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Ankle Fractures, Short Term Operative Outcome: A Retrospective Case Series

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Abstract

Introduction and Background: Ankle injury is one of the most frequent presenting injuries to the emergency room and ankle fractures are common fracture in the lower limbs injuries that may require operative treatment with variable outcomes. **Materials and Methods:** Sixty-three patients were included in my retrospective study, and all with a displaced fracture of the ankle caused by high energy trauma were treated by open reduction and rigid internal fixation. **Results:** After follow-up at six weeks and twelve weeks, the results were satisfactory in fifty-five percent out of all the sixty-three patients. **Conclusions and Recommendations:** Ankle fractures occur mainly in young males of the age group between 26 and 35 years, mostly caused by fall down and motor vehicle accident.

Keywords

Ankle Fractures, AO Classification, Short Term Follow-Up

1. Introduction

Ankle injury is the most frequent presenting injury to the emergency room and ankle fractures are common fracture in the lower limbs injuries treated with variable functional outcomes [1] [2] [3] [4].

The aim of this study is to know:

1) The age-specific incidence of ankle fractures.

2) The most frequent mechanism of injury.

3) The incidence of the different AO Weber subgroup.

4) Short term complications related to ankle fracture.

Exclusion criteria from my series were the non-operatively treated patients, like ankle ligamentous injury, stable fractures, minimally displaced fractures, and fractures in patients with significant co-morbidity that preclude surgery.

The pre-operative, intra-operative and post-operative radiological evaluation, indications and contraindications for surgery the operative techniques are discussed in this "retrospective case series".

The introduction of the AO classification (Muller *et al.* 1990) has made analysis of the most common fracture patterns easier.

In this article, I will summarize the different patterns of ankle injuries that can be seen in the casualty department and discuss the different operative techniques [5] [6].

In the year 2007 (January 1 2007 to December 31 2007), 290 patients had recorded to have ankle injuries varying from ankle ligament sprain to ankle fracture, only 140 of them had ankle fracture, 31 of them were treated with open reduction and internal fixation and had follow-up records, while 109 treated conservatively due to undisplaced unimalleolar fracture or the patient refuse the surgical treatment option in our hospital (discharge against medical advice).

If we take into consideration these numbers for the year 2008 (January 1 2008 to December 31 2008) where 300 was the total number of registered patients with ankle injuries, 148 of them had ankle fractures only 32 were treated with open reduction and internal fixation and had follow-up records, so the other 116 patients treated conservatively and the other 152 had ankle ligament injury, and we notice the incidence is slightly increased.

Those patients with varying degrees of ankle ligaments sprain and those patients with undisplaced unimalleolar fractures are excluded because of the lack of follow-up records and incomplete follow-up data also because of poor patient compliance.

Only those treated operatively were followed 6 weeks and 12 weeks post-operative and ankle scoring (Olerud and Molandeer's ankle scoring system) was performed on them [7].

2. Materials and Methods

Because of poor patient compliance and lack of full follow-up data, out of 288 registered patients seen in the casualty department over two years period with ankle fractures (January 1 2007 to December 31 2008), only 63 were treated operatively and were followed as outpatients for clinical review at 6 weeks and 12 weeks post-operative.

Details of all patients who underwent operative treatment of their ankle fractures according to the AO recommendations at Tripoli central hospital were obtained from operative room's database and follow-up resides.

In this study, most of ankle fractures are caused by fall down from height injury and RTA (road traffic accident).

These mechanisms of injuries tend to occur in young patients. The third commonest cause of ankle fractures is twisting injury while the least common causes of ankle fractures are sport injuries and direct blows.

2.1. Physical Examination (Local Examination)

The foot, ankle, leg and the knee were circumferentially inspected to evaluate the skin status. The color of the foot was observed as part of a complete physical examination, that included palpating the dorsalis pedis and posterior tibial arteries pulses and observing the nail beds for capillary refill if weak pulses, and comparing them with the opposite side is necessary to fulfill the examination.

Sensory nerves examination should be done, including the dorsum of the foot (superficial peroneal nerve), first web space (deep peroneal nerve), lateral border of the foot (sural nerve), and plantar aspect of the foot (tibial nerve branches). Light touch and sharp dull discrimination usually suffice.

Initial motor examination is confined to dorsiflexion and plantar flexion of the toes, but this should be accurately described and graded. The initial neurovascular examination should be repeated after reduction maneuvers whenever fracture dislocation is there.

In patients with minimal deformity, gentle palpation of the bony landmarks of the ankle to determine maximum tenderness is a guide to order proper x-rays, which may need to include foot, leg and knee radiographs. Tenderness on deep palpation lateral to the midmalleolar point is one sign of a syndesmosis injury.

2.2. Radiological Examination

The ankle radiograph is needed if there is a bony tenderness or if one or more of the following conditions is present (Ottawa ankle rule) [8]:

1) Age 55 years or older.

