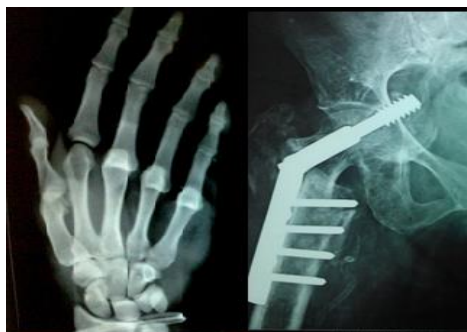




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Nischal Sharma

Lecturer, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Sagar Panthi

Associate Professor, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Bikash Neupane

Assistant Professor, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Rishishwor Shrestha

Lecturer, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Mukesh Prasad Kushwaha

Associate Professor, Department of
Orthopaedics, National Medical
College, Birgunj, Nepal

Himanshu Shah

Assistant Professor, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Rupesh Man Sherchan

Lecturer, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Vijaya Duwadi

Medical Officer, Bakulahar
Ratanagar Hospital, Chitwan,
Nepal

Mohit Thapa

Medical Officer, Sumeru City
Hospital, Lalitpur, Nepal

Corresponding Author:

Nischal Sharma

Lecturer, Department of
Orthopaedics, Rapti Academy of
Health Sciences, Ghorahi, Dang,
Nepal

Study of functional outcome of medial malleolus fractures with modified tension band wiring at tertiary level hospital

Nischal Sharma, Sagar Panthi, Bikash Neupane, Rishishwor Shrestha, Mukesh Prasad Kushwaha, Himanshu Shah, Rupesh Man Sherchan, Vijaya Duwadi and Mohit Thapa

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Abstract

Background: Medial malleolar fractures are the most common injuries seen in day-to-day clinical practice. The management of an undisplaced fracture includes the use of a plaster of Paris cast. However, fractures with more than 2 mm of displacement need surgical intervention. This study was conducted to assess the functional results obtained using the modified tension band wiring method for the fixation of medial malleolar fractures.

Methodology: The study was a hospital-based cross-sectional study and was performed over the period of one year. A total of forty cases of medial malleolar fracture were enrolled in the study after taking informed consent. The fractures were treated utilizing a modified tension band wiring technique. All patients were followed for a minimum of six months and the final functional outcome was determined using the Baird Jackson scoring system. Data was collected as per a pre-made proforma. Data analysis was done as per standard statistical protocol.

Results: The mean age of patients in this study was 35.65 (SD±12.31) years. A male preponderance (n=26; 65%) was observed in our study. Road traffic accidents accounted for the majority (n=19; 47.50%) of the medial malleolus fractures. The right side (n=26; 65%) was involved in the majority of our patients. The majority (50%) of the patients had a supination external rotation type of fracture. The majority (77.5%) of the patients had radiological union of the fracture at 8 weeks. According to the Baird and Jackson scoring system, the majority (n=28; 70.0%) of our patients reported excellent results. Good and fair results were obtained in 17.5% and 12.5% of our patients, respectively.

Conclusion: The study found that the modified tension band wiring is an effective modality in the management of medial malleolus fractures in order to obtain a good functional outcome.

Keywords: Medial malleolar fracture, modified tension band wiring, functional outcome

Introduction

The medial malleolus is the slightly enlarged medial segment of the distal extremity of the tibia. Ankle fractures rank as one of the most prevalent injuries treated by orthopedic surgeons and constitute the second most frequent type of lower limb fracture, subsequent to proximal femoral fractures, with an incidence rate of 9% [1]. Medial malleolus fractures are common injuries of the ankle and foot, constituting about 10.43% of ankle and foot fractures [2]. Ankle and medial malleolus injuries typically result from either minor twisting incidents or high-energy traumas [3, 4, 5].

In contemporary practice, the protracted use of plaster immobilization for osteoarticular fractures is not totally warranted, especially in comparatively younger individuals. [6]. Furthermore, in elderly patients, early mobilisation and early ambulation are the ideal treatment for fractures. Management of an undisplaced medial malleolus fracture is a plaster of Paris cast application [7]. And for fractures displaced more than 2 mm, surgery is needed. The aim of surgical management is to provide a normal contour of the joint and early mobilisation [8].

