

**FUNCTIONAL OUT COME OF TREATMENT OF
BIMALLEOLAR FRACTURES**

**A STUDY DONE AT APOLLO HOSPITAL
HYDERABAD.**



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By

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DECLARATION

I hereby declare that the dissertation titled

“FUNCTIONAL OUTCOME OF TREATMENT OF BIMALLEOLAR FRACTURES”

Has been prepared by me under the direct guidance and supervision of Dr. Hari Sharma, Consultant Orthopaedic Surgeon, Apollo Hospitals, Hyderabad.

This dissertation is submitted to University of Sychelles in partial fulfillment of rules and regulations for the award of “Mch in Orthopaedics”

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INTRODUCTION

Ankle fractures are one of the most common injuries treated by orthopaedic surgeons. Ankle fractures have been the subject of numerous studies and articles regarding the mechanism of injury, classification and treatment modalities. The ankle is a mortise joint formed by the lower end of the tibia and fibula articulating with the talus. The anatomy of the joint makes it very unstable in cases of fractures or ligamentous injuries of the ankle. As fractures of the ankle have been treated with various modes of internal fixation devices, the best possible implant is determined according to the anatomy of the fracture. In the postoperative period, the protocol of mobilization of the ankle has been a topic of conflict. The final outcome of a fractured ankle is of prime importance, as the treatment should benefit the patient just not in short term but also in the long term. The treatment of fractures has its challenges in cases where the fracture is complicated by co-morbid conditions such as Diabetes mellitus, peripheral vascular diseases and neuropathic conditions which complicates the treatment and influences the overall outcome. A thorough understanding of the ankle anatomy, mechanism of the injury, interpretation of the radiographs and adherence to basic principles of fracture management are the basis for a good result. Considering all of the above, we have tried to analyse the results of bimalleolar fractures treated at Apollo hospital, Hyderabad.

REVIEW OF LITERATURE

In 1985, *Ulf Lindsjo*^{90,91} in his paper put a detailed account of various classifications of the fractures of ankle.

*Ashurst – Bromer*³ in 1922 classified as external rotation. Adduction and abduction injuries.

*Lauge Hansen's*⁵² classifications was put forward in 1922. This system was a pioneering system which when employed correctly has improved the results of conservative treatment.

*Danis*¹⁸ *Weber*⁹⁶ classification is the system that was first put forward by Danis and later modified by Weber and adopted by the *AO group*. This is based on the level of fracture seen in the fibula with respect to the syndesmosis

They are classified as:

Infrasyndesmotoc

Syndesmotoc

Supra

Syndesmotoc

Danis Weber classification was more suited for surgical treatment rather than non-operative treatment.

In 1947, *Gregory. Joy*³³ et al did a study to assess the reduction achieved in the immediate postoperative period, adequacy of reduction and to correlate it with the final result. The various criteria have been discussed and the one that has been adopted was *Kristenson's*³³ criteria.

The criteria for the radiological assessment as given by is

Good-

Talus Correctly placed

Medial Malleolus No displacement or fracture gap of less than 2mm

Lateral malleolus Negligible lateral displacement and up to 2mm of posterior displacement

Posterior malleolus Upward displacement displacement of less than 2mm

Fair -

Talus	Correctly positioned
Medial Malleolus	Anterior or posterior displacement of 2-5 mm and a fracture gap of 2-5mm
Lateral malleolus	Lateral displacement up to 2mm and posterior displacement of 5mm
Posterior malleolus	Displacement of 2-5mm

Poor -

Talus	Displaced
Medial Malleolus	Medial displacement of more than 2 mm and fracture gap of more than 5 mm
Lateral malleolus	Lateral displacement of 2mm and more
Posterior malleolus	Upward displacement of 5mm

In 1984, *Harold C Leeds*³⁴ et al conducted a study on bimalleolar and trimalleolar fractures mainly due to supination external rotation and pronation external rotation injuries, wherein syndesmotomotic injuries had occurred. Post operatively and on follow up it was observed that the initial reduction of syndesmosis and fixing of lateral malleolus was ideal. This influence long-term syndesmotomotic stability and in preventing development of late arthritis and the final outcome. The reduction of the syndesmosis was necessary for the stability of the ankle in all cases of supination external rotation and pronation external rotation injuries and needs to be combined with the fixation of the lateral malleolus.

In 1985, *ULF Lindsjo*⁹⁰ in his study treated ankle fractures with open reduction and internal fixation using AO principle of internal fixation. The study brought the fact that the most decisive factors were the type of fractures, adequacy of reduction, sex of the patient and also exact reduction, rigid fixation, early post operative joint exercises and subsequent full weight bearing walking in a below knee plaster cast. The study highlighted that the late development of arthrosis, invariably developed following fixation and suggested an improper reduction. The risk of development of degenerative arthritis was more common in the middle aged and the elderly.

In 1985, *Mats Bauer*⁶³ et al did a controlled study where operative treatment was compared to non operative treatment. The patients were followed up till recovery and it was observed that immediate results favored operative treatment and in the long term follow-up there was not much of a difference. It was also noted that the incidence of arthrosis in the long term was more

common in operative group, when compared with those fractures treated conservatively even when anatomical reduction was obtained. This was mainly attributed to the severity of injury, which necessitated surgical intervention.

In 1985, **David Segal**²⁰ et al analysed the institution of weight bearing walking in a functional orthosis in both operative and non-operatively treated ankle fractures. A functional orthosis which allowed only plantar flexion and dorsiflexion at the ankle was use. Operatively treated fractures with stable fixation could be mobilized immediately by the end of the first week and in patients treated conservatively, mobilization could be started by the end 5th week. The use of functional brace allows flexion and extension at the ankle with a hinge and hence prevents any rotational stress on the ankle fracture.

This study highlights early ankle mobilization by 5-6 days in cases of surgically treated ankle fractures in an orthosis and to immobilize conservatively treated fractures for 4-6 weeks and later begin mobilization of the ankle.

In 1986, **D I Rowley**¹⁶ et al showed in their series that there was a comparison of all the ankle fractures treated at their institute with the closed manipulation and immobilization and those managed by surgical fixation. The results at the end of twenty weeks showed not much of a difference with respect to range of movements of the ankle and gait.

In 1987, **Robert Baird**⁷⁷ et al suggested open reduction and internal fixation of lateral malleolus. Deltoid ligament repair was not required as good clinical recovery was observed. In cases where even with fibular fixation, anatomic reduction of the ankle was not obtained on the radiograph with medial joint space widening, it was necessary to explore the medial side and repair the medial deltoid ligament and to remove any ligament, tendon or chondral fragment interposition. There was no evidence of joint instability in such cases where medial aspect was not explored and ligament was not repaired.

