

Chapter 2

Approach to the peroneal nerve

Based on

Dellon AL, Entrapment of the deep peroneal nerve on the dorsum of the foot.
Foot and Ankle 11:73-80, 1990

Dellon AL, Ebmer J, Swier P, Anatomical variations related to decompression of the
common peroneal nerve at the fibular head.
Ann Plast Surg, 48: 30-34, 2002

The first nerve entrapment site for the peroneal nerve to be described was for the common peroneal nerve at the fibular neck. In this location, the common peroneal nerve transitions from the popliteal fossa, posteriorly, to travel laterally across the neck of the fibula and into the anterior and lateral compartments of the leg. In 1897, a woman having a gynecologic procedure awoke from surgery with foot drop. During surgery she had been positioned with stirrups in the classic lithotomy position.¹

COMMON PERONEAL NERVE ENTRAPMENT

Surgical considerations related to the common peroneal nerve are classic within Orthopedic Surgery, as it is recognized that this nerve can be injured concomitantly with knee joint and ankle joint injuries.²⁻⁸ Stretch and traction injuries can be sufficient to give foot drop, with complete peroneal motor and sensory loss, to less severe gradations of chronic nerve compressions. Surgical approaches have been described variously from 6 months of observation, awaiting spontaneous recovery, to surgical exploration. At surgery, the approach varies from neurolysis, to nerve repair, to nerve grafting of the common peroneal nerve depending upon the pathology observed.⁹⁻¹³

My first surgical approaches to the common peroneal nerve involved primarily division of the superficial fascial of the peroneus longus muscle, and our reported series was the largest at that time.¹⁴ That series of 31 patients was a retrospective review of patients from 1980 through 1990. Following neurolysis of the common peroneal nerve at the fibular neck, 90% of the patients had improvement in peroneal nerve motor function, and early intervention in patients with post-traumatic peroneal palsy was recommended.

During my early procedures upon the common peroneal nerve, I observed that there was most often a fibrous band of varying width *deep* to the peroneus longus muscle. This was a band not normally seen during an anatomy dissection. This band clearly had to be divided, and deep to this band was often a definitive indentation in the common peroneal nerve, with the nerve deep to this band being flattened, soft and consistent with axonal loss. There was also a loss of the vascular marking on the nerve. In the trauma cases, without neuropathy, the nerve was white in appearance, except at this site of compression (**Figure 1**).

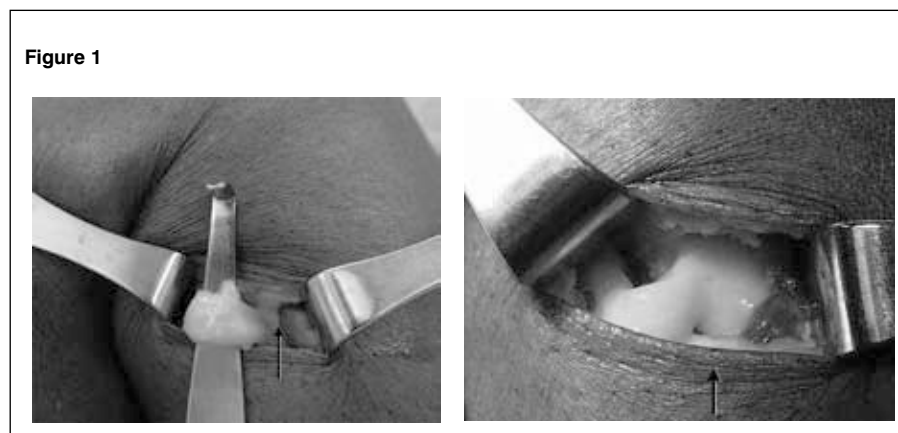


Figure 1
Exposed right common peroneal nerve held beneath the small retractor. Arrow identifies the deep white fibrous band beneath the retracted peroneus longus muscle (muscle retracted beneath large retractor to the right). Note white color of nerve. Right: after division of the deep fibrous band, the indentation of the nerve by the band is noted by arrow. Note absence of vascular markings on the nerve.

