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Original Research Article

ANALYSIS OF THE FUNCTIONAL OUTCOME OF SURGICAL MANAGEMENT OF DEGENERATIVE ARTHRITIS OF ANKLE JOINT MANAGED BY ANKLE ARTHRODESIS USING HIND FOOT NAILING

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ABSTRACT

Background: Degenerative ankle disease caused by trauma, osteoarthritis, or systemic conditions causes pain, deformity, and difficulty in walking. Retrograde intramedullary hindfoot nailing is a surgical method used in severe cases to stabilise the joint, correct deformity, and allow early weight bearing. **Objective:** This study evaluated the functional outcomes of ankle arthrodesis using retrograde intramedullary hindfoot nailing, focusing on pain relief, deformity correction, gait restoration, and independent weight-bearing. **Materials and Methods:** A prospective study was conducted on 20 patients with degenerative ankle conditions, all of whom underwent retrograde intramedullary hindfoot nailing and were followed up for six months. Functional outcomes were assessed using the AOFAS score, and pain was measured using the Visual Analogue Scale (VAS). **Result:** The mean age of the patients was 46.4 years, with 13 males (65%) and 7 females (35%). Right-sided involvement was observed in 11 patients (55%) and left-sided involvement in 9 (45%). The diagnoses included post-traumatic arthritis in seven patients (35%), primary osteoarthritis in six (30%), Charcot arthropathy in five (25%), and rheumatoid arthritis with severe deformity in two (10%). The surgery duration ranged from 110 to 150 minutes. At six months, 16 patients (80%) had good AOFAS scores (70–79), 2 patients (10%) had excellent scores (80–89), and 2 patients (10%) had poor scores (<69). Complications were observed in five patients (25%), including three infections (15%) and two broken implants (10%). **Conclusion:** Retrograde intramedullary hindfoot nailing is a safe and effective procedure for treating degenerative ankle disease, providing pain relief, stable foot alignment, and improved walking ability.

INTRODUCTION

The ankle joint is an important weight-bearing joint that allows movement necessary for walking and normal gait.[1] The tibiotalar joint carries most of the body weight and is subjected to both compressive and shear forces. Stability of the ankle is provided by the bony structure of the tibia, fibula, and talus, as well as ligaments connecting the lower leg to the hind foot.[2] Damage to these structures from trauma, disease, or degeneration can lead to pain, deformity, and difficulty in walking.[3]

Trauma is the most common cause of ankle-joint degeneration. Injuries such as ankle fractures, tibial plafond fractures, talus fractures, and cartilage damage can lead to osteoarthritis over time. Persistent instability after injury also contributes to joint degeneration.[4] Less common causes include systemic diseases like rheumatoid arthritis, psoriatic arthritis, gout, or infections, which can destroy cartilage through inflammation or enzymatic activity.[5] Patients with degenerative ankle disease often experience pain, limited movement, deformity, and problems with weight bearing.[6]

Ankle arthrodesis or fusion is the standard treatment for severe ankle arthritis or deformity when non-surgical options fail. Fusion relieves pain and provides a stable, flat-footed (plantigrade) position for ambulation. However, it may increase stress on nearby joints, such as the subtalar joint.[7] Tibiotalocalcaneal arthrodesis (TTCA) using retrograde intramedullary nails is especially useful for severe or complex cases.[8] This technique is often

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chosen when there is significant deformity, poor bone quality, or combined ankle and hindfoot problems, and it can prevent the need for amputation.[9]

Retrograde intramedullary nails offer stable fixation and compression at the fusion site, which helps bone healing and allows for early weight bearing. Curved nail designs improve stability, maintain normal hindfoot alignment, and reduce the risk of nerve or blood vessel injury. These features help achieve a stable foot, correct deformity, relieve pain, and improve walking ability.[10] This study aimed to evaluate the functional outcomes of ankle arthrodesis using hindfoot nailing in patients with degenerative ankle disease. The focus is on achieving a pain-free, stable foot, correcting deformities, promoting wound healing, restoring gait, and enabling independent weight bearing for daily activities.

MATERIALS AND METHODS

This hospital-based prospective study was conducted on patients with degenerative ankle joint conditions at the Department of Orthopaedic Surgery and Traumatology at Government Rajaji Medical College and Hospital, Madurai, over one year, from May 2024 to April 2025. Ethical approval was obtained from the Institutional Ethical Committee, and written informed consent was obtained from all patients before their inclusion in the study.