In 1989, **Bostman**⁹ et al, used polyglycoside and polylactide in their study for medial malleolar fixation. Fixation with bio absorbable screws shoed bony union and maintenance of reduction which was comparable, with metallic implants. However it had an advantage that it didn't require removal. Occasionally a few instances of late swelling around the ankle or aseptic sinus discharge were noted which was attributed to delayed inflammatory reaction.

In 1989, **Vilhjalmur Finsen**⁹³ et al compared the bone mineral concentration of the bones in cases of ankle fractures treated with surgical fixation. They were divided into three regimens of

treatment 1. Active ankle and sub talar joint movements with non-weight bearing ambulation, 2. Plaster cast application without weight bearing, 3. Plaster cast application with full weight bearing ambulation. The findings were compared over a period of two years. It was observed that not much of a difference was present between the three groups and post traumatic osteopenia was natural and was maximum in the first 76 months following the trauma, but later on stabilized and it improved.

In 1990, **RK Marti**⁷⁴ et al, study on malunited fractures of the ankle which were treated by reconstructive osteotomies and were followed up. Pre operative and post operative subjective and objective improvement were compared and the results suggested that whatever time had elapsed since the injury and led to malunion, reconstruction should be attempted for complete restoration of the anatomical alignment of the joint. The commonest cause of malunion was found to be shortening or lateral rotation of the lateral malleolus, which led to the widening of the mortise and tilt to the talus. In case there was an associated deformity of the medial malleolus, posterior malleolus and or the anterior chaput fragment, the problem worsened. A modified Weber criterion was adopted.

In 1990, **Winkler**⁷ et. Al showed the use of fixation of the antiglide plate in the fixation of lateral malleolus in case of type B Weber fractures. The study showed the construct to be bio-mechanically sound. The use of this technique is being recommended especially in the osteoporotic bones.

In 1991, **Eugene J Carrage**²⁷ et al studied the major and minor complications that were associated with fractures of the ankle and the factors those were associated in development of these complications. They noted that the fractures that were fixed at the earliest and even those done on an emergency basis did better than those whose surgery was delayed.

In 1991, **William Cimino**⁹⁷ et al in their study included ankle fractures treated with open reduction and internal fixation. The subjects post operatively were either put on an ankle foot orthosis or a plaster cast. Immediate mobilization was started as soon as the patient tolerated, with partial weight bearing with crutches will 3 wks and later without it bearing full weight. Early ankle motion was instituted in ankle foot orthosis group. No complications arose and also no difference was noted in the two groups with respect to ultimate ankle range of movement.

In 1993, **Moshe Pritsh**⁶⁶ et al followed up ankle fractures with ankle pain. They had no significant radiological abnormalities and were evaluated with arthroscopy. The findings at

arthroscopy was adhesions of the distal tibiofibular joint, which was the cause of ankle pain and was treated with resection of the adhesions that did relieve the pain.

In 1994, **Robert Bucholz**⁷⁸ et al did a study a operative treatment of ankle fractures. It was to compare the medial malleolar fixation with bio absorbable screw and metallic implant. The bio-absorbable screw used was that of polylactide and the lateral malleolus was fixed with the standard metallic implants. The study showed comparable results of both the methods of internal fixation. Bio-absorbable implants were more of an advantage as the repeat surgery of implant removal was avoided. There was however few episodes of post operative swelling due to delayed lysis of the screw.

In 1994, **Margaretta Henderson**⁶¹ et al compared the outcome of fractures of the ankle treated operatively followed with early ankle exercises and weight bearing in an orthosis with those where no ankle movements was instituted with weight bearing in a plaster cast. There was not much of a difference between the two groups and early weight bearing did not show any risk of redislocation.

The long term study was to evaluate the degenerative changes in the ankle joint using the following classification.

Classification of arthrosis deformans by Cedell-Magnusson as seen on radiographs

1. Slight reduction of the joint space and slight formation of deposits on joint margins.
2. more pronounced changes than mentioned above possibly with the addition of a sub chondral sclerotic configuration within the sub chondral osseous tissue of tibia.
3. The joint space only about half as high as that of the uninjured side and rather pronounced formation of deposits.
4. The joint space has quite or almost disappeared.

In 1995, **Hugh R Chissell**³⁸ did a retrospective study of factors affecting the outcome in Weber C fractures. This study analysed the use of the diastatic screw for the fixation of diastasis of the inferior tibio fibular joint. They observed that a diastasis of more than 1.5 mm was unacceptable. The criteria for the use of syndesmotic screw was when there was a deltoid ligament rupture in combination with the fracture of the fibula within 3.5 cm from the syndesmosis. In case of medial malleolar fracture, the diastatic screw was needed to be put in case the fracture of the fibula was more than 1.5cm from the syndesmosis.

In 1995, *lew.C.Schon*⁵⁵ studied management of ankle fractures in neuropathic joints. The controversies associated with the surgical intervention in these patients was highlighted. The first reference to a neuropathic joint has been attributed to a French neurologist, Jean Martin Charcot^{55, 76} in 1868 who described the bone and the joint changes seen in a case of syphilis. The first reported account associated with diabetes was made by Jordan in 1936. the estimated incidence in diabetes is 0.1%-2.5% and not directly related to the disease process. It was common in patients with a duration of DM over 10 years. Intervention in these case, whether a surgical procedure or a non surgical procedure. The idea was to create a plantigrade foot, to maintain adequate foot and ankle motion, to prevent bony protuberances to prevent ulceration and subsequent abscess or osteomyelitis. The treatment of neuroarthropathic fracture or dislocation depends on the timing, the clinical stage of the injury, and the radiographic feature of the fracture, presence of subluxation or dislocation, location and magnitude of deformity. These elements are not the only criteria, but it must be viewed in light of the overall general condition of the patient, the limb perfusion, neurologic status, pre-existing activity, degree of compliance of the patient. Hence it is important to diagnose the presence of neuroarthropathy of the ankle fracture dislocation for an early open reduction and internal fixation. Diabetes should not be a contraindication for surgery and postoperative care would involve prolonged immobilization to prevent neuroarthropathy.

In 1995, *Stuart. D.Miller*⁸⁶ et al showed that the ankle fractures requires precise reduction. It was noted that with adequated anatomic reduction, the cartilage change was unremarkable and survives well. The criteria for the radiological factors of reduction were under the following headings.