2) Inability to bear weight.

3) Bone tenderness of either malleolus.

In the casualty settings, the standard radiographic views of the ankle include mortise view, anteroposterior (AP) view, and lateral non-weight-bearing view. If the patient is able to stand comfortably, weight-bearing views are preferred to check alignment and stability [8], in some patients, stress views are performed [9]-[16].

The mortise view is taken with the patient's leg internally rotated approximately 15 degrees. The lateral view is taken with the foot perpendicular to the long axis of the tibia, and the beam is centered on the talus [17].

Other studies that can be considered in the acute trauma setting for special purposes, like Computed Tomography (CT) scans that show more detailed bony anatomy, especially in patients with tibial plafond injury [18] [19], and Magnetic Resonance Imaging (MRI) to detect occult cartilaginous, ligamentous, or tendinous injuries [13] [20].

Arthroscopy has also been used in diagnosing and aiding treatment of ankle fractures in some cases [21] [22].

2.3. Radiographic Measurements of Alignment and Stability

After an injury or reduction, radiographic studies are used to determine the adequacy of alignment and to infer the degree of stability. In young, active, healthy individuals, malalignment can contribute to unsatisfactory results [23].

Restoration of the fibula length is considered to be critical to satisfactory positioning of the talus and function of the ankle joint [4] [24] [25].

In normal ankle, on plain radiographs joint line of the distal tibia to the medial aspect of the fibula (subchondral bone) around the talus is not disrupted (**Figure 1(a)**). After proper reduction of a fibular fracture, this line should be continuous, as in the normal state. Disruption of this line indicates shortening, rotation, or displacement of the fibula.

Other measures that help to determine alignment after ankle injury include:

1) Measurement of the talocrural angle.

2) Determination of the medial clear space.

3) Assessment of syndesmotic widening.

4) Lateral shift of the talus.

The mortise view is probably the best for making all these measurements (**Figures 1(b)-(d)**).

2.3.1. Talocrural Angle

Is the angle formed by a line drawn parallel to the articular surface of the tibial plafond and one connecting the tips of both malleoli. Normally, the angle ranges from 8 to 15 degrees. When the opposite side is used as a control, the talocrural

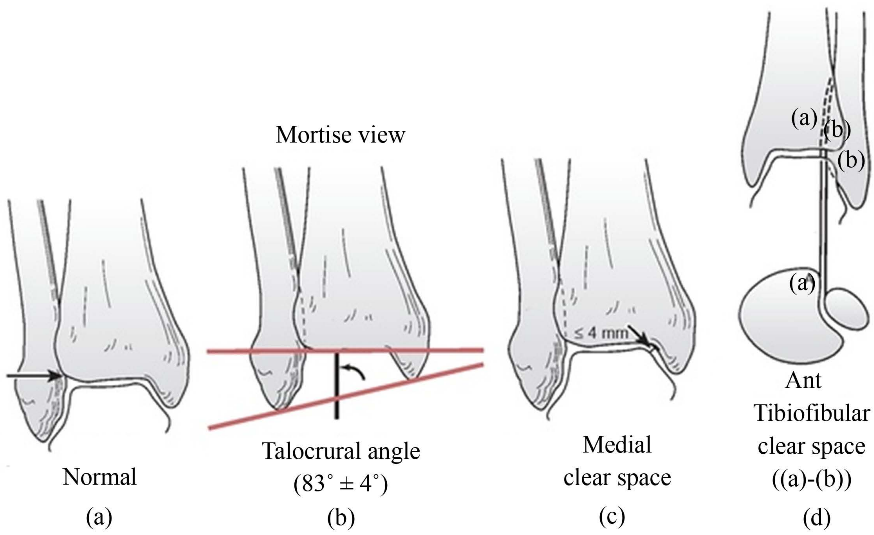


Figure 1. Radiographic appearance of the normal ankle on mortise view. (a): The condensed subchondral bone should form a continuous line around the talus. (b): Talocrural angle should be approximately 83 degrees. When the opposite side can be used as a control, the talocrural angle of the injured side should be within a few degrees of the noninjured side. (c): The medial clear space should be equal to the superior clear space between the talus and the distal tibia and less than or equal to 4 mm on standard radiographs. (d): The distance between the medial wall of the fibula and the incisural surface of the tibia, the tibiofibular clear space, should be less than 6 mm. ((a)-(c) adapted from Browner B, Jupiter J, Levine A, eds. Skeletal trauma: fractures, dislocations, and ligamentous injuries, 2nd ed. Philadelphia: WB Saunders, 1997).

angle of the treated injured side should be within a few degrees of the noninjured side. Any difference greater than 2 to 3 degrees is considered abnormal and indicates fibular shortening [26] [27].

2.3.2. Medial Clear Space

On the mortise view, the distance between the lateral border of the medial malleolus and the medial border of the talus (the medial clear space) should be equal to the superior clear space between the talus and the tibial plafond. A space greater than 4 mm is considered abnormal and indicates a lateral shift of the talus.

