches. This approach however was not as effective in patients suffering from recurrent disease after having undergone an excisional procedure [12]. The most recent 2013 practice parameters developed by the Standards Practice Task Force of the American Society of Colon and Rectal Surgeons suggest that gluteal shaving should be used as a primary and/or adjunct treatment measure for acute and chronic pilonidal disease. Although there is no ideal extent of shaving that has been determined in the literature, the common recommendation is roughly a 4–5 cm area be shaved around the pits in the gluteal cleft [3]. In our practice, we advise patients to remove their hair from the lower back to the lower thighs, including the perineal area. We have found that in hirsute individuals, surrounding hairs easily travel into the cleft from more distant areas. Moreover, it is important to continue regular hair removal in the postoperative period if a patient has undergone a surgical procedure. The length of time and frequency of shaving however are not clear, so it is currently recommended to do so until the wound is healed [10]. It is very important to avoid leaving any little hairs behind as even one single hair shaft can lead to impaired healing and possible recurrence. The majority of surgeons advise their patients to continue keeping the area around the healed wound bare of any hair in order to prevent recurrence. There is controversy around the topic of shaving with studies actually showing that shaving is harmful and leads to higher recurrence rates in patients operatively treated for pilonidal disease. One reason for this is that possible microtrauma that results secondary to the blades [13]. For now, the idea of hair removal is compelling and there are promising studies looking at other methods of hair removal such as laser. In one study of 14 patients with recurrent disease, all patients reported improvement in their disease, with only 4 diagnosed with recurrent disease. One important disadvantage was the pain associated with the laser procedure [14]. Despite these findings, there is still insufficient evidence for this technique to be generally used. In our practice, we recommend clipping, depilation creams, or waxing, rather than shaving, to avoid the microtrauma caused by the razor blade.

Other possible nonoperative treatments that can be used for chronic pilonidal sinuses include the use of phenols or fibrin glues to attempt to occlude the tract. Small series have reported up to 95 % success rate with phenol injections combined

with proper hygiene and excellent hair removal of the surrounding area [11]. Another study by Dogru et al. in 2004 showed that crystallized phenol placed into a wound resulted in low recurrence rates at 8-month follow-up [15]. The crystals were applied in the wound after careful removal of all remaining hair or debris, allowed to liquefy at body temperature, and then expressed out of the wound after a 2 min period. This noninvasive technique appears promising however availability of these crystals may be an issue [2]. A review in 2009 concluded that phenol injections were appropriate for patients with 1–3 sinus tracts with good overall success rates, up to 97 %, with quicker return to work despite longer healing times, up to 1 month. Despite this, the current evidence is weak and more studies are needed to assess long-term outcomes [16].

Fibrin glue also appears to be promising in a variety of settings such as application after the curettage of the sinus tracts or in the bed of the excised tract prior to primary closure [11]. Most studies looking at fibrin glue are small series; however, success rates reported are quite high, up to 100 % in some, with minimal recurrence and good tolerance by the patients [11, 17, 18]. One retrospective review with 93 patients treated with fibrin glue over a 5-year period found high levels of patient satisfaction as well as rapid return to normal activities [18]. Lastly, similar to the treatment of an acute pilonidal abscess where antibiotics are not recommended, the use of oral or intravenous antibiotics for chronic disease has not been found to have any benefit for the patient. In both the pre- and postoperative settings, antibiotics have not shown any significant benefit for wound healing or prevention of complications when compared to patients not receiving them [19]. In addition, the evidence for use of topical antibiotics such as gentamicin-impregnated sponges is conflicting. Some studies have found a positive association between topical antibiotics and healing, while other studies showed no benefit. It remains unclear whether topical antibiotics in the treatment of chronic or complicated pilonidal disease have any advantages and more studies are looking into this matter. In summary, at this time, antibiotics should only be used as adjuncts in patients with severe cellulitis from an abscess or any underlying systemic illness or immunocompromised patients [11].

13.5.2 Operative Approaches

When the nonoperative approach fails, it is best to proceed to surgery. If a patient suffers from chronic, recurrent, or complex pilonidal disease, the surgeon must decide whether to proceed with an excisional approach with primary closure of the defect or excision with secondary healing of the wound. There is no strong evidence proving one approach is superior to the other, and in the end, it comes down to surgeon experience and comfort level in performing the procedure. In other words, there is no ideal treatment modality that has proven to be strongly superior to other approaches. There are a few differences in outcomes of these two approaches (which will be reviewed later); however, the main goal of treatment for pilonidal disease is one that allows the patients a quick return to their daily activities, has a low recurrence rate, minimizes pain, requires limited wound care, and is

cost-effective [8]. Keeping all of this in mind, this allows the surgeon to tailor the best approach for each patient.

