Sudan University of Science and Technology
College of Graduate Studies

Study of Pediatric and Adolescence Ankle and Foot Fractures using different Imaging Modalities in United Arab Emirates

دراسة كسور الكاحل والقدم لدى الاطفال و المراهقين باستخدام طرق التصوير المختلفة في الامارات العربية المتحدة

A Thesis Submitted, for partial fulfillment for the requirement of Master Degree in Diagnostic Medical Imaging Technology

By:

Rania Taha Osman Taha

Supervisor:

Prof, Dr. Mohamed Mohamed Omer Youssef

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الآية الكريمة

(أَوْ كَالَّذِي مَرَّ عَلَى قَرْيَةٍ وَهِيَ خَاوِيَةٌ عَلَى عُرُوشِهَا قَالَ أَنَّى يُحْيِي هَذِهِ اللَّهُ بَعْدَ مَوْتِهَا فَأَمَاتَهُ اللَّهُ مِئَةَ عَامٍ ثُمَّ بَعَثَهُ قَالَ كَمْ لَبِثْتَ قَالَ لَبِثْتُ يَوْمًا أَوْ بَعْضَ يَوْمٍ قَالَ بَلْ لَبِثْتَ مِئَةَ عَامٍ فَانْظُرْ إِلَى طَعَامِكَ وَشَرَابِكَ لَمْ يَتَسَنَّهْ وَانْظُرْ إِلَى حِمَارِكَ وَلِنَجْعَلَكَ آيَةً لِلنَّاسِ وَانْظُرْ إِلَى الْعِظَامِ كَيْفَ نُنْشِزُهَا ثُمَّ نَكْسُوهَا لَحْمًا فَلَمَّا تَبَيَّنَ لَهُ قَالَ أَعْلَمُ أَنَّ اللَّهَ عَلَى كُلِّ شَيْءٍ قَدِيرٌ)

صدق الله العظيم

سورة البقرة(59)

Dedication

Proudly dedicate thesis to the soul of my beloved

Father Taha Osman

Who passed away recently, his words of inspiration and

Encouragement in pursuit of excellence, still linger on.

I remember fondly the past we shared but miss the future

That we will not have.

Acknowledgement

First and the foremost, praise to ALLAH, the creator of the world, the beneficent and the most merciful

I am especially indebted to Dr Mohammed Omer for providing expert supervision, constant advice for his patience, motivation, enthusiasm, and immense knowledge, His guidance helped me in all the time of research and writing of this thesis, I could not have imagined having a better advisor and mentor for my thesis.

Special thanks to my family and my best friend Fatima Omer who endured this long process with me, always supporting me spiritually throughout my life.

ABSTRACT

The prevalence of fractured foot is reported to be increasing across the world. This study is done to know the main causes of the fractures of ankle and foot in pediatrics and adolescence as to aid the emergency department doctors to manage these challenging injuries more effectively in the acute settings, also to determine the demographic variation among study population.

A cohort study underwent in an Ambulatory Care Centers, Al Mafraq and Al Rahba Hospitals in Abu Dhabi city of United Arab Emirates, from September 2014 till September 2015. A total of 200 cases of pediatrics and adolescence between zero to 20 years of age were included in a study were suspected ankle and foot fractures can be found.

This study concluded that 41% had foot and ankle fractures and the majority of them is due to car accidents, also they found to be of male adolescence population.

ملخص البحث

نلاحظ أن انتشار كسر القدم والكاحل في تزايد مستمر في جميع أنحاء العالم.
هذه الدراسة تمت لمعرفة الاسباب الرئيسية لكسور الكاحل و القدم في فئة الاطفال و المراهقين مما يقود و يوجه طاقم أطباء الطوارئ الى معالجة هذه الكسور معالجة فعالة و ناجعة و لحظية. كما بينت هذه الدراسة التنوع العمري و النوعي للحالات تحت الدراسة.
تمت هذه الدراسة بنظام كوهورت للبحوث في عيادات الخدمات الخارجية الاولية وفي مستشفيات المفرق و الرحبة داخل مدينة أبوظبي التي تقع في دولة الامارات العربية المتحدة. تمت في الفترة من سبتمبر من العام 2014 حتى سبتمبر 2015. شملت الدراسة عدد 200 حالة من حالات كسور الكاحل و القدم لدى الاطفال والمراهقين الذين تتراوح اعمارهم من صفر حتى 20 عام.
تم الوصول الى ان 41% من الحالات تحت الدراسة تم تشخيصها بكسور في الكاحل و القدم. و أن أغلبية هذه الكسور ناتجة عن حوادث السيارات وايضا من الاولاد المراهقين.

Contents

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LIST OF ABBREVIATIONS

AP	Anteropostierior
APR	Association Of Pediatric Radiographers
C.T	Computer Tomography
MRI	Magnetic Resonance Imaging
MRN	Medical Record Number
ORIF	Operation Reduction Internal Fixation
RF	Radio Frequency
SPSS	Statistical Package For Social Science
UAE	United Arab Emirates

Chapter 1

INTRODUCTION

CHAPTER ONE

1.1 INTRODUCTION:-

Injuries around the juvenile foot and ankle constitute a complex problem for a number of reasons. This group of injuries are common and have been reported to account for 14% of attendances at the outpatient department. (Chambers HG.2003).