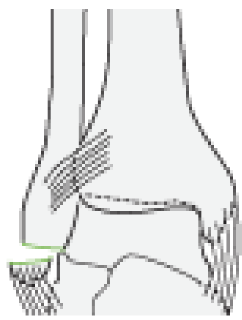
2.3.3. Evaluation of Syndesmosis

Evaluating syndesmotic widening is difficult task when interpreting ankle radiographs for alignment and stability. The simplest approach is to measure the distance between the medial wall of the fibula and the incisural surface of the tibia. This tibiofibular clear space should be less than 6 mm on both AnteroPosterior and mortise views [16].

2.4. AO Classification for Tibia and Fibula, Malleolar Segment (44) [5] [6]

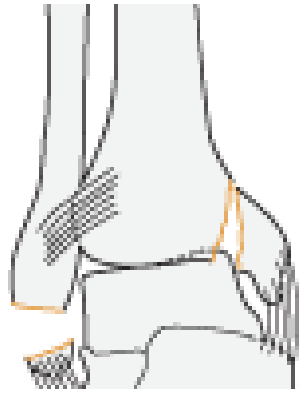
Group A (infrasyndesmotic lesion).

A1 Infrasyndesmotic lesion, isolated:



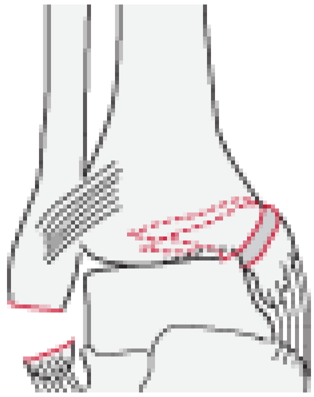
1) Rupture of the lateral collateral ligament.
2) Avulsion of the tip of the lateral malleolus.
3) Transverse fracture of the lateral malleolus.

A2 Infrasyndesmotic lesion, with fracture of the medial malleolus:



1) Rupture of the lateral collateral ligament.
2) Avulsion of the tip of the lateral malleolus.
3) Transverse fracture of the lateral malleolus.

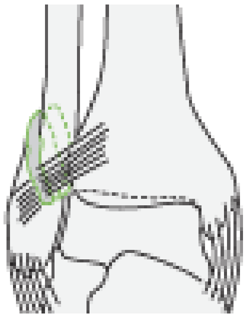
A3 Infrasyndesmotic lesion, with postero-medial fracture:



1) Rupture of the lateral collateral ligament.
2) Avulsion of the tip of the lateral malleolus.
3) Transverse fracture of the lateral malleolus.

Group B (transsyndesmotic lesion).

B1 Transsyndesmotic fibular fracture, isolated:

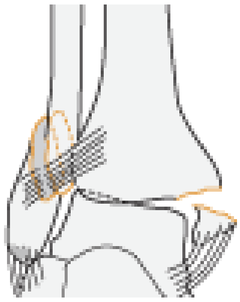


1) Simple.

2) Simple, with rupture of the anterior syndesmosis.

3) Multifragmentary.

B2 Transsyndesmotic fibular fracture, with medial lesion:

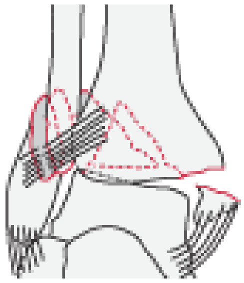


1) Simple with rupture of the medial collateral ligament and rupture of the anterior syndesmosis.

2) Simple with fracture of the medial malleolus and with rupture of the anterior syndesmosis.

3) Multifragmentary.

B3 Transsyndesmotic fibular fracture, with medial lesion and a Volkmann (fracture of the postero-lateral rim):



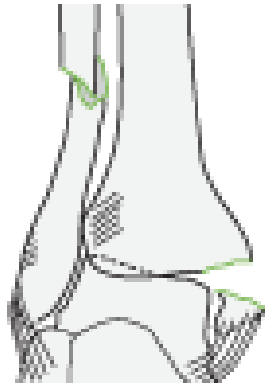
1) Fibula simple, with rupture of the medial collateral ligament.

2) Fibula simple, with fracture of the medial malleolus.

3) Fibula multifragmentary, with fracture of the medial malleolus.

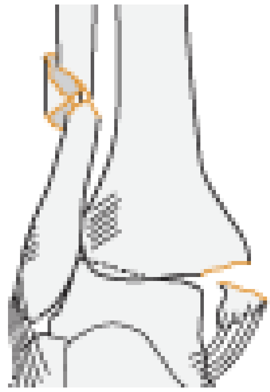
Group C (suprasydesmotic lesion).

