Operative Management of Trimalleolar Fractures

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Abstract

Introduction
Fractures and fracture dislocations of the ankle are common, most of them are caused by twisting mechanism and usually need operative fixation. Trimalleolar ankle fractures can be difficult to manage and convey a high risk of long-term morbidity(1).

Aim of study
Assessment and evaluation of operative management of primary trimalleolar fractures with refernce to results and possible complications in 20 cases.

Patients and methods
This prospective study involved 20patients with trimarlleolar fracture in the period between May 2016 and December 2017. They were treated in the hospital and evaluated after 3 and 6 months. The posterior malleolus in 11 cases was treated by anteroposterior fixation with one or two lag screws and in 9 cases was treated by ligamentotaxis.

Results
The results showed no statistically significant relation between the posterior fragment size and olerud and molander score with better outcome in the patients treated with anteroposterior fixation of the posterior malleolus.

Conclusion
Our study supports a direct role of fixation of the posterior malleolus in postoperative follow up and rehabilitation.

Keywords
Trimalleolar Fractures, Posterior malleolus, ankle.

Introduction

The foot and ankle support and propel the body and are well adapted for these roles. During running and jumping, loads well in excess of 10 times body weight are transmitted through the ankle and foot. If this loading is excessive, or excessively repeated, it can lead to foot and ankle injuries[2].

The ankle is a close-fitting hinge-like joint of which the two parts interlock like a mortise (the box formed by the distal ends of the tibia and fibula) and tenon (the upward projecting talus). The mortise bones are held together as a syndesmosis by the distal (inferior) tibiofibular and interosseous ligaments, and the talus is prevented from slipping out of the mortise by the medial and lateral collateral ligaments and joint capsule[3].

Fractures and fracture dislocations of the ankle are common. Most are low-energy fractures of one or both malleoli, usually caused by a twisting mechanism. Less common are the more severe fractures involving the tibial plafond, the pilon fractures, which are high-energy injuries often caused by a fall from height [4].

Fractures of the medial and lateral malleoli are frequently associated with fractures of the posterior malleolus, comprising trimalleolar fractures. The posterior fragment may be posteromedial or posterolateral and its size determines the necessity for surgical or non-surgical treatment [5]..

Trimalleolar ankle fractures can be difficult to manage and convey a high risk of long-term morbidity. The question of whether internal fixation of the posterior malleolar fragment is warranted remains open [6].

Aim of the work

Assessment and evaluation of operative management of primary trimalleolar fractures with reference to results and possible complications in 20 cases.

Patients and Methods

Type of the study and number patients:

In the period between May 2016 and December 2017 in **Al-Zaitoun** specialized hospital, a prospective study was conducted involving 20 patients with Trimalleolar fracture The youngest was 20 years old, and the oldest was 56 years old a mean age **(40 years and2 months)**,12 cases were females and 8 cases were males.

The posterior malleolus in eleven cases was managed by antero-posterior lag srew fixation of the posterior malleolus, while the other nine were managed by conservative method. The follow up period of the cases ranged from 6 to 10 months. No cases were lost to follow up.

Inclusion criteria:

- Patients with acute trimalleolar fractures.
- Patients who are skeletally mature.
- Patients with significant involvement of the posterior malleolus.

Exclusion criteria:

- Revision cases.
- Cases of any plane deformity prior to fracture.
- Patients who are suffering from vascular or neurological problems in the ipsilateral limb.
- Patients with walking disturbance before the fracture.
- Patients with pathologic fractures.

Sex Distribution

Twelve cases were females and eight cases were males.

Age Distribution:

Affected Side Distribution:

Eleven patients had fractures on the right side and nine patients on the left side.

Mode of Trauma:

Seven patients had MVA, Four patients had their injury due to sport injuries and seven patients had industrial accident.

Assessment:

Patients were assessed preoperatively, immediately after surgery, 3 months and 6 months postoperatively using History taking, clinical examination, Olerud and Molander Scoring system and x-rays.

