Postherniorrhaphy Groin Pain and How to Avoid It

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Henry Kissinger once stated that, “soccer is a game that hides great complexity in the appearance of simplicity”; he could have very well been describing an inguinal hernia repair. Few other anatomic dissections in general surgery can prove as challenging as an inguinal hernia repair. Despite the procedure’s seemingly straightforward steps, if strict adherence to anatomic planes of dissection is not followed as well as the use of precise knowledge of potential pitfalls, morbidity can easily result. One of the most common sources of postoperative morbidity in surgical patients is the occurrence of postherniorrhaphy chronic groin pain, defined as pain that persists after the normal healing process has occurred—typically 3 months after surgery. Chronic groin pain is most often a result of nerve injury sustained during improper dissection. Careful dissection of the five major nerves encountered during this procedure and their protection can help to reduce this complication substantially and its concomitant adverse effects on quality of life.

The complexity of nerve dissections in the inguinal region is increased by the varied patterns of distribution. It has been shown that there is direct communication between branches of the major innervations of the groin. In fact, only approximately 20% of patients were found to have the “normal” pattern of sensory distribution of the iliohypogastric and ilioinguinal nerves, as outlined by modern anatomic references. This is further
complicated by the fact that these patterns of innervation are only symmetrical in approximately 40% of patients [1].

The true incidence of postherniorrhaphy groin pain has not been fully elucidated, in part because most surgeons have been more concerned with recurrence rates than with this seemingly insignificant symptom. However, with the advent of tension-free mesh repairs, inguinal hernia recurrences are uncommon, unless underlying patient factors predispose to the development of hernias. Furthermore, not all patients suffering with chronic groin pain seek medical assistance, especially for mild symptoms. Few are referred back to the operating surgeon, and only a small percentage of patients seek help from a pain specialist [2]. In fact, one study demonstrated that after 24 to 36 months of follow-up, approximately 30% of patients undergoing inguinal herniorrhaphy reported pain or discomfort and nearly 6% reported high-intensity pain resulting in inability to perform activities of daily living. This was in comparison with a recurrence rate of only 4.5% [3]. The point of maximal tenderness is usually at the pubic tubercle, usually from incorporation of a stitch or staple into the peritoseum [2]. In recent years, emphasis has shifted toward evaluation of the patient’s quality of life after surgical intervention and relief of symptoms, with presence of inguinal pain viewed as an endpoint in evaluating hernia surgery. This emphasis is of particular importance: if a patient is undergoing herniorrhaphy to reduce inguinal pain, it would be a disservice to cause undue pain secondary to improper groin dissection. It is also crucial to determine whether any other associated pathology exists and can contribute to the sensation of inguinal pain because this will lead to persistent pain after surgical intervention.

This article aims to provide a thorough review of pertinent anatomic landmarks for the proper identification of the nerves that, if injured, result in chronic groin pain and to provide a treatment algorithm for patients suffering with this morbidity.

