Chapter 1
The History of the Ileoanal Pouch

John Nicholls and Guy Worley

Abstract This chapter summarises roughly 100 years of innovation in colorectal surgery. Colectomy was introduced as a treatment for ulcerative colitis in the 1940s, dramatically lowering mortality. Quality of life improved markedly with the introduction in the early 1950s of the spout everted ileostomy. By the 1960s there was general consensus that proctocolectomy with permanent ileostomy was the procedure of choice for ulcerative colitis when surgery was indicated.

In parallel, there had been focus on the avoidance of the permanent ileostomy through procedures such as colectomy with ileorectal anastomosis and to a lesser extent proctocolectomy with 'straight' ileoanal anastomosis. With the introduction in the late 1960s of the continent ileostomy which included a small intestinal reservoir and the simultaneous development of endoanal anastomotic technique, the essential elements of restorative proctocolectomy or the 'pouch operation' were in place. The operation was first carried out in the late 1970s and included a mucosal proctectomy with manual anastomosis. The initial 'S' reservoir was modified to a 'J' in the early 1980s and later to a 'W' to increase capacity. The 'J' configuration has proved most used over time. There have been important technical developments of restorative proctocolectomy in the subsequent decades regarding design, the method of construction of the anastomosis, whether a de-functioning ileostomy is routinely necessary and the use of minimally invasive surgery.

Keywords Restorative proctocolectomy · Ileoanal pouch · Development
Innovation · Ulcerative colitis · Familial adenomatous polyposis

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1.1 Introduction

The Ileal Pouch procedure, also referred to as 'Restorative Proctocolectomy' (RPC) or 'Ileal Pouch-Anal Anastomosis' (IPAA), has for over 40 years afforded patients the option to live without a permanent ileostomy after proctocolectomy. The first ileal reservoir with anastomosis to the anus was performed in 1976, and the publication of the technique and the results in five patients in 1978 [1]. Arriving at this point had followed nearly 70 years of evolution in surgery for ulcerative colitis, detailing innovation in the techniques of appendicostomy, ileostomy, total colectomy, proctocolectomy with ileostomy and then with ileoanal anastomosis with the subsequent inclusion of an ileal reservoir or pouch. The chapter will review the events leading up to the creation of the ileal pouch, and the following major developments in pouch surgery up to the present.

1.2 The History of Surgery for Ulcerative Colitis

Developments between 1875 and 1888 [2, 3] led to the characterisation of UC as a specific disease separate to infective colitis and a report from the 1909 Royal Society of Medicine (RSM) meeting on ulcerative colitis reported a mortality rate of 48% for patients admitted to London hospitals with UC [4].

Appendicostomy was the first surgical treatment, developed from 1895 onwards, and this involved bringing the appendix to an opening on the skin in order to infuse irrigations, vaccines and serums as topical treatment of the colonic mucosa (Fig. 1.1).

Ileostomy to defunction the large bowel was described by Brown of St Louis in 1913 [5] and became the most used operation over the 1920s and 1930s. The positive effects of resting the large bowel were offset by the high mortality of ileostomy

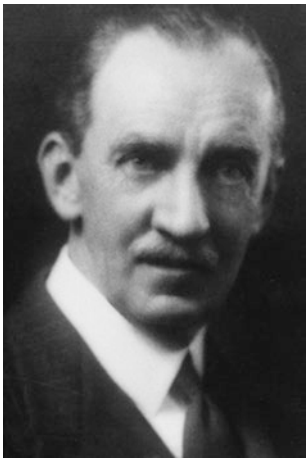

Fig. 1.1 JP Lockhart Mummery. ("Reproduced with permission from St. Mark's Hospital, Harrow.")

which was around 30% in severely ill patients often with profound hypoalbunimaemia. It was not clear when to operate on patients who were only suffering mild or moderate symptoms, as described in the Royal Society of Medicine (RSM) 1944 presidential address to the Section of Proctology given by Mr Rupert Corbett of St Bartholomew's Hospital, London [6].

In the same era, surgeons were beginning to experiment with surgical removal of the diseased large bowel. Cattell (Fig. 1.2) at the Lahey Clinic, USA, reported 12 patients undergoing colectomy in 1929 with only one death [7]. The strategy of defunctioning by ileostomy changed with the seminal publication of Gavin Miller (Fig. 1.3) and colleagues from Montreal in 1947 who reported the results of 20 patients with severe colitis treated by colectomy with preservation of the rectal stump without any surgical death [8].

