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Retrograde Intramedullary Nailing for Arthrodesis of Ankle Joint

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Abstract: ***Introduction: End - stage ankle arthritis (EAA) is a common joint disease resulting in severe pain and dysfunction due to degenerative changes in the ankle joint. Ankle arthrodesis is traditionally the surgical treatment of choice for patients in which conservative treatment or joint - preserving surgery has failed. The main goal in ankle arthrodesis is solid fusion of the tibiotalar joint aiming for a painless, plantigrade, and stable foot. The purpose of this study was to evaluate the union rate and complication rate in patients with end - stage ankle arthritis of different etiology. Methods: A total of 10 patients with end - stage ankle arthritis of different etiology were treated with retrograde intramedullary nailing i. e. TTC nail. Functional outcome was assessed using a visual analog scale post - operative at 6 weeks, 3 months, and 6 months. Results: out of 10 Patients who underwent retrograde intramedullary nailing with TTC nail 2 had excellent outcomes, 4 had good outcomes, 4 had satisfactory with 1 patient had superficial infection treated conservatively with antibiotics. Conclusion: This study of retrograde intramedullary nails provides excellent results for end - stage ankle arthritis with high union rates and a low complication rate. The modern design of the retrograde tibia nail appears to be an ideal implant, which is a load - sharing device and allows better positioning of the foot and compression of the fusion site.***

Keywords: ankle arthritis, ankle arthrodesis, visual analog scale.

1. Introduction

End - stage ankle arthritis represents a debilitating condition marked by the advanced degeneration of the ankle joint, resulting in profound pain and functional limitations[1]. This musculoskeletal ailment exerts a considerable impact on the overall well - being of affected individuals, significantly compromising their quality of life[2]. Ankle arthrodesis is a well - established treatment option for end - stage ankle arthritis, aiming to alleviate pain, enhance stability, and improve function by eliminating motion in the affected joint[3]. The decision to pursue ankle arthrodesis is often based on the severity of symptoms and the inadequacy of conservative treatments. In summary, ankle arthrodesis stands as a supported treatment option for end - stage ankle arthritis, providing effective relief and improved functionality. Retrograde intramedullary nailing offers advantages such as reduced soft tissue disruption, improved biomechanical stability, and enhanced fusion rates compared to some alternative methods[4]. However, it is crucial to consider patient - specific factors and weigh the benefits against potential complications when choosing the most suitable method for ankle arthrodesis[5]

Before the surgery, all patients completed preoperative questionnaires and rated their pain on a scale from zero to ten. Additionally, evaluations were conducted using the AOFAS ankle - hindfoot score. Radiographic assessment of the fusion mass was performed with plain anteroposterior (AP) and lateral weight - bearing X - rays. The average follow - up time was 14.7 months (ranging from 12 to 18 months). Postoperatively, patients were clinically evaluated, providing pain ratings on a zero to ten point scale and undergoing assessments using the AOFAS hindfoot scoring system.

2. Methodology

A prospective clinical study was performed between 1st April 2022 to 31st September 2023 on patients with end - stage ankle arthritis admitted to the dept of Orthopaedics, Mahadevappa Rampure Medical College, Kalaburagi. The purpose of this study was to evaluate the union rate and complication rate in patients with end - stage ankle arthritis of different etiology. Inclusion criteria are Post - traumatic arthritis, osteoarthritis - Rheumatoid or autoimmune, Gout, Post - infection arthritis, Charcot neuroarthropathy, Osteonecrosis of the talus, and Instability of the ankle from neuromuscular disorders. Exclusion criteria are Severe arterial vascular disease, Skin infection at the approach site, Peripheral neuropathy, and Non - compliance.