Talocrural angle is a line drawn perpendicular to the tibial articular surface and a line connecting the ends of the medial and lateral malleoli. The average being $83^{\circ} \pm 4^{\circ}$ Medial clear space is the width of the ankle joint space at the medial malleolar level which should be similar to the space between talar dome and the tibia. Any variation of less than 1mm or more than 4 mm indicates poor outcome.

Talar tilt measures the differences on the mortise film the tibial plafond and the top of the talus as drawn across the medial and lateral talar ridges and a difference of 2mm is abnormal. This is also measured by the differences in the perpendicular line across the top of the talus and the weight bearing line down the centre of the tibia on the anteroposterior film and a difference of more than 5° from the contralateral side is abnormal. Syndesmotic width is the horizontal distance from the

tibial incisura to the medial border of the fibula, 1cm proximal to the joint surface of the tibia in an anteroposterior view. Measurement of the syndesmotic width involves the tibiofibular clear space from the lateral border of the posterior tibial malleolus to the medial border of the fibula. This distance should be less than 5mm.

Using these criteria, an early malunion of the fracture can be predicted and also diagnosed and the necessary treatment modes are enumerated.

In 1996, **G H Robert Albers**³¹ et al did a long term study on all cases of fractures of the ankle treated by internal fixation, which developed distal tibiofibular synostosis. This study noted that though the synostosis developed as early as 3 months, in most of the cases in the long term, there was no significant complaint or any restriction of joint movements or degenerative changes. The incidence of this condition is more common in weber type c fractures.

In 1998, **Mc Cormack R G**⁶⁴ et al did a case control study, where a group of diabetic patients were matched with a group of non-diabetic patients who were either treated conservatively or surgically and results were compared. The incidence of complications in diabetics was as high 42% in the operative group. It was found that wound infection was the commonest complication in diabetics. In conservatively treated patients, malunion was the most common complication noted, which in case of elderly patients was acceptable as the functional results were satisfactory.

In 1998, **John F Connolly**⁴⁶ et al studied that Diabetes and Neuropathic joint with associated ankle trauma predisposes to multiple complications. This was a study of six cases where there was associated diabetic neuropathy and ankle fractures. There is an elaboration of the causes of Charcot arthropathy and early detection of these cases. This article suggests that an early internal fixation with a period of immobilization with restricted weight bearing as the better option to avoid development of complications including hyperaemia and swelling around the ankle. There is an opinion that a preoperative treatment in such cases with biphosphonates had helped.

In 1998, **David J.Musgrave** et al did a retrospective study of whether two or three radiographic views were required for intraoperative evaluation of low energy rotational ankle fracture reduction and fixation. The study involved four orthopaedic surgeons independently reviewing sets of radiographs of 93 low energy fractures treated with open reduction and internal fixation. Set 1 consisted of mortise and lateral views and set 2 consisted of anteroposterior,

mortise and lateral views. The study indicated that the mortise and lateral views were sufficient for the assessment of the accurate reduction of fractures and hence reduced the cost.

In 1998, **Mc Cormack. R G**⁶⁴ et al studied the complications associated with treatment of ankle fractures in diabetics. The incidence of post operative complications was high especially with wound healing in subjects treated operatively complications was high especially with wound healing in subjects treated operatively when compared to non operatively treated subjects. Malunion was commoner in fractures of ankle that were reduced by closed reduction. This study also showed that closed reduction was more acceptable as malunion even if occurred did not cause any disturbing symptoms. The multi system involvement of diabetes mellitus also favoured conservative treatment with closed reduction to avoid the complications. Operative intervention is advocated in patients with peripheral neuropathy.

In 2001, **Keith C Donatto**⁴⁸ et al reviewed an article which highlighted the basic mechanism of injury and the associated bony and ligamentous injuries. The various methods of treatment, be it non-operative mode of treatment or operative mode of fixation are highlighted. The basic principles of fracture fixation are applied on which treatment is based. The treatment of the bony injuries and the ligamentous injuries are enumerated.

In 2001, **Christopher Bibbo**¹⁴ et al reviewed a series of articles that dealt with the ankle fractures of the patients with associated diabetes mellitus. The conclusion of this series were analysed and inferred that the ankle fractures in a diabetic showed delay in healing. The patients were at risk for developing wound and soft tissue complications. Another reason was that the incidence of Charcot arthropathy was high and went undiagnosed. In patients where immobilization was delayed and in those with displaced fractures treated non operatively, the joint went for neuropathic arthropathy.

Delayed fracture healing is attributed to impaired collagen syntheses and bone turnover. Remodeling is also impaired. Wound healing in diabetics is impaired by hyperglycemia, associated tissue hypoxia, impaired inflammatory reaction and vascular insufficiency. The author has summarized the treatment of ankle fractures in diabetics as a stepwise protocol to minimize the risk of complication and development of Charcot arthropathy. In case of undisplaced fractures, non operative treatment with prolonged immobilization and in case of undisplaced fractures, nonoperative treatment with prolonged immobilization and in case of a displaced

fracture, operative fixation and adequate period of immobilization is advised. The adequate control of glucose levels is needed to improve the fracture milieu and to ameliorate complications.

In 2001, *Paul Tornetta III*⁷⁰ et al did a cadaveric study to understand whether there was a possibility to over tighten the mortise and restrict ankle dorsiflexion. They concluded that the fixation of the syndesmosis was important and that maintaining the foot in dorsiflexion while fixing the syndesmotic screw was not necessary but there was a possibility of the reduction of the fracture being lost in trying to maintain the dorsiflexed position of the ankle. The analysis of this study was for only passive movements and not active flexion of the ankle.

In 1979, *Hughes*³⁹ et al made a comparison of the studies of both operatively and conservatively treated fractures of the ankle.

The scale adopted is the Weber's criteria

Subjective-

- Pain**
0. None
 1. Slight pain with excess activity
 2. Mild pain with normal activity
 3. Pain on standing
 4. Pain at rest
- Walking**
0. Normal
 1. Restricted strenuous activity
 2. Slight limp
 3. Partially disabled
 4. Totally disabled
- Activity**
0. Full at work and sport
 1. Can work normally but restricted in some strenuous activity
 2. Normal walk but very limited in activity
 3. Partially disabled
 4. Totally disabled and must change job.

