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Research Article

FUNCTIONAL OUTCOMES FOLLOWING TENSION BAND WIRING VERSUS CANNULATED CANCELLOUS LAG SCREW FIXATION FOR MEDIAL MALLEOLAR FRACTURES: A PROSPECTIVE RANDOMIZED COMPARATIVE STUDY

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ABSTRACT

Background: Medial malleolar fractures are frequently managed by operative fixation to restore ankle stability and function. Tension band wiring (TBW) and cannulated cancellous screw (CCS) fixation are commonly used techniques. This study aimed to compare the functional and radiological outcomes of these two methods.

Methods: A prospective randomized comparative study was conducted involving 40 patients with Herscovici type B and C medial malleolar fractures. Patients were allocated into two groups: Group A (n=20) underwent TBW, while Group B (n=20) underwent CCS fixation. Functional outcome, ankle range of motion, time to radiological union and postoperative complications were evaluated over a six-month follow-up period.

Results: At six months, excellent functional outcomes were observed in 90% of patients in both groups, with no significant intergroup difference (p=0.572). Dorsiflexion and plantarflexion were also comparable. The mean time to radiological union was significantly shorter in the TBW group than in the CCS group (8.20 ± 0.69 weeks versus 11.13 ± 0.68 weeks; p<0.001). Postoperative complications occurred in two patients in each group, with no statistically significant difference (p=0.261).

Conclusion: Both TBW and CCS fixation provided satisfactory functional outcomes, with comparable ankle mobility and postoperative complication rates. TBW was associated with earlier radiological union; however, this did not translate into superior functional recovery at six months.

KEYWORDS: Medial Malleolar Fractures, Tension Band Wiring, Cannulated Cancellous Screws, Functional Outcome, Radiological Union, Ankle Range of Motion.

Introduction

Ankle fractures are common injuries encountered in orthopaedic trauma practice. The ankle is a weight-bearing joint formed by the distal tibia, distal fibula and talus. Its stability depends on the congruity of the articular surfaces, surrounding ligaments and integrity of the malleoli. Restoration of normal anatomy is important to maintain joint stability and function. Kyriacou et al. (2021) emphasised the importance of accurate reduction and appropriate management of associated soft-tissue and ligament injuries in ankle fractures[1].

The medial malleolus forms the medial boundary of the ankle mortise and provides attachment to the deltoid ligament complex, which contributes significantly to ankle stability. Fractures involving this structure may compromise articular congruity and medial support. Their management depends on displacement, fragment size, fracture configuration and overall ankle stability. Carter et al. (2019) highlighted the continuing challenges in selecting appropriate treatment for medial malleolar fractures, particularly when associated with other malleolar injuries[2].

Undisplaced fractures with a stable ankle mortise may be managed conservatively, whereas displaced fractures or those associated with ankle instability often require operative fixation. Herscovici et al. (2007) reported satisfactory outcomes following conservative management in selected patients with isolated medial malleolar fractures[3]. When surgery is indicated, the principal objectives are anatomical reduction, stable fixation, maintenance of reduction during healing and early functional rehabilitation.

Tension band wiring (TBW) and cancellous screw fixation are commonly used techniques for medial malleolar fractures. TBW works by converting tensile forces into compressive forces across the fracture. It generally involves two Kirschner wires and a figure-of-eight cerclage wire and may be useful when the fracture fragment is relatively small. Johnson and Fallat (1997), in a biomechanical study, reported greater resistance to clinical failure with tension band fixation than with cancellous screw fixation[4]. However, hardware prominence, soft-tissue irritation and K-wire migration are potential complications.

Cannulated cancellous lag screw fixation achieves interfragmentary compression through a screw inserted over a guidewire. It is generally suitable when the fragment is sufficiently large to accommodate screw placement and the fracture orientation permits effective compression. Potential limitations include inadequate screw purchase in poor-quality bone, implant prominence and loss of fixation. The choice between these techniques therefore depends on fracture characteristics and the stability required[2,4].

