A DISSERTATION ON ‘‘A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME OF BIMALLEOLAR ANKLE FRACTURES’’

Dissertation submitted to

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DECLARATION

I Dr. V. Senthil Kumar, solemnly declare that this dissertation titled **‘‘A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME OF BIMALLEOLAR ANKLE FRACTURES’’** is a bonafide record of work done by me under the guidance of Prof. Dr. R. Balachandran, M.S.Ortho. D. Ortho., Professor of Orthopaedics. Department of Orthopaedic Surgery, Government Royapettah Hospital, Chennai. This dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University, Chennai in fulfilment of the University regulations for the award of MS degree in Orthopaedic Surgery Branch II, Orthopaedic surgery examination to be held in APRIL 2014.

Place : Chennai

Date :

(Dr. V. Senthil Kumar)

CERTIFICATE

This is to certify that this dissertation entitled **''A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME OF BIMALLEOLAR ANKLE FRACTURES''** is a record of bonafide research work done by **Dr. SENTHILKUMAR. V**, post graduate student under my guidance and supervision in partial fulfilment of regulations of The Tamilnadu Dr. M.G.R. Medical University for the award of M.S. Degree Branch II (Orthopaedic Surgery) during the academic period from 2011 to 2014, in the Department of Orthopaedics, Government Royapettah Hospital & Govt. Kilpauk Medical College, kilpauk, Chennai-600010

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CONTENTS

ABSTRACT

AIM: To analyse the results of Surgical management of bimalleolar ankle fractures.

Materials and Methods: This prospective study done in Government Royapettah Hospital, Chennai. In our study, 30 cases of bimalleolar ankle fractures were analysed. Classification used was Lauge-Hansen and A.O. classification. Road traffic accident was major mode of injury. Average injury surgery interval was 6 days. Malleolar screw for medial malleolus and plate and screws for fibula was common mode of fixation.

Results: Results were analysed using Olerud and Molendar subjective and objective scoring. The subjective scoring was excellent and good in 80% of cases and objective scoring was good in 22 cases.

Conclusion: Accurate anatomical reduction and fixation results in good functional outcome.

Key Words: Bimalleolar ankle fractures, Lauge – Hansen, Olerud and Molendar scoring, functional outcome.

INTRODUCTION

In the lower extremity intra-articular fracture around ankle joint is the most common one. These fractures when occurred in olden days, ended up with permanent disability.

About three centuries ago, scientific study started with sir. Percival pott, who in the year 1768,in his paper some few general remarks on fractures and dislocations discussed on fracture complex occurring around the ankle Dupuytren, Leforte-wagstaffe, Tillaux-Chaput, Maisonneuve and others analyse ankle joint injuries.

After studying large number of cases in 1922 Ashhurt and Bromer classified and analysed the ankle injuries by taking into consideration the direction of forces. Lauge-Hansen in1948-1954 recognized four patterns based on pure injury sequences and takes into account at the time of injury, deforming force direction and position of the foot[40].

Many of the ankle injuries are mixed bony and ligamentous components. MRI nowadays is useful in precisely diagnosing ligamentous injury and repairing these components have to be borne in mind ,while treating these fractures.

Achieving anatomical reduction by open methods and internal fixation of Bimalleolar ankle fractures is necessary to avoid complications as in all intra-articular fractures.

With the advent of A.O principles of management, the results of bimalleolar ankle fractures are better with emphasis on anatomical reduction of fracture, stable internal fixation, regaining full length of fibula and early active pain free mobilization.

AIM OF STUDY

To analyse the results of surgical management of Bimalleolar ankle fractures.

HISTORICAL REVIEW

Large contributions were made by many authors in the mechanism of production of ankle injuries about three centuries ago. In olden times injuries around ankle were diagnosed as subluxations or dislocations.

It was Percival pott in 1768 who first described injuries around ankle. He was born in London and obtained Grand diploma of the Barber surgeons company in 1736 and was appointed as staff in St. Bartholomens Hospital. He first described a fracture of fibula within 2 or 3 inches of its lower extremity associated with deltoid ligament tear and talus lateral subluxation.

In 1839 DUPUYTREN demonstrated the role of inward and outward movement of the foot in ankle injuries, distinguishing fractures caused by talar impact and those by ligamentous avulsion. By outward movement of the foot he demonstrated the fibular fracture observed by pott. He was the first to describe proximal dislocation of talus following diastasis and to identify rupture of tibio fibular ligaments which is a common accompaniment of this fracture.

In 1840 MAISONNEUVE described pronation –external rotation type of ankle injury and proved it was determined by the strength of syndesmosis. He emphasized the ankle injury with fracture of proximal third of the fibula and distinguish it from direct trauma to fibula.

In 1872 TILLAUX described that a combination of abduction and external rotation forces occur together and produces avulsion fractures of anterior tibial margin by anterior tibio fibular ligament.

In 1890 ROCHE demonstrated vertical compression was necessary to produce marginal fractures of distal fibula which was first described by ASTLEY COOPER.

With the innovation of x-rays in 20th century, the study on ankle fractures added a new dimension. DESTOT named posterior lip of tibia as third malleolus. In 1912 COTTON drew attention to posterior malleolus fracture.

In 1922 ASHHURST AND BROMER put forth classification of injuries to ankle mortise.In1948-54,LAUGE-HANSEN proposed the genetic classification which emphasized the etiological interdependence of sequential events or stages.

At the beginning of this century, LANE pioneered in the operative treatment of ankle fractures. He employed no-touch surgical technique and preferred screw fixation of fracture fragments.

The importance of fibula fixation was proved beyond doubt in the stability of ankle fractures with the advent of AO era[1]. The Weber work towards ankle injuries like classification, treatment modalities and complications is worth mentioning[4].

The biodegradable implants is now being used in some centers for fixing bimalleolar ankle fractures. The degradation within the body by hydrolysis is between 2 months to 6 months[7].

SURGICAL ANATOMY OF ANKLE

The ankle joint is a modified hinge joint and the functional unit consisting of three bones and the ligaments that bind them[17]. The Ankle mortise is formed by distal tibial articular surface reffered to as tibial plafond together with medial and lateral malleolus.

The bones taking part in the articulations of ankle joint are

a. Distal tibia
b. Lateral malleolus and
c. Talus

DISTAL TIBIA

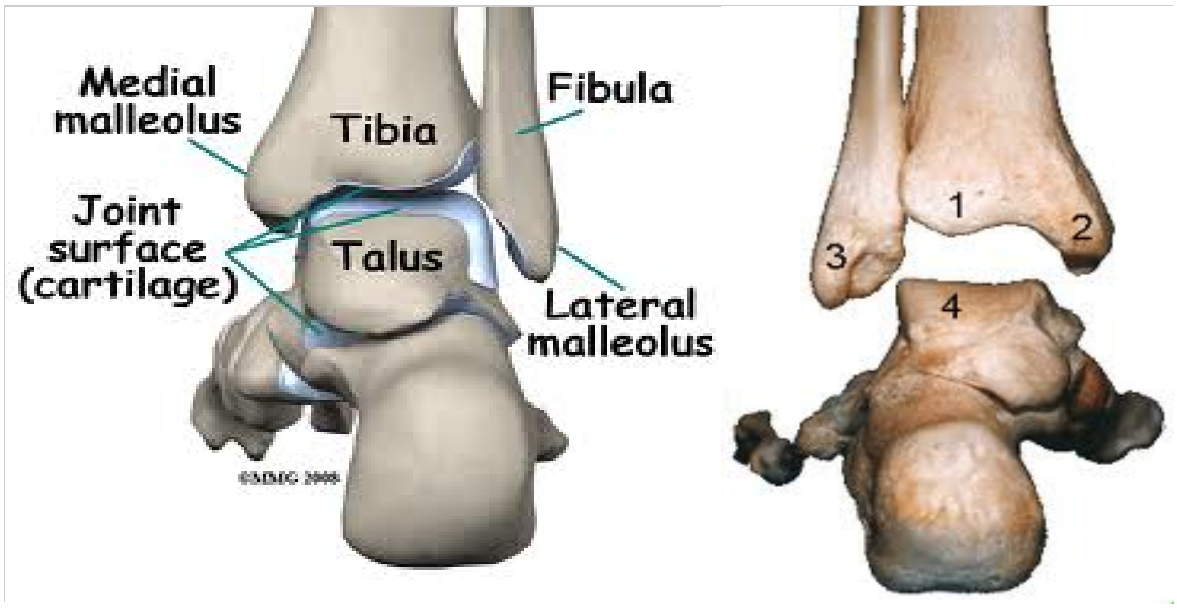
The inferior surface of distal tibia is articular and is referred to as the tibial plafond which is concave in anteroposterior plane but convex in lateral plane and wider anteriorly than posteriorly to allow for congruency with talar dome. In weight bearing, it provides functional stability. The plafond is continuous medially as medial malleolus which articulates with medial facet of talus and divides into anterior and posterior colliculus, which serves as attachment for deltoid ligaments.

LATERAL MALLEOLUS

The lower end of fibula makes up lateral malleolus which project about 1 cm distal and posterior to the medial malleolus. It makes a valgus tilt of about 10˚-15˚to shaft of fibula[19].

THE TALUS

The dome of talus is trapezoidal, with anterior aspect 2.5mm wider than posterior talus matched with tibial plafond which provides intrinsic stability. It has comma shaped medial facet and triangular lateral facet that articulate with corresponding malleoli[12].



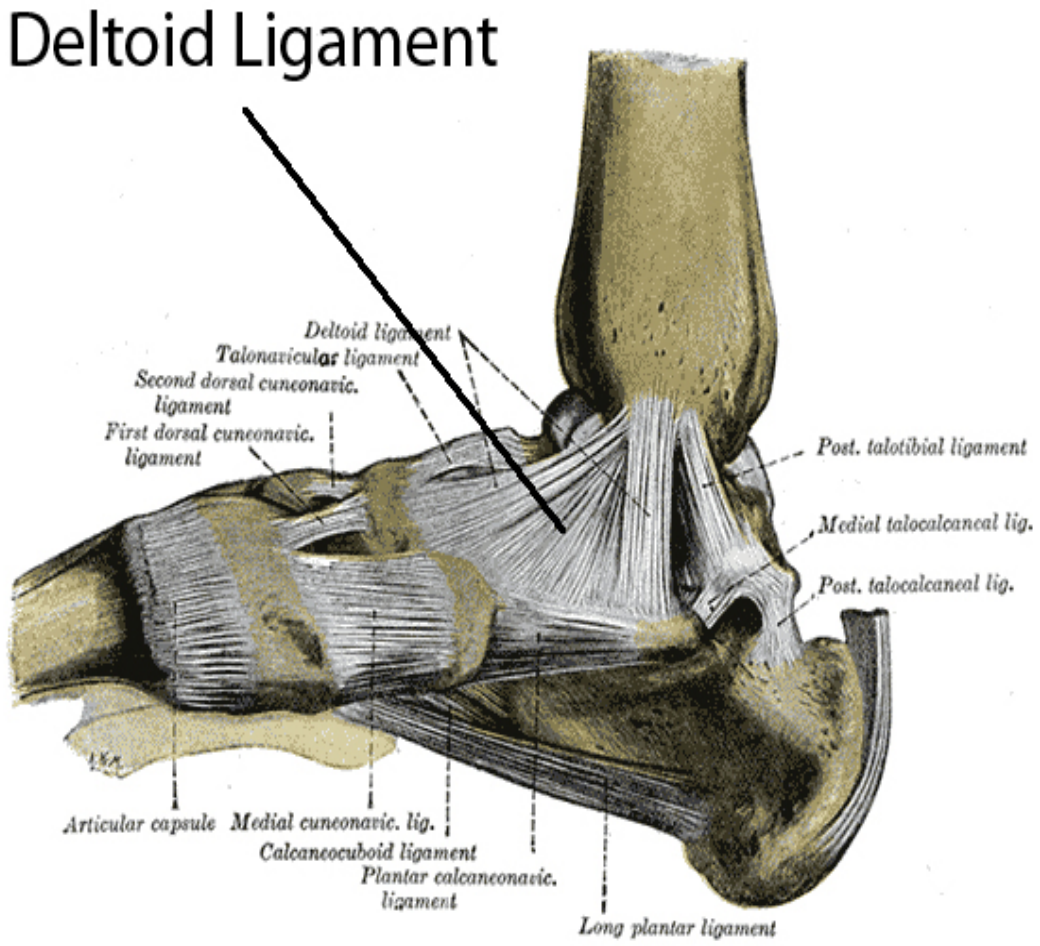
Bones taking part in the articulation of ankle joint

LIGAMENTS OF THE ANKLE JOINT

The ankle being a complex hinge joint is in close association with a complex ligamentous system. They are

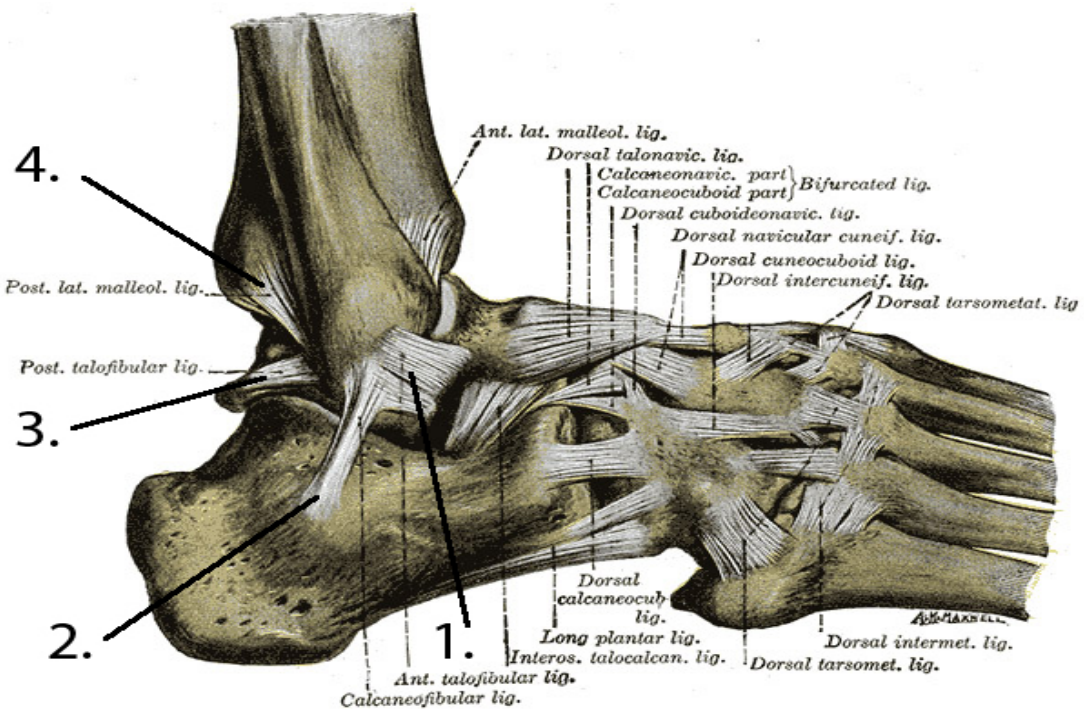
a. Medial collateral or deltoid ligament
b. Lateral or fibular collateral ligament
c. Syndesmotic ligament complex

Medial collateral or deltoid ligament is a triangular band consisting of two set of fibres. The superficial portion composed of three ligaments that orginate from anterior colliculus and attached to navicular (Tibionavicular ligament),sustentaculum tali(Tibiocalcaneal ligament),and neck of talus (Talotibial ligament). The deep portion is intra-articular and the fibres are transversely placed running from intercollicular groove and posterior colliculus to the medial surface of talus[15].



