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Original Research Article

Comparative study on functional outcome of medial malleolus fracture management by tension band wiring versus screw fixation

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ABSTRACT

Introduction: There is an increasing trend of ankle fractures in young as well as elderly patients recently. This study aimed to compare the advantages and disadvantages of tension band wiring with screw fixation for medial malleolar fractures.

Materials and Methods: All the cases of suspected ankle fractures were taken up for the study. Then the patient's radiographs were taken, anteroposterior and lateral views of the ankle joints. CT scan is taken if it was indicated. A Total of n=30 cases were studied in this study. They were allotted into two groups of n=15 each. One group was treated with tension band wiring and the second group was treated with screw fixation.

Results: Cases managed by tension band wiring (TBW), n=12 (80%) cases had a range of motion of the ankle within 10° of the uninjured ankle and n=2 (13.3%) patients were having motion within 15° of the uninjured ankle. The rest n=1 (6.66%) patients had motion within 20° of the uninjured ankle. Patients managed with screw fixation, n=10 (66.6%) patients had a range of motion of the ankle within 10° of the uninjured ankle and n=3 (20%) patients were having motion within 15° of the uninjured ankle. The rest n=2 (13.3%) patients had motion within 20° of the uninjured ankle.

Conclusions: Isolated medial malleolar fractures had a better outcome compared to the bimalleolar fractures. As far as the choice of treatment tension band wiring appears to be more desirable than screw fixation because it produces Excellent functional outcomes with minimal complications.

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1. Introduction

The ankle is most susceptible joint of the body for fractures. However, it is the most maltreated as compared to other joints.[1] Orthopedic surgeons are therefore faced with the challenge of better treatment of ankle fractures and obtain the best possible functional outcomes. Ankle is a point where the body weight is transmitted through this during the function of locomotion and the mobility is mostly dependent on stability of this joint. The estimated incidence of ankle fractures is about 10% of all the fractures and it is the only next to the most common the hip fractures.[2,3] They are more common in the obese and those with a history of multiple falls. Ankle is a joint formed by interlocking tenons and mortises hence called mortise joint which is formed by the articulations of lower ends of tibia and fibula along with talus.[4] The peculiar anatomy of this joint makes it unstable in cases of fractures and injuries of the joint. Ankle fractures are a result of low energy indirect forces and usually cause fractures of one or both malleoli with and without ligament injuries.[5] Malleolar fractures have diverse presentations, hence wide variety of classifications have been used, of which and Danis – Weber classification is commonly followed.[6] The joint complex is an articulation primarily between the tibial plafond

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and the dome of the talus. Medial complex is formed by Medial Malleolus, medial facet of the talus, and the superficial and deep components of the deltoid ligament.[7,8] Eversion of the ankle causes injury to the superficial, and if sufficient, the deep deltoid ligament. With the continuation of these forces, impaction of the distal lateral malleolus occurs, resulting in rupture of syndesmosis or transverse fracture of the fibula.[9] Treatment is done conservatively in cases of non-displaced fractures. Whereas, in the cases of displaced malleolar fracture requires accurate reduction and stable internal fixation. Failure of reduce malleolar fractures accurately will lead to post-traumatic painful restriction of movements and or osteoarthritis and sometimes both.[10] Diverse methods are available for fixation of the medial malleolar fractures in this study we studied two most used techniques. Tension band wiring is based on the principle of conversion of tensile forces to compressive forces at the fracture site, advantages being rigid fixation and early ambulation.

2. Material and Methods

This cross-sectional study was conducted in the Department of Orthopedics, Mahatma Gandhi Memorial Hospital, Warangal attached to Kakatiya Medical College between September 2019 to February 2021. Institutional Ethical committee permission was obtained for the study as per protocol. Written consent was obtained from all the participants of the study after explaining the nature of the study and expected outcomes in their local language. All the cases of suspected ankle fractures were taken up for the study. The complete survey was carried out to rule out significant injuries. Then the patient's radiographs were taken, anteroposterior and lateral views of the ankle joints. CT scan is taken if it was indicated. Inspection**:** Relation of the ankle to foot either normal, equinus, calcaneus – valgus or varus. Interrelation of malleoli and fossa in the front of malleoli. The prominence of tendoachillis fossa on both sides of tendoachillis. Palpation**:** All bones forming the ankle i.e. lower end of tibia, fibula including both malleoli, calcaneus and talus are looked for local bony tenderness, bony irregularities, displacement, abnormal mobility, crepitus, and interrelation of malleoli. Dorsalis pedis and posterior tibial artery pulsations were checked and noted. Active and passive movements of the ankle joint are noted. Analgesics were given and patients were put on a below-knee posterior POP slab to alleviate pain antibiotics were given as needed. Patients were operated on as early as possible once the general condition stable and the patient was fit for surgery.

