A 1-Stage Surgical Treatment for Postherniorrhaphy Neuropathic Pain

Triple Neurectomy and Proximal End Implantation Without Mobilization of the Cord

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Background: The recommended surgical treatment for chronic neuropathic pain after herniorrhaphy has been a 2-stage operation including: (1) ilioinguinal and iliohypogastric neurectomies through an inguinal approach and (2) genital nerve neurectomy through a flank approach.

Hypothesis: A 1-stage surgical procedure resecting all 3 nerves from an anterior approach avoids a second operation through the flank and successfully treats chronic neuralgia.

Setting: A private practice dedicated to abdominal wall hernia surgery in general community hospitals.

Patients: Between 1995 and 2001, 49 patients underwent triple neurectomies with proximal end implantation to treat chronic postherniorrhaphy neuralgia.

Intervention: Triple neurectomy of the ilioinguinal, iliohypogastric, and genital nerves performed under local anesthesia with implantation of their proximal ends and without mobilization of the spermatic cord.

Results: Two patients (4%) reported no improvement. Eighty percent of patients recovered completely, and 16% had transient insignificant pain with no functional impairment. These results are comparable to the results of the 2-stage operation.

Conclusions: Simultaneous neurectomy of the ilioinguinal, iliohypogastric, and genital nerves without mobilization of the spermatic cord is an effective 1-stage procedure to treat postherniorrhaphy neuralgia. It is performed under local anesthesia and avoids testicular complications. Proximal end implantation of the nerves prevents adherence of the cut ends to the aponeurotic structure of the groin, which can result in recurrence of the pain.

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PROLONGED PAIN (neuralgia) and burning sensation (paresthesia) in the inguinal region after inguinal hernia repair are potentially incapacitating complications that represent a substantial diagnostic and therapeutic challenge. According to Starling et al1 and the number of calls and referrals to the Lichtenstein Hernia Institute, Los Angeles, Calif, the incidence of chronic neuralgia after herniorrhaphy is probably understated. Chronic neuralgia is easily distinguished from normal postoperative pain. The latter occurs immediately after surgery, is easily treated with analgesics, and gradually subsides as the wound heals. Chronic neuralgia, however, is an often debilitating pain that includes paresthesia, hypoaesthesia, and dysesthesia. Many patients with this complication also have other problems, such as mood swings, depression, or long-term drug dependency, and often are unable to return to work.

Resection of the ilioinguinal, iliohypogastric, and genital nerves is an established procedure for permanent elimination of postherniorrhaphy neuralgia.1,2 The recommended treatment has been a 2-stage operation: resection of the ilioinguinal and iliohypogastric nerves through an inguinal approach, then resection of the genital nerve through a flank approach.2 This article presents a 1-stage operation performed under local anesthesia and without mobilization of the spermatic cord for the treatment of postherniorrhaphy pain complex.

ANATOMY

The inguinal region, which includes the inguinal canal, spermatic cord, skin of the groin, hemiscrotum, labium majus, and the upper medial aspect of the thigh (Scarpa triangle), receives sensory innervation from the 12th thoracic nerve and the ventral branches...
of the first and second lumbar spinal nerves through the ilioinguinal, iliohypogastric, and genital branches of the genitofemoral nerves. The ilioinguinal nerve arises from the 12th thoracic and first lumbar nerves. It enters the groin through the transversus abdominis muscle medial to the anterosuperior iliac spine, follows the spermatic cord just below to the external oblique aponeurosis, lies over the ventral surface of the cremasteric sheath, and exits the external ring to supply sensory innervation to the inguinal region, root of the penis, hemiscrotum, labium majus, and the Scarpa triangle. In approximately 35% of cases, the ilioinguinal nerve travels within the cremasteric muscle.

The iliohypogastric nerve also arises from the 12th thoracic and first lumbar nerves. It enters the groin through the transversus abdominis above the ilioinguinal nerve and crosses the groin in the anatomic cleavage plane between the external and internal oblique layers. The sensory innervation field of this nerve is similar to that of the ilioinguinal nerve. The genitofemoral nerve originates from the first and second lumbar nerves. The genital branch of the genitofemoral nerve enters the inguinal canal through the deep ring just deep to the lateral crus of the internal ring and travels below the spermatic cord and adjacent to the external spermatic vessels to end in the skin of the scrotum or labium majus.

The following great variations in the nerves are common: (1) ilioinguinal nerve within the cremasteric muscle; (2) premature surfacing of the ilioinguinal nerve or a branch of the nerve from the inguinal canal through the external oblique aponeurosis anywhere between the external and the internal ring; (3) ilioinguinal nerve joining the iliohypogastric nerve or one of the nerves being completely absent; and (4) an aberrant branch of the ilioinguinal nerve descending within the genital branch of the genitofemoral nerve. In addition, the sizes of the groin nerves are inversely proportional.