The anatomical differences between the pediatric and adult populations predispose the former to an entirely different set of injuries than adults. Therefore, a sound understanding of the bony, ligamentous and developmental anatomy of the skeletally immature foot and ankle is crucial when treating these injuries. Normal anatomical variants, when unrecognized, can cause undue anxiety to both the clinician and family. Furthermore, children can prove difficult to glean a succinct history from, especially in the context of pain, which will impact on diagnostic accuracy. Myriad of overuse injuries were not included, which present in a more chronic manner. In this article, the pertinent anatomy were described along with, history, physical examination, diagnosis and basic treatment guidelines of the common acute foot and ankle injuries, in an anatomically oriented fashion. The aim is to aid the emergency department doctor to manage these challenging acute injuries more effectively.

Radiographic examination of the human skeleton may identify a range of pathologies or appearances that identify traumatically induced changes. Many of the conditions identified in this section are found generally throughout the skeleton or its articulations. (Dodd A.2013).

Wrong management of ankle and foot fractures can lead to premature physical growth arrest and crossponding limb length in-equality.

1.1.1 Pediatric patients:-

Pediatric patients presenting for radiographic imaging range from the very small, such as neonates and premature babies, to teenagers and young adults.

Regardless of age, each group has unique differences and presents separate challenges to the examining radiographer. Most children will first encounter the hospital environment through an attendance at the emergency department of a local general hospital, despite the presence of specialist pediatric units throughout the country. As a consequence, children are likely to meet radiographers who are more at home examining adults, using equipment and surroundings designed for that purpose. It has been decided to include key examinations likely to be encountered in independent practice as opposed to those regularly carried out in pediatric radiology departments. Some of the radiographic techniques explored will need to be cross-referenced with the relevant chapter elsewhere in this book. Details of invasive procedures and specialized examinations are therefore not included, and readers are encouraged to refer to specialist pediatric texts for in-depth information. This research is not designed to be definitive or exhaustive, but provides a general overview of techniques which from the authors' experience have been shown to work well. It is recognized that alternative methods may be used which can also achieve desired results. Radiographers are encouraged to formulate collaborative approaches through interprofessional working with other healthcare professionals and contact with colleagues at dedicated pediatric units throughout the country. The Association of Pediatric Radiographers (APR) is an excellent initial contact. Not only will this be of direct benefit to patients but it will also contribute to the radiographer's continuing professional development. The specialty of pediatric imaging provides potential scope for the introduction of advanced and consultant radiographer practitioners for those aspiring to a career in this area. (Chambers HG.2003).

1.1.2 Special Considerations When Imaging Children:-

The key factor in obtaining a high-quality diagnostic image is undoubtedly the gaining of the child's trust prior to the commencement of the examination. With such trust follows the development of the patient radiographer relationship that will result in compliance by the child and positive feelings about the imaging experience. Positive feelings are invaluable in the paediatric age group, as a large proportion of children are likely to return for X-rays in their formative years. The Kennedy Report, in the context of heart surgery, advises that all children should be treated in a paediatric environment by paediatric specialists and healthcare professionals. Clearly this is unachievable in many general hospitals. It is likely that most will agree that radiology departments should have at the very least a named lead radiographer and a core team of staff that are specially trained, competent and keen to examine children. It is not unreasonable to strongly suggest that all undergraduate diagnostic radiography students should be provided with learning opportunities in dedicated paediatric departments. Most radiographers will examine children as early as their first appointment as a radiographer. Therefore, a sound knowledge and understanding of the paediatric specialty gained during placement will be of great benefit to all radiographers commencing their careers. Anxiety is a common emotion in patients of any age, but is often heightened in children due to unfamiliar surroundings, adults, and sometimes the reactions of their parents/carers. The radiographer needs to appear friendly, positive and self-assured and able to instil a sense of confidence in both the child and the parent/carer (**Figure 1.1**). Ensuring that the physical environment is favorable to imaging children is an important factor, although this is often dependent upon additional funds and the backing of management. Child-friendly decor and furnishings with toys and books, ideally away from the adult waiting area, helps to achieve a welcoming, relaxed and warm atmosphere (**Figure 1.2**).

Understanding the different stages of child development is vital in order to tailor the examination for the individual: make the examination fit the child rather than vice versa. Some helpful tips are as follows:

• Enabling the child to make choices, such as selection of a lead gown for their parent/career, will give them a degree of feeling in control over their surroundings.

• Allowing the child to bring a favorite toy or comforter into the examination room helps dispel fears. On occasions taking an X-ray of the toy can prove a worthwhile venture to help the child understand what the examination involves. (Dodd A.2013).

1.2 **The Problem of the Study:-**

There is many car accident and traumatic fractures for children under 20 years old. Which cause fracture lower extremity?

1.3 **General objective of the Study**:-

The aim as to aid the emergency department doctor to manage these challenging injuries more effectively in the acute setting.

1.4 **Specific objective of the study:-**

To determine the demographic variation among the study population.

Chapter 2

Literature Review

Chapter 2

2.1 Literature Review

Injuries around the foot and ankle are challenging. There is a paucity of literature, outside that of specialist orthopedic journals, that focuses on this subject in the pediatric population.

I outline pediatric foot and ankle fractures in an anatomically oriented manner from the current literature. My aim is to aid the emergency department doctor to manage these challenging injuries more effectively in the acute setting.

