Review of Literature
HISTORICAL REVIEW

Even before the invention of roentgenography much has been learned about the mechanism of injury to the ankle on the basis of clinical examination, and the laboratory production of experimental injuries in cadavers.

One of the first investigator Sir Percivall Pott (1714-1788) who in 1768 described a fracture of the fibula with in two or three inches of its lower extremity and lateral subluxation of talus. Since, neither malleolus was fractured, use of the term “Potts” fracture to indicate bimalleolar fracture should be avoided. He did, however emphasized the importance of accurate reduction which he achieved more easily by flexing the knee to relax the calf muscles.

After him the French dominated the field of ankle. Jean-Pierre David, was the first to explain the role of indirect or counter-coups forces in the production of ankle fractures.

Bromfeid (1773) and Fabre (1783) considered that abnormal motion of talus in ankle motion produced fractures of the malleoli. Posterior marginal fractures of the distal tibia were probably first recorded by Sir Astley Cooper (1822) which healed with posterior talar subluxation. Earle (1829) in Lancet
published the autopsy findings of a fresh posterior lip fracture. In 1840, Maisonneuve emphasized the role of external rotation of talus in the production of ankle injuries. He demonstrated in Cadaver that external torsinal force applied to the foot were determined by the strength of syndesmosis.

Hugunier (1848) demonstrated the importance of external rotation by showing that this force could produce a distal one third or proximal one third fibular fracture after ruptures of anterior tibio-fibular and deltoid ligament.

Tillaux (1872) described the lesions resulting from a combination of abduction and external rotation. He also observed, a small bone fragment from tibia (fragment troisteme). Wagstaffe (1875) recognized a rare type of fracture of anterior margin of lateral maleolus. Similar lesions were noted by Leforte (1886) and LeRoy (1887) they interpreted the mechanism as supination and abduction.

Nelaton (1874) described the fracture of the anterior articular margin of the distal tibia. Dupuytren (1877-1935) emphasized the role of inward and outward movements of foot in the production of ankle injuries, distinguishing fractures caused by ligamentous avulsion, which he believed to be the primary injury and those caused by talar impact, which he thought to be secondary one. He was first to describe the proximal intercrural
dislocation of the talus that might follow diastasis. This injury complex is known after his name.

Rochet (1890) documented the mechanism of production of posterior articular lip of the tibia by dropping a weight on the tibia while the ankle was held in plantar flexion. Destot (1911) named the posterior lip of tibia, the third malleolus.

**Fractures of Distal Tibial and Fibular Physis**


**Mechanism of Injury**

Lauge-Hansen described injury mechanism in 1950. In his system, the position of foot at the time of injury is described first and direction of deformation force is described second.

1. **Supination Abduction**: As the foot supinates, the lateral structure tightens, continued supination and adduction may rupture portions of the lateral collateral ligaments or avulse them. Alternatively, the distal fibula may be avulsed,
resulting in a transverse fracture below the level of syndesmosis. Further adduction, drives the talus against the medial side of joint resulting in a vertical fracture of medial malleolus.

2. **Supination – External rotation**: The lateral structures and anterior syndesmotic ligaments tighten first. The anterior syndesmosis is usually injured with either rupture of the ligament or avulsion of its bony insertion. External rotation produces a spiral fracture of the fibula, which runs antero inferior to posterosuperior. Anterior syndesmosis is partially or completely disrupted. With continued force, the rotating talus may put tension on posterior syndesmosis, results commonly in avulsion of postero- lateral tubercle.

Finally, if sufficient force remains, medial structure tightens, resulting in either an avulsion fracture of the medial malleolus or rupture of the deltoid ligament.