In the management of medial malleolar fractures, the restoration of anatomical alignment is crucial, since even a minor deviation from normalcy is detrimental to optimal joint function.

Ramsey and Hamilton have indicated that a mere 1 mm lateral displacement of the talus reduces the contact area by 40%, while a 3 mm shift diminishes it by 60% [9].

The tension band wire acts on the principle of opposing the tensile stresses at the fracture site by transforming them into compressive forces. The preceding placement of two parallel Kirschner wires (K-wires) across the fracture site prior to the insertion of the modified tension band wire enhances alignment, resists rotation, and offers greater stability. The complications may arise, such as visible and symptomatic hardware which is largely attributable to the subcutaneous location of the medial malleolus and localised pain, infections of the skin, impaired healing of the wound, K-wire migration, and malunion [10, 11].

Nondisplaced fractures of the medial malleolus are typically managed with cast immobilization; however, for patients with elevated functional demands, internal fixation may be suitable to expedite healing and rehabilitation. Displaced fractures of the medial malleolus necessitate surgical intervention, as ongoing displacement permits the talus to tilt into varus [12].

There is a lack of local data which evaluates the functional outcome that can be achieved with modified tension band wiring in medial malleolus fractures. Hence, this study was conducted to determine the efficacy of modified tension band wiring along with postoperative complications and outcomes.

2. Materials and Methods

2.1 Study Design and Setting

From May 2020 to June 2021, this prospective, hospital-based, cross-sectional study was conducted in the Department of Orthopaedics at a tertiary care hospital. The Institutional Review Board granted ethical approval, and all participants provided informed consent.

2.2 Participants

Forty patients who presented with isolated, closed, displaced (>2 mm) oblique fractures were enrolled. Exclusion criteria included comminuted or vertical shear fractures, open injuries, neurovascular deficits, and previous ankle fractures.

2.3 Surgical Technique

Under spinal anaesthesia, a standard anteromedial approach was utilised. After fracture reduction, a 4.5 mm cortical screw was inserted unicortically into the proximal tibia, 2 cm from the fracture site. Two parallel 1.8 mm K-wires were passed across the fracture. An 18-gauge stainless steel wire was looped under the screw head and twisted in a figure-of-eight pattern over the K-wires to achieve compression. The K-wires were bent, cut, and impacted.

2.4 Postoperative Protocol

A below-knee plaster slab was applied postoperatively. Sutures were removed at two weeks, and active ankle

mobilisation was initiated. Non-weight-bearing was advised for six weeks, followed by progressive weight-bearing as tolerated.

2.5 Outcome Measures

There was follow up with patients at 4, 8, and 12 weeks, and at 6 months. Primary outcomes were radiological union and functional outcome assessed at 6 months using the Baird-Jackson scoring system [11]. Secondary outcomes included time to union, range of motion, pain, and complications.

2.6 Statistical Analysis

Data were analysed using the IBM SPSS Statistics (Version 20). The descriptive statistics (such as mean, standard deviation, frequencies, percentages) were used to summarise demographic and clinical variables.

3. Results

3.1. Age Distribution

The mean age of the patients was found to be 35.65 (SD±12.31) years. The maximum patients included in the study belonged to the age group 21-30 years. Findings are shown in Table 1.

Table 1: Age distribution

Age Group (years)	Frequency (n)	Percentage (%)
10-20	02	05.0
21-30	17	42.5
31-40	09	22.5
41-50	06	15.0
51-60	05	12.5
61-70	01	02.5
Total	40	100

3.2. Sex Distribution: A male preponderance (n=26; 65%) was observed in the study. Females comprised 35% of the study (n=14). Findings are as shown in Table 2.