Comparative clinical studies have reported variable findings. Mohammed et al. (2016) reported shorter radiological union time and a higher proportion of excellent or good functional outcomes with TBW compared with screw fixation[5]. Park et al. (2022), in a prospective randomized trial comparing headless compression screws with TBW, found no significant differences in the principal functional and radiological outcomes[6]. Kim et al. (2023), in a systematic review and meta-analysis, also found no significant overall difference between TBW and screw fixation in union time, functional outcomes and several postoperative complications[7]. These findings suggest that neither technique has demonstrated consistent clinical superiority.

Functional recovery is an important measure of treatment success, as radiological union alone does not reflect the patient's ability to resume daily activities. The Olerud–Molander Ankle Score (OMAS), developed by Olerud and Molander (1984), assesses symptoms and functional limitations following ankle fractures, with higher scores indicating better function[8]. McKeown et al. (2021) evaluated its measurement properties in adults with ankle fractures[9].

Despite the established use of both fixation techniques, uncertainty remains regarding their comparative functional and radiological outcomes. This study was undertaken to compare tension band wiring and cannulated cancellous lag screw fixation for medial malleolar fractures, assessing functional outcome, ankle range of motion, radiological union time and postoperative complications over six months.

Materials And Methods

Study Design and Setting

This prospective, randomized comparative study was conducted in the Department of Orthopaedics at Jaipur National University Hospital, Jaipur, Rajasthan, from March 2024 to July 2025. The study included patients presenting with medial malleolar fractures who fulfilled the predefined eligibility criteria. A total of 40 patients were enrolled and allocated into two equal groups of 20 patients each. Group A underwent open reduction and internal fixation using tension band wiring (TBW), whereas Group B underwent fixation using cannulated cancellous lag screws (CCS). Allocation was performed using a computer-generated table of random numbers.

Study Population and Eligibility Criteria

Patients aged 18–70 years, irrespective of sex, with medial malleolar fractures classified as Herscovici type B or type C were included. Both closed fractures and open fractures classified as Gustilo–Anderson grade I and II were considered eligible. Patients with Herscovici type A or type D fractures, pathological fractures, or fractures managed conservatively were excluded. Patients younger than 18 years or older than 70 years, those with associated fractures or injuries involving either the ipsilateral or contralateral upper or lower limb, and those unwilling to provide informed consent were also excluded.

Initial Assessment and Preoperative Preparation

On admission, all patients underwent detailed history taking and clinical examination, with particular attention to the injured ankle. Distal vascularity, active toe movements and sensory status were assessed and documented. Standard anteroposterior, mortise and lateral radiographs of the ankle were obtained to evaluate the fracture pattern, which was classified according to the Herscovici classification. Initial management included closed reduction, where required, followed by immobilisation in a below-knee plaster-of-Paris slab. Antibiotics were administered in patients with open fractures, and limb elevation with active toe movements was advised to minimise swelling. Preoperative preparation included routine laboratory investigations, pre-anaesthetic evaluation, skin preparation with povidone-iodine and administration of prophylactic antibiotics.

Operative Procedure

All patients underwent open reduction and internal fixation under spinal anaesthesia in the supine position using a tourniquet and an anteromedial approach to the medial malleolus. In Group A, the fracture site was exposed and cleared of interposed periosteum and fibrous tissue. Anatomical reduction was achieved and temporarily maintained. Two parallel 2-mm Kirschner wires were inserted through the tip of the medial malleolus, perpendicular to the fracture surface. An 18-gauge stainless-steel cerclage wire was passed through a drill hole in the tibia and secured around the K-wires in a figure-of-eight configuration to achieve compression. The K-wires were cut, bent medially and tapped into the bone. The wound was irrigated, haemostasis secured and closure performed in layers, followed by sterile dressing and application of a below-knee POP slab.

In Group B, the medial malleolus was exposed through the same anteromedial approach. After removal of interposed tissue, the fracture was reduced anatomically and temporarily stabilised using a K-wire placed perpendicular to the fracture line. A guidewire was positioned across the fracture, followed by insertion of a 4-mm cannulated cancellous screw to achieve interfragmentary compression. The guidewire was subsequently removed, haemostasis was secured and the wound was closed in layers. Sterile dressing and a below-knee POP slab were then applied.

