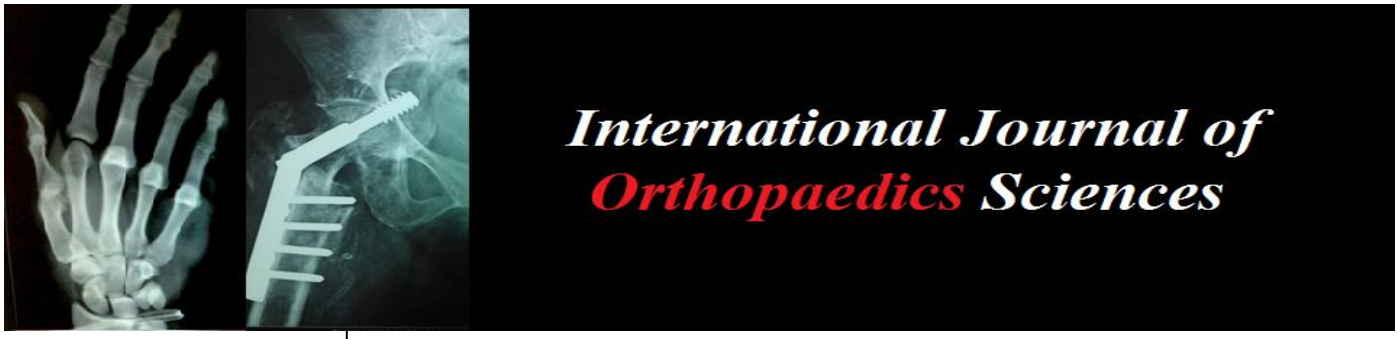

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Functional and radiological outcome of ORIF in bimalleolar and Trimalleolar fractures of ankle: A prospective study

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Abstract
Background: Ankle Fractures are always technically demanding for an Orthopaedic surgeon for management. A stable fracture usually needs minimal splinting whereas unstable fractures need open reduction and internal fixation to achieve near normal anatomical reconstruction.
Materials and methods: Our prospective study was conducted on 23 patients fractures in Tirunelveli Medical College Tirunelveli. With a mean age of 36.17 years at surgery. There were 18 male patients and 5 female patients with an incidence of 78.26% and 21.73% respectively. The right ankle joint was involved in 19 patients and left ankle joint in 4 patients. Most of the injuries were due to RTA with 16 patients and 7 patients had injuries due to self fall.
Results: The overall results were graded based on Olearud Molander scoring system. Excellent results were achieved in 19 patients (82.60%), good results in 2 patients (8.69%) and poor results in 2 patients (8.69%).
Conclusion: In our study, it was observed that the functional outcome of a bimalleolar fracture does not depend upon the type of implant. Irrespective of the implant used, the final functional outcome was similar. Anatomical reduction, restoration of fibular length and stable fixation were found to be essential for achieving good return of joint function.

Keywords: Bimalleolar fractures, Trimalleolar Fractures, Syndesmotic Injury

Introduction
Fractures of the Ankle are one of the commonest lower limb fractures encountered in orthopedic practice possibly due to increase in number of road traffic accidents, fall from heights, etc. Fractures or Ligamentous injury around the ankle makes the joint very unstable. Hence the Tibio-Talar articulation needs to be restored accurately by closed manipulative reduction or by surgical intervention Otherwise it may lead to severe post traumatic arthritis because the Talus takes the entire load of the joint.
The goals in the treatment of these fractures are aimed at near perfect anatomical reduction which includes restoration of normal Distal Tibial articulation Fibular Malleoli such that distal Tibio-Fibular distruption is addressed. Chosen according to the anatomy of the fracture and the bone quality The treatment should benefit the patient not only in the short term but also in the long term. One should have a thorough understanding of the ankle anatomy and mechanism of injury. With a good radiographic interpretation, CT 3D re-construction and basic principles of fracture management excellent results been possible to attain.

Materials and Methods
Our prospective study is From May 2016 to October 2018 in patients who had undergone surgery for Bimalleolar fractures in Tirunelveli Medical College Tirunelveli.