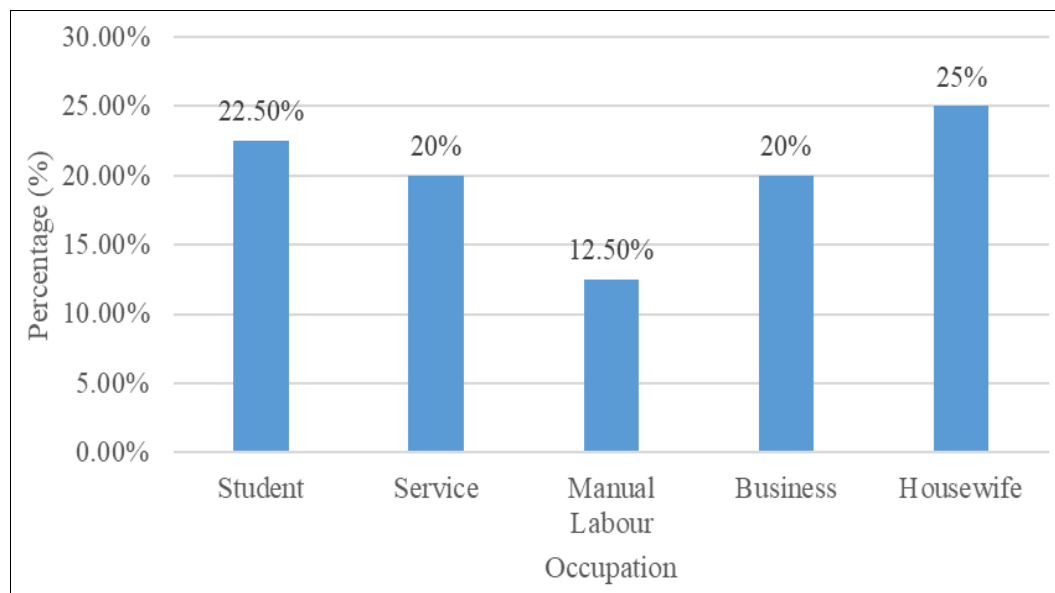
Table 2: Sex distribution

Gender	Frequency (n)	Percentage (%)
Female	14	35
Male	26	65

3.3. Occupation: Majority of the patients were housewives (n=10; 25%), followed by students (n=09; 22.50%). Findings are shown in Figure 1.

3.4. Mode and nature of injury

Road traffic accidents accounted for the majority (n=19; 47.50%) of the medial malleolus fractures. Slip (n=17; 42.50%) and sports injury (n=04; 10.00%) accounted for the rest of the cases. Findings are shown in Table 3. All cases (n=40; 100%) encountered in the study were simple in nature.

**Fig 1:** Bar diagram depicting occupation**Table 3:** Mode of injury

Mode of Injury	Frequency (n)	Percentage (%)
Road traffic accident	19	47.50
Slip injury	17	42.50
Sports injury	04	10.00

Table 4: Side of involvement

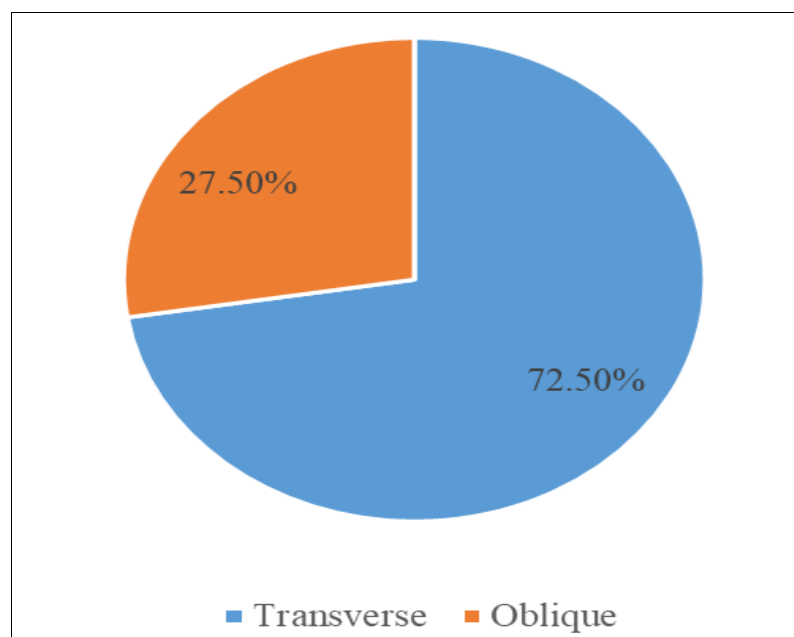
Side	Frequency (n)	Percentage (%)
Right	26	65
Left	14	35
Total	40	100

3.5. Side of involvement

The right side (n=26; 65%) was involved in the majority of our patients. Findings are shown in Table 4.