The Olerud and Molander fuctional score (O&M functional score) assesses pain, swelling, stiffness, swelling, stairs climbing, running, jumping, squatting and supports. The O&M functional score also was measured in 4 categories according to the patient's score on a maximum of 100 (excellent >95; good 91–95, fair 81–90, bad <80).

For data analysis, an event of interest was considered a favorable outcome, that is, a good or excellent result.

Lag time between trauma and surgery:

Time before surgery ranged from two days to a maximum of seven days, with a mean of approximately 5 days.

Patients and methods

Like any other operative procedure in orthopedics, management of Trimalleolar fractures is divided into preoperative, intraoperative, post-operative stages and rehabilitation.

Pre-operative Stage

This includes: Patient counseling, clinical evaluation (history, general examination and local examination), radiological evaluation, patients distribution and preoperative preparation of the patient.

Patient Counseling:

The followings were discussed with the patients in depth:

The proposed procedure, preoperative investigations, details of the operative procedure, Post-operative rehabilitation program and average time of this program, The possible complications, The anticipated outcome.

Patient counseling was essential in order to decrease patient anxiety and to get the maximum patient' cooperation.

Clinical Evaluation:

Each patient in this study was carefully assessed clinically by taking a detailed clinical history and performing a thorough examination.

Clinical History:

The clinical history aimed to cover the following:

The mechanism of injury, the time of the injury to the moment of presentation at the emergency department, any pre-existing history of ankle injury, any previous surgery, especially involving the ankle and foot.

Pre-assessment of the patient by anaesthesiologist to identify fitness and prerequisites of surgery (general history taken about cardiac, chest, renal, and hepatic problems, and chronic medical illness as diabetes mellitus or hypertension).

Clinical Examination:

A comprehensive general examination of each patient was performed. After evaluating the patient's general condition, local clinical examination was performed with particular emphasis on the following:

1. Observation of the soft tissue envelope with special attention to the degree of swelling, presence of fracture blisters, areas of ecchymosis especially located over the medial aspect indicating the presence of medial side injury, as well as the presence of any associated wounds or skin tenting over obvious deformities

2. Complete neurovascular examination of the involved extremity including a check of the dorsalis pedis and posterior tibial pulses as well as complete sensory and motor examination of the injured ankle.

Then, the following demographic data and diagnosis sheet is then completed:

* Patient research number, name, gender, age, patient's job, affected side, date of trauma, diagnosis, patient's activity level and associated medical illness.

Radiological Evaluation:

A precise radiological evaluation is the corner stone for a proper management of trimalleolar fracture. The aim of pre- operative radiological evaluation was to:

Understand the fracture pattern and mode of injury, determine the fracture type, stability and any associated injury, determine the best approach to the injury.

Radiological evaluation consisted of plain radiographs. Each patient underwent an ankle trauma series which included antero-posterior (AP) view, lateral and mortise views.

Laboratory investigations:

- CBC to evaluate patients haemoglobin level.
- Other laboratory investigations to assess the general condition of the patient (Bleeding profile, liver function test, kidney function test).
- Random blood sugar to control cases with diabetes.

Preoperative Preparation of the Patient:

All the patients received a prophylactic parenteral antibiotic (first generation cephalosporin) 1000 mg/12 hours 24 hours pre-operatively and continued for 2 post-operative days. The affected limb was shaved then scrubbed with betadine prior to surgery.

Operative Stage

Anesthetic technique:

Anesthetic technique was the decision of the anesthetist according to the patient health status and intraoperative conditions.

Asepsis:

Patients were operated in conventional operating room. The number of persons in the operative theatre was kept to a minimum, as possible. Traffic in and out of the theater was minimized as possible.

Antibiotics:

One dose of first generation cephalosporin was given intravenously for every patient at the induction of anesthesia.

Surgical procedure for Trimalleolar Fractures

Position:

All cases had supine position

Fixation of lateral malleolus

Approach: Direct Lateral approach to the fibula

Procedure

8 cases were fixed with neutralization plate and lag screw and 12 cases were fixed with compression plate.

