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Case Report

A Minimally Invasive Surgical Technique for the Treatment of Posttraumatic Trigeminal Neuropathic Pain with Peripheral Nerve Stimulation

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Background: Facial pain occurring after traumatic injury of the facial branches of the trigeminal nerve is a medical condition that is often very difficult to treat. Patients are quite disabled by their symptoms and most therapies are ineffective in relieving this pain. Peripheral nerve stimulation has been used as a treatment to provide pain relief for this type of intractable atypical facial pain.

Objective: To describe a minimally invasive peripheral nerve stimulation surgical technique for treating posttraumatic trigeminal neuralgia.

Study Design: Case report based on a patient seen in a university setting with posttraumatic trigeminal neuropathic pain who underwent a minimally invasive technique for the placement of a peripheral nerve stimulator.

Setting: University-based outpatient clinic.

Methods: A patient with a clinical picture suggestive of trigeminal neuropathic pain secondary to trauma involving the V1 and V2 branches of the trigeminal nerve was selected. Conservative management was attempted with no improvement before peripheral nerve stimulation was tried with a minimally invasive surgical technique. We recorded the patient's subjective assessment of pain and daily function before and after the procedure.

Results: Following the procedure, the patient's pain score decreased approximately 50% and the patient reported a better quality of life with improvement in daily function as well as a more positive outlook on her condition. There were no complications after the procedure and the patient reported no complaints with the device.

Limitations: Case report.

Conclusions: This surgical technique for placing peripheral nerve stimulators allows for a minimally invasive approach for the treatment of intractable posttraumatic trigeminal neuralgia with potentially less risk of facial nerve damage. This case confirms the need for further studies to be done in the future to prove the safety and effectiveness of this technique.

Key Words: Peripheral nerve stimulation, posttraumatic trigeminal neuralgia, neuropathic pain, minimally invasive technique, facial pain.

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Facial pain occurring after traumatic injury of the facial branches of the trigeminal nerve is a medical condition that is very difficult to treat (1). This type of posttraumatic trigeminal neuropathic pain differs from classic trigeminal neuralgia since the pain is usually continuous in nature, but it can fluctuate in intensity, eventually leading to chronic pain. The term atypical facial pain has also been used to describe persistent facial pain which may be located in the trigeminal nerve region that does not present with the classic symptoms of typical trigeminal neuralgia (2). Some physicians state that atypical facial pain is more of a somatoform pain disorder and should be classified apart from posttraumatic trigeminal neuropathic pain (3). However, other articles have stated that atypical facial pain may result from trauma to the trigeminal nerve, implying that posttraumatic trigeminal neuropathic pain is a possible etiology to atypical facial pain. (4) Nonetheless, patients diagnosed with atypical facial pain or posttraumatic trigeminal neuralgia usually describe the pain as constant, burning, aching or cramping, pinching, and pulling, and it may be located in the region of the trigeminal nerve after a traumatic event such as surgery (4). Patients with atypical facial pain also often have comorbid psychiatric conditions such as depression as well as other emotional disturbances affecting their perception of pain (5). A diagnosis of atypical facial pain or trigeminal neuropathic pain versus classic trigeminal neuralgia is essential to establish a proper treatment plan (6).

In contrast to the constant symptoms seen in posttraumatic trigeminal neuropathic pain or atypical facial pain, classic trigeminal neuralgia is characterized by severe attacks of electric-like pain often triggered by a tactile stimulus. It can last seconds to minutes initially, and sometimes can last as long as one hour, but the patient is usually symptom-free between attacks (7). This disorder of the sensory division of the trigeminal nerve may be due to degenerative changes in the ganglion or tortuous blood vessels compressing the root as it exits the brain stem (8). The understanding that vascular structures may compress the nerve root in classic trigeminal neuralgia has lead to successful treatments such as microvascular decompression (9). In a long-term follow-up study of patients who underwent microvascular decompression, 82% with typical trigeminal neuralgia had good long-term results after the operation (10). In addition to microvascular decompression, percutaneous stereotactic radiofrequency rhizotomy has also been proven to be effective for the treatment of idiopathic trigeminal neuralgia (11). Unfortunately, both of these techniques are not as effective for treating atypical facial pain (8,12).

