Primary repair of an iatrogenic lateral plantar nerve laceration: A case report

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Statement of Purpose

We present a case of an iatrogenic lateral plantar nerve laceration status post endoscopic plantar fasciectomy procedure. The chosen repair method was autogenous harvesting of the sural nerve.

Introduction

Peripheral nerve injuries affect approximately 3% of trauma patients (1). Nerve injuries occur more frequently in the upper extremity (81%) and less frequently in the lower extremities, with the remainder occurring elsewhere in the body (2). The peripheral nervous system is damaged primarily by traumatic injury, surgery, or repetitive compression. Traumatic injuries can occur with mechanisms of stretch, crush, laceration, and ischemia (3). Nerve lacerations about the foot and ankle are typically caused by a penetrating mechanism and the sequelae depends on the specific nerve injured as well as the level of the injury. Although the majority of lower extremity nerves function to provide sensation, they also carry functional motor components. Thus, denervation of those nerves can result in clawing of the toes and possible loss of intrinsic muscle function. An early repair is preferred as it is advantageous for neurobiological reasons (4). In addition, nerves are usually repaired primarily with sutures, but various grafts are viable when the injury induces a nerve defect (5). Without an adequate repair, the two most common complications associated with nerve injuries include a loss of sensation at the distal distribution of the nerve and the formation of a painful neuroma, which can result in complex regional pain syndrome.

Types of nerve repair:

End to Side and End to End

Dvali and Myckatyn in 2008 described end to side nerve repair as coapting of the transected nerve's distal stump to the site of a donor nerve. Although this was first described more than a century ago, it was not made popular until revived by Viterbo in the 1990's. Often times, the surgeon's preferred method is end to end neurorrhaphy (EEN), which uses a healthy nerve as a donor, thereby sacrificing donor function (6).

Allograft

Nerve allografts avoid graft site morbidity and act as temporary scaffolding to allow future axonal regeneration. Allografts should be reserved for specific patients with irreparable peripheral nerve injuries, which, if left untreated, would lead to an essentially nonfunctional limb. There are several synthetics commonly used such as: silicon, polygolic, polyglycolic (DL-lactide-E-Caprolactone), and collagen and laminin (7).

Autograft

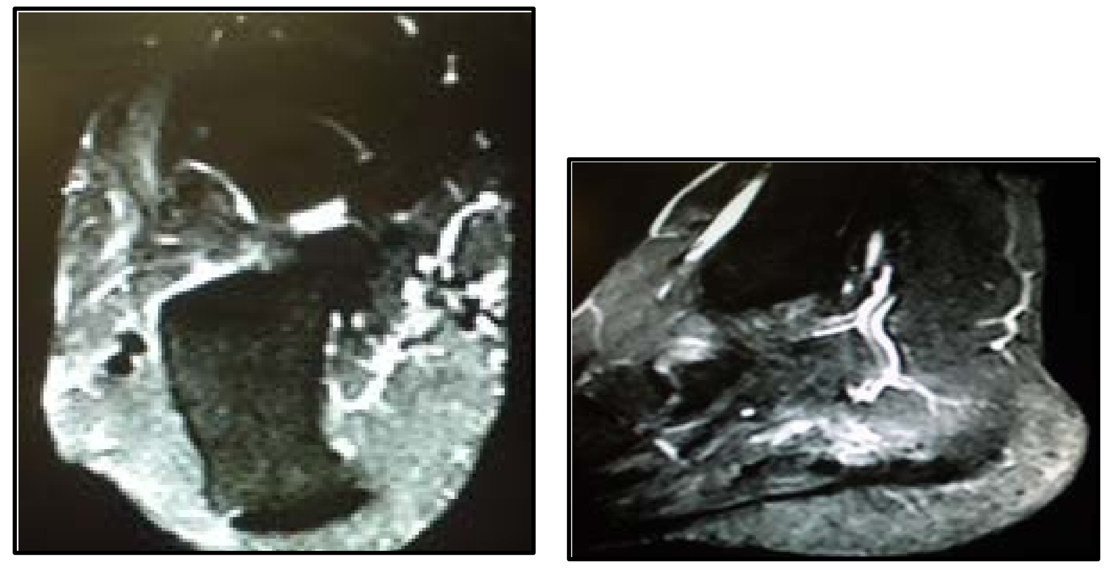
Autografts offer pristine structural and biological composition, almost mirroring the nerve being repaired. There are technical considerations for autogenous nerve grafting: diameters of donor and host nerve, length of nerve graft required, number of fascicles, fascicular pattern, cross-sectional shape and area and patient preference (8).