C1 Suprasyndesmotic lesion, diaphyseal fracture of the fibula, simple:



1) With rupture of the medial collateral ligament.
2) With fracture of the medial malleolus.
3) With fracture of the medial malleolus and a Volkmann (=Dupuytren).

C2 Suprasyndesmotic lesion, diaphyseal fracture of the fibula, multifragmentary:



1) With rupture of the medial collateral ligament.
2) With fracture of the medial malleolus.
3) With the fracture of the medial malleolus and a Volkmann (=Dupuytren).

C3 Suprasyndesmotic lesion, proximal fibular lesion:

1) Without shortening, without Volkmann.
2) With shortening, without Volkmann.
3) Medial lesion and a Volkmann.

2.5. Olerud and Molandeer Ankle Scoring System

An ankle-hind foot scoring system of 100 points total.

A score of 91 - 100 is considered "excellent", 61 - 90 "good", 31 - 60 "fair", and less than 30 "poor".

It includes assessment of **pain**, **function** and **alignment**. [7]

Pain (40 points)

- None: 40 points.
- Mild, occasional: 30 points.
- Moderate, daily: 20 points.
- Severe, almost always present: 0 points.

Function (50 points)

1) Activity limitation, support requirement (10 points)

- No limitation, no support required: 10 points.
- No limitation of daily activities, limitation of recreational activities, no support required: 7 points.
- Limited daily and recreational activities, cane: 4 points.
- Severe limitation of daily and recreational activities, walker, crutches, wheelchair or brace: 0 points.

2) Maximum walking distance (in meters) (5 points)

- Greater than 500 meters: 5 points.
- 250 - 500 meters: 4 points.
- 100 - 250 meters: 2 points.
- Less than 100 meters: 0 points.

3) Walking surfaces (5 points)

- No difficulty on any surface: 5 points.

- Some difficulty on uneven terrain, stairs, inclines, ladder: 3 points.
- Severe difficulty uneven terrain, stairs, inclines, ladder: 0 points.

4) Gait abnormality (8 points)
- None, slight: 8 points.
- Obvious: 4 points.
- Marked: 0 points.

5) Sagittal motion (flexion plus extension) (8 points)
- Normal or mild restriction (30˚ or more): 8 points.
- Moderate restriction (15˚ - 29˚): 4 points.
- Severe restriction (less than 15˚): 0 points.

6) Hind foot motion (inversion plus eversion) (6 points)
- Normal or mild restriction (75% - 100% normal): 6 points.
- Moderate restriction (35% - 74%): 3 points.
- Marked restriction (less than 35%): 0 points.

7) Ankle-hind foot stability (anteroposterior, varus-valgus) (8 points)
- Stable: 8 points.
- Definitely unstable: 0 points.

Alignment (10 points)
- Good, plantigrade foot, ankle-hind foot well aligned: 10 points.
- Fair, plantigrade foot, some degree of ankle-hind foot malalignment observed, no symptoms: 5 points.
- Poor, nonplantigrade foot, ankle-hind foot severe malalignment, with symptoms: 0 points.

3. Treatment

3.1. Initial Management

In polytrauma patients, we follow the protocols of basic life support and the advanced trauma life support.

Initial treatment of ankle fractures should include immediate closed reduction and splinting, with the joint held in neutral position as possible to prevent neurovascular compromise of the foot. An ankle joint should never be left in a dislocated position. If the fracture is open, the patient should be given appropriate intravenous antibiotics and taken to the operating room on an emergent basis for irrigation and debridement of the wound, fracture site, and ankle joint. The fracture should also be appropriately stabilized at this time. If the reduction is difficult, analgesia is necessary. Sedating the patient with intravenous morphine and midazolam is usually sufficient; however, more analgesia may be required in some cases [3] [28]. Flexing the knee to relax the gastrocnemius may be helpful. If the ankle cannot be reduced, it is not acceptable to leave the talus widely displaced. Areas of pressure necrosis of the skin may occur, neurovascular structures may be compromised, the articular cartilage is further damaged, and the ankle remains grossly swollen and unfit for surgery [15]. For this reason, failure to reduce the talus underneath the tibia necessitates urgent operative intervention. Failing to reduce an ankle closed may be caused by impacted fragments or interposition of soft tissues. These conditions must be discovered and corrected with direct operative intervention. The fracture should then be definitively internally fixed.

When swelling is severe, it must be at least partially resolved before surgical treatment can be safely performed, and for all ankle fractures, minimizing swelling limits potential soft tissue complications postoperatively [26]. Traditional methods to decrease swelling have included limb elevation, ice packs, and delay of the surgery. Newer methods include the use of continuous cryotherapy and intermittent pneumatic pedal compression (foot pumps) [19] [27] [29] [30].

3.2. Non-Operative Treatment

3.2.1. Stable Fractures

The most predictable outcomes are in stable ankle fractures with a fibula fracture without a medial side injury, for which closed treatment is the treatment of choice [4] [24] [25] [30].