Medial aspect of the ankle joint showing various ligaments

Lateral or fibular collateral ligament is made of three ligaments that provide lateral support to ankle which is not so strong as the medial ligament. The anterior talofibular ligament which is the weakest ,prevents anterior subluxation of talus in plantar flexion. The posterior talofibular ligament which is the strongest, prevents posterior and rotatory subluxation of talus. The calcaneofibular ligament stabilizes subtalar joint and rupture leads to positive talar tilt test.



Lateral aspect of the ankle joint showing various ligaments

Syndesmotic ligament complex maintains the integrity of ankle mortise resisting axial, rotational and translational forces.

The ligaments of syndesmosis are

a. Anterior inferior tibiofibular ligament

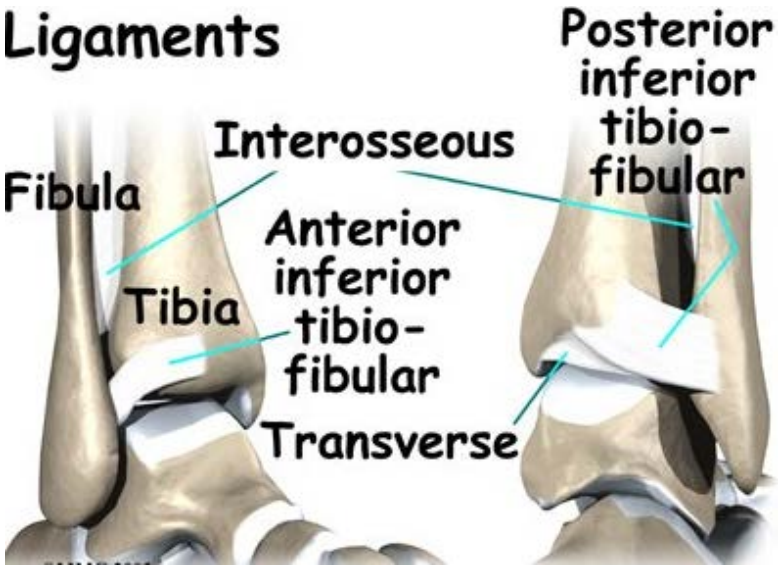
b. Posterior inferior tibiofibular ligament

c. Transverse tibiofibular ligament

d. Interosseous ligament

The anterior inferior tibiofibular ligament and posterior inferior tibiofibular ligament runs between anterior and posterior margins of tibia and

fibula in the inferior aspect and transverse tibiofibular ligamentis inferior to posterior tibiofibular ligament. The interosseous ligament is the distal continuation of the interosseous membrane. The arrangements permits slight fibular movement in craniocaudal, rotatory, mediolateral, anteroposterior planes during normal ankle movements[7].



Syndesmotic ligaments of ankle joint

MOVEMENTS OF ANKLE JOINT

The main movements are dorsiflexion(15˚-18˚) and plantarflexion(39˚-48˚). Some amount of rotation occurs with dorsiflexion (external) and plantarflexion (internal). The movements of ankle joint said to occur about a single axis between the tips of the malleoli and is directed 20˚-25˚laterally, posteriorly and downward[12].

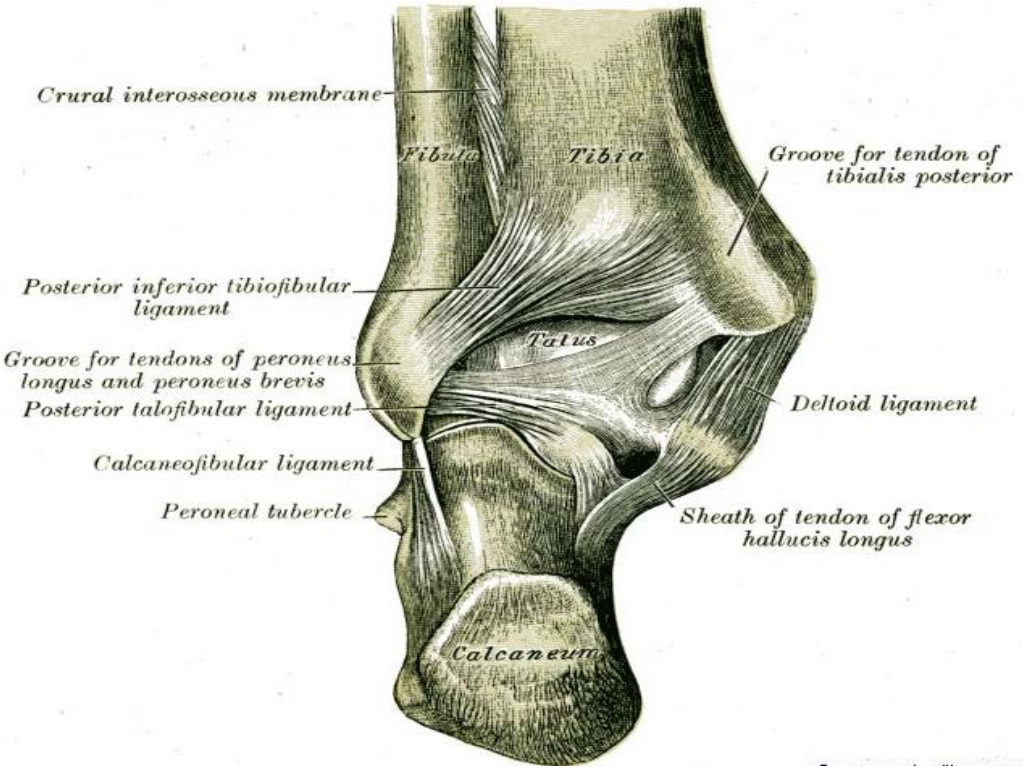
THE RING OF ANKLE MORTISE

Neer has pointed out that, the ankle mortise actually constitutes a ring of three bones and their uniting ligaments. Because these ligaments do not stretch, a single break in the ring permits no anteroposterior or talar shift of the talus in the mortise. Since most ankle injuries are produced by abnormal motion of talus, the talus may be said to be the ring leader. For talar shift to occur, there must be atleast two breaks in the ring- either a fracture of both malleoli or a fracture of one malleolus and rupture of one ligament[14]. This fact is important in assessing the stability or potential for displacement of any ankle injury.

ANKLE MORTISE

ROLE OF BONES AND LIGAMENTS IN THE STABILITY OF ANKLE JOINT

There was no instability when deltoid ligament alone was torned. Medial malleolus fracture at the level of joint produced 10˚ of rotatory instability whereas lateral malleolus fracture distal to anterior tibiofibular ligament produced instability of about 20˚of inversion and 40˚of external rotation[17]. Fibular collateral ligament injury produced 10˚ of inversion and 30˚of external rotation instability which emphasis that lateral side was more important than medial side with regard to stability.



Posterior aspect of the ankle joint showing various ligaments

BIOMECHANICS OF ANKLE JOINT

KINEMATICS OF ANKLE

The ankle joint is structured for skeletal mobility by virtue of the soft tissue and bony architecture. The normal range of motion of ankle in dorsiflexion is 20 degrees and in plantar flexion is 45 degrees occurring mostly at subtalar joint.

For normal gait ,10 degrees of dorsiflexion and 20 degrees of plantar flexion are required as revealed by motion analysis. The ankle axis which runs between two malleoli is 20 degrees externally rotated compared with the knee axis.

FORCES AT ANKLE JOINT

The articulations of ankle joint are required to transfer the forces imposed by weight bearing. The joint reaction forces may be classified into external and internal forces.

The External forces are-ground reaction forces, gravitational forces due to body weight and inertial forces both by gravity and muscular contraction resulting in acceleration and deceleration of limbs[2]. The Internal forces are related to tension forces which develop in the soft tissue structures, muscles, ligaments and joints.

JOINT INCONGRIUITY AND WEIGHT BEARING

The ankle joint exhibits incongruity during swing phase and early stance phase. During ankle motion, the sliding of tibia on the talus contributes to a changing instantaneous center of rotation and also changes contact areas across the joint surfaces[2,29]. The motion between the mortise and talus ,including some incongruence in the ankle joint may be necessary for normal load distribution, cartilage nutrition and lubrication of the ankle joint. The enhanced stability at the ankle joint in dorsiflexion allows the ankle to withstand compression forces to as much as 450 percent of body weight.

IMMUNITY TO DEGENERATIVE ARTHRITIS

The configuration of multiple skeletal components of ankle- foot complex is such that the ankle is resistant to primary degenerative osteoarthritis[31]. The structures serves as energy –absorbing elements are the interosseous membrane, inferior tibio fibular syndesmosis, fibula, subtalar joints and multiple distal joints protecting the integrity of the ankle. Any impairement of these anatomical structures following ankle injuries lead to increased mechanical demand at subtalar joint subsequently to osteoarthritis.

CLASSIFICATION OF ANKLE INJURIES

Various classification are available for ankle injuries. The Lauge-Hansen and Danis-Weber classifications are widely accepted.

LAUGE-HANSEN CLASSIFICATION

From cadaveric studies, this system distinguished four major patterns divided into several stages by takes into account the position of foot and deforming force direction at the time of injury[40]. In this classification, first word represents the position of foot at the time of injury and second word to the direction of injuring force.

SUPINATION-ADDUCTION (SA)

Medial displacement of talus occurred only in this type.

Stage I - Transverse avulsion fracture of fibula distal to joint

Stage II - stage I + vertical medial malleolus fracture

SUPINATION – EXTERNAL ROTATION

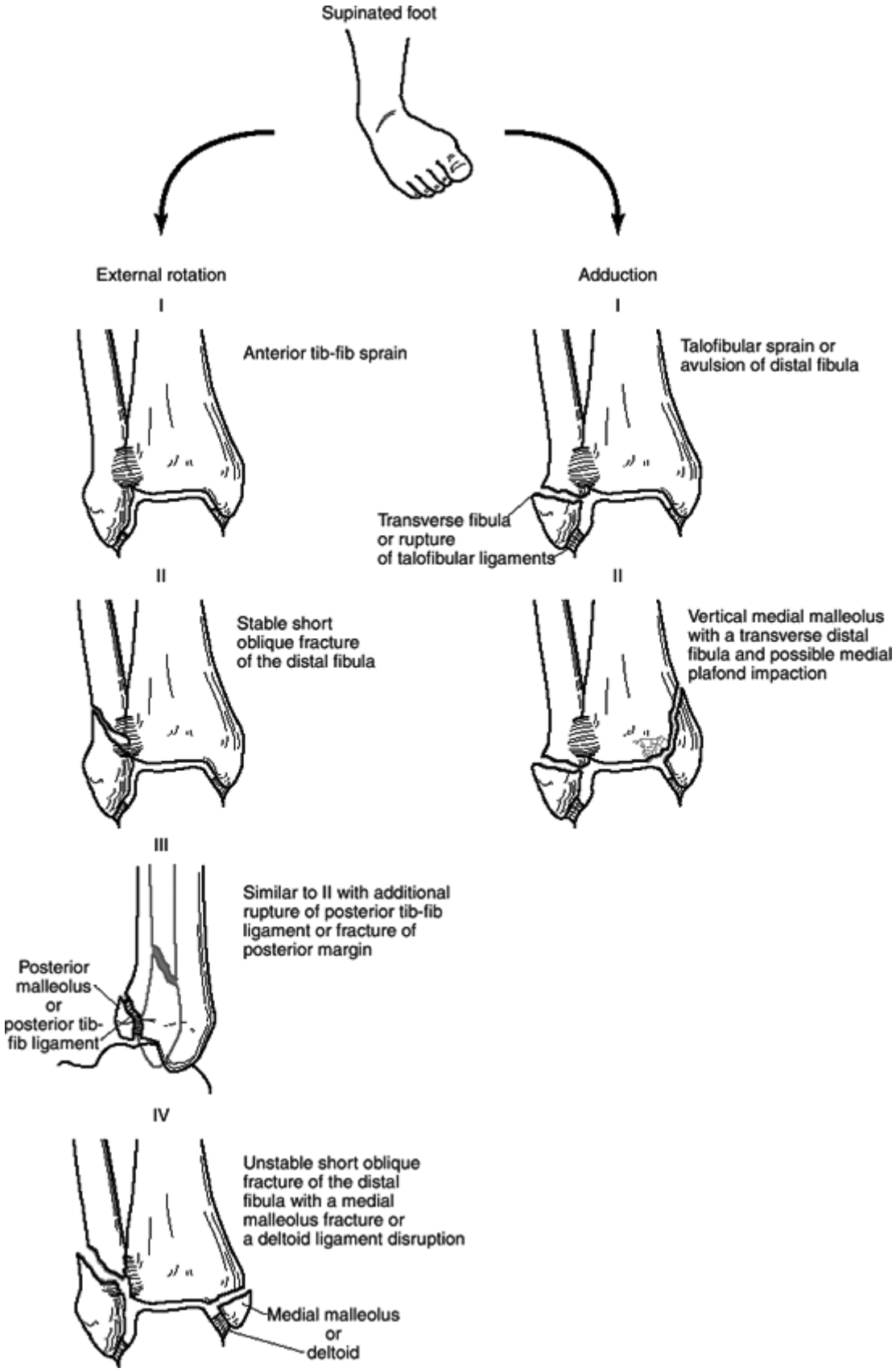
Stage I - Disruption of anterior inferior tibiofibular ligament or

avulsion of bone fragment from tibia or fibula.

Stage II - stage I + short stable oblique fracture of distal fibula.

Stage III - stage II + disruption of posterior inferior tibiofibular Ligament or posterior malleolus fracture.

Stage IV - stage III + transverse medial malleolus fracture or Rupture of deltoid ligament.


Supinated foot
External rotation
Adduction
I
Anterior tib-fib sprain
I
Talofibular sprain or
avulsion of distal fibula
Transverse fibula
or rupture
of talofibular ligaments
II
Stable short
oblique fracture
of the distal fibula
II
Vertical medial malleolus
with a transverse distal
fibula and possible medial
plafond impaction
III
Similar to II with additional
rupture of posterior tib-fib
ligament or fracture of
posterior margin
Posterior
malleolus
or
posterior tib-
fib ligament
IV
Unstable short oblique
fracture of the distal
fibula with a medial
malleolus fracture or
a deltoid ligament disruption
Medial malleolus
or
deltoid

PRONATION – ABDUCTION (PA)

Stage I - Transverse fracture of medial malleolus or rupture of deltoid ligament.

Stage II - stage I + rupture of syndesmotic ligaments.

Stage III - stage II + transverse or short oblique or laterally Communited fibula fracture at or above the level of Joint.