Inclusion Criteria
Male and Female Patients between the ages of 20 to 60 years
Closed Bimalleolar and Trimalleolar ankle fractures

Exclusion Criteria

1. Skeletally immature skeletal fractures.
2. Open bi/trimalleolar fractures.

Physical examination of the ankle is carried out depending on the type of injury. The status of the skin, soft tissue and neurovascular structures as well as the bones and ligaments are examined. The ankle should be examined circumferentially for open or impending wounds. The vascular examination includes inspection for edema and venous engorgement and palpation of the skin temperature, Dorsalis Pedis and Posterior Tibial arteries and capillary filling.

Radiological Evaluation

The standard radiographic evaluation of the ankle includes Anteroposterior, Lateral and Mortise Views.

CT scan: It is useful in evaluating comminuted fractures and complex bone injuries, such as pilon fractures and in case of malunion.

MRI SCAN- is useful in understanding the tendon and other soft tissue injury. It is the best imaging modality for incomplete or subtle fractures not discernible on plain films, for diagnosing osteochondral injury and for following the osteonecrotic changes in the Talus.

Surgical technique

Spinal anaesthesia is used in all patients. operative limb is thoroughly prepped and drapped. lateral malleolus is fixed first. Posterolateral approach is used. Peroneral tendons erased and retracted. Lateral plating done and Locking plates were used in osteoporotic patients Antiglide plating technique used in distal comminution

The fixation of lateral malleolus

In type A fractures as in a large avulsion fracture, is fixed with a one third semi tubular plate over the lateral surface. A single screw can be inserted from the anterolateral aspect and directed superomedially toward the posteromedial cortex. A small fragment is fixed with a K wire or with a tension band wiring.

Type B fractures are usually spiral and oblique and may be long or short. They are fixed with two interfragmentary screws – either 3.5mm cortical or 4mm cancellous screws are generally being used for the distal malleolar segment. If the fixation is not stable another neutralization plate is added on the lateral side. If the fracture is short then a single one third tubular plate is fixed. The fixation of the plate should allow atleast four cortices fixation in the proximal fragment as the lower part has the articular surface on its medial aspect. The plate placed on the lateral aspect is bent to accommodate the bend of the fibula. If this is not done then the lateral bend of the fibula is obliterated and the talo fibular part of the joint is narrowed with the subsequent dysfunction and degenerative changes.

In Type C fractures the fibular shaft needs to be stabilized with a one third tubular neutralization plate of a length which will allow the 4 to 6 cortices for screw fixation on either side of the fracture the plate being placed on the lateral aspect and contouring at the lower end. The anterior tibio fibular ligament needs to be explored. An avulsion from the Chaput tubercle is fixed with a screw. A transverse fracture of the lower end is fixed with compression by eccentric placement of the screw on either side of the fracture. Intramedullary fixation with either a K-wire or TENS nail can be done.

A large butterfly fragment is fixed by an interfragmentary 2.7mm AO lag screw proximally to distally or it can be incorporated in the plate. In case of shortening then the fibula lower end is pulled down with the help of a towel clip and is temporarily fixed with a K wire passing transversely into the talus and is verified with a radiograph. A posterior malleolar fracture is fixed if the fragment is more than 25% of the articular surface. The anterior tibiofibular ligament is repaired and a syndesmotic screw is passed.

Fig 1: Mulitimodal Approach In Fixation Of Lateral Malleolus

Management of A Diastasis

As is seen in type C Weber injury and in case of supination external and pronation abduction and pronation external rotation injuries, various maneuvers are suggested to test the integrity of the syndesmosis.

They are maximal dorsi flexion of the foot, mediolateral movement of the heel (Cottons test), abduction and external rotation of the foot and a lateral pull of the fibula with a syndesmotic hook. If there is instability and there is lateral displacement of the fibula then it is an indication of fixation with a syndesmotic screw. A 4.5mm cortical screw inserted through the fibula into the tibia. It is placed 2-3 cms above and parallel to the ankle joint. As the fibula is posterior in relation to the tibia the point of screw entry is from the fibula posterolaterally and is directed 30° anteriorly in the antero medial direction into the medial tibial cortex. The foot needs to be kept in maximum dorsiflexion during this procedure. The hole is drilled, tapping both the tibia and the fibula and held reduced.

