International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 7, July 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.7.2024.94

ORIGINAL RESEARCH

Functional outcome of subtalar arthritis with tibiotalar arthritis treated with tibiotalocalcaneal arthrodesis using retrograde intramedullary nailing: A case series

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Received: 16May, 2024 Accepted: 17June, 2024

ABSTRACT

Introduction: Ankle arthrodesis has emerged as a definitive treatment for various complications affecting the distal third of the leg. The operation was first described by Edward Albert in 1879 and refined by John Charnley until internal fixation became a viable option. It has been shown to be an effective treatment option for pain relief and correction of hindfoot malalignment. The tibiotalocalcaneal arthrodesis(TTCA) is used as a salvage procedure for the ankle joint in patients with changes in the subtalar joint. Principles of treatment by fusion are removal of cartilage till bleeding of subchondral bone, keeping the joint surfaces congruous, proper positioning of the foot and ankle and stable fixation.**Objective:**To overcome functional outcome in tibiotalocalcaneal arthrodesis using retrograding intramedullary nailing.**Materials and Methods:**A series of 10 patients having subtalar arthritis with degenerative changes in the ankle joint (tibiotalar arthritis) were selected. For this study, 10 patients (06 males and 04 females) were included with median age group of 55 years (45-70 years). All the patient were treated with tibiotalocalcaneal arthrodesis using retrograde intramedullary nailing at our institute **(Navodaya Medical CollegeHospital and Research Center)**. All of them were followed up for the period of 1 year. The main outcome measurements included the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot scale, radiologic assessment and clinical examination.**Results:**Bony union was achieved in 90% of subjects, the mean time to union being 6.4months (range, 4.4 to 9.2 months). "Structural bone graft was used in all patients". Postoperative radiologic results showed a good hindfoot alignment in all patients. The complications were, two cases of delayed wound healing and one case of non-union which underwent revision surgery. The mean post operative AOFAS ankle-hindfoot scores were 72.9 (range, 45 to 88) points, respectively.**Conclusion:**It was concluded that TTCA using retrograde intramedullary nailing is a good mode of fixation with good functional outcome where both the tibiotalar and subtalar joints needs to be fused.

Key words: Subtalar arthritis, TTCA, retrograde intramedullary nailing, union

INTRODUCTION

Tibiotalocalcaneal arthrodesis (TTCA) is a salvage procedure for patients with severe arthritis and pain of the tibiotalar and subtalar joints. On one hand, a severely deformed, arthritic hindfoot and ankle can improve significantly with this type of arthrodesis. It can dramatically reduce pain, restore a more normal balance of gait, and markedly improve someone's life. On the other hand, however intraoperative or postoperative complicationscan lead to a worsening of all of the above and extend to loss of both life and limb. The procedure offers an alternative to amputation and can be used to treat degeneration caused by osteoarthritis, rheumatoid arthritis,

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posttraumatic arthritis, Charcot arthropathy, talar osteonecrosis, osteomyelitis, and failed total ankle replacement, subtalar arthritis[1-4].

It has been shown to be an effective treatment option for pain relief and correction of hindfoot malalignment in such subjects[2,5].

The main goal of TTCA is to provide a pain-free, functionally stable, and realigned fused ankle and hindfoot for patients with severe subtalar arthritis with degenerative changes of ankle joint. Many alternative fixations such as crossed cancellous screws[6], angle bladed plates[7], external fixator frames[8], and intramedullary nails combined with bone graft have been reported for performing TTCA[1,2,4,9,10]. External fixations, compression screws and plates are usually associated with longer periods of non- or partial weight-bearing postoperatively and low bony fusion rates[7, 11]. Intramedullary nail have become more popular than other forms of fixations because of the stability and compression they achieve, they are capable of generating compression and thereby increasing fusion rates, especially in patients with poor bone quality[11-13]. Despite the clinical efficacy and mechanical advantage of intramedullary nails, complications are not uncommon, including wound healing issues, infections, plantar nerve damage, and tibial stress fracture proximal to the nail.

Intramedullary nails can lose compression with bone resorption, which often occurs over time, and locking screws in the calcaneus and talus often have poor bone purchase[14,15].

Both these factors can contribute to the development of nonunion.

Compared with other fixation methods, intramedullary nails have been shown to have higher bending stiffness, increased rotational stability, and dynamic compression capability[16].

Berson *et al.*[14] demonstrated that more compression is achieved and maintained when an ankle arthrodesis nail-mounted compression device is used compared with external fixation. In a biomechanical study, Mückley *et al.* [17] showed that intramedullary nails with compression produced good contact surfaces and high primary stiffness and were notably superior in these effects compared with uncompressed nails or screw constructs.