Operative approaches for pilonidal disease can be classified by wound closure as follows: primary closure or open (secondary) wound closure techniques. A Cochrane review in 2009 looked at the healing rates of primary versus secondary closure in the surgical treatment of a pilonidal sinus. Their primary outcomes were time to healing, infection, and recurrence rates. Overall, there were benefits to either approach such that patients who had primary closure of their wounds showed more rapid healing and quicker return to work, whereas those with open healing wounds had lower recurrences. The good news is that both approaches showed no difference in infection and complication rates as well as length of stay after the procedure [20].

The open wound approaches include traditional wide excision with packing of the wound, the use of vacuum-assisted closure (VAC) therapy, or marsupialization of the sinus tract, whereas primary closure approaches include a variety of flap procedures with midline or off-midline closure of the wound. All these approaches will be covered in the following sections.

There are several ways one can approach treating pilonidal disease. The open wound approaches have been used for years and are still very successful at treating pilonidal disease because they are simple to perform and many surgeons feel comfortable with this technique. They have also been found to have lower recurrence rates compared to primary closure [20]. The primary flap closure techniques are mostly reserved for the more complex cases, including patients who have failed prior treatment or who persistently have recurrence of their disease, despite having undergone surgical management. There is minimal prospective evidence that compares excision with secondary healing versus excision and primary closure. There is an older randomized control trial that found midline excision with primary closure to show no clear benefit over the secondary healing technique and had a tendency toward higher recurrence rates [21]. In this case, the patient had a recurrence following an excision with primary midline closure. A reasonable approach at this point would be to offer him excision of the sinus tracts with an open wound healing by secondary intention. Several open techniques exist and will be described below.

Case 3

A 27-year-old male presents to your office 6 months after having undergone a resection and primary midline closure of a pilonidal sinus. On his initial follow-up visits after surgery, he was doing well and the wound was healing nicely. He is now complaining that the sinus and discharge has come back. It is not that painful but he regularly has discharge and it is uncomfortable to sit. He also mentioned that his girlfriend noticed some hair sticking out of the sinus tract. He denies any other symptoms. You recall having offered him resection and primary closure because he works as a security guard and really wanted to get back to work as quickly as possible.

On exam, you notice a healed midline scar with three small little pits, with hair sticking out of them. No discharge or induration is observed. Digital rectal exam is normal.

13.5.3 Open Wound Approaches

13.5.3.1 Midline Excision of Sinus Tracts

In the case of a chronic sinus, it is still advocated to proceed with a traditional excision of the sinus tract with secondary healing [14]. Because the sinuses or pits are located in the midline of the gluteal cleft, the natural tendency when excising the sinus tracts is to make an elliptical incision to encompass the pits (Fig. 13.10). Once this is done, the skin and tissue are discarded and the cavity is irrigated. Contrary to traditional teaching, it is not necessary to dissect the subcutaneous tissues all the way down to the presacral fascia [3]. The open cavity is then packed with saline gauze and left to heal by secondary intention. The packing, as in the case of the abscess, acts initially for hemostasis and then to prevent further hair from entering the area. Post-procedure, patients should be continuously reminded to keep the area clean and free of any hair. With proper wound care and regular follow-ups, patients heal very well over a 4–6-week period.

In the case of excision and secondary healing, sometimes the cavity can be quite extensive and morbid for the patient, with longer healing times required. A less morbid alternative is to simply unroof the sinus pits and lay open and curettage the tracts. This results in a smaller wound that will require roughly half the healing time [3]. It is also associated with a recurrence rate of 13 % [3]. In order to accelerate wound healing, marsupialization can be performed and/or a vacuum-assisted closure device can be used.