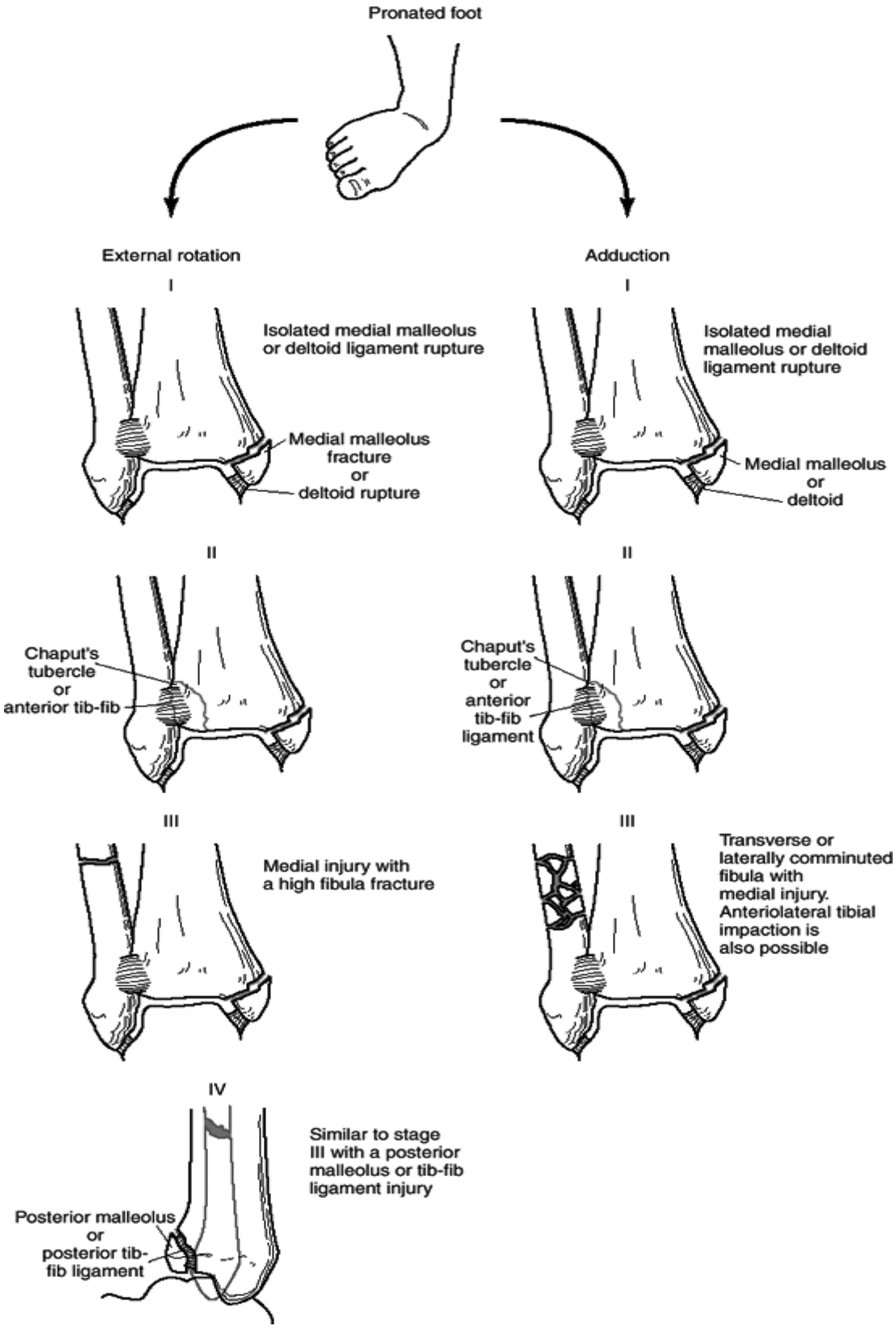
PRONATION – EXTERNAL ROTATION (PER)

Stage I - Transverse fracture of medial malleolus or rupture of deltoid ligament.

Stage II - stage I + Disruption of anterior inferior tibiofibular ligament

Stage III - stage II + spiral fracture of fibula at or above the level of syndesmosis.

Stage IV - stage III + disruption of posterior inferior tibiofibular Ligament or posterior malleolus fracture.


Pronated foot
External rotation
Adduction
I
Isolated medial malleolus or deltoid ligament rupture
Medial malleolus fracture or deltoid rupture
I
Isolated medial malleolus or deltoid ligament rupture
Medial malleolus or deltoid
II
Chaput's tubercle or anterior tib-fib
II
Chaput's tubercle or anterior tib-fib ligament
III
Medial injury with a high fibula fracture
III
Transverse or laterally comminuted fibula with medial injury. Anteriolateral tibial impaction is also possible
IV
Similar to stage III with a posterior malleolus or tib-fib ligament injury
Posterior malleolus or posterior tib-fib ligament

DANIS – WEBER CLASSIFICATION

This classification is based on the level of fibula fracture. The AO classification expands on Danis - Weber classification to include ligamentous injuries and fractures from medial side[10].

TYPE A : Infrasyndesmotic lesion

A1. Isolated infrasyndesmotic lesion

A2. A1 + medial malleolus fracture

A3. A2 + posteromedial fracture.

In this syndesmotic ligamentous complex is always intact.

TYPE B : Transsyndesmotic lesion

B1. Isolated transsyndesmotic fibular lesion.

B2. B1 + medial lesion.

B3. B2 + Volkmans lesion.

The medial lesion includes medial malleolus fracture and anterior syndesmosis rupture or medial collateral ligament injury. The volkmans lesion is fracture of posterolateral aspect of distal tibia. Interosseous membrane as a rule is intact.

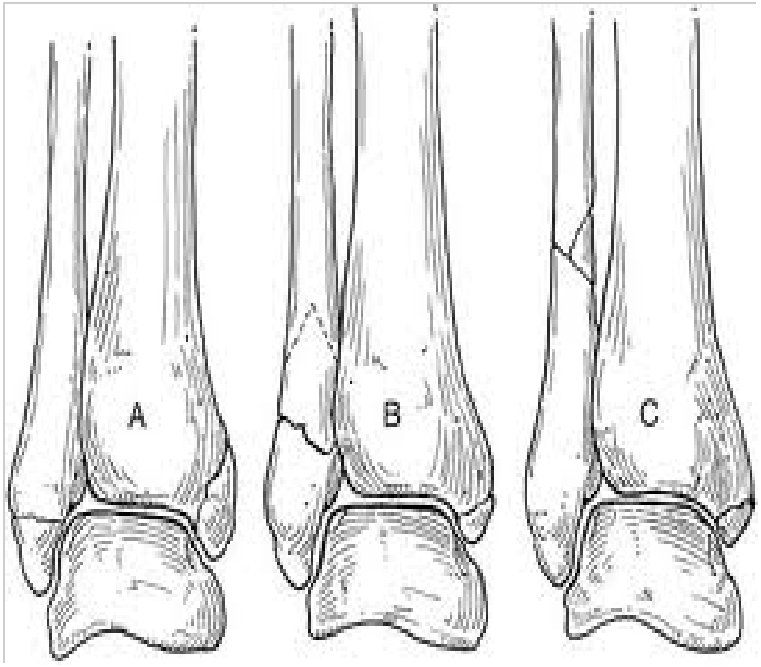
TYPE C : Suprasyndesmotic lesion

C1. Simple suprasyndesmotic lesion associated with or Without medial lesion and volkmans lesion.

C2. Multifragmentary diaphyseal fibula fracture. Other associated injuries like C1 are present.

C3. Proximal fibula fracture with disruption of syndesmotic Ligament complex and interosseous membrane atleast to the level of fibula fracture.

The severity of injury progressively increases from type A to type C .



RADIOLOGY OF ANKLE

The standard radiographic examination of ankle includes the anteroposterior (AP), 15- degree internal rotation view (mortise) and lateral views.

The antero-posterior x-ray is taken in the long axis of the foot and is particularly useful for evaluation medial or lateral tilt of the talus, tibiofibular overlap and tibiofibular clear space[13].

In the lateral x-ray the dome of the talus should be centered and congruous with the tibial plafond. This view is useful to demonstrate anteroposterior shift and avulsion fractures of the talus,posterior tibial tuberosity fractures and external rotation fractures of the fibula.

In Mortise view the anteroposterior projection is taken by positioning the foot on the table with the fifth metatarsal in about 15˚of internal rotation. This view is useful for evaluation of medial clear space, talocrural angle, tibiofibular overlap and talar shift.

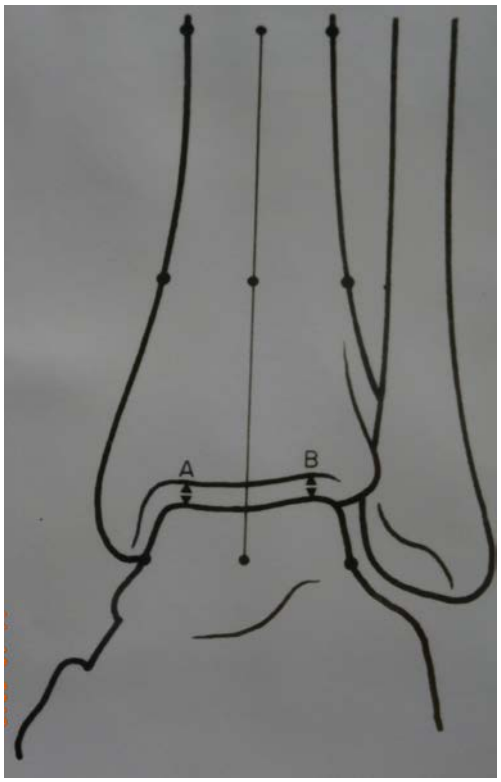
RADIOLOGICAL ASSESSMENT OF REDUCTION

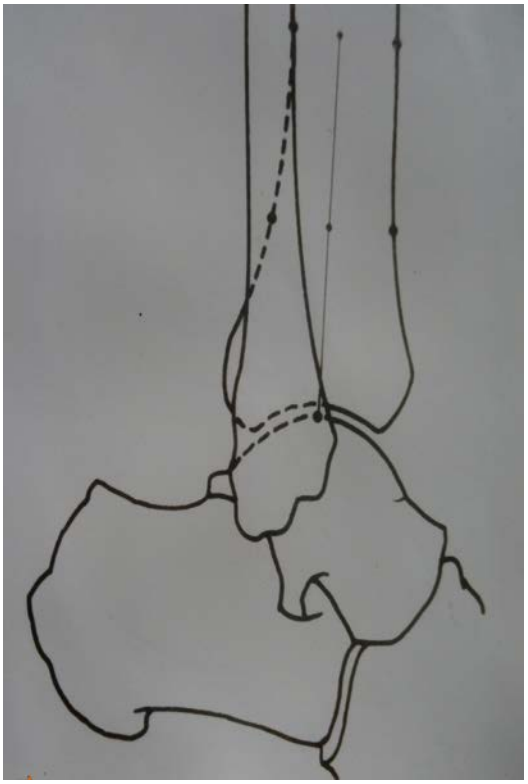
1. Measurement of the clear space

The clear space is the distance between the inner surfaces of the medial and lateral malleolus and the opposing articular surface of the talus. The medial clear space is better seen in an anteroposterior view and the space should normally be of equal width throughout. Normally less than 2mm is permissible.

2. Assessment of talar shift

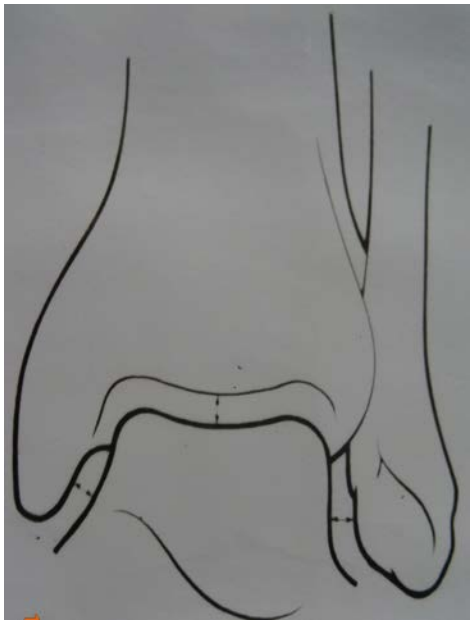
In anteroposterior view a vertical line drawn down through the centre of tibia should pass through the centre of the talus. The talus is shifted medially or laterally if this line does not pass through the centre of the talus. A medial clear space more than 5 mm indicates lateral talar shift. In lateral view a vertical line along the centre of tibia should pass through the most superior part of the doome of talus. If it is not so it indicates anterior or posterior shift.





3. Assessment of talar tilt

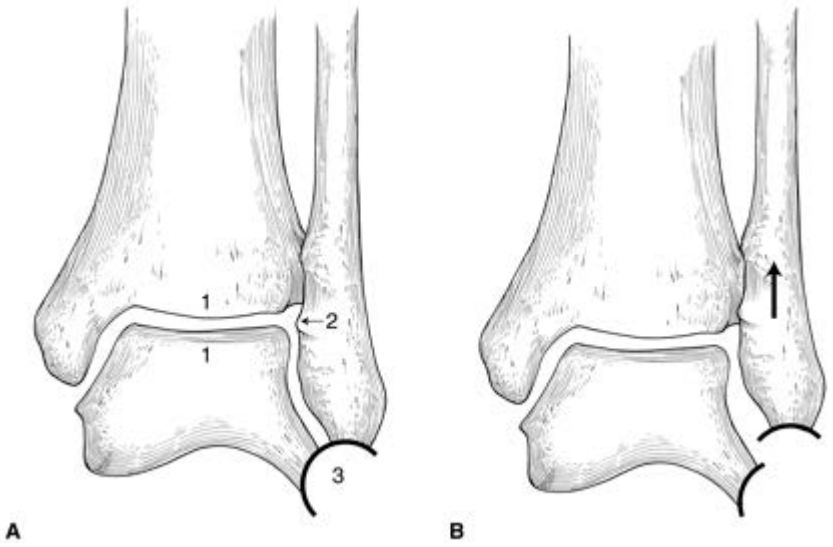
The talar tilt is assessed by measuring the superior joint space on the medial and lateral borders of the joint. More than 2mm indicates talar tilt.



