Traumatic Hip Disarticulation with Sciatic Nerve Capping for Neuroma & Phantom Pain Prevention

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Background

Hip disarticulation surgeries are not only uncommon, but they are also associated with a rate of morbidity and mortality.[1] Lower limb amputations are often accompanied by phantom or residual pain, which for a subset of lower limb amputees is disabling.[2]

Treatments for phantom limb pain remain limited, while frequency continues to increase due to improved surgical techniques allowing for decreased rates of mortality.[3] Pain following surgery can have a significant impact on quality of life, as this may inhibit a patient's ability to ambulate using a prosthesis. These patients are often diagnosed with chronic pain and prescribed narcotics or antidepressants with little to no relief.[4]

Given that traumatic amputations transect nerves of the affected limb, lower limb amputees are often at risk for developing neuromas and/or phantom pain. In a study of patients who underwent surgical excision of painful neuromas, it was reported that 14.2% of lower limb amputees develop painful neuroma requiring operative intervention.[5]

We describe a case of a patient who sustained traumatic hip disarticulation and subsequently developed neuroma accompanied by phantom and stump pain. While surviving this injury pattern is extremely rare and most often affects members of the military, the number of patients with this presentation is on the rise.[6,7] As more patients survive these types of injuries, it is important to understand treatment options that may allow improved function and quality of life post-amputation.

Methods

The patient, a 25 year old male, was involved in a severe motorcycle accident which required amputation of his right leg with hip disarticulation. The patient underwent an initial amputation followed by continued procedures for debridement, as well as wound irrigation for numerous infections.

One month after the initial operation, the patient underwent a surgery in which an infected hematoma was removed. During this procedure, the sciatic nerve and epineurium were found to be inflamed, with the sciatic nerve measuring roughly 2cm in width. (Figure 1)

In order to prevent formation of a terminal neuroma and reduce the possibility of phantom pain, the decision was made to cap the nerve. Given that these caps are a new product, the largest available size could only accommodate a 7mm diameter nerve. (Figure 2)

After discussion with the family, the nerve was dissected into 7 separate 7mm diameter portions that would fit into each individual nerve cap. (Figures 3 & 4)

A muscular trough was created in the posterior pelvic muscular wall into which the capped nerve bundle was laid and covered with muscle. In the one month following the procedure the patient continued to have irrigation and debridement to eliminate infection.

Results

Two months following the procedure, the patient's family stated pain decreased in frequency from every 5 minutes to about 2 times daily. The patient had both phantom pain and incision pain.

At 11 months postoperatively the patient's phantom sensation and stump pain reduced to roughly 3 times a week, lasting only 30 minutes. At the time of this follow-up the patient no longer had signs of infection and was improving with physical therapy. The patient was also able to ambulate with a walker for greater than 250 feet at a time, and was ready for prosthetic fitting.

He is currently taking 300mg Gabapentin at night, and his progress continues to be monitored.

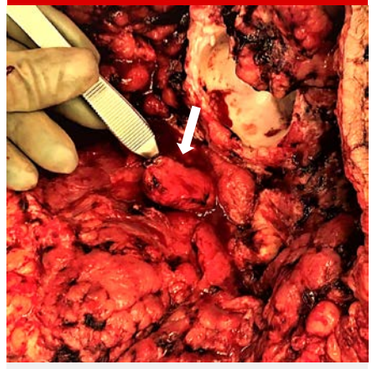
Discussion

Although it is more typical for the sciatic nerve to atrophy after resection, hypertrophy has been reported based on the age of the patient, level of amputation, time since initial resection, and presence of neuroma.[8,9] In a study of 21 patients with chronic stump pain, a peripheral nerve surgery in which neuromas were removed and proximal nerve endings were implanted into muscle was found to provide significant improvements in pain, quality of life, and ambulation status.[4] In cases such as ours, however, this is not an option due to the lack of available targets for implantation.

In an effort to address situations such as these, nerve caps have been developed to diffuse the abnormal signaling of severed, terminal nerves which may be responsible for phantom and/or stump pain. These nerve caps also act as a barrier between the peripheral nerve end and the surrounding environment. They are thought to function in part by inducing increased expression of RhoA, a Ras GTPase protein, which inhibits axonal regrowth thereby preventing further neuroma formation.[10] A recent study in a rat model found that when using biocompatible materials (PRGD/PDLLA), painful terminal neuromas can be prevented by capping nerves.[11] Another study focusing specifically on rats with transected sciatic nerves found that capping nerves with either atelocollagen or silicone tubes prevented the formation of neuromas and suppressed induced pain.[12]

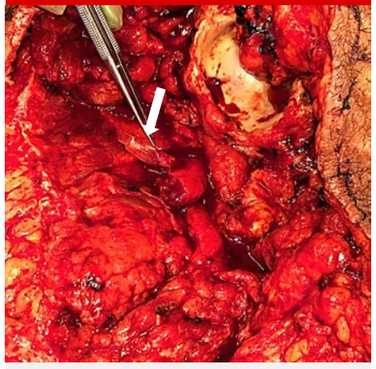
Prospective human studies are untenable in this injury pattern, and case reports such as ours provide valuable data for surgeons treating these rare, devastating injuries. Peripheral nerve capping following amputation may serve as an effective method to prevent neuromas, reducing the need for future follow-up surgeries and minimizing chronic debilitating pain.

Figure 1



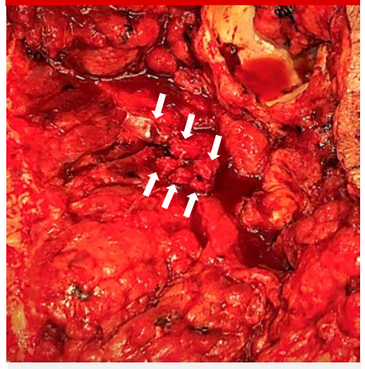
Intraoperative image of edematous sciatic nerve (arrow) measuring ~2cm in width.

Figure 2



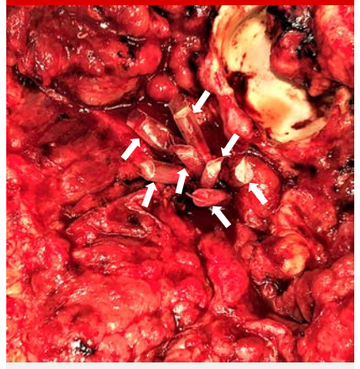
Intraoperative image showing the size of a single nerve cap (arrow) compared to the sciatic nerve.

Figure 3



Intraoperative image of the sciatic nerve divided into fascicular bundles (arrows) for capping.

Figure 4



Intraoperative image of the 7 sciatic nerve fascicular bundles with caps (arrows) fitted on each.

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