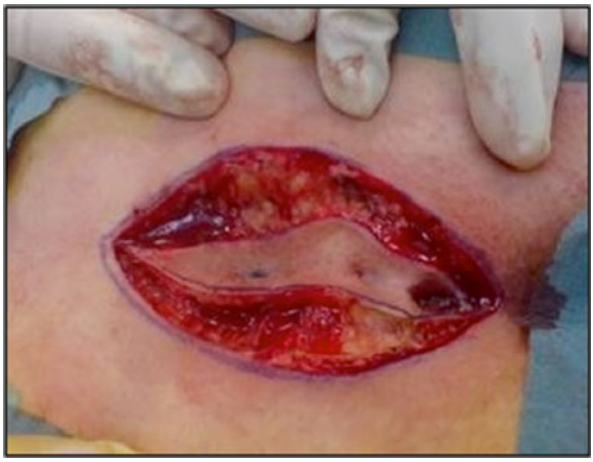

Fig. 13.10 Excision of midline pits (adapted from Fette and Pichotta [22] with permission)

13.5.3.2 Marsupialization

Marsupialization of a wound is a well-known treatment for patients with chronic pilonidal sinuses. It is done by opening a midline wound, over the pits, and unroofing the underlying sinus tract. Once this is done, the granulation tissue is scraped with a curette and the walls of the tract are sutured to the skin edges, keeping the tract open and allowing it to heal (Fig. 13.11).

The act of marsupializing a wound allows it to remain open by converting a closed cavity into an open tract [2]. There is no strong evidence demonstrating the efficacy or superiority of marsupialization over primary closure techniques. As mentioned earlier, there are advantages to both open and closed approaches to wound healing, so it is surgeon preference and comfort level that decide the method to be used. One recent randomized controlled trial looked at comparing marsupialization to rhomboid excision and Limberg flap in patients with chronic pilonidal sinuses. Outcomes included postoperative pain level, return to daily activities, and time to healing. Marsupialization was found to have a shorter hospital stay and return to daily activities; however, patients undergoing the flap procedure had quicker healing times and scored slightly higher on the quality of life questionnaires, which is probably a result of the postoperative wound care required after marsupialization. Overall, the authors felt that marsupialization provided more clinical benefits over the Limberg flap and should be the procedure of choice for patients with chronic pilonidal disease, as long as patients are made aware of the dedicated wound care required postoperatively [23].

13.5.3.3 Vacuum-Assisted Closure Therapy

After the midline pits have been circumferentially excised (Fig. 13.10), another technique used to accelerate wound healing is the placement of a vacuum-assisted closure (VAC) device (Fig. 13.12). The VAC device is a tool that accelerates the formation of granulation tissue by optimizing blood flow, it keeps the wound dry,

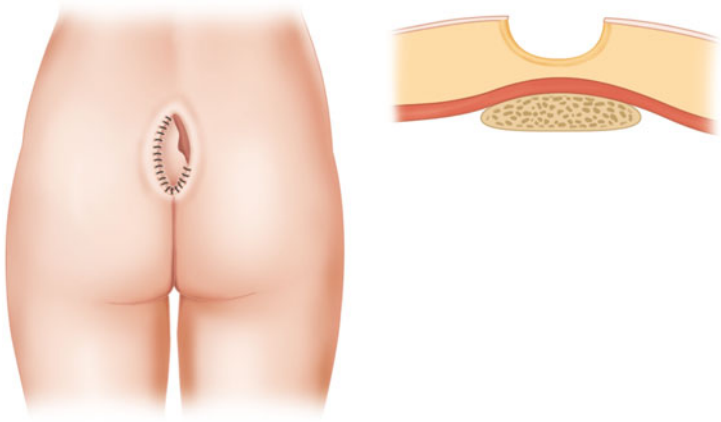

Fig. 13.11 Marsupialization of the wound. Frontal and cross-sectional view of the marsupialization technique

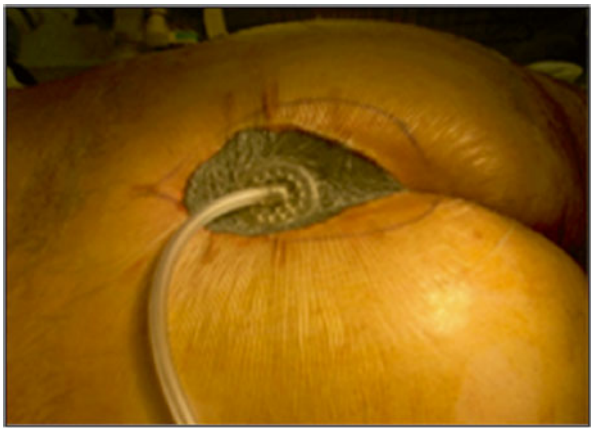

Fig. 13.12 Application of VAC device for healing (adapted from Saad et al. [24], with permission)

