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Original Research Article

Comparative analysis of tension band wiring and cannulated cancellous screws for displaced medial malleolus fractures: a prospective study

Karthik Aiyanna N. C., Deekshith Shetty K., Manjunath Swamy*, Kiran J. Kailath

Department of Orthopaedics, A. J. Institute of Medical Sciences, Mangalore, Karnataka, India

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***Correspondence:**
Dr. Manjunath Swamy,
E-mail: manju.honeydew@gmail.com

ABSTRACT

Background: The displaced medial malleolus fractures require surgical intervention, and the management includes tension band wiring (TBW) and cannulated cancellous screws (CCS).
Methods: This prospective randomized study was conducted from December 2019 to December 2022. Sixty patients with closed displaced medial malleolus fractures were randomized into two groups: group A (TBW) and group B (CCS). Patients were evaluated based on radiological fracture union and functional outcomes assessed using the modified Olerud and Molander ankle score (OMAS). Follow-ups were conducted for two years to assess healing, range of motion, complications, and functional outcomes.
Results: Mean age was 41.46 years in group A (TBW) and 39.4 years in group B (CCS). Radiological union was achieved faster in group B (10.4 weeks) compared to group A (11.53 weeks, p=0.003). Functional outcomes showed excellent scores in 16.67% of group A patients and 30% of group B patients. Group B had fewer complications, with only one case of screw loosening compared to a higher rate of hardware prominence (30%) and exertional pain (10%) in group A, necessitating implant removal in 12 patients. No significant differences in range of motion were observed, although group B demonstrated slightly better functional outcomes.
Conclusions: Both TBW and CCS effectively achieve fracture union in displaced medial malleolus fractures. However, CCS fixation demonstrates superior functional outcomes, faster union rates, and fewer complications compared to TBW. Lower risk of hardware-related issues and reduced need for secondary surgeries, CCS is recommended as a preferred method for the surgical management of displaced medial malleolus fractures.

Keywords: Medial malleolus fracture, Tension band wiring, Cannulated cancellous screws, Functional outcomes, Fracture union

INTRODUCTION

Ankle joint fractures account for approximately 9% of all fractures, with their incidence steadily increasing. Among these, 60-70% occur as unimalleolar fractures, 15-20% as bimalleolar fractures and 7-12% as trimalleolar fractures.[1] These fractures can result from low velocity injuries, such as twisting force, or a high velocity trauma, including road traffic accidents. A comprehensive understanding of the complex anatomy of ankle joint is essential for effective management of these fractures. The ankle joint is a hinged synovial joint formed by the articulations of the tibia, fibula, and talus. The medial malleolus, tibial plafond, and lateral malleolus collectively form a recess into which the talar dome projects, creating a highly congruent articular structure. Detailed anatomical knowledge and the Lauge-Hansen classification system, developed in 1950, have provided a rational basis for treating ankle fractures.[2] Medial malleolus fractures that are non-displaced are typically managed with cast immobilization. However, internal fixation may be necessary for patients with high functional demands to facilitate early healing and rehabilitation. Displaced medial malleolus fractures should be surgically treated with internal fixation, as

chronic displacement can cause the talus to tilt into varus.[3] Two commonly employed internal fixation methods for medial malleolus fractures include tension band wiring (TBW) and cannulated cancellous screws (CCS). This study compares the radiological and functional outcomes of these two techniques using the modified Olerud and Molander ankle scoring system.

Objectives

Objectives of the study were: to analyse functional outcomes of medial malleolar fractures operated with tension band wiring and cannulated cancellous screws, to analyse fracture union in these cases, to compare complications between the two techniques, and to assess functional outcomes using the modified ankle scoring system of Olerud and Molander.

METHODS

This prospective randomized study was conducted at A. J. Institute of Medical Sciences, Mangalore, India between December 2019 and December 2022. Institutional ethical committee approval was obtained, adhering to the ethical standards of the responsible committee on human experimentation and the Helsinki Declaration (1975, revised in 2000). After obtaining written informed consent, 60 patients with closed displaced medial malleolus fractures were randomized into two groups. Group A patients were treated with open reduction and internal fixation with tension band wiring (TBW) and group B patients were treated with open reduction and internal fixation with cannulated cancellous screws (CCS). Statistical package for the social sciences (SPSS) version 23 was used to analyse the data. Level of significance: $p<0.05$ was considered significant.

