43 Laparoscopic Approaches to Chronic Postoperative Inguinal Pain

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Inguinal hernia repair continues to be one of the most commonly performed operations, with an estimated 20 million cases performed worldwide and 800,000 in the United States per year [1–3]. The introduction of mesh and refinement of tension-free techniques have markedly reduced recurrence rates and improved patient outcomes. However, chronic postoperative inguinal pain (CPIP) remains a significant complication. This is defined as a new or different quality of pain persisting 3 months after the hernia has been repaired. Up to 63% of patients are affected by some degree of chronic pain, with 6–8% experiencing significant interference with quality of life and activities of daily living [3–6].

CPIP can happen for multiple reasons. Hernia recurrence must be ruled out. The patient can also experience neuropathic pain associated with injury to the ilioinguinal, iliohypogastric, genitofemoral, and lateral femoral cutaneous nerves. These injuries can happen during dissection, tissue handling, mesh fixation, or scarring. Nociceptive pain is another culprit, associated with tissue injury and inflammation caused by tissue handling and trauma or foreign body inflammation due to meshoma [3–12]. Management of CPIP is difficult as there is often not a discrete distinction between nociceptive and neuropathic pain. Diagnosis is also often complicated by psychosocial factors.

Most patients are successfully treated with multimodal pharmacologic, interventional, and behavioral therapies through a multidisciplinary approach involving surgeons, pain specialists, radiologists, psychiatrists, and primary physicians [3]. Some patients, however, will require remedial surgery. With regard to neuropathic inguinodynia, the most definitive of these surgeries is a triple neurectomy of the ilioinguinal, iliohypogastric, and genitofemoral nerves. This was first described as a two-stage operation approached through the inguinal and retroperitoneal fields but was refined by Amid into a single-stage, open operation in 1995. Recent technical modifications have yielded response rates of 85–95% [13].

With the evolution of mesh-based, tension-free repairs, recurrence rates declined, and pain became the more relevant clinical outcome of inguinal repair. Surgical options for chronic post-inguinal hernia repair pain have also progressed and evolved to utilize minimally invasive operative approaches. The guiding principle is identification of the involved or at-risk inguinal nerves with division proximal to the area of the repair. However, identifying the three nerves in the scarred re-operative field is difficult, and the neuroanatomic variation increases along the course of the nerves especially within the inguinal canal [15–17].

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In the last three decades, use of the extraperitoneal space has become ubiquitous as a part of endoscopic transabdominal preperitoneal (TAPP) repairs, totally extraperitoneal (TEP) repairs, and open preperitoneal repairs [18–20]. However, inguinodynia that arises after preperitoneal operations and those that cross both the anterior and posterior planes pose a more complex challenge. Nerve injuries associated with these operations are often too proximal to reach through an open anterior inguinal approach, and addressing preperitoneal mesh through an open incision is also difficult [19–21]. Orchialgia resulting from vas and spermatic cord injury proximal to the internal ring is also a technical challenge. These aforementioned challenges make an endoscopic approach, either retroperitoneally or transabdominally, a desirable alternative [21–23].

Patients with CPIP should be offered surgical intervention if there are appropriate targets for remediation (meshoma, neuropathic pain, recurrence, orchialgia) after attempting and failing conservative therapies for a minimum of 3 but optimally 6 months after the initial repair. CPIP is traditionally defined by this 3-month chronicity, but the timing of mesh integration and resolution of normal postoperative scarring with mesh-based repairs make 6 months a more conservative time frame. The preoperative workup needs to be thorough and methodical as successful intervention and the minimization of secondary complications are primarily predicated on proper patient selection. Characterization of symptoms, assessment of prior pharmacologic and interventional treatments, as well as cross-sectional imaging to identify recurrence, meshoma, or other anatomic abnormalities should be done. A plain film of the pelvis or scout films from a CT scan may determine whether metallic fixation tacks were used and where they were placed. Prior operative reports should be reviewed to determine the type of operation, use of mesh, location of mesh, fixation, identification, and handling of nerves as all these factors can influence the most appropriate type of remedial operation. Dermatosensory mapping should be used during the preoperative assessment to help determine if neuropathic pain is present and which nerve distributions are implicated. Quantitative sensory testing when available is also useful in characterizing neuropathic inguinodynia but is often too time and labor intensive for daily clinical practice. All patients considered for neurectomy should undergo diagnostic and therapeutic blocks of the ilioinguinal, iliohypogastric, and genitofemoral nerves.

