



## International Journal of Orthopaedics Sciences

ISSN: 2395-1958

IJOS 2019; 5(3): 351-354

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www.orthopaper.com

Received: 24-05-2019

Accepted: 28-06-2019

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### Clinical outcome of isolated medial malleolar fractures fixation with tension band wire vs partially threaded cancellous screws-prospective clinical study

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i3f.1555>

#### Abstract

**Objectives:** The aim of this study is to compare two methods of internal fixations for isolated fractures of medial malleolus by partially threaded screw fixation and tension band wiring.

**Patients and Methods:** Over the period of 2 years we grouped 20 patients of fractured medial malleolus randomly into two groups of operative treatments, group 1 treated by 4mm partially threaded lag screw fixation and group 2 by tension band wiring. Modified ankle scoring system of Olerud and Molander was used to assess outcome of procedures. We use Independent sample t test for analysis and make a comparative study between the two ways of surgical treatment. Clearance from ethical committee is obtained and informed consent from all patient taken for study.

**Results:** The mean time for radiologic bone union was 11 weeks in Group 1 patients and Group 2 patients. No patients had any sign of fixation failure or Kirschner (K) wires migration. According to the modified ankle scoring system of Olerud and Molander excellent and good results were achieved in 80 % in group 1 patients and 90 % in group 2 patients ( $P = 0.049$ ).

**Conclusions:** Tension-band wiring may be better treatment option for internal fixation of medial malleolar fractures than screw fixation in small fragments avulsion fracture.

**Keywords:** Avulsion fracture, lag screw, tension band wiring, medial malleolus fracture

#### Introduction

Because of increasing sporting activities and modern civilisation medial malleolar fractures are most common injury seen in day today practice. These fractures typically result from a low-energy indirect rotational forces in which the ankle is twisted & the talus tilts or rotate forcefully in the mortise, causing a low-energy fracture of one or both malleoli, with or without associated ligament injuries, but can also present as a more complex, high energy injury. Management of these fractures depends on careful identification of the extent of bony injury as well as soft tissue and ligamentous damage. Management of displaced fracture more than 2 mm needs surgery. Various modalities of surgical fixation are available in literature [1-3]. Closed reduction and internal fixation with two parallel K wires, closed reduction and internal fixation with two parallel cancellous screws, open reduction and internal fixation using cancellous screws. Each modality has got its own advantage and disadvantage. Here we are done a study to know the clinical and radiological outcome in the management of the medial malleolar fractures by tension band wiring technique verses inter fragmentary 4mm partially threaded cancellous Lag screw.

#### Material and Methods

The study was performed at Department of orthopaedic, B.K.L Walawalkar Medical College, Dervan, India between the period from June 2017 to June 2019. We randomized 20 consecutive patients with displaced closed fractures of medial malleolus, which were isolated medial malleolus fractures. All were treated by open reduction and internal fixation with either malleolar screw or with tension-band wiring and the choice of mode of fixation were on alternate basis. They were then allocated to one of two treatment groups:

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- Group1 (10 patients) had 4mm partially threaded cancellous screw fixation.
- Group2 (10 patients) had tension-band wiring.

Functional outcome assessed using a scoring system proposed by Olerud and Molander<sup>4</sup>. The fractures were classified according to the Danis–Weber classification<sup>5</sup>

#### Inclusion criteria

1. Patient age 15–60 years.
2. Patient of Weber type B&C.

#### Exclusion criteria

1. Age <15 years.
2. Age >60 years.
3. Patient of Weber type A.
4. Open fractures
5. vertical fracture patterns of medial malleolus
6. Bimalleolar fracture
7. Distal Tibiofibular syndesmotic injury

Clearance from ethical committee is obtained and informed consent from all patient taken for study

#### Preoperative planning

Preoperative evaluation includes assessment of general health and a thorough assessment of neurovascular status of the lower extremity. Radiographic evaluation<sup>3</sup> includes anteroposterior, mortise, and lateral views of the ankle. The surgery was performed before the ankle swells up or when the swelling subsided, which was usually after 5–10 days<sup>4</sup> of elevation.

#### Surgical technique

All the patients in this study were operated upon under spinal anaesthesia. The patient was positioned supine and pneumatic tourniquet was applied to the mid thigh. After routine skin preparation and draping, we made an anteromedial incision that began approximately 2 cm proximal to the fracture line, extended distally and slightly posteriorly, and ended approximately 2 cm distal to the tip of the medial malleolus. Handling the skin with care and reflecting the flap intact with its underlying subcutaneous tissue. The blood supply to the skin of this area is poor, and careful handling is necessary to prevent skin sloughing. We protect the great saphenous vein and its accompanying nerve. A small fold of periosteum commonly is interposed between the fracture surfaces. We removed this fold from the fracture site with a curette or periosteal elevator, exposing the small serrations of the fracture. We debrided small, loose osseous or chondral fragments; large osteochondral fragments were preserved. With a small bone-holding clamp, the displaced malleolus was brought into normal position and, while holding it there, internally fixed with either 4mm partially threaded screw or tension-band wiring.