3. **Pronation-Abduction**: Medial structure tightens first, there is either avulsion fracture of the medial malleolus or rupture of deltoid ligament. Then abduction forces either ruptures syndesmotic ligaments or avulses their bony attachment sites. Continued lateral force from the talus, fracture the fibula at or above the level of syndesmosis.
4. **Pronation -External rotation**: Medial side is injured first. External rotation then results in rupture of the anterior tibiofibular ligament followed by fracture of the fibula at or above the syndesmosis. Fibular fracture is in spiral form from anterosuperior to postero inferior, and the interosseous membrane is ruptured. With continued force the posterior syndesmosis is also injured.

5. **Vertical loading**: It derives the talus into the distal tibia. It results in isolated fracture of the anterior or posterior lip of tibia or pilon fracture; according to the position of foot and rate of loading.

**CLASSIFICATION**

In 1922 Ashhurst and Bromer provided the first comprehensive classification of ankle fractures according to mechanism of injury.

The fractures were divided into three main groups: Abduction, adduction and external rotation fractures. In their series of 300 cases, majority were caused by abnormal movement of external rotation (60%), abduction (20%) and adduction (15%) of the talus in the ankle mortise. Rest of the 5% cases were anterior and posterior marginal fractures of lower end of tibia, 'T' and 'Y' type of fractures of tibia involving ankle and comminuted fractures of the ankle, which they included in fourth
category of fractures caused by compression force. Within each major group they distinguished three degrees of injury which they attributed to progressively increasing violence; first degree injuries involved only one malleolus; second degree injuries were bimalleolar or malleolar fracture and contralateral ligament rupture; and third degree injuries involved a fracture of the entire lower end of the tibia as well as the lateral malleolus.

This classification has the following limitations:

i) It fails to emphasize ligamentous damage sufficiently, especially in relation to diastasis;

ii) The third degree of injury in each group probably represents a different mechanism of injury rather than a progression in the severity of the injuring force;

iii) It suggests that ankle fractures are produced by a unidirectional force rather than a combination of forces, which is more often the case.

Many workers from the Scandinavian countries during this period used the term ‘supination’ and ‘pronation’ to describe abduction trauma and classified the injuries into supination fractures, pronation fractures and rotational fractures.

Bonnin’s (1944) classification, a modification of Ashhurst and Bromer’s classification was also later discarded.

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Lauge Hansen in 1950 has provided the most useful and comprehensive classification based on the position of the foot and the direction of deforming force at time of injury, 98% to 99% ankle fractures can be fitted into his system.

According to Lauge Hansen classification

1. **Supination – adduction**
   
   **Stage-I** : Transverse fracture at lateral malleolus at varying heights or tear of the lateral collateral ligament.
   
   **Stage-II** : Stage I plus fracture of medial malleolus (vertical fracture)

2. **Supination – External rotation**
   
   Stage-I : Disruption of anterior tibiofibular ligament
   
   Stage-II : Spiral oblique fracture of distal fibula.
   
   Stage-III: Disruption of posterior tibiofibular ligament or fracture of posterior malleolus.
   
   Stage-IV: Fracture of medial malleolus or rupture of deltoid ligament.

3. **Pronation – Abduction**
   
   Stage-I : Transverse fracture of medial malleolus or rupture of deltoid ligament.
Stage-II: Rupture of syndesmotic ligament or avulsion fracture of their insertion.

Stage-III: Short, horizontal oblique fractures of the fibula above the level of the joint.

4. Pronation- External rotation

Stage-I: Transverse fracture of medial malleolus.

Stage-II: Disruption of anterior tibiofibular ligament.

Stage-III: Short oblique fracture of fibula above the level of the joint.

Stage-IV: Rupture of posterior tibiofibular ligament or avulsion fracture.

5. Pronation- Dorsiflexion

Stage-I: Fracture of medial malleolus.

Stage-II: Fracture of anterior margin of tibia.

Stage-III: Supra malleolar fracture of fibula.

Stage-IV: Transverse fracture of the posterior tibial surface.

About three fourths of Lauge-Hansen’s cases fell into the first two groups (i.e. occur with the foot inverted, which reflects the inclusion ofsprains of the lateral collateral ligament.

