Malleolar Screw Versus Tension-Band Wiring In Treatment For Closed Fracture Of Medial Malleolus

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Abstract:

Introduction: Large, one-piece, medial, malleolar fractures are usually fixed with single or two lag screws. The tension band wiring is indicated for fixation of small medial fragments, avulsion fractures, or osteoporotic bone.

Aim of study: To compare between two methods of internal fixation of displaced closed fractures of medial malleolus malleolar screw and tension band wiring. (comparative study between malleolar screw & TBW, in treatment for displaced closed fractures of medial malleolus)

Patients & Methods: A cross sectional study carried out in Al-Yarmouk Teaching hospital from April, 2012 to June, 2013 on twenty patients with displaced closed fractures of medial malleolus treated by open reduction and internal fixation with either malleolar screw (I) or with tension-band wiring (II) divided equally with ethical consideration. After surgery, all the patients were reviewed at 10 to 14 days, six weeks, three months, six months and one year after operation. At each assessment we perform a physical and radiological examination included in a prepared questionnaire for each patient.

Results: No significant differences were observed between two groups of the patients regarding age, gender, fracture type and etiology. The mean time for radiological bone union was 11.8 weeks in group I patients and 9.4 weeks in group II patients (p=0.03). Excellent and good results were achieved in 80% in group I patients and 90% in group II patients. (p=0.049). Assessment of complications revealed no significant differences except for delayed union that was more prevalent among group I.

Conclusions & Recommendations: Tension-band wiring more valid option for internal fixation of medial malleolar fractures that may be more available and its usage could translate into overall cost saving when applied to the large number of ankle fractures treated surgically in our country.

Key words: Malleolar Screws, Tension band wiring, Malleolus.

Introduction:

Ankle fractures account for 9% of fractures representing a significant portion of the trauma workload: proximal femoral fractures are the only lower limb fracture to present more frequently. (1) Ankle fractures have a bimodal age distribution with peaks in younger males and older female. (2).

There has been three-fold increase in the incidence amongst elderly females over the past three decades. (3) Two other common classification systems for rotational ankle fractures attempt to aid in this distinction; The Danis-Weber classification system is more practical system for classifying ankle fractures (4, 5) and The Lauge-Hansen system, a mechanistic classification. (6) Non-displaced fractures can almost always be successfully treated non-operatively with close follow-up. Most displaced bimalleolar fractures benefit from operative reduction and fixation if no surgical contraindications exist. Certain displaced-ankle fractures can be treated with closed reduction, and if successful, carefully followed to union with non-operative treatment. (7, 8) Large, one-piece, medial, malleolar fractures are usually fixed with single or two lag screws (4.0-mm partially threaded cancellous screws or 4.5mm malleolar screws). While small-fragment fixation includes the use of a single lag screw with a K wire, small diameter screws, or tension band wiring. **(**9)

The tension band wiring is indicated for fixation of small medial fragments, avulsion fractures, or osteoporotic bone. The tension band converts tensile forces into compression forces as showing in figure (1).

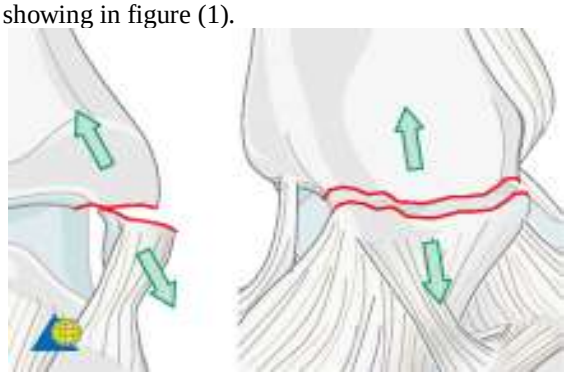

Figure 1: Tension band principle. (10)

In order to be able to use a tension band, the opposite cortex needs to have contact and be able to resist compression as showing in figure (2).

