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TECHNICAL NOTE - PERIPHERAL NERVES

A simple test to assist with the diagnosis of common fibular nerve entrapment and predict outcomes of surgical decompression

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Abstract

Background Common fibular (peroneal) nerve (CFN) entrapment is the most frequent nerve entrapment in the lower extremity. It can cause pain, sensory abnormalities, and reduced ability to dorsiflex the foot or a drop foot. A simple test to assist with diagnosis of CFN entrapment is described as an adjunctive clinical tool for the diagnosis of CFN entrapment and also as a predictor of successful surgical decompression of a CFN entrapment.

Methods The test, a lidocaine injection into the peroneus longus muscle at the site of a common fibular nerve entrapment, was studied retrospectively in 21 patients who presented with a clinical suspicion of CFN entrapment. Patients ages ranged from 17 to 71 (mean 48.5).

Results The lidocaine injection test (LIT) was positive in 19 patients, and of these, 17 underwent surgical decompression and subsequently experienced improved ability to dorsiflex their foot and reduced sensory abnormalities.

Conclusion The LIT is a simple, safe adjunctive test to help diagnose and also predict a successful outcome of surgical decompression of a CFN entrapment. The proposed mechanism of action of the LIT could lead to new, non-surgical treatments for CFN entrapment.

Keywords Common fibular nerve · Common peroneal nerve · Common fibular nerve decompression · Drop foot · Common peroneal nerve decompression · Common peroneal nerve entrapment

Introduction

The common fibular (peroneal) nerve (CFN) is the most frequent nerve entrapment of the lower extremity [3, 6, 25, 38]. This nerve contains motor and sensory fibers, and its entrapment can cause sensory-related pain in the leg, ankle, and foot, which may be described as pain, numbness, burning, and/or tingling; it can also cause weakness of the foot's dorsiflexor muscles, at times manifesting as drop foot [3, 6, 25, 38]. CFN entrapment can be contributory to ankle weakness [33] and vascular issues [18, 21] and, even when not clinically apparent, is a risk factor for falling [30].

Diagnosis of a CFN entrapment is based primarily on the patient's history and the physician's clinical examination, which may include eliciting a provocative sign, Tinel's sign, and/or performing diagnostic nerve blocks. Testing may include pressure-specified sensory device, nerve conduction velocity, electromyography, and ultrasound or magnetic resonance imaging [3, 38, 10]. Clinicians must be aware that other problems can produce the symptomatology seen in CFN entrapment, including sciatic mononeuropathy, lumbosacral plexopathy, lumbar L5 radiculopathy, tibiofibular joint pathology, peripheral vascular disease, or central motor system pathology [3, 6, 25, 27, 42].

The Phoenix sign block has been put forth as a prognostic test for CFN entrapment. The test is done by placing a small subanesthetic dose of lidocaine onto the CFN at the fibular neck. A positive result occurs when improved extensor muscle strength occurs, and this has been described as the ability to actively dorsiflex the great toe, which prior to the injection could not actively dorsiflex or was significantly weak. In positive test outcomes of the Phoenix sign block, improvement in vascularity and cutaneous sensation has been noted, and the test has value in predicting the outcome of surgical decompression of the CFN.

No Presentations at Conferences

This article is part of the Topical Collection on *Peripheral Nerves*

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This test must be done under ultrasound guidance, taking care to avoid injury to the common peroneal nerve [4].

Entrapment of the CFN typically involves compression by a band of fascia under the peroneus longus muscle (Fig. 1) [3, 11]. As such, surgery to decompress a CFN entrapment releases the fascia overlying the peroneus longus, allowing retraction of the muscle belly so that the deep band of fascia under the muscle can be accessed and released. The release of the fascial bands above and below the peroneus longus is followed by removing or lessening the cut, redundant fascia with bipolar cautery to reduce the possibility of fibrosis of the fascia over the CFN and the peroneus longus muscle belly [3, 14, 17, 18]. Surgery for CFN entrapment has shown good results [16, 20, 34, 36].