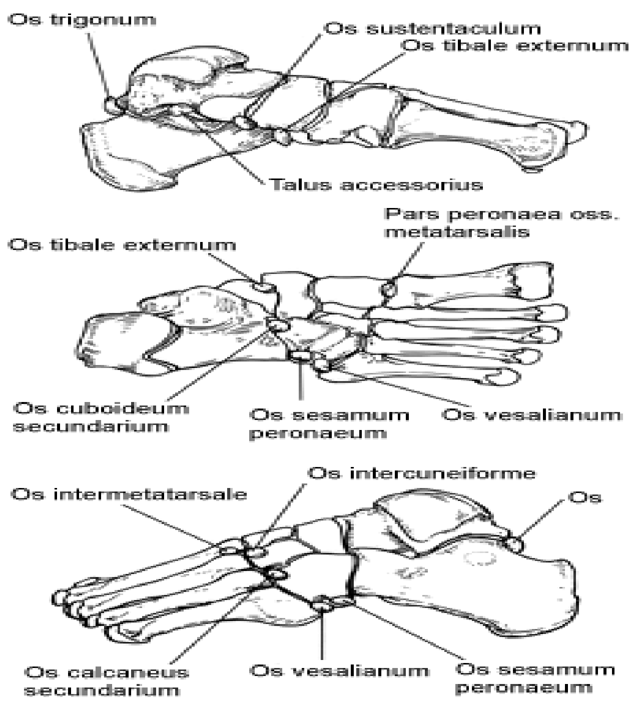


Figure 2.1:- Foot Accessory Ossicles

2.2 Anatomy of the Ankle and foot

2.2.1 Ankle Anatomy

When imaging the foot and ankle all artifacts should be removed, including socks, stockings and bandages. Extra care must be taken in cases of trauma.

Gonad protection should always be used and particular care should be taken with the direction of the central beam, as the gonads can easily be irradiated with the primary beam when examining the foot and ankle, particularly if a cranial angle is used. A lead rubber apron should always be applied when examining the lower limb extremities.

The ankle is a synovial hinge joint comprising of the tibia and fibula which articulate around the central talus. Its role is to transfer force from the foot to the rest of the axial skeleton (and vice versa), allow stability when mobilizing and to allow foot movements. (Englanoff G, et.al.1995).

This complex is frequently referred to as the ankle mortise. Movement occurs in dorsiflexion and plantar flexion. The commonly used terms of supination (plantarflexion with inversion and adduction) and pronation (dorsiflexion with eversion and abduction) refer to triplanar composite ankle movements. Stability of the ankle joint is offered by the bony and ligamentous anatomy. The talus is wider anteriorly such that the ankle is more stable in dorsiflexion. Static stability is provided by the lateral ligamentous complex (anterior talofibular, calcaneofibular and posterior talofibular ligaments) and the medial deltoid ligament complex (superficial and deep). Dynamic stability is offered by the peroneal tendons laterally and by the tibialis posterior medially. The distal tibio-fibular joint also accounts for some minor movement at the ankle joint. The bony and ligamentous anatomy of the foot and ankle joint are summarized in Figs. 1.6 and 1.7 from specimens taken from our anatomy laboratory. Moving distally, the hindfoot comprises the talus and the calcaneus. They articulate with each other at the subtalar joint. The midfoot contains the tarsal bones (navicular, cuboid and three cuneiforms). (Gatt A and Falzon O 2013).

The articulation between the talus and navicular and the calcaneum and cuboid (chopart joint) forms a functional unit referred to as the transverse tarsal joint.

Finally, the forefoot consists of the metatarsals and phalanges. The hind, mid and forefoot collectively function to support the body, dissipate forces from impact and to provide a rigid base for ambulation. The LisFranc joint merits special attention as injury here is often missed. (Goff I and Bateman BJ 2012).

It refers to the articulation involving the 1st and 2nd metatarsals with the medial (1st) and middle cuneiforms. The keystone wedging of the 2nd metatarsal into the middle cuneiform forms the focal point that supports the entire tarsometatarsal articulation. Transverse ligaments connect the bases of the lateral four metatarsals; however, no such transverse ligament exists between the base of the fi rst and second metatarsals. The LisFranc ligament primarily connects the plantar base of the 2nd metatarsal to the plantar surface medial cuneiform (Fig. 1A). A complete account of the preceding events is important with an emphasis on the mechanism of injury (high/ low velocity, twisting, compression, direct blow) and the characteristics of the pain. The location of pain, in our opinion, is the most important factor in aiding diagnosis from the history. A pertinent question is to ask about a previous fracture to the area as old fractures can often masquerade as fresh injuries on radiographs.

(Gustilo RP and Anderson JT 1976). Consistency and plausibility of the story is vital to determine, as these may be the early clues to a non-accidental injury. The effect of the injury of the child should be noted. For example, is the child limping? Analgesia usage can give an insight to the severity. (Harty MP. 2001).