2.1. Inclusion criteria

1. Bimalleolar and isolated medial malleolar fractures.
2. Age between 18-70 years
3. Both males and females included
4. Closed as well as grade 1 and 2 compound fractures.
5. Articular comminution (step off or gap).
6. Secondary loss of reduction.

2.2. Exclusion criteria

1. Age of <18 years and >70 years.
2. Pathological fractures
3. Fractures managed conservatively with a POP slab**.**

Under appropriate anesthesia, the patient was put in a supine position on the table with a sandbag underneath the affected side buttock. A pneumatic tourniquet was applied to the proximal thigh after noting the time. Surgical Approach: A medial longitudinal incision of 8 cms was put over the medial malleolus between its anterior and posterior borders with the lower end curving anteriorly at the tip of the medial malleolus.

2.3. Tension band wiring procedure

After reduction of the fracture site, two K- wires of 2mm diameter and 8 cm long were passed one anterior and one posterior from the tip of the malleoli to the proximal tibia transfixing the malleoli to the tibia without entering the joint. The towel clip was removed, and a drill hole was made, 5cm proximal to the fracture, on the tibia from anteromedial aspect to anterior aspect with a 3.5mm drill bit protecting the soft tissues anteriorly with a right-angled retractor. An AO wire of 20 gauge is passed through the predrilled hole on/the tibia from anteromedial to anterior aspect and was made in the figure of eight passing behind the two K-wires and tensioned with an AO tensioner and the tips of wire were cut with a cutter. The two K- wires were bent with a bender and punched into bone engaging the wire, protecting the tibialis posterior tendon and neurovascular bundle.

2.4. Screw fixation procedure

In this procedure with screw fixation, similarly reduction of fracture was done with a towel clip and a drill hole was made perpendicular to the fracture line with a 3.2mm drill bit securing the reduction. In these cases, a 4.5mm malleolar screw was used. The screws were tightened to provide compression at the fracture site. The wound was washed with Betadine and sutured in layers. A suction drain was used in 13 cases. Sterile dressings were applied, and a compression bandage was given. Below the knee, the posterior pop slab was given. The tourniquet was removed and the appearance of capillary filling over the toes was confirmed. The patient was shifted to the recovery room and then to the post-operative ward.

2.5. Postoperative care

IV fluids were infused as appropriate. Antibiotics consisting of Cefotaxime and Amikacin were continued for 5 days. Analgesics and Serratiopeptidase were given. Elevation of the affected limb was done. The suction drain was removed after 24 to 48 hours and X-rays anteroposterior, lateral, and mortise views were taken. Wounds were inspected on 3rd day. Sutures were removed on the 12^{th} postoperative day on average. Below knee, the pop cast was given and discharged with instruction of non-weight bearing crutch walk for a period of 6 weeks and to come for follow-up after 3 weeks. Follow Up: Weight-bearing is restricted for 6 weeks. If the bone condition and other factors prevented secure fixation, the fracture was protected for longer. At 3 weeks of follow-up in OP, the POP was removed. Clinical examination was done regarding tenderness and movement of the ankle. At 6 weeks x-ray of the ankle was taken on both AP and lateral views and looked for signs of fracture union and then were advised partial weight-bearing for a further period of 6 weeks and elevation of the limb at night times and active movements of ankle joints. Patients were allowed full weight bearing on the affected limb. Regular follow-up was done at 1, 2, and 6 months after discharge till the fracture was united.