A thorough discussion of risks, benefits, and expectations should be carried out with the patient undergoing remedial surgery [24, 25]. These include but are not limited to failure to identify or resect all three nerves, persistent pain, permanent numbness, bulging of the lateral abdominal wall muscles due to motor denervation of the lower oblique muscles, labial numbness, testicular atrophy or loss, loss of cremasteric reflex, injury to the spermatic cord, and deafferentation hypersensitivity. If the patient has nociceptive pain caused by tissue injury, meshoma, or other factors, their pain will not be alleviated with triple neurectomy alone, and mesh-, hernia-, or tissue-based causes must also be addressed. Similarly, isolated orchialgia is unlikely to resolve with inguinal neurectomy alone.

43.1 Surgical Techniques

43.1.1 Endoscopic Groin Exploration

Endoscopic groin exploration should be considered a part of the diagnostic evaluation and can be used as an adjunct (with hybrid approaches to the inguinal canal) or primary means to address many of the pathologies associated with CPIP. It is appropriate for patients with a prior history of laparoscopic inguinal hernia repair (TEP or TAPP) with evidence of meshoma and use of lateral penetrating fixation or for patients with anterior or preperitoneal approach, equivocal imaging, and unremitting pain that is mesh-related or neuropathic on physical exam. Diagnostic laparoscopy is the first step, as it allows for identification of interstitial hernias, recurrent hernias, mesh migration, and intra-abdominal adhesions that could be contributing to the patient's symptoms. Offending tacks or other types of fixation can also be identified and often removed from the intraperitoneal working space without violating the preperitoneal space.

Exploration of the preperitoneal space and myopectineal orifice, whether through a transabdominal or totally extraperitoneal approach, is an important next step. Developing the preperitoneal view of the myopectineal orifice helps to rule out occult causes of pain including recurrence, retained lipoma, and mesh migration and allows for subsequent preperitoneal mesh repair of the resultant or recurrent hernia if desired. This allows for visualization of the cord structures and hernia spaces and identification of the lateral femoral cutaneous nerve and genitofemoral nerves. The peritoneal flap should be initially separated from the mesh and preserved; however, this is sometimes not possible. If the main issue is recurrence and the mesh is otherwise flat, it may be left in place with creation of a larger dissection space, and additional mesh is placed. Alternatively, recurrence may be addressed with an anterior Lichtenstein repair avoiding the preperitoneal plane altogether. However, if recurrence is not the only factor leading to pain, hernia repair alone is unlikely to remediate the problem.

Neuropathic pain that arises with laparoscopic preperitoneal repair without traumatic fixation should by anatomy and mechanism be isolated to the genitofemoral or lateral femoral cutaneous nerves. Similarly, cases with dermatosensory mapping suggestive of an isolated neuropathic distribution involving the genital or lateral femoral cutaneous nerves can be addressed in the preperitoneal space without involvement of the ilioinguinal and iliohypogastric nerves. The genital and femoral branches of the genitofemoral nerve may be identified over the psoas and iliac vessels as they pass toward the internal ring and iliopubic tract. The lateral femoral cutaneous nerve can be identified lateral to the psoas passing over the iliacus muscle toward the lateral thigh. Neurectomy of these two nerves may be safely and effectively performed during endoscopic groin exploration with minimal morbidity in this location (Fig. 43.1).

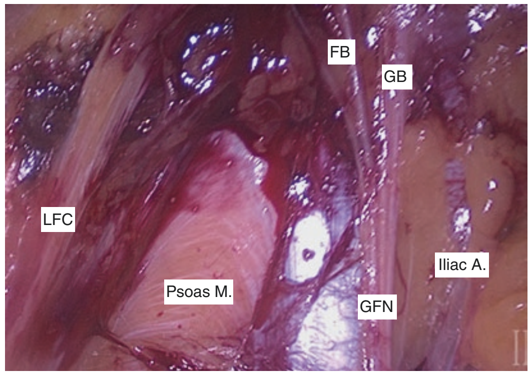

Fig. 43.1 Left preperitoneal inguinal neuroanatomy. Lateral femoral cutaneous (LFC) nerve over iliacus. Genitofemoral nerve (GFN) with its genital (GB) and femoral (FB) branches passing over the psoas medial to the iliac vessels

43.1.2 Meshoma

Meshoma pain after laparoscopic preperitoneal repair may require mesh removal. Laparoscopic mesh removal is difficult and fraught with potential dangers. However, compared to open mesh removal, laparoscopic dissection and visualization allow for a broad assessment of mesh position and configuration, involvement of surrounding visceral structures, and potential mechanisms of pain. Laparoscopic dissection also provides a controlled approach to removal of the mesh especially with regard to adherence to vascular structures. In the case of an isolated preperitoneal laparoscopic mesh (TEP, TAPP) (Figs. 43.2 and 43.3), open preperitoneal mesh placement (TIPP, Kugel, TREPP), or plug (Fig. 43.4a), removal may often be accomplished entirely through a laparoscopic approach. With repairs that traverse the anterior and posterior plane (plug and patch and bilayered meshes), laparoscopic mesh removal can address the posterior mesh component alone or may be used as an adjunct to facilitate the posterior dissection as part of a hybrid open inguinal and laparoscopic preperitoneal approach (Fig. 43.4).