A comparison study of 29 bilateral cadaver dissections and 65 unilateral clinical decompressions was undertaken then to identify the anatomic variations about the common peroneal nerve at the fibular neck.¹⁷ This study demonstrated that while the fibrous band deep to the peroneus longus muscle was present in only 30% of cadavers, it was present in 78.5% of patients requiring neurolysis of the common peroneal nerve for clinical symptoms of nerve compression. Additional findings were that the lateral gastrocnemius muscle may have a thick fascial origin deep to the common peroneal nerve (43% of cadavers and 20% of patients) that would require division (**Figure 2**), and that the entrance of the common peroneal nerve into the anterior and lateral compartments of the leg can be tight due to a proximal origin of the soleus muscle (9% of cadavers and 6% of patients). These observations require a surgical approach for neurolysis of this nerve to be adjusted accordingly to search for each of these variations.

SUPERFICIAL PERONEAL NERVE ENTRAPMENT

Entrapment of the superficial peroneal nerve as it transits from below the fascia and muscles of the lateral compartment of the leg and into the subcutaneous tissue was first described by Henry in 1945.¹⁸ Little however has been written about

Figure 2



Right knee with exposure of common peroneal nerve. Patient had previous blunt trauma to the knee. The nerve is held beneath small retractor. Fibrous band seen in Figure 2.1 has been released. The white thickened fascia of the lateral gastrocnemius (arrow), seen deep to the common peroneal nerve, remains to be decompressed.

chronic compression of this nerve. In 1981, Banerjee and Koons described two patients with entrapment of the superficial peroneal nerve.¹⁹ As recently as 1997, Styf and Moberg reported an incidence of superficial peroneal nerve entrapment as a source of pain in just 3.5 % of 480 patients with lower extremity pain.²⁰ The most commonly understood cause of this nerve entrapment is an induced compartment syndrome due to exercise, described first in 1977 by Gafins, Murbarak, and Owen,²¹ and then popularized by Rorabeck, Bourne and Fowler in 1983.²² This condition continues to be reported extensively today, for example with a series of 50 patients in whom the specificity and sensitivity of different diagnostic techniques were evaluated.²³

My own involvement with this nerve began in attempting to treat patients with dorsal foot pain due to neuromas of the peroneal nerve distal branches. Ultimately an approach was described that required first resecting the distal neuromas of the deep and/or superficial peroneal nerves, and then translocating the proximal ends of these nerves into a muscular environment in the anterior compartment of the leg, away from the movements of the ankle joint.²⁴ During the care of these patients, there were some who remained with some degree of pain in the distribution of the superficial peroneal nerve despite my having personally identified and resected the superficial peroneal nerve in its traditional location, the lateral compart-

Figure 3



Left: Overview of surgical site in the lower extremity. Right: The fascia of the anterior and lateral compartment has been removed, as has the septum between the anterior and lateral compartments. The larger portion of the superficial peroneal nerve is noted by a single arrow in the lateral compartment, while the portion in the anterior compartment is noted by a double arrow.

ment.²⁵⁻²⁹ I found that a local anesthetic block of the superficial peroneal nerve at the ankle would relieve the persistent pain, suggesting that there was another anatomic route to innervate this region. My own subsequent dissections identified the presence of a branch of the superficial peroneal nerve in these patients, located in the anterior compartment of the leg. An example of a subsequent patient having a branch of the superficial peroneal nerve in both the anterior and the lateral compartment of the leg is given in **Figure 3**.

The presence of a nerve in the anterior compartment was not described in an early anatomic report of this region by Kosinski in 1926.³⁰ A report of the clinical success of decompression of the superficial peroneal nerve by Styf in 1989 noted that 6 of 22 patients had a branch of the superficial peroneal nerve located outside of the lateral compartment and within the anterior compartment.³¹ Subsequently, variations in the locations of branches of this nerve was reported by Adkinson, et al in 85 legs: the superficial peroneal nerve was within the lateral compartment only in 75% of their dissections.³² I have subsequently studied this in both cadaver dissections and clinical explorations of the superficial peroneal nerve.³³⁻³⁵ These results are summarized in **Table 1**.