Accurately diagnosing a stable fracture requires a careful review of radiographs and precise physical examination. Stable fractures usually have a fracture of the lateral malleolus only. Medial or posterior malleolar fracture lines provide evidence of a potentially unstable injury.

Stable ankle fractures are protected in a short-leg cast or brace for 4 to 6 weeks [31].

3.2.2. Unstable Fractures

Conservative treatment for patients with unstable ankle fractures is used only when the patient is having a significant co-morbidity that preclude surgery. If the talus is subluxed or dislocated on initial radiographs, the injury is unstable [32]. If there is a medial or posterior malleolar fracture, the ankle is almost always unstable [28].

Bimalleolar fractures require an exact reduction of the malleoli to ensure a good outcome from closed treatment. Radiographs should be repeated on a weekly basis for at least 4 weeks to make sure that the reduction has not been lost.

When an exact initial reduction is obtained, it can be difficult to maintain as swelling diminishes. Conservative treatment requires diligence. If subsequent radiographs indicate that the position of the talus or malleolar fractures has changed, cast changes and repeated reduction will be necessary.

3.2.3. Contraindications to Closed Treatment

Closed treatment is contraindicated if an exact reduction of the talus in the mortise cannot be obtained and maintained. It is also contraindicated when closed treatment does not reduce other critical displacements. These include displacement of significant portions of the articular surface of the distal tibia such as shoulder fractures of the medial malleolus, large posterior malleolar fractures, or anterolateral corner fractures. Closed treatment is exceedingly difficult in patients with considerable fibular shortening and in patients with syndesmosis injury and distal tibial-fibular diastasis [33].

3.3. Operative Treatment

3.3.1. Indications

1) Stable Fractures

Stable fractures are considered for operative treatment only when closely linked associated injuries require surgical intervention, such as osteochondral fractures of the talar dome or talar neck fractures. These injury combinations are unusual [4] [33].

2) Unstable Fractures

Open treatment is indicated when closed reduction failed. Syndesmosis injury is treated with operative treatment. Large displaced medial or and posterior malleolar fractures are indicated for surgical treatment.

Although the foregoing is the only absolute indications, surgical reduction and internal fixation have become the mainstays of treatment for most unstable fractures unless there are extenuating circumstances. There is reasonable support in the literature for this approach because in, many studies, the results are improved over closed treatment when the talus is anatomically restored in the mortise.

Additional advantages of treating ankle fractures surgically include easier rehabilitation without a long-leg cast, early ankle joint motion, and earlier weight bearing. The major disadvantage of open treatment is a small but definite incidence of complications directly related to surgical intervention. Other disadvantages include the potential for increased costs and the need for hardware to be removed in some patients.

3.3.2. General Principles of Operative Treatment

1) Timing of Surgery

The optimal time for surgery depends on many factors including the type of fracture, the condition of the soft tissues, other injuries, medical problems, operating room availability, cost, and the patient's social circumstances. Because of all these factors, the decision must be individualized in each case.

Early surgical treatment allows rehabilitation to begin and relatively rapid hospital discharge [1] [2].

2) Antibiotics

The use of antibiotics to prevent post-operative infection after ankle fracture surgery is common despite a relatively low infection rate and a lack of clear evidence that antibiotics are effective in lowering that rate [12].

3) Use of a Pneumatic Tourniquet

Surgical treatment is performed in a bloodless field, which facilitates obtaining an exact anatomic reduction, and it may shorten the surgical time. There are disadvantages to using a tourniquet including more postoperative pain and a higher incidence of wound complications.

3.4. Surgical Approaches

3.4.1. Lateral Approach

A direct lateral approach over the fibula is standard for reducing and internally fixing distal fibula fractures. The dissection should be kept anterior to the peroneal tendons, which can be left undisturbed posterior to the distal fibula. Proximally, enough muscle is dissected to expose the bone without stripping periosteum. The dissection plane is between the peroneus tertius anteriorly and the peroneus longus and brevis posteriorly. The superficial peroneal nerve is close anteriorly, particularly in the proximal part of the incision, and when more proximal dissection is required for a proximal fibula fracture or when the incision is more anterior, it should be identified and protected. The sural nerve is posterior to the incision and the plane of dissection. The syndesmosis integrity can be evaluated by performing Cotton test, by using a small bone hook.

The standard lateral incision can be moved slightly anterior to anticipate the need to fix the anterior syndesmosis or a Chaput's tubercle. For this approach, the superficial peroneal nerve should be identified and protected.

3.4.2. Posterolateral Approach

This approach allows access to posterior malleolar fractures, and to the posterior aspect of the fibula and is performed with the patient prone. The longitudinal incision is made midway between the posterior border of the lateral malleolus, and the lateral border of the Achilles tendon. Blunt dissection through fat avoids injury to the sural nerve and exposes the deep fascia of the leg which is incised sharply. The internervous plane is between the peroneal tendons (superficial peroneal nerve) which are retracted laterally, and the flexor hllucis longus FHL (tibial nerve). The FHL has muscular origins from the fibula and tibia even at this level, and should be elevated and retracted medially to expose the posterior malleolus.