Postoperative Care and Rehabilitation

Following surgery, patients were advised to maintain limb elevation and perform active toe movements. Intravenous antibiotics were administered for two postoperative days, followed by oral antibiotics until the fifth postoperative day. Sutures were removed on the fourteenth postoperative day, and the wound was assessed for healing, marginal necrosis, stitch abscess, discharge and superficial or deep infection. A below-knee POP cast was maintained for four weeks following suture removal. Partial weight-bearing and mobilisation of the ankle and foot were initiated after six weeks, depending on radiological findings and fixation stability. Full weight-bearing was generally permitted after three months.

Follow-up and Outcome Assessment

Patients were followed up at 2 weeks, 6 weeks, 3 months and 6 months after surgery. Clinical assessment included pain, swelling, limp, stiffness, stair climbing, ability to perform daily activities, use of walking support, tenderness, deformity and ankle movements. Functional outcome was assessed at six months using the modified Olerud–Molander Ankle Score. The recorded domains included pain, stiffness, swelling, stair climbing, sports, supports and daily activities/work. The score was categorised as excellent (>91), good (81–90), fair (71–80) and poor (<70), according to the scoring.

Ankle range of motion was evaluated by measuring dorsiflexion and plantarflexion. Radiological assessment was performed using serial ankle radiographs to evaluate fracture healing, displacement of fracture fragments, implant breakage or loosening, and varus or valgus deformity. Time to radiological union and postoperative complications were also recorded.

Statistical Analysis

Data were compiled and analysed using appropriate statistical tests. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 40 patients with medial malleolar fractures were included in the study. Twenty patients were treated with tension band wiring (TBW; Group A), while the remaining 20 underwent fixation with cannulated cancellous screws (CCS; Group B). The demographic profile, injury characteristics, functional outcomes, ankle range of motion, radiological union and postoperative complications were compared between the two groups.

The mean age was 41.40 ± 18.16 years in the TBW group and 36.80 ± 14.20 years in the CCS group. Males constituted 82.5% of the study population. The right ankle was involved in 65% of patients, while the left ankle was involved in 35%. There was no statistically significant difference between the groups with respect to sex or side of injury.

Road traffic accidents were the most common mode of injury, accounting for 55% of cases, followed by falls from height (30%). Open fractures accounted for 65% of the study population, including 37.5% Grade I and 27.5% Grade II injuries. According to the Herscovici classification, Type C fractures were slightly more frequent (52.5%) than Type B fractures (47.5%). The distributions of injury mechanism, fracture type and Herscovici classification did not differ significantly between the two groups.

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Table 1: Demographic and baseline characteristics

Characteristic	TBW (n=20)	CCS (n=20)	Total (n=40)	p-value
Age (years), mean ± SD	41.40 ± 18.16	36.80 ± 14.20	39.10 ± 16.30	0.378
Age distribution, n (%)				
≤20 years	2 (10.0)	0 (0.0)	2 (5.0)	0.537
21–30 years	4 (20.0)	9 (45.0)	13 (32.5)	
31–40 years	6 (30.0)	4 (20.0)	10 (25.0)	
41–50 years	1 (5.0)	3 (15.0)	4 (10.0)	
51–60 years	1 (5.0)	2 (10.0)	3 (7.5)	
61–70 years	6 (30.0)	2 (10.0)	8 (20.0)	
Sex, n (%)				
Male	18 (90.0)	15 (75.0)	33 (82.5)	*0.212*
Female	2 (10.0)	5 (25.0)	7 (17.5)	
Side involved, n (%)				
Right	14 (70.0)	12 (60.0)	26 (65.0)	*0.507*
Left	6 (30.0)	8 (40.0)	14 (35.0)	