Table 1
Anatomic variability of superficial peroneal nerve

Study	Number legs	Lateral	Anterior	Lat + anter	Subcut
Adkinson, et al, 1991 ³²	cad 85	73%	12%	14%	0%
Styf, 1989 ³¹	clin 22	73% (16/22)	22% (5/22)	5% (5/22)	0%
Rosson, et al, 2005 ³³	clin 35	57% (20/35)	21% (6/35)	26% (9/35)	0%
Barrett, et al, 2006 ³⁴	cad 75	72% (54/75)	17% (23/75)	5% (4/75)	6%
Ducic, et al, 2006 ³⁵	cad				

the results of the clinical explorations³³ and cadaver dissections^{34,35} carried out in my own series of studies confirms the earlier observations of Adkinson et al,³² and of Styf³¹ in terms of the variability of the superficial peroneal nerve. The clinical implication of these anatomic studies is that if the superficial peroneal nerve requires decompression, neurolysis or resection, then the surgeon must evaluate both the anterior and the lateral compartments of the leg. An example of the superficial peroneal nerve being located completely in the anterior compartment is given in **Figure 4**.

From **Table 1**, it may be calculated that percentage of patients with the superficial peroneal nerve located only within the lateral compartment is 43% in the two clinical series, whereas it is 72% in the cadaver series. This difference is significantly different at the $P < .05$ level by chi-square analysis. This reinforces the need to explore both compartments at the initial operation. This suggests, furthermore, that patients with failure to recover from a traditional neurolysis of the superficial peroneal in the lateral compartment should be re-explored looking for a remaining branch of the nerve that is still entrapped. Indeed, a recent study of 18 patients who failed to improve from their first surgical attempt to treat their exertional compartment syndrome found that 75% did improve after additional fasciectomy and neurolysis.³⁶

Figure 4

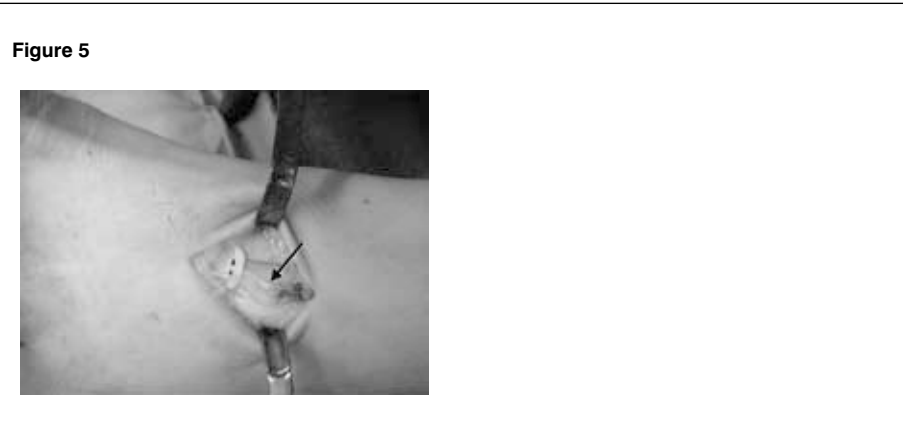


Overview of surgical site in the lower extremity. Right: After fasciectomy, a portion of septum between the anterior and lateral compartment (arrow) is left to identify the location of the entire superficial peroneal nerve within the anterior compartment (double arrow).

THE DEEP PERONEAL NERVE ENTRAPMENT

During my training in Hand Surgery, surgically transferring a toe to the hand by microsurgical transfer focused my attention of the relationship between the tendon of the extensor hallucis brevis and the deep peroneal nerve. During the 1980's, as I was increasingly being referred patients to treat foot pain, it became clear to me that localized dorsal foot pain, or radiation of pain between the first and second toes might be due to compression of the deep peroneal nerve at the location where the tendon of the extensor hallucis brevis crosses the deep peroneal nerve in close association to the first and second metatarsal junctures with the cuneiform bones.