Objective –

Ankle Joint function

0. Full or equal to the other side
1. Loss of motion 10° or less

2. Loss of motion greater 10° but dorsi flexion of 95° possible
3. Motion less than 10° but dorsi flexion to 95° possible
4. Stiff foot

Sub talar joint function

0. Full or equal to the other side
1. Slight diminution
2. Limitation less than 50% compared to the other side
3. Limitation more than 50% compared to the other side
4. No motion

Radiograph

1. Anatomically perfect with no arthritis
2. Anatomically perfect with light calcification in the ligaments but not arthritis.
3. Anatomical disruption on the medial side
4. Anatomical disruption on the lateral side with arthritis
5. Step off in the joint with arthritis

The rating as given above when applied, the result is said to be excellent when there are no negative points. A good result has one or two negative points. A poor result is one that has three or more negative points.

MATERIALS AND METHODS

Sixty patients with fractures of the ankle treated at Apollo hospital, Hyderabad between June 2008 and July 2010 were included in the study. Patients admitted to this hospital were in the age group 20 yrs to 75 yrs and the sex distribution was 42 males and 18 females.

Exclusion criteria:

1. Patients with open fracture dislocations of the ankle
2. Patients with epiphysis ankle fractures
3. Patients with bilateral ankle fractures
4. Cases with Pilon fractures

Patients operated at Apollo hospital, Hyderabad with a minimum period of 6 months follow up were included in the study.

The patients were examined in the casualty and in the out patient department. History was recorded and a thorough clinical evaluation was done. Patients were stabilized haemodynamically and were administered adequate analgesia. Analgesics administered were Inj Tramazac, Inj Diclofenac or Inj Pentazocine. Patients were put on a below knee splintage either with a malleable splint or a plaster or Paris posterior slab. Radiologic investigations were done with anteroposterior and lateral views of the ankle.

The fractures were classified according to the Lauge-Hansen and Weber's classifications and graded as per Kristensons criteria. There were 12 cases of Supination-Adduction injury, 24 cases of Supination – External rotation injury, 2 cases of Pronation – Abduction injury, 20 case of Pronation – External rotation injury and 2 cases of Pronation – Dorsiflexion injury.

There were 6 cases of type A, 32 cases of type B and 22 cases of type C Weber injury.

Following the radiological evaluation, patients were briefed regarding the need for operative treatment and were investigated with routine investigations for the surgical procedure. Patients with co-morbid medical illnesses were treated appropriately with the help of general Physicians. Evaluation by anesthesiologists was done. Consent for the surgical procedure was obtained. Antibiotics were administered at the time of induction of anesthesia. The antibiotics used were either a first or second generation Cephalosporin's.

Surgical procedure:

General anesthesia was administered to 35 patients and Spinal anesthesia for 25 patients. The patient was placed in supine position with a sand bag under the ipsilateral buttock in cases of lateral malleolar fracture. Following exsanguinations, tourniquet was inflated with time being noted. The affected limb was prepared with a primary scrub with Betadine. The parts were then painted with Betadine and Spirit. Surgical draping was done using the standard methods and the foot was covered with a hand towel or a glove.

The operative approach for the fixation of the lateral malleolus was done as per the standard approaches, depending on the mode of fixation planned. The lateral malleolar fracture was exposed first. Lateral malleolar fixation was done in 60 cases.

Medial malleolus was approached according to the mode of fixation planned using the standard approaches. Fixation was done in 60 patients. Posterior malleolar fracture was noted in 11 cases. The posterior malleolar fracture was not fixed in any of the cases as there was anatomical reduction of the fragment.

48 patients were operated within first day of the injury. 11 patients were operated between two and five days because of uncontrolled Diabetes and due to fracture blisters. Two patient was operated 10 days later due to unsatisfactory skin condition and fracture blisters.

All the patients were operated under tourniquet control. The duration of surgery varied from 30 mins to 1 hour and 30 minutes averaging 1 hour

The implants used for the fixation of fractures were as follows:

The medial malleolus was fixed with Malleolar screws in 54 cases of which six were single screw. Tension band wiring was done in 6 cases.

The lateral malleolus was fixed with Semi tubular plate in 10, One third tubular plate in 26, Tension band wire in 6, Dynamic compression plate in 10, Rush pins in 2 and K-wire in 6 cases.

Syndesmotic screw was used in 16 cases:

The wound was washed with normal saline, drain tubes were placed and subcutaneous sutures applied using 2-0 Vicryl. Skin was closed with staples. Dressing was done with adequate padding and a below knee plaster of Paris slab was applied.

Patients were administered adequate analgesics. Antibiotics were administered for 72 hours postoperatively. The foot was kept elevated over pillows. Radiological evaluation was done in the postoperative period which included both Anteroposterior and Lateral views. These

were graded as per the *Kristensons* criteria. Drain tube was removed on the second post operative day. Patient was mobilized on the first post operative day, non weight bearing on the affected leg with the help of walker or auxiliary crutches. Patients were discharged on the fifth day on an average. Staples were removed at follow up in the out patient clinic at the end of two weeks. Patients were advised to continue non weight bearing ambulation with a walker or axillary crutches for a period of six weeks. However in patients who had other associated injuries, ambulation was delayed or mobilized on a wheelchair.

The Plaster slab or cast was removed at the end of 6 weeks. Check x rays were done at six weeks. Presence of callus and status of the joint was noted. The patients were started on active ankle mobilization. Patients with syndesmotic screw fixation were admitted on a day care basis and the syndesmotic screw was removed. Partial weight bearing was started with support. Weight bearing was decided on the basis of the X-ray picture. Patients were followed up at 3 months and 6 months.

The patients were evaluated as per the rating of the *Weber's* criteria which included objective criteria, subjective criteria and Radiological evaluation. These were graded into good, fair and poor categories.

The objective criteria included the movements of the ankle joint and subtalar joint function together which was deemed good when the rating was 0-1, fair when the rating was between 2-4 and poor when it was 5 and above.

The subjective criteria involved the rating of pain, walking and return to activity. These were graded as good when the rating was 0-2, fair when it was between 3-6 and poor when it was above 6.

The radiological rating was good when it was 0, fair when it was 1-2 and poor when it was 3 and above.

The removal of implants was done after the union of the fracture at patient's convenience at an average period of 1 year.

