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# Predictive Reliability of the Phoenix Sign for the Outcome of Common Fibular (Peroneal) Nerve Decompression Surgery

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## Abstract

A positive Phoenix sign occurs when a patient, with a suspected focal nerve entrapment of the Common Fibular (Peroneal) Nerve (CFN) at the level of the fibular neck, demonstrates an improvement in dorsifexion after an ultrasound guided infiltration of a sub-anesthetic dose of lidocaine. Less than 5 cc's of 1% or 2% lidocaine is utilized and the effect is seen within minutes after the infiltration, but usually lasts only 10 minutes. This effect may be due to the vasodilatory action of lidocaine on the microcirculation in the area of infiltration. This nerve block has significant diagnostic utility as it is highly specific in the confirmation of true focal entrapment of the CFN, has high predictive value for a patient who may undergo surgical nerve decompression if they have demonstrated a positive Phoenix Sign, and may help in the surgical decision-making process in patients who have had a drop foot for many years but still may regain some motor function after decompression. In this retrospective review, 26 patients were tested, and 25 of this cohort demonstrated a Positive Phoenix Sign (an increase in dorsiflexion strength of the Extensor Hallucis Longus muscle (EHL)). One patient had no response to the peripheral nerve block. Of the 25 patients who demonstrated a positive "Phoenix Sign" and underwent nerve decompression of the CFN, and 25 (100%) showed an increase in dorsiflexion strength of the EHL after nerve decompression surgery of the CFN. The one patient in this cohort who did not demonstrate any improvement in dorsiflexion of the EHL after the nerve block did not have any improvement after surgery.

## Keywords

Peripheral Nerve Block, Drop Foot, Ultrasound Guidance, Common Peroneal Nerve Entrapment, Common Fibular Nerve Entrapment

## 1. Introduction

In peripheral nerve surgery, the use of diagnostic blocks with local anesthetics, and particularly lidocaine has been well established and widely used to determine pain generator location, and to determine if pain reduction may be obtained for the patient after a planned surgery [1] [2]. A positive "Phoenix Sign" exists when there is an increase in motor strength of the extensor hallucis longus (EHL) after infiltration of a small amount of lidocaine, (always less than 0.5 cc's) usually 0.1 - 0.3 cc's around the Common Fibular Nerve at the level of the fibular neck under high resolution sonographic guidance [3]. Within 2 - 4 minutes after the nerve block motor strength is tested and compared to the level of strength documented before the infiltration. We have found that if there was a substantive increase in motor function there was a very high correlation of a positive outcome after neurolysis as we report in this article. It is imperative to differentiate the predictive ability of peripheral nerve blocks when comparing a planned decompression surgery versus some type of neuroablative or denervation surgery, as with decompression the predictive value is much higher than with any nerve destructive procedures [1] [4].

In patients with Common Fibular Nerve entrapment, there are varying degrees of symptoms ranging from chronic pain after ankle sprain to a complete drop foot. It can be difficult for clinicians to make a definitive diagnosis of nerve entrapment at this level in many cases, and the implementation of this diagnostic test can provide important and life changing benefits for patients in which clinical findings may be equivocal. For example, we have seen patients who have had a complete drop foot for many years—well past the point on the theoretical timeline where it would be believed by any neurologist or peripheral nerve specialist that the motor endplates within the muscle fiber would still be present allowing for a return of motor function after a successful neurolysis, to have more than several grades of motor strength improvement after this diagnostic test. Because of these findings, many patients who had been told previously that there was nothing that could be done to restore normal lower extremity function now have complete, or greatly improved dorsiflexion—and do not have a drop foot solely because of the findings from this test.

Entrapment of the CFN is the most common nerve entrapment in the lower extremity—and may be the most under recognized and misdiagnosed nerve entrapment in patients [5]. The diagnosis of a peripheral nerve entrapment can be made primarily by obtaining a detailed HPI, extensive and detailed clinical evaluation that includes an occasionally positive Tinel's sign, a provocation sign, a decreased level of sensation within the nerve innervation distribution including two-point discrimination, and motor testing. Additional testing such as nerve conduction velocity and EMG studies can help in the diagnosis—but do not make the diagnosis. There can be a high level of false negative electrodiagnostic findings in patients with lower extremity peripheral nerve entrapment [6]. Even if accurate diagnosis of a CFN entrapment is made, previously there has been no test that can indicate what outcome would likely be seen by the patient after peripheral nerve decompression surgery.