**ETIOLOGY**

The cause of chronic postherniorrhaphy pain can be non-neuropathic or neuropathic. The former includes excessive scar formation as a result of multiple hernia operations, a periosteal reaction resulting from sutures or staples inserted into the pubic tubercle, or the mechanical pressure of rolled-up, bulk-forming mesh material.

Neuropathic pain is usually caused by actual nerve involvement as a result of (1) perineural fibrosis of 1 or more nerves (Figure 1), a naturally occurring condition for which the term nerve entrapment should not be used; (2) entrapment of 1 or more nerves by staples (Figure 2A), sutures (Figure 2B), or prosthetic materials (Figure 3); and (3) actual nerve damage due to stretching, contusion, crushing, electrical damage, and partial or complete division of the nerves. The main causes of nerve injury are inadequate dissection, failure to visualize and protect the nerves during hernia repair, and failure to recognize the aberrant location and anatomic variations of the nerves.

**PATHOLOGIC FINDINGS**

Nerve injuries can be either lesions in continuity or complete transection injuries. Lesions in continuity can vary from neurapraxis (in which the axons and myelin sheath are both intact) to axonotmesis (interruption of the axons but intact myelin sheath) or neurotmesis (interruption of both axons and the myelin sheath). Nerve injuries resulting in axonotmesis, neurotmesis, and complete transection of the nerve lead to traumatic neuroma formation via inward migration and proliferation of fibroblast and perineural cells and outward growth of axons. With complete transection, the neuroma manifests itself as a round tumor at the proximal cut end of the nerve (Figure 4A). With lesions in continuity, neuromas manifest as small bulbar deformities along the course of the nerve (Figure 4B).

**DIAGNOSIS**

The main clinical features of neuropathic pain complex are intermittent or constant presence of the previously mentioned symptoms in the inguinal region. Unlike non-neuropathic neuralgia, neuropathic pain complex is associated with radiation of the pain to the skin of the corresponding hemiscrotum, labium majus, and Scarpa triangle. The symptoms are frequently triggered or at least aggravated by walking, stooping, or hyperextension of the hip and can be decreased by recumbency and flexion of the thigh. The neuropathic neuralgia pain complex can also be reproduced by tapping the skin medial to the anterosuperior spine of the iliac bone or over an area of point tenderness (the Tinel sign). It is extremely difficult, if not impossible, to pinpoint the involved nerve for 4 basic reasons. First, peripheral communication be-

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tween the ilioinguinal, iliohypogastric, and genital branches of the genitofemoral nerves is very common and results in an overlap of their sensory innervation.4,6 Second, in addition to their intercommunication, the innervation fields of these 3 nerves overlap.1,6 Third, at the central level, both ilioinguinal and iliohypogastric nerves arise from the 12th thoracic and first lumbar nerves, and both the genital and ilioinguinal nerves receive communication from the first lumbar nerve.4,6 Fourth, more than 1 involved nerve can cause postherniorrhaphy pain syndrome (Figure 1). Peripheral nerve block or differential paravertebral root block, although helpful for differentiating neuropathic from non-neuropathic pain, is often inconclusive in making a discriminatory diagnosis of the involved nerve.

SURGICAL TREATMENT

Pain related to neurapraxia, which may last up to 6 months postoperatively, is usually a self-limiting condition and does not require surgical intervention. However, perineural fibrosis, nerve entrapment by suture or staple, and neuroma formation as a result of axonotmesis, neurotmesis, or complete nerve transection do require surgery.

Because of central and peripheral communication and frequent multiple nerve involvement (Figure 1), discerning which nerve is specifically involved can be extremely difficult, if not impossible. Therefore, surgical treatment of postherniorrhaphy neuralgia should not be limited to only a grossly involved nerve,2 but should instead address all 3 nerves. Furthermore, the fact that neuropathic pain complex is triggered or aggravated by walking or hyperextension of the hip and alleviated by recumbency and flexion of the thigh suggests that traction of the involved nerve plays a major role in postherniorrhaphy pain syndrome. This is another issue that must be addressed in the surgical treatment of postherniorrhaphy neuralgia to avoid recurrent neuralgia caused when the cut ends of the resected nerves adhere to the aponeurotic elements of the groin.