Peripheral nerve stimulation has been used to treat posttraumatic trigeminal neuropathic pain with excellent symptoms relief (13). Although there have not been any randomized controlled trials, case reports and case series have described the effectiveness of this treatment for trigeminal neuropathic pain when all other treatments have failed (14).

Our objective was to perform a minimally invasive surgical technique with peripheral nerve stimulation for treating a patient with posttraumatic trigeminal neuropathic pain. The inspiration for using this technique was to complete the procedure in a timelier manner with smaller incisions with potentially less risk of injury to the facial nerve. Furthermore, there should be less risk of bleeding, infection, and visible scarring by utilizing these smaller incisions. Previously in our academic institution, patients were referred to ear, nose, and throat surgeons who used a more invasive technique with a larger incision for placing the leads and pulse generator. Now, as demonstrated in this case, the same interventional pain physician who performed the trial procedure is able to execute the permanent placement of the device without the need to refer the patient to another surgeon, thus preserving continuity of care. To our knowledge, there have been cases regarding the effectiveness of peripheral nerve stimulation for the treatment of posttraumatic neuropathic pain; however, based on a PubMed/MEDLINE search, this is the first case which describes this minimally invasive surgical technique in detail for treating this condition.

Case Report

A 42-year-old woman with a past medical history of depression and anxiety presented to an outpatient pain clinic complaining of pain around her right eye for the past 9 months. The pain began after undergoing a surgical resection for a metastatic lesion in her right eye from lacrimal duct adenocarcinoma that resulted in enucleation of the eye. The patient described the pain as sharp, tingling, throbbing and aching in nature. The pain was variable in intensity, lasting a few hours at a time, and was located around the right eye in the distribution of the V1 and V2 branches of the right trigeminal nerve. There were no reported triggering factors for the pain. On a numeric pain scale, her pain reached 10 out of 10 at its maximum and decreased to 6-8 out of 10 with the use of pain medications such as morphine, ga-

bapentin, tramadol, ibuprofen, and oxycodone with acetaminophen; however, the pain never completely went away since it began after surgery. On physical exam, her right eye was enucleated with a clean postsurgical scar. Allodynia was noted in the right V1 distribution and hyperalgesia in the right V2 distribution just under the eye socket. The working diagnosis at this point was posttraumatic trigeminal neuropathic pain likely secondary to trauma from the previous right eye surgery.

Conservative treatment was initially attempted with opioid and neuropathic pain medications for over 6 months before the patient was seen in our pain management clinic. At first, nerve blocks and pulsed radiofrequency ablations of the supraorbital and infraorbital nerves were attempted without any success. The pulsed radiofrequency ablations were performed at 50°C for 90 seconds with no difference in symptoms after the procedure; thus, further nerve damage by denervation was not suspected after this procedure. One month later, a right peripheral orbital steroid injection had an unsuccessful outcome, then a right stellate ganglion block under fluoroscopy was performed two weeks after that with no relief of her symptoms again. The decision was then made to attempt a peripheral nerve stimulator trial for the treatment of this intractable neuropathic facial pain.

Informed consent for the trial procedure was obtained and the patient was taken to the operating room. She was placed in the supine position and her right face was prepped with sterile technique. The patient was given incremental midazolam sedation. From a lateral insertion point at the hairline, a local anesthetic was given, followed by the passage of a 14-gauge Coudé needle which was pre-bent to the curvature of the forehead. The needle was advanced in the V1 region toward the eyebrow. Then an 8-contact electrode with 4-mm electrode spacing (Boston Scientific, Valencia, CA) was placed and the needle was removed. An identical procedure was performed in the V2 region with needle insertion 3 to 4 cm in front of the ear with passage of the needle toward the nose followed by placement of another electrode. The stylets were then removed from the leads and silicone anchoring sleeves were placed over the leads and secured with sutures. Finally, the leads were attached to their screening cables and affixed to the right anterior chest with strain-relief loops present.