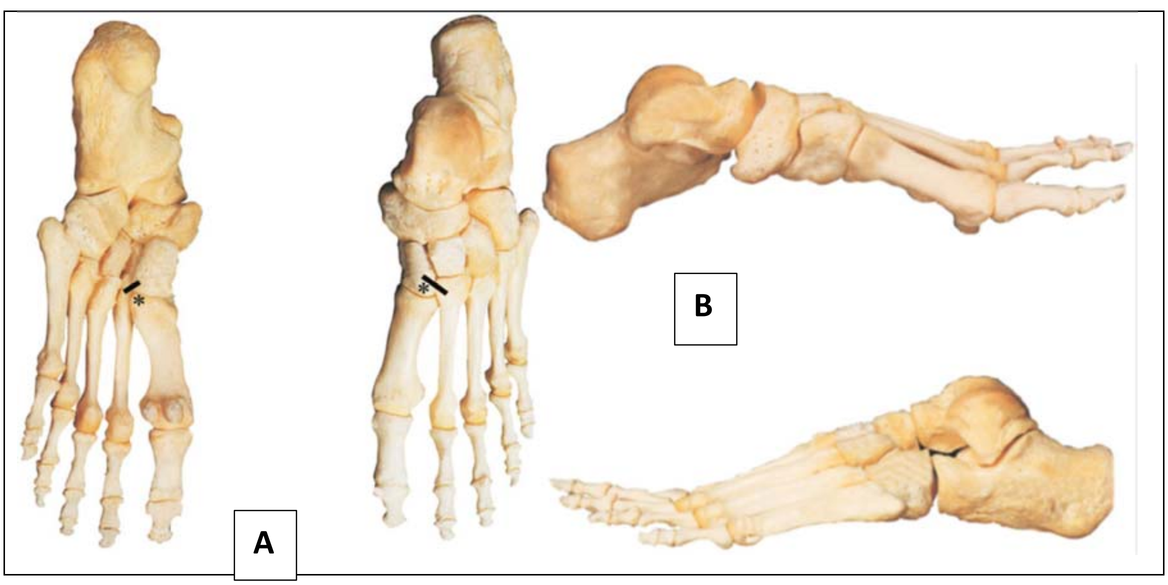


Figure 2. 2:-The bony anatomy of the foot and ankle in cadaveric samples from our laboratory. Pictures are from plantar and dorsal **(A)**, medial and lateral aspects **(B)**. MP: middle phalynx; P: plantar; D: dorsal. *: LisFranc ligament.

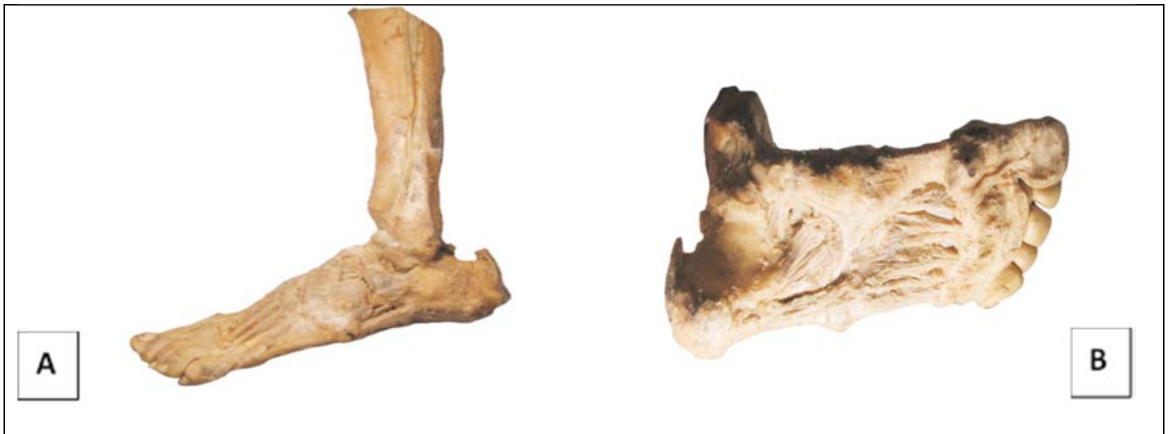


Figure 2.3:-The ligamentous anatomy of the ankle in cadaveric samples from our laboratory: lateral **(A)**, medial **(B)**.