## 2. Materials and Methods

Patient data that was included in this retrospective study met the following criteria: 1) Each patient gave informed consent to have their data included in this report, and this study received Institutional Review Board approval from Kennesaw State University, Kennesaw, Georgia, 2) Each patient had a primary diagnosis of a Common Fibular Nerve entrapment, 3) They received a pre-operative ultrasound-guided peripheral nerve block of the CFN (**Figure 1**), 4) They underwent subsequent decompression surgery of their CFN, and 5) They were followed up post-operatively for an evaluation of EHL motor strength. A total of 44 charts were reviewed, and 26 patients met the criteria outlined above. 18 patients/charts were not included in this retrospective review because there was not a clear delineation of assessment in muscle grade from manual motor testing.

If a diagnosis of an entrapment of the CFN was made after the HPI (history of present illness) and physical examination, the patient was consented for a diagnostic peripheral nerve block with 1% lidocaine. Pre-injection motor strength of the ipsilateral extensor hallucis longus muscle (EHL) was made using a 0 - 5 motor strength grading scale [7]. EHL motor strength was measured and measured 3 - 5 minutes after the local anesthetic infiltration was completed.

Using sonographic guidance, the Common Fibular Nerve was identified by the characteristic "honeycomb" echotexture adjacent to the fibula at the level of the fibular neck. Less than 0.5 cc of 2% lidocaine was then infiltrated with a 30-gauge needle. Careful attention was always utilized to avoid direct contact with the actual nerve itself with the needle, and to verify that the infiltrate was deep to the peroneus longus fascia creating an anechoic signal adjacent to the

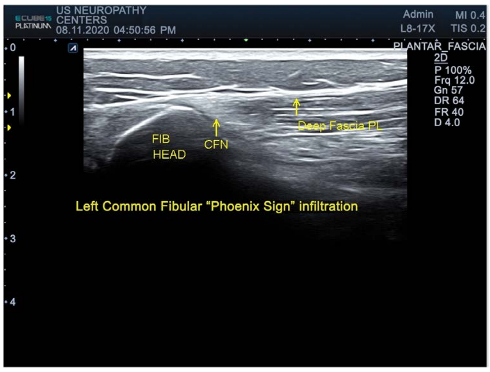


**Figure 1.** The CFN is seen as the honeycombed structure adjacent to the cortex of the fibular head and just deep to the deep fascia of the fibularis longus muscle.

nerve indicating that the infiltrate was properly administered. All infiltrations in this study were completed by the lead author to diminish the possibility of inter administrator variability.

A video of the infiltration can be seen at this link: https://www.youtube.com/watch?v=LeW3uMAi_Jg .

A positive Phoenix Sign was noted when the patient demonstrated a demonstrable increase in EHL motor strength compared to their pre-injection strength (at least one grade of motor strength). If there was no increase in EHL motor strength then this was classified as a negative Phoenix sign.

## 3. Results

25 patients who demonstrated a positive Phoenix Sign underwent Common Fibular Nerve surgical decompression surgery (Table 1). 25 out of the 25 patients who demonstrated a positive "Phoenix Sign" had an improvement in EHL strength and dorsiflexion after nerve decompression of the CFN. The age range was from 33 to 79 years of age. Patient follow up ranged from 3 months to 2 years which consisted of follow up manual motor testing of the EHL of the decompressed extremity.

**Table 1.** Dorsiflexion improvement post-surgery.

| Patient Number | Age | Phoenix Sign | Dorsiflexion Improvement |
|---|---|---|---|
| 1 | 79 | Positive | Yes |
| 2 | 37 | Positive | Yes |
| 3 | 40 | Positive | Yes |
| 4 | 36 | Positive | Yes |
| 5 | 57 | Negative | No |
| 6 | 51 | Positive | Yes |
| 7 | 60 | Positive | Yes |
| 8 | 33 | Positive | Yes |
| 9 | 53 | Positive | Yes |
| 10 | 62 | Positive | Yes |
| 11 | 42 | Positive | Yes |
| 12 | 64 | Positive | Yes |
| 13 | 61 | Positive | Yes |
| 14 | 56 | Positive | Yes |
| 15 | 57 | Positive | Yes |
| 16 | 71 | Positive | Yes |
| 17 | 72 | Positive | Yes |
| 18 | 50 | Positive | Yes |
| 19 | 72 | Positive | Yes |
| 20 | 39 | Positive | Yes |
| 21 | 72 | Positive | Yes |
| 22 | 72 | Positive | Yes |
| 23 | 36 | Positive | Yes |
| 24 | 29 | Positive | Yes |
| 25 | 61 | Positive | Yes |
| 26 | 50 | Positive | Yes |