3. Results

Based on the inclusion and exclusion criteria a total of n=30 cases were included. They were randomly allotted in two equal groups. n=15 patients were managed with tension band wiring to the medial malleolus and other n=15 patients were managed with screw fixation, were followed until fracture union occurred. The majority of patients n=12 (40%) were from the 41- 50 years age group, followed by n=8 (26.6%) patients in the 21-30 age group. The mean age in our study was 42.0 ± 3.5 years (table 1)

In the study occupation of the patients included n=12 (40%) of patients who had fractures were daily laborers making up the majority followed by n=10 (33.3%) of agricultural workers and n=6 (20%) who were housewives and n=2(6.66%) were students. Road Traffic accidents was the major cause of fractures found in n=15 (50%) and in n=11 (36.6%) patients' fracture was due to slipping. N=2 cases each of fall from height and industrial accidents cases were found. The laterality of involvement showed Right ankle was involved in n=18 (60%) patients and in n=12 (40%) patients left ankle was involved. The type of ankle injury was classified based on Lauge Hansen classification [10] showed n=12 (40%) patients had supination and external rotation injuries which is the majority, followed by n=9 (30%) patients with pronation external rotation injuries, n=5(16.6%) supination adduction injury and n=3(10%) had pronation abduction injuries. The mean time of Routine immobilization in Tension band wiring was 5.87 weeks and screw fixation were 6.47 weeks. Tension band wiring fixation cases the meantime for fracture union was 12.53 weeks and for screw fixation it was 12.40 weeks. In tension band wiring fixation, only n=1 patient had moderate pain and n=3 patients had mild pain after 6 months. The rest of them has no pain. No cases were reported with severe pain. In screw fixation, n=2 patients had moderate pain and n=3 had mild pain after 6 months. This is attributed to postoperative stiffness of the ankle joint. The Baird and Jackson criteria [11] given in table 2 was used for functional outcomes. In this study, the patients managed with tension band wiring, n=12 (80%) patients had a range of motion of the ankle within 10° of the uninjured ankle and n=2(13.3%) patients were having motion within 15° of the uninjured ankle. The rest n=1 (6.66%) patients had motion within 20° of the uninjured ankle. The patients managed with screw fixation, n=10 (66.6%) patients had a range of motion of the ankle within 10° of the uninjured ankle and n=3 (20%) patients were having motion within 15° of the uninjured ankle. The rest n=2 (13.3%) patients had motion within 20° of the uninjured ankle.

This study out of n=15 patients with ankle fractures treated by open reduction and internal fixation by tension band wiring, Excellent results were accomplished in n=10 (66.6%) patients, good in n=4 (26.6%), and Poor in n=1 (6.66%) patient. Of the n=15 patients managed with open reduction. Excellent results were achieved in n=8 (53.3%) patients, Good in n=4 (26.6%), Fair in n=2 (13.33%) and Poor in n=1 (6.66%) patient the p-values were 0.048 hence considered significant (Table 3). The patient with poor results had mild pain with activities of daily living, diminution in the abilities to run and to do work, the reduced motion of the ankle, and narrowing of joint space.

The complications in the cases of study are depicted in Table 4. Of all the n=15 patients managed with TBW, n=3 patients had superficial skin infection which subsided with the usage of antibiotics. Of the series of patients managed with screw fixation, n=2 patients had superficial skin infection which got subsided with the usage of oral antibiotics, and one patient developed sinus with discharge after surgery which did not subside with antibiotics while one patient developed measurable joint space narrowing and arthritic changes on follow-up x-rays.

4. Discussion

Fractures of the ankle being intraarticular and, in a weight -bearing extremity needs accurate reduction if residual pain and disability are to be avoided and the incidence of arthritis to be reduced. The present study found the mean age of the cases in 42.0 years similar observations have been reported by other studies in this field.[12–14] In the current study post-operative evaluation was done by Lauge Hansen's classification system. The most common type of injury was supination external rotation (40%) followed by

Table 1: Age and sex wise distribution of cases in the study

Age Group	Male	Female	Frequency	Percentage
21-30	5	3	8	26.67%
31-40	1	1	2	6.66%
41-50	7	5	12	40%
51-60	4	2	6	20%
> 60	1	1	2	6.66%
Total	18	12	30	100