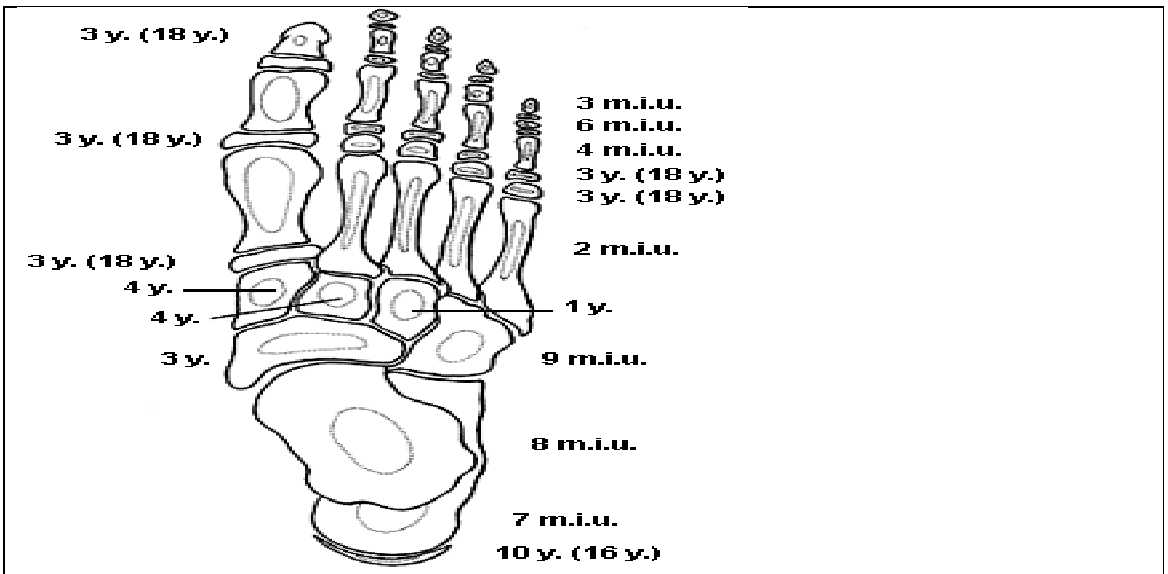


Figure 2.4:-Pediatric Foot Anatomy

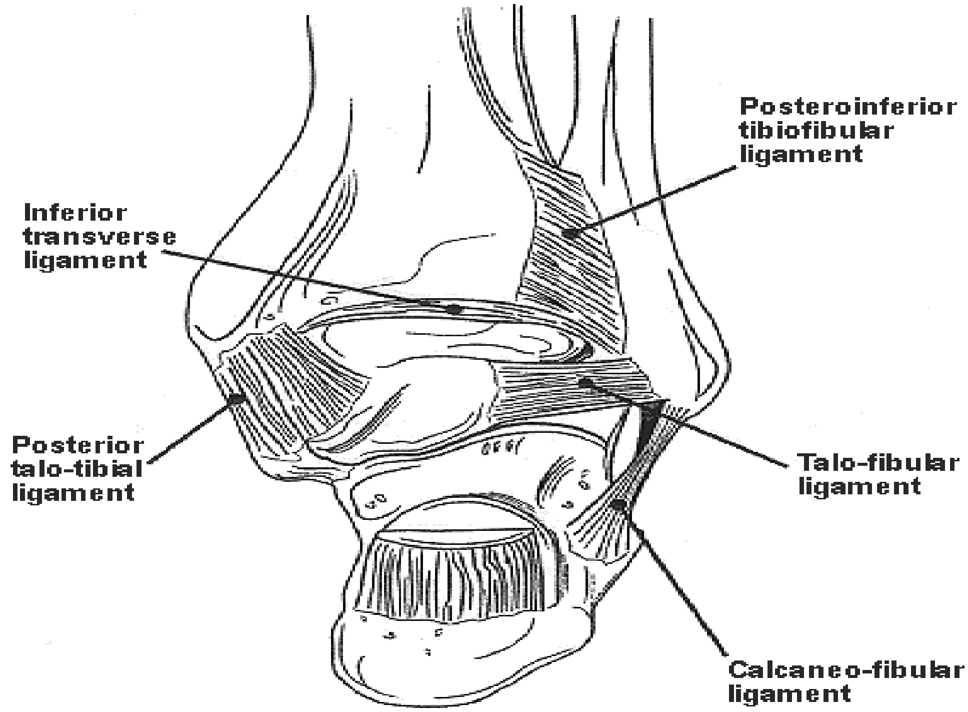


Figure 2.5:-All ligamentous structures attach distal to the physis

2.2.2 The clinical examination

Examination is tailored to according to the history provided by the patient and other witnesses. General orthopedic examination relies upon examination of the joint proximal and distal to the zone of injury. The ankle is inspected for open wounds. Wounds overlying a fracture site constitute an open fracture and are an orthopedic emergency. These have been ably described by Gustilo and Anderson. (Hoppenfeld S. 1976).

Similarly, any pressure on the skin from a displaced fracture necessitates urgent reduction as the soft tissues can rapidly become compromised. The injured extremity should be examined for swelling and ecchymosis. Palpation should be systematic and include palpation of the deltoid ligament posteromedially, the medial malleolus, tibialis anterior, the syndesmotic ligaments, the lateral ligamentous complex and the lateral malleolus. The calcaneum and the midfoot bones should then be palpated in a similar stepwise manner. Each metatarsal should be examined proximal to distal. Tenderness along the course of the Achilles tendon, the peroneals laterally or tibialis posterior will alert the clinician to an overuse tendonitis. The ankle plantar-flexes to 40°, but only dorsiflexes to 10°. Other movements to note are: subtalar eversion (15°-20°), subtalar inversion (35°-40°), forefoot adduction (20°), forefoot abduction (10°), 1st gives information about the prognosis and implications for potential growth disturbance. Five types were originally described and are illustrated in Fig. 3; the most common being type 2, with type 5 having the highest likelihood of growth arrest. (Philbin T, et. al.2003).

However, in the foot and ankle, a type 1 fracture of the distal fibula is the most frequent fracture and usually corresponds to a lateral ankle sprain with no involvement of the metaphysis or epiphysis. Salter-Harris type 1 involves only the growth plate and type 2 involves both the physis and part of the corresponding metaphysis. Type 3 fractures extend from the growth plate into the epiphysis, and type 4 fractures extend from the metaphysis to the epiphysis, through the growth plate. Salter-Harris type 5 presents with no acute radiographic abnormality, but the key is in the history of a crushing mechanism. These rare type 5 fractures are often seen retrospectively as they are a cause of premature growth arrest. (Pizzutillo PD, et.al.2005).