**Anatomic considerations**

To prevent technical errors resulting from improper nerve dissection, a thorough understanding of the innervation to the groin and the anatomic location of the nerves is essential for their preservation and protection from injury. This will help to not only better understand the etiology of the problem, but also to provide a means of preventing this complication. Interestingly, according to the present author’s residents, only the ilioinguinal nerve is routinely sought in groin dissections and protected from injury. This may be the fundamental problem in the technical approach to inguinal herniorrhaphy that predisposes to chronic groin pain. In fact, there are five main nerves that must be identified and preserved during an inguinal herniorrhaphy: the ilioinguinal, the iliohypogastric, the genitofemoral, the lateral femoral cutaneous, and the femoral nerves. Table 1 presents a complete review of the origin and course of these vital structures.
<table>
<thead>
<tr>
<th>Nerve</th>
<th>Origin</th>
<th>Course</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>Ilioinguinal</td>
<td>T12-L1 nerve roots</td>
<td>It emerges from the border of the psoas major, passes the quadratus lumborum and iliacus, perforates the transverses abdominis, and then accompanies the spermatic cord</td>
<td>Supplies sensory innervation to the proximal and medial thigh. In females it innervates the mons pubis and labium majus; in males it innervates the root of the penis and upper scrotum.</td>
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<tr>
<td>Iliohypogastric</td>
<td>T12-L1 nerve roots</td>
<td>Same as ilioinguinal</td>
<td>Same as ilioinguinal</td>
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<tr>
<td>Genitofemoral</td>
<td>L1-L2 nerve roots</td>
<td>It emerges from the medial border of the psoas muscle and subsequently divides into a genital and femoral branch. The genital branch pierces the transversalis fascia, where it travels with the spermatic cord to the scrotum; the femoral branch travels with the external iliac artery and passes beneath the inguinal ligament and extends to the anterior surface of the thigh.</td>
<td>The genital branch supplies sensation to the mons pubis and labium majus. In males it supplies sensation to the scrotum and motor fibers to the cremasteric muscle. The femoral branch supplies innervation to the anteriorlateral thigh.</td>
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<tr>
<td>Laternal femoral</td>
<td>L2-L3 nerve roots</td>
<td>It emerges from the lateral border of the psoas muscles, goes toward the anterior superior iliac spine, and passes under the inguinal ligament</td>
<td>Provides sensory innervation to the anteriorlateral thigh. Injury most commonly results in severe burning sensation along its course.</td>
</tr>
<tr>
<td>cutaneous</td>
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<tr>
<td>Femoral</td>
<td>L2-L3 nerve roots</td>
<td>Emerges at the inferior border of the psoas muscle and passes beneath the inguinal ligament to innervate the thigh</td>
<td>Provides sensory branches to the anterior thigh. Predominant function is motor innervation to the quadriceps resulting in muscle atrophy if injured.</td>
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When the groin is explored via the anterior approach, one may encounter the ilioinguinal nerve, the genital branch of the genitofemoral nerve, and the iliohypogastric nerve (Fig. 1). The ilioinguinal nerve can usually be identified lateral to the internal ring. The genital branch of the genitofemoral can be identified in the lateral crus of the internal ring. Another possible anatomic location of this nerve is between the spermatic cord and inguinal ligament. The iliohypogastric nerve can be identified by separating the aponeurosis of the external oblique from the internal oblique muscle. The iliohypogastric nerve is the regional nerve that is at highest risk during tension-free repair because it can be trapped by the overlapping mesh in the scar tissue that forms between the mesh and the muscle plane along which the nerve runs [4].

When the groin is explored with minimally invasive techniques, the nerves that are prone to injury include the lateral femoral cutaneous, the femoral branch of the genitofemoral nerve, and the femoral nerve (Fig. 2). During a laparoscopic repair, one must identify the “triangle of pain,” appropriately named because of the many nerves that course through it and the potential for injury if careful dissection is not performed. This

Fig. 1. Nerves encountered during the anterior inguinal herniorrhaphy approach. (Courtesy of A. Erickson, Brooklyn, NY.)
The triangle is a theoretical space bounded by the gonadal vessels medially, the reflected peritoneum laterally, and the iliopubic tract superiorly.

**Risk factors for chronic pain following inguinal herniorrhaphy**

One study sought to understand the phenomenon of postoperative inguinodynia with a population-based study involving more than 9000 patients undergoing inguinal hernia repair. Patients were given a questionnaire designed to identify postoperative inguinal pain and determine severity and impact on quality of life—specifically in impeding functional daily activities and ability to work and exercise. In multivariate logistic analyses, severe preoperative groin pain and presence of postoperative complications such as infection or hematoma were found to independently predict postoperative inguinal pain in a statistically significant manner ($P = 0.001$ and $P = .003$, respectively) [3]. Preoperative pain may indicate complicated disease pathology prior to surgical intervention resulting in stretching,
entrapment, or inflammation of inguinal nerves. It may also indicate
the presence of psychologic predisposition and lowered pain thresholds
among these patients, increasing potential for postoperative pain [3].
There may be an underlying cycle of chronic pain that is difficult to
break.