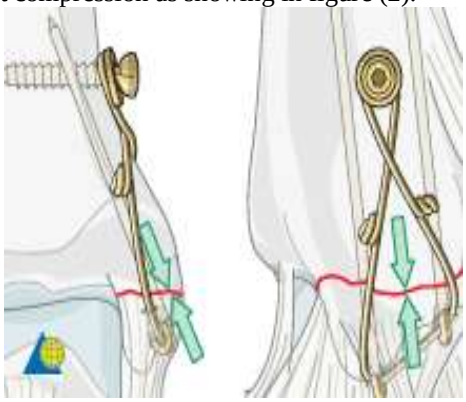

Figure 2: The figure-of-eight wire loop lies on the medial (tension) surface of the medial malleolus and acts as a tension band when tightened. (10)

Post-operative complications (1) are:

1-Early that includes: A-Vascular injury. B-Wound breakdown. C-Infection.

2-Late: included: A-Mal-union. B-Non-union. C-Joint stiffness. D-Algodystrophy. E-Post-traumatic arthritis.

Patients and methods:

Study design

A cross sectional study carried out in Al-Yarmouk Teaching Hospital for period from April, 2012 to June, 2013.

Population

All patients admitted to Al-Yarmouk Teaching Hospital with displaced closed fractures of medial malleolus.

Exclusion criteria

- ✓ Patients refused to participate.
- ✓ Those with vertical fractures of medial malleolus because these fractures usually require horizontally directed screws and difficult to be fixed internally by tension band wiring.

Sampling

A convenient sample of twenty patients with displaced closed
fractures of medial malleolus. They were then allocated to one of two treatment groups:

1. Group I (10 patients) had malleolar screw fixation.
2. Group II (10 patients) had tension-band wiring.

The two groups were comparable in age (mean 37 years), sex, fracture type (Weber type B and C), and etiology (twisting, fall, or motor vehicle accident). The fractures were classified according to the Denis-Weber classification.

Data collection

The data were collected from selected patients through a prepared questionnaire included:

Preoperative planning:

In emergency unit the researcher reported information as name, age, gender, residence, date of injury, mechanism of injury, type and site of fracture. On admission, general condition of the patient was assessed with regards to hypovolemia, associated orthopedics or other systemic injuries and resuscitative measures taken accordingly. Routine investigation including Hb, RBS, Renal faction test, CXR, was done to all patients. Clinical assessments of the injury were done to all patients. The surgery was performed before the ankle swells up or when the swelling subsided, which was usually after 10 to 15 days of elevation (on average).

Surgical Technique:

All the patients in this study were operated upon under general anesthesia after preoperative assessment. After routine skin preparation and draping, anteromedial incision was done 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. In group I patients, 3.2 mm hole was drilled 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 a malleolar screw (4,5mm) was inserted without tapping also to prevent the screw head from sinking into the thin malleolar cortex, the use of a washer is recommended especially in osteoporotic bone figure (3).

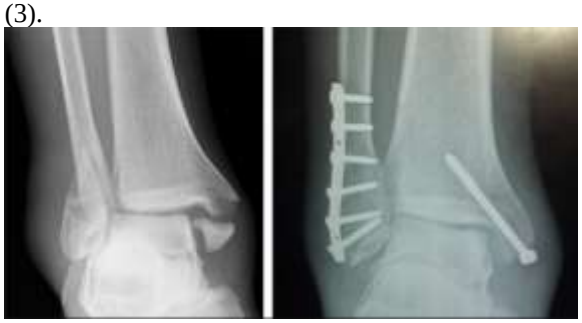

Figure 3: Pre-and postoperative x-rays of patients in group I treated with malleolar screw.

In group II patients the fracture was internally fixed with two 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 showing in Figure 4.

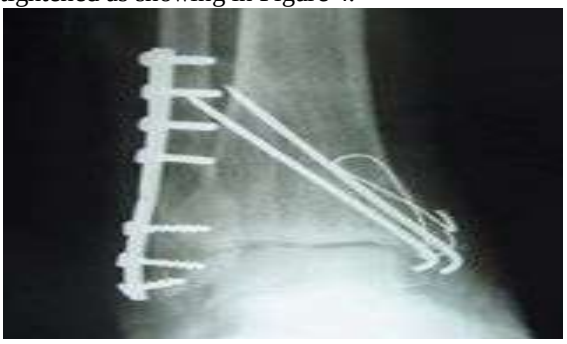

Figure 4: Postoperative x-rays of patient in group 2 treated with tension band wiring

Follow up:

All the patients were reviewed at 10 to 14 days, six weeks, three months, six months and one year after operation. At each assessment we perform a physical and radiological examination.