The treatment of physical injuries is pivotal on the patient's age. Accordingly, if the patient is near skeletal maturity, there is less cause for concern regarding premature physical growth arrest and corresponding limb length inequality. The converse is also true. Generally, these fractures heal in 4 to 6 weeks. Reduction of the fracture is crucial. If the fracture is reduced in an aligned position, the fracture can be treated non-operatively in a below knee walking cast, and it is the usual treatment for type 1 and 2 fractures. The key is monitoring the fracture in the outpatient clinic at weeks 1 and 2 post injury. At these visits, a check radiograph is recommended. (Plint AC,et.al.1999).

Any initial or subsequent displacement merits closed reduction under anesthesia with the supplementation of a wire, or screws for longer metaphyseal fragments, if necessary to maintain the reduction. The wire is then removed once healing has occurred both radiologically and clinically. Types 3 and 4 fractures require a closed reduction more often but if their displacement is more than 2 mm, an open reduction with internal fi xation may be necessary. In those patients in whom closed reduction is not possible, one must remain aware of the possibility of soft tissue interposition at the fracture site, usually by the periosteum. If the treating doctor is unsure about the possibility of a physeal fracture (for example type 5), the options are either to immobilize the child in a cast and review in a week or to perform an MRI scan of the extremity. MRI may demonstrate associated soft tissue injury and subperiosteal bruising which are subtle signs of a fracture. Two specifi c pediatric epiphyseal fractures that require separate elaboration are the triplane fracture and the juvenile tillaux fracture. (Pommering TL,et.al.2005).

Figure 2.6:- Plain X-rays Ankle

2.2.3 Triplane fracture

As the name suggests, this is a multiplanar fracture. Classically, the fracture extends through the sagittal (epiphysis), axial (physis) and coronal (distal tibial metaphysis) anatomic planes, disrupting the tibial plafond (Fig. 4). These fractures are similar to the aforementioned tillaux; they occur in adolescence with a partially fused physis (anterolateral plate is still open) and external rotation is the deforming force. Radiographically, these injuries appear as Salter Harris type 3 injuries on the anteroposterior (AP) radiograph and a type 2 injury on the lateral. True appreciation of the fracture pattern is difficult from plain X-rays alone. MRI is valuable in delineating fracture geometry with management, as always, depending upon displacement. Less than 2 mm of displacement can be accommodated in cast, but >2 mm of displacement merits open anatomical reduction and rigid internal fixation with screws, with care taken not to breach the physics.

- Distal tibia ossification center appears between 6 - 24 months
- Distal fibula ossification center appears between 9 - 24 months
- Medial malleolar extension appears at about 7 years

(Pontell D,et.al.2006).

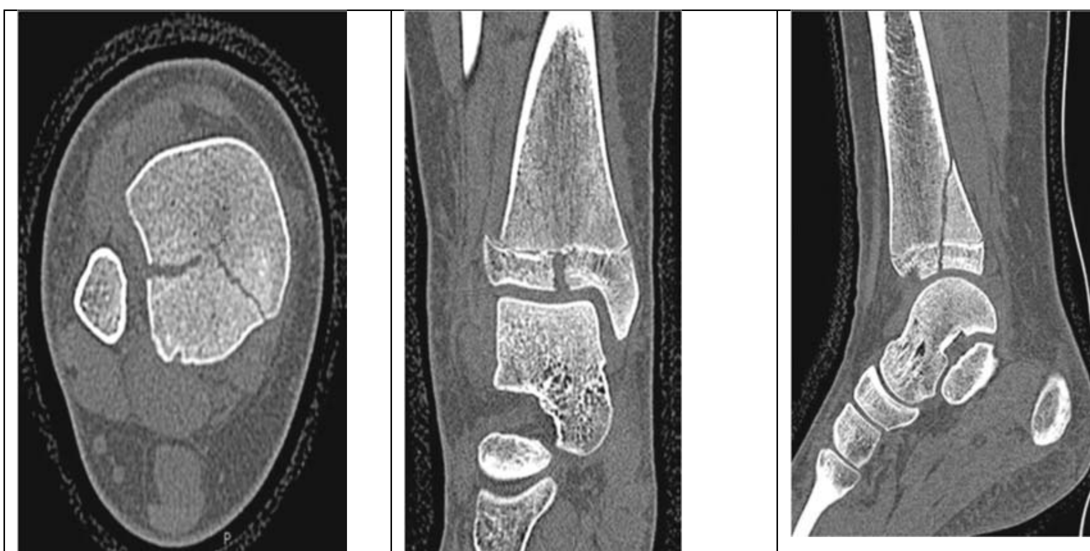


Figure 2.7:- Corresponding computed tomography slices illustrating a right triplane fracture in the axial **(B)**, coronal **(C)** and sagittal slices **(D)**.

2.2.4 Juvenile tillaux fracture

This Salter-Harris type 3 injury is a fracture of the anterolateral tibial epiphysis (Fig. 5). It frequently presents in adolescence because the central and posteromedial segments of the physis have fused first, leaving the partially open anterolateral side. With external rotation of the foot, the strong anterior inferior tibiofibular ligament pulls off bone from the distal tibial epiphysis with the fracture line then propagating until it meets the fused physis and then passes through the epiphysis into the joint. Children present with anterior ankle pain and swelling in the setting of an external rotation injury. Occasionally, CT is required if the fracture displacement is not clear on plain radiographs due to the oblique plane of the epiphyseal fracture. (Ribbans WJ, et.al.2005).