The patient tolerated the trial procedure well with no apparent discomfort or complications. Three days later, the patient reported a decrease in her pain symptoms by approximately 50% in addition to improved daily function and a more positive outlook on her condition. Due to the positive response of the trial, she was then taken back to the operating room for implanting permanent leads and the pulse generator using a minimally invasive surgical technique.

Surgical Technique

An informed consent was obtained for the implantation of a peripheral nerve stimulator for the treatment of right-sided posttraumatic trigeminal neuropathic pain involving the V1 and V2 branches of the trigeminal nerve. The patient was positioned on the left side supine on the table, anesthetized with general anesthesia, and prepped sterilely. On the upper right side of the face 2 cm above the zygomatic arch at the shaved hairline, a 5 mm vertical incision with a 15 blade was executed and a blunt dissection was performed. After this, a 10 cm Coudé 14-gauge needle, which was pre-bent, was inserted following the upper border of the orbit all the way to the midline (Fig. 1) and placement was confirmed with an anteroposterior (AP) view on fluoroscopy (Fig 2).

Next, a 70 cm lead with 8 contacts with 4 mm spacing was inserted and the needle was retracted slightly with confirmation of the lead placement with an AP view on fluoroscopy (Fig 3). After this, a 1.5 cm longitudinal incision was made 5 cm posterior to the previous incision just above the mastoid process. Through

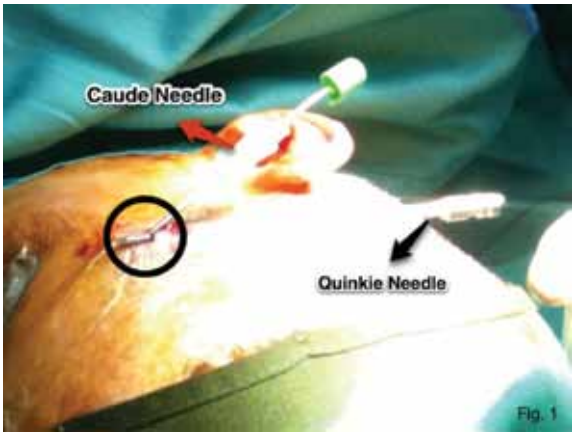


Fig. 1. *A 10 cm Coude 14-gauge needle, which was pre-bent, was inserted following the upper border of the orbit all the way to the midline at the 5 mm vertical incision 2 cm above the zygomatic arch at the shaved hairline.*

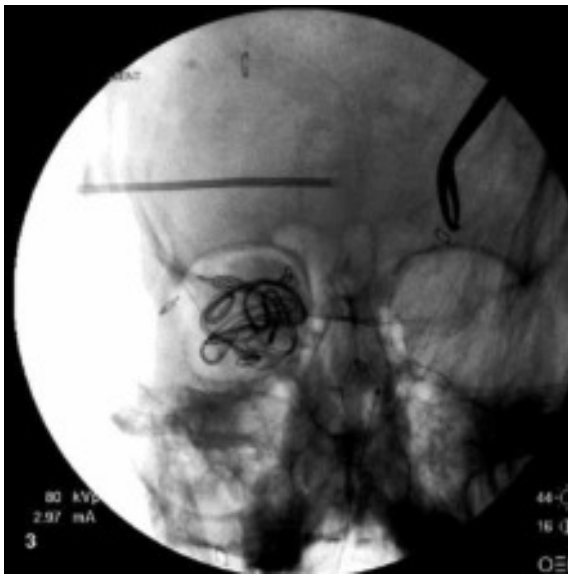


Fig. 2. *Placement of the 10cm Coude 14-gauge needle was confirmed with an AP view on fluoroscopy.*

