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Tri-malleolar Ankle Fractures: Trans-syndesmotic Versus Posterior MalleolarFixation

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Abstract

Background: Trimalleolar fractures are often referred to as posterior malleolar fractures and have been the subject of continuing interest for a long time as one of the most controversial issues of the treatment of ankle injuries. The aim of this work was to evaluate the effect of posterior malleolus fractures direct reduction and internal fixation on syndesmotic injuries reduction, compared to the direct syndesmotic fixation in trimalleolar ankle fractures, on the functional and short radiological outcomes. **Methods:** This was a prospective randomized comparative study on the effect of posterior malleolus fractures reduction and internal fixation on syndesmotic injuries reduction, compared to the direct syndesmotic fixation in trimalleolar ankle fractures, on the functional and short radiological outcomes. Patients were divided into two equal groups: Group A: 15 patients with Posterior malleolar fracture left with no direct reduction and internal fixation and group B: 15 patients with posterior malleolar fragment that was fixed directly by screw or plate and screw. 1 case was excluded from group due to open syndesmosis during cotton test intraoperatively during fixing of posterior malleolus, so the patient needed trans syndesmotic screw. **Results:** Operative duration was significantly lower in group A than group B ($p < 0.001$). Regarding the potential complications of procedures in groups A and B, infection occurred in only 1 (6.67%) patient in group B and didn't occur in group A, and mechanical irritation occurred in only 1 (6.67%) patient in group A and didn't occur in group B.

Keywords: Trimalleolar Ankle Fractures, Trans-syndesmotic, Posterior Malleolar, Fixation.

Introduction

Tri-Posterior malleolar (PM) fractures have long been one of the most contentious ankle injury treatment concerns. The strong and compact posterior tibiofibular ligament originates on the distal tibia's posterior aspect. (1) The PM greatly improves ankle stability and load transfer. PM avulsion of portion of the distal tibia's articular surface should impair load transmission in the tibio-talar joint and syndesmosis stability. Inherently unstable tri-malleolar fractures or comparable ankle fractures usually occur with more force, disrupting the syndesmosis. (1) These injuries need surgery to repair the ankle joint complex and prevent post-traumatic arthritis. (2) Restoring the posterior malleolus improves ankle rotational stability and tibio-talar congruity. More attention is being paid to treating posterior malleolar fractures regardless of size or displacement for direct posterior syndesmosis stabilisation. (3) In most posterior ankle fractures, PITFL may be treated by reducing and fixing the posterior malleolus, which fixes the syndesmosis and eliminates the requirement for transfixation. (4) Anatomic stabilisation of the avulsed posterior tibiofibular ligament stabilises syndesmosis and restores incisura tibiae, allowing distal fibula reduction. (1)

Patients and methods

This is a randomized prospective Comparative study of posterior malleolus fracture reduction and internal fixation on syndesmosis injuries compared to tri-malleolar ankle fractures' direct syndesmosis fixation on functional and short radiological results.

The research was done at Helwan University Hospital and Benha Health Insurance Hospital from December 2019 until the conclusion. Post-op follow-up was 6 months.

Thirty tri-malleolar ankle fracture patients from the emergency department or outpatient clinic were studied. The research population was randomly and evenly split into two groups: Group A: Posterior malleolar fracture was left untreated and only trans-syndesmosis screw fixation was done. Group B: Only posterior fragment was repaired directly by screws or plate and screws.

Our research comprised patients with tri-malleolar ankle fractures, recent fractures (within three weeks), ages 18–65, isolated or poly-traumatized patients, and closed and open fractures. Our research excluded populations with these criteria: Neurovascularly compromised individuals, neglected fractures (greater than four weeks), ankle fracture-dislocation, anterior tibial plafond fractures.

Group A included 9 men and 6 women, while group B had 11 men and 4 women. The

patients in group A were 23–55 years old and in group B, 21–55. B.

Patient Evaluation:

All patients had a thorough medical history, including personal information and distinctive behaviours. smoking, co-morbidities such DM, HTN, current illness, past therapy.

Identify soft tissue changes such swelling, skin tenting, open wounds, and blanching during physical examination. Assessment of neurovascular status should precede first reduction efforts.