Meshoma is typically scarred, fixated, or contracted around the epigastric and iliac vessels along with the cord structures. Occasionally the bladder is adherent to the mesh as well. Preoperative counseling must include discussion

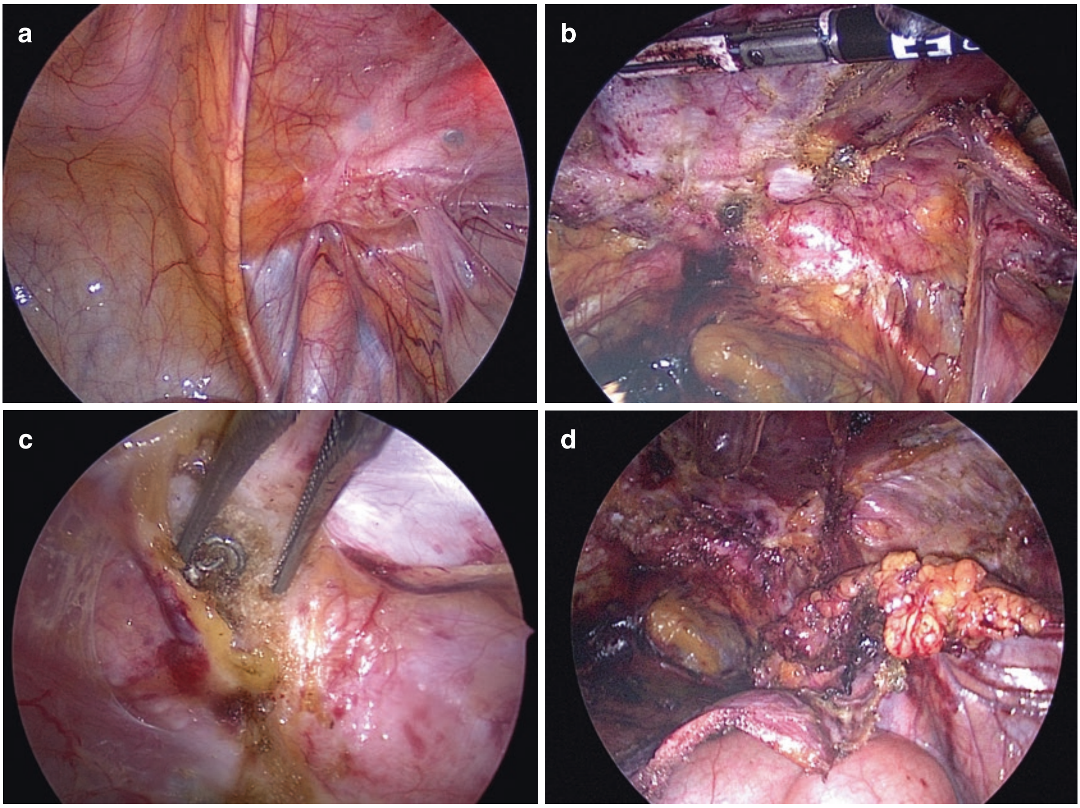

Fig. 43.2 Laparoscopic removal of tack-fixated preperitoneal mesh. (**a**) Intra-abdominal view (**b**) Preperitoneal view with mesh and tacks (**c**) Tack removal (**d**) Mesh and tacks dissected off cord and vascular structures

about injury to these structures and contingency plans to control bleeding and repair any potential damage carefully thought out before starting the operation. When separation from the vessels, the viscera, or the spermatic cord is difficult, it is often prudent and safer to leave a cuff of mesh behind to minimize injury to these structures especially in cases of fixation with tacks and suture. With meshoma pain, patients typically are affected by the amount of mesh present and its three-dimensional configuration and bulk. Reduction in the mass of the meshoma can potentially alleviate symptoms with decreased morbidity and risk by leaving small adherent areas of mesh behind. Bladder decompression for laparoscopic mesh removal operations is recommended to maximize the operative field and facilitate mesh removal or repair in the case of bladder erosion. Robotic-assisted groin exploration, following the same operative principles of laparoscopic surgery, may be helpful for complex cases as the added range of motion, superior optics and visualization, and increased operative dexterity may facilitate more precise mesh dissection and minimally invasive vascular repair.