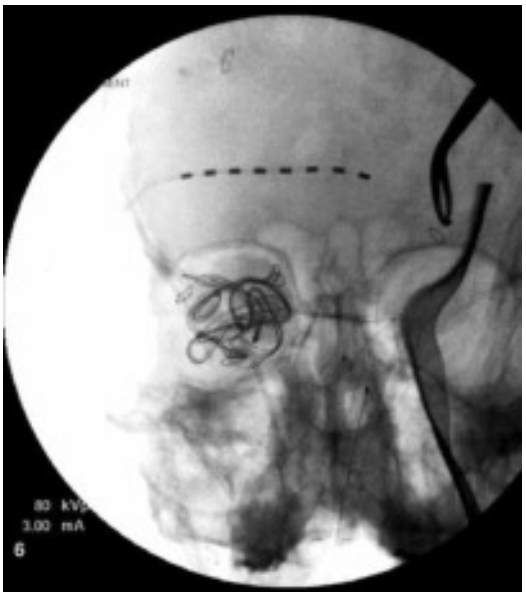


Fig. 3. *A 70 cm lead with 8 contacts 4 mm spacing was inserted and the needle was retracted slightly with confirmation of the lead placement with an AP view on fluoroscopy.*

this second incision, the same 10 cm Coudé 14-gauge needle was inserted coming out from the anterior incision (Fig 1). The loose end of the lead was then inserted from anterior to posterior and the needle was retracted with confirmation on fluoroscopy (Fig 4). Insertion of the lead was done without the stylet to achieve better mobility (Figs. 5,6).

Another vertical incision was then done one cm anterior to the earlobe just on top of the zygomatic arch; the incision was 5 mm in size and a 10 cm Coudé 14-gauge needle was inserted following the inferior border of the orbit just on top of the maxillary sinus (Fig 7). This was confirmed with fluoroscopy (Fig 8). Then a 70 cm 8-contact lead was inserted (Fig 9) and the needle was retracted which was confirmed with an AP view on fluoroscopy (Fig 10). After this, a 15 cm Coudé 14-gauge needle was inserted from the posterior incision above the mastoid and redirected inferiorly through the incision where the lead was inserted along the inferior border of the orbit (Fig 9). The loose end of the lead was then inserted from anterior to posterior and the needle was retracted (Figs. 11,12). Confirmation of placement was done with an AP view on fluoroscopy. A one cm horizontal incision was done just inferior and

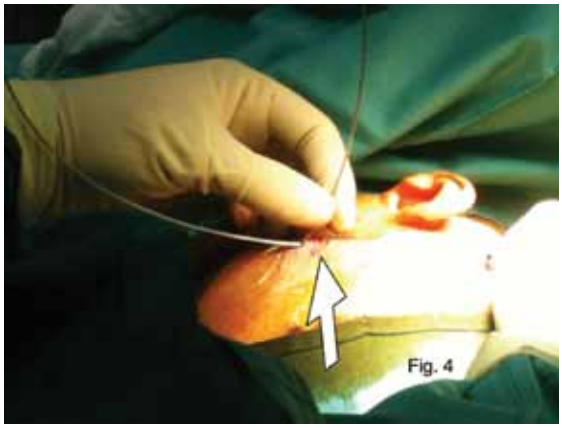
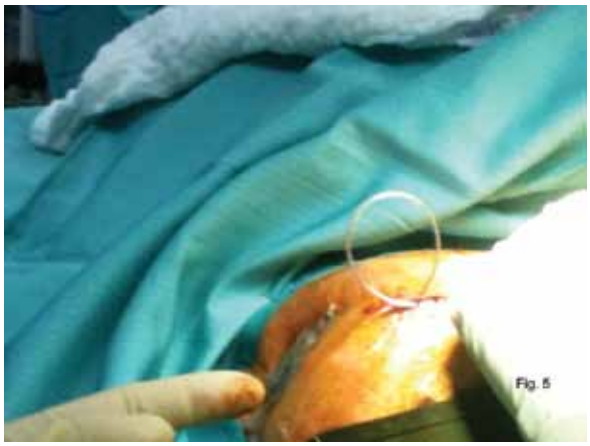