One syndesmotic screw is sufficient but in case of a high fibular fracture or ruptured interosseous membrane and if the posterior syndesmosis is not repaired two screws are applied The syndesmotic screw is never a lag screw as compression is not required and if possible can be incorporated into the plate.

This is retained for 6-8 weeks and is removed before weight bearing is advised.

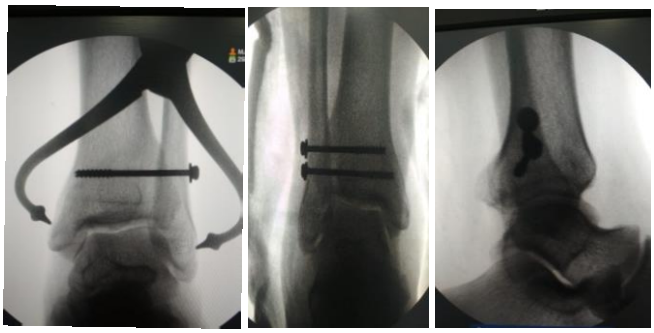

Fig 2: Syndesmotic Fixation

Fig 3: Fixation through plate

Fixation of the posterior malleolus

Fracture of the posterior malleolus is usually seen on the medial side. It can be fixed once the medial malleolus is stabilized. It can be fixed with one or two 4mm AO cancellous screw.

The fractured posterior malleolus is located laterally at the site of the attachment of the posterior tibiofibular ligament in the Volkmann triangle and is sometimes referred to as Volkmann's fracture. If the fragment size is involving more than 25% of the articular surface it needs to be fixed. On reducing the lateral malleolus the posterior fragment usually falls back to place but in case there is still a residual displacement it is manipulated by dorsiflexion of the ankle and by dorsiflexion of the great toe as this manoeuvre stretches the posterior capsule and the Flexor Hallucis Longus. Once reduction is achieved, a 4mm cancellous screw is placed in anteroposterior direction through a small stab incision placed on the anteromedial aspect of the ankle.

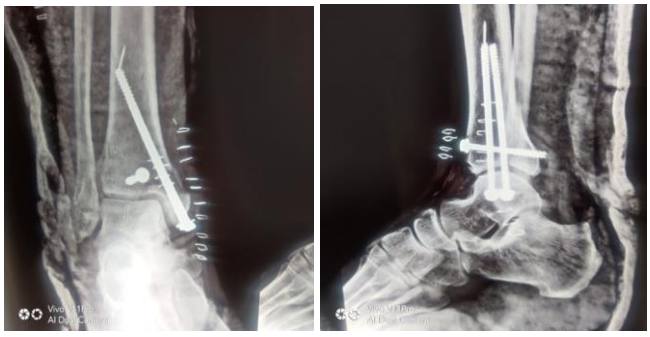

Fig 4: The direction of the screw is posterolateral.

If the fragment remains unreduced even after the manipulation then open reduction is carried out. This can be made by a posterolateral approach or by an extended lateral approach depending on the circumstances. The fracture site is exposed and after complete reduction of the fragment is the fixation done. The periosteum elevator is used and the fragment is reduced to the position and fixed with two K wires. Following verification under radiography one or two 4mm cancellous screws is used in a posterolateral to anteromedial direction keeping the screw perpendicular to the fracture site. The posterior malleolus can be approached from a posteromedial side but is a bit cumbersome.