Direct injury to nerves that results in either partial or complete transac-
tion can lead to neuroma formation and the subsequent development of
chronic pain. Some have implicated the role of mesh as well. It has been
demonstrated experimentally that when peripheral nerve tissue comes in
contact with polypropylene mesh, myelin degeneration, edema, and fibrosis
result and can lead to neuralgia and peripheral neuropathy [5,6]. Multiple
studies have examined this issue and the weight of the evidence seems to
favor a lack of association with mesh and the occurrence of chronic pain
[7–9]. In fact, one study sought to determine the outcomes of hernia repair
with the use of biocompatible, “light” meshes and the potential for reduc-
tion of postoperative pain. These light meshes have been constructed with
an aim to improve tissue integration into the mesh, thereby reducing the
foreign body reaction thought to be partly responsible for postherniorrhap-
hy groin pain. In a prospective, randomized clinical trial, light meshes
were associated with similar rates of chronic groin pain compared with
traditional meshes, 3% and 4%, respectively [10]. These data are largely
preliminary, and research into alternatives to polypropylene will surely
continue.

Operative technique has been implicated in the etiology of groin pain
following inguinal herniorrhaphy. There are numerous published reports
of nerve entrapment by tacks placed during laparoscopic repair [11–13].

Laparoscopic herniorrhaphy without the use of a tacker has been
described and eliminates the risk of misplaced tacks [1,14,15]. It has been
accepted, however, that laparoscopic hernia repairs result in less chronic
pain syndromes in comparison with open repairs, predominately owing to
failed identification of the ilioinguinal nerve in the latter approach. Further-
more, laparoscopic repair requires limited dissection and avoids undue
stress and trauma to the ilioinguinal and iliohypogastric nerves [10].

**Avoiding chronic pain following inguinal herniorrhaphy**

The cornerstone of avoiding postoperative pain following inguinal hernia
surgery is precise knowledge of groin anatomy and careful dissection and
preservation of inguinal nerves. Some have even gone to the extreme of
advocating “watchful waiting” for asymptomatic hernias to avoid postoper-
ative pain, but this must be carefully weighed against the potential for incar-
ceration or strangulation. Judicious clinical judgment would advocate early
intervention with careful dissection to avoid preventable nerve injury,
thereby minimizing this potentially debilitating morbidity.

Care must be taken to avoid placement of sutures at the medial insertion
of the inguinal ligament to avoid excessive tightness of the inguinal ligament
at the pubic tubercle. Most somatic pain following inguinal herniorrhaphy results from damage to the pubic tubercle during stapling or suturing of the mesh prosthesis with incorporation of the periosteum of the pubic tubercle [16]. A description of six specific maneuvers to reduce the risk of nerve injury during open herniorrhaphy has been described [17]: avoiding indiscriminate division of the subcutaneous tissue, avoiding removal of the cremasteric muscle fibers, avoiding extensive dissection of the ilioinguinal nerve, identifying and preserving all neural structures, avoiding making the inguinal ring too tight, and avoiding placement of sutures in the lower edge of the internal oblique muscle. Nerve trauma can be caused by several mechanisms, including partial or complete transaction, stretching, contusion, crushing, cautery damage, or suture compression [16].