In group 1 patients a 3.2-mm hole was drilled in a superior posterior direction while distal fragment was held reduced with a pointed clamp or with two Kirschner wires bent to stay out of way as temporary fixation devices. Length of hole was measured, and 4mm partially threaded screws was inserted without tapping till it reached the other cortex. Kirschner wires were removed after screw was tightened. In two cases the fragments were large and tend to rotate, so we used additional point of fixation a second screw.

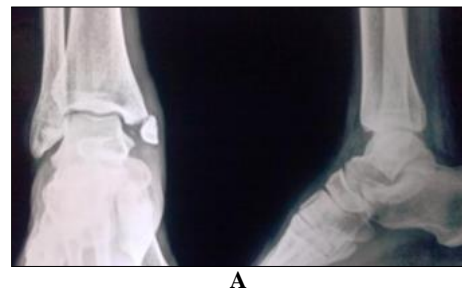
In group2 patients the fracture was internally fixed with two

2-mm smooth Kirschner wires drilled perpendicular to the fracture line. The Kirschner wires should be parallel, and their ends were bent at 90° angles. This will eventually prevent the figure-of-eight wire from slipping over the exposed ends of the Kirschner wires. A stainless steel 1.2 mm AO wire was passed through the previously drilled hole and around the bent ends of the Kirschner wires in a figure-of-eight configuration. The wire was then tightened as shown in image 1

We were carefully inspected the interior of the joint, particularly at the superomedial corner, to make sure that Kirschner wires or the screw had not crossed the articular surfaces., we made roentgenograms to verify the position of the screw or the Kirschner wires and any faulty insertion could be avoided as shown in image 2. Hook or cotton test<sup>[17]</sup> performed to assess syndesmotic injury. At the end of operation, we deflated the tourniquet, obtained haemostasis, and closed the wound with interrupted suture. We avoided tight stitches to prevent necrosis of the skin edges. We applied thick padding and a posterior plaster splint with the ankle in neutral position.



**Image 1:** Clinical photograph intraoperative



**A**



**B**

**Image 2:** Radiograph-A-preoperative and B-post operative

#### After treatment

- The ankle is immobilized in a posterior plaster splint with the ankle in neutral position and elevated.
- Postoperative X-ray was taken with anterior, lateral, and mortise views.

#### Follow up

All the patients were reviewed at 10–14 days, 6 weeks, 3, and 6 months after operation. At each assessment we perform a physical examination and X-ray was taken soon after the operation, at 6 weeks, and during subsequent visits to assess

radiological healing. After 10–14 days the stitches were removed and the wound examined and any complication was reported and treated accordingly. The posterior plaster splint was changed and the patient was instructed to remove it every day and to start range-of-motion exercises. Weight bearing was restricted for 12 weeks. Full weight bearing is allowed after 12 weeks

### Evaluation

We evaluate all the patients clinically, radiologically, and functionally using a modification of the scoring system proposed by Olerud and Molander <sup>[4]</sup>. The scores for each component of this scale were assessed by use of a questionnaire, in combination with clinical objective criteria. The scoring scale has a maximum of 100 points (>91 excellent results, 81–90 good results, 71–80 fair results, <70 poor results). The continuous variables were analysed between groups using Independent sample t test. P value of <0.05 was considered statistically significant.

### Results

There were no significant differences between the two groups in age (Median 32 years), gender, and fracture type <sup>[5]</sup> (Weber type B and C).

Review of postoperative radiographs confirmed anatomic reduction with stable fixation in all twenty patients. All the series of radiographs showed normal fracture healing and no patient had malunion, nonunion, or loss of reduction. In our study the mean time for radiologic bone union was 10 weeks for group1 patients and group2 patients.

No patients had any sign of fixation failure or Kirschner wires migration. According to the modified ankle scoring system of Olerud and Molander <sup>[4]</sup>, 1 (10 %) patient in group1 and 2 (20 %) patients in group2 were excellent: good in 7 (70 %) patients in group1 and 7 (70 %) in group2: fair in 1 (10 %) patients in group1 and 1 (10 %) in group2: poor in 1 (10 %) patients in group1 and non in group2 patients. Excellent and good results were achieved in 80 % in group1 patients and 90 % in group2 patients (P = 0.049).

**Table 1:** Results of study

Results category	poor	fair	Good	excellent	Total Patients	P value
Group 1	1	1	7	1	10	0.049
Group 2	-	1	7	2	10	

### Discussion

The importance of anatomic reduction and rigid internal fixation in displaced fractures of the medial malleolus has been emphasized in order to achieve rapid return of normal function and to reduce the incidence of complications related to this fracture. Even though many reports of operative treatment of medial malleolar fractures have been published, comparison of the reports is difficult largely because of lack of uniformity in the subject material and in the criteria to assess the results.