43.1.3 Fixation

Penetrating fixation with tacks or permanent suture may cause nociceptive symptoms at the point of fixation or neuropathic injury with distal dermatosensory effects. Tacks or other penetrating fixation devices can be removed if they correspond to areas of targeted pain on preoperative exam. Tack removal may be accomplished intraperitoneally or extraperitoneally. Isolated tack pain can occasionally be addressed with simple cutdown over the site of pain. However, laparoscopic removal is recommended for multi-

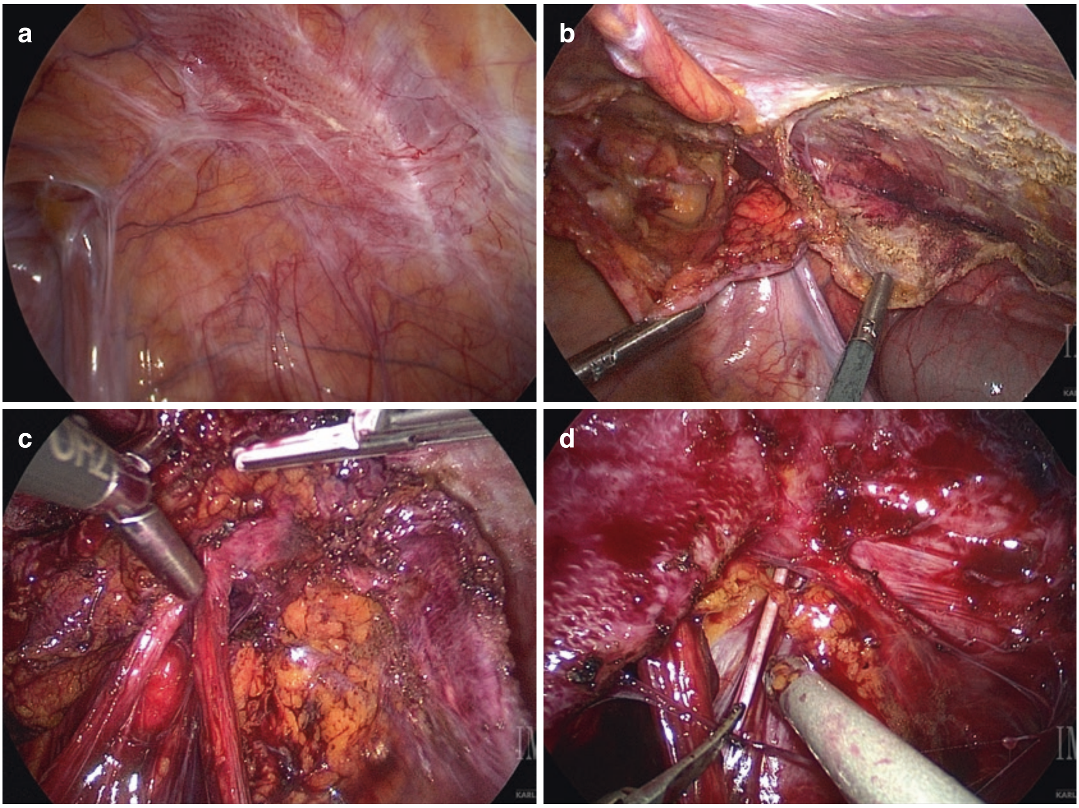

Fig. 43.3 Operative approach to laparoscopic removal of preperitoneal mesh. (**a**) Intra-abdominal view (**b**) Cephalad dissection from abdominal wall and epigastric vessels (**c**) Caudal dissection from cord structures and vessels (**d**) Genital nerve neurectomy with mesh removal

ple problematic locations and coexisting pathology, and removal is typically less traumatic from a posterior approach (Fig. 43.2b, c). Intraoperative fluoroscopy may be a useful adjunct to localize metallic tacks, clips, and devices.

43.1.4 Recurrent Hernia and Retained Cord Lipoma

With laparoscopic repairs, symptomatic recurrences tend to occur due to a retained cord lipoma, incomplete dissection of the preperitoneal space, or incomplete coverage of the myopectineal orifice. Adherence to the recently proposed critical view of the myopectineal orifice by Felix and Daes may minimize these recurrences and sets a technical standard for performance of a laparoscopic repair. Retained cord lipomas may be reduced posterior to the mesh. The existing mesh can remain flat and adherent to the flap without need for removal. If it is folded or clamshelled, this mesh should be removed if feasible to allow for placement of new mesh.