Fixation of the medial malleolus

Fracture of the medial malleolus in case of a Type A Weber or a supination adduction where the fracture is vertical and at the level of the tibial plafond. The fracture is fixed with two 4mm AO cancellous screws placed perpendicular to the fracture. Fracture of the medial malleolus in types B and C is an avulsion fracture often distal to the plafond and in type C often horizontal. It is fixed as in type A by a 4mm AO cancellous screw placed perpendicular to the fracture. In case two screws cannot be inserted then a K wire is put to give rotational stability. Tension band wiring is equally effective method. A circlage wire taken in a form of figure of 8 around two K wires and is tightened following the stabilization. Vertical fractuire pattern stabilized with horizontal screws or plating as well. Open reduction is always done due to periosteal interposition.

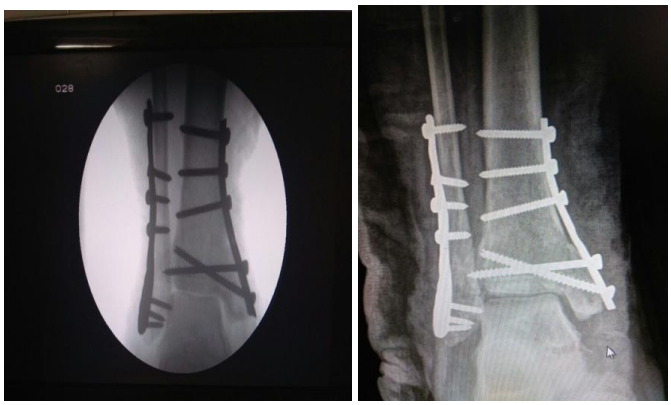

Fig 5: Periosteal interposition

Post-operative care

Generally a well-padded below knee slab is applied to hold the ankle fully dorsiflexed till the sutures are removed.sutures removed on fourteenth post-perative day Range of motion, strengthening, endurance and exercises were included in rehabilitation program. After six weeks, progressive unrestricted weight bearing is allowed.

Results

This study was conducted on 23 patients with a mean age of 36.17 years at surgery. There were 18 male patients and 5 female patients with an incidence of 78.26% and 21.73% respectively. The right ankle joint was involved in 19 patients and left ankle joint in 4 patients. Most of the injuries were due to RTA with 16 patients and 7 patients had injuries due to self fall. 16 patients were with supination-external rotation type injuries, 7 patients with pronation-external rotation type injuries The patients were taken up for surgery approximately 2-5 days after the injury. All patients were operated under spinal anesthesia with tourniquet control. IV antibiotics were administered pre operatively. Open reduction and internal

fixation were performed for both bimalleolar and tri-malleolar fractures. The lateral malleolus was first fixed followed by the medial malleolus in 13 patients. The choice of implant was based on the fracture pattern.

Out of the 23 patients, one patient went for delayed union of the lateral malleolus which later united at 7 months with an excellent functional outcome. Even though one medial malleolus failed to unite at 1 year, the functional outcome was excellent. One patient developed superficial wound infection at 6 weeks which settled with daily dressing and IV antibiotics. One patient had persistent subluxation of the joint owing to inadequate fixation and early weight bearing. The overall results were graded based on Olearud Molander scoring system. Excellent results were achieved in 19 patients (82.60%), good results in 2 patients (8.69%) and poor results in 2 patients (8.69%).

Age Distribution

The age incidence between 20 to 30 years was the commonest in this study with an incidence of 39.13%.

Table 1: Age Distribution

Age group (in years)	Number of Cases	Percentage
20-30	9	39.13%
30-40	5	21.73%
40-50	5	21.73%
50-60	4	17.39%

Sex Distribution

The present study had a majority of 18 male patients with an incidence of 78.26%.

Table 2: Sex Distribution

Sex	Number of Cases	Percentage
Male	18	78.26%
Female	5	21.73%

Mode of Injury

Road traffic accidents contributed to the ankle injury in 69.56% of patients, 16 out of 23. The rest of the patients presented with self fall as the cause of injury.

Table 3: Mode of Injury

Mode of Injury	Number of Cases	Percentage
RTA	16	69.56%
Self fall	07	30.43%

Results

The overall results were excellent in 19 patients, good in 2 patients and poor in 2 patients.