Fixation of medial malleolus

Approach Posteromedial approach to the medial malleolus.

Procedure

7 Cases were fixed by tension band and K wires.
Two cases were fixed with 1 lag screw.
The medial malleolus in the rest of cases was fixed by 2 lag screws.

Fixation of Posterior malleolus

Nine cases were fixed with **ligamentotaxis** as the posterior malleolus of these cases was less than 25% in relation to the distal tibial articular surface.
Two cases were fixed by 1 antero-posterior lag screw.
Nine cases were fixed with 2 antero-posterior lag screws.

Technique of fixation

Ligamentotaxis:

Following fixation of the fibular fracture, reduction of the Volkmann's triangle may be attempted through ligamentotaxis by dorsiflexing the foot.

If necessary, the Volkmann's fragment is holded in place with a dental hook through the lower extent of the lateral approach used for the fixation of the fibula.

If anatomic reduction of the Volkmann fragment is achieved with these methods, it can be fixed with screws inserted anteriorly.

Screw selection

The chosen 4.0 mm cancellous screw must lie with its

threads completely beyond the fracture line and totally within the Volkmann's triangle, in order to achieve good interfragmentary compression. If possible, engage the posterior cortex. Use a washer.

If the thread of the 4.0 mm cancellous screw should come to lie on both sides of the fracture, a 3.5 mm cortex screw is inserted as a lag screw instead, overdrilling the anterior tibia as a gliding hole.

Insertion of the first screw

One K-wire is removed and a hole is drilled through both fragments parallel to the K-wire, using a 2.5 mm drill bit and protection sleeve.
The depth of the hole and tap the near tibial cortex with the 4.0 mm cancellous tap and protection sleeve. A4.0 mm cancellous screw is inserted with a washer.

Insertion of the second screw

The K-wire is removed.

As a rule, a screw which is 5 mm longer than the measured size must be chosen for the second screw as the more medial portion of even a large Volkmann's triangle is often not deep enough to accommodate the whole of the threaded portion of the cancellous screw.

The screw tip may therefore protrude a little posteriorly.

If the thread of the 4.0 mm partially threaded screw would still come to lie on both sides of the fracture, or to prevent protrusion of the tip of the screw into the posterior soft tissues, A 3.5 mm cortex screw is inserted as a lag screw.

Postoperative Stage

Patient Transfer procedure:

The transfer procedure was supervised. The foot and ankle was held in a combined back and side to side slab. The peripheral circulation got assessed.

Recovery Room:

The patient was observed and pulse oxymeter was applied to record the pulse and the oxygen saturation. In addition, the blood pressure was checked.

In the Ward:

Regular vital signs and patient general condition evaluation as well as assessment of the peripheral circulation of the involved extremity was performed.

Patients received intravenous 1st generation cephalosporin for 2 days postoperatively, followed by oral broad spectrum antibiotics.

Patient controlled analgesia was continued for the first 36-48 hours.

Second-day post-operative radiographs were done.

Post-disharge Period:

Oral Antibiotic was continued after patient' discharge till the 7th post-operative day.

Wound condition was followed till stitches were removed at the end of the second to third week postoperatively.

After stitches removal, slab exchange with another one permitting active range of motion exercises was done.

Rehabilitation:

Non-weight bearing was instructed for 6 weeks with active range of motion exercises followed by graduated weight bearing up to full weight bearing according to patient condition and state of union.

Statistical analysis

Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

– Probability (P-value)
– P-value <0.05 was considered significant.
– P-value <0.001 was considered as highly significant.
– P-value >0.05 was considered insignificant.

Results

A prospective study was conducted involving 20 patients with trimalleolar fracture The youngest was 20 years old, and the oldest was 56 years old a mean age **(40 years and2 months)**, 12 cases were females and 8 cases were males.

The posterior malleolus in eleven cases was managed by antero-posterior lag srew fixation of the posterior malleolus, while the other nine were managed by conservative method. The follow up period of the cases ranged from 6 to 10 months.