Evaluation:

The patients were evaluated clinically, radiologically, and functionally using a modification of the scoring system Proposed by Olerud and Molander. The scores for each component of this scale were assessed by the 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).

Statistical analysis:

All patients' data entered using computerized statistical software; Statistical Package for Social Sciences (SPSS) version 17 was used. Descriptive statistics presented as (mean ± standard deviation) and frequencies and percentages. Multiple contingency tables conducted and appropriate statistical tests performed. T test was used for continuous variables. In all statistical analysis, level of significance (p value) set at ≤ 0.05 and the results presented as tables and or graphs.

Ethical considerations

- Approval of the study proposal was obtained from Ethical Committee.
- Objectives of the study were clarified and informed consent had been taken from the patients written on ethical paper with privacy [appendix 1].
- Confidentiality of the data was maintained throughout the study.

The researcher was responsible of treating post-operative complications throughout the study.

Results:

There were no significant differences between the two groups in age (median 37 years), sex, fracture type and etiology. 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.

The mean time for radiological bone union (indicated by disappearance of fracture line) was 11.8 weeks (ranging from 8 to 18 weeks) in group I patients and 9.4 weeks (ranging from 6 to 12 weeks) in group II patients (P=0.03) as in figure (5). No patients had any sign of fixation failure or Kirschner wires migration. According to the modified ankle scoring system of Olerud & Molander, 1(10%) patients in group I and 2(20%) patients in group II were excellent: good in 7(70%) patients in group I and 7(70%) in group II: fair in 1(10%) patients in group I and 1(10%) in group II: poor in I (10%) patients in group I and non in group II patients as in figure (6). Excellent and good results were achieved in 80% in group I patients and 90% in group II patients. (p=0.049).

Complications

Intraoperative:

During reduction of the fracture, use of instruments such as pointed clamps to align and hold the fragments can cause further comminution or crushing of the medial malleolus especially in osteoporotic bone, this complication occurred in one case (5%) and it was difficult to fix such fracture using malleolar screws. We removed the bone clamp and fixed the fracture using two Kirschner wires and tension-band wire.

Postoperative:

1. Skin necrosis. Necrosis of the skin edges at the site of the operation was recorded in two patients (10%), one in group1 and the other in group2 patients. They were treated with meticulous debridement of the necrotic skin and dressing.
2. Superficial wound infection. It developed in 2 patients (10%). One in group1 and the other in group2. The condition resolved with local wound care, regular dressing and antibiotics (Broad spectrum A.B.).
3. Delayed union. only one case (5%) out of 20 cases develops this complication. The patient was female aged 49 years, diabetic; she is treated by malleolar screw (group1 patients). The patient continues to have pain on the medial side of ankle joint after 12 weeks of fixation and the fracture takes around 18 weeks to unite radiologically. During this period, we continue in protection of the fracture with splint and full weight-bearing was also delayed, table (2).
4. Limitation of movement. Clinically the loaded dorsal range of movement was measured at the final follow-up examination by standing the patients on a small elevated box with the knee and hip flexed. Both ankles were measured. 80% of group1 patients compared with 70% of group 2 patients had ankle dorsiflexion greater than 15 degrees (p=0.628).

Osteoarthritis was assessed by radiological observation of the joint space, osteophyte formation and ligament calcification.

However, no patient developed such complication in this study, and this may be due to short follow-up duration.

Tab 1: The details of 20 patients with medial malleolar fractures

Variable	Group1 (malleolar screw)	Group2 (tension- band)
Mean age in years	37 (24-50)	37 (21-53)
Male: female	4:6	4:6
Right: left	5:5	6:4
Weber B:Weber C	7:3	7:3
Causes of the fracture		
Twisting	6	6
Fall	2	3
Motor cycle accident	2	1

Figure 5: The mean time of radiological union.