Surgical treatment for periosteal reaction or osteitis pubis consists of removing suture materials, staples, bulky suture knots, and bulk-forming or rolled-mesh material from the inguinal region. Injection of 80 mg of methylprednisolone acetate under direct vision during the operative procedure may also be helpful. Surgical treatment of neuropathic pain consists of resection of the involved nerves. Neurolysis is not recommended because it does not address neuromas or inevitable secondary scarification.2 Similarly, simple division of the nerves without complete resection is also not recommended. Instead, the most recommended procedure is neurectomy. In this procedure, as suggested by Starling et al.,1,2 the entire length of the nerves should be resected as far proximally and distally as possible to include the involved segment and account for the numerous neural communications that inevitably exist between the 3 nerves. The transected nerve ends should be ligated to close the neurilemmal sheath to prevent neuroma formation. Any staple, suture, or prosthetic material along the course of the nerve should be included with the resected portion of the nerve.2 Complete removal of mesh is not necessary because, similar to Starling and Harms,2 we found that previous mesh repair did not predispose patients to neuropathic pain.

Other important elements of the procedure should also be taken into account. In addition to those mentioned previously, we suggest:

- Resecting the genital nerve from the same anterior approach to avoid a second-stage operation through the flank and the difficulty of repairing a frequently associated lumbar incisional hernia.
- Implanting the ligated proximal ends of the ilioinguinal and iliohypogastric nerves within the fibers of the internal oblique muscle. This prevents the cut ends of the nerves from adhering to the inguinal ligament and/or external oblique aponeurosis, which subjects the nerve to traction on walking or moving the hip joint and once again sets the stage for postoperative neuralgia. For this purpose, the end of an absorbable suture attached to a needle is used to ligate the proximal cut end of the nerve. Then, the needle is passed through a gap made by splitting the internal oblique muscle fibers with a clamp approximately 2 cm above

Figure 3. Nerve entrapment by a mesh plug.

Figure 4. Neuroma formation (arrows) at the proximal cut end of a nerve (A) and as a lesion in continuity (B).
the cut end of the nerve. When the suture is pulled, the cut end of the nerve is directed upward and buried within the muscle fibers. The same suture is used to close the split in the muscle. With the genital nerve, the proximal cut end of the nerve is ligated with the nerve under slight tension to allow retraction of the nerve into the internal ring after the ligating suture is cut.

- Resecting and submitting any tissue fibers resembling a nerve as well as grossly evident nerve trunks for histological verification to ensure that the resected specimens are in fact neural tissue (Figure 1, GN2). With exhaustive exploration and adequate experience, intraoperative frozen section may not be necessary, although it can be helpful.

The ilioinguinal nerve can easily be identified lateral to the internal ring (Figure 5). This is usually an untouched area, so identification of the nerve is simple. The nerve is then traced toward the external ring and resected as distally as possible. The iliohypogastric nerve can easily be identified by separation of the external oblique aponeurosis from the underlying internal oblique muscle and aponeurosis as cephalad as possible (Figure 5). The nerve should then be resected as proximally and distally as possible. The genital nerve is the most difficult to identify from the anterior approach. However, in all but 3 of our cases (2 patients had previous multiple hernia repairs), the nerve could be visualized within the lateral crus of the internal ring, between the spermatic cord and the inguinal ligament, or within the internal ring. The use of magnifying devices will facilitate identification. Complete resection of the genital nerve, which could be difficult, may not be necessary if the other 2 nerves are adequately resected. In the majority of our cases, we were not able to resect the genital nerve completely, but so far the anterior approach has been successful for avoiding a second operation through the flank approach in which the inguinal segment of the nerve cannot be resected either. There have been few anecdotal reports of a preperitoneal endoscopic approach for multiple neurectomies. If and when this approach proves practical and successful, it may provide an alternative treatment for this problematic condition.

PATIENTS

Between 1995 and 2001, we operated on 49 patients (47 male and 2 female). Twenty-nine patients (60%) were workers’ compensation cases. All patients had previous herniorrhaphies and were referred by pain management centers or by their physicians after unsuccessful treatment for pain. Nonprosthetic tissue approximation repair was performed on 28 patients (58%), and 19 patients (38%) had previous mesh repair. Two patients (4%) had mesh plug hernia repair. In 1 of the 2 patients, the iliohypogastric nerve was sutured to the margin of the plug; in the other, the ilioinguinal nerve was entrapped within a fold of the plug (Figure 3). In another patient in the prosthetic repair group, the iliohypogastric nerve was entrapped with rolled-up mesh after a sutureless hernia repair. All patients, except for 5 who had previous multiple hernia repairs, were operated on under local anesthesia. None of the patients required mobilization of the spermatic cord. There were no testicular complications. One patient developed superficial wound dehiscence due to seroma formation, and the wound healed spontaneously. There was no infection. Six patients (12%) had histologically verified traumatic neuroma, 10 (20%) had nerve entrapment by suture or staple, and 33 (68%) had perineural fibrosis. The most common nerve affected by perineural fibrosis was the ilioinguinal nerve, and the most frequent location of involvement was at the suture line of the external oblique closure, particularly at the level of the external ring. The next most common affected nerve was the iliohypogastric nerve at the inguinal floor suture line.