Procedure: Comprehensive imaging, including X - rays and possibly CT scans, to assess ankle joint pathology[6]. Measurement of the medullary canal diameter for appropriate nail selection. Patient placed in a supine position on a fracture table with a bump under the ipsilateral hip[7]. Appropriate padding and positioning to allow fluoroscopic imaging throughout the procedure. Determine the position by holding the patella straight up and placing the foot in neutral dorsiflexion - plantarflexion, 5 degrees of valgus at the heel, and slight posterior displacement of the calcaneus in relation to the tibia. Place provisional Kirschner wires and evaluate the foot position. For intramedullary nailing, determine the starting point on lateral fluoroscopy where the entry point on the calcaneus will allow the nail to pass into the center of the tibial diaphysis. In the coronal plane, the starting point must allow for the nail to pass into the diaphysis, which may be more medial on the calcaneus with a straight nail compared to more central in the calcaneus with a nail that has a valgus bend distally. Take care not to enter the calcaneus through the

sustentaculum tali because the calcaneus may fracture and drift into valgus. In the sagittal plane, draw a line from the second toe to the centre of the heel; in the coronal plane, draw a line at the junction of the anterior and middle thirds of the heel pad. The intersection of these lines approximately indicates the entry portal for the nail; however, this should be confirmed on fluoroscopy. An incision is made in the heel, and a Kelly clamp is used to dissect down to the calcaneus. The guide pin is inserted into the center of the tibial medullary canal using fluoroscopy, avoiding a too posterior aim to prevent foot equinus. An entry reamer through a soft - tissue sleeve is used to enter the calcaneus and ream up to the tibia. Some implants, particularly those with a valgus bend, may involve removing the initial guide pin and inserting a ball - tip guidewire for sequential reaming based on the chosen nail size specifications.

Generally, reaming is done 0.5 to 1.0 mm larger than the selected nail size, considering larger diameter nails for increased resistance to breakage. However, caution is advised to avoid tibia fracture during reaming or nail insertion with larger sizes. The nail is seated just inside the cortex of the calcaneus, and as compression is applied, it moves just outside the calcaneal cortex. Interlocking screws are then placed in the calcaneus, talus, and tibia using outriggers or the perfect - circle technique based on the specific implant.

Follow - up involves radiographic evaluation, assessing fusion status through X - rays and, if necessary, CT scans. Monitoring for signs of nonunion or hardware complications is crucial in the clinical evaluation, which includes pain assessment using a visual analog scale (VAS) and American Orthopaedic Foot and Ankle Society (AOFAS)
ankle - hindfoot score,

The patients were requested to fill the questionnaires of the American Orthopedic Foot & Ankle Society (AOFAS) and to a Visual Analog Scale (VAS) preoperatively. According to the AOFAS criteria, the patient can be classified with a poor (0–69), fair (70–80), good (80–90) or excellent (90–100) function. The VAS criterion classifies pain as absent (0), mild (1–3), moderate (4–6), high intensity (7–9) and intolerable (10). After surgery and after six months of evolution, the same patients answered again to the questionnaires (AOFAS and VAS).

3. Discussion

Managing individuals with arthritis, pain, and deformities in the ankle and subtalar joint poses ongoing challenges. The objectives of tibiotalocalcaneal fusion surgery are to alleviate pain and establish a stable, plantigrade foot for walking. The retrograde intramedullary nail stands as a viable choice among fixation devices and remains a suitable treatment option for achieving successful fusion.

Kile et al.8 conducted a retrospective analysis of patients undergoing tibiotalocalcaneal (TTC) fusion with an intramedullary nail as a salvage procedure for various disease processes, achieving a notable union rate of 93%. All patients in the study underwent a posterior approach with iliac crest autograft, and smoking history was not mentioned. Pelton et al.9 also reported an 88% union rate in their series of TTC nail fusions, with no reference to smoking history.

In a more recent study, Ahmad et al.1[0] utilized 7.3 mm cannulated screws with a proximal humeral locking plate for TTC arthrodesis, achieving a union rate of 94%. However, smoking history and other comorbidities were not addressed in their report.

It is worth noting that smoking has been identified as a significant factor impacting the union rate in hindfoot fusions. Ishikawa et al.[11] studied 160 patients undergoing hindfoot arthrodesis and found that smokers had a nonunion rate more than two and a half times higher than non - smokers. Perlman et al.[12] reported a 28% nonunion rate in high - risk ankle fusions, with comorbidities including a history of open fractures, smoking, and alcohol abuse.

Colman et al.[13] presented the outcomes of their series focusing on isolated ankle fusions. In this study, the American Orthopaedic Foot & Ankle Society (AOFAS) score showed significant improvement, increasing from 38 points to 74 points in a high - risk patient population and from 34 points to 69 points in a low - risk patient population. The fusion rate achieved was 93% in the high - risk group and 97% in the low - risk group.