It was hypothesized that an adjunctive clinical test to assist with the diagnosis of a CFN entrapment and also predict the outcome of surgical decompression, while avoiding injury or accidental injection of anesthetic into the CFN, would be to anesthetize the peroneus longus muscle belly above the primary area of compression of the CFN with a local anesthetic and observe the immediate effects.

Methods

In this retrospective study, 21 patients presented with signs and symptoms that suggested a clinical suspicion of a CFN entrapment. Among their clinical signs and symptoms, all patients had reduced sensation on the dorsum of their foot, which was evaluated with two-point discrimination testing, and all patients were unable to actively dorsiflex their great toe or could do so only weakly. In all patients, the great toe's extensor strength was less than or equal to 2 over 5. Patients ages ranged from 17 to 71 (mean, 48.5). Eleven of the patients were male, and 10 were female. None of the patients related an allergy or hypersensitivity to lidocaine. Consent was obtained, and the test was performed on each patient.

To perform the lidocaine injection test (LIT), the relevant landmarks are identified: the CFN, which courses just distally and anteriorly to the head of the fibula, and the peroneus longus muscle, which courses over the CFN (Fig. 1). At the area of the peroneus longus muscle where the CFN courses under it, the muscle is gently squeezed together from side to side to cause it to bulge upward slightly. Using aseptic technique, a 27-gauge needle is angled about 25° to the leg as 4 cc's of lidocaine 1% plain is slowly injected into the muscle belly (Fig. 2). Care should be taken to only inject superficially, never deep or even halfway through the belly, to avoid an injury to the CFN. As the lidocaine is injected, it should cause a slight tenting or bulge of the skin as the muscle's overlying fascia expands to a small extent. Depending on the physician's experience and the patient's anatomy, ultrasound may be utilized to assist with the injection (Fig. 3).

The LIT is deemed positive when the patient actively dorsiflexes their great toe with improvement in strength, greater than that which was present prior to the injection. In practice, positive test results are pronounced and occur within a few minutes. For patients with significant muscle weakness or outright drop foot, when the test was positive, their ability to dorsiflex their entire foot, including the great toe, improved dramatically. The failure to dorsiflex the great toe or dorsiflex the toe with an increase in strength is considered a negative result.

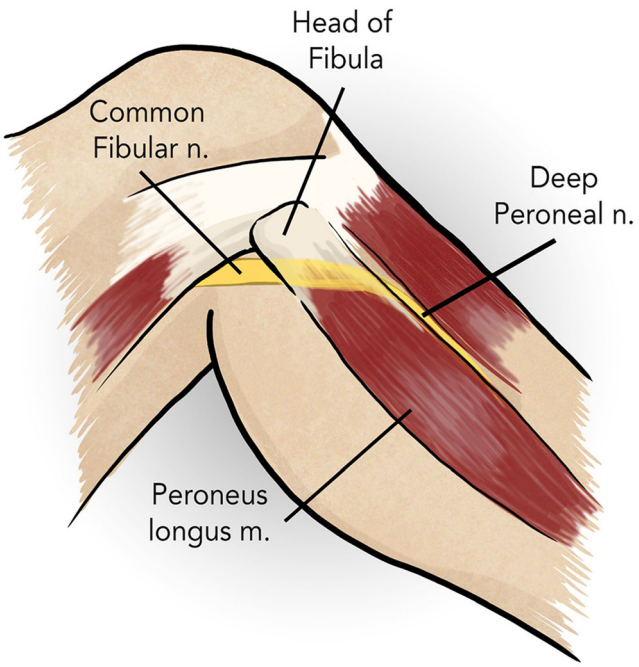

Fig. 1 Anatomy of the common fibular nerve as it passes under the peroneus longus muscle (PLM). The PLM attaches to the head of the fibula and inserts into the foot, at the base of the 1st metatarsal. As the CFN courses beneath the PLM, it passes over the neck of the fibula and divides into the superficial fibular nerve (not shown) and the deep peroneal nerve

Fig. 2 To perform the LIT, the relevant landmarks are identified: the CFN, which courses anteriorly to the head of the fibula, and the peroneus longus muscle (PLM), which courses over the CFN. At the area of the PLM where the CFN courses under it, the muscle is squeezed together from side to side with two fingers to cause it to bulge upward slightly