Anteroposterior, lateral, and mortise ankle radiographs were taken immediately before reduction in all cases. Surgery planning included preoperative CT.

The patients' clinical history, examination, and pre-operative lab tests determined their surgical fitness. Standard patient consent was obtained.

Surgical Technique:

The surgery was done under general or spinal anaesthetic. Group I patients were supine with a pump under the ipsilateral buttock.

The lateral and medial malleolar fractures were reduced and fixed using conventional ankle techniques. Trans-syndesmosis fixation was established by intraoperative lateral translation stress test and external rotation stress mortis fluoroscopic image.

When fracture fixation attained rotational stability, trans-syndesmosis fixation was not employed. Specifically, a 3.5 mm cortical or 4.5 mm malleolar screw was tri-cortically inserted from fibular plate to tibia 3.5–4.5 cm above the ankle joint. (Figure 1)

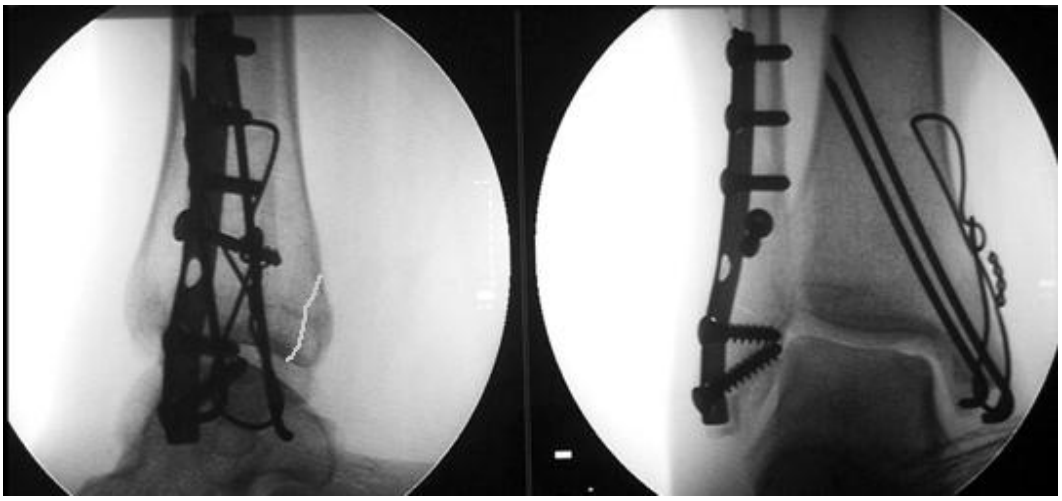

Fig. (1) Internal fixation of medial and lateral malleoli. A: lateral view; B: AP view

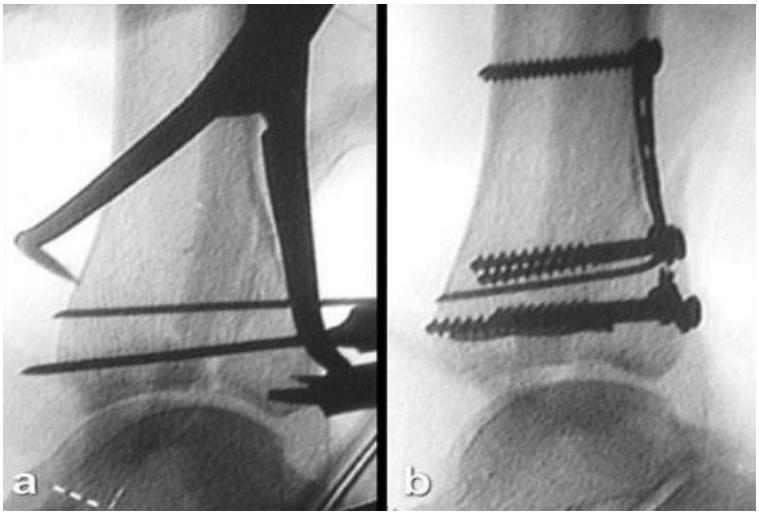

Fig. (2) Posterior malleolus internally fixed. A: K-wire reduction and temporary fastening; B: lag screws and buttress T-shaped plate.