Fig. 4. *A 1.5 cm longitudinal incision was done 5 cm posterior to the previous incision just above the mastoid process. Through this second incision, the same 10 cm Coude 14 gauge needle was inserted coming out from the anterior incision. The loose end of the lead was then inserted from anterior to posterior and the needle was retracted*



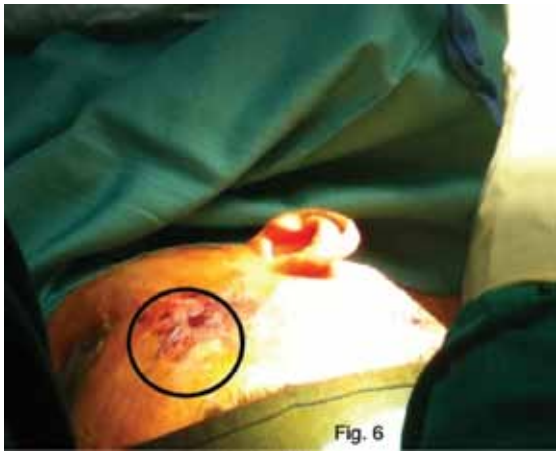


Fig. 5 and 6. *Insertion of the lead was done without the stylet to achieve better mobility*

Fig. 7. *A 10 cm Coude 14-gauge needle was inserted following the inferior border of the orbit just on top of the maxillary sinus through a 5mm vertical incision 1 cm anterior to the earlobe just on top of the zygomatic arch.*

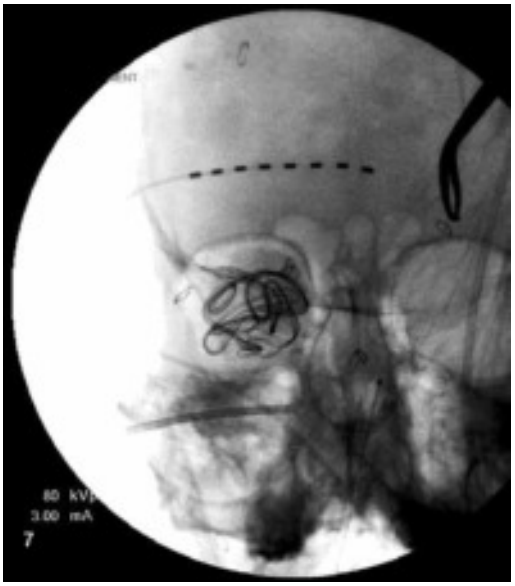


Fig. 8. *Placement of the 10cm Coude 14-gauge needle was confirmed with fluoroscopy.*

posterior to the longitudinal incision with a 15 blade just at the insertion of the hairline on the right side (Fig 13). A 15 cm Coudé 14-gauge needle was then inserted from inferior to anterior coming out to the longitudinal incision where the loose leads were located. Both leads were previously anchored to the target on the temporal fossa at the longitudinal incision just above the mastoid with 3-0 silk suture and then inserted one at a time through the needle to come out through the horizontal incision. Another 5 cm horizontal incision was made just below the right scapula and a pocket was formed to fit the generator (Fig 14).

Once hemostasis was achieved, the introducer was guided through the incision from inferior to superior and then came out through the one cm incision where the loose leads were located at the beginning of her hairline. Both leads were then introduced through the introducer and came out through the horizontal inci-

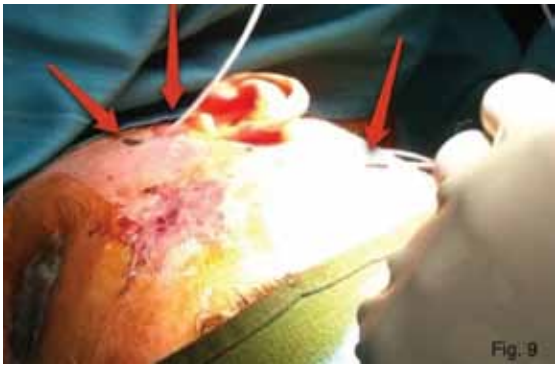


Fig. 9. *A 70 cm 8 contact lead was inserted following the inferior border of the orbit just on top of the maxillary sinus through the 5mm vertical incision 1 cm anterior to the earlobe just on top of the zygomatic arch*