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It is of interest that the lesion produced by external rotation varied with the position of the foot; with external rotation of the supinated foot the first injury on the lateral side of the ankle, whereas with external rotation of the pronated foot, the first injury was to the medial structures. External rotation produced extensive damage to the syndesmotic ligaments only when the foot was pronated. Also, fracture of the posterior lip of the tibia involving more than a small portion of the articular surface of the tibia required vertical compression in addition to external rotational forces, whereas small posterior lip fractures were avulsed by the posterior tibiofibular ligament as result of talar rotation in the mortise.

In Lauge-Hansen's classification the different types of injuries can readily be differentiated by means of the nature of the fibular fracture which is characteristic of each type. It is based on experiments on cadaver and is very much useful in pathogenetic understanding of ankle injuries by indicating the relationship of ligamentous damage of fracture patterns and the sequences in which different structures are damaged when specified forces are applied; however it is unnecessarily detailed and cumbersome for routine use in manipulative reductions.
Jergesen in 1959, advocated a more simplified classification...

1. **External rotation – eversion and abduction injuries:**

   a) **Medial side**

   i) Transverse avulsion fracture of the medial malleolus

   ii) Ruptured deltoid ligament

   b) **Lateral side**

   i) Spiral fracture of the lateral malleolus with the fracture line preceeding from the distal anterior to the proximal aspects (external rotation).

   ii) Spiral fracture of the shaft of the fibula above the syndesmosis usually associated with disruption of the syndesmosis (external rotation).

   iii) Short oblique fracture of the fibula in the mediolateral plane below or above the syndesmosis, often with a small lateral butterfly fragment at the fracture (abduction).

   c) **Syndesmosis**

   i) Torn anterior tibiobular ligament (external rotation) through a complete syndesmosis rupture (more common abduction mechanism).

   ii) Avulsion fracture of the posterior malleolus (external rotation).

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2. Adduction- inversion injuries

a) Medial side

i) Oblique fracture of the medial malleolus extending from the corner of ankle mortise proximally and medially.

b) Lateral side

i) Transverse avulsion of the lateral malleolus below the syndesmosis.

ii) Rupture of the lateral collateral ligaments.

c) Syndesmosis

i) As part of a fibular fracture (torn inferior fibres rare in adduction injuries).

d) Posterior malleolus

i) With postero-medial dislocation (occasional fracture of the posterior and medial malleoli)

In recent years much more attention has been focussed on the lateral malleolus as a significant weight bearing structure in addition to being the lateral buttress for the ankle mortise. Studies have shown that during the stance phase of gait upto 20% of the upward force is absorbed by the lateral malleolus, and thus more frequent rigid internal fixation of this structure is indicated, even small alterations in the position of the lateral

[24]
malleolus with tilting or shortening can markedly distort the talotibial weight bearing area and lead to rapid degenerative arthritic changes within the ankle joint. If a congruent ankle joint is to be maintained, the mortise must have normal width. Even a small malposition of the lateral portion of the tibiofibular articulation will lead to abnormal wear. For the mortise to function satisfactorily the fibula must be:

1) Normal in length
2) Correctly positioned in the groove of the tibia, and
3) Effectively anchored to the tibia through the syndesmosis.

The Denis Weber classification (1966) also recommended by AO (Arbutsgeneinschaft fur osteosynthes) emphasizes the fibular fracture, pointing out that the higher the fibular break the greater the syndesmosis injury and displacement of mortise.

The three types of fracture are as follows:

Type-A: Caused by internal rotation and adduction is a transverse fracture at or below the joint line, with a possible shear fracture of medial malleolus.

Type-B: Results from external rotation, which produces a fracture rising obliquely from the joint line in antero posterior plane and associated medial injury.

Type-C: Fracture are divided into

[25]
C1: Resulting from abduction alone which cause an oblique medial to lateral fibular break above ruptured tibio-fibular ligament.