When a nerve autograft is chosen in the lower extremity, the more common nerve choices are: saphenous, lateral femoral cutaneous, superficial peroneal, and the sural nerve. The sural nerve is a common source of nerve graft in both the upper and lower extremity. It supplies the skin of the lateral and posterior part of the lower third of the leg (9).

In a retrospective study by Trumble et al in 1995, fourteen patients (age range 8-63 years) had sural nerve grafts to reconstruct the sciatic or peroneal nerves. All but one of the patients regained protective sensation and five patients regained useful motor function. The study concluded that improved functional outcome correlated with the nerve injured, patient age, mechanism of injury, length of graft, and the time to grafting (10).

Case Presentation

A 26-year old female with no significant past medical history presents with chief complaint of numbness and "burning" to her right foot. She is status-post endoscopic plantar fasciectomy by another surgeon two months prior to initial presentation. Her EMG's confirmed a working diagnosis of tarsal tunnel syndrome with reduction in the medial plantar nerve response and complete absence of lateral plantar nerve response, which suggested a laceration/injury. The tibial study showed increased latency with decreased amplitude. Conservative measures comprised of physical therapy and corticosteroid injections in the tarsal tunnel area for an additional 10 weeks provided no significant relief. Surgical treatment was discussed and planned.



STIR MRI images of the lacerated nerve

Study	Amplitude Pre-op	Amplitude post-op
Tibial	8.0	6.8
Tibial motor to Medial Plantar Nerve	.393	.317
Tibial motor to Lateral Plantar Nerve	0	***.210***

Study	Sensory Latency Pre-op (ms)	Sensory Latency post-op (ms)
Tibial	5.4	***4.8***
Tibial motor to Medial Plantar Nerve	7.5	***5.5***
Tibial motor to Lateral Plantar Nerve	N/R	***6.6***

Incision placement for the Tarsal tunnel release with extension distally at the medial longitudinal arch

Technique

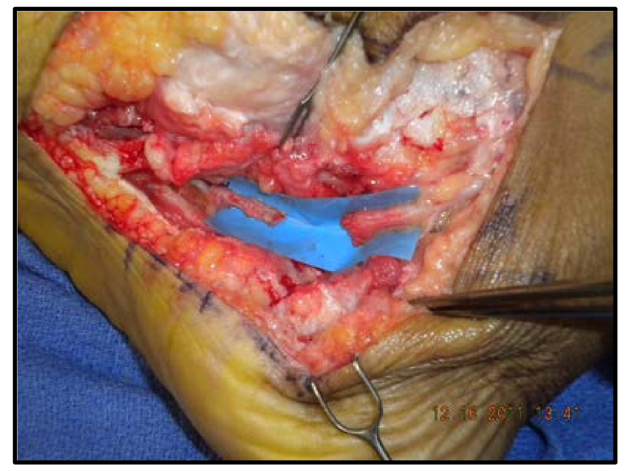
The patient underwent tarsal tunnel release as well as exploration of the plantar nerve branches and repair of the lateral plantar nerve. Loop magnification was also utilized throughout the course of the procedure. A straight posterior medial linear incision was made and extended at a forty-five degree angle distal plantarly approaching the lateral mid foot. Dissection was taken through the flexor retinaculum proximal and the deep fascia distally. The posterior tibial nerve was visualized, identified, and soft-tissues in this area were safely dissected. The medial plantar nerve was also safely released from impinging soft and scar tissue. Decompression was also performed into the level of the medial calcaneal nerve.