Table 2: Injury characteristics and fracture classification

Characteristic	TBW (n=20)	CCS (n=20)	Total (n=40)	p-value
Mode of injury, n (%)				
Road traffic accident	9 (45.0)	13 (65.0)	22 (55.0)	*0.520*
Fall from height	7 (35.0)	5 (25.0)	12 (30.0)	
Sports injury	3 (15.0)	2 (10.0)	5 (12.5)	
Cow hit	1 (5.0)	0 (0.0)	1 (2.5)	
Fracture type, n (%)				
Closed	10 (50.0)	4 (20.0)	14 (35.0)	*0.136*
Open, Grade I	6 (30.0)	9 (45.0)	15 (37.5)	
Open, Grade II	4 (20.0)	7 (35.0)	11 (27.5)	
Herscovici classification, n (%)				
Type B	11 (55.0)	8 (40.0)	19 (47.5)	*0.342*
Type C	9 (45.0)	12 (60.0)	21 (52.5)	

Table 3: Functional outcomes at six months

Functional parameter	TBW (n=20), mean ± SD	CCS (n=20), mean ± SD	p-value
Pain	23.50 ± 3.285	23.42 ± 2.912	0.937
Stiffness	9.50 ± 1.539	9.74 ± 1.147	0.591
Swelling	10.00 ± 0.000	10.00 ± 0.000	0.871
Stair climbing	9.75 ± 1.118	9.74 ± 1.147	0.971
Sports activity	9.75 ± 1.118	9.47 ± 1.577	0.530
Support requirement	9.50 ± 1.539	9.47 ± 2.294	0.967
Daily activities/work	24.50 ± 1.539	24.47 ± 1.577	0.958

Overall functional outcome

Functional category	TBW (n=20), n (%)	CCS (n=20), n (%)	Total (n=40), n (%)	P -value
Excellent	18 (90.0)	18 (90.0)	36 (90.0)	*0.572*
Good	0 (0.0)	1 (5.0)	1 (2.5)	
Fair	1 (5.0)	0 (0.0)	1 (2.5)	
Poor	1 (5.0)	1 (5.0)	2 (5.0)	

Table 4: Ankle range of motion and radiological union

Parameter	TBW (n=20), mean ± SD	CCS (n=20), mean ± SD	Test statistic	p-value
Dorsiflexion (degrees)	16.35 ± 3.360	17.35 ± 2.852	t = 1.015	0.317
Plantarflexion (degrees)	38.25 ± 6.742	39.60 ± 6.492	t = 0.645	0.523
Radiological union time (weeks)	8.20 ± 0.6936	11.13 ± 0.6768	t = 13.522	<0.001

Table 5: Postoperative complications

Postoperative outcome	TBW (n=20), n (%)	CCS (n=20), n (%)	Total (n=40), n (%)	p-value
No complications	18 (90.0)	18 (90.0)	36 (90.0)	*0.261*
Stiffness	2 (10.0)	0 (0.0)	2 (5.0)	
Deep infection	0 (0.0)	1 (5.0)	1 (2.5)	
Superficial infection	0 (0.0)	1 (5.0)	1 (2.5)	

At the six-month follow-up, excellent functional outcomes were recorded in 90% of patients in each group. One patient in the TBW group had a fair outcome, while one patient in the CCS group had a good outcome. Poor outcomes were observed in one patient in each group. None of the individual functional domains showed a statistically significant difference between the two fixation methods. The overall distribution of functional categories was also comparable ($p = 0.572$).

The mean dorsiflexion and plantarflexion values were slightly higher in the CCS group; however, these differences were not statistically significant. The mean radiological union time reported is 8.20 ± 0.6936 weeks in the TBW group and 11.13 ± 0.6768 weeks in the CCS group. This difference was reported as statistically significant ($p < 0.001$), with earlier union in the TBW group.

Most patients in both groups had an uncomplicated postoperative course. Complications were recorded in two patients (10%) in each group. Stiffness was observed in two patients in the TBW group, whereas one case of deep infection and one case of superficial infection were reported in the CCS group. The difference in complication distribution was not statistically significant ($p = 0.261$).

Both fixation methods produced favourable functional outcomes at six months, with excellent outcomes recorded in 90% of patients in each group. Ankle range of motion and the overall distribution of postoperative complications were comparable. The Results reported a shorter mean radiological union time following TBW fixation; however, this finding requires confirmation because a different set of union-time values.