and it removes excess bacteria which promotes wound healing [22, 25]. Because of its special properties, it decreases the treatment time as well as the incidence of septic complications [26]. The VAC is applied to the wound immediately after curettage and only needs to be changed if there is any evidence of soaking or leaking from the wound, indicating saturation of the VAC sponges. Patients are regularly followed in clinic, ideally by a wound care specialist nurse, who ensures that the wound is healing well and that there are no developing wound complications. In a small, randomized prospective study analyzing the benefits of VAC therapy versus conventional wound packing for patients with a chronic pilonidal sinus, the authors found that patients treated with a VAC had a significant decrease in length of healing time compared to the packing group as well as a quicker return to work and regular activities with decreased overall pain [24, 26].

13.5.3.4 Coring Out of Pits

A less invasive technique for treating primary disease includes simply coring out each of the individual pits and sites of previous drainages, in addition to curettage of the sinus tracts, allowing the wounds to heal by secondary intention. In our practice, we prefer this method because of the decreased morbidity to the patient. It is also a good way to see how the patient responds to a minimally invasive approach, without burning any bridges. If the patient heals, then this spares him/her a more extensive en bloc resection. It is a reasonable approach to use for patients with simple, chronic, or even recurrent sinuses who do not warrant a more extensive operation. We have observed excellent success with this approach, and the rare patients who recurred were managed by an open excisional approach.

There are a few ways to proceed with the coring out of the pits and the secondary opening(s). In our practice, we simply excise the pits with a scalpel, similar to the technique used for excising the pits in a Bascom I repair, which will be described later on. Each individual pit is excised with an incision no greater than a grain of rice. The incisions are then left to heal by secondary intention to avoid closing a cavity to minimize recurrence. In addition, we counsel patients to keep excellent

hygiene, have daily wound care, shave the entire area regularly, and maintain low physical activity until the wounds have completely healed. In our experience, this method is quite successful.

Another minimally invasive approach has been studied using trephines to core out the pilonidal pits followed by debridement. A study assessing long-term outcome of this technique in roughly 1300 patients found that this trephine technique was a feasible approach with low recurrence rates of 6.5 % at 1 year and 16.2 % at 10 years and low postoperative morbidity [27]. Trephines ranging from 2.0 to 9.0 mm in diameter were used to core out both superficial pits and larger, deeper tracts that connected to a cavity. This was followed by debridement of underlying tracts and cavities when present. Patients were then sent home and followed up at regular intervals for wound assessment and debridement or re-excision if necessary. Most patients in this study had previous drainages and excisions of various types rendering this technique plausible in patients with difficult pilonidal disease presentations.

Sinusectomy is also described as a technique that could be used to treat primary pilonidal disease. It is thought to be a less invasive approach with less morbidity for the patient. A Swiss study showed that sinusectomy had a low recurrence rate of 7 % at 4 years with a quicker return to work and improved quality of life [28]. The approach is simple and consists of injecting the sinus tracts with methylene blue to delineate each subcutaneous tract. Once this is done, each pit opening and individual tract can be excised and left to heal by secondary intention. In this study, patients were advised to keep the area clean at least twice a day and practice proper intergluteal hygiene, including shaving the area of the natal cleft [28]. This is a reasonable approach for patients with simple pilonidal disease and avoids the morbidity of larger en bloc excisions.

13.5.3.5 Bascom's Midline Pit Excision and Closure with Curettage (Bascom I)

This open technique has been mostly used in patients who present with chronic abscesses. Similar to the management of an acute pilonidal abscess, you make an off-midline incision, roughly 1 cm from the midline, which is dissected down to the cavity. The cavity contents are then curetted to encourage healing. Next, the midline pits are individually excised and closed, allowing only one route for drainage, through the off-midline wound which is left open. The size of the excision for each pit should be very small, comparable to a grain of rice [3]. It is feasible to perform this procedure under local anesthesia and it is generally well tolerated by patients [29] (Fig. 13.13).