In Group II patients were lateral. We treated the posterior malleolar fracture and fibular fractures posterolaterally at the ankle. Fixation of medial malleolus was medial. Figure 2

Post-operative Following up:

After surgery, AP and Lat x-rays were taken. Patient released the day after surgery on parenteral antibiotics and oral analgesics for 3 days, then oral antibiotics for 5 days. The patient was radiologically and clinically monitored at weeks 1, 2, 4, 8, 12, 16, 18, and 24.

Statistical Analysis

The Statistical Package for Social Science was used to edit, code, tabulate, and import data to a PC (SPSS v20 for windows). Quantitative data were reported as Mean and Standard Deviation (±SD) for parametric data and Median and Inter-quartile range for non-parametric data. Qualitative data was presented using frequency and percentage. According to the data, appropriate analysis was done. Chi square and Fisher extract tests analysed qualitative data, whereas Student T Test or Mann Whitney test analysed quantitative data. P-value ~ 0.05 indicated statistical significance..

Results

The study population was randomly and evenly split into two groups: Group A: Posterior malleolar fracture was left untreated and only trans-syndesmosis screw fixation was done. Group B: Only posterior fragment was repaired directly by screws or plate and screws. The research population was randomly and evenly split into two groups: Group A: Posterior malleolar fracture was left untreated and only trans-syndesmosis screw fixation was done. Group B: Only posterior fragment was repaired directly by screws or plate and screws.

Both groups had similar baseline characteristics (age, gender, smoking, and diabetes). (Table1)

Table (1) Baseline characteristics in both studied groups

		Group I	Group II	P value
Age	**Mean ± SD**	37.87 ± 10.59	40.27 ± 10.44	0.537
	Range	23 - 55	21 - 55	
Gender	**Male**	9 (60%)	11 (73.33%)	0.699
	Female	6 (40%)	4 (26.67%)	
Smoking	**Smoker**	2 (13.33%)	5 (33.33%)	0.389
	Non-smoker	13 (86.67%)	10 (66.67%)	
DM	**Diabetic**	3 (20%)	2 (13.33%)	1
	Non-diabetic	12 (80%)	13 (86.67%)	

Weber and Lauge-Hansen classifications were insignificantly different between the studied groups. Fragment size (%) was significantly higher in group B than group A (p =0.011). (Table 2)

Table (2) Fractures characteristics in the studied groups

		Group I	Group II	P value
Weber classification	**Type B**	3 (20%)	2 (13.33%)	1
	Type C	12 (80%)	13 (86.67%)	
Lauge-Hansen classification	**PER**	11 (73.33%)	12 (80%)	1
	SER	4 (26.67%)	3 (20%)	
ent size(%)	**Mean ± SD**	14.47 ± 3.93	18.93 ± 5.06	0.011*
	Range	10 - 23	10 - 30	

PER: Pronation external rotation, SER: supination external rotation, *statistically significant as p ≤0.05

Time from injury to operation and Length of hospital stay were insignificantly different between the studied groups. Operative duration was significantly lower in Group I than Group II. (Table 3)

Table (3) Surgical characteristics in the studied groups

		Group I	Group II	P value
me from injury to operation (days)	Mean ± SD	2.6 ± 1.06	2 (13.33%)	0.724
	Range	1 - 5	1 - 5	
tive duration(minutes)	Mean ± SD	99.67 ± 7.89	122 ± 4.55	<0.001*
	Range	85 - 115	115 - 130	
th of hospitalstay (days)	Mean ± SD	1.87 ± 0.91	2.13 ± 0.99	0.45
	Range	1 - 4	1 - 4	

*statistically significant as p ≤0.05

Time to complete union and time to full ambulation were significantly lower in Group I than in Group II. Regarding the complications, infection occurred in only 1 (6.67%) patient in group II, and, mechanical irritation occurred in only 1 (6.67%) patient in group I. Nerve injury, re-operation and osteoarthritis didn‘t occur in any patients in both groups. (Table 4)