3.4.3. Medial Approach

The medial malleolus is approached directly through a longitudinal incision over the malleolus. In the anterior part of the incision, care must be taken to avoid the saphenous vein and the accompanying nerve. Posteriorly, the posterior tibial tendon is the first structure behind the medial malleolus. Moving the incision slightly anterior and dissecting over the shoulder of the malleolus allows the surgeon to explore and lavage the joint, to visualize the reduction of the medial malleolus fracture in two planes, and to visualize and reduce a more complex shoulder impaction injury. The dome of the talus can be inspected for osteochondral injuries. Through a more posterior medial incision, the posterior tibial tendon and neurovascular bundle can be elevated to access the posterior portion of the medial malleolus and the posterior aspect of the tibia, which may be involved with some fracture patterns.

3.4.4. Posteromedial Approach

The posteromedial incision allows access to the posterior malleolus and can be particularly helpful where the fracture plane results in a posteromedial distal fragment. The incision is made longitudinally half way between the medial malleolus and the Achilles tendon. Blunt dissection will expose the fascia overlying the flexor tendons and this can be incised longitudinally well away from the back of the medial malleolus. The safest interval is found between the flexor hallicus longus (FHL) tendon (which can be identified by the muscle fibers which insert into it at this level) and the peroneal tendons lateral to it. Retracting FHL medially will expose the back of the ankle joint whilst protecting the neurovascular bundle. Access to the malleolus more medially requires the identification and careful retraction laterally of the neurovascular bundle.

3.4.5. Anterior Approach

Treating routine rotational ankle fractures rarely requires an anterior incision. When a posterior malleolus fracture is fixed indirectly with a screw directed from front to back, a small, 1- to 2-cm incision is made directly over the anterior aspect of the distal tibia, and the soft tissues are spread bluntly down to the tibia. Blunt dissection and placement of soft tissue sleeves over drills and taps avoid injury to the superficial peroneal nerve and to the dorsalis pedis neurovascular bundle.

3.5. Implants

- The mainstay of internal fixation of malleolar fractures is the use of small fragment plates and screws, most often one-third tubular plates and 3.5- and 4.0-mm partially and fully threaded screws. Rarely, for severely comminuted cases or for the repair of fibular malunion, heavier 3.5-mm reconstruction or dynamic compression plates are required. Some surgeons use 4.5-mm fully threaded cortical screws for transfixing the syndesmosis. Large fragment hardware is otherwise not used for rotational ankle fractures. For the medial malleolus, malleolar screw is usually used for large bony fragment in the medial malleolar fractures. Clover leave plate is often used to fix both medial and posterior malleoli if coexist.
- Kirschner wires (K-wires) are used temporarily to hold reductions, particularly of the medial malleolus, and they may occasionally be used as two K-wires in conjunction with tension band wire for definitively fixing the distal lateral malleolus or the medial malleolus.

Stainless steel alloy has been and remains the most common alloy used for plate and screw systems. Commercially pure titanium and titanium alloy implants are now available from several manufacturers. These have the possible advantage of MRI compatibility, although this is not particularly important for the treatment of malleolar fractures. They are more expensive than equivalent stainless steel systems.

- Intramedullary rods have been used for fibula fractures and have been reported to result in fewer complications and faster rehabilitation of the ankle than when plates and screws are used. The use of these implants has been limited because of poorer rotational control of the fibula and the inability to use adjunctive screw fixation for syndesmosis [28] [34].

There are other implants used for ankle injuries like locked head compression plates, interlocking retrograde intramedullary nails, and tight rope. In my series, fixation was done using one-third tubular plate, malleolar screw, K-wires and tension band wires.

3.6. Post-Operative Fracture Care

3.6.1. Initial Care

Postoperative care always includes elevation of the extremity to minimize the chances of wound complications. The ankle can be splinted in a neutral position so it does not develop an equinus contracture, which can seriously compromise the results. The use of ice or cold therapy may be beneficial.

3.6.2. Motion and Weight Bearing

Patients started early ankle movement and partial weight bearing for earlier return to function. A variety of different postoperative programs including unprotected motion and non-weight bearing, protected motion and non-weight bearing, non-weight bearing in a plaster cast, weight bearing in a plaster cast, and active motion protected in a brace with weight bearing [1] [2] [3]. It's recommended to allow most patients early weight bearing because it is less restricting and allows them to be more mobile during the early phases of recovery. Exceptions are made in patients with very unstable ankle fracture-dislocations in which fixation is not optimal or large articular areas of the plafond are involved with the injury. In compliant patients, weight bearing is allowed in a fracture boot, which is removed for range-of-motion exercises. Noncompliant patients are immobilized in a short-leg cast with the ankle in the neutral position for 4 to 6 weeks [29].