Removing the colon and forming an ileostomy had a much reduced mortality than ileostomy alone and by the 1950s the staged approach of colectomy and ileostomy with subsequent removal of the rectum began to take hold. By 1953 Cattell presented a series of 267 patients with a mortality rate from colectomy down to 5%, establishing colectomy as an effective treatment for UC [9].

Fig. 1.2 R Cattell. ("Reproduced from the author's private collection.")

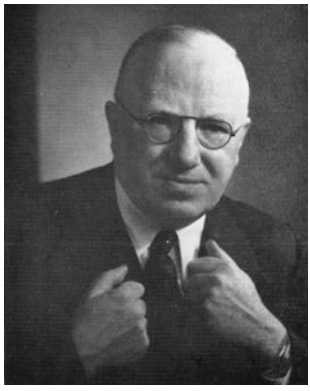

Fig. 1.3 CG Miller. ("Reproduced with permission from the Royal College of Surgeons of England.")

Fig. 1.4 Early ileostomy appliance

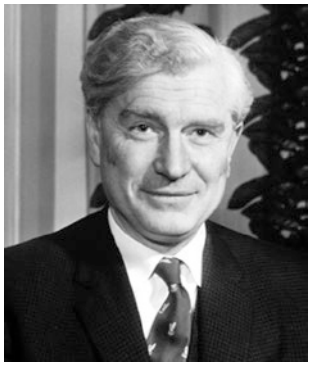

Fig. 1.5 BN Brooke. ("Reproduced with permission from the Royal College of Surgeons of England.")

The resulting permanent ileostomy presented great practical difficulty for the patient mainly due to the primeval design of the early ileostomy appliance (Fig. 1.4). Various surgical techniques were described to improve quality of life of the patient with an ileostomy, but were not successful until the description by Brooke (Fig. 1.5) in 1952 [10] of the everted ileostomy which created a spout away from the skin edge.

During the first Bipartite meeting of the American Society of Proctology and the Section of Proctology of the Royal Society of Medicine held in London in 1959 [11] proctocolectomy with permanent ileostomy was regarded as the operation of choice for ulcerative colitis when surgery became necessary despite a surgical revision rate of the ileostomy at 5 years of about 10%.

1.3 Ileostomy Avoidance

1.3.1 Colectomy with Ileorectal Anastomosis

Owing to the difficulty of managing a permanent ileostomy, some surgeons in the 1940s and 1950s developed ileostomy avoiding procedures. Devine in the 1940s [12] and then Aylett [13] nearly 20 years later, had trialled staged approaches to joining the small bowel to the rectum to form an ileorectal anastomosis after colectomy. Owing to the presence of rectal inflammation as part of the pathology of UC nearly 50% of patients were left with poor bowel function due to the persisting inflammation and the risk of malignant transformation [14] requiring conversion to proctectomy with permanent ileostomy in about one third of cases [15]. Colectomy with ileorectal anastomosis is nevertheless still an option today for carefully selected patients.

1.3.2 Restorative Proctocolectomy

Complete proctocolectomy with ileoanal anastomosis was first described by Nissen (Fig. 1.6) in 1933 in a 12-year-old boy with polyposis, who was continent after the procedure [16]. In 1947 Ravitch and Sabiston rekindled interest in restorative surgery when they published a series of 22 procedures in dogs where the remaining small bowel was joined to the anus forming an 'ileoanal anastomosis'. The mortality of the dogs was high, mostly because of pelvic sepsis, but the procedure was performed successfully in two human patients reported in 1948 [17].

Fig. 1.6 R Nissen. (https://commons.wikimedia.org/wiki/File:Bundesarchiv_Bild_183-R45871,_Prof._Dr._Ferdinand_Sauerbruch.jpg)

Over the next 10 years a few surgeons carried out what later became known as proctocolectomy with 'straight' ileoanal anastomosis, but a review of the published results by Valiente and Bacon in 1955 [18] revealed high frequency and urgency of defaecation in many cases. Bacon, who contributed so much to colorectal surgery, felt this was due to a lack of rectal reservoir capacitance. He and Valiente carried out experimental reservoir construction in dogs by folding the small bowel on itself to increase capacity. Two out of their seven dogs survived, and the frequency of defaecation was reduced to 2–6 per day. The high mortality discouraged adoption of this procedure in surgical practice, as was commented on by Turnbull who was Chairman of the Department of Colon and Rectal Clinic at the Cleveland Clinic at the time; "…somewhere in the future someone may perhaps solve this problem. I think that it is in the dream stage at the present time".