13.5.4 Primary Closure Techniques

Case 4

A 32-year-old obese, hirsute male presents to your office for a second opinion. He is a smoker. He has been suffering from pilonidal disease for 6 years. Four years ago, he underwent an excision with primary midline closure, which recurred the

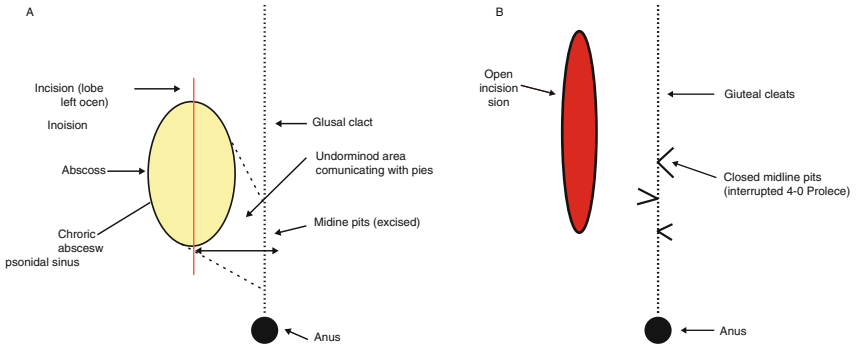

Fig. 13.13 Bascom I procedure (adapted from Papaconstantinou and Thomas [3], with permission)

following year. He then underwent excision and healing by secondary intention. Unfortunately, he had recurrence of abscesses twice in the last year that were treated with incision and drainage while travelling overseas. On exam, you notice midline pits with multiple surrounding scars and underlying fibrotic tissue from his previous interventions. What would you offer him at this point?

Case 5

A 28-year-old female flight attendant comes to see you with a recurrent pilonidal sinus. She has had one abscess drainage in the past and now noticed midline pits with serosanguinous discharge that stains her undergarments regularly. She is very anxious about this problem and would like to have it treated quickly. Because of the nature of her work, she cannot afford to remain off work for a long period of time and has read on the internet that there is an operation that can help her heal quickly with a good quality of life. What would you offer this patient?

Both of these patients suffer from recurrent pilonidal disease and both would benefit from a primary closure procedure. There is no ideal procedure to date that has proven to be superior to others, and most procedures are performed based on surgeon preference and comfort level. A Cochrane review found that patients who underwent primary closure procedures, including a variety of flap procedures, healed more rapidly and returned to work quicker than patients who had open surgical procedures [20]. There are a variety of primary closure techniques for pilonidal disease, and these approaches can be further divided into midline and off-midline closure procedures. The same Cochrane meta-analysis addressed midline versus off-midline primary closure procedures (also including flap procedures) and concluded that there was strong evidence demonstrating that off-midline closure is superior to midline closure with regard to faster healing times, less infections, and lower recurrence rates [20]. Midline closures can have recurrence rates as high as 42 % [30]. In addition, the data from the meta-analysis was strong enough to suggest that off-midline closure should be the standard management whenever a primary closure approach is chosen [20]. The ASCRS guidelines recommend that patients

with recurrent, complex pilonidal disease should undergo flap-based procedures after failure of other techniques. Although flap procedures have been found to have higher recurrence and higher rate of infection [31], their use for the treatment of complex disease is supported because they allow for the removal of a large area of diseased tissue and the use of healthy tissue to fill the defect. There are multiple flaps described in the literature; some are more invasive than others. We have chosen to describe two off-midline closures including the Karydakis and Bascom II flap and two more involved flap closure techniques including the rhomboid excision and Limberg flap as well as the V–Y advancement flap.

13.5.4.1 Off-Midline Closure Techniques

Karydakis Flap

This technique was first described in 1965, in Greece, by Dr. Karydakis. The goal of this procedure is to excise diseased tissue located in the midline and then displace healthy tissue laterally [3]. Figure 13.14 depicts the frontal and cross-sectional views of this procedure. Basically, you mark an ellipse around the diseased midline area, big enough to encompass at least 1 cm of tissue lateral to the midline. You then dissect all the way down to the sacral fascia. The flap is then sutured down to the sacral fascia in such a way that it is laterally pulled over to cover the defect. Once this is done, you close the incision, which should now be laying lateral to the midline.

In one series by Karydakis, he followed his patients for 21 years after the procedure and had a recurrence rate of 1 % [32]. This procedure was also found to have low morbidity and high patient satisfaction [33].