C2: Resulting from combination of abduction and external rotation, where in more extensive syndesmotic rupture occurs.

All types may occur with posterior malleolus fragments, either large or small.

According to **AO classification**

Type A: Fibula fracture below syndesmosis

- A1 Isolated
- A2 With fracture of medial malleolus
- A3 With posteromedial fracture

Type-B: Fibula fracture at the level of syndesmosis

- B1 Isolated
- B2 With medial malleolus
- B3 With medial lesion and fracture of posterolateral tibia.

Type-C: Fibula fracture above syndesmosis

- C1 Diaphyseal fracture of fibula, simple
- C2 Diaphyseal fracture of fibula, complex
- C3 Proximal fracture of fibula

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DIAGNOSIS

CLINICAL EXAMINATION

Bostrom (1965), Cedell (1975) and others have stressed the importance of clinical examination. The foot, ankle and calf up to knee should be palpated for tenderness or deformity or both. Specifically the course of deltoid ligament and the individual lateral ligaments of the ankle, the malleoli, the anterior and posterior tibiofibular ligaments, the entire length of fibula, the anterior and posterior margins of the tibio-talar joint, the sinus tarsi, the peroneal tendons and the achilles tendon should be palpated. The active range of motion of the ankle should be recorded. Pedal pulse should be palpated, and sensory and motor function should be assessed (Dobner and Kersy 1985).

Hopkinson (1990) described that compression of the fibula against tibia at the midcalf level elicits pain near the ankle when the syndesmosis has been injured. The commonly used clinical stress tests for evaluation of lateral ligament laxity of the ankle are the talus in relation to the tibia, is known as the anterior drawer of the ankle. The anterior talofibular ligament is the primary restraint in the anterior drawer test. Talar instability is also assessed with the talar tilt test, in which the angle formed by the tibial plafond and the talar dome is measured as an inversion force is applied to the hind foot. This test is useful for evaluation of combined injury of both the anterior talofibular and [27]
the calcaneofibular ligaments. Dijk et al (1996) described the method of clinical examination and reported that it is sufficient to diagnose sprained ankle.

**Radiographic Examination**

Bonnin (1944) described the radiographic examination and emphasized that it should be performed in well-defined and reproducible projections. Both ankles should be examined for evidence of old injuries, incongruity in the joints between the talus and the malleoli, or widening of the ankle mortise. The radiographs are generally taken in four views:

- Antero-posterior view
- Lateral view
- Bimalleolar view (Mortise view)
- Oblique view

Anteroposterior view in $10^\circ$ of internal rotation of leg gives good view of the joint space and specially the space between the talus and medial malleolus (Bonnin, 1944).

The lateral view is taken with the lateral border of the foot resting on the cassette. Mann (1992) told that it assesses the ankle for effusion, talocalcaneal relationships, tibiofibular integrity, and tibiotalar joint congruity.
Bonnin (1950) described Bimalleolar view (Mortise view) which is taken in 30° of internal rotation of the leg as a result of the X-rays pass paralleled to the plane of inferior tibiofibular joint and the later is better visualized in this view.

An oblique view, a special view, may be needed to distinguish an oblique spiral fracture of fibula and posterior marginal fracture of tibia. This view is taken in the lateral position of the foot and the central beam of X-rays directed from 30° cephalad and posteriorly. The external oblique view primarily adds information about the medial malleolus.

**TREATMENT OF FRACTURES AROUND ANKLE JOINT**

*Conservative vis a vis Operative Treatment*

The treatment should be based on a clinical determination of stability. For the mortise to function satisfactorily the fibula must be (1) normal in length (2) correctly positioned in the groove of tibia and (3) effectively anchored to the tibia through syndesmosis.

There are four criteria that must be full filled for best functional results in the treatment of ankle fractures given by Michal W. Chapmen (1992).