POST INJURY



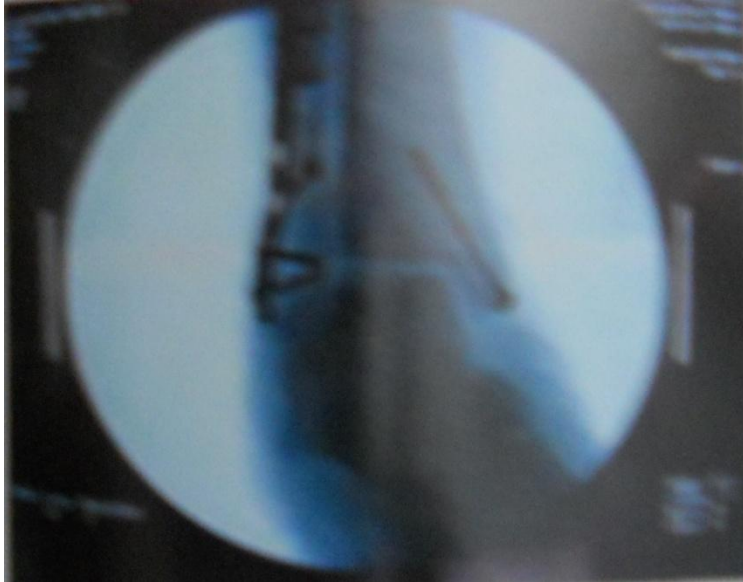


MEDIAL APPROACH AND FRACTURE SITE EXPOSED



LATERAL APPROACH AND FRACTURE SITE EXPOSED

IMAGE INTENSIFIER PICTURE



POST OPERATIVE SPLINTING IN SLAB



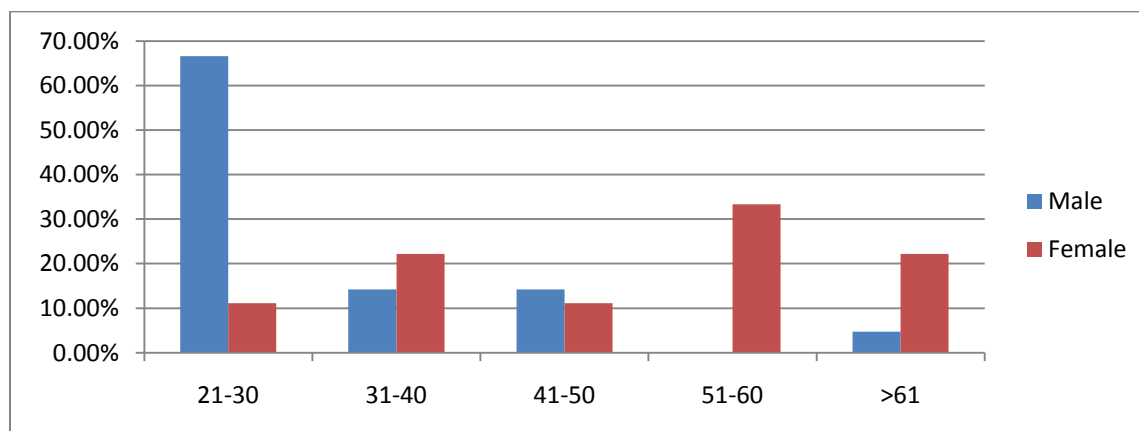
OBSERVATIONS AND RESULTS

This study was done on patients admitted at Apollo hospital, Hyderabad who were surgically managed and internal fixation was done for fracture fixation. This study was done on patients admitted between 2005 March and 2007 September.

Table 1:- Table depicting sex incidence in different age groups

<i>Age in Years</i>	<i>No of patients</i>	<i>%</i>	<i>Male</i>	<i>%</i>	<i>Female</i>	<i>%</i>
21-30	30	50%	28	66.6%	2	11.1%
31-40	10	16.6%	6	14.2%	4	22.2%
41-50	8	13.3%	6	14.2%	2	11.1%
51-60	6	10%	0	0	6	33.3%
61-more	6	10%	2	4.76%	4	22.2%
Total	60		42		18	

Fig 1:- Bar diagram of age and sex incidence



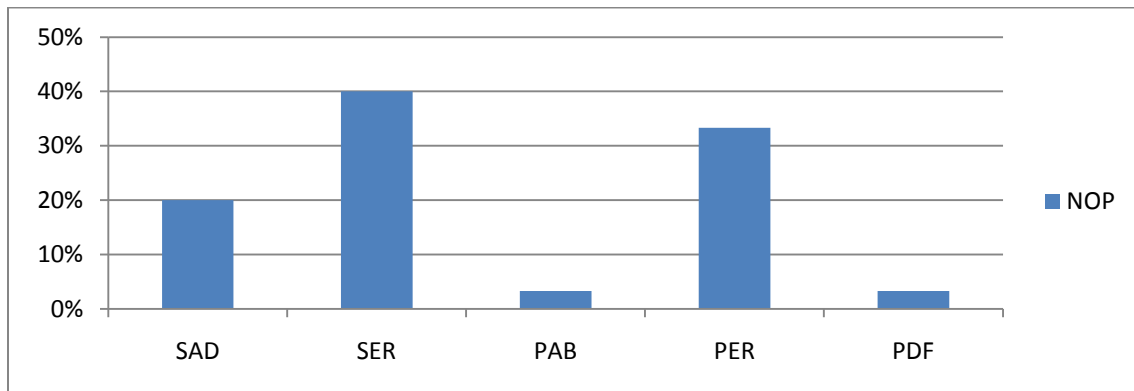
Maximum number of patients in our study ranged between 21-30 years and males were predominant.

Mechanism of injury as per Lauge Hansen classification:

Table 2:- Depicting incidence of fractures depending on the mechanism of injury

Type	No of Patients	%
<i>Supination Adduction</i>	12	20%
<i>Supination External rotation</i>	24	40%
<i>Pronation Abduction</i>	2	3.3%
<i>Pronation External rotation</i>	20	33.3%
<i>Pronation Dorsiflexion</i>	2	3.3%

Fig 2:- Bar diagram of the mechanism of injury and incidence



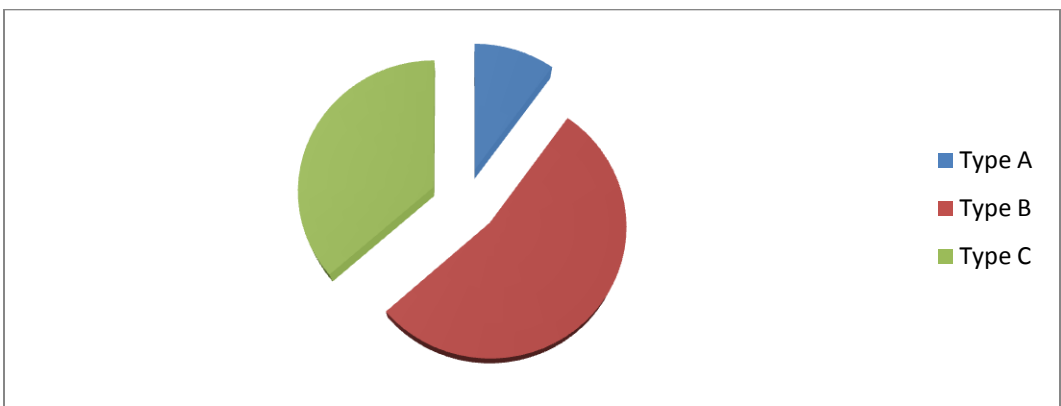
Supination – External rotation injury was the most common mechanism of injury in our study as per Lauge – Hansen’s classification comprising upto 40% of the total number.