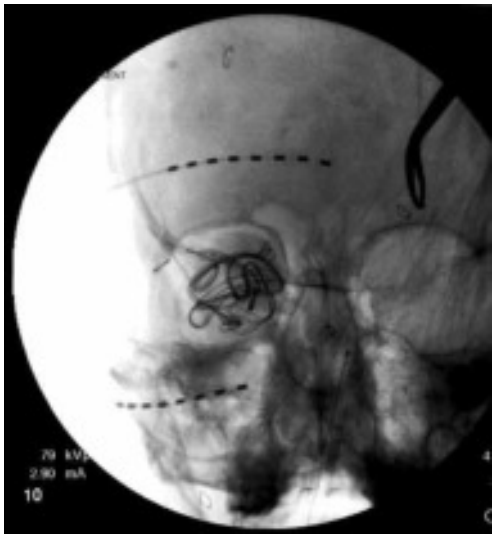
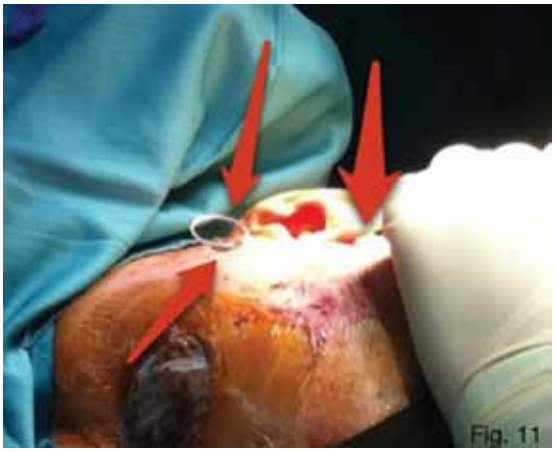


Fig. 10. *The 10cm Coude 14-gauge needle was retracted which was confirmed with an AP view on fluoroscopy.*



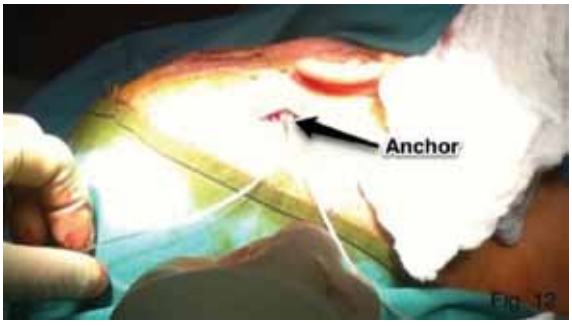


Fig. 11 and 12. *A 15 cm Coude 14-gauge needle was inserted from the posterior incision above the mastoid and redirected inferiorly through the incision where the lead was inserted along the inferior border of the orbit. The loose end of the lead was then inserted from anterior to posterior and the needle was retracted*

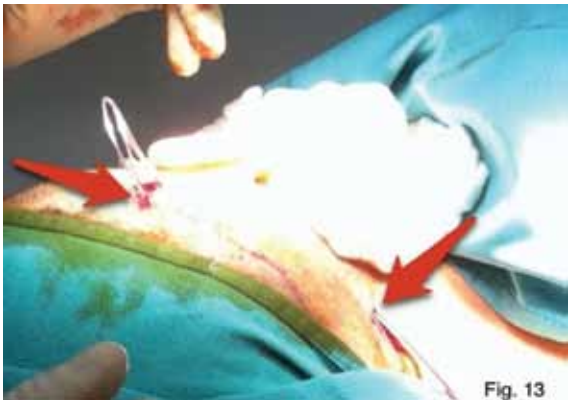


Fig. 13. *A 1 cm horizontal incision was done just inferior and posterior to the longitudinal incision with a 15 blade just at the insertion of the hairline on the right side.*

sions just below the scapula. The generator was connected to the leads and hand-held computer screening was performed to confirm impedance and proper connection (Fig 15). The generator was then placed inside the pocket and closed with VICRYL 3-0 interrupted subcutaneous sutures and MONOCRYL 4-0 interrupted subcuticular sutures. The rest of the incisions were closed