Discussion

The present study compared the functional and radiological outcomes of tension band wiring (TBW) and cannulated cancellous screw (CCS) fixation in 40 patients with medial malleolar fractures. Both techniques produced satisfactory functional outcomes at six months, with comparable ankle range of motion and postoperative complication rates. However, radiological union occurred significantly earlier in the TBW group. These findings suggest that both fixation methods are effective options for appropriately selected medial malleolar fractures, although a difference in the time required for radiological healing was observed.

Demographic and Baseline Characteristics

The study population consisted predominantly of male patients, with most participants belonging to the younger and middle-aged adult groups. Road traffic accidents were the leading cause of injury, followed by falls from height. The distribution of sex and side of injury was comparable between the two treatment groups, without a statistically significant difference.

Mohammed et al.[5] also reported comparable demographic characteristics, fracture types and injury mechanisms between patients treated with TBW and screw fixation. Their study included 20 patients and provides a direct clinical comparison of the two techniques. Aiyanna et al.[10], in a prospective study of 60 patients with displaced medial malleolar fractures, also evaluated both fixation methods and reported comparable baseline characteristics between the treatment groups.

The predominance of male patients and road traffic injuries may reflect the pattern of trauma-related admissions in the study population. However, these findings should be interpreted descriptively because the study was not designed to examine sex-specific or occupational differences in injury risk. The similarity in baseline characteristics supports the comparability of the two groups. The age-category statistical result, however, requires verification before a conclusion regarding statistical equivalence can be drawn.

Injury characteristics and fracture classification

The distribution of injury mechanisms, closed and open fractures, and Herscovici type B and C fractures was similar in the two groups. No statistically significant differences were observed. Comparable injury characteristics are important when evaluating fixation methods because fracture

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morphology, displacement and soft-tissue condition can influence implant selection and subsequent recovery.

Mohammed et al.[5] also found no significant differences in fracture type or injury mechanism between their TBW and screw fixation groups. Kochai et al.[13], in a comparative study of 90 patients, evaluated three fixation methods: TBW, partially threaded cannulated compression screws and fully threaded cannulated headless compression screws. Their findings demonstrated that implant-related outcomes may vary according to the fixation construct used.

The Herscovici classification is commonly used to describe the level of medial malleolar fractures, although it does not fully characterize all morphological features relevant to fixation. Aitken et al.[11] assessed the reliability of this classification in 130 patients and reported moderate inter-observer reliability. They also found that fracture-line obliquity and extension created difficulties in classification. Aamir et al.[12], in a large single-centre morphological study, further examined the variation in medial malleolar fracture patterns and their relationship with healing complications.

The comparable distribution of Herscovici type B and C fractures in the present study reduces the likelihood that an imbalance in fracture level influenced the comparison between the two groups. However, fragment size, fracture-line orientation, comminution and medial cortical support were not separately evaluated. These features may influence the stability achieved by each fixation method and should be considered when applying the findings to individual patients.

Functional Outcomes at Six Months

Functional outcomes were satisfactory in both groups, with most patients achieving an excellent result at six months. No statistically significant difference was observed in the overall functional categories or in the individual domains of pain, stiffness, swelling, stair climbing, sports activity, use of support and daily activities or work. These findings indicate that both fixation techniques provided adequate stability for functional recovery in most patients.

Mohammed et al.[5] reported good or excellent functional outcomes in 80% of patients treated with screw fixation and 90% of those treated with TBW. Their findings favoured TBW, although the study included only 20 patients and the results should be interpreted cautiously. In contrast, Park et al.[6], in a prospective randomized trial comparing headless compression screws with TBW, found no significant differences in Olerud–Molander Ankle Score (OMAS), pain or general health-related quality-of-life scores. Although headless compression screws differ from conventional CCS implants, their findings support the observation that screw-based fixation can achieve functional outcomes comparable to TBW.