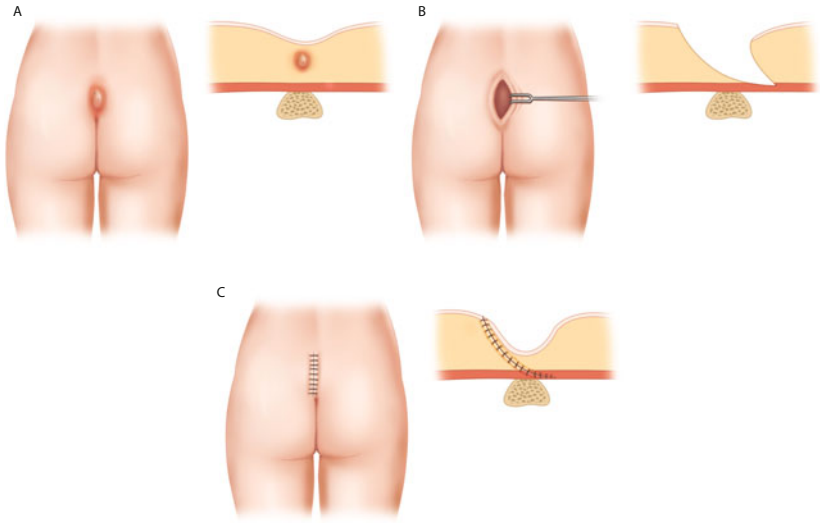

Fig. 13.14 Karydakis technique

Bascom Cleft Lift Procedure (Bascom II)

This procedure was developed after the Karydakis flap and is similar in such a way that it excises tissue and closes the defect off midline. The difference is that the Bascom II procedure does not excise any normal subcutaneous tissue, where the Karydakis approach does. In addition, with this technique, only a portion of the skin is excised and the underlying gluteal fat is re-approximated in the midline to obliterate the gluteal cleft (Fig. 13.15). The remaining sinus cavities are curetted and left to heal as opposed to being excised. In a prospective randomized controlled trial comparing Bascom I to Bascom II, the authors concluded that both procedures were successful in the treatment of pilonidal disease; however, Bascom II was the preferred technique to treat moderate to severe disease [29]. In addition, recurrence rates were less for Bascom II compared to Bascom I mostly because of the flattening out and obliteration of the natal cleft [29].

13.5.5 Flap Closure

13.5.5.1 Rhomboid Excision and Limberg Flap

As shown in Fig. 13.16, the rhomboid excision and Limberg flap procedureconsists of removing the diseased area with a rhomboid-like excision (points A–B–C–D)

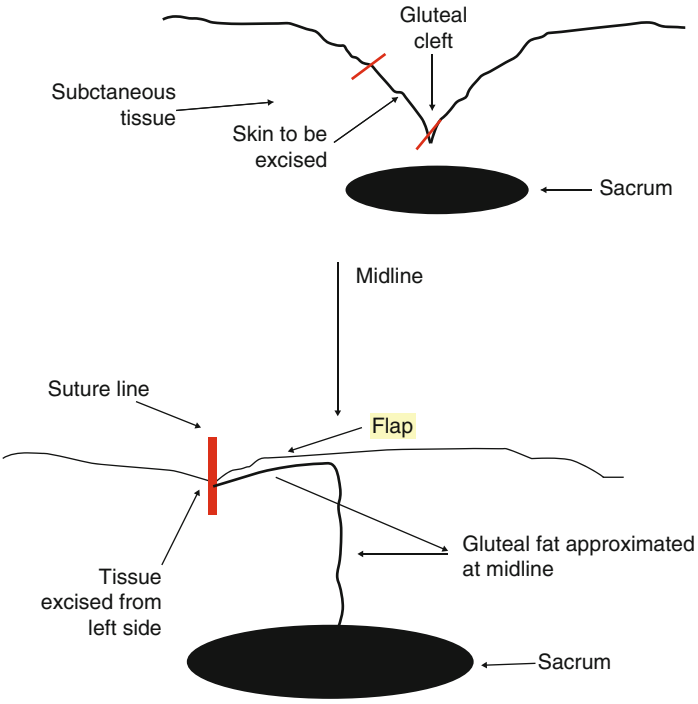

Fig. 13.15 Bascom II (adapted from Papaconstantinou and Thomas [3], with permission)