Fig. 14. *A 5cm horizontal incision was made just below the right scapula and a pocket was formed to fit the generator.*

Fig. 15. *The generator was connected to the leads and hand-held computer screening was performed to confirm impedance and proper connection.*

using PROLENE 3-0 interrupted sutures. The patient tolerated the procedure well with no complications. When the patient returned to the clinic 10 days later to have the PROLENE sutures removed, she reported greater than 50% reduction in pain. The surgical wounds appeared clean on examination with no evidence of infection or hematoma. At the 3-month follow-up visit, the patient was satisfied with the device and again reported more than 50% continuous relief of her pain.

Discussion

As described in this case, peripheral nerve stimulation is able to provide adequate pain relief for patients with posttraumatic trigeminal neuropathic pain when other treatment modalities have failed. It has also been proven to be effective for other trigeminal neuropathic pain conditions, such as classic trigeminal neuralgia or cephalgia (15) and postherpetic trigeminal neuralgia (16). With the increasing use of peripheral nerve stimulators for the treatment of trigeminal neuropathic pain, it is important to utilize surgical techniques that will be both safe and effective for the permanent implantation of the device. Although there is no literature documenting exact complication rates of this minimally invasive technique, making smaller incisions can potentially minimize the risks associated with peripheral nerve stimulator implantation.

For the most part, the benefits of using this minimally invasive surgical technique for the permanent placement of peripheral nerve stimulators can be attributed to the size and location of the incisions. Facial nerve injury is a major concern when performing this surgery; however, this risk is minimized with the application of smaller incisions in specific locations outside of the anatomical path of this superficial nerve. In addition to evading nerve injury, this less invasive technique may also result in a smaller amount of facial scarring and decreased cosmetic defects which patients will appreciate after the surgery. It is also important to mention that the use of the Coudé needle was essential for the success of our technique due to the maneuverability of this silicone-based stylet as compared to more rigid metal needles. By using this minimally invasive technique, the surgery may be performed in a timelier manner with potentially fewer risk complications as compared to using larger incisions with a more invasive surgical technique.

Despite these advantages, there are risks and limitations to the procedure that should be recognized. The superficial temporal artery is located just superior to the ear in close proximity to some of the incisions as well as the passing of the 15 cm Coudé needle. Consequently, if this blood vessel is injured during the procedure, significant bleeding may occur. Proper surgical tools must be readily available to address this complication should it occur. However, one may avoid this complication by palpating the pulse of the artery and passing the needle as subcutaneously as possible. Also, a critical limitation to consider when deciding to permanently place a peripheral nerve stimulator for trigeminal neuropathic pain is the likelihood that the patient will require magnetic resonance imaging of the head in the near future. At

the present time, peripheral nerve stimulators placed anywhere within the facial region must be removed in order to obtain a magnetic resonance image of the head. These risks and limitations should be considered when planning for and performing this minimally invasive surgery.

In this particular case, there were no complications during or after the procedure and the patient was pleased with her reduction in pain as well as the lack of visible postsurgical scars. We will continue to use this technique in the future for the placement of trigeminal peripheral nerve stimulators; however, larger studies evaluating clinical outcomes are still needed to confirm the clinical feasibility of this technique.

Conclusions

In this article, we describe a minimally invasive technique for the permanent placement of a peripheral nerve stimulator for the treatment of intractable posttraumatic trigeminal neuropathic pain. Our patient tolerated the procedure well and showed significant improvement in pain relief without any complications. To be noted, Boston Scientific had no influence on this article and there were no secondary gains for anyone involved. The findings from this case report suggest that our minimally invasive surgical technique for the permanent placement of a peripheral nerve stimulator for trigeminal neuropathic pain is a viable option with certain advantages over the classically more invasive techniques; nonetheless, more studies are still needed to confirm this.

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