Originally aiming for bladder replacement after cystectomy, Kock during the 1960s developed a small bowel reservoir which he then applied to the permanent ileostomy created by proctocolectomy to form a 'continent ileostomy' [19]. He constructed a nipple valve by the intussusception of the terminal ileal segment into the reservoir which was closed by intra-abdominal pressure to render the ileostomy continent. Evacuation was effected by the insertion of a catheter via the ileostomy into the reservoir.

Mucosectomy of the lower rectum had been described by both Devine and Peck [20, 21]. This allowed removal of the inflamed mucosa while leaving the rectal muscular wall, enabling an anastomosis between the ileum and the anal canal having removed the proximal disease prone tissue. These technical developments set the scene for the combination of total proctocolectomy with ileoanal anastomosis with the addition of an ileal reservoir to optimise bowel function. The operation was first carried out by at the London Hospital in 1976 by Parks (Fig. 1.7) and subsequently at St. Mark's Hospital. The technique was published in 1978 as 'Proctocolectomy without ileostomy for the treatment of ulcerative colitis', with the results of the first five patients treated [1]. Restorative Proctocolectomy (RPC) has given patients the option to live without a permanent ileostomy after proctocolectomy and remains the standard operation for most patients with ulcerative colitis requiring surgery. It is also applicable to many patients with familial adenomatous polyposis and rarely to some with large bowel cancer and functional bowel disease.

Fig. 1.7 AG Parks. ("Reproduced from the author's private collection.")

1.3.3 Polyposis Syndromes

Selected patients with FAP, Lynch syndrome, Peutz-Jeghers and Juvenile polyposis have undergone RPC. In FAP adenoma formation in a Kock pouch was reported by Beart et al. in 1982 [22] and these lesions were subsequently found in the ileoanal pouch [23, 24].

1.4 Restorative Proctocolectomy Since 1978

1.4.1 Early Clinical Results

Of the 759 cases presented in a Symposium in 1986 there was only one post-operative death, but there were rates of pelvic sepsis between 8% and 22% and ileoanal anastomotic stricture of 10%. The frequency of defaecation at 6 months after an 'S' or a 'J' pouch construction was five to six times per 24 h, with nocturnal evacuation in 25% of patients [25]. The next decade saw the publication of the results of the first 10 years experience of St. Mark's Hospital (Fig. 1.8) [26], large series from the Mayo (Fig. 1.9) [27] and Cleveland Clinics (Fig. 1.10) [28], Hopital Saint Antoine, Paris,) (Fig. 1.11) [29], Gothenborg where a Kock pouch with ileo-anal anastomosis was favoured (Fig. 1.12) [30] and Mount Sinai Hospital Toronto (Fig. 1.13) [31].

Inflammation in the Kock ileal reservoir had been reported in 1975 [32] and in 1986 pouch inflammation after restorative proctocoloectomy was described in detail with an overwhelming prevalence in UC over FAP [33]. An early review of 'pouchitis' was published in 1990 [34] which offered a definition of the condition. This was followed in 1994 by publication of a pouchitis activity index scoring system developed by Sandborn et al. at the Mayo Clinic [35]. Pouchitis was shown to be amenable to antibiotics and also to probiotic treatment [36, 37].

Fig. 1.8 RJ Nicholls

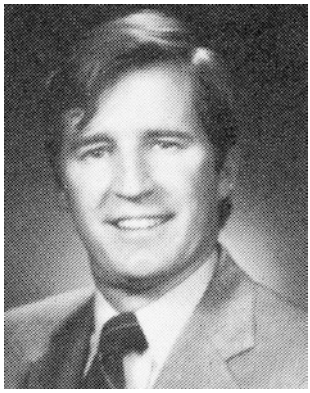

Fig. 1.9 RR Dozois

Fig. 1.10 VW Fazio

Fig. 1.11 R Parc

Fig. 1.12 T Oresland. (http://www.med.uio.no/klinmed/personer/vit/tomor/index.html)

Fig. 1.13 Z Cohen

A fall in female fecundability was first reported by Olsen et al. in 2001 who showed it to be reduced after RPC to less than 50% of the normal population [38], but not after colectomy with ileorectal anastomosis [39]. Many authors have since confirmed this observation. There is recent evidence that laparoscopic may be associated with a lower incidence of infertility than open surgery [40, 41].