## 4. Discussion

While there is scant literature dealing with efficacy of peripheral local anesthetic nerve blocks for diagnosis and prognosis of peripheral nerve pathology, the findings in our patients would strongly support the judicious use of peripheral local anesthetic nerve blocks. Additionally, Nirenberg recently reported his results in a retrospective study of 21 patients. Of the 21 patients he tested, 19 showed a positive response to the nerve block that he called a "Lidocaine Injection Test (LIT)". Seventeen of these 19 patients subsequently underwent nerve decompression of the Common Fibular Nerve, and all 17 (100%) of them had an improvement in dorsiflexion and sensory findings after their surgery [4]. Our clinical results as well as the findings we present here strongly correlate with his findings.

It may be conjectured that previous equivocal reports [1] in the literature addressing the questionable efficacy of local anesthetic peripheral nerve blocks is due to performance of the block itself, and the quantity of the infiltrate used. We have found that it is imperative to perform this block in real time with high resolution sonographic guidance in order to administer only sub-anesthetic does of the lidocaine in close proximity to the nerve without infiltrating into the nerve. We suggest that never more than. 5 cc's of lidocaine be infiltrated and many times we use only 0.2 - 0.3 cc's of the anesthetic. It should also be noted that in our experience over the last 20 years local anesthetic diagnostic blocks are not highly specific for nerve destruction procedures, and may only be accurate half the time.

This leads to our hypothesis on why this nerve block is effective in the confirmation of focal nerve entrapment of the CFN. With the administration of a sub-anesthetic dose we hypothesize that it is the vasodilatory effect of the agent that is temporarily improving blood flow, which results in improved neural function [8]. All local anesthetics, except cocaine [9] [10], demonstrate a vasodilatory effect [8].

Another hypothesis that could be proffered is that there is some focal anesthetic effect on nervinervorum in the locality of the infiltrate resulting in a reduction of the sympathetic tone to the microvasculature leading ultimately again to vasodilation [11]. However, that hypothesis could be refuted by our clinical findings not reported in this study. To further support our hypothesis, we have tested several patients who did demonstrate improvements in motor strength with plain lidocaine, but when these same patients were infiltrated with lidocaine with 1:200,000 epinephrine (vasoconstrictor) they did not show a positive Phoenix Sign [6]. This would lead one to conclude that it is more likely a direct effect on the microvasculature and not a change in sympathetic tone via the depolarizing effect of the lidocaine of the nervinervorum effecting the vessels.

If performed properly, a positive Phoenix Sign is a highly reliable diagnostic test that is very predictive (100%), and may give the surgeon a stronger indication for implementing nerve decompression that would not be the case if the diagnosis was based solely on previous traditional methods of evaluation. Within our research we noted that 25 patients out of the 26 patients showed a positive Phoenix Sign indicating that those patients did indeed have a common fibular nerve entrapment as evidenced by the fact that they regained motor function after peripheral nerve decompression. The one patient who did not demonstrate a positive "Phoenix Sign" did not gain any improvement in motor function.

## 5. Conclusion

Because this was a retrospective study there are limitations, and further investigation consisting of double blinded randomized prospective studies are needed to elucidate both the physiological mechanism that is responsible for this phenomenon, and to give more robust data as it is counter intuitive that administration of a local anesthetic would be able to increase motor strength. The Phoenix Sign is a powerful diagnostic tool that may save many patients from having to continue living with a drop foot because of the erroneous perception that they do not have a focal entrapment of the CFN, and that they are beyond the time where return of motor function could be expected. This diagnostic block requires minimal infiltrate of lidocaine under high resolution ultrasound guidance, but is safe and inexpensive. The initial clinical results indicate that there is a very high predictive value of both confirmation of CFN focal entrapment at the level of the fibular neck, and prognostic for an improvement in dorsiflexion after nerve decompression surgery.

## Conflicts of Interest

All authors report no conflict of interest in this work.

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