43.1.5 Orchialgia

Patients with orchialgia after inguinal hernia repair may occasionally have isolated or coexisting orchialgia. True testicular pain must be distinguished from scrotal pain or referred pain extending to the testicle. Scrotal pain is mediated by the genital branch of the genitofemoral nerve and is discrete from orchialgia. Testicular pain may arise from nociceptive and neuropathic causes. Nociceptive testicular pain may be caused by direct parenchymal compromise, trauma, or isch-

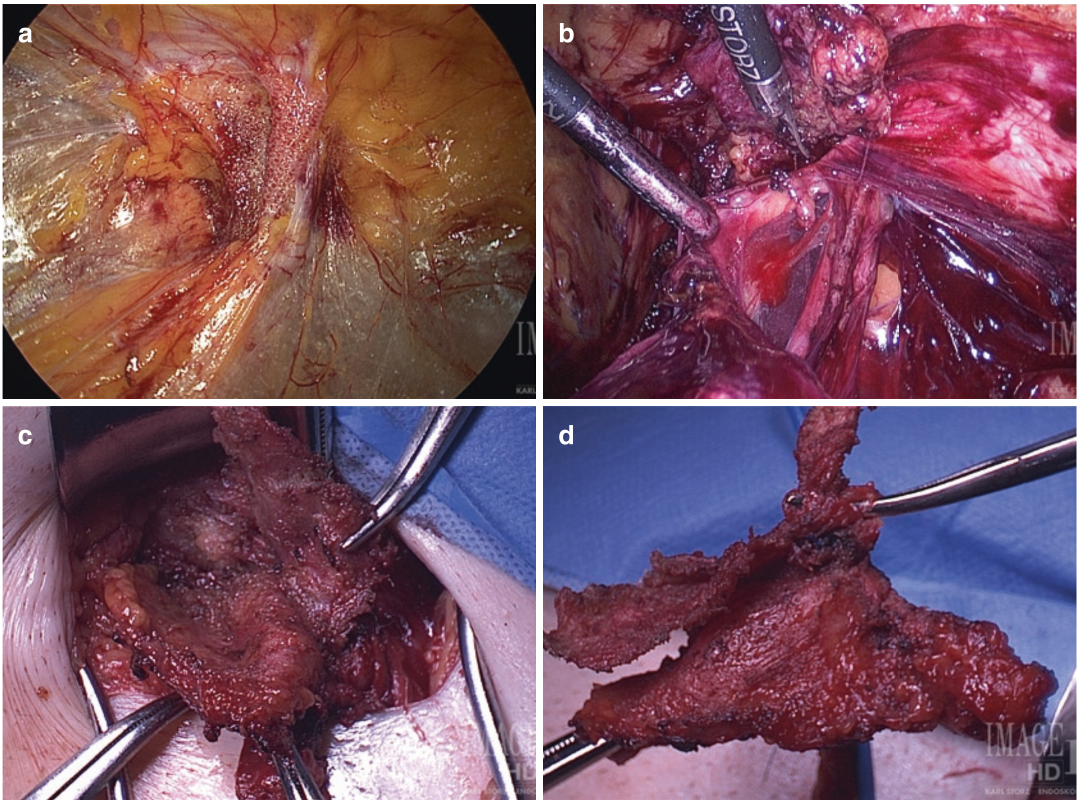

Fig. 43.4 Hybrid approaches to mesh removal. (**a**) Laparoscopic plug removal (**b**) Laparoscopic bilayer mesh removal (posterior layer meshoma) (**c**) Anterior view of anterior and posterior fold after laparoscopic dissection of posterior fold (**d**) Hybrid removal of bilayer mesh

emia. In CPIP, this is typically caused by compromised arterial inflow with injury or scarring to the spermatic vessels or obstructed venous outflow with mesh, scarring, or constriction from the repair. Neuropathic orchialgia is mediated by the autonomic nerve fibers that envelop the cord structure as a plexus and then coalesce to travel within the cord (Fig. 43.5). The majority of these fibers travel along the vas deferens. After preperitoneal repair with plug, plug and patch, bilayered mesh, and laparoscopic and open preperitoneal mesh, these nerves and the vas deferens may be involved. Laparoscopic exposure of the preperitoneal plane allows for paravasal neurectomy of these autonomic fibers taking the tissue between the skeletonized vas and spermatic vessels (Fig. 43.5b, c). This procedure must be performed proximal to the injury and scarring and may alleviate orchialgia in patients with neuropathic testicular symptoms.