1. Dislocations and fractures should be reduced as soon as possible. Reduction is easier to obtain before swelling occurs and before the fracture hematoma between the fragments
organized. Furthermore, gross displacement particularly in the ankle, subtalar and midfoot joints- results in considerable distortion of the soft tissues and can lead to impairment of peripheral circulation, neuropraxias and loss of skin. Early reduction minimizes these complications.

2. All joint surfaces must be precisely reconstituted- non anatomic reduction may lead to joint instability and/or joint surface incongruity which predisposes to arthritis.

3. Reduction of the fracture must be maintained during the period of healing. Once anatomic reduction has been achieved, it must be held until healing of bone and ligaments sufficient to provide stability has occurred. This can be accomplished by external immobilization with a plaster cast or splints, by external fixation, or by internal fixation.

4. Motion of joints should be instituted as early as possible. To maintain itself in a state of health, any organ or organ system must be used. Suppression of the normal functioning of the musculoskeletal system by immobilization of any of its parts is attended by numerous undesirable sequelae, including muscular atrophy, myostatic contracture, decreased joint motion, proliferation of the connective tissue in the capsular degeneration and bone atrophy. Furthermore, vascular changes occur during the period of immobilization and these often result in edema after the external support is removed.

[30]
The aim of the treatment of ankle fractures in the restoration of normal function, which is best accomplished by exact anatomic restoration and the maintenance of this reduction until healing is complete (Bohler 1923, Vasli 1957, Jergesen 1959, Cedel & Wisberg 1962, Burwell and Charnley 1965, Muller 1979). Exact anatomical reduction in displaced ankle fracture is often obtained and maintained by operative mean than by conservative methods. Recent workers have applied conservative treatment only for undisplaced and stable fractures.

Scandinavians have accepted surgical intervention as being the most effective means of restoration of joint anatomy, while in north America and at other places, many workers think that a primary attempt at closed reduction should be made before operative interference is considered.


AO group surgeons (1966) aim at a totally stable joint reconstruction and at a post operative treatment without immobilization in plaster.
Cedell (1975) found the frequent cause for failure in conservative method of treatment is interposition of soft tissue, cartilage and bone fragments.

Rowly, Norris and Duckworth (1986) done a prospective comparing of operative and manipulative treatment of ankle fractures. They reported that if a good reduction can be achieved and maintained then closed treatment is as good as operative treatment in short time and seemed to result in a quicker return to normal gait.

Chapman (1992) reported that the accuracy of alignment is much more important on the lateral side as compared to medial. Upto 2mm of displacement of the malleoli and 1 to 2 degrees of talar tilt are compatible with a satisfactory resuts.

METHODS OF TREATMENT

1. Fracture without displacement

The treatment only required is immobilization in a POP cast till the union of the fracture is obtained.

In stable injuries such as unimalleolar fracture without contralateral ligament ruptures, most authors prefers a below knee POP cast for about six weeks.

However, unstable injuries such as bimalleolar fracture or unimalleolar with contralateral ligament ruptures require
immobilization in long leg cast extending from groin to the toes till the union is firm (Yablan 1981).

Recently, many workers specially AO group surgeons, have advocated surgical treatment for undisplaced but unstable ankle fractures.

1. Fracture with displacement

   Mainly three method of treatment are available ;

   1. Closed reduction and plaster immobilization.

   2. Traction through calcaneum.

   3. Open reduction and internal fixation.

Kristensen (1956), Klossner (1962), Hughes et al (1979), Duckworth (1986), reported satisfactory result with conservative management in Weber type A and type B fracture if reduction maintained.

Calcaneal traction is mainly used in comminuted fractures of the tibial plafond (Cox and Caoxson 1952).