3.7. Hardware Removal

Removal of ankle hardware is one of the most common hardware removal procedures performed. Removal of the hardware used for internal fixation of ankle fractures is variably required depending on the fracture, the patient, and the preference. Plates placed on the lateral aspect of the fibula and medial malleolus screws frequently become prominent in thin patients after swelling resolves. Patients frequently complain of soreness over the implant and the scar, a feeling of stiffness, and activity-related pain. Relief of this local hardware-related discomfort can be expected in approximately 75% of patients after hardware removal, but this requires a second operative procedure. It is reserved for patients who definitely want it removed or for patients with clear local symptoms over prominent implants [34].

Several strategies have been used to decrease the need for late hardware removal. These include bioresorbable implants and using lag screw fixation instead of plate fixation for distal fibula fractures.

4. Results

The tables and the figures were obtained using SPSS 11.5 (Statistical Product and Service Solutions).

In the 2-year study period (January 1 2007 to December 31 2008), among the 63 patients with ankle fracture that were treated, 38 patients (60.3%) occurred in men, 25 patients (39.7%) in women.

The average age of the ankle fracture population was 37.86 years (16 - 75 years).

The highest incidence in men was seen between the ages of 26 and 35. In women, the highest incidence was between 36 and 45 years of age (Table 1).

The peak incidence of ankle fractures in this study was found to be at 26 - 35 years of age for all age groups.

The incidence of the different AO subgroups is as follows:

63.5% were trans-syndesmotic type B fractures (B2.2, B3.3 are the predominant), 27% were supra-syndesmotic type C fractures (mainly C3.2) and the remaining 9.5% were infra-syndesmotic type A fractures (A2.1) (Table 2 and Figure 2).

47.6% of all ankle fractures are caused by fall down from height and 33.3% are caused by RTA (road traffic accident).

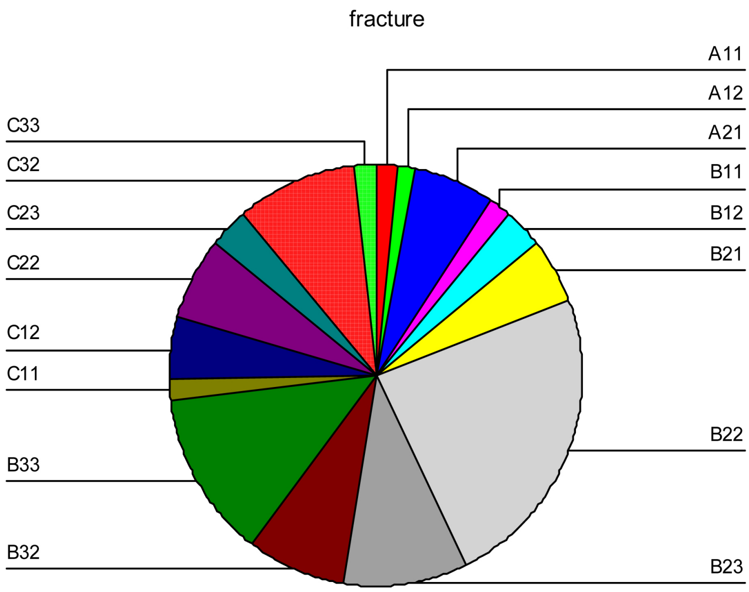


Figure 2. Incidence of the different AO subgroups.

Table 1. Age specific incidence of ankle fractures.

		decade						Total
		16 - 25	26 - 35	36 - 45	46 - 55	56 - 65	66 - 75	
SEX	male	9	16	8	2	2	1	38
	female	5	3	6	6	3	2	25
Total		14	19	14	8	5	3	63

Table 2. Frequency of the different AO subgroups.

		Frequency	Percent	Cumulative Percent
Valid	A11	1	1.6	1.6
	A12	1	1.6	3.2
	A21	4	6.3	9.5
	B11	1	1.6	11.1
	B12	2	3.2	14.3
	B21	3	4.8	19.0
	B22	15	23.8	42.9
	B23	6	9.5	52.4
	B32	5	7.9	60.3
	B33	8	12.7	73.0
	C11	1	1.6	74.6
	C12	3	4.8	79.4
	C22	4	6.3	85.7
	C23	2	3.2	88.9
	C32	6	9.5	98.4
	C33	1	1.6	100.0
	Total	63	100.0	

These mechanisms of injuries tend to occur in young patients.

The third commonest cause of ankle fractures is twisting injury while the least common causes of ankle fractures are sport injuries, and direct blows (Table 3).

The causes of the different AO fracture types were mainly fall from height in almost all fracture subtypes, mainly B2.2 and type B2.3 fractures, with RTA causing B2.2 and B3.3 mainly (Table 4).

