

The Utilization of Abductor Hallucis Muscle Flap for Recalcitrant Tarsal Tunnel Syndrome

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Statement of Purpose:

Recalcitrant tarsal tunnel symptoms present a challenge to foot and ankle surgeons. This case study demonstrates the successful use of a proximally based abductor hallucis flap (AbHF) to treat recalcitrant tarsal tunnel.

Literature Review:

Success rates of surgical decompression for tarsal tunnel syndrome varies widely in the literature ranging from 44% to 96%.^{2,3} Timing, surgical technique and etiology all play a role in success rates for surgical intervention. Cracchiolo and Pfeiffer presented a 38% dissatisfaction rate and concluded the best indication and most predictable outcome is to perform surgery in the presence of a space occupying lesion.³ Timing of surgical intervention is another important factor, as chronic nerve compression leads to intraneural fibrosis which is extremely detrimental. Sammarco and Chang showed an improvement in foot score and better outcomes in those who had symptoms for shorter than one year.⁴ Patients with continued symptoms after tarsal tunnel release where other etiologies are ruled out, are found to often have perineural fibrosis, reducing the nerve gliding mechanism and reducing blood flow; both vital for nerve function.^{5,6} Since internal neurolysis alone has been shown to increase fascicular scarring, it has been advocated to cover the nerve below a soft vascularized bed. The main goal is safe coverage with adequate padding of the nerve, preventing the nerve from contacting the overlying skin.⁴ Rodriguez et. al addressed perineural fibrosis using muscle flaps to treat 10 patients with tibial and peroneal nerve entrapment. In using hemi distally based soleus flaps in adjunct with internal neurolysis for recurrent tarsal tunnel, they decreased pain and improved NCV.⁴ Muscle flaps for nerve compression are also used in the upper extremity. Flap coverage for recalcitrant carpal tunnel and neuromas are well documented including vein wrapping, hypotheran fat pad flap, ulnar and radial artery perforator adipofascial flaps for median nerve coverage.⁷ To our knowledge, the proximally based AbHF for treatment of recurrent tarsal tunnel syndrome is yet to be described.

Case Study:

Background: 41 year old male with longstanding tarsal tunnel symptoms along with radiculopathy. Underwent 3 tarsal tunnel releases with only short term relief of symptoms. Patient also has history of subtalar joint fusion along with several forefoot procedures. Patient's symptoms were debilitating and preventing him from performs activities of daily living. Positive Tinel's Sign was elicited over the Tarsal tunnel

Case Study Cont.

Procedure:

- An approximately 12 cm curvilinear skin incision was made along the medial aspect of the foot along the glabrous junction from the medial malleolus to the 1st metatarsophalangeal joint.
- Careful dissection was performed to reveal the tibial nerve. External neurolysis performed with removal of overlying fibrotic tissue. The upper and lower chambers of the tarsal tunnel were identified and fibrotic tissue in proximity to both chambers was released.
- The distal aspect of the incision was deepened with the #15 blade until the abductor hallucis muscle was visualized. Muscle belly was developed from surrounding tissue (Figure 1)
- A single perforating vessel was ligated at the mid portion of the abductor flap and the flap was then delivered proximally to a level 4 cm proximal to the tibial nerve bifurcation.
- Flap was sutured to deep subcutaneous tissue with absorbable suture and biologic graft stapled into place overtop (Figure 3)
- Wound vac applied at the conclusion of the case and set to 75 mmHg of negative pressure. Non adherent placed between graft and vac.
- Patient was placed in a posterior splint and instructed to remain Non weight bearing to the Right lower extremity.

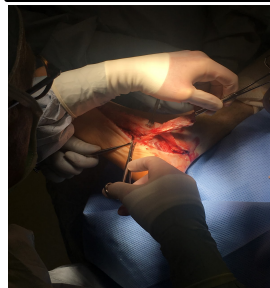


Figure 1.) Reflecting the AbHF while retaining arterial supply from the medial plantar artery.



Figure 2.) Proximally based AbHF over the tarsal tunnel



Figure 3.) Integra graft is applied over the AbHF



Figure 4.) Drain is removed after 24 hours.



Figure 5.) 3 weeks s/p initial procedure. Granulation tissue to the AbHF site. Operation scheduled for application of skin graft.



Figure 6.) Flap 10 weeks following muscle flap procedure. Sharp debridement of graft site with application of split thickness allograft on 12/18/18



Figure 7.) 16 weeks s/p AbHF



Figure 8.) 19 weeks after AbHF

Results:

At most recent follow up visit, patient related he had no neurogenic symptoms to the right foot or leg. Negative Tinel's sign noted to the right foot with no pain on percussion to the tibial nerve. Patient has increased light touch sensation in the region of the muscle flap compared to preoperatively. Range of motion is unchanged due to fusion procedure. Patient is walking in sneakers at this time.

Analysis and Discussion:

Recalcitrant tarsal tunnel symptoms present a challenge as repeat procedures often lead to increased perineural fibrosis and unpredictable outcomes.¹ Revisions often include more aggressive decompression along with internal vs external neurolysis and depending on preference, the application of a biologic graft to serve as a scaffold for nerve regeneration.^{1,3,9} Skalley et al. looked at outcomes for revision tarsal tunnel surgery on 12 patients and reported mixed results. Their findings suggested that in patients with epineural fibrosis around the tibial nerve, outcomes were significantly worse with minimal to no improvement of pain and function.⁹ A muscle flap is considered as it provides a vascular bed to reduce ischemia and protects the nerve gliding function.^{5,7} Peripheral nerves require a certain amount of mobility to function correctly. In the tarsal tunnel region, studies find the normal tibial nerve excursion to be around 2.99 mm with simulated ankle range of motion throughout the gait cycle.⁶ Increased perineural fibrosis causes increased traction on the tibial nerve in the tarsal tunnel which leads to elongation and ischemia. Nerve elongation of 5-10% leads to impaired blood flow while 15% elongation impedes it entirely.⁶ A muscle flap can be applied to provide neo-vascularization to nerves negatively impacted by fibrosis and traction. Additionally, the muscle flap serves as mechanical coverage protecting the nerve from direct interaction with the subcutaneous tissue.⁵ As reported by Rodriguez et al., the use of a muscle flap as an adjunct to internal neurolysis is a viable procedure in patients with recalcitrant neurogenic symptoms in tarsal tunnel and other impingement neuropathies.⁵ In the right patient with debilitating symptoms of tarsal tunnel, we believe an abductor hallucis muscle flap is a viable option to decrease symptoms.

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