Medial, lateral and superior joint space of equal width

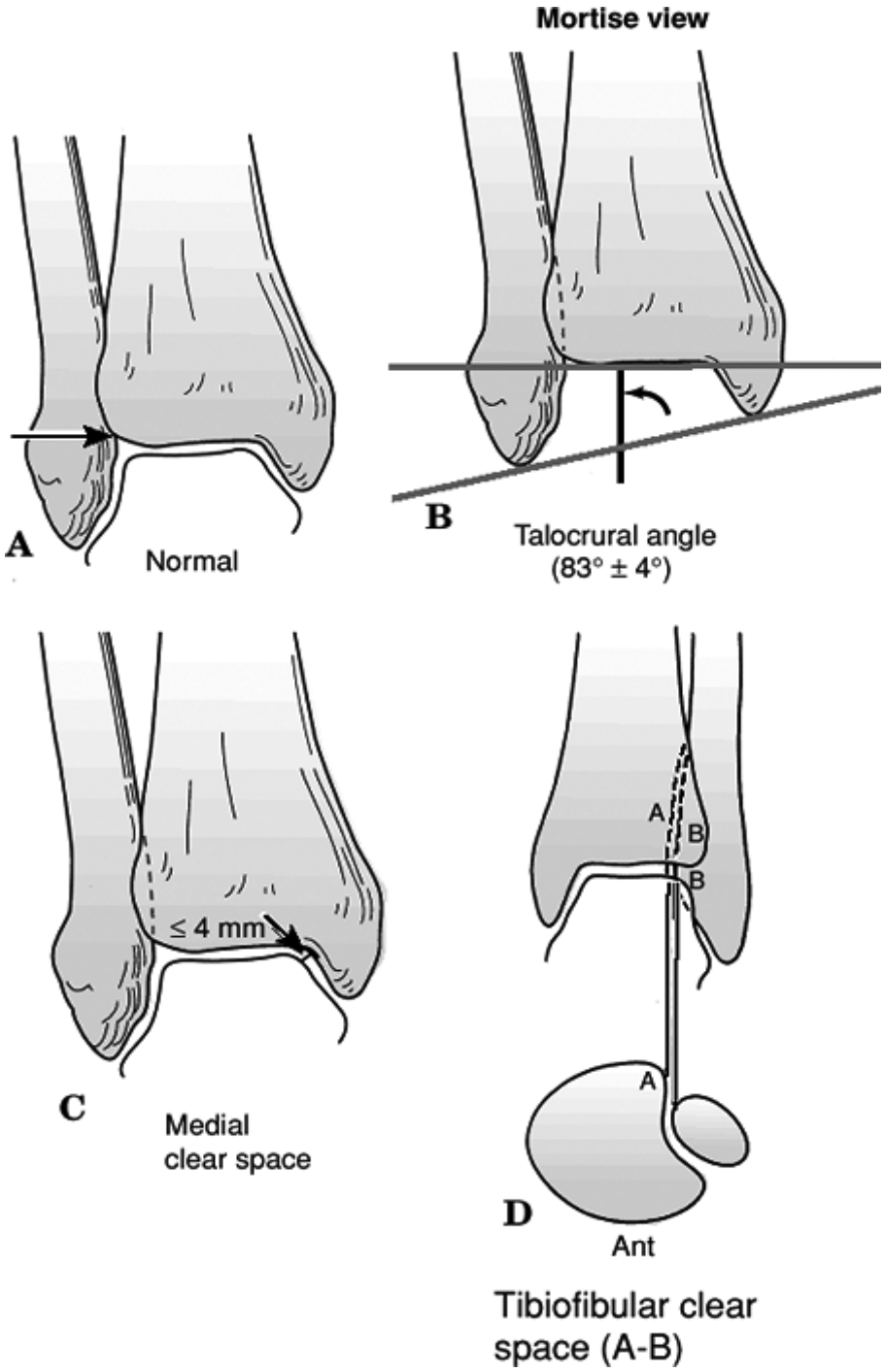
4. Assessment of fibular length

The fibular length can be assessed by drawing shentons line of the ankle[16].In mortise view ,the dense subchondral bone of the tibia can be followed over the syndesmotic space to the fibula, where a small spike is seen. The spike points exactly to the level of tibial subchondral bow. In fibular shortening , shentons line is broken. The dime sign is unbroken curve connecting the distal tip of the fibula and the lateral process of talus when the fibula is out to length on AP radiograph[6,11].In fracture when fibula is malreduced ,dime sign is absent.The Talo-crural angle is angle between the intermalleolar line and a line perpendicular to tibial plafond.Normal range is $83^0 \pm 4^0$ This angle should be within 2^0 to 3^0 of the uninjured ankle.



A- Normal , B- Break in shentons line and Dime sign

For all these measurements we need radiographs of good quality and it is difficult to delineate the borders of the bones if the patient is immobilized in a cast.



Syndesmotic Disruption

Tibio fibula overlap of less than 10mm and tibia fibula clear space more than 5mm is abnormal and indicates syndesmotic disruption[33,34].

MECHANISM OF INJURY

Most of the ankle injuries are as the result of movement of talus within ankle mortise. There are four main injury patterns, where the first part of name denotes the position of foot at the time of injury while the second part represents the direction of deforming force.

SUPINATION – ADDUCTION INJURY

In this supinated foot experiences forcefull adduction which results in compressive force over medial ankle structures and traction force over lateral ankle structures. If the talus gets forcibly adducted in plantar flexed position of ankle it causes injury to anterior talofibular ligament.This isolated lesion is called sprained ankle. If forcible inversion occurs with foot at right angle to tibia,a low transverse fracture of fibula created at a level below the syndesmosis.If the deforming force continues, vertical fracture line is created in medial malleolus extending from the medial axilla of the joint and proximally into the metaphyseal cortex of the tibia and is the sine quenon of this injury.

PRONATION ABDUCTION INJURY

In abduction injury, talus is forcibly abducted in the ankle mortise with traction force on the medial side and compression force on the lateral side. It results in transverse fracture of the medial malleolus and if the abduction force continues it produces fracture of the fibula at the junction of shaft and lateral malleolus with characteristic commination.

SUPINATION EXTERNAL ROTATION INJURY

In a supinated foot, when the talus begins to rotate externally the medial structures are not in tension. Since the talus is not free to rotate forwards out of mortise, it begins to rotate backwards pivoting on medial structures. This pushes the lateral malleolus posteriorly, rupturing the anterior talofibular ligament and a short oblique fibular fracture running anteroinferior to posterosuperior. This is the commonest fracture around the ankle and the patient usually gives history of inversion injury to foot.

If the deforming force continues, the talus rotates further backwards right out of the mortise, frequently pushing off the restraining posterior malleolus as a large fragment at this moment of dislocation. At the same time injury progresses to the medial sided structures where the medial malleolus osteoligamentous complex (MMOLC) is injured. Reduction of fibula will sometimes reduce the posterior fragment.

PRONATION EXTERNAL ROTATION INJURY

With the foot pronated and as the talus starts to rotate externally within the mortise, the medial structures are under tension and the deltoid ligament is torned with medial malleolus fracture. The talus is then free and swings forward out of the inner side of the mortise about a lateral axis. This produces torsion force to the fibula which tears the anterior talofibular ligament.

If the deforming force continues, one of the two things may happen. If the force continues to rotate the fibula, it relaxes the posterior tibiofibular ligament and a spiral fracture of the fibula occurs above the level of syndesmosis. Secondly where posterior tibiofibular ligament is intact, if the tibia is pushed medially off the rotating talus under the influence of the body weight and forward thrust as in a running injury the posterior tibiofibular ligament is also ruptured.

TREATMENT OF BIMALLEOLAR ANKLE FRACTURES

Beauchamp et al reported that in patients above 50 years,2 years follow up showed little difference in functional outcome treated both conservatively and operatively[3,37]. This study was supported by many studies like Salai et al, Srinivasan et al, and Pagilaro et al stated that the results are almost equal in elderly age group treated either by conservatively or operative methods.

The treatment can be classified into

1. Conservative management

2. Surgical management

The surgical management and the aim of our treatment was to obtain good functional outcome by assessing the accuracy of reduction[5,25]. They are

1. To restore full length of fibula

2. Anatomical positioning of talus beneath the tibial plafond

3. Restoration of medial joint space to its normal width

4. No tibiofibular diastasis.

Before embarking on any mode of treatment based on an x-ray a careful clinical examination should be done to localise tenderness in the area of

probable ligamentous damage. ie, below the medial malleolus, around the lateral malleolus and the anterior tibiofibular ligament area.

The talus, medial malleolus and lateral malleolus all move as one piece being inseparably connected by ligaments of the ankle joint. The reduction of displacement is essentially a case of realigning the hindfoot in relations to the leg i.e, the talus to the tibia, rather than making any correction on one or other malleoli. Lauge-Hansen classification is especially helpful in closed reduction.

SURGICAL MANAGEMENT

In open reduction and internal fixation of displaced bimalleolar fractures, a variety of implants had been suggested by different surgeons. Malleolar screw, tension band wiring and kirschner wire fixation of medial malleolus, tension band wiring, rush nail plate and screw fixation for lateral malleolus. The principles of internal fixation as advised by the AO group have greatly revolutionized and simplified the fixation of bimalleolar fractures.

TIMING OF SURGERY

When surgery is delayed more than a week, there is higher rate of malreduction by Fogel et al[35].There is no difference in functional outcome by surgical delay except long period of stay in delayed group by Breederveld et al[39] and Koonrath et al. The ideal time for the surgical fixation is within the first 6-8 hours of injury. In the presence of severe edema or fracture blisters, surgery

must be postponed until the soft tissue condition has improved. On such situation the fracture is reduced, immobilized and the limb is kept elevated. Surgery is postponed for 4-6 days, until the edema has subsided.

BASIC PRINCIPLES

Restoration of the length of fibula is very important, so reduction and fixation on lateral side has got much priority[25,] .Occasionally the anatomical reduction of fibula is impeded by soft tissue interposition on the medial side. In such cases before the fixation of fibula is completed the medial malleolus must be exposed and reduced. The joint surface must be inspected and any small fracture fragments removed. The temporary stabilisation of fracture fragments after reduction can be done with K wire or pointed reduction holding forceps[8]. The definitive fixation is then carried out. A well contoured plate has to be used for fixation of fibula. The valgus bend of the fibula lies about 3.5 cm above the tip of lateral malleolus, and is about 10^0 - 15^0. The plate has to be bend accordingly. X- ray of the opposite ankle will be helpful in assessing the exact valgus tilt of the fibula.

SPECIFIC FRACTURE PATTERN FIXATION

Supination-External Rotation

Most common fracture pattern .Fracture pattern is identified by the level of fibula fracture at the level of ankle mortise running from anteroinferior to posterosuperior fracture lines in lateral radiograph. Syndesmotic breakage occurs in 50% of our cases. simple SER fracture pattern are treated by posterior plating of fibula. Fibula is first reduced and fixed with anteroposterior lag screw. This fixation is supplemented with a well contoured neutralisation plate and screws on lateral aspect of fibula. Exact reduction of the lateral malleolus results in reduction of the displaced posterior malleolus by the pull of posteroinferior tibiofibular ligaments. Fractures involving less than 25% of the articular surface may not need fixation[5,10]. If more than 25% of articular surface is involved fracture site is approched through posteromedial incision, reduced and fixed with cancellous screws. Medial malleolus is fixed by means of malleolar screws or tension band wiring technique.

Pronation-External Rotation

This fracture pattern differs from supination variant in that fibula fracture occurs at suprasyndesmotic level with syndesmotic disruption. Medial malleolus and lateral malleolus are fixed in the same way as in SER pattern. In addition to that syndesmotic disruption was treated by syndesmotic positioning

screw. It was inserted from back to front at an angle of 25^0-30^0 starting posterolaterally and aiming anteromedially 2-3 cm above the ankle joint.

Supination- Adduction

If lateral malleous is avulsed, it may be fixed by modified tension band wiring technique or a one third tubula plate and screws. The joint is inspected through the torn anterior capsule. Medial malleous is fixed with one or two malleolar screw with or without K-wire supplementation. The tension band wiring is unsuitable for medial malleolar injury. A posteromedial fragment must be carefully reduced and fixed from the posteromedial aspect.

Pronation-Abduction

It is characterized by comminuted fibular fracture secondary to various degree of bending. It requires Push-Pull technique or external distractor application to regain length of fibula. In severe cases acute bone grafting may be needed.

CARE OF THE SOFT TISSUES

Carrragee et al, in high velocity ankle fractures if the delay of surgery is more than 24 hours, results in higher soft tissue complications[9]

Skin necrosis is one of the commonest problems after fixation of bimalleolar ankle fractures. This can be prevented by

1. Undertaking surgery after subsidence of edema.
2. The skin and soft tissues to be handled gently.
3. No undermining of skin or subcutaneous tissue should be done. The incision is to be carried down to the level of the periosteum.
4. Adequate haemostasis, suction drainage, active movement of the toes and elevation of the leg all help in decreasing edema and consequent skin necrosis.

POSTOPERATIVE MANAGEMENT

The AO group advocates a double U-splint, which prevents an equinus deformity, but at the same time allows dorsiflexion of the ankle[30]. This is removed by about fourth to tenth day, depending on several conditions like pain, edema, wound feeling etc.

Many surgeons prefer to immobilize for three to six weeks, to aid in the healing of ligaments and soft tissue injury or if the fixation do not appear really sound. Non-weight bearing crutch walking is permitted. Then active movements of ankle are started.

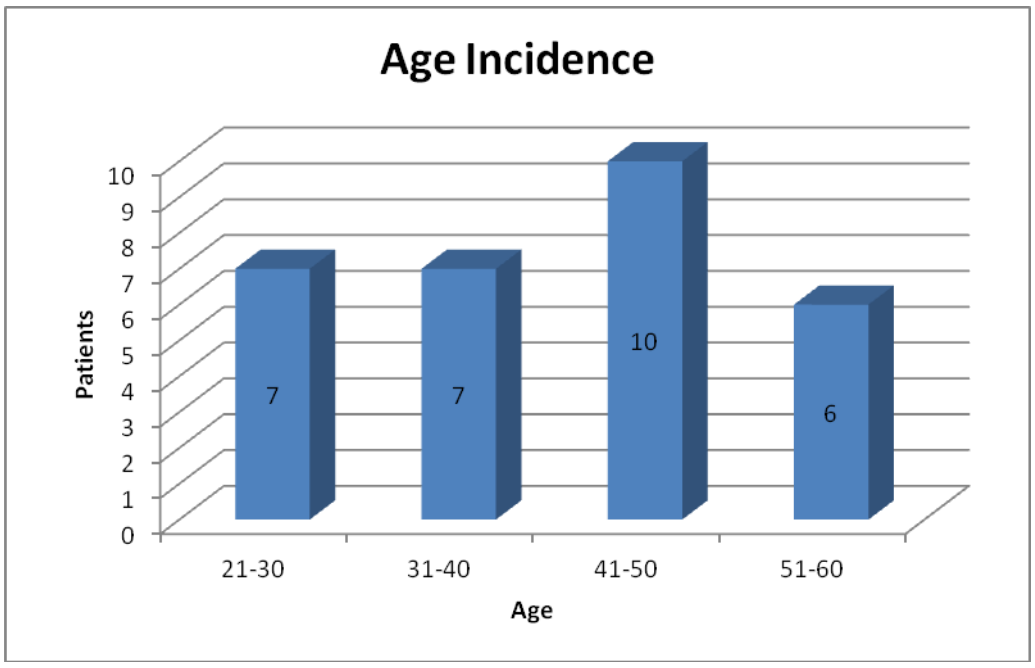
Full weight bearing is permitted after radiological union. Supination injuries take about eight weeks and in pronation injuries are delayed for about twelve weeks for full weight bearing.

MATERIALS AND METHODS

This was a Prospective study includes 30 cases of closed bimalleolar ankle fractures who were treated surgically at Government Royapettah Hospital, Chennai from June 2011 to June 2013.Approval from institution ethical committee was obtained.