1.5 Technical Developments

1.5.1 Pouch Design

The different ileal pouch configurations were described in the early years between 1978 and the mid 1980s. The original 'S' pouch required 60% of patients to catheterise the pouch to empty, due to the long distal ileal limb from the pouch to the anus. This was almost completely avoided by the J-pouch described by Utsunomiya et al. (Fig. 1.14) in 1980 [42] and the need for anal catheterisation to evacuate the pouch became very uncommon. Function was further improved and the operation

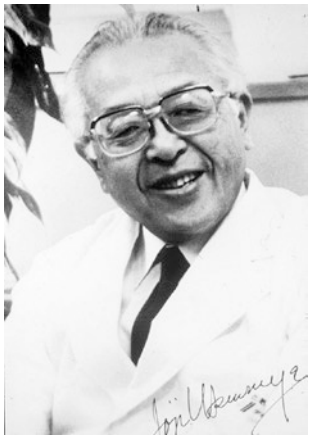

Fig. 1.14 J Utsunomiya. (http://www.cancer.or.jp/outline.html rights belong to BCPF)

made easier by the removal of the rectum with ileoanal anastomosis performed directly between the pouch and the anorectal junction just above the dentate line.

An inverse relationship between capacity and frequency of defaecation was reported in 1986 [43] as it had earlier for the straight ileoanal neorectum [44]. For this reason a larger reservoir, the W-pouch, was designed to ensure a pouch of adequate capacitance [45]. Fonkalsrud had developed another design referred to as the 'H-pouch' [46]. The 'J' pouch is the simplest to create and now the most popular. Meta-analysis of the three different designs did not find any difference in the short term outcome, but confirmed the greater need for catheterisation in 'S' pouches, which are now almost obsolete. A greater requirement for anti-diarrhoeal medication was found for 'J' than for 'W' pouches, but a randomised trial comparing 'J' and 'W' configurations with 68% of participants followed up to 8.7 years showed that the 'W' pouch advantage was only evident at 1 year. By 9 years there was no difference between the two forms of reconstruction, and so the 'J' pouch became established as the most used pouch design [47, 48].

1.5.2 The Ileoanal Anastomosis

The ileoanal anastomosis was originally constructed manually using the technique described by Parks. It included a mucosectomy to remove the most distal part of the disease. The initially long rectal cuff became shorter and with the increasing use of stapling devices the anastomosis was increasingly performed mechanically [49]. A manual anastomosis gives greater precision of height, is less likely to stricture and allows mucosectomy to remove almost all the inflamed colorectal mucosa. In contrast a stapled anastomosis is technically simpler and for this reason has become the more frequently used technique. It may furthermore result in less stretching of the anal sphincter. A meta-analysis showed a similar short-term outcome with either technique although there was better night time continence in the stapled group but less chance of leaving inflamed mucosa after manual anastomosis [50].

1.5.3 Defunctioning Stoma

There are conflicting data on whether a defunctioning ileostomy reduces anastomotic leakage, but it is commonly accepted that the septic sequelae are reduced [51, 52]. There is however a significant morbidity of stoma formation and closure operations of 20–40%, the majority being local complications or ileus, and anastomotic leakage of 4–5%. This rate of comorbidity has led some surgeons to argue the case for avoiding de-functioning ileostomy in all but selected high-risk cases [53].

1.5.4 Minimally Invasive Techniques

In one of the first reports of the use of multiport laparoscopy in performing RPC, Santoro et al. [54] described five patients operated on between 1993 and 1996 without any intra-or post-operative complications. Bemelman et al. reported a series of 16 patients in 2001 in whom quality of life and function were no different to a group of 19 patients having open surgery [55]. Subsequent techniques have included single-incision laparoscopic surgery (SILS) and transanal minimally invasive surgery (TAMIS) [56, 57]. A meta-analysis of laparoscopic vs open pouch surgery including 27 comparative studies of 2428 patients [58] showed longer operating times and slightly shorter inpatient stay. There was a lower incidence of wound infection and intra-operative blood loss with no difference in failure and improved function.

1.5.5 Long Term Outcome and Failure

Failure rates initially were reported to be around 5% but follow up over several years showed that there was a steady unremitting rise of failure with time [59]. Over a 20 year period a failure of 6% at 20 years was reported at the Mayo Clinic [60]. Failure was considerably higher in a UK national audit of ten centres performing RPC with rates of around 20% at 20 years [61]. Over this period there was an increase in anal soiling, although frequency of defaecation remained the same. The learning curve related to failure at the Cleveland Clinic was estimated to be around 23 cases for trainees [62].

Mechanical failure due to stricture formation at the IAA, a retained rectal stump or threatened failure due to sepsis have been treated by salvage surgery with satisfactory results, particularly in non-septic cases [63–69].

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