Inclusion Criteria

The study included patients with post-traumatic arthritis of the ankle, neuroarthropathy (Charcot's joint), rheumatoid arthritis with severe deformity, advanced osteoarthritis, avascular necrosis of the talus, and those requiring revision following failed ankle arthrodesis.

Exclusion Criteria

Patients with osteomyelitis or soft tissue infection, acute purulent infection, established peripheral vascular insufficiency, or chronic non-healing ulcers at the proposed nail entry site were excluded from the study.

Methods

This study included 20 patients selected through randomisation, with the first 20 eligible volunteers. Patients were evaluated preoperatively through clinical examination and imaging, including weight-bearing radiography, CT, or MRI, when needed. The surgical procedure involved joint preparation, nail insertion, and bone grafting, if required. Postoperatively, patients were kept non-weight bearing, with gradual weight bearing initiated between 8 and 12 weeks. Functional outcomes were assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) score, and pain was measured using the Visual Analogue Scale (VAS) at 6 weeks, 3 months, and 6 months postoperatively. Routine follow-up included clinical and radiological assessments to monitor fusion and detect complications. Rehabilitation with physiotherapy supported gait and functional recovery.

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using SPSS v22. Categorical variables, including the side of injury, diagnosis, duration of surgery, functional outcomes, and complications, were expressed as frequencies and percentages.

RESULTS

The mean age was 46.4 years (range, 27–62 years). Most patients were in the 46–55-year age group (7 patients, 35%), followed by 36–45 years (6 patients, 30%), >55 years (4 patients, 20%), and 26–35 years (3 patients, 15%). The study group consisted of 13 males (65%) and 7 females (35%).

In this study, right-sided involvement was more common, observed in 11 patients (55%), whereas the left side was affected in nine patients (45%). Among the underlying conditions, post-traumatic arthritis was the most frequent diagnosis, seen in 7 patients (35%), followed by primary osteoarthritis in 6 (30%). Charcot's arthropathy accounted for five cases (25%), and rheumatoid arthritis with severe deformity was present in two patients (10%). [Table 1]

Table 1: Distribution of side of injury and diagnosis

Variable		N (%)
Side of Injury	Right	11 (55%)
	Left	9 (45%)
Diagnosis	Post-traumatic arthritis	7 (35%)
	Primary osteoarthritis	6 (30%)
	Charcot's arthropathy	5 (25%)
	Rheumatoid arthritis	2 (10%)

The duration of surgery varied from 110 to 150 min; 9 patients (45%) underwent surgery lasting 110 min, while 7 patients (35%) had procedures lasting 130 min. The remaining four patients (20%) required 150 min for completion of the surgery. [Table 2]

Table 2: Distribution of surgery duration

Duration of surgery (mins)	N (%)
110	9 (45%)
130	7 (35%)
150	4 (20%)

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At 6 months' follow-up, the majority of patients showed good functional outcomes according to the AOFAS score, with 16 patients (80%) scoring between 70 and 79. Two patients (10%) achieved excellent outcomes (80–89), whereas two others (10%) had poor outcomes (<69). Regarding complications, most patients 15(75%) experienced no issues. Three patients (15%) developed infections, and two (10%) had broken implants. [Table 3]

Table 3: Functional outcomes and postoperative complications at six months' follow-up

Variable		N (%)
AOFAS at 6 months	80–89 (Excellent)	2 (10%)
	70–79 (Good)	16 (80%)
	<69 (Poor)	2 (10%)
Complications	None	15 (75%)
	Infection	3 (15%)
	Broken implant	2 (10%)

DISCUSSION

This study aimed to assess the functional outcomes of the management of degenerative ankle joints by ankle arthrodesis using hindfoot nailing. The study patients were adults of varying ages, including both men and women. Similarly, Nogod et al. reported that the participants had a mean age of 52.2 years, with 36.4% aged between 40 and 50 years, and included 43 females and 45 males.[11] Van den Heuvel et al. reported that the mean age of participants in this retrospective study was 50 years, with ages ranging from 22 to 75 years.[12] Participants across studies were adults of diverse ages and genders, reflecting a broad population undergoing ankle arthrodesis.

In our study, injuries affected both sides, with a higher incidence on the right side. Similarly, Morelli et al. found in a prospective case series comparing arthroscopic and open ankle arthrodesis that right-sided involvement was observed in 55% of patients, while left-sided involvement was observed in 45%.[13] Scott and Hyer reported in a retrospective review of 20 patients that right-sided ankle arthrodesis was observed in 55% of cases, while left-sided involvement accounted for 45%.[14] Right-sided ankle involvement was slightly more common, consistent with previous studies comparing surgical outcomes.