Of interest, a study performed by Lichtenstein that investigated the prevention of postherniorrhaphy neuralgia proposed that transection of the ilioinguinal and genitofemoral nerves may prove to be a useful solution [18]. Several groups have attempted to avoid chronic postoperative pain by the use of selective neurectomy during elective repair of groin hernias. A small number of patients undergoing resection of the iliohypogastric and ilioinguinal nerves during open, tension-free mesh repair have been studied [19]. It was demonstrated that none of these patients developed chronic groin pain; however, 6.2% reported numbness at the 1-year follow-up. A retrospective review found that ilioinguinal neurectomy during open, tension-free mesh repair resulted in significantly less pain after 1 year compared with routine nerve preservation, 3% and 25%, respectively [20]. A double-blinded, randomized controlled trial to investigate the effects of prophylactic ilioinguinal neurectomy following tension-free mesh repair of inguinal hernia was conducted with 100 male patients randomized into two groups: prophylactic ilioinguinal neurectomy or ilioinguinal nerve preservation. The findings demonstrated that the incidence of chronic groin pain at 6 months was significantly lowered compared with the nerve preservation group (8% versus 28.6%, \( P = .0008 \)). No significant difference was found in the incidence of neurosensory complaints, including groin numbness and sensory loss [21]. The authors advocated that prophylactic neurectomy should be incorporated into the essential steps of a Lichtenstein hernia repair. However, this remains controversial because other studies have failed to demonstrate a statistically significant difference in incidence of postoperative pain between nerve division versus preservation. A recent study was conducted to determine whether prophylactic neurectomy might prevent persistent pain after inguinal herniorrhaphy. Unilateral iliohypogastric neurectomy was performed on 100 men requiring bilateral inguinal hernia repair, with each patient also serving as a control. Pain was evaluated on postoperative days 1 and 7 and at years 1 and 2 with established pain scale tools to compare pain on the neurectomized and non-neurectomized sides and to assess altered sensation, including both hypoesthesia and paraesthesia on both sides. The study found that although patients complained of less
pain on the neurectomized side after postoperative day 7, no statistical significance was reached. Interestingly, no significant difference was found in the incidence of sensory abnormalities between the two sides [4]. The authors concluded that studies involving larger patient samples are warranted to definitively demonstrate, with statistical significance, whether prophylactic neurectomy can help to alleviate persistent pain after inguinal herniorrhaphy. In fact, the only difference between these two groups was a decrease in touch sensation and numbness in the group that underwent routine division of the ilioinguinal nerve. One major criticism of prophylactic neurectomy is the resulting neurosensory disturbances that cause loss of sensation and groin numbness. However, it has been postulated that the sensory loss that may result following prophylactic neurectomy might be compensated for by cross-innervation provided by cutaneous nerves from the contralateral side and, therefore, the morbidity following neurectomy would be negligible [21].

The most crucial preventative step to reduce the incidence of postoperative groin pain is careful dissection and preservation of the ilioinguinal, iliohypogastric, and genitofemoral nerves [22]. It has been demonstrated that when all three nerves are identified and preserved, no cases of chronic pain were identified at 6-month follow-up. This was in stark contrast to the 40% of patients who reported moderate to severe pain when all three nerves were divided.

Evaluating and treating chronic pain following inguinal herniorrhaphy

Although chronic groin pain following inguinal herniorrhaphy may be mild and nondebilitating, a subset of patients will suffer with severe groin pain that significantly inhibits their ability to perform activities of daily living. A brief trial of conservative management is appropriate in all cases of groin pain; however, when symptoms are persistent, surgical intervention is warranted and this presents a difficult and challenging dilemma to surgeons. It is hoped that this article provides a useful algorithm to evaluate these patients and to effectively treat inguinodynia. It is important to remember, however, that each treatment plan must be individualized to every patient on the basis of the surgeon’s judgment and that management of these patients will never fall into a standard regimental protocol.

When evaluating a patient with postoperative groin pain, it should be remembered that, although the most likely source of morbidity is the repair itself, the differential for symptoms is broad and must be considered carefully (Table 2). Causes of chronic pain related to herniorrhaphy can be divided into neuropathic and non-neuropathic etiologies. The most common non-neuropathic etiologies include, most commonly, hernia recurrence, excessive scar formation, and pressure from the bulk of the mesh.

The neuropathic etiologies of chronic pain include nerve entrapment by sutures or staples (Fig. 3) and neuroma formation with partial or complete
transection of the involved nerve [6,23]. Neuropathic pain related to the genitofemoral nerve may result in testicular pain in men and labial pain in women. In these patients, a thorough urologic evaluation aimed at identification of underlying testicular or epididymal pathology in men and careful gynecologic examination in women is also necessary [24].

Hernia recurrence may be a source of chronic pain and should be ruled out early in the evaluation. CT scan may be helpful for establishing a diagnosis in cases of recurrence that are not readily apparent on physical examination [25]. Ultrasound is another potential diagnostic modality to help
Fig. 3. Neuropathic etiologies of postherniorrhaphy groin pain. (Courtesy of A. Erickson, Brooklyn, NY.)
determine occult recurrences as a potential cause of postoperative pain [26]. MRI has also been used to detect recurrence, delineate mesh position, and demonstrate non–hernia-related causes of pain [27, 28]. One may or may not be able to elicit a history of pain presenting in a classic distribution of a particular nerve. One can specifically elicit ilioinguinal nerve entrapment by having the patient hyperextend and twist the trunk of the body—twisting toward the affected side does not reproduce symptoms, whereas twisting away from it does [29].