Tibiotalocalcaneal arthrodesis (TTCA) with intramedullary fixation is not a new idea.

Lexer E[18] reported in 1906 the use of boiled cadaveric bone as an intramedullary device for tibiotalocalcaneal arthrodesis. The first case of tibiotalocalcaneal arthrodesis with an intramedullary (IM) nail was reported by Adams JC[19] in 1948. Before the advent of retrograde intramedullary nailing, ankle and subtalar joints were fused using internal or external fixation. However, retrograde tibial nail has certain advantages.

MATERIALS AND METHODS

During the time frame from April 2022 to April 2024, the patient coming to the Department of Orthopedics at NMCH &RC were selected for the study.

INCLUSION CRITERIA

1. Patients between age group of 45-70 years.
2. Patients with subtalar arthritis and tibiotalar arthritis.

EXCLUSION CRITERIA

1. Infection.
2. Vascular impairment of the limb.

All the cases were clinically assessed, the patients had difficulty in walking on uneven surface and stiffness when tested for side-to-side motion.

Painfull ankle range of motion.

IMAGING

- X ray of ankle-Anteroposterior view, Lateral view, and Mortise view.

X ray revealed loss of subtalar and tibiotalar joint space that is best seen on lateral view of the foot taken with weight bearing.

Figure 1: Showing subtalar and tibiotalar arthritis

- MRI of ankle revealed subtalar arthritis with tibiotalar arthritis.

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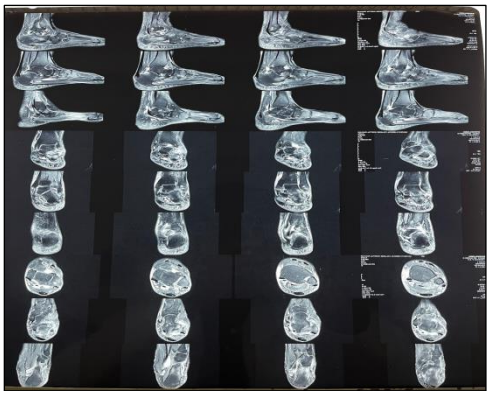

Figure 2: Showing MRI of subtalar and tibiotalar arthritis

A total of 10 patient were enrolled, they were asked to come for follow ups at regular intervals. Finally, 10 patients were selected for TTCA using retrograde intramedullary nailing.

PROCEDURE

Pre operatively the medullary canal size was measured and looked for any tibial malunion.

POSITION-SUPINE

Under spinal anaesthesia, patient was put in supine position and the tourniquet inflated over operative limb and was painted and drapped. A curved incision was made over the lateral aspect of ankle joint, from 5 cm above the lateral malleoli and extending to the base of 5th metatarsal. Subcutaneous tissue dissected and the distal fibula was exposed and distal fibula osteotomy done. Ankle joint was prepared for arthrodesis with clearing of the articular surface of tibiotalar and subtalar joint. After the clearing of articular surface, the alignment of tibiotalar joint and subtalar joint (8-10 degree of hindfoot valgus and foot in neutral position) confirmed under IITV and found satisfactory.

The entry point was made at the point of intersection between the line joining both medial and lateral malleoli and the perpendicular line from the 2nd toe. Guide wire was inserted under IITV guidance and confirmed in both anteroposterior and lateral views, then reaming was done. The retrograde intramedullary nail was passed and the nail was secured withinterlocking screws. Distal fibula bone was used as the graft material after thorough wound wash. A drain was paced and wound was closed layer by layer. Sterile dressing was done and below knee slab was applied.

Post operatively below knee slab was placed for 2-3 weeks and patient was advised for non-weight bearing for 3-4 week and later partial weight bearing for further 3-4 week and later full weight bearing.

Figure 3: Showing position of patient

Figure 4: Showing skin incision marking

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Figure 5: Showing clearing of articular cartilage