Our study found a range of joint disorders, with post-traumatic arthritis being the most common, followed by primary osteoarthritis, Charcot's arthropathy, and rheumatoid arthritis with severe deformities. Similarly, Duan et al. found in a retrospective study of 68 patients undergoing arthroscopic ankle arthrodesis that post-traumatic arthritis was the most common diagnosis (51.5%), followed by primary osteoarthritis (35.3%) and rheumatoid arthritis (13.2%).[15] Mahamid et al. found in a large study that primary osteoarthritis was the leading cause of ankle arthrodesis, representing 55.4% of cases.[16] Post-traumatic and primary osteoarthritis are the most frequent indications for ankle arthrodesis, consistent with previous research.

In our study, the duration of surgery varied, with most procedures completed in approximately 110 min. Similarly, Chen et al. found in a study of patients undergoing simultaneous total ankle replacement and contralateral ankle arthrodesis that the average operative time for total ankle replacement was 110 min, ranging from 90 to 130 min.[17] In contrast, Townshend et al. found in a multicentre study comparing arthroscopic and open ankle arthrodesis reported an average operative time of 81.4 ± 7.9 min for arthroscopic procedures.18 Surgery duration was moderate and generally consistent with other studies, varying slightly with technique and procedure type.

Our study shows that at six months, functional outcomes were generally favourable, with the majority of patients achieving good or excellent results. Similarly, Morelli et al. found in a multicentre study comparing arthroscopic and open ankle arthrodesis that patients in the arthroscopic group had a higher average AOFAS score at six months (78.5) than those in the open group (62.2), indicating better functional outcomes.13 Veldman et al. reported in a study of 59 adult patients with open ankle fractures that the average AOFAS score was 68.2, with scores ranging from 38 to 95; nine patients had poor outcomes (<60), six had fair outcomes (60–79), two had good outcomes (80–89), and four had excellent outcomes (90–100).[19] Most patients achieved functional improvement with pain relief and mobility, and radiological fusion at six months, consistent with reported fusion rates exceeding 85–95% in the literature.

In our study, most patients had no complications postoperatively, although a few experienced infections or implant failure. Similarly, Pottanat et al. found that following ankle arthrodesis, 14.9% of patients experienced medical complications within 90 days, 6.6% developed infections, and 4.6% required revision surgery within one year.[20] Ross et al. reported that following ankle arthrodesis, most patients did not experience complications, although 19.3% had joint-related complications within 90 days, including peri-prosthetic fractures and hardware removal, and 4.3% developed infections.[21] Complications were few, mainly infections and implant issues. Compared with plates, external fixation, or ankle replacement, hindfoot nailing offers stable fixation, deformity correction, less soft-tissue disruption, and earlier mobilisation, contributing to favourable outcomes.

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The small sample size and short follow-up limit the strength of the conclusions, particularly regarding long-term outcomes and fusion durability. The absence of a control group restricts comparison with other fixation methods, and variations in patient health and rehabilitation may have influenced recovery. Reliance on plain radiographs for fusion assessment may also have reduced accuracy compared with advanced imaging. However, hindfoot nailing remains a reliable technique for ankle arthrodesis, providing high fusion rates, functional improvement, and low complication rates, especially in complex cases such as severe deformity, poor bone quality, or Charcot arthropathy. Larger, long-term comparative studies are required to validate these findings.

Limitations

The study included a small number of patients and had a short follow-up period, which may limit the long-term conclusions. There was no control group for comparison, and differences in patient health and rehabilitation could have affected the outcomes. Imaging was mostly limited to X-rays, which may reduce the accuracy of fusion assessment.

CONCLUSION

Our study highlights that ankle arthrodesis using retrograde intramedullary hindfoot nailing provided good functional outcomes in patients with degenerative ankle conditions. Most patients achieved a stable, pain-free foot with improved walking ability and satisfactory AOFAS scores at six months. Complications were minimal and manageable, with infections and implant issues occurring in a few cases. The procedure effectively corrected deformities and allowed early weight bearing, supporting its use in complex or severe ankle and hindfoot disorders. Overall, hindfoot nailing is a reliable option for restoring function and improving the quality of life in patients who require ankle fusion.

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