POTT'S FRACTURE

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Introduction

The ankle is a complex joint formed by articulations between lower end of tibia, fibula and the talus. Stability of the ankle joint is because of a combination of the bony architecture, ligaments around the joint and the joint capsule. Bony injuries and fractures around the ankle joint are colloquially known as Pott's fractures. Accurate anatomical reduction of the fracture by closed or open means is very important. Any residual incongruity left in the articular surface will lead to early degenerative arthritis of the joint.

Historical Review

Ankle fractures have always drawn the attention of workers and have been found in the remains of mummies from ancient Egypt [1]. Percival Pott (1768) described a fracture of fibula 2-3 inches above the distal tip with an associated rupture of the medial ligaments and lateral subluxation of talus and therefore bears his name. He was one of the first to emphasize the importance of anatomical reduction in the treatment of ankle fractures [2]. Tillaux [3] described a lateral marginal fracture of distal tibia while Lefort [4] described avulsion fracture of the anterior margin of fibula at the insertion site of anterior tibiofibular ligament. Tri-malleolar fracture has been recognised by the name of Cotton [5]. Maisonneuve [6] recognised the importance of both external rotation forces and syndesmotic ligaments in determining the fracture pattern. Lane [7] as early as 1894 recommended operative treatment to achieve an anatomical reduction of the ankle.

Classification

They have been classified in many ways based on mechanism of injury, joint stability, number of malleoli involved or the level of the fracture. Few of the classification are as under:-

1) Henderson's Classification [8]

This is the simplest classification based on the number of malleoli fractured when seen on skiagram. Type 1-Unimalleolar, Type 2-Bimalleolar and Type 3-Tri-malleolar. This does not deal with fracture pattern, mechanism of injury or the ligamentous injuries.

2) Danis Weber's Classification [9]

This classification is based on the level of the fracture of the fibula. Type 1- Fracture of fibula below the level of syndesmosis. Type 2- Fracture of fibula at the level of syndesmosis. Type 3- Fracture of fibula above the level of syndesmosis

3) Lauge-Hansen's Classification

This classification is based on radiographic, clinical and experimental observations [10-14]. It takes the mechanism of injury into consideration i.e. the position of the foot at the time of injury is described first and the direction of the deforming force later. It has the following types:-

a) Supination-Adduction:-There is a transverse avulsion fracture of the lateral malleolus below the level of the syndesmosis or tear of lateral collateral ligament. If the force continues there will be a vertical fracture of medial malleolus.

b) Supination-External Rotation: It leads to disruption of anterior tibio-fibular ligament, spiral oblique fracture of distal fibula, disruption of posterior tibio-fibular ligament or fracture of posterior malleolus and fracture of medial malleolus or rupture of deltoid ligament.

c) Pronation-Abduction:-It causes transverse fracture of the medial malleolus or rupture of the deltoid ligament, rupture of all syndesmotic ligaments or avulsion fracture of their insertions and a short, horizontal fracture of fibula above the level of syndesmosis.

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d) Pronation-External Rotation:-This causes transverse fracture of medial malleolus or disruption of the deltoid ligament, disruption of the anterior tibiofibular ligament, short oblique fracture of fibula above the level of the joint. And if the force continues there is rupture of posterior tibio-fibular ligament or avulsion fracture of the postero-lateral part of tibia.

e) Pronation-Dorsiflexion:- This injury causes fracture of the medial malleolus, fracture of anterior margin of tibia, supramalleolar fracture of fibula and transverse fracture of posterior tibial surface.

4) AO'S Classification

This classification is a modification of the Danis Weber classification. Three main types of the fracture have been described depending on the level of the fibular fracture. Each of these types are further divided into 3 subgroups each. [15]

Type A: Fibular fracture below syndesmosis

A1-isolated

A2-with fracture of medial malleolus

A3-with a postero medial fragment

Type B: Fibular fracture at level of syndesmosis

B1-isolated

B2-with medial lesion

B3-with medial lesion and fracture of posterolateral tibia

Type C: Fibular fracture above syndesmosis

C1-diaphyseal fracture fibula-simple

C2-diaphyseal fracture fibula-complex

C3-proximal fracture fibula

Clinical Examination

The history of mechanism of injury is important and will tell us the likely pattern of injury sustained to the ankle. Careful physical examination is needed to see the status of the skin, soft tissues, neurovascular deficit, bones and ligaments. Stress tests like anterior drawer, inversion, eversion, external rotation can also be done under sedation or anaesthesia to find out details of injuries.