The best modality for treatment of chronic groin pain is yet to be elucidated and is an area that continues to perplex even the most competent of surgeons. Treatment modalities include oral analgesics, regional nerve blocks, re-operation with mesh excision, and surgical neurectomy. Continued experience with this long-term complication of inguinal herniorrhaphy will undoubtedly result in other proposed solutions. Some have described performing selective nerve blocks for both diagnostic and therapeutic purposes [30, 31]. For example, if physical examination suggests involvement of the ilioinguinal nerve, a nerve block may help to confirm relief of symptoms followed by definitive surgical neurectomy. Acupuncture, tricyclic antidepressants, and gabapentin have been useful in the treatment of chronic pain syndromes, but their utility in management of chronic groin pain is unclear. Pulsed radiofrequency techniques have also been described and have become an accepted modality for neurodestructive treatment of severe pain syndromes. This technique applies a high-frequency and high-temperature electrical current to the affected tissue, resulting in neurodestruction and prevention of the transmission of pain signals [32]. However, this treatment is not without its own potentially debilitating complications—in particular, the formation of a neuroma and a neuritis reaction that can increase the sympathetic discharge and exacerbate pain. Therefore, this modality remains highly controversial. Unfortunately, a large percentage of patients with chronic groin pain fail to experience symptomatic improvement with nonoperative management strategies. The question arises as to who needs an operation and what is the preferred procedure that will relieve the symptoms without causing worsening of pain. If the pain persists for 6 months to 1 year, operative intervention should be discussed with the patient. The surgical approach of identification and resection of neuromas involving the ilioinguinal, iliohypogastric, and lateral femoral cutaneous nerves results in 80% success rates in pain relief as well as the ability to resume activities and return to work [24].

For patients with chronic pain resulting from laparoscopic repair with mesh and probable improper placement of securing tacks, it may be necessary to re-operate laparoscopically and remove the offending tacks. This may prove to be challenging because re-operating in the preperitoneal space may be difficult, but certainly feasible. Success has been reported with this technique [23, 33, 34].

The best surgical option to date may in fact be open-groin exploration with neurectomy and possible mesh removal. A thorough description of
operative technique in re-operation for testicular pain has been described and involves careful exposure of the operative field with an incision over the inguinal canal. In these cases, injury to the genitofemoral nerve was suspected. Given its anatomic variations, steps to careful identification of the nerve were developed following careful examination and dissection of cadavers. The technique that has been postulated includes following the nerve distally along the canal to exclude other communications and then following it proximally to the preperitoneum, where it is resected [24]. The authors stress the importance of high resection of the nerve, allowing it to retract behind the peritoneum and preventing the nerve end from rescarring (which would result in continued groin pain following re-exploration) [24]. On a reported series of 54 patients who underwent groin exploration with triple neurectomy that included the ilioinguinal, iliohypogastric, and genitofemoral nerves, 68% were relieved of pain [35]. This was confirmed in another study, which demonstrated that triple neurectomy resulted in a 72% complete pain relief and 25% partial relief [29]. In the largest series to date, 225 patients underwent triple neurectomy resulting in an 80% complete resolution of pain [35]. Despite these high rates of success, surgical intervention for chronic groin pain remains a source of distress for both patient and surgeon.

Summary

The number of patients afflicted with chronic groin pain following inguinal herniorrhaphy is grossly underestimated and unacceptably high. Despite attempts to predict who may or may not develop this complication, it is not entirely understood who is at risk and why. For this reason, the present authors emphasize the importance of a preoperative discussion of the possibility of this complication with the patient. To date, evidence suggests that the best prevention for this morbidity is avoiding inguinal nerve injury. All measures should be taken to ensure meticulous technique and careful dissection, with particular attention to avoiding incorporation of the inguinal nerves into stitches or staples. This will not only decrease the potential for recurrence, but will likely also result in decreased incidence of postoperative inguinal neuralgia.

It must be recognized that groin pain may be multifactorial, and it is quite possible that no specific etiology is identifiable. Given that a significant number of patients may improve with nonoperative management, the authors advocate observation with supportive care. However, if after 1 year the patient continues to suffer from this potentially debilitating symptom, operative intervention is the only solution, with triple neurectomy offering the most acceptable results.

References