Barnard Kleiger 1961, Soloman 1965, Colton 1971, Hughes 1979 found better results in the fractures treated surgically. They also found that most of the supination-external rotation and pronation-external rotation fractures required surgery.
INDICATIONS FOR OPERATIVE INTERVENTION

Bohler 1954 gave following indications for surgical intervention:

1. Attached ligaments preventing a small fragment from opposition from the main fragment.

2. Interposition of soft tissue at the fracture site.

3. Interposition of some bony fragment at the fracture site preventing accurate reduction.

4. Interposition of tibialis posterior tendon or medial ligament between medial malleolus and talus or in medial malleolar fracture line.

5. Upper fragment of fibula caught behind the lower end of tibia.

6. Twisting or tilting of medial malleolar fragment.

Denham (1964) suggested operative treatment in all the displaced second and third degree fractures. David Segal (1979) recommended internal fixation in unstable ankle fractures where there was bony or combined bony ligament injury and where talus is displaced by 2mm or more.
MW Chapman (1992) gave following indications for surgery:

1. Fractures of one malleolus: If it is associated with ligamentous injury or if the patients is young. Fractures at the level of ankle joint.

2. Bimalleolar fractures and fracture dislocation.

3. Trimalleolar fracture and fracture dislocation.


5. Fracture with severe communciation and instability.

6. Repair of ligament ruptures.

7. Fractures of lateral malleolus with posterior displacement of proximal fibular fragment.

8. Open fractures and fractures- dislocation of the ankle.

**Operative Technique**

1. **Fractures of medial malleolus:**

   The commonest method of fixation is screw (Muller 1945, Mitchell and Fleming 1959, Burwell and Charnley 1965). When the medial malleolar fragment is very small excision of this fragment with repair of deltid ligament was done by Portis and Mudilson (1953). Recently workers are recommending AO technique of rigid internal fixation.
2. Fractures of fibula

Cedell and Wiberg (1962) paid attention to the necessity of a careful reconstruction of the injuries of the lateral malleolus a view advanced by Danis as early as 1949. New observations have proved that even minute rotation and displacements of lateral malleolar fragments by displacing the vertical axis of the talus give rise to a considerably reduced contact surface between the tibia and the talus. Thus the precise fit between the articular ridge of the tibia and the corresponding articular groove of the talus cannot be disturbed without leading to incongruity, dysfunction and arthrosis deformans.

Recently work by Lambert (1971) and Ramsey and Hamilton (1976) has given scientific basis for the importance of the lateral malleolus fixation and its function in carrying out the stabilization of ankle mortise.

Yablon, Heller and Shouse (1977) reported the results of primary stabilization of the lateral malleolus is of paramount importance in obtaining anatomical restoration of the displaced fractures of the ankle involving both the malleoli.

Various forms of internal fixation technique and devices may be used. Circumferential wiring was employed in long oblique fractures by Vasli (1957) but condemned by Charnley (1957). Oblique and spiral fractures whose lengths are greater than 1½
times the diameter of the bone at the level of the fracture are best fixed with interfragmentary lag screws. Neutralisation of the forces across the fractures should always be accomplished by one third fibular plate applied to the lateral border of fibula.

The AO tension band wire technique is useful to transverse fracture (Weber type A) at or below the syndesmosis.

3. Fractures of posterior malleolus:

It is mostly agreed that fractures of the posterior malleolus involving more than 25-30% of the tibial articular surface should be internally fixed if they are displaced. Burwell and Charnley (1965) advocated the use of two screws but according to AO technique, posterior malleolus is rigidly fixed by means of compression lag screw from anterior to posterior.

Huber, Stutz and Gerber (1996) found that open reduction and internal fixation of the posterior malleolus with a posterior antiglide plate using a postero-lateral approach gives better anatomical reduction and stability than the AO/ASIF technique of antero posterior lag screw.

4. Syndesmosis injury:

Many workers have reported internal fixation of the inferior tibio-fibular syndesmosis essential for treatment of diastasis. Commonest method to fix the diastasis of the joint is the use
of a screw across the syndesmosis (Bonin 1950, Mayer 1956; Vasli 1957).

Burwill and Charnley (1965), however hold the opinion that trans syndesmotic fixation is not essential when the associated fracture have been fixed.