Inclusion criteria

Patients having medial malleolus fracture, of the age group: 20 years to 60 years, and willingness to participate were included.

Exclusion criteria

Patients unfit for surgery or anaesthesia, with history of previous medial malleolus fracture of either ankle, open ankle fractures and pathological fractures, co-morbidities like diabetes mellitus, vertical shear (adduction) fracture of medial malleolus, an immature skeleton**,** and unwillingness to participate in the study were excluded.

Surgical technique

All procedures were performed under spinal anesthesia with the patient in a supine position and a pneumatic tourniquet placed around the patient's proximal thigh. After skin preparation and draping, an anteromedial incision that started around 3 cm proximal to the fracture line, extended distally, and finished roughly 2 cm distal to the tip of the medial malleolus was made. The tibialis posterior tendon and its sheath are less likely to sustain injury with this incision, and the surgeon can clearly examine the articular surfaces, particularly the anteromedial side of the joint, allowing for precise alignment of the fracture. After skin incision, flap was reflected as a whole with the subcutaneous tissue beneath. Cautious handling is required to prevent skin sloughing since there is precarious blood supply to the skin in this area. The great saphenous vein and its associated nerves are protected after dissection. A curette or periosteal elevator is used to remove a thin periosteum fold from the fracture site, which typically lies in between the fracture surfaces, revealing the fracture's minute serrations. The displaced medial malleolus was reduced anatomically using a tiny bone-holding clamp, and while it was held there, it was internally secured using TBW or CCS.

In group A (TBW) patients, the fracture was internally fixed with two 2-mm smooth K wires drilled perpendicular to the fracture line from the tip of medial malleolus and parallel to each other, and their ends bent at 90° angles. This will eventually prevent the figure-of-eight wire from slipping over the exposed tips of the K wires. A stainless steel 18G wire was passed through the previously drilled hole proximal to the fracture and then around the bent ends of the K wires in a figure-of-eight configuration. The wire was then tightened and excessive length trimmed off.

In group B (CCS) patients, after fracture reduction two guide wires were inserted perpendicular to the fracture and parallel to each other. A 3.2 mm cannulated drill bit was used to drill over these guide wires and the length of the hole was measured. Two appropriately 4.0 mm sized CC screws were then inserted over these guide wires which were removed after tightening the screws.

Intraoperative radiographs were taken to confirm the position of k wires and CC screws. Following which normal saline wash was given and wound was closed in layers using triclosan coated polyglactin 910 Trusynth plus neo suture (Healthium Medtech, India). Care was taken to avoid tight closure of skin to prevent necrosis. After sterile dressing, below-knee posterior slab was provided with thick cotton padding. Limb was kept elevated for 2 days postoperatively to prevent swelling. On postoperative day 2, wound was inspected and sterile dressing was done.

Follow up

After 2 weeks of procedure, posterior slab was changed into a removable splint and the patient was encouraged to perform range of motion exercises. Non weight bearing was continued for 6 weeks after which partial weight bearing was advised as tolerated. Full weight bearing was started after the fracture union. Patients were followed up at two-week intervals for the first six weeks, monthly until six months, bi-monthly until one year, and quarterly thereafter until two years.

During follow up, all patients were evaluated with clinical examination, radiological examination including ankle joint congruency, fracture healing, fracture reduction and presence of osteoarthritis and functional outcomes were assessed using the modified Olerud and Molander ankle score (OMAS), which ranges from 0 (totally impaired) to 100 (completely unimpaired) based on nine different items: pain, stiffness, swelling, stair climbing, running, jumping, squatting, supports and activities of daily living.[4] The scores were assessed with the use of questionnaires and clinical objective criteria. Following which, the results were tabulated as excellent (score >91), good (score 81-90), fair (score 71-80) and poor (score <71).

RESULTS

A total of 60 patients (30 in each group) were enrolled. There was no significant difference in the mean age of group A (41.46±8.08) and group B (39.4±9.74) (Figure 1). Similarly, there was no significant difference between the two groups in gender and mode of injury.

