Introduction
INTRODUCTION

In ancient India- the Bharat- the sacred land of Shiva, Brahma & Vishnu, the feet have assumed a very special importance. Humbly, submitting with reverence and sincerity to the sacred feet of God, Goddesses and parents bring peace, happiness and sublimity to the soul. In all dances of India, classical to folk and those meant for the temples to court dancing halls, the role of feet has supreme importance.

Wood Jones has written “The feet is most distinct human part of whole anatomical make up, the hallmark which distinguishes him from all other members of the animal kingdom”.

Achilles’, as per Greek mythology, the son of Palesus and Thetis fought famous war of Trozan. To make Achilles’ immortal and invulnerable, his mother dipped him in holy. River of Styx by holding both his ankle. That’s how whole body of Achilles’ became immortal, but his heels remained vulnerable point for injury. These vulnerable heels he always protected with strong shoes against injuries. It was this vulnerable heel which exposed him to death by arrow while he was kneeling in the temple of

[1]
Diana bare footed for worship. This is how the epitome Achilles' tendon was born representing one's weak point.

According to another myth, Talus, was a giant, last creature of bronze age who was given responsibility to save islands of crete. To make him immortal he was injected ichor in his vein just above ankle and nail was plugged in. But, while he was fighting with enemies, nail got struck to the rocks and ichor bleeded out of vein and Talus died.

This shows us, ankle as a soft target of ancient warriors. Compared with the hand, the foot and ankle has been grossly neglected by artists, by sculptors and by poets as well as medical authors. This may be the result of a mistaken impression that foot and ankle is much simpler than hand. Infact, it is much more specialized. If one doubts this, think of unfortunate people without hands, they may become foot and mouth artists. But no one have ever heard of anyone who without feet learned to walk on his hands.

The lower limb in its basic design is similar to the upper limb because formerly both of them (as in animals) were used for locomotion. However, with the evolution of erect posture in man, the two limbs despite their basic similarities have become specialized in different directions to meet the new functional stability. The emancipated upper limb is specialized for [2]
prehension and free mobility where as lower limb is specialized for support and locomotion. In general, the lower limb attains stability at the cost of some mobility, and the upper limb attains freedom of mobility at the cost of some stability.

Ankle injuries are quite common for which an orthopaedic surgeon is often called upon. It causes, destruction, not only of the bony architecture but often of the ligamentous and soft tissue components. The joint comprises the distal tibia articulating surface, with extension on medial side as medial malleolus and the lower end of fibula as lateral malleolus. Together these structures form the ankle mortise which provides the stability as well as mobility to the ankle joint with the help of ligamentous structures.

The human ankle and foot are dynamic and complex mechanism of functionally interrelated parts, primary among which are bone, tendons and ligaments. Alteration in the anatomy of structure of one part significantly affect the function of other.

The basic function of foot in human is to provide support for ambulation, freeing the hands for dextrous activity. Though small in proportion to the rest of body, the ankle and foot must bear its entire body weight. Typically foot and ankle handles
approximately sixty three tonnes of stress with one mile of walking.

The weight borne by ankle joint of about one half square inch area is tremendous especially during running, jumping etc. However, the structures of foot by virtue of its special designing absorbs / disperses major portion of this energy. But failure of this mechanism of foot often result in disruption of ankle joint.

Ankle injuries occurs when load exceeds the capacity of the involve tissue to accommodate them. The abnormal loading environment is often difficult to judge, because of complex nature of forces involved.

Ankle injuries have been one of the difficult problems to tackle because the fractures that involve the joints ranked amongst the most serious with implication of pain, limitation of movements, instability and eventually secondary arthritis giving rise to prolonged morbidity and these complications are frequently attributed to inadequate reduction of the medial and lateral malleoli.

Only one mm of joint incongruity leads to forty two percent loss of joint contact area resulting in grossly increased contact pressure across remaining joint, is a factor contributing to secondary osteoarthritis, aside from gross anatomic incongruity
and instability. The need for accurate anatomical restoration is both obvious and essential.

Ankle injuries occur most commonly because of slipping and twisting of ankle, poor street lightening, defective roads, uneven surface in houses.

Road accidents, another major cause are increasing day by day due to rapid increase in automobiles. India, has one of the highest road accident rates in the world because of large number of old, poorly maintained vehicles, low driving standards and mixed traffic. Ankle injuries to foot and ankle has also increased due to increasing popularity of track and field sports.

None the less there is no uniform opinion regarding the best method of management of ankle fractures.

Various modalities of treatment available are as follows :-

1. Conservative treatment (Plaster of paris)
2. Compression screws (Malleolar or cancellous)
3. Plating (Semitubular or butress plate)
4. External fixator
5. Joint ablation technique (arthrodesis)

Pertaining to the controversy in method of treatment of ankle fractures and related complications, this study was undertaken to [5]
analyse and understand the problems and clinical behaviour of these common and yet complicated ankle injuries and also to evaluate and compare the results of conservative and operative treatment in ankle fractures.
ANATOMY OF ANKLE JOINT

The ankle joint is formed by the tibia, fibula and talus. The dome of the talus (trochlea) fits into mortise formed by the tibia and fibula. The medial and lateral malleoli projects downward to articulate with the sides of trochlea. The lateral malleolus projects down to the level of the subtalar joint considerably further than does the medial malleolus and thus provides greater bony stability for the lateral side of ankle joint. The ankle joint has sophisticated motion in three dimensions that results in plantar flexion and dorsiflexion of the foot. The bony arrangement also helps to promote anterior stability of the ankle joint so the tibia is driven forward on the planterflexed talus, the narrower part of tibia impinges on the widened anterior portion of talus, blocking forward dislocation of the tibia on the talus.

