COMBINED ULTRASOUND AND FLUOROSCOPIC GUIDANCE FOR PERCUTANEOUS ILIOINGUINAL PERIPHERAL NERVE STIMULATION

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Postprocedure surgical pain can progress from acute to an unyielding chronic pain pattern. Inguinal herniorrhaphy pain is one of the most common procedures to undergo this progression. Peripheral nerve field stimulation of the ilioinguinal nerve has been well documented as a successful means of treating this pain condition. Various imaging modalities have been utilized for placing the electrodes, including fluoroscopy and ultrasound, with each having specific advantages. A review of the literature did not show any prior documented combination of the two. We describe here combined fluoroscopic/ultrasound guidance for ilioinguinal nerve stimulation.

A 59-year-old patient with intractable pain following inguinal herniorrhaphy underwent an ilioinguinal nerve stimulation trial with combined ultrasound and fluoroscopic guidance; he received significant relief during the trial period and was subsequently implanted permanently. Following implantation he obtained significant pain relief and ceased opioid and benzodiazepine use. The combination of the 2 imaging modalities allowed for easy identification of the relevant fascial layers for nerve localization, lead maneuverability, and pain coverage. The reliable identification of specific target nerves and electrode orientation helped to allow reproducibility from successful trial to permanent lead placement.

Combined ultrasound and fluoroscopy use for ilioinguinal nerve stimulation is feasible and provides anatomic reassurance; further research needs to be conducted to ascertain cost effectiveness and large-scale outcomes of this combined imaging modality. Limitations include the small number of cases and short outcome follow-up.

Key words: Neuralgia, ilioinguinal, implantable neurostimulators, peripheral nerve stimulation, neuromodulation, neuropathic pain, ultrasound, fluoroscopy, combination technique

Chronic pain following surgical injury is an unfortunate, yet well established entity. Inguinal hernia repair is one of the most common procedures causing persistent postsurgical pain (PPSP) with an approximate prevalence of 12% (1), often causing distressing and debilitating pain. Conventional therapies include physical therapy, antineuropathic pain medications, ilioinguinal / iliohypogastric nerve blocks, cryoanalgesia, radiofrequency lesions, and surgical management (2). Alternatively, peripheral nerve stimulation (PNS) can offer benefit in refractory patients. We present a case of chronic incapacitating PPSP post open herniorrhaphy successfully managed with percutaneous PNS performed under a combined ultrasound and fluoroscopically guided technique.

METHOD

A 59-year-old man without significant past medical history presented for evaluation of left inguinal pain present for over 30 years following left open inguinal hernia repair and subsequent revision. The pain was described as continuous, burning, sharp, and stabbing in nature. The pain was located in the left groin throughout a previous well-healed oblique scar along the inguinal ligament with radiation into the left iliac

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crest and testicle. Average intensity was 7/10 on an 11-point visual analog scale (VAS) with exacerbations to 10/10 resulting in incapacitation. Aggravating factors included lateral rotation and flexion of the lumbar spine, sexual activity, and touch over the surgical site. He reported no real alleviating factors identified other than rest and inactivity.

Prior to PNS the patient had failed conservative measures with oral medications (gabapentin, venlafaxine, amitriptyline), multiple left ilioinguinal and genitofemoral nerve blocks, scar injections, and T12-L2 selective nerve root blocks; all of these treatments had marginal and short-lived benefits. Subsequently the patient underwent a 7-day ilioinguinal PNS trial and demonstrated significant analgesia (greater than 50% reduction in VAS) and improved function (ambulation, bending, sitting, hobbies, and activities of daily living). The patient subsequently underwent permanent implantation as described below.

The patient was brought into the operating room suite and placed comfortably in the supine position. The procedure was performed under monitored anesthesia care to allow intraoperative patient feedback. The ilioinguinal nerve was located under ultrasound guidance between the internal oblique and transverse abdominis muscles at the level of the anterosuperior iliac spine (Fig. 1). Subsequently, a 21-gauge SonoPlex Stim (Pajunk®, Norcross Georgia) needle was inserted in plane to the location of the nerves and the internal oblique and transverse abdominis muscle planes were hydro-dissected along the course of the nerve with sterile water to facilitate