The cases were assessed with Olerud and Molander Ankle Score After 3 and 6 months of postoperative follow up **Table** (1).

As regard postoperative complications;13 cases had no complications,1 case had shoe wear discomfort,2 cases had superficial infection,1case had DVT,1 case had postoperative ankle stiffness

1 case had delayed union and one case had failure of fixation **Table (**2**)**

The results showed significant relation between age and O&M score **Table (**3**)**

There were no significant relation between O&M score and posterior fragment size **Table (**4**)**

Table (1): Olerud and molander score distribution of the study group.

Olerud and Molander score	After 3m		After 6m		x2	p-value
	No.	%	No.	%		
Excellent	0	0	5	25	9.855	0.019
Good	4	20	6	30		
Fair	7	35	7	35		
Bad	9	45	2	10		
Total	**20**	**100**	**20**	**100**		

Table (2): Complications distribution of the study group.

Complications	No.	%
Non	13	65
Shoe wear discomfort(prominent hardware)	1	5
Superficial infection	2	10
DVT	1	5
Stiffness	1	5
Delayed Union	1	5
Failure of fixation	1	5
Total	20	100

Table (3): Relation between Olerud and Molander score and age (years).

Age (years)		Olerud and Molander score				Chi-square test	
		Bad	Excellent	Fair	Good	x2	p-value
≤40	No.	0	5	0	4	14.813	0.002
	%	0.0%	100.0%	0.0%	66.66%		
>40	No.	2	0	7	2		
	%	100.0%	0.0%	100.0%	33.33%		
Total	No.	2	5	7	6		
	%	100.0%	100.0%	100.0%	100.0%		

Table (4): Relation between Olerud and Molander score and posterior fragment size.

Posterior Fragment Size		Olerud and Molander score				Chi-square test	
		Bad	Excellent	Fair	Good	x2	p-value
<25%	No.	2	4	2	1	7.629	0.054
	%	100.0%	80%	28.57%	16.66%		
>25%	No.	0	1	5	5		
	%	0.0%	20%	71.42%	83.33%		
Total	No.	2	5	7	6		
	%	100.0%	100.0%	100.0%	100.0%		

Figure (1): A: AP and lateral pre-operative radiographs. B: AP and lateral intraoperative radiographs. C: 3 month AP and lateral post-operative radiographs.

Discussion

On our study the main supervisor devised for the assessment of operative management of trimalleolar fractures, it was conducted over 20 patients the youngest was 20 and the oldest was56 with mean age 40.15 years 60% of the patients were females and 40% were males. 35% of patients were presented to ER on MVA, 35% of the patients were presented due to industrial injury, 20% due to sport injuries and 10% due to other causes.

The posterior tibial fragment in 11 cases was more the 25% of the distal tibial articular surface, they needed A-P lag screw fixation as the posterior malleolus was reduced after fixation of the lateral malleolus.

In 9 cases the posterior malleolus was fixed by ligamentotaxis as it was less than 25% of the distal tibial articular surface.

All patients were assessed by Olerud and Molander score at 3 months and 6 months of postoperative follow up.

The Olerud and Molander fuctional score (O&M functional score) was used for postoperative assessment of the cases.

After 3 months of postoperative follow up 4 cases had good results according to O&M score, 7cases had fair results and 9 cases had bad results.

After 6 months of postoperative follow up 5cases had excellent outcome, 6 cases had good results, 7 cases had fair results and 2 cases had bad results.

The excellent and good results were due to accepted reduction of the fracture, absence of postoperative infection and commitment of the cases to the postoperative rehabilitation program.

The fair and bad results were due to presence of postoperative complication, noncompliance to postoperative rehabilitation program and presence of preoperative comorbidities as osteoporosis , diabetes meilletus and hypertension.

For example case number [19] 55 years old female with history of hypertension and osteoprosis complains from right trimalleolar fracture, she had bad O&M score as the lateral malleolus had non accepted reduction and the cases complains from delayed union during the follow up .