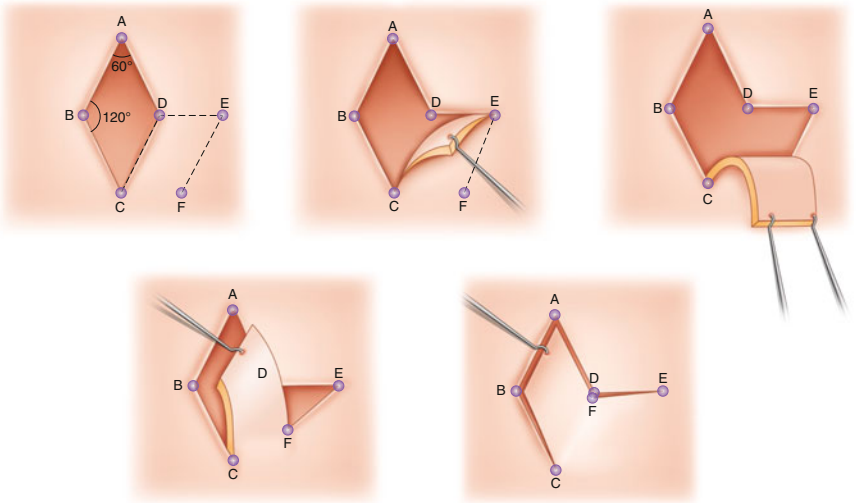

Fig. 13.16 Rhomboid excision and Limberg flap

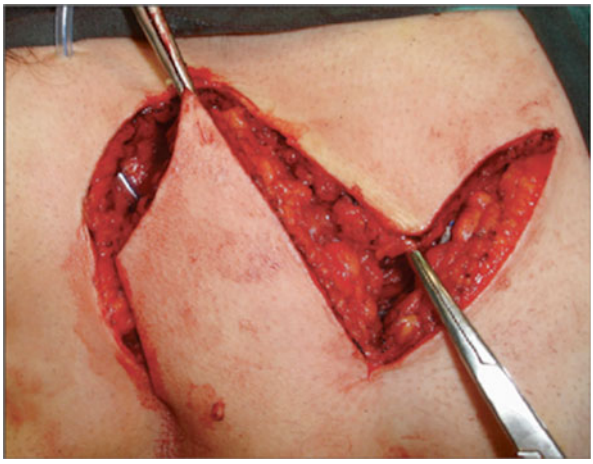

Fig. 13.17 Rhomboid excision and Limberg flap (adapted from Altintoprak et al. [34], with permission)

and using a flap from tissue adjacent to it (C–D–E–F) to cover the defect. The main problem with this flap procedure is the removal of a large amount of tissue along with a poorer cosmetic end result (Fig. 13.17). It is a preferred method for patients who have their abscess and pits all located more or less close to the midline, as the amount of tissue that would have to be removed is less, therefore causing less morbidity and an improved end cosmetic result. This technique can also be considered in patients who have previously had their disease removed in the midline and now have a chronic non-healing wound [3]. In a randomized trial looking at the Limberg flap compared to primary midline closure, the Limberg flap proved to have fewer

complications, quicker healing, shorter hospital stay, and less pain compared to midline closure [5]. Furthermore patients who received the Limberg flap procedure were more satisfied and had a better quality of life. Another study by Daphan et al. [35] showed similar results with lower recurrence and complication rates, quicker return to daily activities, and less pain in their cohort of young males treated with the Limberg flap technique. Overall, recurrence rates range anywhere from 0 to 6 % [11]. Due to the extensiveness of this procedure, cosmesis may be an issue for patients. A study particularly looking at cosmesis found that patients' perceived outcome was overall good, possibly due to the fact that the area is mostly hidden; however, it was an issue for some which is why patients must be well informed about the overall outcome [30, 34, 36].

13.5.5.2 V–Y Advancement Flap

This tension-free flap procedure is used in the treatment of complicated, extensive, and recurrent pilonidal disease. It was first described by Khatri et al. in 1994 [37]. As seen in the pictures below, it consists of a large elliptical incision made around the midline pits and dissected all the way down to the sacral and gluteal fascia. The diseased area is then resected. A "V"-shaped incision is made lateral to the ellipse with one arm starting at the superior aspect of the ellipse and the other from the inferior edge, meeting laterally on the gluteal area. The triangular island of tissue is advanced medially and joined to the lateral edge of the elliptical defect, flattening out the natal cleft. This edge is sutured and the two other sides are sutured superiorly and inferiorly in order to create a "Y" configuration as is seen in Fig. 13.18. This is a convenient flap procedure with minimal recurrence rates because of the flattening of the natal cleft [38]. The wound heals well and the procedure is well tolerated by patients; however, similar to the Limberg flap, cosmesis may be an issue and should be mentioned during preoperative discussion of potential outcomes with the patient. Recurrence rates are described to range between 0 and 11 % [39].