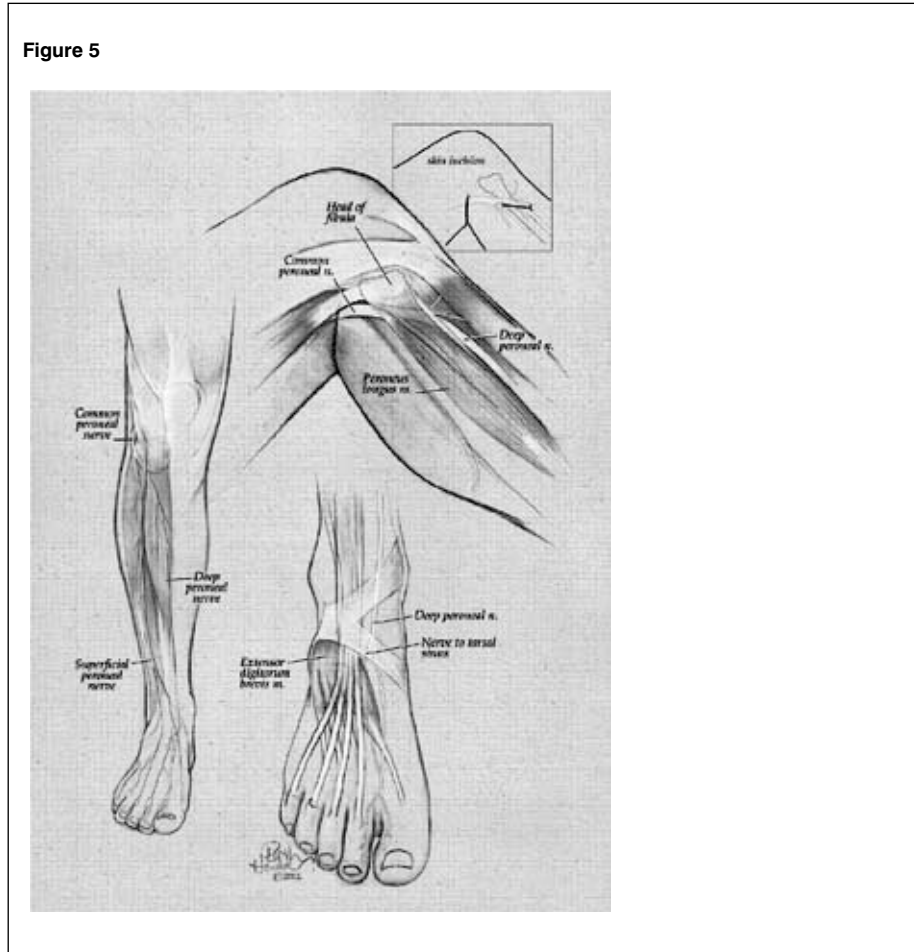
In 1990, my report of compression of the deep peroneal nerve was published along with my technique for the neurolysis.³⁷ The neurolysis included resection of a segment of the tendon of the extensor hallucis brevis where it caused the compression (**Figure 5**). There is also frequently a small distal fascial band at the site at which the nerve becomes superficial to enter the skin.



Dorsum of foot after excision of portion of tendon of the extensor digitorum brevis that compressed the deep peroneal nerve (overlying the marker). Note the indented area and widening of the nerve proximal to the site of compression (arrow).

SUMMARY

Three sites of anatomic narrowing must be evaluated by the physician who suspects the patient of having sensory or motor symptoms related to the peroneal nerve. Because there are no useful surgical illustrations that demonstrate the anatomic observations made in the above studies, **Figure 6** was commissioned.³⁸



Anatomic sites of compression along the peroneal nerve include the common peroneal nerve at the knee (incision site shown in inset), the superficial peroneal nerve in either the anterior or lateral compartments (or both), and the deep peroneal nerve over the dorsum of the foot, caused by compression of this nerve branch by the tendon of the extensor digitorum brevis (http://www.dellonipns.com/peroneal_nerve_compression.php)

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