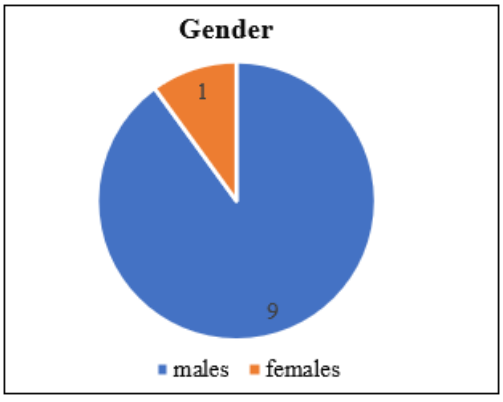
Johnson et al.[14] shared their findings on isolated subtalar fusions combined with a flexor digitorum longus transfer for treating posterior tibial tendon dysfunction. In this research, AOFAS scores demonstrated notable enhancement, rising from 40 points to 82 points.

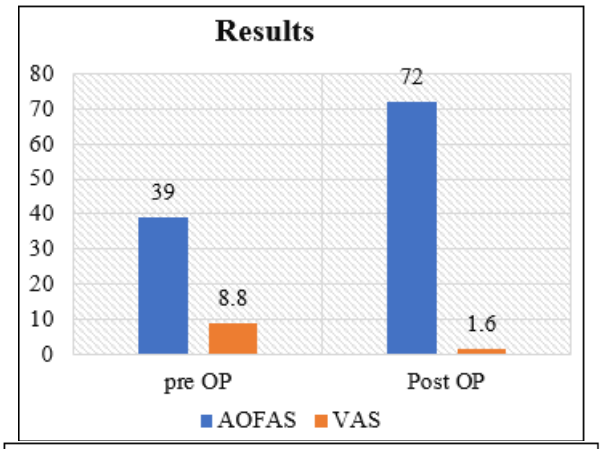
4. Results

10 Patients underwent retrograde intramedullary nailing with TTC, 2 had excellent outcome, 4 had good outcome, 4 satisfactory with 1 superficial infection managed conservatively with antibiotics.

The average AOFAS ankle - hindfoot score improved from 39 points preoperatively to 72 points postoperatively (range 51 to 91). The pain score decreased from 8.8 points preoperatively (range 7 to 10) to 1.6 points postoperatively (range 0 - 7).

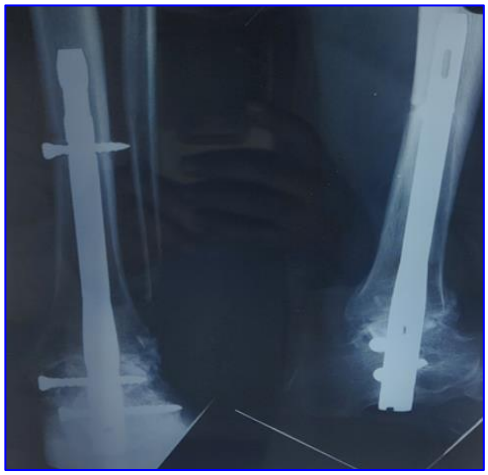
A significant reduction in pain and increase in activity was seen in patients treated by arthrodesis with TTC nail at 6 months follow up.





Case 1
A neglected case (3 months) of right medial malleolar fracture with ankle subluxation in a 42yr old male treated with TTC nail.

Case 2
A case of primarily treated left ankle dislocation with talus fracture came with severe ankle pain and unable to walk 6 month post - operatively. Diagnosed as left ankle arthritis and treated with TTC nail.



Case 3

A neglected case of right trimalleolar fracture with ankle subluxation in a 68 yr male resulting in right ankle arthritis treated with TTC nail.

5. Conclusion

Retrograde intramedullary nailing in ankle arthrodesis stands out as a valuable surgical technique for managing end - stage ankle arthritis. Its stability, minimally invasive nature, bone - preserving features, and positive clinical outcomes make it a significant option in the armamentarium of orthopedic procedures aimed at improving patient mobility and relieving pain in this challenging clinical scenario.

While pain relief may not be absolute and AOFAS scores show improvement, they may not reach levels comparable to isolated ankle or subtalar fusions We beleive that tibiotalocalcaneal (TTC) arthrodesis serves as a salvage procedure, and the outcomes presented in this study reinforce its continued relevance and utilization.

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