Colton (1968) described that a screw should be directed upwards, forwards and medially.

Hugh R Chissell, J Jones (1995) recommended that when the deltoid ligaments is ruptured a diastasis screw should be used in the fibular tibial plafond.

**Tibial Pilon (Plafond) Fractures**

Most workers presently believe that even in severely comminuted fractures of the tibial plafond, attempt should be made to achieve anatomic restoration of the joint surface as much as possible to achieve best results. Howell (1975); Robert (1979) advocate internal fixation of all the fragments with whatever the device may be suitable depending on the size and site of various fragments. Muller et al (1979) also advocate total reconstruction of comminuted fractures with multiple fixation devices, including large buttress plates, to stabilize the shaft component and permit early mobilization.
TREATMENT OF COMPOUND FRACTURES

The same principles of meticulous debridement, copious irrigation and the use of systemic and local bactericidal antibiotics apply to open fractures of the ankle as apply to open fractures and injuries elsewhere in the body. Open fractures of ankle are commoner because bones are superficial (Watson Jones, 1955 and Conwell 1961). Chapman and Mahoney (1976) found that 60% of open ankle injuries had type I wounds and only 10% had type III wounds.

Injuries closed within 6-8 hours may not get infected. Cut tendons and nerves should not be repaired primarily unless it is sure that infection will not occur, secondary repair may be carried out after the wound has healed (Watson-Jones 1955). Joint closure, as either primary or a delayed primary procedure is essential (Jergesen 1959). The skin wound can be closed by primary closure, delayed primary closure, or secondary closure depending on the degree of soft tissue damage and contamination and on the amount of elapsed time since occurrence of the injury (Edwards 1965). There is difference of opinion regarding the internal fixation in compound fractures. Edwards (1965), Burwell (1971), Olerud (1972). Gregory (1975) have emphasised the role external fixator in such injuries.

Chapman and Mahoney (1976), found in their patients that if immediate fixation was achieved, the infection rate in type I
[39]
wounds was two percent in type II wounds eight percent, in type III wound, 29%. This is significant insofar as it means that immediate internal fixation of ankle with type I wounds can be performed without an infection rate greater than that seen in closed fractures.

Wiss et al (1989) in 76 open ankle fractures treated by immediate internal fixation had only a five percent deep infection rate. Twenty eight of their 76 fractures had grade III wounds. They suggested that primary internal fixation of ankle fractures can be carried out with acceptable risks.

**Complications**

*Malunion*: It may occur at any of the malleolar fracture sites and is often responsible for the later clinical deformity. Malunion predispose to degenerative arthritis of the ankle.

*Nonunion*: This complication in commonly encountered in transverse avulsion fractures of malleoli specially medial malleolus at the level of joint (Magnusson, 1944, Klossner 19620. Otto Sneppen 1969) noted psuedoarthrosis of medial malleolus.

*Infection*: This may follow either open fractures or the open treatment of closed fractures. The reported incidence varied from 1% to 18% in the latter group.
Joint stiffness and persistent edema: This is common complication specially in cases treated by closed method as reported by Watson Jones (1955) and Burwell and Charnley (1965).

Post traumatic arthrosis: Burwell and Charnley (1965), Yablon (1977), Magnusson (1965), Cedell (1971) reported this complication in 20% to 40% of ankle fractures regardless of method of treatment.

Sudek's Osteodystrophy: A form of reflex sympathetic dystrophy. This is characterized by pain, early patchy demineralization, edema, cyanosis, a tout, shiny skin which is hypersensitive and a markedly diminished range of motion.

Synostosis: Ossification of the interosseous membrane may follow injuries to the syndesmosis.

Trapping of the tibialis posterior tendons: Coonard, Bugg and Durham (1954), Parrish (1959) reported this complication and is the unusual cause of inability to reduce lateral fracture dislocation of the ankle joint.

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