Fig. 3 Using aseptic technique, a 27-gauge needle is angled about 25°to the leg as 4 cc's of lidocaine 1% plain is slowly injected into the peroneus longus muscle. Care should be taken to only inject superficially so as to avoid an injury to the CFN

Test results

Of the 21 patients studied, 19 of them exhibited a positive LIT (Table 1). There were no side effects or complications from the test other than one patient relating transient discomfort in the area of the injection which they described as a "bruised" feeling, though no discoloration or signs of a hematoma were present. In theory, there is a small risk of infection or a hematoma, though this did not occur.

Table 1 Summary of dorsiflexion muscle strength of the great toe pre- and post-LIT and after CFN decompression

Patient	Prior to LIT	Post-LIT	Result	After surgery
1	2	5	+	5
2	0	3	+	3
3	0	2	+	4
4	1	3	+	3
5	0	3	+	2
6	0	2	+	3
7	1	4	+	5
8	1	3	+	3
9	0	3	+	2
10	0	3	+	3
11	1	4	+	4
12	1	3	+	4
13	0	3	+	2
14	2	4	+	5
15	0	3	+	2
16	0	2	+	2
17	1	4	+	5
18	0	4	+	
19	1	3	+	
20	0	0	–	
21	0	0	–	

For those 19 patients with a positive result occurring, they returned for follow-up within 2 to 4 weeks. One patient continued to have an improvement in their symptoms and was satisfied with their increased muscle function and symptom relief. For the other 18 patients, the symptoms, including dorsiflexion weakness, had returned. Of these patients, 17 consented to undergo surgical decompression of the CFN, which was performed within 3 months of the LIT. Of note, in 5 of these patients, during the physical exam (and prior to the LIT), a Tinel's sign (the elicitation of paresthesias along the distribution of the nerve) [32] was unable to be elicited.

The CFN decompression surgery was performed according to the technique noted previously herein [3, 11, 14, 18]. Postoperatively, almost immediately (in the post-surgery recovery room) or within a week, all 17 patients experienced improvement in their ability to dorsiflex their foot. These patients also subjectively related sensory symptom improvement. Verification of improved sensation on their foot was done with two-point discrimination testing.

Patients were followed for a minimum of 4 months, and they all maintained their surgical result. None of the patients experienced any serious complications. A summary of patients' muscle strength on a scale of 0 to 5 during active dorsiflexion of their great toe pre- and post-LIT and after CFN decompression (for patients who had surgery) is shown in Table 1.

Discussion

In 1992, the seminal textbook by Travell and Simons, *Myofascial Pain and Dysfunction*: *The Trigger Point Manual,* explained the use of injections of local anesthetics into muscles to diagnose and alleviate pain [37]. Myofascial entrapment of the CFN may be considered such a trigger point entrapment and, as such, a reasonable site to address with injection. Indeed, though not the intent of this study or reason for performing the LIT, one patient did have some measure of improvement following the test, satisfied with their improvement. This patient was contacted 23 weeks after the injection, and they related that their foot's strength improvement had continued and the sensory problems had not returned. They did not feel the problem required any further treatment.

Lidocaine, like most local anesthetics, causes a transient flaccid paralysis or "relaxation" of skeletal muscle [2, 28]. In this instance, it is hypothesized that the peroneus longus muscle becomes flaccid or relaxed, to an extent, allowing compression of the muscle (and its underlying fascia band) on the CFN to lessen, reducing and/or eliminating the nerve entrapment. This theory suggests that the fascial band that occurs

under the peroneal longus muscle and has been considered responsible for compressing the nerve is not the primary cause of the CFN's compression, but it is secondary to the peroneal muscle pressing or perhaps tightening down on the fascial band, which impinges the nerve. The concept that the peroneus longus muscle is the main cause, in some instances, of CFN entrapment may give rise to the development of new non-surgical methods of treatment. Such treatments may possibly include addressing the muscle's biomechanics with orthoses, physical therapy treatments, or causing temporary paralysis of the muscle with the use of botulinum toxin.