Kim et al.[7], in a systematic review and meta-analysis of 512 medial malleolar fractures, also found no significant difference between TBW and screw fixation in the proportion of patients achieving excellent or good OMAS outcomes. Aiyanna et al.[10], however, reported a higher proportion of excellent functional outcomes in the CCS group. Differences in fracture selection, follow-up duration and functional assessment may partly explain the variation between these findings.

The functional scoring method requires particular consideration. The assessment used in the present study included seven domains, whereas the standard OMAS consists of nine items. The findings should therefore be described as the functional assessment used in this study rather than as an unmodified standard OMAS. This distinction is important when comparing the results with studies using the validated nine-item instrument.

The absence of a statistically significant difference does not establish that the two techniques are equivalent. With 20 patients in each group, smaller differences in functional recovery may not have been detected. Furthermore, a six-month follow-up may be insufficient to identify differences in higher-demand activities, return to sports or symptoms related to implant prominence.

Ankle Range of Motion

Dorsiflexion and plantarflexion were comparable between the two groups, and neither difference was statistically significant. This suggests that the fixation method did not produce a measurable difference in ankle movement at six months. The similar range of motion is consistent with the functional findings and indicates that both techniques provided sufficient stability to permit postoperative rehabilitation.

Park et al.[6] reported comparable clinical outcomes between headless compression screw and TBW fixation, with no significant difference in their principal functional measures. Aiyanna et al.[10] also found no significant difference in ankle range of motion between the two fixation groups, despite reporting better functional scores and earlier union with CCS fixation. These findings suggest that differences in radiological healing or patient-reported function do not necessarily translate into measurable differences in ankle movement.

The mechanical principles of the two fixation methods may help explain the comparable recovery. TBW converts tensile forces into compression across the fracture site, whereas lag screw fixation produces interfragmentary compression through screw purchase. Both constructs can provide satisfactory stability when used in suitable fracture patterns. Johnson and Fallat[4] compared the mechanical behaviour of TBW and cancellous screw fixation, while Fowler et al.[14] examined the biomechanics of different medial malleolar fixation constructs. Their findings emphasize the importance of fracture configuration and fixation technique in determining construct stability.

Ankle movement is also influenced by factors other than

the implant, including the severity of the initial injury, associated soft-tissue damage, immobilization, pain and adherence to rehabilitation. These factors may contribute to individual differences in recovery and may explain why the two groups demonstrated similar average ankle movement.

Radiological Union

The time to radiological union was shorter in the TBW group, and the difference was statistically significant. This was the principal finding favouring TBW in the present study. One possible explanation is the compression produced by the tension-band construct across the fracture site. However, fracture reduction, fragment size, bone quality, fixation stability and postoperative loading also influence healing. The observed difference should therefore not be attributed solely to the mechanical properties of the implant.

Mohammed et al.[5] reported earlier radiological union with TBW than with screw fixation, showing a similar direction of effect. In their study, the mean time to union was 9.4 weeks in the TBW group and 11.8 weeks in the screw fixation group. Their findings are consistent with the shorter union time observed with TBW in the present study, although their small sample size limits the generalizability of the results.

In contrast, Kim et al.[7] found no significant pooled difference in time to union between TBW and screw fixation. Their meta-analysis included 10 studies and demonstrated considerable heterogeneity in union-time results, suggesting that the advantage observed in individual studies may not be consistently reproduced across different clinical settings. Aiyanna et al.[10] reported faster union with CCS fixation, with a mean union time of 10.4 weeks compared with 11.53 weeks in the TBW group. This finding differs from the direction of the present result. Differences in fracture selection, fixation technique, rehabilitation protocols and radiological assessment may account for some of the variation.

Kochai et al.[13] also reported shorter union time with fully threaded cannulated headless compression screws than with the other fixation constructs studied. However, headless compression screws differ from conventional cannulated cancellous lag screws, and their results should not be considered a direct comparison of identical implants.

The shorter reported union time with TBW was not accompanied by a significant difference in six-month functional scores or ankle range of motion. Earlier radiological union may facilitate progression of rehabilitation, but it does not necessarily result in better patient-reported function within the same follow-up period. The clinical importance of the difference therefore remains uncertain. The mean union-time values should also be confirmed before publication because different values have been reported in the manuscript. The final analysis should use the figures verified by the original study investigators.