Non-operative treatment requires an attempt at closed reduction with internal rotation of the ankle and supination of the foot. (Salter RB and Harris WR 2005.).

A long leg cast should be used initially. Open reduction and fi xation may be required if >2 mm of displacement persists. Growth arrest seldom complicates a tillaux fracture because by the late teens, most of the physis has already fused. Nevertheless avoiding diastasis at the inferior tibiofibular joint and restoring of joint congruity is essential. (Sankar WN,et.al.2008)

Figure 2.8:- Computed tomography with 3-D reconstruction illustrating a right displaced juvenile tillaux fracture in the coronal plane.

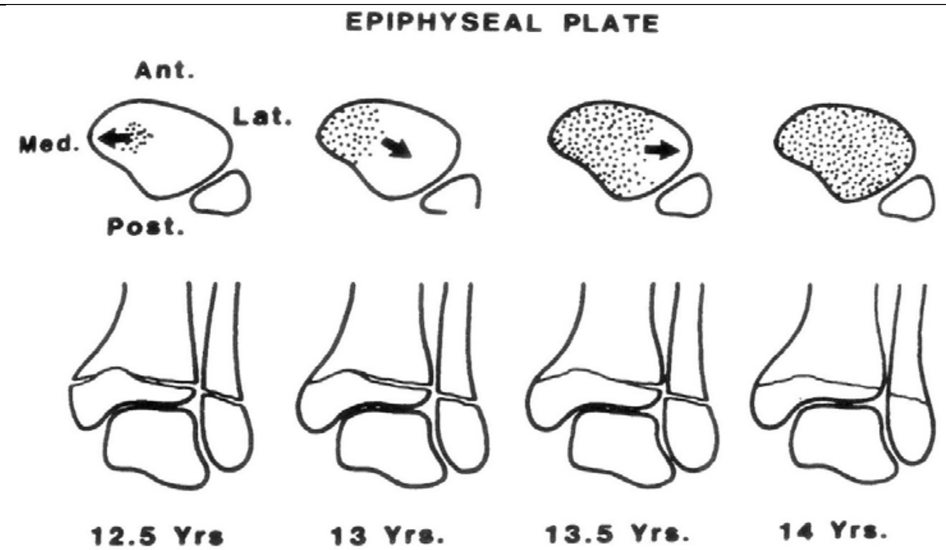


Figure 2.9:- Distal Tibial Physeal Closure

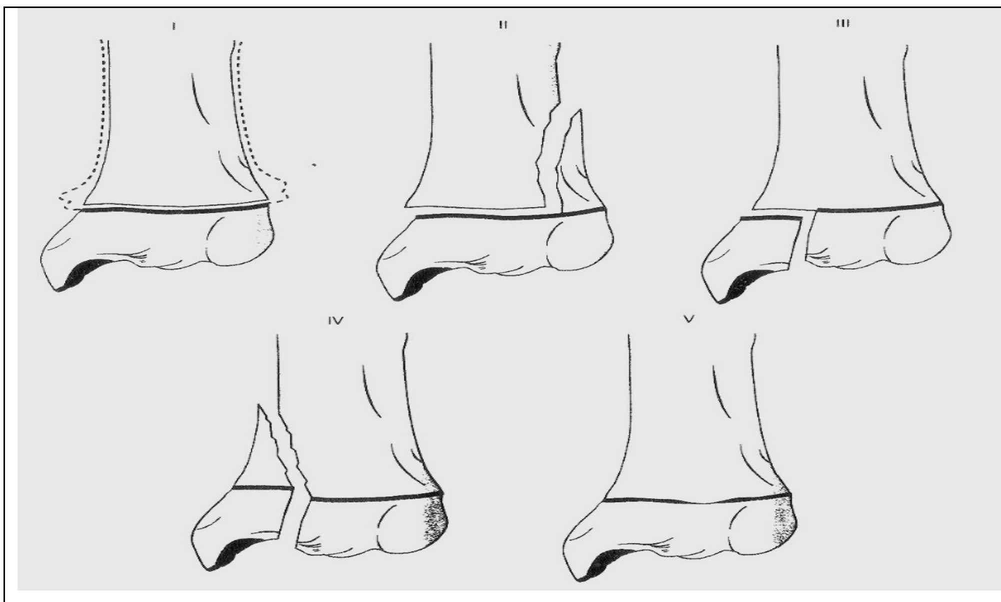


Figure 2.10:- Classification AnatomicSalter-Harris High interobserver correlation Correlated with outcomes

Figure 2.11:- Accessory Ossification Centers – Smooth Borders

Chapter 3

MATERIAL AND METHODS

Chapter 3

3- MATERIAL AND METHODS

3.1 Study design

This study is a cohort underwent investigation has been done Diagnostic X-ray Imaging in Ambulatory of Health Care Centers in Abu Dhabi City.

3.2 Duration of the study:-

This study was started from September 2014 and finished in 2015 in September 2015.

3.3 Area of the Study

The study was carried out in Ambulatory of Health Care Centers in Abu Dhabi City along with Al Mafraq and Al Rahba Hospitals.