3.6. Type of fracture

Transverse fracture (n=29; 72.5%) was observed in the majority of the patients. Findings are shown in Figure 2.

**Fig 2:** Pie diagram depicting type of fracture**3.7. Lauge Hansen type of fracture**

Most patients had a Supination External Rotation fracture type (n=20; 50%). Findings are shown in Table 5.

Table 5: Lauge Hansen type of fracture

Lauge Hansen Type	Frequency (n)	Percentage (%)
Supination external rotation	20	50.0
Pronation abduction	12	30.0
Pronation external rotation	05	12.5
Pronation dorsiflexion	03	7.5
Total	40	100

3.8 Duration to surgery and hospital stay

The mean interval between fracture of the medial malleolus and surgery was 4.10 (SD± 1.46) days. Mean duration of hospital stay was 11.30 (SD± 2.72) days.

3.9. Pain at follow up: At follow-up of 4 weeks, the majority of patients (n=35; 87.50%) complained of pain. At 8 weeks, the majority of patients (n=23; 57.50%) complained of no pain. At 12 weeks, a vast majority (n=36; 90%) of patients complained of no pain. Findings are summarised in Table 6.

Table 6: Pain at follow up

Pain at follow up	At 4 weeks n (%)	At 8 weeks n (%)	At 12 weeks n (%)
Yes	35 (87.50%)	17 (42.50%)	04 (10.00%)
No	05 (12.50%)	23 (57.50%)	36 (90.00%)
Total	40 (100%)	40 (100%)	40 (100%)

3.10. Restriction of movement at follow-up

At follow-up of 4 weeks, the majority of patients (n=22; 55.00%) had restriction of movement amounting to <10°. At 8 weeks, the majority of patients (n=22; 55.00%) had no

restriction of movement. At 12 weeks, a vast majority (n=30; 75%) of patients had no restriction of movement. Findings are summarised in Table 7.

Table 7: Restriction of movement at follow-up

Restriction of movement	At 4 weeks n (%)	At 8 weeks n (%)	At 12 weeks n (%)
None	00 (00.0%)	22 (55.0%)	30 (75.0%)
<10°	22 (55.0%)	10 (25.0%)	09 (22.5%)
10° to 30°	17 (42.5%)	07 (17.5%)	01 (02.5%)
>30°	01 (02.5%)	01 (2.5%)	00 (00.0%)

3.11. Complications: The majority (n=29; 72.5%) of our patients had no complications. Joint stiffness (n=05; 12.5%)

was the most frequent complication seen in our cases. Findings are shown in Table 8.

Table 8: Complications

Complications	Frequency (n)	Percentage (%)
None	29	72.5
Joint Stiffness	05	12.5
Superficial Infection	02	5.0
Migration of K-wire	04	10.0
Total	40	100.0

3.12. Duration to radiological union

The majority of our patients (n=31; 77.5%) had radiological

union of fracture at 8 weeks. The findings are summarised in Table 9.

Table 9: Duration to radiological union

Duration	Frequency (n)	Percentage (%)
4 weeks	03	7.5
8 weeks	31	77.5
12 weeks	06	15.0
Total	40	100.0

3.13. Functional results: Functional results were assessed as per the Baird and Jackson scoring system. Accordingly, the

majority (n=28; 70.0%) of our patients reported excellent results. Findings are summarised in Table 10.