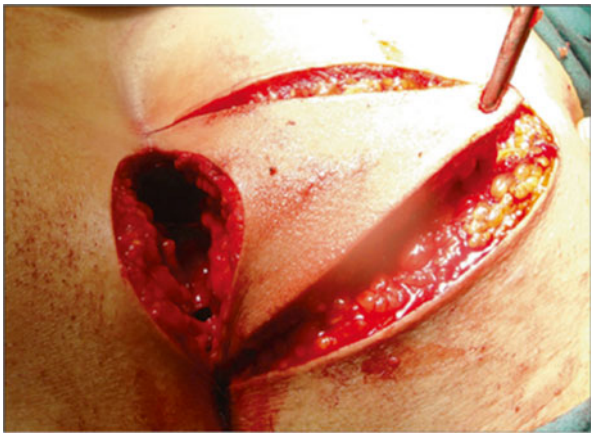

Fig. 13.18 V–Y advancement flap (adapted from Altintoprak et al. [34], with permission)

When the Limberg flap was compared to the V–Y advancement flap, the Limberg flap was found to have lower recurrence rates; however, there was no difference in wound infection, seroma formation, and length of hospital stay [11, 39].

13.6 Conclusion

Pilonidal disease is a common problem with a variety of different approaches to treatment. Because of this variety, many surgeons manage their patients differently, leading to a plethora of treatment options. When assessing a patient with pilonidal disease, it is important to take a good history and perform a focused physical exam, asking about any past medical or family history, including inflammatory diseases, as well as previous treatments patients may have received. This will give you an overall sense of how simple or complex the patient's problem may be. Once you have gathered all this information, you can make a diagnosis and use the treatment algorithm (Fig. 13.19) to help guide your decision-making.

Although there are many studies looking at pilonidal disease and its different treatment approaches, it is important to understand that there is strong evidence supporting the use of open techniques to minimize recurrence and to use off-midline closure techniques to achieve faster healing with lower recurrence rates. This knowledge will help provide better care for patients with the hope of improving their quality of life and decreasing the recurrence rate.

The main goal of treatment is to improve patients' quality of life and help them quickly return to their daily activities. As we have seen in the cases presented, there are multiple ways of approaching the same problem. It is important to offer patients the treatment approach that will best help them deal with the acute phase of their

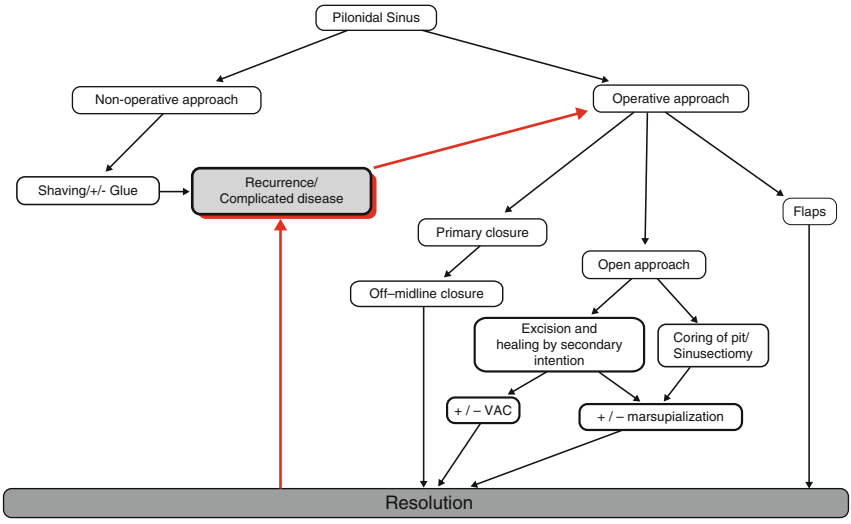

Fig. 13.19 Algorithm for management of pilonidal disease

disease. Whether the problem recurs or persists, it is important to realize one's limitations and to have a low threshold for referral to experts for more advanced procedures, such as flaps.

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