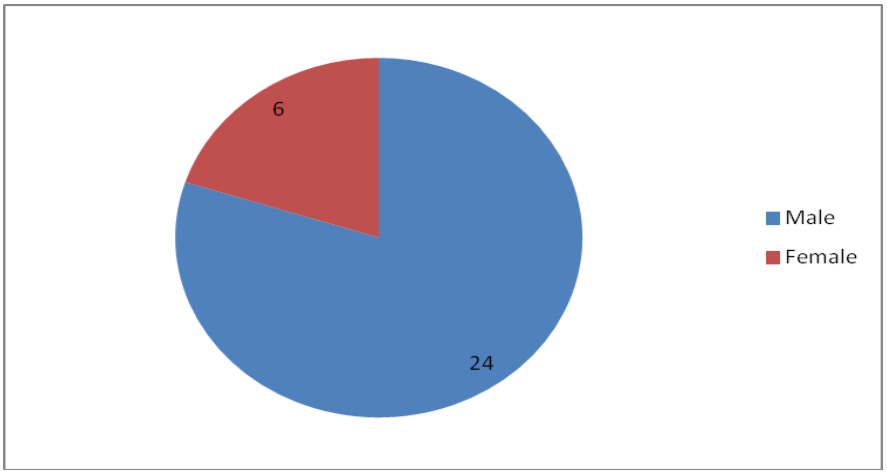
AGE INCIDENCE

AGE(In years)	Number of patients
21-30	7
31-40	7
41-50	10
51-60	6



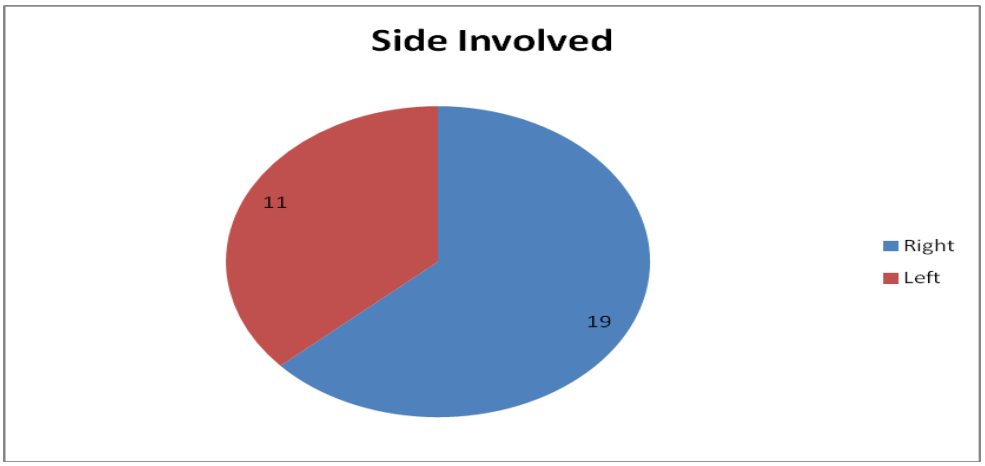
SEX RATIO

Sex Ratio	No.of patients
Male	24
Female	06



SIDE

Side	No. of patients
Right	19
Left	11

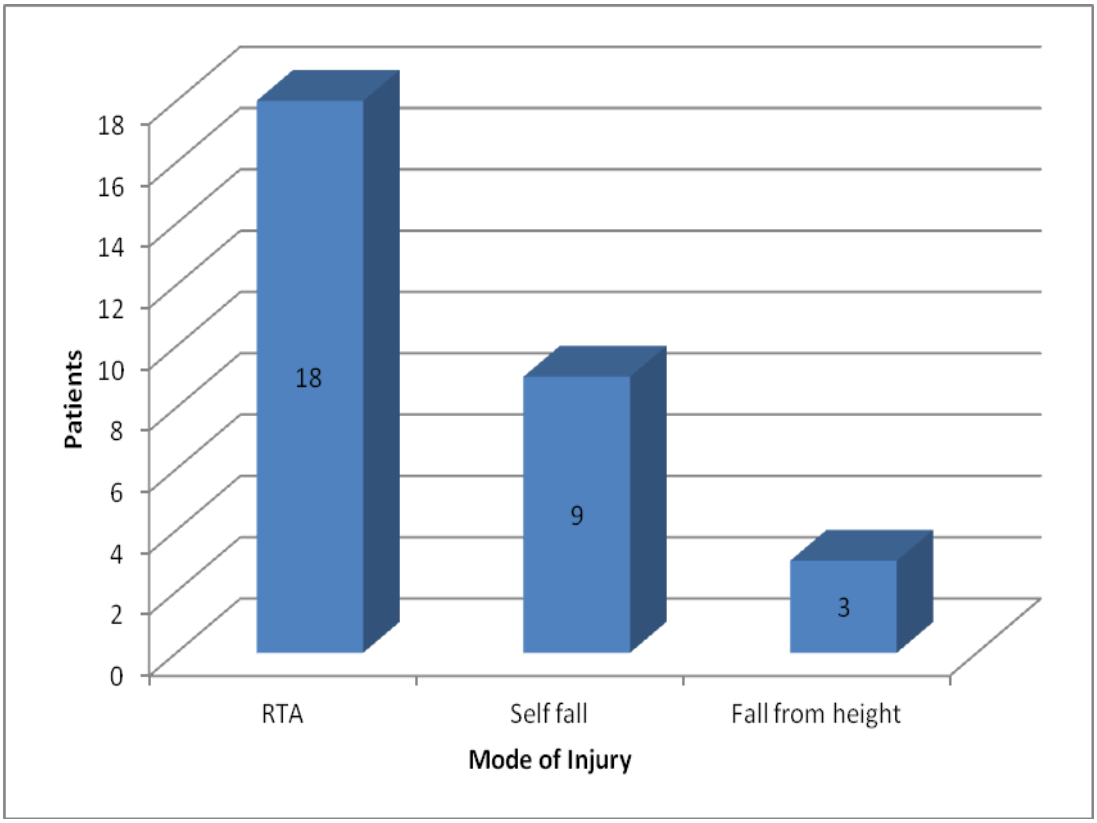


MODE OF INJURY

Road Traffic Accident - 18

Self fall, Twisting - 9

Fall from height - 3



Inclusion criteria:

- Bimalleolar ankle fractures
- Age group-20-60 years

Exclusion criteria:

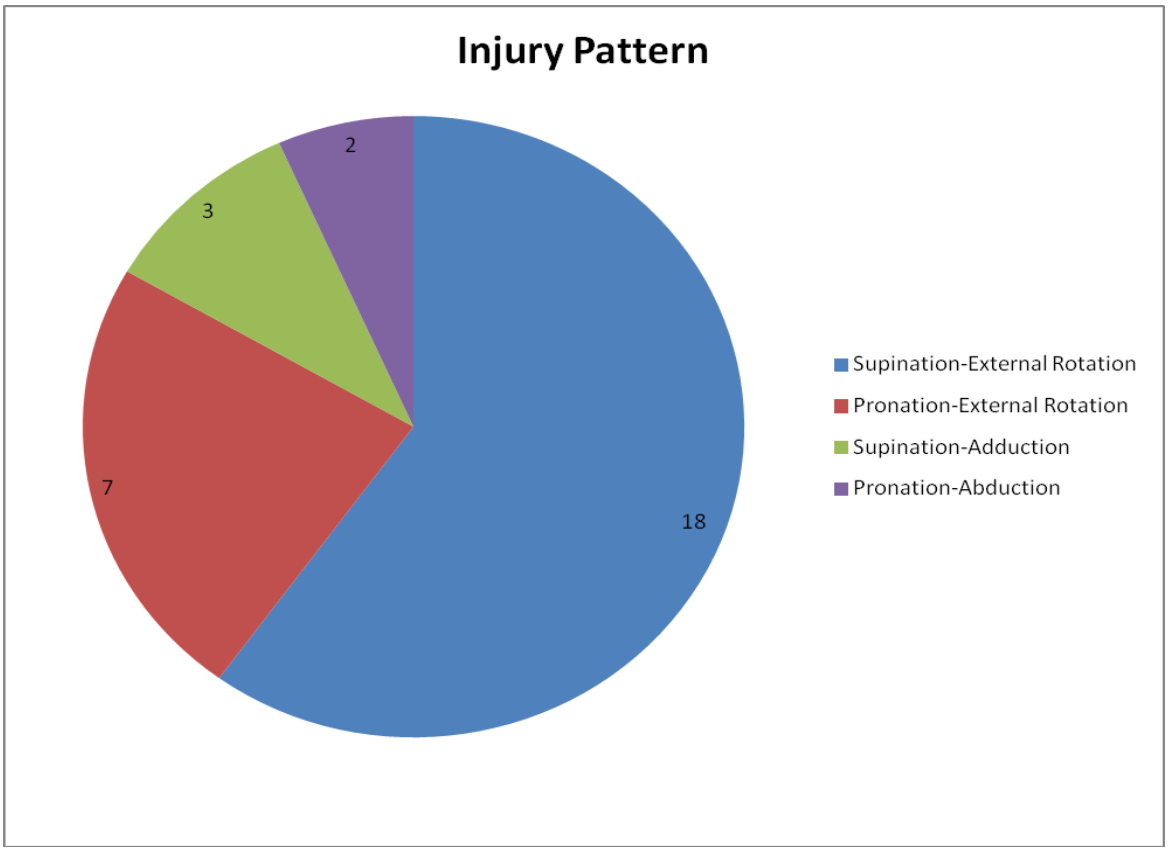
- systemic infection
- open injury with dislocation
- skin diseases
- previous arthrodesis at target level.

The Lauge-Hansen classification and AO classification were used to evaluate the fractures radiologically.

LAUGE-HANSEN CLASSIFICATION

Based on the position of foot and direction of force applied to foot, four type of injury patterns described by Lauge-Hansen and their incidences

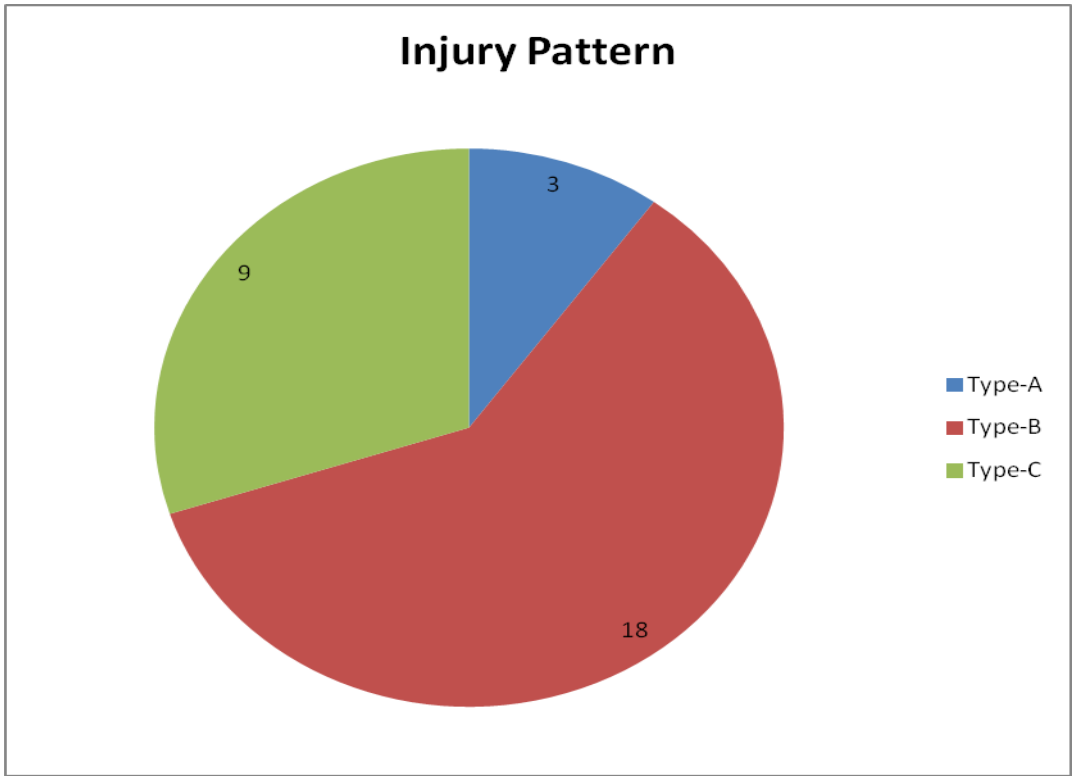
Injury pattern	Number of cases
Supination-Adduction	3
Supination-External rotation	18
Pronation-Abduction	2
Pronation-External rotation	7



AO-DANIS-WEBER CLASSIFICATION

Based on the level of fibula fracture, the AO classification expands on Danis-Weber which is perhaps the most rudimentary classification the following distribution was seen.

Danis-Weber classification	Number of cases
Type A	3
Type B	18
Type C	9



The injury - surgery interval was ranged from one day to two weeks and the average period was six days.

Preoperative care and planning

The patients who were presented in the casualty and out-patient department were examined clinically and radiologically. Closed reduction and immobilisation with plaster of Paris was done for all cases. Check x-rays were taken and planned for surgery accordingly. High quality radiographs helps in planning for reduction and choosing proper implants.Radiographic views of contralateral ankle are taken in few cases for comparision.The size and position of the malleolar fragment and involvement of distal tibiofibular joint was assessed by computed tomographyand was done in four cases.Magnetic resonance imaging to assess soft tissue injury and ligamentous involvement was done in seven cases and is useful to obtain good functional outcome. Displacement and stability of the fracture was assessed by X-rays.In displaced fracture reduction was done immediately to maintain tibiotalar congruity. Stress radiographs were done in ten cases to assess preoperative syndesmotic injury. In syndesmotic instability shentons line broken and dime sign present.

INTRAOPERATIVE MANAGEMENT:

All our cases were done under sub-arachnoid block without tourniquet control.

The fibula was exposed first. The fracture was reduced after clearing the hematoma at fracture site. A pointed reduction forceps was used to hold reduction. A cortical screw of 3.5 mm was used as a lag screw in anteroposterior direction. Lag screw was used in fourteen cases.The one-third tubular plate is low profile and provoide sufficient strength for most fractures and is called Work horse plate of distal fibula. Fibula were fixed with one third tubular plate in 16 cases, reconstruction plate in 10 cases with cortical screws. Syndesmotic screws were used for four cases. Two cases each of fibula fracture were treated by K- wires and conservative methods.

FIBULA

One third tubular plate	-	16
Reconstruction plate	-	10
K-Wires	-	02
Conservative	-	02

The medial malleolus was then exposed and hematoma drained. The fracture site was then reduced after clearing the soft tissue interposition and held in position with the help of towel clips, pointed reduction forceps and k wires. The definitive fixation was undertaken with malleolar screws, cancellous screws and tension band wiring.

MEDIAL MALLEOLUS

Malleolar Screws	-	14
Cancellous Screws	-	7
Tension Band Wiring	-	4
K-Wires	-	5

The following peroperative findings were observed.

- Periosteal interposition at medial malleolus 3
- Comminuted small fragments of bone inside ankle joint 3
- Saphneous vein injury 2

A suction drain was placed and wound closed in layers after complete hemeostasis. Compression bandage was applied and a below knee slab was applied.

POSTOPERATIVE CARE AND MANAGEMENT:

Postoperatively, the affected limb was kept elevated on a pillow and active toe movements and quadriceps exercises were started. Patients were put on parenteral antibiotics cefotaxime one gram and gentamycin 80mg for three days and changed to oral antibiotics. The removal of drain and first wound inspection was done on second post operative day. On fifth postoperative day second wound inspection was done and dressings were changed. Depending on the condition of the wound, wound inspection and change of dressings were done, accordingly. If drainage was present it was sent for culture and sensitivity and patient was put on appropriate antibiotics. Suture removal was done by 12^{th} to 14^{th} day. Patient was discharged from the hospital in a below knee cast. Routinely, postoperative X-rays were taken to assess the congruity of the joint and assess the alignment of the fractures.

FOLLOW UP: The maximum follow up was two years and Minimum follow up was six months. Patients were called for review at 6^{th} week, 3^{rd} month, 6^{th} month and 12^{th} month. If there is substantial evidence of union both clinically as well as radiologically, gradual weight bearing started accordingly[29]. patients were put on physiotherapy for mobilization of ankle joint.

ANALYSIS OF AND RESULTS

The results were analyzed based on olerud and molander scoring[24] . In olerud and molander, subjective and objective scores was used. The four fracture patterns of Lauge-Hansen classification were analysed for results and complications.

ANALYSIS

The subjective and objective criterias and the scoring systems are given below.