43.1.6 Endoscopic Retroperitoneal Triple Neurectomy

Neuropathic pain refractory to conservative measures with pathology proximal to the inguinal canal may be approached via a laparoscopic retroperitoneal operation within the lumbar plexus. This single-stage procedure allows access to the main trunks of the ilioinguinal, iliohypogastric, and genitofemoral nerves. The retroperitoneal approach allows nerve resection proximal to any potential sites of neuropathy from either anterior or preperitoneal approaches. The neuroanatomy of the inguinal nerves is less variable in the region increasing the reliability and success of nerve identification. However, this technique also increases the distribution of numbness and causes some oblique muscle denervation and bulging due to the proximal nature of this neurectomy. It is

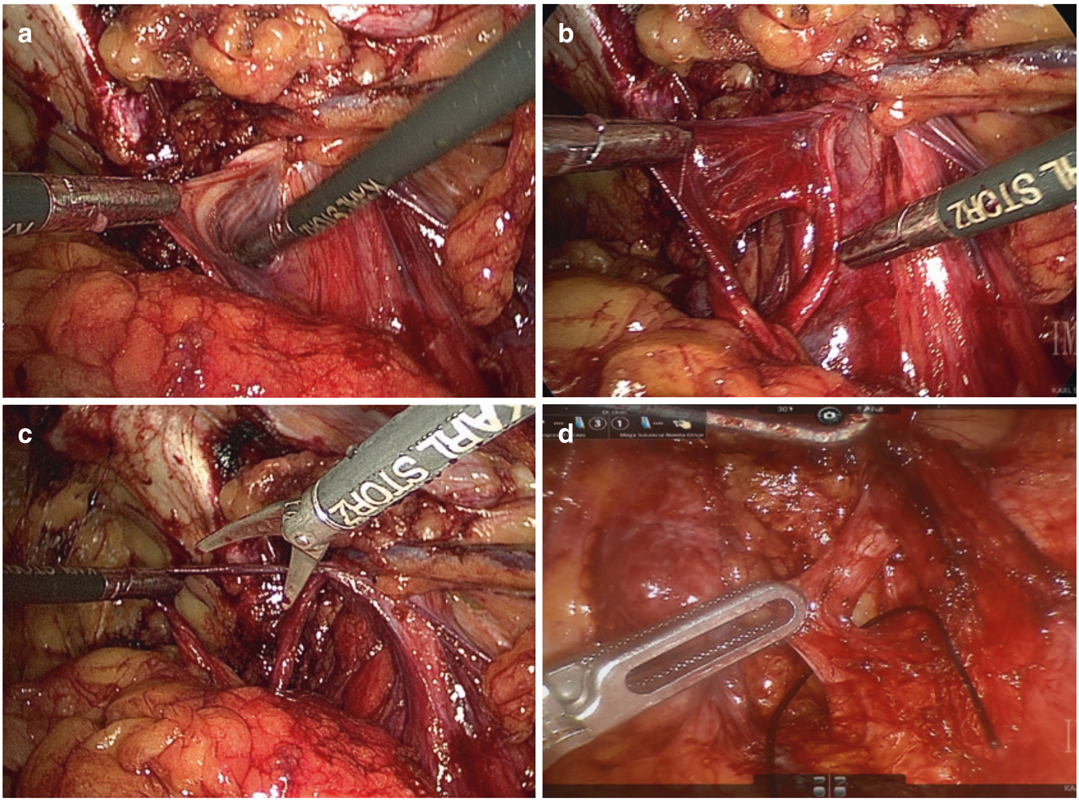

Fig. 43.5 Paravasal neurectomy. (**a**) Paravasal autonomic nerve fibers enveloping vas (**b**) Isolation of fibers from vas deferens (**c**) Division and neurectomy of paravasal nerve fibers proximal to prior preperitoneal mesh (**d**) Robotic approach to paravasal neurectomy

most effective and appropriate for patients that have neuropathic pain with nerve symptoms originating proximal to the inguinal canal, after multiple prior open inguinal operations or infection, or after failed anterior inguinal neurectomy where an anterior approach is unlikely to be successful.

43.1.6.1 Operative Technique

1. Position the patient in lateral decubitus position. Flex the table to open the space between the iliac crest and costal margin.
2. Identify and mark the midaxillary line. A 12 mm transverse incision is made anterior to the midaxillary line 3–4 cm above the iliac crest through the lateral aspect of the oblique muscles.
3. Incise the external oblique fascia, and spread the muscle fibers of the external oblique, internal oblique, and transversalis until the retroperitoneum is accessed.
4. Insert an oval dissecting balloon into the potential space and inflate under direct visualization. This should rotate the peritoneum and viscera medially exposing the retroperitoneal space.
5. Remove the dissecting balloon, place a 12 mm balloon-tipped trocar, and insufflate to 15 mmHg.
6. Insert a 5 mm trocar 2–3 cm medial to the initial incision under direct vision.
7. Dissect and mobilize the retroperitoneal fat pad medially with laparoscopic dissector or vessel-sealing device to expose the psoas and quadratus lumborum muscles.
8. Define the lumbar plexus prior to taking any nerves. The cephalad extent of the dissection

is identified by the subcostal nerve at T12 costal margin (Fig. 43.6).