Figure 6: Showing entry point for guide wire

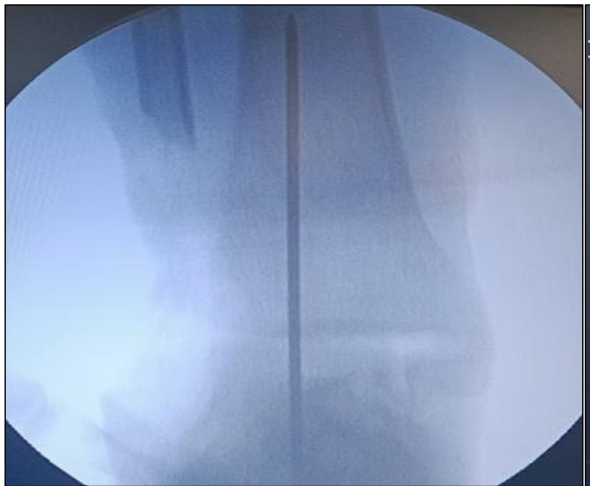

Figure 7: Showing intra operative image of guide wire

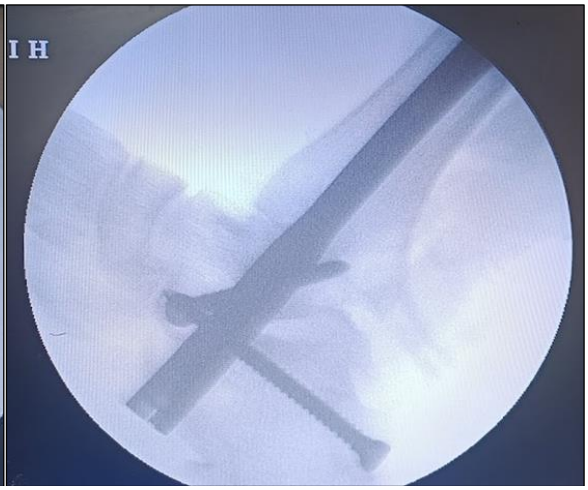

Figure 8: Showing intra operative nail fixation

POST OP FOLLOW UP

Below knee slab was applied for 2-3 weeks, sutures were removed after 2 weeks. Partial weight bearing was allowed after 4 weeks of surgery, whereas full weight bearing was allowed after 8 weeks of surgery. Patients were followed up for a period of 1 year. At the end final clinical and radiological union was seen.

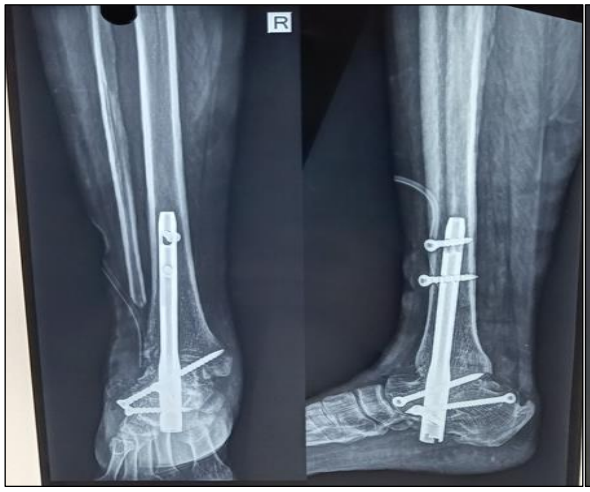

Figure 9: Showing immediate post op x ray

Figure 10: Showing 1 month post op follow up x ray

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Figure 11: Showing 3 month post op x ray

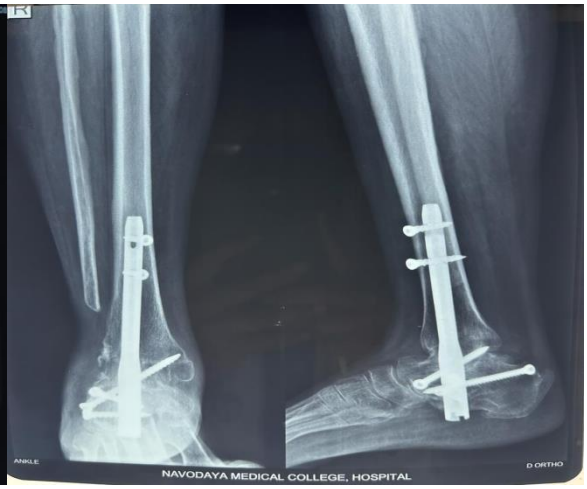

Figure 12: Showing 6 month post op x ray

OBSERVATION AND RESULTS

The present study consists of 10 cases of subtalar and tibiotalar arthritis treated with TTCA using retrograde intramedullary nailing.

SEX DISTRIBUTION

Sex	Frequency	Percent
Male	06	60
Female	04	40
Total	10	100

SIDE OF INJURY

Side	Frequency	Percent
Right	07	70
Left	03	30
Total	10	100

RESULTS

Successful TTC arthrodesis was achieved in 09/10 patients. In patients who achieved bony union, the average time to union was 6.4 months. Two patient had a delayed union, whereasone patient had a nonunion. The mean operation time was 135 minutes (range, 70 to 220 minutes).

UNION

Radiographic and clinical union was achieved in 90% (09/10) of patients.