Type of fracture as per Weber classification:

Table 3:- Depicts radiological types depending on Weber's classification

Type of fracture	No of Patients	%
Type A	6	10%
Type B	32	53.7%
Type C	22	36.6%

Fig 3:- Pie diagram showing the types of fractures based on Weber's classification



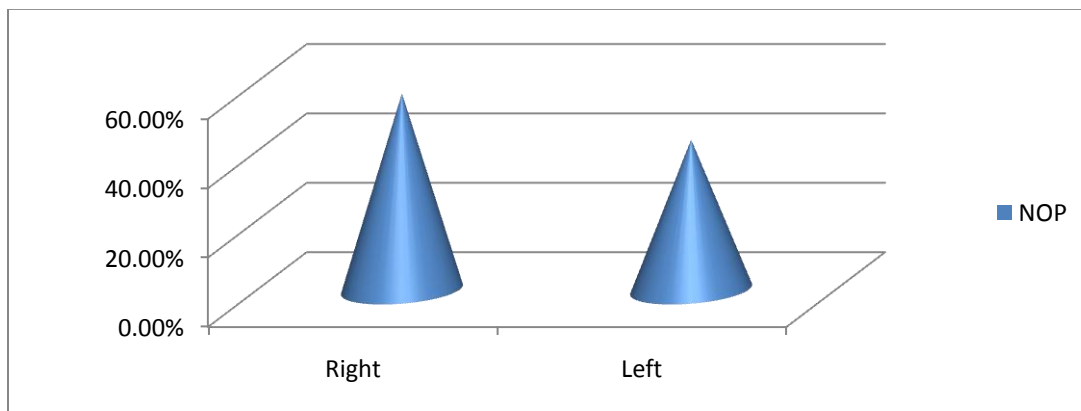
Weber type B fracture were the commonest type in our study comprising 36.6% of patients.

Side of ankle fracture:

Table 4:- Shows the side of involvement of fractures

<i>Side</i>	<i>No of Patients</i>	<i>%</i>
<i>Right</i>	34	56.6%
<i>Left</i>	26	43.3%

Fig 4:- Bar diagram showing the side of involvement



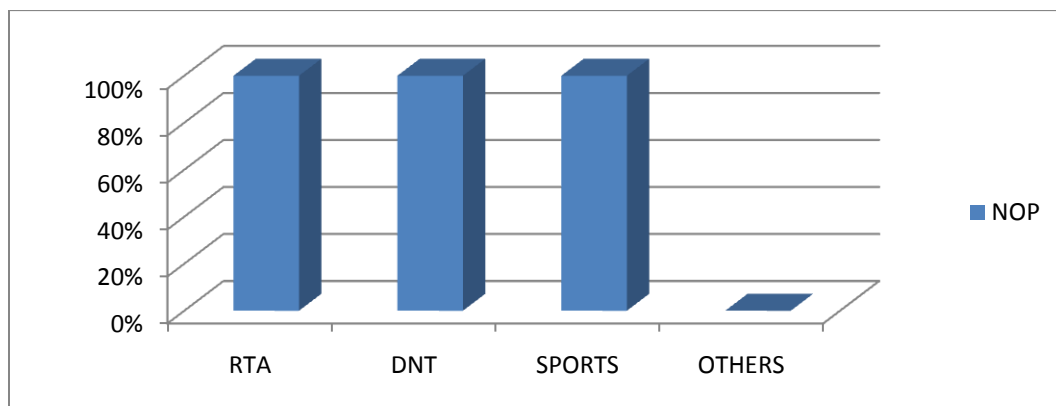
Right sided fractures were more predominant than the left side in our study comprising 56.6%

Causes of injury:

Table 5:- Different causes of injury and their incidence

<i>Causes of injury</i>	<i>No of Patients</i>	<i>%</i>
<i>Road traffice accident</i>	32	53.3%
<i>Domestic slipping & twisting</i>	20	33.3%
<i>Sports</i>	8	13.3%
<i>Others</i>	0	0

Fig 5:- Bar diagram showing different causes of injury



Road traffic accidents followed by domestic injuries were the most common cause of injury in our study

Associated injuries and the co-morbidities noted were two cases each with fracture of the radius, head injury, Two cases with fracture blisters, and one case fracture of humerus, fracture of shaft of femur and fracture of 5th metatarsal.

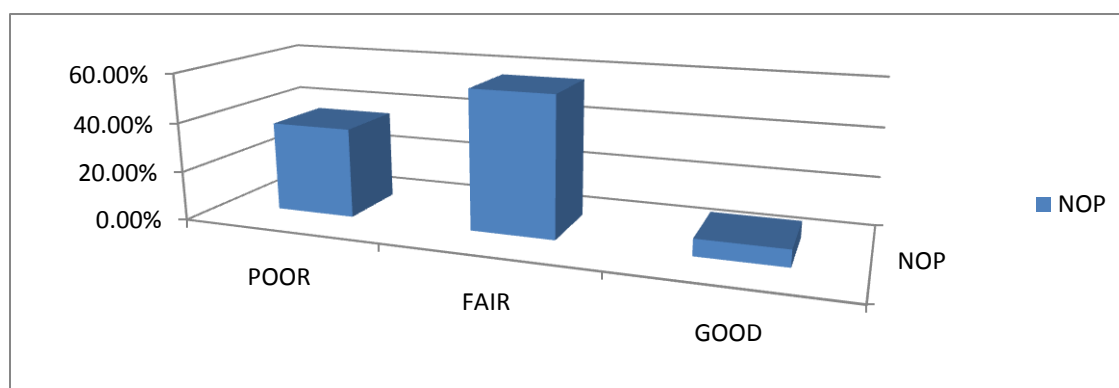
Twelve cases were having diabetes mellitus and four with hypertension.