Investigations

Plain Skiagrams

Skiagrams in antero-posterior, lateral and mortise views are essential and are usually sufficient for diagnosis and management. Mortise view is taken with leg in 15-20 degrees of internal rotation. Several lines and angles have been mentioned to be seen on skiagrams to determine the integrity of the ankle joint.

They are:

1) Tibiofibular line:-On the mortise view a line

formed by subchondral bone of distal tibia and medial aspect of fibula should be continuous [16].

ii) Talocrural angle:-This is formed on mortise view by a line drawn parallel to the articular surface of distal tibia and one connecting the tips of both malleoli. The angle is normally between 8 and 15 degrees [17,18].

iii) Talar tilt:-Lines drawn parallel to the articular surfaces of distal tibia and talus should be parallel [16].

iv) Medial clear space:-On mortise view the distance between the lateral border of medial malleolus and medial border of the talus is measured. Normally this is equal to the superior clear space. A space of greater than 2 mm is abnormal and indicates lateral shift of the talus [16].

v) Syndesmotic integrity:-Fibula is posterior and lateral to tibia, so anterolateral part of tibia overlaps fibula. On antero-posterior view this overlap should be less than 10 mm in syndesmotic injuries. Tibiofibular or interosseous clear space should be less than 5 mm on antero-posterior view [16]. Stress views are used to confirm suspected ligamentous instability and compared with identical skiagrams of opposite side. Arthrography is performed to evaluate the integrity of the joint capsule and ligaments [19]. It is seldom required. Tomography is helpful in evaluating complex fracture patterns and where the facilities for CT scan are not available. Computed tomography is indicated in grossly comminuted fractures of the lower end of tibia where the fracture pattern is not clearly seen on plain skiagrams. 3-D reconstructions provide additional information and help in planning the reduction and fixation of fracture. Osteochondral fractures and chronic ligamentous injuries are better seen on MRI. Arthroscopy of the ankle is extremely useful for evaluating and managing osteochondral lesions of the talus [20,21].

Management

Fractures of the ankle joint can be managed either by conservative or operative means. Non operative treatment is indicated for undisplaced and stable fractures or when stable reduction has been achieved in displaced fractures. Open reduction is indicated for failed closed reduction, displaced and unstable fractures. It is also indicated when mortise has widened by more than 1-2 mm. The goal of surgery is to achieve anatomical reduction and stable fixation so that early mobilisation of the joint can be started. Current trend is to do open reduction and internal fixation for any displaced fracture involving the articular surface [16].

Various types of fixation devices in the form of malleolar screws, tension band wiring of malleoli, plate fixation for fibula and syndesmotomic screws etc have been used.

Fixation of Lateral Malleolus : The lateral malleolus is approached through an anterolateral or posterolateral incision centered over the fracture site. Avulsion fractures (Weber Type A) of the distal fibula may need operative treatment if displaced or associated with a medial malleolus fracture. The fracture is reduced and stabilised by either a tension band technique or a lag screw. Two parallel Kirschner wires (0.045 inch) are inserted at the distal end of the fibula to engage proximal medial cortex above the fracture site. A 20 gauge wire is then passed through a transverse drill hole above the fracture site and placed in a figure of eight fashion around the tips of the protruding K wires which are bent thereafter to prevent subsequent proximal migration. Alternatively, a 4.0 mm cancellous screw or malleolar screw is placed so as to gain purchase in the proximal medial cortex of the fibula above the fracture site. The most common fracture of the fibula is caused by external rotation, resulting in an oblique fracture at the level of syndesmosis (Weber type B). After reduction, the fracture is fixed with one or two lag screws placed perpendicular to the line of the fracture. A 2.7 mm or 3.5 mm cortical screw is used, depending on the size of the fibula. An oblique fracture that is longer than two times the diameter of the bone can be fixed with lag screws alone. More commonly a contoured one third tubular plate is used to neutralise the rotational and axial forces on the fibula. Fractures above the syndesmosis (Weber type C) result from external rotation or abduction forces that also disrupt the syndesmosis and are usually associated with an injury to the medial side. Transverse fibular fractures are reduced and fixed with a one third tubular plate applied to provide compression at the fracture site. If comminution is present, the size, number and position of butterfly fragments determines whether these fragments are reduced and fixed with lag screws or reduced by an indirect reduction technique and then spanned with a plate using screw fixation proximal and distal to the fracture site. The most important single step is to restore the length of the fibula. Fractures of the proximal fibula (Maisonneuve type) especially those around the neck of the fibula, need not be internally fixed. Intramedullary fixation of the fibula has been achieved with a contoured Rush pin. This type of fixation offers much less predictable control of rotational and axial forces. Displacement and shortening can occur even when the intramedul-

lary device is supplemented by cerclage wires.