Table 4: Results

Grade	Number of Cases	Percentage
Excellent	19	82.60
Good	2	08.69
Poor	2	08.69

Discussion

Ankle Fractures Are One of The Commonest Injuries of The Lower Limb. They Constitute 9% Of All Fractures. The Most Common Causes Are Road Traffic Accidents and Sports Injuries. Trivial Injuries Cause Ankle Fractures in The Elderly Due to Osteoporosis. As Ankle Joint Is A Very Forgiving Joint in The Body, Most Of The Injuries Resolve satisfactorily and a few end up with late sequelae, irrespective of the method of treatment.

management of ankle fractures depends on the stability of the joint following injury. most of these injuries are often unstable. a stable fracture needs minimal splinting whereas an unstable fracture may need open reduction and internal fixation.

Muhammed Ayaz Khan *et al*. have recommended open reduction and internal fixation with ao technique to manage this problem with good results. every surgery is aimed at anatomical reduction of the fracture, which in turn locates the talus in the ankle mortise. much attention has been focused on the lateral malleolus as a significant stabilizing structure in the ankle joint.

our study had patients with a mean age of 36 years at surgery with majority of the patients in the 20 to 30 age group. we had 18 male patients and 5 female patients with an incidence of 78% in males and 22% in females showing a male preponderance. this is similar to most of the studies. we observed an increased involvement of the right side with an incidence of 82%. c.l. colton has shown the left side to be more involved in his study. road traffic accidents produced a majority of the injuries In Our Study.

We used lauge hansen classification system along with danis weber classification system to classify our fractures. most of the fractures were supination-external rotation type iv injuries; with 16 patients (70%) belonging to those type. 7 patients had pronation-external rotation type iii injuries.

P. Kumar *et al*. [9] studied 28 cases of displaced ankle fractures which were treated by open reduction and internal fixation in which he achieved excellent anatomical reduction and functional outcome in 75% of treated cases. ahamad hafiz z *et al*. [8] studied ankle fractures and the operative outcome in 208 cases. he attained excellent and good outcomes in 93.8% of all operated cases.

in our study of operative management for bimalleolar and trimalleolar fractures, excellent outcome in 82.60% And Good Outcome In 8.69% Were Observed.

CASE – I

PRE OP

POST OP

One Year Follow Up

Range of Movement

CASE – II

PRE OP

6 Months Post Op

1 Year 3months Postop

Range of Movement

Complications
CASE – I

Intra-Articular Screw Fixation

CASE – II

1 Year Post Op Non Union Of Medial Malleolus

Conclusion

In our study, it was observed that the functional outcome of a bimalleolar fracture does not depend upon the type of implant. Irrespective of the implant used, the final functional outcome was similar. Anatomical reduction, restoration of fibular length and stable fixation were found to be essential for achieving good return of joint function.

Early surgical intervention reduces the rate of post- operative infection, makes fracture reduction easier and in turn decreases the rate of secondary arthritis and give excellent functional outcomes. However the gross edema around the

ankle in the early post injury days may impede soft tissue healing. Care should be taken in handling the soft tissues during surgery. Case where there are fracture blisters incision would need to be modified as to avoid the blister sites.

We conclude that for most bimalleolar fractures, the patients condition permitting, operative choice is the best. This alows for restoration of the ankle geometry to restore anatomical integrity. Earlier the intervention, lower the complication. If the original fracture has not damaged the articulating distal tibial and Talar articular cartilages then pain on weight bearing does not ensue. All cases after preliminary fixation requires to be examined at 10°to 15° internal rotation view intra operatively and anterior posterior view to rule out distal Tibio fibular syndesmotic rupture. Even at the slightest instance of doubt additional syndesmotic screws are inserted and to be retained for 4weeks to allow the distal Tibio fibular ligament complex and Interosseous Membrane to heal completely. Failure to do so would result in Ankle pain and future Instability.

Hence the key message is Operate, Fix, Secure Distal Sydesmosis, Early Non Weight Bearing Mobilization (14 Days) And Weight Bearing (8 to12 weeks) depending on fracture union progress.

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