Pre operative Kristenson’s radiological criteria:

Table 6:- Depicts pre operative radiological grading of fractures

<i>Kristenson’s grade</i>	<i>No of Patients</i>	<i>%</i>
<i>Poor</i>	22	36.6%
<i>Fair</i>	34	56.6%
<i>Good</i>	4	6.8%

Fig 6:- Bar diagram showing radiological grading of fractures

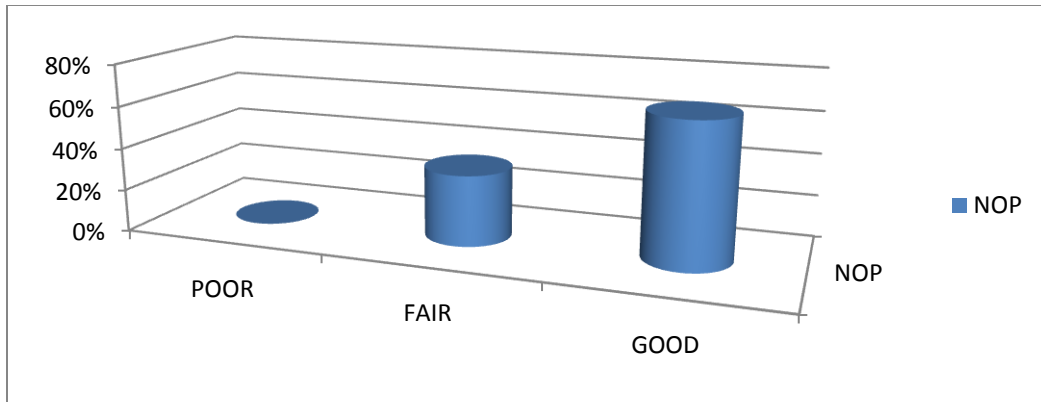


Radiologically 56.6% patients were in the fair group according to Kristensons’s radiological criteria pre-operatively.

Post operative kristenson’s radiological criteria:

Table 7:- Depicts post operative radiological grading

<i>Kristenson’s Criteria</i>	<i>No of Patients</i>	<i>%</i>
<i>Poor</i>	0	0%
<i>Fair</i>	20	33.4%
<i>Good</i>	40	66.6%



Kristenson's grading

Post operatively all the patients were evaluated as per *Kristenson's* criteria and the results were as shown above 66.6% of patients had good results, 33.3% had fair results and none had poor results.

The cases after discharge were followed up at two weeks, six weeks, three months and six months and at the end of one year regularly. The minimum period of follow up was six months and maximum was thirty months. The average time for fracture union was six months.

The complications encountered were delayed wound healing and dehiscence in 6 patients. The wounds of four patients healed at three weeks with regular dressings. 2 patients required split skin grafting due to skin necrosis. Those who required SSG were the ones who had fracture dislocation.

One patient with DCP fixation of the fibula was noted to have a long screw with intra-articular extension. It was replaced at six weeks with a shorter screw before range of motion exercises of the ankle was instituted.

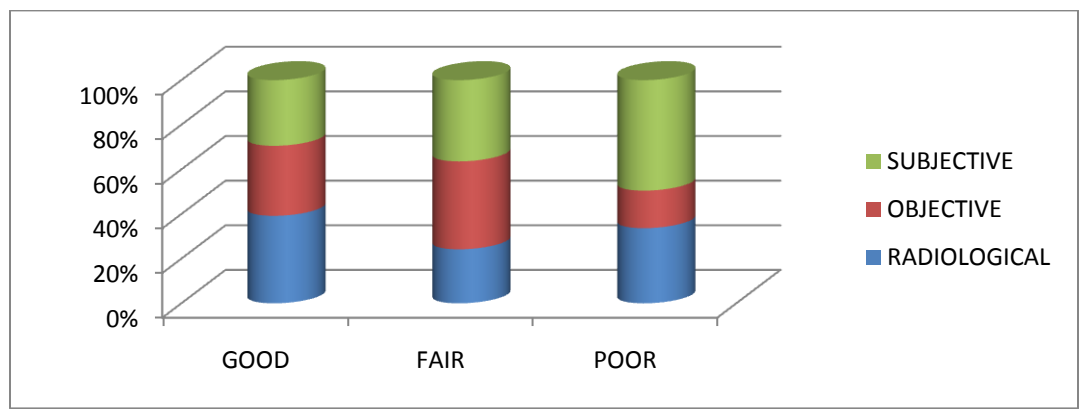
One case had a discharge from the incision site over the medial malleolus after one month which showed no evidence of deep infection. The wound healed over a time of 1 month without any further complications.

No cases of degenerative arthritis and no cases of malunion were noted.

Final outcome of the study as per Weber’s criteria:

Table 8:- Depicts the percentage of the results based on Weber’s criteria

	<i>GOOD</i>	<i>GOOD</i>	<i>FAIR</i>	<i>FAIR</i>	<i>POOR</i>	<i>POOR</i>
<i>SUBJECTIVE</i>	30	50%	24	40%	6	10%
<i>OBJECTIVE</i>	32	53.3%	26	43.3%	12	3.4%
<i>RADIOLOGICAL</i>	40	66.6%	16	26.6%	4	6.8%



Weber’s grades

All the patients who had good results returned to normal activity and had regained their full ankle movements by the end of three months.

Those patients with fair results complained of swelling which was noticed towards the end of the day and would respond to rest. Associated pain was related to activity.

DISCUSSION

The fractures of the ankle are injuries seen in the young and middle aged patients commonly. The mean age in our series was noted to be 36 yrs with a male predominance of 66.6%

Table 9:- Sex distribution in various studies

Study	No of Patients	Male:Female	% males
Roberts SR	25	11:14	44
Beris et al	144	56:88	38.8
Present study	60	42:18	66.6

Sex distribution in our study showed a male preponderance compared to other studies.

Table 10:- Mean age distribution in various studies.

Study	No of Patients	Mean age
Roberts SR	25	40
Beris et al	144	30
Liestal	108	41
Present study	60	36

Mean age in our study was comparable to other studies.

Weber's Type B fractures consisted of 53.7%

Table 11:- Weber's type of injury:

Study	No of Patients	Type	%
Liestal	108	Type B	64.8
Freiburg	100	Type B	60
St. Gallen	130	Type C	47.7
Present Study	60	Type B	53.7

The findings were similar to those of Leistal and Freiburg.