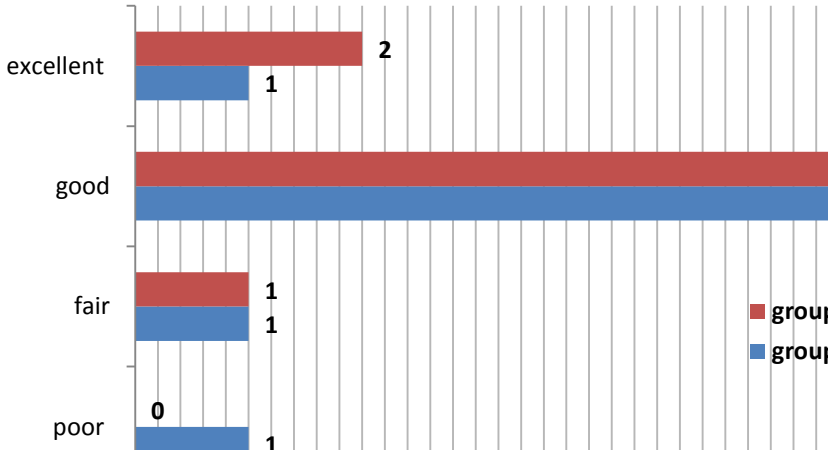

Figure 6: The results as comparison between two groups.

Table 2: The distribution of the patients with medial malleolar fractured according to intra & post operation complication.

complications	No.	%
Intra operation: Medial malleolar crushing	1	16.6
Post operation: Skin necrosis	2	33.3
Superficial wound infection	2	33.3
Delayed union	1	16.6

Appendix 1: Informed consent paper.

Discussion:

According to the modified ankle scoring system of Olerud & Molander[(11)], the current study showed that excellent and good results were achieved in 80% in group1 patients (treated with malleolar screws) and 90% in group2 patients (treated with tension-band wiring). This agrees with the results of Sang-Hanko and Young- Junpark study who were achieved excellent and good results in about 78% of cases treated with malleolar screws and 89% of cases treated with tension-band wiring [(12)] The mean time for radiological bone union was 11.8 weeks (ranging from 8 to 18 weeks) for group1 patients and 9.4 weeks (ranging from 6 to 12 weeks) for group 2 patients. This is similar to Nuru SK, et al. study that was reported a mean time of 12 weeks for malleolar screws and 9 weeks for tension-band wiring. [(13)] In this study one case of delayed union (5%) out of 20 cases of the study and no non-union developed. This result slightly differs from the results of Nuru SK, et al. study who achieved 100% union rate in both groups without any case of delayed union [(14, 15, 16).]

Authors reported loss of reduction with the use of tension band technique as a result of Kirschner wires become loosened and migrate

proximally [17]. On the other hand, many authors did not agree with the frequency of this complication and reported that with the proper surgical techniques, wire migration was not a problem [18, 19]. In this study we did not see any wire migration or loss of reduction. Limitation of movements and swelling of the ankle are usually the result of neglect in treatment of soft tissue.

In this study better range of motion was noticed in group1 patients (80%) as compared with group2 (70%).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 Nuru SK, et al. study who reported in his study that the group treated with malleolar screw showed better range of motion [13].

Tension-band fixation of the medial malleolar fractures has been described or referred to previously by many authors [20-22]. Ostrum & Litski recently demonstrated the biomechanic advantages of the tension-band over other fixation techniques for medial malleolus [19]. When resisting pronation forces and applying compression force tension-band were four times stronger than malleolar screw [23]. This might explain the faster union rate we were achieved in group2 patients (mean of 9.4 weeks) as compared with group1 patients (mean of 11.8 weeks). Rovinsky 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 [24]. Screw fixation alone may provide poor stability against torsional forces [25, 26]. This may require an additional point of fixation, which may be a second screw or a Kirschner wire. Dr. Jones in his study disagrees with these results and showed that single screw fixation had similar results to double screw fixation [26]. In the current study we use additional point of fixation (second screw and Kirschner wire) in two cases in which the fragment was large and tend to rotate.

Conclusion:

The present study concluded that tension-band wiring more valid option for internal fixation of medial malleolar fractures and more technically advantageous for small fragment fixation of medial malleolar fractures. The tension-band wiring may be more available and its usage could translate into overall cost saving when applied to the large number of ankle fractures treated surgically in our country.

Limitations of the study

1. Small sample size.
2. Loss to follow up.
3. Selection bias.

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