SUBJECTIVE SCORING

Criteria's are given Below

Parameters		Score
1. Pain	Never	25
	Walking on uneven surface	20
	Walking on even surface outdoors	10
	Walking indoors constant and severe	05
2.Stiffness	None	10
	Present	0
3.Swelling	None	10
	Only evenings	05
	Constant	0
4.Stairclimbing	No problems	10
	Impaired	05
	Impossible	0
5.Running	Possible	05
	Impossible	0
6.Jumping	Possible	05
	Impossible	0
7.Squating	Possible	05
	Impossible	0
8.Type of supports	None	10
	Tapping, wrapping	05
	Stick or crutch	0
9.Affecting work and Activities of daily life	Same as before injury	20
	Loss of tempo	15
	Part time work/Simpler job	15
	Severely impaired	0

Subjective score was classified into four groups

1. poor <60

2. fair 60-80

3. Good 81-90

4. Excellant >90

OBJECTIVE SCORING

Objective score was based on clinical and Radiological criteria. Clinical criteria includes pain, Range of ankle movements and Deformity. Radiological criteria on the evidence of osteoarthritic changes, talar tilt, talar shift and restoration of joint congruity.

Parameters		**Score**
1.Pain	Rest pain	3
	Routine walking	2
	Prolonged walking	1
	Pain free	0
2.Range of movements(plantar flexion+Dorsiflexion) Normal 65□	No movement	4
	0-15□	3
	16□-30□	2
	31□-45□	1
	Above 45□	0
3.Deformity	Present	2
	Absent	0
4.Radiological criteria	Osteo arthritic changes	3
	Unacceptable Talar shift and or Talar tilt	2
	Acceptable Talar shift and or Talar tilt	1
	Normal	0

Objective score was classified into 3 groups

Good - 0 -3

Fair - 4 -6

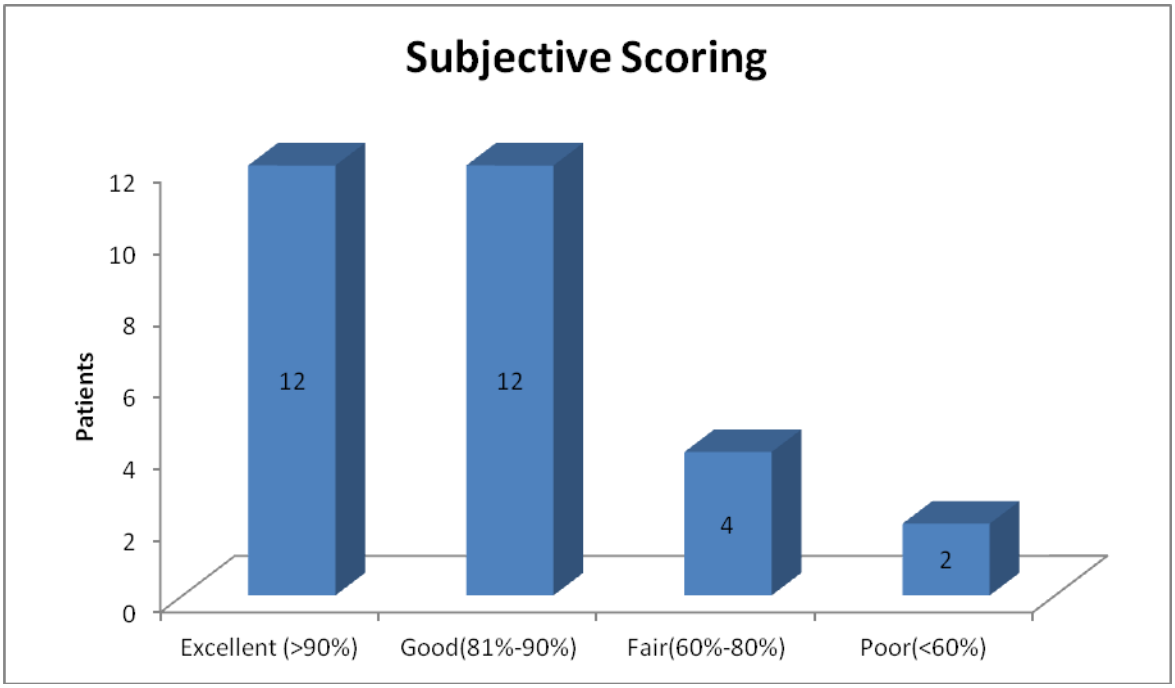
Poor - 7 -12

RESULTS

Based on the subjective scoring these are the results.

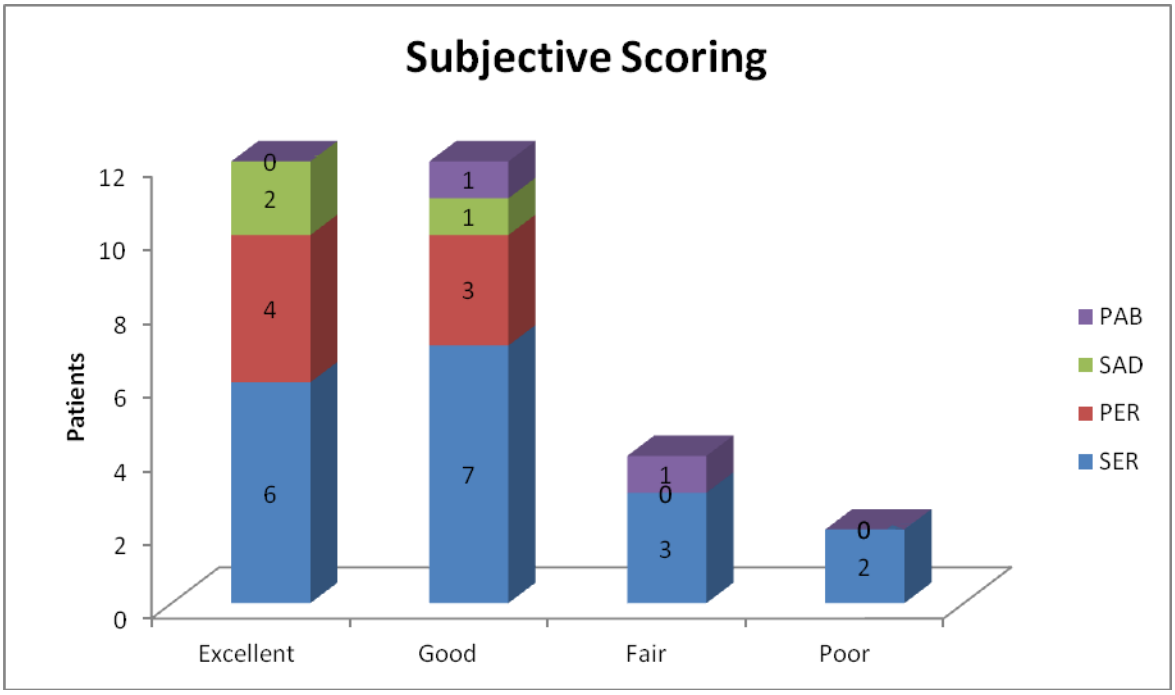
Overall functional outcome for our patients are as follows.

Results	No. of patients	Percentage
Excellent(>90%)	12	40%
Good (81%-90%)	12	40%
Fair (60%-80%)	04	13.33%
Poor (<60%)	02	6.66%



Based on the **fracture pattern** the following on functional outcome.

SUBJECTIVE SCORING	FRACTURE PATTERN			
	SER	PER	SAD	PAB
Excellent	6	4	2	0
Good	7	3	1	1
Fair	3	0	0	1
Poor	2	0	0	0

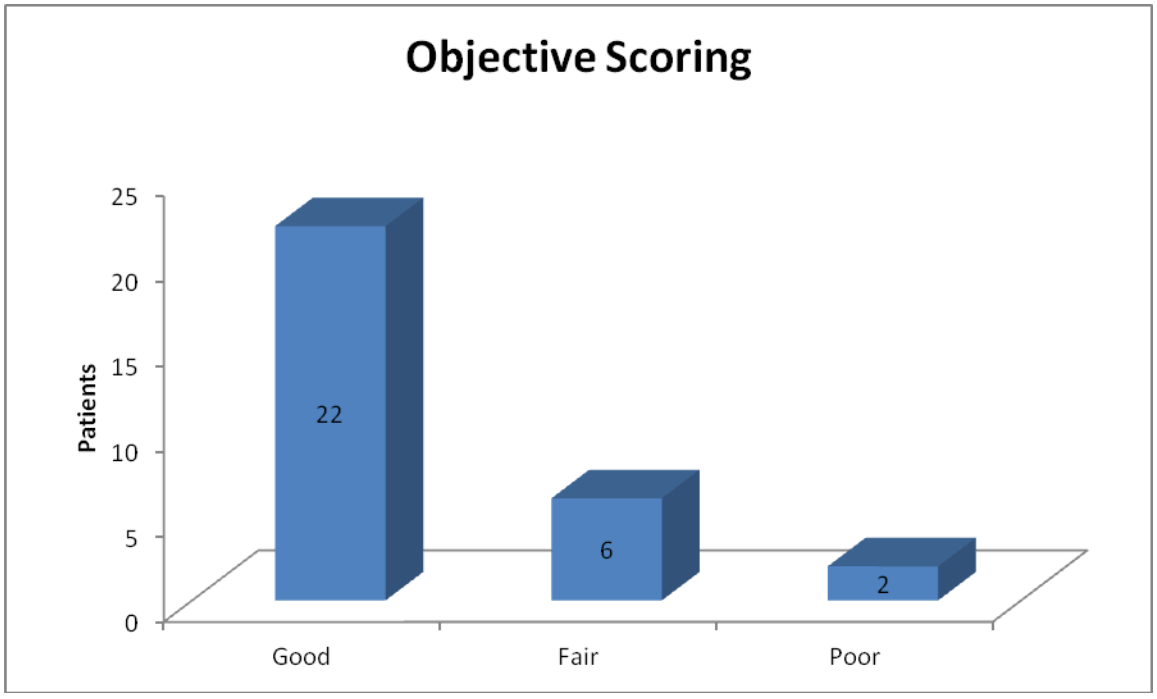


RESULTS

Based on the objective scoring these are the results.

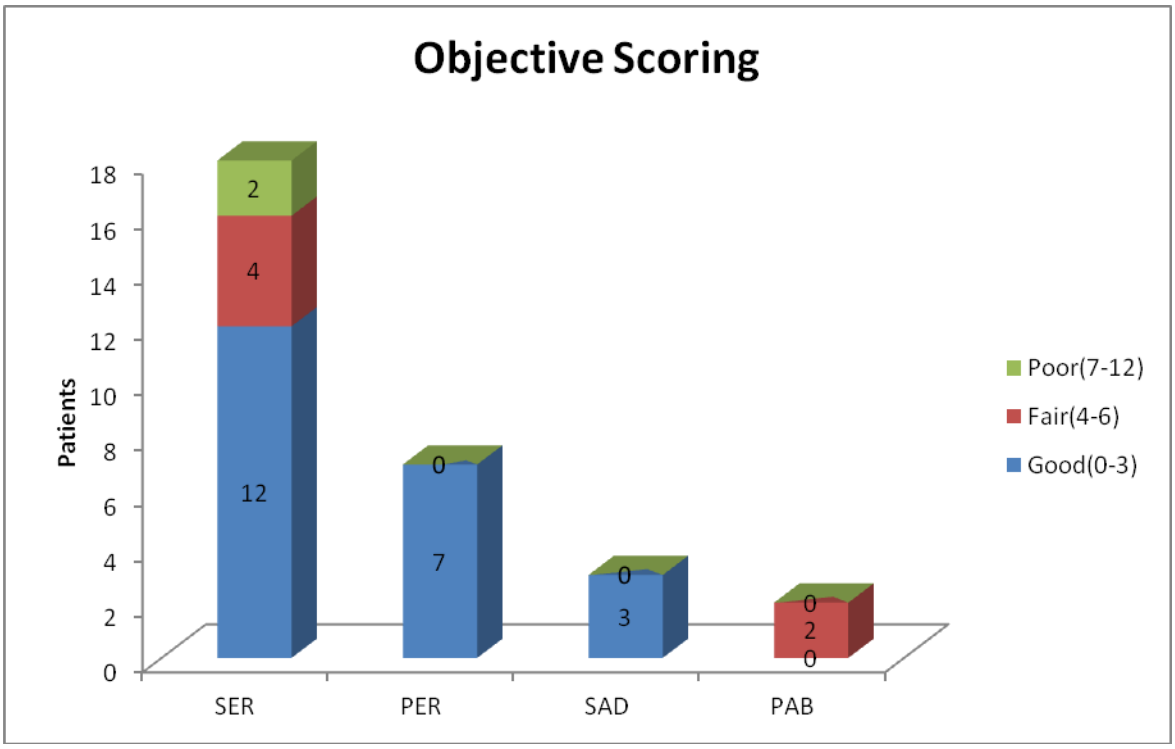
Overall functional outcome for our patients are as follows.

Results	No. of patients	Percentage
Good (0-3)	22	73.33%
Fair (4-6)	6	20%
Poor (7-12)	2	6.66%



Based on the **fracture pattern** the following on functional outcome.

OBJECTIVE SCORING	FRACTURE PATTERN			
	SER	PER	SAD	PAB
Good	12	7	3	0
Fair	4	0	0	2
Poor	2	0	0	0



COMPLICATIONS

The following postoperative complications were encountered.

- Superficial infections with and without skin necrosis 6
- Deep infections 2
- Nonunion 2
- Talar tilt 2
- Talar shift 2
- Malunion 1
- Arthritis 1

Non-union

Superficial infection

TREATMENT OF COMPLICATIONS

Patients with superficial infection were treated with repeated saline dressings and appropriate antibiotics. They all responded well to this mode of treatment. Patients with deep infection were treated with repeated saline dressings and antibiotics. Those patients who did not respond were treated with early removal of implants.

One patient with moderate to severe skin necrosis was treated with spilt thickness skin graft, once the area was covered by healthy granulation tissue.

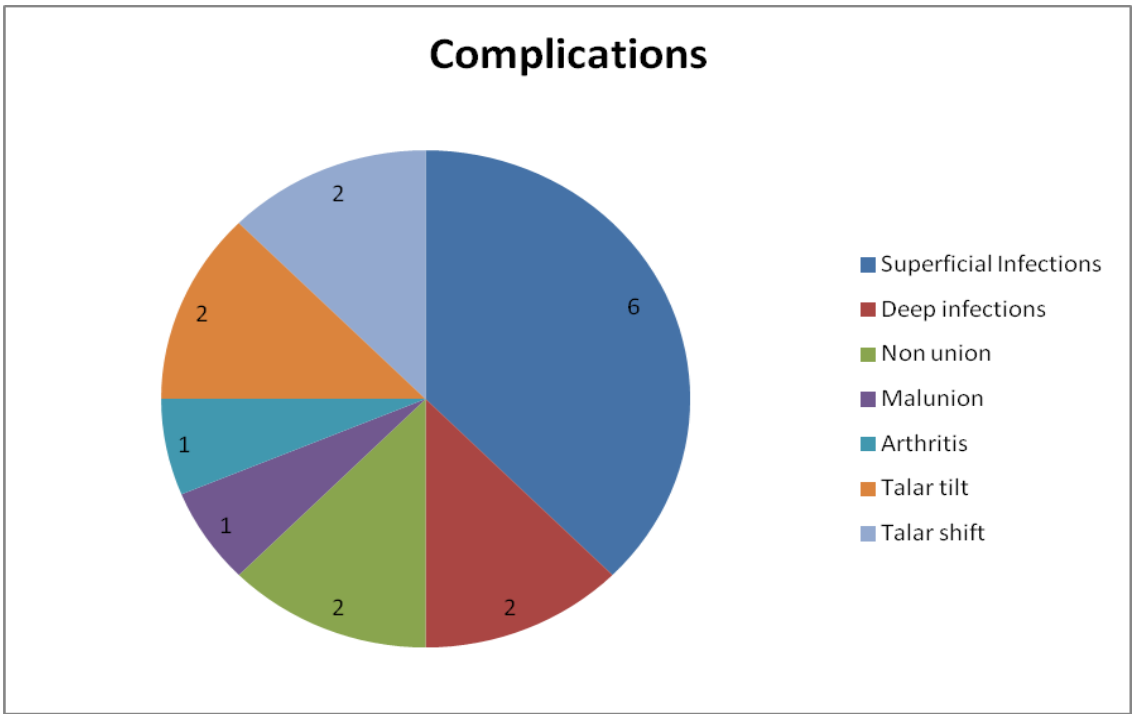
The patient with non-union of medial malleolus was treated with freshening of fracture site and revision fixation done.