Postoperative Complications

Most patients in both groups did not develop a recorded postoperative complication. Joint stiffness was observed in the TBW group, whereas the CCS group had one case each of deep and superficial infection. The overall difference in complication distribution was not statistically significant. These findings do not demonstrate a clear safety advantage for either fixation method.

Kim et al.[7] found no significant difference between TBW and screw fixation in superficial infection or fixation failure rates. Their pooled findings support the comparable complication profile observed in the present study. Park et al. [6] reported similar clinical and radiological outcomes with headless compression screws and TBW, although patients treated with headless screws had greater satisfaction with implant-related symptoms. This may be related to the lower implant prominence of buried headless screws compared with exposed wire constructs. However, headless compression screws are not identical to conventional CCS implants.

Ostrum and Litsky[15] reported satisfactory results with tension-band fixation in a prospective series of 30 patients with 31 fractures. They observed no nonunion or postoperative wire migration, although two patients required removal of symptomatic hardware. Aiyanna et al.[10] also reported more hardware prominence and exertional pain in the TBW group, with several patients requiring implant removal. These findings highlight the possibility of implant-related symptoms following TBW, even when fracture healing is satisfactory.

The small number of complications in the present study limits meaningful comparison between the two methods. Stiffness may be influenced by immobilization, soft-tissue injury, pain and rehabilitation, whereas wound infection may be related to the initial soft-tissue condition, open-fracture status and perioperative wound care. A larger study with longer follow-up would be required to determine whether either technique carries a higher risk of specific complications.

Clinical Implications

Both TBW and CCS fixation produced satisfactory six-month functional outcomes and comparable ankle range of motion. The shorter reported union time with TBW may be relevant when considering fracture healing, but the absence of a corresponding functional advantage means that it should not be interpreted as overall clinical superiority.

The choice of fixation should be based on fracture morphology, fragment size, bone quality and the condition of the surrounding soft tissues. TBW may be useful when the fracture fragment is relatively small and the construct can provide effective compression. CCS fixation may be appropriate when the fragment permits secure screw purchase and the fracture configuration allows suitable screw

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placement. The potential for implant prominence, patient activity and surgeon experience should also be considered. The findings of Kim et al.[7] support an individualized approach rather than the routine preference for one fixation method in all medial malleolar fractures.

Strengths and Limitations

The prospective randomized design, equal group sizes and management of both groups in the same clinical setting are important strengths of this study. It also assessed relevant outcomes, including functional recovery, ankle movements, radiological union and postoperative complications. However, the small sample size and six-month follow-up limit the ability to identify uncommon complications and long-term outcomes. Details of allocation concealment and blinding were not available, and the functional scoring table differed from the standard nine-item OMAS. Radiological union criteria and statistical methods were also not clearly described, while some reported values require verification. In addition, limited information on fracture morphology restricts the extent to which the findings can be applied to other medial malleolar fracture patterns.

Conclusion

Both tension band wiring and cannulated cancellous lag screw fixation provided satisfactory functional outcomes in patients with medial malleolar fractures at six months. The majority of patients in both groups achieved excellent functional results, with no significant differences in the functional score components or ankle range of motion. Tension band wiring demonstrated significantly earlier radiological union than cannulated cancellous screw fixation in the study results. Although the pattern of postoperative complications differed between the groups, the overall complication rates were not significantly different.

These findings suggest that both techniques are effective options for the fixation of medial malleolar fractures. The choice of implant should be guided by fracture morphology, fragment size, bone quality, soft-tissue condition and the surgeon's assessment. Tension band wiring may be particularly useful when its compression principle is advantageous, whereas cannulated cancellous screws provide a direct method of interfragmentary fixation. Larger studies with longer follow-up are required to confirm these findings and establish whether the observed difference in radiological union translates into a meaningful long-term functional benefit.