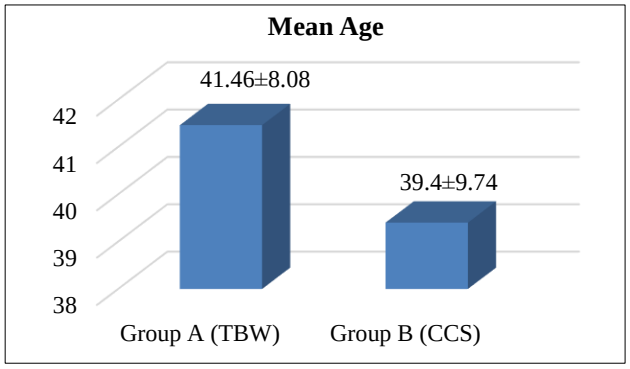

Figure 1: Mean age between the groups.

The average time taken for radiological union was 11.53±1.6 weeks in group A (TBW) and 10.4±1.3 weeks in group B (CCS) (Figure 2). Statistical analysis using unpaired t test showed significant difference (p value=0.003) between the two groups. None of the patients in both the groups had delayed union, malunion or non-union.

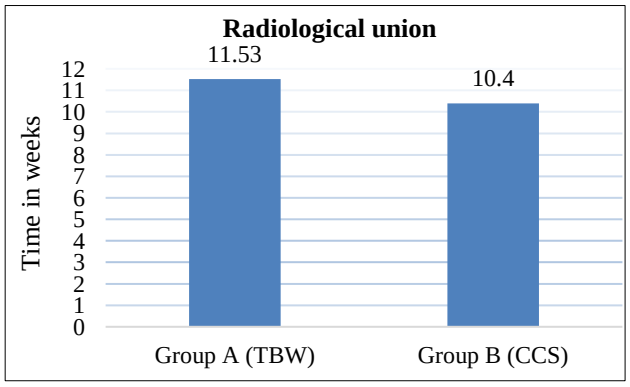

Figure 2: Average time taken for radiological union.

There were no significant differences between the two groups in the range of motion of ankle joint. The mean dorsiflexion at 6 weeks in group A (TBW) was 20.75º and group B (CCS) was 19. 96º. Similarly, the mean plantar flexion in group A (TBW) was 33.76º and in group B (CCS) was 33.06º.

In group A (TBW), 2 patients developed delayed hardware infection whereas in group B (CCS), 1 patient had a screw loosening which required revision surgery. The most common complication in group A (TBW) patients was hardware prominence reported by 9 out of 30 patients (30%). No patients in group B (CCS) reported it.

According to modified ankle scoring system of Olerud and Molander, 5 patients (16.66%) in group A (TBW) and 9 patients (30%) in group B (CCS) had excellent score. 19 patients (63.33%) in group A (TBW) and 18 patients (60%) in group B (CCS) had scored good. 4 (13.33%) patients in group A (TBW) and 2 patients (6.66%) in group B (CCS) had scored fair and 2 patients (6.66%) in group A (TBW) and 1 patient (3.33%) in group B (CCS) had scored poor (Figure 3).

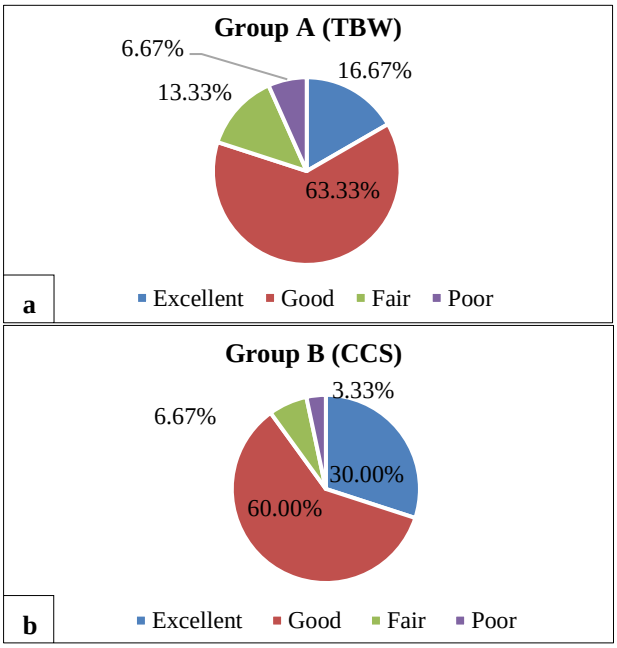

Figure 3 (a and b): Comparison of Olerud and Molander modified ankle scoring between both the groups.