In the LIT, only the peroneus longus muscle is anesthetized by the injection, as no other muscles course in the area injected. Lidocaine was chosen for the test because of its rapid onset and short duration of action. Epinephrine should not be in the lidocaine, as in theory, it would cause the peroneus longus muscle to contract and tighten down on the CFN [43].

This study suggests that the LIT is an inexpensive and safe adjunctive test to help diagnose and also predict surgical success in CFN entrapment. The LIT could assist the clinician in narrowing the myriad of differential diagnoses that must be considered in reaching a diagnosis of CFN entrapment and provide some predictability of surgical success.

Though numerous clinical and diagnostic tests assist with diagnosing CFN, the clinical picture may vary, and in some cases, the LIT may be valuable. For example, electrophysiological testing is considered generally useful, but research shows such testing does not always recognize CFN entrapment [13, 24]. Also, electrophysiological testing is costly, and some patients may not be able to tolerate it, and the pain the patient experiences during the test can cause inconclusive or incomplete results [13, 22, 23, 39, 41].

Iwamoto et al. note that in patients whose symptoms worsen with walking or standing, causing extension of the knee and loading of the CFN, performing electrophysiological testing while such patients are at rest may fail to detect CFN entrapment [19]. Iwamoto et al.'s research supports the concept that the peroneus longus muscle is a factor in CFN entrapment. They found that repetitive plantarflexion of the foot (repeated peroneus longus contracture) increased loading on the CFN, worsening the symptoms of CFN entrapment.

In this study, a Tinel's sign was absent in 5 patients who had a CFN entrapment that improved with surgical decompression. A Tinel's sign is considered an indicator for the diagnosis of CFN entrapment, but it is not always present [1, 3, 5, 12, 25, 26, 29, 31, 35, 38, 40], and recent research has questioned its utility [8]. This study suggests that the LIT may be more useful than the Tinel's sign for assisting with the diagnosis of CFN entrapment, though the LIT is not meant to be a replacement for a thorough history, clinical history and relevant diagnostic testing.

In the two patients who did not exhibit a positive LIT, it may prove notable that each had no active dorsiflexion strength and both had a concomitant history of back problems and one of them had undergone prior back surgery. As such, these patients' signs and symptoms may be due in full or part to a radiculopathy or other unknown issue. At the time of this writing, there has not been any further insight into the cause of their problems.

There is a significant risk of peroneal nerve palsy developing after total joint replacement of the hip or knee, [9, 44], and the LIT may help identify which of these patients would benefit from surgical decompression of the CFN.

The LIT appears to have similar utility as the earlier discussed Phoenix sign block test, though the LIT may mimic the effect of surgical decompression more closely and also addresses the primary source of the nerve's compression. Though the authors of the Phoenix sign block state it is safe, the test requires injection adjacent to the CFN and the use of ultrasound guidance as there is a risk of injury to the nerve or of accidentally injecting anesthetic into the nerve's motor fibers. The LIT avoids the CFN altogether, and the LIT generally does not require ultrasound.

The LIT may have benefit in assisting with diagnosing other nerve compressions as well. The test is currently being trialed for nerve entrapments related to compression of the abductor hallucis muscle, [3, 7, 15, 38], and early results show that the LIT alleviates nerve-related symptoms and in some cases increases strength and movement of the toes.

This study was limited by its small number of patients and the length of postoperative follow-up, and as such, use of the LIT should be implemented with caution. Further studies on the LIT should be done with greater numbers of patients, a longer postoperative follow-up time, and with consideration given to the effect of concomitant medical conditions.

Conclusion

CFN entrapment is the most frequent nerve entrapment in the lower extremity, and its clinical picture is similar to that of other medical issues. The mainstay of diagnosing CFN entrapment is the physician's clinical examination. The LIT provides a simple, safe adjunctive tool that this study suggests may assist in diagnosing CFN entrapment and in also predicting a positive outcome from surgical decompression.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Informed consent For this type of study, formal consent is not required.

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