The Use of Femoral Intramedullary Nails vs. Standard Hindfoot Nails for Anatomic Arthrodesis of the Tibiotalocalcaneal Joints

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Introduction

Tibiotalocalcaneal arthrodesis (TTCA) with retrograde intramedullary nailing (IMN) has been utilized as a powerful limb salvage procedure for a variety of ankle and hindfoot pathologies including trauma, post-traumatic arthritis (PTA) of ankle and subtalar joints, avascular necrosis, and nonunion/malunion. Nevertheless, the reported learning curve and complication rates commonly deter the use of hindfoot nails.

With the evolution of intramedullary nailing for TTCA, there has been a growing popularity of the procedure for various hindfoot pathologies. Important components of IMNs that have evolved are increased rotational stiffness and stability and facilitation of optimal anatomic alignment due to its superior characteristics. [1]

In our study, we hypothesize that the femoral IMN would serve as a viable option for TTCA, with comparable outcomes to the standard hindfoot nails. .

Materials & Methods

A retrospective comparative study was performed utilizing 51 patients who underwent tibiotalocalcaneal arthrodesis (TTCA) as a limb salvage procedure. The first group consisted of 22 patients who underwent TTCA utilizing a femoral nail (FN); while the second group consisted of 29 patients who underwent TTCA utilizing a standard hindfoot nail (HN). Average follow up for the FN group was 25.2 months and 17 months for the HN group.

Our inclusion criteria was based on patients with preoperative diagnoses of avascular necrosis, fractures, post-traumatic arthritis/osteoarthritis, and nonunion/malunion. We excluded patients with charcot neuroarthropathy. We did not exclude patients with open fractures, equinovarus deformity, or prior history of osteoarthritis.

Categorical variables were tested with Chi-square or Fisher's exact test and continuous variables were tested with two sample t-test.

Anatomy of the Intramedullary Nails:

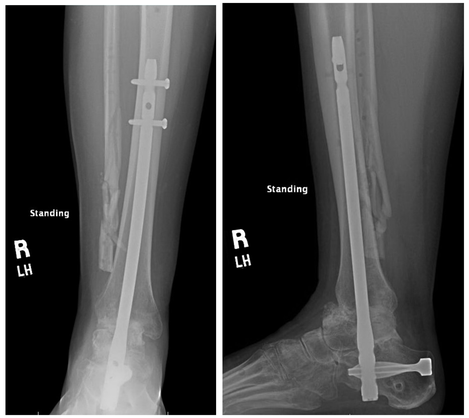
The femoral nail utilized has a lateral bow of approximately 4 degrees. It utilizes a spiral blade which inserts into the calcaneus. It ha static and dynamic holes for proximal locking of the nail.

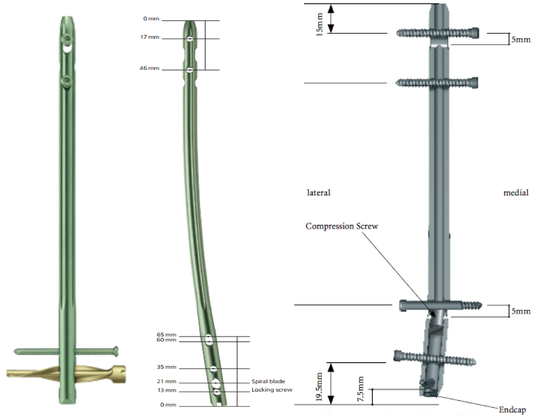
The standard hindfoot nail utilized has a 5 degree valgus bend with two fully threaded screws, one in the calcaneus, and the other in the talus. Similarly to the FN, there are static and dynamic holes for proximal locking of the nail.

Statement of Purpose

The primary aim of this study is to compare two methods of retrograde intramedullary nailing for anatomic arthrodesis of the tibiotalocalcaneal joints. The two methods of retrograde intramedullary nailing investigated were a femoral nail and a standard hindfoot nail.

Femoral Nail





Results

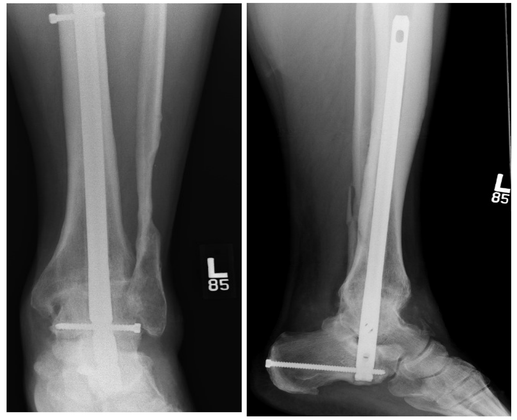
The Femoral Nail (FN) was utilized in a total of 22 patients, with an average age of 50 years, in a population of 55% males and 45% females. Among the FN group, 86% of patients were diagnosed with posttraumatic arthritis, 45% with avascular necrosis, 23% with nonunion/malunion, 14% with osteoarthritis, and 14% with hindfoot fractures.