The relationship of the tibia, talus and fibula is maintained by three ligaments. These are the deltoid ligament, the lateral collateral ligament, and the syndesmosis. The deltoid is considered the strongest of the three ligaments and is so by necessity because of decreased bony protution medially.

The deltid ligament is a broad, triangular band that has four parts as defined by their bony insertion on the navicular, calcaneum and talus. It is functionally divided into a deep and a
superficial portion. The deep portion attaches to the non articular part of medial talus and is horizontal, therefore resists lateral displacement of the talus.

The lateral collateal ligament of the ankle consist of three distinct parts.

a) The posterior talofibular ligament arises from posteromedial portion of the tip of the fibula and runs backward and slightly downward to attach to the lateral tubercle of the posterior process of talus. This ligament is the strongest of the three ligaments and helps to resist the forward dislocation of leg on the foot.

b) The calcaneofibular ligament is the largest of the three and passes inferiorly in a posterior direction to insert on the lateral surface of the calcaneum. It is lax in the normal, standing position owing to the relative valgus orientation of the calcaneum. This ligament is extracapsular but is intimately associated with the peroneal tendon sheath.

c) The anterior talofibular ligament arises from anterior border of the lateral malleolus and passes forward to attach to the neck of talus. It is the weakest of three ligaments and is taut in all positions of ankle.

The syndesmosis is the ligament that maintains the relationship of tibia and fibula. It consists of the anterior and
posterior tibiofibular ligaments and the interosseous membrane. The anterior and posterior ligaments arise from the anterior and posterior tubercles respectively, on the lateral side of the tibia. These ligaments actually hold the fibula snugly in a groove on the tibia, where fibula rotates about its vertical axis with dorsal flexion and plantar flexion of the ankle. There is three degree of rotation of the fibula laterally with dorsiflexion and three degree of medial rotation with plantarflexion.

The interosseous membrane runs between the tibia and fibula to the level of proximal tibio-fibular joint. It stablises the fibula, provides attachment sites for muscles and have some load bearing function.

**IMPORTANT RELATIONS OF ANKLE JOINT**

**Anteriorly**

Saphenous nerve and great saphenous vein

Superficial peroneal nerve

Tibialis anterior tendon

Extensor hallucis longus tendon

Anterior tibial artery with venae comitantes

Deep peroneal nerve

Extensor digitorum longus tendon

Peroneus tertius

[9]
Posteriorly :-

Tibialis posterior tendon
Flexor digitorum longus
Posterior tibial artery
Tibial nerve
Flexor hallucis longus
Sural nerve and small saphenous vein
Peroneus longus and brevis tendons
Tendo-achilles

Distal tibial and fibular growth :-

The distal tibial ossifie nucleus appears between second and third year of life and fuses with the shaft at about the age of 15 years in girls and 17 years in boys.

The distal fibular ossifie nucleus also appears at the second year and unites with the shaft by the age of 20.

Biomechanics of the ankle :-

The tibiotalar, talofibular and tibiofibular joints make up the ankle joint. The following anatomic considerations affect the function of the joint.

1. The medial malleolus is more anteriorly located than the lateral malleolus.

[10]
2. The superior surface of the talus is wedge shaped.

3. The medial malleolus extends about one third of the way down the medial surface of the talus and the fibular malleolus extends down almost the entire lateral surface.

Iman (1969) established the axis of rotation of the ankle joint as one that postero inferiorly from tip of the medial malleolus to tip of lateral malleolus. From the long axis of the tibia, this ankle axis forms an angle of 82 degrees in a coronal plane.

A functional range of motion for the ankle as seen in walking of the order of 10 degree of dorsal flexion and 20 degrees of plantar flexion. Wright used a mechanical unit with potentiometer acting as electrogoniometer and reported the following breakdown of one subjects functional ankle range in walking, 14 degree ankle rotation, 6 degree subtalar rotation and 5.5 degree of toeing out.

Lambert demonstrated in a biostatic model that one sixth of the static load on leg was carried by a fibula. Ramsey focused on the tibiotalar joint and noted that there was 4.4 cm² of contact area in weight bearing neutral orientation. One mm of lateral talar displacement effectively reduce this area by 42 percent which is the equivalent of almost doubling the stress between the surfaces still in contact.

[11]
Movements of ankle joint:

Barnard kleiger described the movement of ankle joint as follows:

**Dorsiflexion**

That is the motion of the forepart of the foot in a cephalad direction on the transverse axis through the body of the talus.

**Plantar flexion**

Defined as the opposite motion through the same axis. These movements take place in part in the tibiotalar joint.

**Lateral rotation**

Defined as lateral direction of the forepart of the foot on a longitudinal axis through tibia.

**Medial rotation**

It involves a medial deviation of the forepart of the foot through the same axis. These motions takes place in part in the tibiotalar joint.

**Eversion**

It is accompanied by lateral rotation and displacement of heel on a longitudinal axis through the calcaneum.

[12]
**Inversion**

It is accompanied by medial rotation and displacement of the heel on a longitudinal axis. These movements normally take place in the subtalar and mid-tarsal joints.

**Pronation**

It is a combination of eversion of the foot, lateral rotation at the ankle and abduction of the forepart of the foot.

**Supination**

It is a combination of inversion of the foot, medial rotation at the ankle and adduction of the forepart of the foot.