There were no local or systemic early post-operative complications, which includes hemorrhage, wound dehiscence and wound infection, neurological or vascular injuries, pulmonary embolism, atelectasis, deep vein thrombosis, medical and anesthesiology problems, or malreduction.

The average post-operative hospital stay was three days, out of all the sixty-three patients, twenty-eight patients have never seen again either because they sought medical advice abroad or because of negligence.

Eleven patients came back after missing their follow-ups during the first three or four weeks post-operatively, because they have already sought a second opinion regarding the surgical technique which was done for them, all of these patients gave good results when ankle scoring was applied.

Fourteen patients were on regular follow-up, they gave good results when scoring system was applied.

Table 3. Frequency of the mechanism of injury.

		Frequency	Percent	Cumulative Percent
Valid	twist	9	14.3	14.3
	fall	30	47.6	61.9
	sport	1	1.6	63.5
	blow	1	1.6	65.1
	RTA	21	33.3	98.4
	other	1	1.6	100.0
	Total	63	100.0	

Table 4. The cause of fracture for each AO subgroup.

		CAUSE						Total
		twist	fall	Sport	blow	RTA	other	
fracture	A11	0	1	0	0	0	0	1
	A12	0	0	0	0	1	0	1
	A21	2	1	0	0	1	0	4
	B11	0	1	0	0	0	0	1
	B12	1	0	1	0	0	0	2
	B21	1	0	0	0	2	0	3
	B22	3	8	0	0	4	0	15
	B23	0	6	0	0	0	0	6
	B32	0	2	0	0	3	0	5
	B33	0	4	0	0	4	0	8
	C11	0	0	0	0	1	0	1
	C12	0	2	0	0	0	1	3
	C22	1	1	0	0	2	0	4
	C23	0	1	0	0	1	0	2
	C32	0	3	0	1	2	0	6
	C33	1	0	0	0	0	0	1
Total		9	30	1	1	21	1	63

Nine patients had fair results, one case she was diabetic, came with extensive cellulitis around here affected left ankle (B3.3 fracture) two week after discharge, treated with antibiotics for ten days and resolved (patient number nine).

5. Discussion

Surprisingly there was so little has been written about the epidemiology of the ankle fractures in Libya.

BengnBr *et al.* (1986) documented the increasing incidence of ankle fractures in Sweden between the early 1950s and the early 1980s and Kannus *et al.* showed a similar increase in Finland between 1970 and 1994.

I found no particular problems in using the AO classification, although it was sometimes difficult to distinguish between type B1.1 and type B1.2 fractures. The only difference between these fractures is damage to the anterior syndesmosis, which is frequently difficult to detect clinically in an acute fracture.

There was also occasionally some difficulty in distinguishing between B2.2 and B2.3 fractures, where the degree of comminution is the only difference and a similar problem sometimes arose with B3.2 and B3.3 fractures. With these minor problems, I found the AO classification useful and easy to apply.

The incidence of ankle fractures is rising, but there are discrepancies between the various figures quoted in the literature. The most likely reason for this is that a number of researchers have examined only inpatient data and consequently their age-specific incidences are lower than they should be.

Most of the ankle fractures in men were seen between the ages of 26 and 35, when there was an incidence of 16 fractures per 100,000 patients a year. Not surprisingly, one-third of this group was fall from height-related injuries. AO type B trans-syndesmotic fractures are commoner than type A infra-syndesmotic or type C supra-syndesmotic fractures. We had as high incidence of type B fractures as Lindsjo (1981) or BengnCr *et al.*

6. Conclusions

In my opinion, ankle fractures are seen more in young males due to high-velocity injuries and the best anatomical reduction may be achieved by surgical treatment.

My review of the cases of sixty-three patients with an ankle fracture that was unstable or displaced, or both, and was caused by high energy trauma and treated surgically by open reduction and rigid internal fixation in accordance with AO-ASIF principles, revealed these findings:

1) The operative results were eminently satisfactory in fifty-five percent of the patients;

2) The more severe injuries were followed by the least satisfactory results;

3) The lateral fracture is anatomically and rigidly fixed and an intraoperative radiograph reveals a normal medial joint space;

4) It is important to restore the length of the fibula;

5) The bend of the lateral malleolus should be reproduced when a plate is being used;

6) As much as two millimeters of lateral residual displacement of the lateral or medial malleolus, or both, is compatible with a satisfactory result, as is a similar lateral shift of the talus, but only when there is an anatomical restoration of the lateral fracture.

In this study, I tended to use screws (3.5 millimeter cortical and 4 millimeter cancellous) to hold fragments of the lateral malleolus in combination with one-third tubular plate, which often needs to be bent and sometimes twisted to conform to the lateral part of the cortex. And for the medial malleolus, I used two K-wires along with tension band wire or malleolar screw. Suprasyndesmotic screw was used for syndesmosis injury and removed 6 to 8 weeks post-operative.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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