9. Identify the iliohypogastric and ilioinguinal nerve trunks, which can often share a common trunk, over the quadratus muscle at L1 (Fig. 43.6).
10. Identify the lateral femoral cutaneous nerve originating from L3 and coursing lateral to the psoas, crossing the iliacus muscle below the iliac crest.
11. Dissect medially toward the groin and identify the genitofemoral nerve trunk running over the psoas muscle. Identify and protect the ureter and iliac vessels, which run medial to the psoas muscle. Areas of caution include these structures immediately medial to the psoas and the femoral nerve running immediately lateral to the psoas muscle. The genitofemoral nerve will run over the psoas itself between these two areas (Fig. 43.7).
12. The genital and femoral nerve trunks exhibit considerable variability. Depending on preoperative examination, the femoral branch can be preserved if there is no evidence of its dermatome being affected and if two separate trunks exist.
13. Neurectomy should only be performed once all the aforementioned nerves have been identified.
14. In the cephalad field, clip or ligate the iliohypogastric and ilioinguinal nerves proximally and distally over the quadratus prior to division to close the neurolemma. Divide the intervening segment, and submit to pathology for confirmation. Clips may also serve as markers for future intervention if proximal nerve blocks are needed. In the caudal field, clip and resect the genitofemoral nerve over the psoas muscle in a similar fashion.
15. If the peritoneum is ripped or retroperitoneal access is difficult, the operation can be performed transabdominally with medial rotation of the viscera.

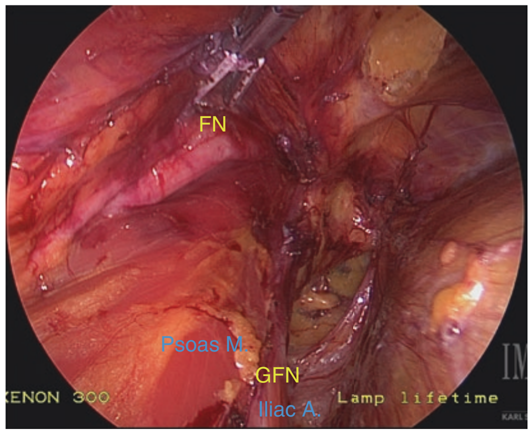

Fig. 43.7 Caudad view of lumbar plexus with genitofemoral nerve (GFN) identified over psoas muscle

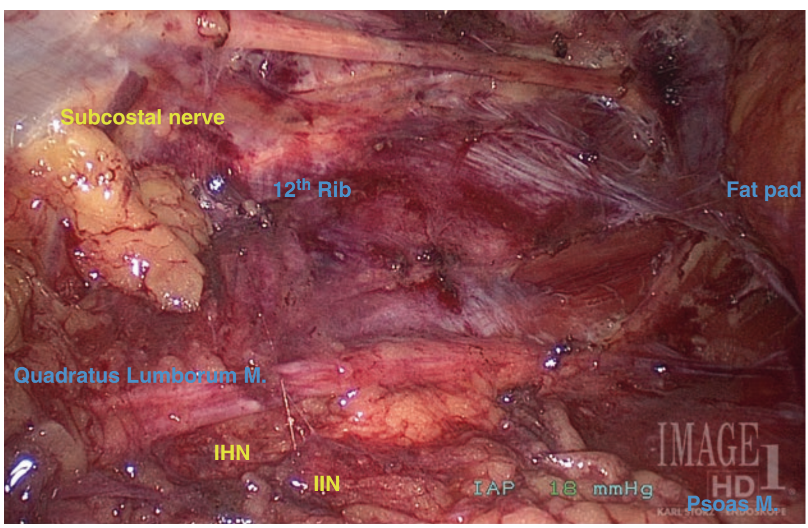

Fig. 43.6 Cephalad view of lumbar plexus with iliohypogastric (IHN) and ilioinguinal (IIN) nerves identified over quadratus lumborum muscle

43.2 Results

The efficacy of pain intervention surgery is challenging to directly compare and quantify given the heterogeneity of inguinodynia. Treatment is truly a tailored process using information from symptoms, anatomy, dermatomal mapping prior operation type, prosthetic material involved, and response to prior interventions to formulate a logical operative plan (if one exists) that may remediate or alleviate the causes of pain and correct identifiable pathology. Diagnostic experience is as crucial as operative experience to maximize the potential for successful outcomes and minimize morbidity. Much of the reported data on inguinodynia has focused on the role of operative neurectomy which can be more directly compared. These studies do not separately factor the type of mesh, role of mesh removal, treatment of orchialgia, and coexisting groin and hip pathology all of which confound the data. The distinction between neuropathic and nociceptive pain is important with most series addressing the neuropathic aspect alone. However, these are often inseparable making objective pain studies complex and challenging.