Medial Malleolus: Avulsion fractures of the medial malleolus can often be treated closed if they are isolated, minimally displaced, and involve the distal portion of the malleolus. If there is displacement or an associated lateral injury, these fractures are reduced and fixed with either a tension band technique (to achieve static compression) or cancellous screws. On the medial side, the tension band figure of eight wire can be anchored proximally through an anterior to posterior drill hole in the metaphysis or by wrapping the wire around the head of a screw (with washer) placed slightly oblique in the metaphysis. A fracture above the deltoid attachment is reduced and provisionally stabilized with K wires or 2.0 mm drill bits placed perpendicular to the fracture. Each wire or drill bit is then removed and replaced with a 4.0 mm cancellous screw. It is not necessary to engage the opposite cortex unless osteoporosis is present. Fractures can result in comminution or impaction of the tibial articular surface. At the time of reduction, both the articular surface and the edges of the fracture should be inspected. A small bone graft may be needed and can be obtained from the adjacent distal tibia. Vertical fractures of the medial malleolus are fixed with cancellous screws placed perpendicular to the fracture site. It is important to buttress the fracture by placing a screw with a washer at the proximal apex of the fracture or to use a small tubular plate or T-plate as a buttress.

Posterior malleolus : Open reduction and internal fixation has generally been recommended when more than 25% of the posterior articular surface is involved or the fracture is displaced more than 2 mm [22]. The decision to fix the posterior fragment is based on the size of the fragment, the amount of residual displacement after reduction of the fibula, the perceived functional demands of the patient, and the experience of the physician. The posterior malleolus may be stabilized by either a direct approach to the fracture with placement of screws from posterior to anterior or by indirectly reducing the fracture and placing screws from anterior to posterior. It may be difficult to achieve lag screw effect when distal fragment is small. Provisional stabilization with Kirschner wires and radiographic confirmation of reduction should be obtained before screw placement.

Anterior Malleolus: Isolated fractures of the anterior margin of the tibia are uncommon. Indications for operative treatment are the same as for the posterior malleolus. Lag screws alone are usually sufficient for fixation, but a buttress screw or plate may be needed if the fragment extends into the distal shaft of the tibia.

Complications

The commonest complication is nonunion. Most nonunions involve the medial malleolus [23]. These are often avulsion injuries that were initially treated conservatively and failed to unite because of residual displacement of the fracture, interposition of soft tissues or associated lateral instability resulting in shearing forces on the fracture from the pull of the deltoid ligament. Treatment is with open reduction, internal fixation and bone grafting. Nonunion of the lateral or posterior malleolus is uncommon. Malunion is more common and incongruity of the articular surface can alter the mechanics of the joint and lead to persistent symptoms, degenerative changes, and loss of function of the joint [24]. A painful arthrosis after ankle fracture may result from severe cartilage damage at the time of injury, a malaligned and shortened lateral malleolus. An arthrodesis is the treatment of choice for severe cartilage damage. Marginal necrosis of skin edges after surgery occurs in about 3% of patients. These problems can be decreased by avoiding surgery during the period of increased swelling, minimizing tourniquet time, careful handling of the soft tissues especially the skin edges, gentle retraction, use of implants appropriate for the size of the fracture fragments, wound closure without tension, appropriate drainage of the wound and avoiding constrictive dressings. The use of posterior antiglide plates in fibular fractures has also been helpful in reducing the tension on the skin. The risk of infection can be decreased with careful attention to the handling of the soft tissues and the technical aspects of internal fixation. The infection rate in treating closed fractures with the current techniques of internal fixation is less than 2%. Osteoarthritis can result from damage to the articular cartilage at the time of the injury from altered mechanics of the joint resulting from ligamentous instability or inadequate reduction of the fracture or both. An ankle arthrodesis is the most dependable method of treatment for prevention of pain. Reflex sympathetic dystrophy may be a disturbing complication of ankle injuries. Heterotopic bone may form between the distal tibia and fibula after injuries to the syndesmosis. Ossification is usually seen at the level of the fibular fracture and often in association with the use of a syndesmotic screw. Osteochondral (transchondral) fractures of the talus can occur after any type of injury to the ankle, including simple sprains [25].

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