Table 2: The functional outcomes were evaluated by Baird and Jackson criteria

Category	Tension band wiring						Screw Fixation						P value
	A	B	C	D	E	Total	A	B	C	D	E	Total	
Pain	11	3	1	0	0	15	10	3	2	0	0	15	0.06
Stability	15	0	0	0	0	15	15	0	0	0	0	15	0.27
Walking	14	1	0	0	0	15	13	2	0	0	0	15	0.71
Running	04	10	1	0	0	15	04	9	2	0	0	15	0.23
Work	14	1	0	0	0	15	12	2	1	0	0	15	0.04*
Motion	12	2	1	0	0	15	10	3	2	0	0	15	0.048*
Radiographs	14	1	0	0	0	15	14	0	0	1	0	15	0.049*

* significant

Table 3: comparison of mean composite scores of two groups

Composite Score	Tension band wiring		Screw fixation	
	No. ofpatients	Percentage	No. of patients	Percentage
Excellent (96-100 Points)	10	66.6	8	53.3
Good (91-95 Points)	4	26.6	4	26.6
Fair (81-90 Points)	0	0.00	2	13.3
Poor (0-80 Points)	1	6.66	1	6.66
Mean composite score	95.87		93.04	

Table 4: Complications in the cases of the study

Complications	Tension band wiring		Screw fixation	
	Frequency	Percentage	Frequency	Percentage
Nonunion	0	0	0	0
Infection	3	20	3	20
Ankle joint arthritis	0	0	1	6.66
Severe pain	0	0	0	0
Implant failure	0	0	0	0

pronation external rotation (30%). Robert RS et al.,[15] found external rotation and pronation 34% of cases. Baird RA et al.,[11] found supination external rotation in 44% of cases and Ostrum RF et al.,[16] found Supination external rotation in 42% of cases. The mean time take for fracture union in tension band wiring cases of this study was 12.53 weeks and for screw fixation it was 12.40 weeks. G Sharma et al.,[17] found 12.3 weeks the average time of union in tension band wiring and Mohammad AA et al.,[18] found 11.8 weeks of union for screw fixation. The ankle range of motion achieved by tension band wiring in the current study was good in 93.3% and G Sahu et al.,[19] in their study observed a good mobility in 100% of patients of their study. Similarly, the ankle range of motion in screw fixation was good in 86.6% of cases and G Sahu et al.,[19] found a good range in 93.3% of cases of their study. Based on the Baird and Jackson's Scoring System, this study found excellent and good results were achieved in 93.26% of patients treated with tension band wiring and 79.9% in patients treated with screw fixation. The result was significant statistically (p-value= 0.04). Our observations were in concordance of Sang Hanko et al.,[20] reported excellent to good results in 89% of cases of tension-and wiring and 78% cases with malleolar screws. Al-Lamy et al.,[21] also found excellent to good results in 80% in the group treated with screws and 90% in the group treated with tension-band wiring. In this study, the mean time for the radiological bone union was 12 weeks (ranging from 10 to 15 weeks) for screw fixation patients and 12 weeks (ranging from 10 to 15 weeks) for TBW patients which were statistically insignificant (P-

value= 0.08). There was difference in two groups based on their ability to work as well as ankle range of motion done in follow-up radiographic examinations (table 2). In the present study, there are n=2 cases of superficial infection in screw fixation and three cases in TBW, all of which were reduced with antibiotic usage for 2 weeks. One case of screw fixation developed deep infection with sinus formation and implant loosening for 6 months follow up. Two cases of the delayed union in TBW and one case in screw fixation were observed. We did not observe any case of non-union out of n=30 cases of our study.

5. Conclusion

Medial malleolar fractures are common in Road Traffic Accidents. Medial malleolar fractures have varied outcomes. Isolated medial malleolar fractures had a better outcome compared to the bimalleolar fractures. A thorough understanding of the mechanism of injury, pathoanatomy, and treatment options along with accurate reduction and early mobilization can best results. As far as the choice of treatment Tension band wiring appears to be superior as compared to screw fixation because it produces Excellent functional outcomes with minimal complications.

6. Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

7. Source of Funding

None.

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