Outcome rates of non-union/malunion, deep infection, wound complications, major amputation (AKA or BKA), and failed hardware were collected. Failed hardware was defined as nail/screw construct lucency, breakage, or migration of screw or nail. When evaluating complications, the FN group had 23% (5/22) nonunion/malunions, 10% (2/22) deep infection, 10% (2/22) wound complications, 0% major amputation (AKA or BKA), and 18% (4/22) failed hardware. Of the noted variables, only wound complications and major amputations were statistically significant in comparison to the HN group.

Outcomes	Femoral Nail	Hindfoot Nail	p-value
Non-union/Mal-union	23%	21%	0.86
Deep Infection	10%	28%	0.10
Wound Complications	10%	34%	**0.03**
Major Amputation	0%	21%	**0.02**
Failed Hardware	18%	41%	0.08

Table 1. Outcomes comparing FN versus HN, which shows a statistically significant difference in wound complication and major amputation outcomes.

Standard Hindfoot Nail



Results

The standard hindfoot nail (HN) was utilized in a total of 29 patients, with an average age of 60 years, in a population of 59% males and 41% females. Among the FN group, 58% of patients were diagnosed with hindfoot fractures, 34% nonunion/malunion, 55% with post-traumatic arthritis, and 24% with osteoarthritis. Unlike the FN group, 0% of the patients had AVN among the HN.

Outcome rates of nonunion/malunion, infection, wound complications, major amputation (AKA or BKA), and failed hardware were collected. Failed hardware was defined as nail/screw construct lucency, breakage, or migration of screw or nail. When evaluating complications, the HN group had 21% (6/29) nonunion/malunions, 28% (8/29) deep infection, 34% (10/29) wound complications, 21% (6/29) major amputation (AKA or BKA), and 41% (12/29) failed hardware. Of the noted variables, only wound complications and major amputations were statistically significant in comparison to the FN group.

Discussion

Tibiotalocalcaneal arthrodesis (TTCA) via retrograde intramedullary nailing (IMN) is a useful salvage procedure; however, the risks of postoperative complications for nonunion/malunion, infection, wound complication, major amputation, and failed hardware deter it's use.

Goebel et. al. reported a non-union rate of 10% (3/29) in their prospective study which evaluated retrograde femoral IMNs used for TTCA.[2] Similarly, Jehan et. al. reported a non-union rate of 13.3% in their systematic literature review that compared union rates and complications of 33 previous studies investigating utilization of IMNs for TTCA.[3] In our study, both the FN and HN groups report greater than 20% nonunion/malunion rates. However it is important to note that in the FN group, 40% (2/5) of patients had a prior history of nonunion and 60% (3/5) were current smokers. Similarly, in HN group, 33.3% (2/6) had a history of nonunion and 66.7% (4/6) were current smokers.

When comparing the two IMN constructs, both wound complications and rate of major amputation were shown to be statistically significant, favoring the FN group. We believe that the high rate of post-operative wound complication in the HN group can be attributed to the fact that 30% of its patients had an open pilon fracture and 30% had a previously treated osteomyelitis of the ipsilateral limb. Similarly, the same reasoning explains the rate of 21% in major amputation among the HN group and 0% in the FN group.

In our study, hardware failure was evident in 18.2% of FN patients and 41.3% of HN patients. Again, the HN group included a more difficult population, for which open pilon fractures and a history of osteomyelitis can certainly increase the likelihood of worsening results.[4] Nevertheless, the HN group had 25% (3/12) hardware failure via screw breakage of a distal calcaneal screw, while the FN group had 0% screw breakage. This highlights the unique FN construct when comparing the spiral blade vs. fully threaded screws. The spiral blade engages the primarily cancellous calcaneus with an increased surface area, unlike the fully threaded screws seen in the HN group. Patients with osteoporotic bone and other metabolic diseases may benefit greatly from utilizing the spiral blade within the FN construct. Regarding the anatomic structure of the hindfoot, both the FN and HN have similar anatomic features that suits the curvature of the hindfoot. This is unlike the straight IMNs which forces medializing the calcaneus.

In conclusion, TTCA using the FN shows comparable results and is a well-suited option for hindfoot arthrodesis.

References

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