RESULTS

All patients were examined 3 days, 1 week, and 1 month postoperatively. Because patients with neuropathic pain have few or no objective signs, follow-up by physical examination beyond 1 month did not seem necessary. However, patients were contacted 6 months after the operation and instructed to report if their pain recurred. We received no calls from patients, their referring physicians, or their workers’ compensation adjusters after the last examination. Twenty-nine patients (60%) made clear distinctions between incisional pain and preoperative neuropathic pain at the time of their first postoperative visit, and 39 patients (80%) had complete elimination of their pain within a month after their operations. However, 2 patients (4%), who both had workers’ compensation cases in litigation, reported that their pain did not improve. Finally, 8 patients (16%) had transient incisional pain distinctly different from their preoperative pain for a few months with no functional impairment. All patients with workers’ compensation cases were able to return to work without restrictions. Many patients in this group felt vindicated in their complaints when it became evident that they were
not “crazy” or “malingering.” All other patients reported a satisfactory quality of life after their operations. Even those with transient mild pain graded their pain as insignificant and clearly different from their preoperative pain. One patient, an Olympic silver medalist in track and field who could not run for a year, returned to regular workouts and competition a month after his triple neurectomy. Reported results of the 2-stage operation are comparable to those from our 1-stage procedure.²

**COMMENT**

Postherniorrhaphy neuralgia is a potentially disabling complication of inguinal hernia repair. Patients whose jobs require heavy lifting or physical labor, as opposed to those with sedentary jobs, are more susceptible to functional impairment as a result of postherniorrhaphy pain. To reduce the incidence of this incapacitating complication of hernia surgery, it is necessary to have a thorough knowledge of the groin anatomy to avoid injury or entrapment of the nerves by sutures or staples. To that end, we suggest the following: (1) avoid removal of the cremasteric layer to prevent injuring the ilioinguinal nerve; (2) avoid making the external ring too small to prevent tight contact between the ilioinguinal nerve and the subcutaneous adipose tissue hastily to prevent injury to the prematurely surfaced branches of the ilioinguinal or iliohypogastric nerves.

**REFERENCES**


**Invited Critique**

Interest in postherniorrhaphy groin pain has escalated in recent years. This discomfort is not postoperative wound pain of short duration, but rather neuralgia that persists for months or even years following various types of operative dissection.

Amid has returned to this subject after 13 years¹ and now urges us to ablate in 1 operation all 3 sensory nerves (ilioinguinal, iliohypogastric, and genital branch of the genitofemoral) from the inguinal anterior approach to ensure that all pathological moieties are removed. This contradicts the position of Starling² who fully agrees with the anterior inguinal approach to the ilioinguinal and iliohypogastric nerves but, because of the difficulty in exposing and dissecting the genital branch anteriorly, prefers the lumbar approach in a second operation, if necessary.

Amid’s concern that lumbar incisional hernia may be a contraindication to use of this approach does not concern me. Even during the era of lumbar sympathectomy (same lumbar approach), I never had a patient develop a lumbar hernia. Indeed, following the 2-nerve excision (ilioinguinal and iliohypogastric) a majority of patients will be cured, removing the necessity to sever the genital branch of the genitofemoral nerve and, thus, the need for a second operation. This point is well-made by both Amid and Starling.

In my hernia operative experience, I have not had a patient with postoperative pain syndrome. However, I have been referred many such patients for evaluation and treatment. Because of the necessity to exclude other complex causes of these groin symptoms (ie, hip or back disease) and the need for meticulous diagnostic and therapeutic injections into the regions of point tenderness, I have regularly referred these patients to our superb Anesthesia Department Pain Clinic, University of Illinois Hospital, Chicago. Operative intervention has only rarely been necessary.

Has there been a real increase in the incidence of this serious complication since the advent of the ubiquitous use of prosthetic mesh? I believe there has been.³ Use of prosthetic mesh is unnecessary in the very common type I and II hernias of our classification⁴ and should be reserved for type III and IV hernias. Thus, with the espousal of a selective approach wherein the time-honored nonmesh repairs are used for the “lesser” hernias, we should see a meaningful decrease in the incidence of this dreaded pain syndrome.

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