The most common mechanism of injury was Supination-external rotation injury with 40% incidence.

Table 12:- Mechanism of injury

Study	No of Patients	Most Common type	Percentage
Roberts S R	25	Supination external rotation	34
Beris et al	144	Supination external rotation	45
Present Study	60	Supination external rotation	40

The findings were similar to observations of Roberts S R, Beris et al.

In this study, right ankle was more affected i.e., 34 Patients (56.6%)

Table 13:- Side affected

Study	No of Patients	Right	Left
Roberts S R	25	14 (56%)	11 (44%)
Beris et al	144	73 (50.6%)	71(49.3%)
Present Study	60	34 (56.6%)	26 (43.3%)

The findings were similar to observations of Roberts S R, Beris et al.

Table 14:- Mode of injury

The commonest mode of injury was Road traffic accident. The findings were similar to observations of Lee at el.

Study	No of Patients	Commonest mode
Baird et al	24 (15)	Fall from height
Lee et al	168 (98)	Road traffic accident
Present Study	60 (32)	Road traffic accident

There was a wide spectrum of co-morbidities in these patients. 36.6% of the patients had poor, 56.6% had fair and 6.8% had good Kristenson's radiological criteria preoperatively. Post operatively 66.6% of patients achieved good results and 33.4% achieved fair results.

In the final score as per *Weber's*^{39,96} criteria, the objective signs and subjective symptoms were noted and compared with the radiological criteria. All the comparisons were made once the fractures united and at later follow ups. The results of the treatment is as shown in table 8.

The results of other studies were compared with our final outcome. This was divided into 2 groups of excellent and poor results in each of the fracture types. The results when compared showed a comparable result as shown below

<i>Study</i>	<i>Excellent</i>	<i>Poor</i>	
<i>St Gallen</i> ⁸⁴	A-78.2%, B-75.6%, C-77.4%	A-21.8%, B-24.4%, C-22.6%	130 Cases with 67.5 months follow-up
<i>Freibrug Series</i> ³⁰	A-82.4%, B-83.4%, C-85.3%	A-17.6%, B-16.6%, C-14.7%	105 Cases with 2-7 years follow-up
<i>Liestal Series</i> ⁵⁶	A-82.7%, B-78.7%, C-61.8%	A-17.3%, B-21.3%, C-38.2%	213 Cases with 4-12 years follow-up
<i>Our Study</i>	A-83.3%, B-87.5%, C-86.5%	A-16.7%, B-12.5%, C-13.6%	60 Cases with 6-30 months follow-up

Table 15:-

The number of complications noted were eleven in ten patients, the most common complication being delayed wound healing in six cases. This was more common in the old aged and more often in patients with diabetes mellitus. No major infections or malunion was noted.

Comparison of complications with other studies:

Table 16:-

<i>Study</i>	<i>Eugene</i> ²⁷	<i>Beauchamp</i> ⁶ <i>et al</i>	<i>Our Study</i>
<i>Major infection</i>	12%	8%	0%
<i>Failed reduction</i>	4.9%	0%	0%
<i>Minor infection</i>	9%	9%	10%
<i>Failed reduction</i>	4.2%	0%	0%
<i>Miscellaneous</i>	1%	4.5%	3.4%
<i>Total</i>	31.1%	21.4%	13.4%

The present study suggests anatomical reduction of the fracture and restoration of the joint congruity of the ankle at the earliest.

The post operative immobilization in a plaster slab or a cast upto six weeks does not affect the final outcome with respect to achieving the ankle and subtalar range of movements as most of the patients had achieved full range of motion at the end of 12 weeks.

The factors that affected the final poor outcome were the presence of long standing and uncontrolled Diabetes and old age, which was seen in four cases of which one had a neuropathic foot.

ANALYSIS

- 60 patients were included in this study with closed ankle fractures that were surgically treated at Apollo hospital, Hyderabad by various surgeons with various techniques of internal fixation.
- The classifications, review of literature, methods of investigations and management have been enumerated.
- The study had a male preponderance of 66.6% with road traffic accidents being the major cause of injury.
- Supination external rotation was the most common mechanism of injury and Weber's type B fractures were the most common type of fracture.
- The associated fractures and injuries noted and the co-morbidities seen in these patients have been enumerated.
- Open reduction and internal fixation under image intensifier control was done in all patients. Post operatively patients were immobilized with a plaster splint for a period of six weeks and were followed up with full weight bearing walking and active range of movement of ankle exercises.
- The final outcome as per the Weber's ^{39,96} radiological criteria was 66.6% good, 26.6% fair and 6.8% poor result which showed good correlation between the immediate post operative radiological score and the final radiological outcome. Objective and subjective findings were also comparable.

CONCLUSION

- 1) The fractures of the ankle are commonly seen in the young adult male population with Road traffic accidents and twisting injuries being the common causes.
- 2) Right side ankles were commonly involved than the left side.
- 3) Weber type B was the commonest type of fracture. Supination external rotation injury was the most common mechanism of injury.
- 4) The aim of surgery is to achieve anatomical reduction of the fracture fragments, ankle mortise congruity, restoration of the length of the fibula and restoration of syndesmotic integrity.
- 5) During surgery, the soft tissues dissection was kept minimal to avoid further vascular compromise in an already tense, swollen ankle.
- 6) In the post operative period, splintage of the ankle and precaution to prevent swelling of the ankle is necessary. The swelling may lead to delayed wound healing. Patients are ambulated with crutches or walker without bearing weight on the injured limb from the first post operative day if there are no associated injuries and can be discharged from the hospital by the first week.
- 7) Most of the fractures in our study were fixed within 24 hours which however did not change the final outcome, though other studies have stressed upon fixation within 8 hours of injury. The complications that arose were in those where the fractures were fixed after 24 hours which were delayed wound healing and superficial infections of the wound which mostly healed with regular wound care.
- 8) The six week period of immobilization did not affect the final range of ankle function as most patients had achieved full range of motion by the end of 12 weeks postoperatively with active exercise regimen.
- 9) The result of this study in comparison with other studies as enumerated shows similar findings with respect to the functional outcome following surgical stabilization of bimalleolar fractures. The rarity of complications in comparison to other studies may be due to a small number of patients and a very short period of follow up.
- 10) Our study used Lauge Hansen's classification for mechanism of injury and Weber's classification for radiological classification. We recommend use of Weber's classification for management which is easier for classification and radiological assessment.

Our series encourage operative intervention within 24 hours in the management of bimalleolar fractures of the ankle as the key for high percentage of good result.

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