The lateral plantar nerve was visualized and traced distally as there was evidence of trauma and laceration at the junction just superior to the endoscopic plantar fasciectomy site. Proximal and distal neurolysis of the nerve were performed. The nerve above the proximal and distal edges was identified. A frozen section was sent to confirm the viability of the nerve for possible graft.

Attention was directed laterally and a multiple level "Z" incision was made allowing for good exposure. The incision was deepened laterally where an oblique incision was made from the lateral aspect of the Achilles tendon. The sural nerve was identified and traced proximally to the mid-calf region. Approximately 20 cm of nerve was harvested from the fibro-fatty tissue. The donor site incision was then closed and the nerve was divided into three pieces to form a cable graft. The three pieces were incorporated together in a cohesive fashion using an 8-0 Nylon suture. At that time, the cable grafts were taken in situ to the defect, which measured 5.2 cm and was repaired in an epineurial fashion. Once, the graft was secured distally and proximally, the wound was irrigated with saline and the incision was closed with two layers

Results

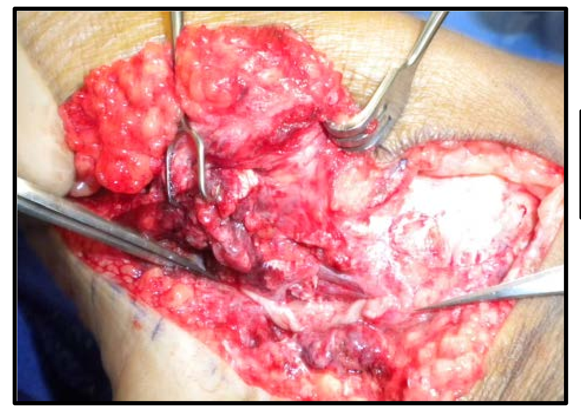
Following a course of physical therapy postoperatively the patient was transitioned into custom-molded foot orthoses for biomechanical control. EMG and NCV values at the 5-months postoperative mark revealed significant improvements. Her medial plantar nerve response had improved in latency to 5.5 ms from 7.5 ms. In addition, the lateral plantar nerve had 6.6 ms of latency with .210 of amplitude. Her pain has improved by 40% and she demonstrated objective improvement in function as well.



Note laceration at the lateral plantar nerve

Harvested Sural nerve

Posterior leg incision for Sural nerve harvest



Cable graft integrated into the defect

Discussion

Nerve injuries either traumatic or iatrogenic are not uncommon occurrences. The primary indications for nerve repair are: an injury or continuity defect in a nerve and loss of normal neurologic function, resulting in anesthesia, paresthesia, dysesthesia, or paralysis (8). A multitude of factors influence the success of nerve repair which include the method of repair utilized, the timing of the repair, the level, extent, and zone of the injury, as well as the technical skill of the surgeon (11).

Injuries to the tibial nerve can be detrimental as a result of the wide area of sensory and motor innervation due to its branches. Nunley and Gabel reported on five patients treated with sural nerve grafting of tibial nerve injuries. Objective results were reported by return of sensation, healing of plantar ulceration, and absence of neurogenic pain. The reported recovery took up to four years (12). Similarly, Dellon and Mackinnon reported successful results in all eight patients with tibial nerve deficits through grafting (13). In addition, Hattrup and Wood used an interfascicular grafting technique for delayed neural reconstruction in their small series of tibial nerve grafts (14).

In our study, we observed objective improvement in NCV and EMG values, which were also clinically correlated with the patient's functional and sensory response throughout the postoperative period.

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