Table 10: Functional Results

Functional Result	Frequency (n)	Percentage (%)
Excellent	28	70.0
Good	07	17.5
Fair	05	12.5
Poor	00	00.0
Total	40	100

Discussion

Modified tension band wiring was first described by Fredrick Pauwel in 1935^[13]. Since then, it has engendered a transformative shift in the management of eccentrically positioned bones, such as the medial malleolus. The utilization of modified tension band wires on the tensile side transforms distractive pressures into compressive forces. This approach is highly effective for eccentrically positioned bones with one side maintaining intact cortical contact. A modified tension band that generates relatively consistent stresses at the fracture site throughout movement is referred to as a Static tension band, exemplified by the medial malleolus^[8].

The mean age of the patients in this study was 35.65 (SD±12.31) years. This observation is similar to a study which found a mean age of 35.13 years^[14]. Other studies also support this^[15, 16, 17]. However, several studies have observed a higher mean age for patients with medial malleolar fractures^[10, 18, 19]. A male preponderance (n=26; 65%) was observed in the study. A male preponderance was also seen in several other studies^[10, 17, 19]. However, a female preponderance was observed in a study^[16]. Local demographic differences may account for observed differences.

The ankle injuries are mainly caused due to the simple twisting injuries to high-energy injuries^[3]. Road traffic accidents accounted for the majority (n=19; 47.50%) of the medial malleolus fractures. This is similar to findings which encountered road traffic accident as the major cause, in 66.6% and 76.67%, respectively^[14, 19]. The right side (n=26; 65%) was involved in the majority of the patients. This is similar to observations made by two different studies which found that the right side was involved in 72% & 54.55% of the cases^[10, 19].

Transverse fracture (n=29; 72.5%) was observed in the majority of the patients. A similar observation was made in a study^[19] which observed a transverse type of fracture in the majority of their patients (56.8%). The Lauge Hansen classification, a crucial and valuable tool, was employed in this investigation to ascertain the diagnosis and predict future outcomes. The classification method comprises two components: the first delineates the foot's position at the moment of damage, while the second articulates the direction of the applied force during the injury^[20]. The majority of the patients had a Supination external rotation type of fracture (n=20; 50%). Other studies conducted also found the Supination external rotation type as the most prevalent type^[14, 19].

The majority of the patients (n=31; 77.5%) had radiological union of the fracture at 8 weeks. Other studies^[15, 21] also observed a similar mean radiological union time of 9.4 weeks and 9 weeks, respectively. Similarly, no cases of non-union or delayed union were encountered in another study^[21].

The management of malleolar fractures with precise open reduction and secure internal fixation utilizing the AO method and principles yielded a significant proportion of excellent and good outcomes^[22]. This present study supports this conclusion. Functional results were assessed as per the Baird and Jackson scoring system. Accordingly, the majority (n=28; 70.0%) of the patients reported excellent results. Good and fair results were obtained in 17.5% and 12.5% of the patients, respectively. In a study^[17] using a similar scoring system, excellent results were achieved in 11 cases (78.57%), good in 3 cases (21.42%). Several other studies have encountered similar good functional outcomes, using Tension band wiring in the management of medial malleolar fractures^[10, 14, 15, 19]. Fractures of the medial malleolus are among the most

prevalent fractures and are frequently inadequately treated^[23]. Accurate anatomical reduction and secure internal fixation are essential in the management of these fractures, as with any intra-articular fracture. Modified tension band wiring is a proven procedure yielding excellent to good outcomes, utilizing relatively affordable and easily available implants.

Conclusion

The modified tension band wiring is an efficacious and dependable therapeutic approach for displaced fractures of the medial malleolus. The technique provides stable fixation that facilitates a high rate of radiological union within a predictable timeframe. Furthermore, it yields excellent functional outcomes, allowing patients to return to their daily activities with a high level of satisfaction. The procedure is biomechanically sound, utilising the principle of converting the tensile forces into the compressive forces at the fracture site. It is also a cost-effective solution, employing readily available and relatively inexpensive implants. While minor complications such as hardware prominence can occur, they are typically manageable and do not detract from the overall success of the procedure. Therefore, it is recommended that the modified tension band wiring technique be used as a primary option for the surgical management of displaced transverse & the oblique fractures of the medial malleolus, particularly in cases with smaller fragments or osteoporotic bone where screw purchase may be compromised.

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