FUNCTIONAL SCORE

Due to lack of sagittal motion (flexion and extension) and coronal motion (inversion and eversion) of the hindfoot, the highest American Orthopaedic Foot and Ankle Society.

(AOFAS) ankle-hindfoot score after TTCA was 88. At the most recent follow-up, the mean postoperative AOFAS ankle-hindfoot score was 72.9 (range, 45-88) points.

Two patients required a walking aid (elbow crutch or cane). Rest all were able to walk without any aid. Eight patients had slight or severe difficulty on uneven terrain, stairs, inclines and ladders. Six patients had obvious or marked gait abnormality.

COMPLICATIONS

70%(07/10) of the patients expressed satisfaction with the therapy and outcome at the most recent follow-up. Three patient who wasn't happy, two patients had a superficial wound that was healing slowly without indications of infection and one patient had non - union for which he underwent revision surgery. Furthermore, there was no sign of cortical stress reactions at the time of the most recent follow-up, including total fracture surrounding the proximal locking screws and the proximal tip of the nail.

DISCUSSION

The aim of this study was to evaluate the effects of the TTCA using a retrograde intramedullary nail. In this series, 90% showed bony fusion rate with a 30% overall complications rate was achieved in 10 patients who had undergone TTCA using a retrograde intramedullary nail.

According to reports, the total complication rate of utilizing a nail in TTCA varies from 4%[2,13] to 59%[20].The complications include delayed wound, superficial and deep infection, neurovascular damage, pseudoarthrosis, misalignment, stress responses, fracture, and chronic pain.

On one hand, this enables an ideal entry point in the heel lateral to the mid-line, thus preventing damage to

DOI: 10.69605/ijlbpr_13.7.2024.94

the branches of the lateral plantar nerve and vascular bundle[21]. On the other side, it helps to achieve a satisfactory position in the tibial medullary canal and a good hindfoot alignment, which may be crucial in preventing abnormal loading and stress in the proximal region of the nail. A point to emphasize is that the relatively short length of the nail, the proximal tip usually of which never exceeds the tibia isthmus, also contributes to preventing such stress fractures[12]. Infection is a common problem with intramedullarynails in TTCA[10,22,23].

In the current study, two patients had superficial delayed wound healing without infection. However, published reports indicate that intramedullary nails have risks of infection, especially in patients with a history of previous infection[2,21,24].

As to the fusion rate in patients treated with TTCA using a nail, Mader *et al.* documented achieving a 100% union rate after TTCA using a retrograde nail in 10 patients with failed ankle arthrodesis[25]. The fusion rate depends on many factors, including the underlying condition of the patient, debridement of the joint facets and the biomechanical characters of implants[7,8,10,20,24].

Firstly, the union rate is dependent on the following patient factors: whether the patient is a habitual smoker, the presence of avascular bone at the arthrodesis site and the patient's compliance with the postoperative non-weight-bearing protocol[10].

Secondly, other factors such as whether the surgeon performs debridement correctly, the degree of compression provided by the fixation and bone graft between the arthrodesis joint, also play important roles[7].

The main techniques for preparing the articular surfaces in TTCA are described in published reports; they include thorough resection of the articular cartilage of both joints and preservation of the anatomical contours of the joints to minimize postoperative leg length discrepancy[10,21]. However, Boer *et al.* recommended TTCA with a nail without debridement of the subtalar joint and a choice between open or percutaneous debridement of the ankle; they achieved a 100%fusion rate of the ankle joint and 96% fusion rate of the subtalar joint using this procedure[2].

In the current study, we performed thorough debridement and achieved a 90% fusion rate of both ankle and subtalar joints.

Thirdly, intramedullary nails provide greater stability than crossed screws and results of a biomechanical study suggested a more favorable fusion rate with the former[26].

One disadvantage of TTCA is the rigidity of the hindfoot, which may predispose to secondary degenerative arthritis in the adjacent talonavicular, naviculocuneiform and tarsometatarsal joints. These complications had not yet occurred by the latest follow-up in our study. We had too few cases to establish a direct relationship between functional outcomes and radiographic findings.

CONCLUSION

Simultaneous fusion of ankle and subtalar joints in one stage is a good salvage procedure. For better outcome, a good joint preparation, compression of fusion sites, proper positioning of the foot and stable fixation are key principles. Modern design of retrograde intramedullary nail appears to be an ideal implant, which is a load-sharing device and allows better positioning of the foot and compression of fusion sites. The results of the present study suggest that TTCA using a retrograde intramedullary nail is an acceptable technique for achieving solid fusion with minimal complications.

However, long-term follow-up is necessary to provide definitive information about topics such as adjacent degenerative arthritis.

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