The Lichtenstein Amid Hernia Clinic recently published prospectively collected long-term data on the efficacy of retroperitoneal triple neurectomy [26]. Data were collected over a 3-year study period, during which time 567 CPIP patients were evaluated. Of these patients, 62 met inclusion criteria and underwent retroperitoneal triple neurectomy after extensive preoperative workup and non-operative management. Exclusion criteria included non-neuropathic pain, low severity of pain, meshoma pain, inadequate non-operative treatment/evaluation, pain limited to area of anterior repair, isolated dermatomal involvement, pain outside of inguinal distribution, multifocal pain, recurrence, unrelated pain, fixation pain, primary orchialgia, prior retroperitoneal surgery, high American Society of Anesthesiologists (ASA) score, and prior histologically confirmed neurectomy. All patients had significant self-reported pain with an average of 8.6 (range, 6–10).

Postoperatively, appropriate numbness was found in all patients within 24 h of the operation and at all subsequent visits with an average follow up of 681 days. Subjectively reported numeric pain scores decreased significantly from a mean of 8.6 to 3.6 on postoperative day 1 to 1.8 by postoperative day 360. After 90 days there were no continued significant decreases in score, but there was durable and consistent efficacy up to 3 years out. Fifty-nine out of 62 patients (95%) had a successful intervention, defined as a decrease in pain intensity to manageable levels below 7. Quantitative sensory testing was also used in a subset of patients to validate the efficacy of the triple neurectomy, with significant increases in sensory and pain detection thresholds. Narcotic and neuropathic pain medication use were eliminated in 44 patients. Twenty patients did experience some degree of deafferentation hypersensitivity. This typically resolved within 6 months, but five patients continued to have some symptoms after 1 year. Nineteen patients experienced some lateral abdominal laxity due to partial denervation of the oblique muscles from loss of the iliohypogastric and ilioinguinal nerves.

In our experience of over 800 patients operated on for inguinodynia, some generalities can be extrapolated. Triple neurectomy for generalized inguinal pain with overlapping dermatomal distribution is more effective than selective neurectomy. This may come at a cost of increased numbness, but the difficulty of reoperation and declining efficacy, neuroanatomic variability, and increased morbidity with subsequent operations make this a negligible consideration. Dermatosensory mapping and correlation to mechanism may help to identify patients that will benefit from selective neurectomy with preservation of obviously unaffected nerves. Nociceptive pain arising from meshoma should be addressed either simultaneously or in staged fashion with complete or partial mesh removal. Orchialgia is a separate and discrete cause of pain with its own intrinsic diagnostic and operative challenges. Recurrence is an independent cause of pain. There are several options for repair, each with their own consideration and risks. In general, removal of mesh or recurrence from an anterior repair is best approached posteriorly and vice versa with prior open or laparoscopic preperitoneal repair. However, in pain remediation, it may be preferable to not enter another plane and confound the causes of an already challenging diagnostic problem. Repeating an anterior repair with a lightweight anterior mesh repair or replacing a posterior meshoma with a non-fixated flat laparoscopic mesh may be the best option in certain cases depending on the final inguinal anatomy after mesh removal and neurectomy. Patients that decline a subsequent mesh operation should be appropriately counseled on recurrence especially with large (>M2/L2) hernia defects but should be offered a Shouldice repair if possible as the best available tissue option if mesh is declined. Referral to or collaboration with dedicated hernia specialists that routinely treat pain is appropriate for challenging cases.

Conclusion

Chronic postoperative inguinal pain refractory to medical management is a challenging condition with significant costs and impact on a patient's quality of life. There are limited options for remediation and pain relief. Open groin exploration and triple neurectomy remain the standard but can be difficult or ineffective due to postsurgical changes, distorted anatomy, and neuropathy that is proximal to the inguinal canal. In addition, cross-innervation and unpredictable distal branching of the nerves can contribute to the challenges of an open neurectomy. Laparoscopic approaches to inguinal neurectomy are a valuable, highly effective adjunct in dealing with neuropathic postoperative inguinal pain. Safe and effective mesh removal may be facilitated by laparoscopic or hybrid techniques that allow for greater visualization and dissection of mesh from the posterior wall. Orchialgia may be improved with laparoscopic paravasal neurectomy. As with all remedial surgery for inguinodynia, the goal is to identify the least morbid and most effective approach to providing significant pain relief. There is no one size fits all, as each approach needs to be tailored to the patient's initial repair, pain symptoms and distribution, physical exam, imaging, and shared decision-making. A solid understanding of the anterior and posterior anatomy, mechanisms of injury, and laparoscopic and open routes to access pathology provides a broad range of options to tailor treatment and improve outcomes.

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