Case number 20 with right trimalleolar fracture with history of hypertension and osteoporosis she had bad O&M score as the reduction of lateral and posterior malleolus was not accepted and she had postoperative deep infection due to bad technique of fixation.

From the 7 fair results, 2 cases had postoperative superficial infection, one case had postoperative stiffnes, one case had prominent tension band at the level of medial malleolus and one case had post operative DVT due to tight cast and high body mass index.

There were statistically significant relation between Olerud and Molander score and history.

The results showed statistically significant relation between Olerud and Molander score and posterior malleolus fixation.

Mingo-Robinet and López-Durán (6) had a retrospective cohort study involving 45 patients who underwent surgical repair of a trimalleolar fracture.

In their study better outcomes were obtained in patients whose fractures involved 25% of the articular surface, and the difference in outcomes was statistically significant in regard to the AOFAS scores, although not statistically significant in regard to Olerud and Molander scores. Anatomic reduction was achieved in 73.3% of patients, but they did not have better clinical results than nonanatomic reduction patients. AOFAS results were good or excellent in 29 (74.35%) cases and the O&M results were good or excellent in 21 (53.85%) cases after 2 years of post operative follow up.

Hong et al. (7) had a retrospective review of 205 patients with operatively treated ankle fractures for a period of 2 years was performed. Outcome variables were union rates, pain ratings using the visual analogue scale (VAS) and the Olerud and Molander (O&M) score, ability to return to sporting activities, satisfaction with surgery, and surgical complications oF the 205 patients, 159 had uni-, bi-, and trimalleolar ankle fractures. All these patients had a mean age of 40 years (range, 18-84 years).

The study population had at least 1 year of follow-up with an average of 16 months (range, 12-24 months). 31 (19.5%) patients with trimalleolar fracture. In addition, 20 (12.6%) patients suffered fracture dislocation, and 15 (75%) of these patients had trimalleolar fracture

In general, the majority of their patients with bimalleolar and trimalleolar ankle fractures achieved good to excellent results post fixation according to the O&M score (mean score 82.1), and there were no notable differences in the VAS and O&M score for both groups Presence of DM did not predict a poorer outcome in both groups. Almost all of their patients, 44 (93.6%), were satisfied with the surgery. All cases achieved union.

O Connor et al. (8) in retrospective study over 27 patients with follow up period up to 32 months found no significant difference between A-P vs Posterolateral platefixation of the posterior malleolus in regard to ROM and the incidence of posttraumatic arthritis.

Fixation of the posterior malleolus was by anteroposterior lag screw fixation eleven cases whether sixteen was fixed by posterolateral plate, all cases were assesed by Short musclo-skeletal functional assessment scores, the results had significant difference toward the posterolateral plate in regard to the mobility and fuctional outcome but there were no significant difference in the development of posttraumatic ankle arthritis.

Odak and Ahluwali (9) A total of 33 studies (8 biomechanical and 25 clinical) with >950 patients were reviewed. The outcome of ankle fractures with posterior malleolar involvement was poor; however, the evidence was not enough to prove that the size of the posterior malleolus affects the outcome. Significant heterogeneity was noted in the cutoff size of the posterior malleolar fragment in determining management. The outcome was related to other factors, such as fracture displacement, congruency of the articular surface, and residual tibiotalar subluxation. Indirect evidence showed that 1large fracture fragments were associated with fracture dislocations and ankle instability and, thus, might require surgical fixation.

Conclusion

Trimalleolar fractures management depends on the size of posterior tibial fragment.

Antero-posterior fixation of the posterior malleolus was done when the posterior malleolus was reduced after fixation of the lateral malleolus.

OMAS becomes reliable after 6 months of postoperative follow up.

The increase in unfavorable results was due to limitation of the study and presence of postoperative complication. The commitment of the cases to the postoperative rehabilitation program showed good and excellent results.The study yields good and excellent results guarded by aseptic percautions and good operative techniques.

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