Table (4) Time to complete union and full ambulation in the studied groups

		Group I	Group II	P value
me to completeunion (weeks)	Mean ± SD	6.33 ± 0.62	7.6 ± 0.98	<0.001*
	Range	6 - 8	6 - 10	
Time to full ambulation (weeks)	Mean ± SD	7.6 ±.63	8.5 ± 0.83	0.002*
	Range	7 - 9	7 - 10	

*statistically significant as p ≤0.05

VAS scores were insignificantly different between the studied groups. But AOFAS scores were significantly lower in group I than group II. (Table 5)

Table (5) VAS and AOFAS score in the studied groups

		Group I	Group II	P value
VAS	Mean ± SD	3.4 ± 0.63	3.4 ± 0.63	1
	Range	3 - 5	3 - 5	
AOFAS score	Mean ± SD	79.67 ± 6.39	85.67 ± 6.51	0.016*
	Range	65 - 90	75 - 95	

VAS: Visual analog scale, AOFAS: American Orthopedic Foot and Ankle Society *statistically significant as p
≤0.05

Discussion

Ankle fractures are prevalent, accounting for 3.92 percent of all body fractures. (5) 7–44% of ankle fractures include posterior malleolus fractures. (6) External talus rotation beneath the tibial plafond with the foot pronated or supinated causes the injury. (7) The PITFL complex stabilises the ankle syndesmosis. Fractures of the posterior malleolus affect tibiofibular syndesmotic stability. (9) The posterior syndesmotic ligaments may stay connected to a damaged posterior malleolus. PITFL integrity is generally indicated by bone failure. (10) Rigid fibula fixation followed by posterior malleolar fracture reduction and fixation may restore PITFL ligamentous tension and support the syndesmosis without trans-syndesmotic fixation.

Gardner et al. found that decreasing and stabilising the posterior malleolus restored 70% of distal tibiofibular articulation stiffness compared to 40% with a syndesmotic screw. Biomechanical model by Van den Bekerom et al. showed that contact stresses shifted anteriorly and medially following a displaced posterior malleolar fracture. (11) Small avulsion fractures are normally left unfixed, but larger pieces comprising >25% of the tibial

plafond need surgical reduction and repair. (12) Post malleolus size does not determine fixation in contemporary literature. Heim recommended internal fixation for all posterior pieces excluding avulsion lip fractures. (13)

This research compared the functional and short radiological results of posterior malleolus fractures' reduction and internal fixation on syndesmotic injuries to tri-malleolar ankle fractures' direct syndesmotic fixation. Complications included infection in 1 (6.67%) patient in group II and mechanical discomfort in 1 (6.67%) patient in group I. No patients in either group had nerve damage, re-operation, or osteoarthritis. Differences in VAS ratings were not significant. However, group I had considerably lower AOFAS ratings than group II.

Our preferred technique of fixation for ankle fractures with posterior malleolus fractures is a posterolateral approach to connect the posterior malleolus with the lateral malleolus, regardless of fracture fragment size, and a medial incision to correct the medial fracture. Flexor hallucis longus and peroneal muscles have a true nerve plane with the posterolateral ankle approach.

Small patient groups have been studied for posterior malleolus fractures. Bois and Dust discovered Grades II or III radiographic osteoarthritis in 67% of their ankle fracture patients at 9.4 years. They found that ankle osteoarthritis radiographic alterations may be easily tolerated early on. (14) Park et al. used posterior malleolar fragments to repair 29 ankle fractures. Syndesmotic screw fixation was employed in 15 instances and posterior malleolar fixation in 14. They observed no significant difference in reduction quality, ankle arthrosis grade, or clinical ratings across groups. (15) Lee et al. examined 10 tri-malleolar fractures. All patients in their series had good AOFAS scores after posterior malleolar fragment open reduction and internal fixation. (16) These results suggest that PITFL may be treated by reducing and fixing the posterior malleolus in most ankle fractures with a posterior fragment, removing the necessity for syndesmotic transfixation.xation.

Conclusion

Successful radiological and functional results following tri-malleolar fracture therapy depend on posterior malleolar fracture repair. Fixing the posterior malleolar fracture may not need trans-syndesmotic screw fixation. Therefore, we propose fixing all posterior malleolar fractures, independent of fragment size.

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