Implant Removal:

Early implant removal were done in four cases. Out of which in three cases implant removal were done due to persistent infection and one case due to persistent pain over the hard ware. Of the three cases of infection two cases went for non union and one case went for mal union.

Complications

Complications	No. of patients				
	SER	PER	SAD	PAB	Total
Superficial Infections	3	1	1	1	6
Deep infections	1	0	1	0	2
Non union	1	0	0	1	2
Malunion	1	0	0	0	1
Arthritis	1	0	0	0	1
Talar tilt	2	0	0	0	2
Talar shift	2	0	0	0	2



ILLUSTRATIVE CASES

- **Case:1**, Age :44years Sex :Male

- Classification : A.O : A

- Injury surgery interval : 4 days Complications: Nil

PREOP

Immediate post op

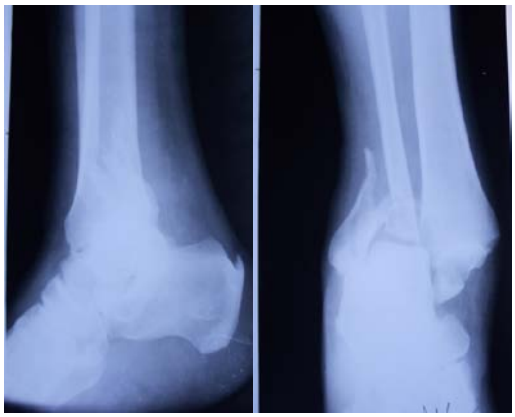
18 Months follow up x-Ray and clinical picture

OLERUD AND MOLANDER SCORING SYSTEM .

Total subjective score is **95** and the result of the patient is **Excellent** .

Total score is **3**. the objective score of the patient is **Good**

- **Case:2**,,Age :51years, Sex : Male
- Classification : A.O : B
- Injury surgery interval : 1 day, Complications :Nil



pre op ankle dislocation with fracture **pre op after reduction**

Immediate post op

One year follow up X-Rays and clinical picture

OLERUD AND MOLANDER SCORING SYSTEM

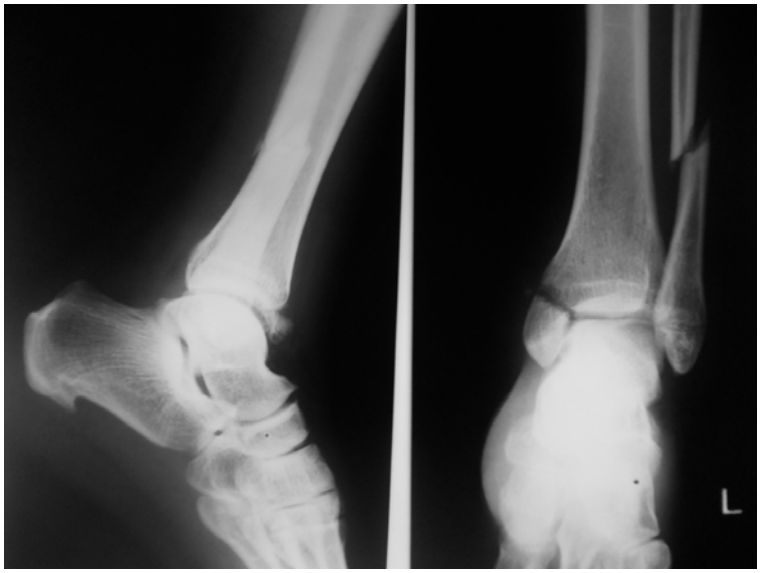
Total score is **95**. The subjective score of the patient is **Excellent**

Total score is **1**. the objective score of the patient is **Good**

- **Case: 3**, Age:40years, Sex : Male

- Classification : A.O : C

- Injury surgery interval : 5 days, Complications: Nil



Pre op

Immediate post op

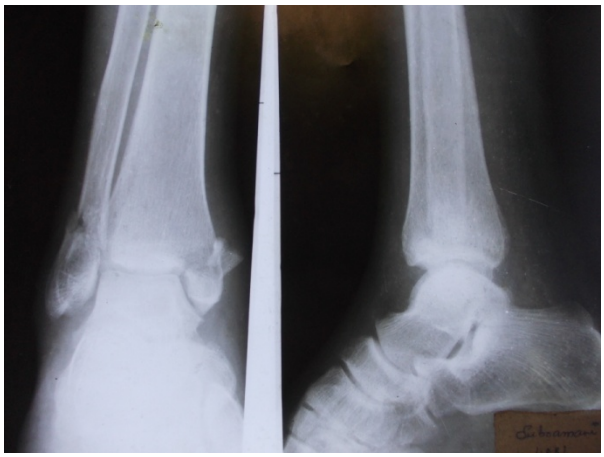
15 Months follow up X-Rays and clinical picture

OLERUD AND MOLANDER SCORING SYSTEM

Total score is **95**. The subjective score of the patient is **Excellent**

Total score is **1**. the objective score of the patient is **Good.**

- **Case:4**,Age: 48years, Sex: Male
- Classification : A.O : B
- Injury surgery interval : 4 days, Complications: Nil**.**



Pre op.

Immediate post op.

14 months Follow up clinical picture

6 months post op. **14 months post op**

OLERUD AND MOLANDER SCORING SYSTEM

Total score is **95**. The subjective score of the patient is **Excellent**

Total score is **1**. the objective score of the patient is **Good**

- **Case:5**,Age: 25years,Sex : Male
- Classification : A.O: C
- Injury surgery interval : 9 days, Complications: Nil

Pre op

Immediate post op

12 Months follow up X-Rays and clinical picture

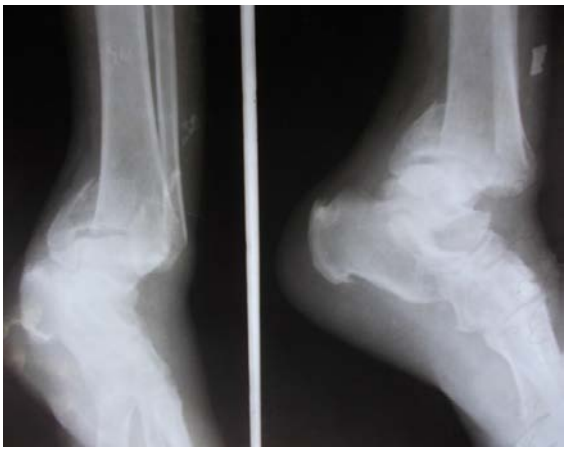



OLERUD AND MOLANDER SCORING SYSTEM

Total score is **90**. The subjective score of the patient is **Good**

Total score is **2**. the objective score of the patient is **Good.**

- **Case:6**, Age:50years, Sex: Male
- Classification : A.O : B
- Injury surgery interval : 14 days, Complications: Wound infection : Present



Pre op. fracture with dislocation

Pre op. after reduction

Immediate post op.

6 months post op.

15 Months follow up X-Rays and clinical picture

OLERUD AND MOLANDER SCORING SYSTEM

Total score is **65**. The subjective score of the patient is **Fair**

Total score is **4**. the objective score of the patient is **Fair.**

DISCUSSION

Our study consists of 30 cases of closed bimalleolar ankle fractures. Maximum incidence of the injury was in the fifth decade of life. Injury was more common in males-24 (80%) and females being 6 (20%). Right side was more commonly involved-19 patients (63.3%)

Road traffic accidents contributed to 60% of injuries, followed by self fall while walking (30%) and fall from height (10%). Out of 30 patients, 18 are SER pattern, 7 patients are PER pattern, 3 cases of SAD pattern and 2 cases of PAB pattern.

The most common injury pattern seen in our study was Supination-external rotation type. Stress radiographs are useful to assess ankle instability. schonk et al suggested that gravity stress test is comfortable and more sensitive than manual stress test . Weber stated that instability is overestimated by stress radiographs. Evaluation of deep deltoid ligament injury associated with ankle instability is assessed by stress radiographs which help to differentiate SER2 injury from SER4 equivalent injury[15]. SER4 fractures are unstable and needs ligament reconstruction and syndesmotic stability[16]. In SER pattern 13 out of 18 patients had good to excellent functional outcome. Among three patients who had dislocations with SER type of bimalleolar fracture, two had good outcome due to early closed reduction of ankle joint followed by open reduction and internal fixation of malleoli; in another patient with dislocation who had

reported late, we had fair outcome indicating the importance of early reduction of ankle dislocation.

Among Supination-Adduction type, all patients had good to excellent outcome, we have addressed the fibular fragment which is too small to fix, using small size K wire or single malleolar screw or lag screw. We had used anteromedial approach to fix the fracture and address the articular pathology as suggested by Hamilton et al[14] in their study instead of Hockey stick incisions used routinely for other type of fractures.

In both the patients with pronation abduction injury, we have fixed medial malleolus first followed by extra periosteal plating for fibula, the advantage of which (to overcome the higher incidence of nonunion in according to their study) has been reported by Ebraheims et al and Aaron et al[28].

In pronation external rotation injury restoration of the fibular length and rotation, ankle mortise and syndesmotic stability is important factor as noted by maverick et al[19]. We had good to excellent results in all seven cases of pronation external rotation injury as we could maintain the syndesmotic stability and fibular length by syndesmotic screws and fibular plating.

Displacement is position of talus in the mortise and depends on intact deep deltoid ligament[18.] Fixing the malleolar fragment will not restore ankle stability and need to repair deep deltoid if torn[7]. Stable fractures do not displace with

axial loading[1]. Treatment decisions are based on the stability of fracture. Prognosis is determined by energy of injury[14]. Fixing the malleolar fragment will not restore ankle stability and need to repair deep deltoid if torn. Even though Lauge-Hansen classification describes in detail about the pattern of ankle fracture it does not deal with syndesmotic injuries.

According to Micheal Bekorom[26], pronation injuries/weber C are commonly associated with syndesmotic injuries than supination injuries/weber B, our study also reflects similar incidence of syndesmotic injury among the various fracture patterns.

Patients with fixation of fibula with K wires had less satisfactory results than in those patients where we used a contoured reconstruction or one third tubular plate for fibular fixation. This may be due to the fact that contured plates accomodate the valgus bend of fibula and provide sufficient stability to the fibular reduction.

We have assessed syndesmotic stability intraoperatively by cotton test or hook test. AO foundation stated that intraoperative cotton or hook test is important to assess the syndesmotic disruption & inturn ankle instability. Boden et al suggested when rigid medial fixation is achieved, no syndesmotic stabilization is required, in the absence of rigid medial fixation if the height of the fibular fracture of more than 4.5 cm above the joint line syndesmotic stabilization is required.

In Hafiz et al study, subjective scoring outcome was excellent and good in 84% and objective scoring was good in 78.8% and poor in 4.2%. The results are comparable with our study that the subjective scoring of Olerud and Molander was excellent and good in 12 patients each (80%), Fair in 4 patients and poor in 2 patients. The objective scoring of Olerud and Molander was Good in 22 patients (73.3%), Fair in 6 patients and poor in 2 patients (6.6%).

In our series 12 cases had complications such as wound infection, nonunion and malunion. Superficial infection (27%) with skin necrosis was the commonest complication we encountered. Skin necrosis was very much less when plate and screws of 3.5 mm system is used. Miller et al noted infection rate of 2.2% in his series of bimalleolar fractures, and he suggested that the skin incision should be carried straight down to the level of bone, without undermining the skin or subcutaneous tissue and skin necrosis was very much less when plate and screws of 3.5 mm system is used. Nonunion of medial malleolus was seen in two cases due to early removal of implant due to deep infection.

One patient among SER/Weber Type B had secondary ankle arthritis probably because of loss of articular reduction due to loosening of K-wire during follow up. Several authors like Huges et al[03], Tunturi et al[04] and Phillips et al[05] implicate factors such as Weber B type fracture pattern, shortened fibula and widened ankle mortise for early post traumatic arthritis.

CONCLUSION

Supination-external rotation injury is the most common type of bimalleolar ankle fracture and also common type associated with dislocations and complications. Pronation -External Rotation type had excellent and good results without much complications.

The accurate anatomical reduction and restoration of articular congruity and early surgical fixation with appropriate implants results in good functional outcome.

Good functional outcome was achieved by restoring sufficient stability and providing good mobility at the ankle joint.

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Patient Performa

- Name:
- Age :
- Sex :
- I.p no:
- Diagnosis :
- Side :
- Classification :

  LAUGE-HAUSEN:

  A.O :

- Injury surgery interval :
- Mode of fixation :

  Medial malleolus :

  Lateral malleolus :

- X-RAYS : Antero posterior view , Lateral view and Harris mortice view taken preoperatively, postoperatively and follow up period.

- **Complications:**

  Malunion

  Nonunion

  Wound infection

  Secondary procedures

- **Functional outcome of results:**

OLERUD AND MOLANDER SCORING SYSTEM AFTER ANKLE FRACTURES(1984)

Based on both **subjective** and **objective** scoring system of **olerud** and **molander**. Follow up visits at 6^{th}week,3^{rd}month,6^{th} month &one year .

Subjective score Parameters		Score	Result
1. Pain	Never	25	
	Walking on uneven surface	20	
	Walking on even surface outdoors	10	
	Walking indoors constant and severe	05	
2.Stiffness	None	10	
	Present	0	
3.Swelling	None	10	
	Only evenings	05	
	Constant	0	
4.Stairclimbing	No problems	10	
	Impaired	05	
	Impossible	0	
5.Running	Possible	05	
	Impossible	0	
6.Jumping	Possible	05	
	Impossible	0	
7.Squating	Possible	05	
	Impossible	0	
8.Type of supports	None	10	
	Tapping, wrapping	05	
	Stick or crutch	0	
9.Affecting work and Activities of daily life	Same as before injury	20	
	Loss of tempo	15	
	Part time work/Simpler job	15	
	Severely impaired	0	
Total			

Subjective score was classified into four groups

1.poor <60

2.fair 60-80

3.Good 81-90

4.Excellant >90

OBJECTIVE SCORE:

Objective score was based on clinical and Radiological criteria. Clinical criteria includes Pain, Range of ankle movements and Deformity. Radiological criteria on the evidence of osteoarthritic changes, talar tilt, talar shift and restoration of joint congruity.