According to the modified ankle scoring system of Olerud and Molander <sup>[4]</sup>, the current study showed that excellent and good results were achieved in 80 % in group1 patients (treated with 4mm partially threaded screws) and 90 % in group2 patients (treated with tension-band wiring) (the difference was significant P = 0.049). This agrees with the results of Sang-Hanko and Young-Junpark<sup>1</sup> who was achieved excellent and good results in about 78 % of cases treated with malleolar screws and 89 % of cases treated with tension-band wiring. A

comparison study <sup>[13]</sup> of the relative strength of tension-band fixation versus cancellous bone screw fixation of medial malleolar ankle fractures was performed on ten fresh-frozen lower limbs from five cadavers. The mean force recorded at clinical failure using cancellous screws was 60.98 N (range 33.49 to 117.86 N) compared with 129.30 N using tension-band fixation (range 85.20 to 194.64 N). Therefore, cancellous screws exhibited only 47.16% the strength of tension-band wiring at clinical failure.

In our study the mean time for radiologic bone union was 11 weeks or group1 patients and group2 patients. This is similar to Kim SK <sup>[2]</sup>, Nurul Alam <sup>[9]</sup>, study that was reported a meantime of 12 weeks for malleolar screws and 9 weeks for tension-band wiring.

We have experienced only one case of delayed union (5 %) out of 20 cases of the study and no non-union developed. This case was a 54 years old male treated with 4mm partially threaded fixation and the fracture took around 18 weeks to unite.

The low incidence of delayed union and non-union in our study might be attributed to stable anatomic reduction and limited soft tissue stripping, or due to small number of cases. Mack and Szabo <sup>[10]</sup> reported loss of reduction with the use of tension-band technique as a result of K wires become loose end and migrate proximally. On the other hand Kinik and Mergen <sup>[3]</sup> did not agree with the frequency of this complication and reported that with the proper surgical techniques, wire migration was not a problem. In our study we did not see any wire migration or loss of reduction. Ostrum and Litski <sup>[13]</sup> recently demonstrated the biomechanics advantages of the tension-band over other fixation techniques for medial malleolus. When resisting pronation forces and applying compression force tension-band were four times stronger than malleolar screw. This might explain the faster union rate we were achieved in group2 patients (mean of 9 weeks) as compared with group1 patients (mean of 12week). Rovinsky <sup>[14]</sup> in his study showed that the tension-band is more technically advantageous over other types of fixation for fixation of small fragment fracture of medial malleolus and is not recommended for the fixation of vertical fracture. We agree with these results as in our study we fixed few vertical fractures with horizontally directed malleolar screws but we excluded them from the comparison groups. Savage *et al* <sup>[15]</sup> in his study show Screw fixation alone may provide poor stability against torsion forces. This may requires an additional point of fixation, which may be a second screw or a Kirschner wire. Dr. Jones <sup>[16]</sup> in his study disagrees with these results and showed that single screw fixation had similar results to double screw fixation. In the current study we use additional point of fixation (second screw and K wire) in two cases in which the fragment was large and tend to rotate as screw fixation alone may provide poor stability against torsion forces.

Limitation of movements and swelling of the ankle are usually the result of neglect in treatment of soft tissue. Although better range of motion was noticed in group1 patients (80 %) as compared with group2 (70 %), it did not reach significance (P = 0.628). This could be attributed to wide soft tissue dissection that was needed with the use of tension-band. These results may show similarity with the results of Nurul Alam <sup>[9]</sup> who reported in his study that the group treated with malleolar screw showed better range of motion, however, soft-tissue irritation and prominent symptomatic implants continue to be a cause of patient dissatisfaction and often require secondary surgeries for

implant removal. Ostrum and Litsky<sup>[13]</sup> reported a 15% complication rate related to painful prominent medial implants. During surgical fixation of medial malleolar fractures excessive pressure with bone clamps to hold the fracture reduction must be avoided to prevent crushing of the fragment particularly if the bone is osteoporotic. The fracture reduction instead can hold temporarily with K wire. Careful and meticulous soft tissue handling is important for prevention of postoperative wound complications, delayed union, and, joint stiffness. We did not face any case of osteoarthritis during the follow-up period. The reason could be explained by the fact that the anatomic reduction was stable and no non-union or it may be due to short follow-up period.

## Conclusions

1. The tension-band wiring is more technically and clinically advantageous for small fragments and large fragments fixation of medial malleolar fractures.
2. Duration of radiological union which was achieved with the use of tension-band wiring is comparable with 4mm partially threaded screw.
3. Soft-tissue irritation and prominent symptomatic implants continue to be a cause of patient dissatisfaction and often require secondary surgeries for implant removal with tension band wire. Also screw removal is easy process can be removed percutaneously as compared to tension band wire which requires more soft tissue dissection.
4. Open reduction preferred over Percutaneous fixation using screws as mostly periosteum get interposed between fracture site preventing anatomic reduction and union.

## Recommendations

We recommending the tension-band wiring over 4mm partially threaded screw for fixation of small fragment medial malleolar fractures as the clinical problem of avulsion fractures that are too small to accept screws. Tension-band wiring with stainless steel has proven to be an effective treatment for these types of fractures.

## Conflict of interest

No conflict of interest to authors

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