![Fig. 1: Ultrasound image showing needle at plane between internal oblique and transverse abdominis musculature.](image-url)
advancement and maintenance within the appropriate plane of the PNS needle and leads as described by Carayannopoulos et al (3). Subsequently octopolar Linear® leads (Boston Scientific, Valencia California) were inserted and advanced medially and caudally in parallel within the dissected plane, along the ilioinguinal nerve trajectory under fluoroscopic guidance until coverage of the painful areas was confirmed by the patient (Fig. 2). A second octopolar lead was advanced subcutaneously to add field stimulation and extend coverage along the surgical scar itself, which was cephalad to the location of the ilioinguinal nerve. The final location and trajectory of the leads were confirmed with the use of fluoroscopy, ensuring a cephalocaudal and lateromedial direction. The leads were then anchored with nonabsorbable sutures to the external oblique fascia at the level of the incision (Fig. 3) and tunneled cephalad through the skin to an abdominal pocket inferolateral to the umbilicus, where a rechargeable generator (Precision Spectra®, Boston Scientific, Valencia California) was ultimately implanted per the patient’s preference (Fig. 4). There were no postoperative complications.

At one-month follow-up, the patient continued to report full coverage of his painful areas with over 50% pain reduction and sustained significant functional improvement, as well as complete discontinuation of opioid and benzodiazepine use. At 6-months follow-up, the pain relief remained intact and there were no reported complications. His preferred program involved a combination of the peripheral field stimulation for scar pain (inferior lead settings: frequency 80 Hz, amplitude 3.9 mA and pulse-width of 210 milliseconds with programmed array of: 10-, 11-, 13+, 14+, 15-), and ilioinguinal stimulation for “hip” and testicle pain (superior lead settings: frequency 80 Hz, amplitude 3.9 mA and pulse width of 250 milliseconds with programmed array of: 1+, 2-, 3-, 5+, 6+, 7-).

DISCUSSION

Chronic PPSP following inguinal herniorrhaphy is a common and unfortunate scenario. Such pain is likely caused by ilioinguinal neuralgia resulting from direct injury, traction, and fibrotic entrapment of the nerve itself during its course between the internal oblique and transverse abdominis muscles (1). It has significant detrimental effects on patients’ qual-

Fig. 2: Introducer needle insertion in relationship to linear ultrasound probe.

Fig. 3: Percutaneous leads through anterolateral incision cut-down.
Neuromodulation, in the form of spinal cord stimulation, is a well-established treatment modality used for a variety of pain syndromes including that from persistent radiculopathy, failed back surgery syndrome, and complex regional pain syndrome (4,5). PNS is an emerging neuromodulation subset which targets peripheral nerve fibers in various neuropathic pain disorders involving the peripheral nervous system. Historically PNS required surgical exposure of the corresponding nerve to the patient’s pain, making it an invasive, traumatic, and less-than-ideal technique (3,6). The development of cylindrical electrodes and percutaneous techniques which allow for PNS without the need for extensive surgical exposure have gained interest and momentum in the field, supporting it as a feasible, minimally invasive and fully reversible alternative for intractable pain caused by peripheral mononeuropathies (7).

Several successful reports have been published on the utility of PNS for ilioinguinal neuralgia (2,3,5,8); however, there is no standardized technique. We based our approach on the ultrasound-guided technique as described by Carayannopoulos et al (3) for visualization of the nerve, initial needle and lead insertion into the appropriate tissue plane, and hydro-dissection of the former; subsequently, fluoroscopy was used to advance the leads into their final positions. To our knowledge this is the first report of combined ultrasound and fluoroscopic guidance for ilioinguinal PNS. It is the authors’ opinion that the addition of fluoroscopy may increase accuracy in lead advancement along the iliohypogastric nerve’s trajectory, as well as confirming final positioning.

Fig. 4: Final lead and implantable pulse generator configuration confirmed with fluoroscopy.
CONCLUSION

Combined ultrasound and fluoroscopy use for ilioinguinal nerve stimulation is feasible and provides anatomic reassurance. Limitations on this case include its small case size as well as the short follow-up period. Taking into consideration individual anatomical variability, additional research is needed to ascertain cost effectiveness and large-scale outcomes of this combined imaging modality, and also to establish an optimal PNS technique for ilioinguinal neuralgia. The results of our case builds on existing knowledge and holds promise for continued advancement in this field.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial, or non-financial interest in the subject matter or materials discussed in this manuscript. They declare no conflict of interest.

REFERENCES