Ethical Considerations

The study was initiated after approval from the Institutional Ethics Committee of Jaipur National University, Institute for Medical Sciences and Research Centre (IEC approval no. JNUIMSRC/IEC/2024/85, dated 1 March 2024).

Informed Consent

Written informed consent was obtained from all participants for participation in the study and publication of their clinical data.

Author Contributions

Conceptualization, AR and AMS; methodology, AR and AMS; formal analysis, AMS and AR; investigation, AMS; resources, AR; data curation, AMS; writing-original draft, AMS; writing-review and editing, AR; visualization, AMS; supervision, AR; project administration, AR. Both authors contributed to the article and approved the submitted version.

Generative AI statement

No use of artificial intelligence was involved in the study.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Kyriacou H, Mostafa AM, Davies BM, Khan WS. Principles and guidelines in the management of ankle fractures in adults. Journal of Perioperative Practice. 2021 Nov;31(11):427-34.
2. Carter TH, Duckworth AD, White TO. Medial malleolar fractures: current treatment concepts. The Bone & Joint Journal. 2019 May 1;101(5):512-21.
3. Herscovici D, Scaduto JM, Infante A. Conservative treatment of isolated fractures of the medial malleolus. The Journal of Bone & Joint Surgery British Volume. 2007 Jan 1;89(1):89-93.
4. Johnson DB. Comparison of tension band wire and cancellous bone screw fixation for medial malleolar fractures. The Journal of foot and ankle surgery. 1997 Jul 1;36(4):284-9.
5. Mohammed AA, Abbas KA, Mawlood AS. A comparative study in fixation methods of medial malleolus fractures between tension bands wiring and screw fixation. Springerplus. 2016 Apr 26;5(1):530.
6. Park YH, Cho HW, Choi JW, Kim HJ. Comparison between headless compression screws and tension band wires for the fixation of medial malleolar fractures: a prospective randomized trial. Archives of Orthopaedic and Trauma Surgery. 2022 Oct;142(10):2627-33.
7. Kim CH, Ma DS, Yoon YC. Tension band wiring versus screw fixation for the treatment of medial malleolar fractures: A systematic review and meta-analysis. Orthopaedics & Traumatology: Surgery & Research. 2023 Sep 1;109(5):103447.
8. Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. Archives of orthopaedic and traumatic surgery. 1984 Sep;103(3):190-4.
9. McKeown R, Parsons H, Ellard DR, Kearney RS. An evaluation of the measurement properties of the Olerud Molander Ankle Score in adults with an ankle fracture. Physiotherapy. 2021 Sep 1;112:1-8.

10. Aiyanna KNC, Shetty KD, Swamy M, Kailath KJ. Comparative analysis of tension band wiring and cannulated cancellous screws for displaced medial malleolus fractures: a prospective study. Int J Res Orthop. 2025;11(2):314–8.
11. Aitken SA, Johnston I, Jennings AC, Chua IT, Buckley RE. An evaluation of the Herscovici classification for fractures of the medial malleolus. Foot and Ankle Surgery. 2017 Dec 1;23(4):317-20.
12. Aamir J, Caldwell R, Long S, Sreenivasan S, Mavrotas J, Panesa A, Jeevaresan S, Lampridis V, Mason L. A morphological review of medial malleolar fractures–A large single centre series. Foot and Ankle Surgery. 2024 Jul 1;30(5):406-10.
13. Kochai A, Türker M, Çiçekli Ö, Özdemir U, Bayam L, Erkorkmaz Ü, Şükür E. A comparative study of three commonly used fixation techniques for isolated medial malleolus fracture. Eklem Hastaliklari ve Cerrahisi= Joint Diseases & Related Surgery. 2018 Aug 1;29(2):104-9.
14. Fowler TT, Pugh KJ, Litsky AS, Taylor BC, French BG. Medial malleolar fractures: a biomechanical study of fixation techniques. Orthopedics. 2011 Aug 8;34(8):e349-55.
15. Ostrum RF, Litsky AS. Tension band fixation of medial malleolus fractures. Journal of orthopaedic trauma. 1992 Dec;6(4):464-8.

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