During a two-year period following primary surgery, 12 patients from group A (TBW) and 1 patient from group B (CCS) underwent implant removal. Among the 12 patients in group A (TBW), 9 had their implants removed due to painful medial hardware, while 3 required removal due to pain experienced after exertional activities. The sole patient from group B (CCS) opted for implant removal because of concerns regarding long-term retention of metallic hardware in the body.

DISCUSSION

Ankle fractures are among the most frequent major lower extremity fractures, with medial malleolus fracture associated with most of them. These fractures may result from indirect shearing and tensile stresses via the talus or direct forces from high-velocity injuries has been achieved when medial malleolar fractures are treated using AO techniques and principles.[5] Even though there are numerous published studies on the various methods of surgical treatment of medial malleolar fractures, the lack of uniform evaluation standards makes comparing findings across various studies challenging.

In this study, we assessed and compared the outcomes of open reduction and internal fixation for medial malleolar fractures using TBW and 4 mm CCS. The mean patient age in this study was 40.5 years, comparable to observations by Roberts et al (40 years) and Xu et al (40.5 years).[6,7]

According to the modified Olerud and Molander ankle scoring system, group A (TBW) showed excellent outcomes in 16.67% of cases and good outcomes in 63.33%, totalling 80% of the study group. In group B (CCS), 30% of patients had excellent outcomes and 60% had good outcomes, totalling 90%. These results align with similar studies showing outcomes in the 80–90% range. While some studies report better outcomes with TBW, this study found superior outcomes with CCS.[8,9] Better functional outcomes in group B (CCS) could be attributed to fewer hardware-related complications, enabling earlier activity resumption and reduced pain compared to group A (TBW).

Radiological union was achieved at an average of 11.53 weeks in group A (TBW) and 10.4 weeks in group B (CCS). These findings align with Ebrahim et al, who also reported earlier union rates with CCS compared to TBW in oblique medial malleolar fractures.[10] Early union in group B (CCS) facilitated earlier weight-bearing and quicker returns to work, a critical factor for patients in the working-age group. Both groups showed no complications related to bony union, such as malunion or non-union, likely due to proper surgical techniques like anatomical reduction and soft tissue handling. Although some authors have reported loss of reduction, loosening and migration of K-wires in TBW techniques, such issues were not observed in this study.[11]

The range of motion between the two groups showed no significant statistical difference. However, patients in group B (CCS) exhibited marginally better range of motion, likely due to lesser soft tissue dissection compared to group A (TBW). Similar results were observed in a study by Alam et al, where patients treated with malleolar screws demonstrated better range of motion.[12]

Biomechanical studies on tibial saw bone models by Johnson et al and Ostrum et al indicate that TBW provides greater resistance to pronation forces than CCS.[13,14] However, clinical follow-up in this study revealed no loss of reduction or union-related issues in either group. Complications unrelated to fracture union included superficial infections, reported in 13.33% of group A (TBW) patients and 6.66% of group B (CCS) patients. These infections resolved with intravenous antibiotics and regular dressing. The most notable complication was hardware prominence in group A (TBW), affecting 30% of patients with symptoms of painful medial hardware at ankle joint. An additional 10% experienced exertional pain, all of whom required implant removal. The need for implant removal exposes patients to the risks of repeat surgery, financial strain, and loss of working life, highlighting the limitations of TBW.

Limitations

Small sample size and lack of long term follow up.

CONCLUSION

Despite a well-understood surgical anatomy, there is no consensus on the gold standard method for fixing medial malleolus fractures. While TBW offers higher biomechanical strength, it is associated with higher complication rates, such as infection and hardware prominence, due to its surface placement. In contrast, CCS fixation minimizes complications, reduces the risk of repeat surgeries, and facilitates earlier return to activity. Instead of prominent metalwork, intramedullary CCS fixation is better tolerated by patients, enabling good healing and fewer complications. Based on our findings, open reduction and internal fixation with two 4.0 mm CCS is a superior alternative to TBW for treating displaced medial malleolus fractures.

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