Objective score was classified into 3 groups

Good - 0 -3

Fair - 4 -6

Poor - 7 -12

Objective score Parameters		Score	Result
1.Pain	Rest pain	3	
	Routine walking	2	
	Prolonged walking	1	
	Pain free	0	
2.Range of movements(plantar flexion+Dorsiflexion) Normal 65□	No movement	4	
	0-15□	3	
	16□-30□	2	
	31□-45□	1	
	Above 45□	0	
3.Deformity	Present	2	
	Absent	0	
4.Radiological criteria	Osteo arthritic changes	3	
	Unacceptable Talar shift and or Talar tilt	2	
	Acceptable Talar shift and or Talar tilt	1	
	Normal	0	

ABBREVIATION IN MASTER CHARTS

R	-	Right
L	-	Left
M	-	Male
F	-	Female
SER	-	Supination External Rotation
PER	-	Pronation External Rotation
SAD	-	Supination Adduction
PAB	-	Pronation Abduction
RTA	-	Road Traffic Accident
ROM	-	Range of Motion
L-H	-	Lauge – Hansen
A	-	Pain
B	-	Stiffness
C	-	Swelling
D	-	Stair Climbing
E	-	Running
F	-	Jumping
G	-	Squating
H	-	Type of Supports
I	-	Affecting Activities of Daily Life.

S.no	NAME	AGE	SEX	SIDE	MODE OF INJURY	CLASSIFICATION		INJURY SURGERY INTERVAL	MODE OF FIXATION	COMPLICATIONS	SUBJECTIVE SCORING											OBJECTIVE SCORING					
						L-H	AO				A	B	C	D	E	F	G	H	I	TOT	RESULT	PAIN	DEFORMITY	ROM	XRAY	TOTAL	Result
1	Mr.Anandan	51	M	R	self fall,twisting	SER	B	1 day	MM-Malleolar screw, fibula-plate&screws	Nil	25	10	5	10	5	5	5	10	20	95	Excellent	0	1	0	0	1	Good
2	Mr.Chandran	50	M	R	RTA	SER	B	14 days	MM-Malleolar screw, fibula-plate&screws and PM-Malleolar screw	Superficial infection, Malunion	10	0	5	10	5	5	5	10	15	65	Fair	2	2	0	0	4	Fair
3	Mr.Devadoss	41	M	L	RTA	PER	C	4 days	MM-Malleolar screw, fibula-plate&screws	Nil	20	10	5	10	5	5	5	10	15	85	Good	1	1	0	0	2	Good
4	Mr.Devan	45	M	R	self fall,twisting	SAD	A	6 days	MM-Malleolar screw, fibula-K-wires	Superficial infection	20	10	5	10	5	5	5	10	20	90	Good	1	2	0	0	3	Good
5	Mr.Elumazhai	42	M	R	self fall,twisting	SER	B	8 days	MM-TBW, fibula-plate&screws	Nil	25	10	10	10	5	5	5	10	15	95	Excellent	0	1	0	0	1	Good
6	Mr.Kasiammal	52	F	R	self fall,twisting	PAB	C	14 days	MM-Malleolar screw, fibula-plate&screws	Non-union of MM, Revision done	10	10	5	5	5	5	5	10	15	70	Fair	2	2	0	1	5	Fair
7	Mr.Pandian	44	M	L	RTA	SAD	A	4 days	MM-Malleolar screw, fibula-plate&screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	1	3	Good
8	Mr.Ponnuswamy	55	M	R	RTA	PER	C	1 day	MM-TBW, fibula-plate&screws	Nil	25	10	5	10	5	5	5	10	20	95	Excellent	0	1	0	0	1	Good
9	Mr.Prabu	22	M	L	RTA	PER	C	4 days	MM- K-wires,fibula-plate&screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	0	2	Good
10	Mr.Ramesh	28	M	R	RTA	SER	B	6 days	MM- K-wires,fibula-plate&screws	Lateral Talar tilt	10	10	5	10	5	5	5	10	15	75	Fair	2	2	0	1	5	Fair

S.no	NAME	AGE	SEX	SIDE	MODE OF INJURY	CLASSIFICATION		INJURY SURGERY INTERVAL	MODE OF FIXATION	COMPLICATIONS	SUBJECTIVE SCORING											OBJECTIVE SCORING					
						L-H	AO				A	B	C	D	E	F	G	H	I	TOT	RESULT	PAIN	DEFORMITY	ROM	X-RAY	TOTAL	Result
11	Mr.Sankaran	40	M	L	self fall,twisting	PER	C	5 days	MM-Malleolar screw, fibula-plate&screws&syndesmotic screw	Nil	25	10	10	10	5	5	5	10	15	95	Excellent	0	1	0	0	1	Good
12	Mr.Sadasivam	40	M	R	RTA	SAD	A	5 days	MM-Malleolar screw, fibula-plate&screws	Deep infection	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	0	2	Good
13	Mr.Santhosh kumar	42	M	L	RTA	SER	B	8 days	MM- K-wires,fibula-plate&screws	Talar tilt & shift	10	0	5	5	5	5	5	5	15	55	Poor	2	2	2	2	2	Poor
14	Mr.Somasundar	48	M	R	self fall,twisting	PER	C	1 day	MM-Malleolar screw, fibula-plate&screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	0	2	Good
15	Mr.Subramani	48	M	L	RTA	SER	B	4 days	MM-Malleolar screw, fibula-plate&screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	0	0	0	1	Good
16	Mr.Yuvaraj	25	M	L	RTA	PER	C	9 days	MM-Malleolar screw, fibula-plate&screws&syndesmotic screw	Nil	25	10	5	10	5	5	5	10	15	90	Good	0	1	0	1	2	Good
17	Mr.Sasi kumar	32	M	R	Fall from height	SER	B	4 days	MM-Malleolar screw, fibula-plate&screws	Nil	20	10	5	10	5	5	5	10	15	85	Good	1	1	0	0	2	Good
18	Mr.Ramalingam	55	M	R	RTA	SER	B	14 days	MM-Malleolar screw, fibula-plate&screws	Superficial infection	20	10	5	10	5	5	5	10	15	85	Good	2	2	0	1	5	Fair
19	Mrs.Hema	24	F	R	RTA	SER	B	4 days	MM-Malleolar screw,fibula-plate &screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	1	3	Good
20	Mrs.Poovizhi	26	F	L	RTA	SER	B	1 day	MM-Malleolar screw,fibula-plate &screws	Superficial infection	20	10	10	10	5	5	5	10	20	95	Excellent	1	0	0	0	1	Good

S.no	NAME	AGE	SEX	SIDE	MODE OF INJURY	CLASSIFICATION		INJURY SURGERY INTERVAL	MODE OF FIXATION	COMPLICATIONS	SUBJECTIVE SCORING											OBJECTIVE SCORING					
						L-H	AO				A	B	C	D	E	F	G	H	I	TOT	RESULT	PAIN	DEFORMITY	ROM	X-RAY	TOTAL	Result
21	Mr.Marimuthu	37	M	R	RTA	SER	B	6 hours	MM-Malleolar screw,fibula-plate &screws	Nil	20	10	10	10	5	5	5	10	15	90	Good	1	1	0	0	2	Good
22	Mr.seetharaman	45	M	L	RTA	SER	B	6 days	MM-Malleolar screw, fibula-conservative	Nil	25	10	5	10	5	5	5	10	15	90	Good	0	1	0	0	1	Good
23	Mrs.Susheela	54	F	R	Fall from height	SER	B	4 days	MM-K Wires,fibula-plate &screws	Non union,arthritis	10	0	5	5	5	5	5	5	15	55	Poor	3	2	2	2	9	Poor
24	Mr.Govindhan	22	M	L	self fall,twisting	SER	B	6 days	MM-K Wires,fibula-plate &screws	Nil	20	10	10	10	5	5	5	10	20	95	Excellent	1	1	0	1	3	Good
25	Mr.Natarajan	26	M	R	RTA	PER	C	9days	MM-TBW, fibula-plate&screws	Superficial infection	25	10	5	10	5	5	5	10	15	90	Good	0	1	0	0	1	Good
26	Mrs.sulochana	33	F	R	self fall,twisting	SER	B	1 day	MM-Malleolar screw,fibula-conservative	Nil	20	10	10	10	5	5	5	10	15	90	Good	1	0	0	0	1	Good
27	Mr. Pachaimuthu	42	M	R	Fall from height	SER	B	10 days	MM-Malleolar screw,fibula-k wire intramedullary	Deep infection ,talar shift	20	0	5	5	5	5	5	5	15	65	Fair	1	3	0	1	5	Fair
28	Mr. sharma	56	M	L	RTA	SER	B	4days	MM-TBW, fibula-plate&screws	Nil	20	10	10	10	5	5	5	10	15	90	Good	0	1	0	0	1	Good
29	Mr.Babu	37	M	R	RTA	SER	B	8 days	MM-Malleolar screw,fibula-plate &screws	Nil	25	10	5	10	5	5	5	10	15	90	Good	0	1	0	0	1	Good
30	Mrs.Vasantha	34	F	R	self fall,twisting	PAB	C	4 days	MM-Malleolar screw,fibula-plate &screws	Superficial infection	20	10	5	10	5	5	5	10	15	85	Good	1	2	0	1	4	Fair

நோயாளி ஒப்புதல் படிவம் (Tamil Consent form)

ஆராய்ச்சி மையம்: அரசு கீழ்பாக்கம் மருத்துவக் கல்லூரி மருத்துவமனை

நோயாளியின் பெயர்: நோயாளியின் வயது:

பதிவு எண்:

நோயாளி கீழ்கண்டவற்றுள் கட்டங்களை (✔) செய்யவும்

1. மேற்குறிப்பிட்டுள்ள ஆராய்ச்சியின் நோக்கத்தையும் பயனையும் முழுவதுமாக புரிந்துகொண்டேன். மேலும் எனது அனைத்து சந்தேகங்களையும் கேட்டு அதற்கான விளக்கங்களையும் தெளிவுபடுத்திக் கொண்டேன். ☐

2. மேலும் இந்த ஆராய்ச்சிக்கு எனது சொந்த விருப்பத்தின் பேரில் பங்கேற்கிறேன் என்றும், மேலும் எந்த நேரத்திலும் எவ்வித முன்னறிவிப்புமின்றி இந்த ஆராய்ச்சியிலிருந்து விலக முழுமையான உரிமை உள்ளதையும், இதற்கு எவ்வித சட்ட பிணைப்பும் இல்லை என்பதையும் அறிவேன். ☐

3. ஆராய்ச்சியாளரோ, ஆராய்ச்சி உதவியாளரோ, ஆராய்ச்சி உபயத்தாரோ, ஆராய்ச்சி பேராசிரியரோ, ஒழுங்குநெறி செயற்குழு உறுப்பினர்களோ எப்போது வேண்டுமானாலும் எனது அனுமதியின்றி எனது உள்நோயாளி பதிவுகளை இந்த ஆராய்ச்சிக்காகவோ அல்லது எதிர்கால பிற ஆராய்ச்சிகளுக்காகவோ பயன்படுத்திக்கொள்ளலாம் என்றும், மேலும் இந்த நிபந்தனை நான் இவ்வாரய்ச்சியிலிருந்து விலகினாலும் தகும் என்றும் ஒப்புக்கொள்கிறேன். ஆயினும் எனது அடையாளம் சம்பந்தப்பட்ட எந்த பதிவுகளும் (சட்டபூர்வமான தேவைகள் தவிர) வெளியிடப்படமாட்டாது என்ற உறுதிமொழியின் பெயரில் இந்த ஆராய்ச்சியிலிருந்து கிடைக்கப்பெறும் முடிவுகளை வெளியிட மறுப்பு தெறிவிக்கமாட்டேன் என்று உறுதியளிக்கின்றேன். ☐

4. இந்த ஆராய்ச்சிக்கு நான் முழுமனதுடன் சம்மதிக்கின்றேன் என்றும் மேலும் ஆராய்ச்சிக் குழுவினர் எனக்கு அளிக்கும் அறிவுரைகளை தவறாது பின்பற்றுவேன் என்றும் இந்த ஆராய்ச்சி காலம் முழுவதும் எனது உடல் நிலையில் ஏதேனும் மாற்றமோ அல்லது எதிர்பாராத பாதகமான விளைவோ எற்படுமாயின் உடனடியாக ஆராய்ச்சி குழுவினரை அணுகுவேன் என்றும் உறுதியளிக்கின்றேன். ☐

5. இந்த ஆராய்ச்சிக்குத் தேவைப்படும் அனைத்து மருத்துவப் பரிசோதனைகளுக்கும் ஒத்துழைப்பு தருவேன் என்று உறுதியளிக்கின்றேன். ☐

6. இந்த ஆராய்ச்சிக்கு யாருடைய வற்புருத்தலுமின்றி எனது சொந்த விருப்பத்தின் பேரிலும் சுயஅறிவுடனும் முழுமனதுடனும் சம்மத்திக்கின்றேன் என்று இதன் மூலம் ஒப்புக்கொள்கிறேன். ☐

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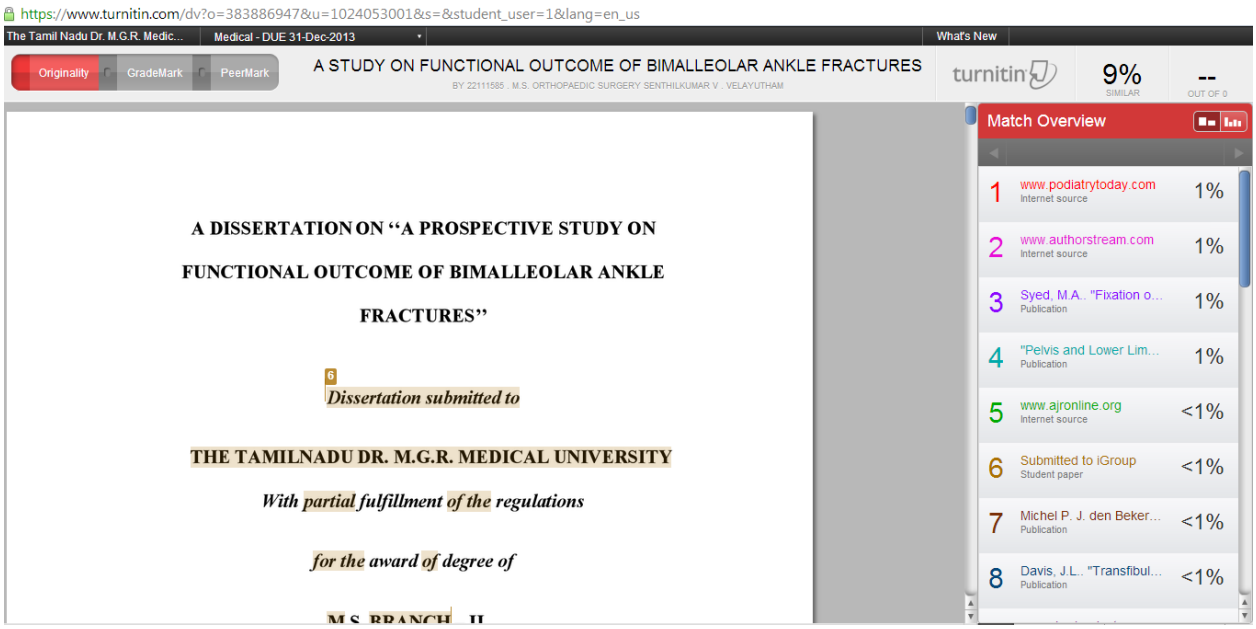
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