3.4 Sample size

Randomly selected patients divided to fractured foot Patient of Non fractured foot, for all sample size.

3.5 Data sources:-

Data were collected by the researchers' patients, others by recorded patients at ambulatory clinics, Al Mafraq and Al Rahba Hospitals.

3.6 Machine used

Magnetic Resonance imaging machines is used Philips system and other Siemens system, Philips Infineon 1.5T. The refurbished Philips Infinion 1.5T MRI machine is an ultra-short, whole body MRI scanner with a dockable patient couch. The used Philips Infinion 1.5T MRI is designed for feet-first entry so the patient's head can remain outside the magnet for the majority of exams. Equipped with a flared gradient coil that enhances patient aperture, the Philips Infinion 1.5T MRI combines a Synergy Integrated Spine Array coil for simplified patient setup with a Synergy Multi-Mode RF coil selection that will enable simultaneous connections of up to 20 coil elements.

3.7 Technique used

Laboratory tests are seldom required in the acute setting. However if there is a possibility of an infective etiology, inflammatory markers should be requested. Although originally described for adults, the Ottawa ankle rules have been shown to be useful in children over 10 years to decrease the number of unnecessary radiographs. (Johnson GF.1981).

According to these Ottawa ankle rules, an ankle and foot X-ray is only required if there is bone tenderness at the posterior edge of the lateral or medial malleolus, 5th metatarsal or navicular. Also if the patient is unable to weight bear in the emergency department, an X-ray is recommended. A summary of these rules is presented in Table. In addition to the standard anteroposterior and lateral radiographs, the clinician should also request a mortise ankle view. This is performed with an affected leg lying in 15° of internal rotation to allow visualization of the tibio-talar joint line. For further visualisation, we recommend magnetic resonance imaging (MRI) as it provides superior detail of the articular and physeal cartilage, periosteum and bone marrow, compared to computed tomography (CT), and avoids the radiation exposure. (Jones MH and Amendola AS 2007).

Chapter 4

Results

Chapter 4

4.1 RESULTS

The data were collected from the patients admitted in AL Rahba Hospital & Al Mafraq Hospital & Ambulatory Care Centers Emergency Units in Abu Dhabi City during the period from 1st April 2014 to 1st April 2015, and it is analyzed using the Statistical Package for Social Science – SPSS version 16.0. The following pages present and discuss the results of the analysis.

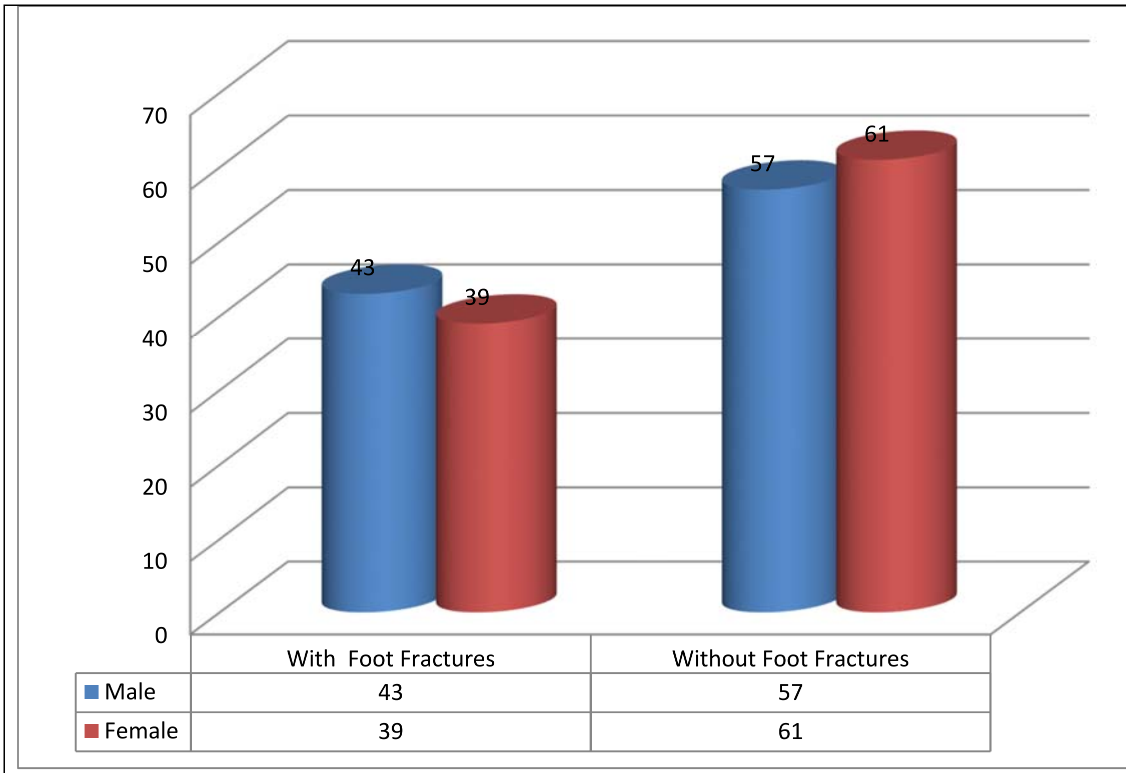


Figure 4.1:- Gender distribution of Patient with Foot and ankle Fractures and without Foot Fracture

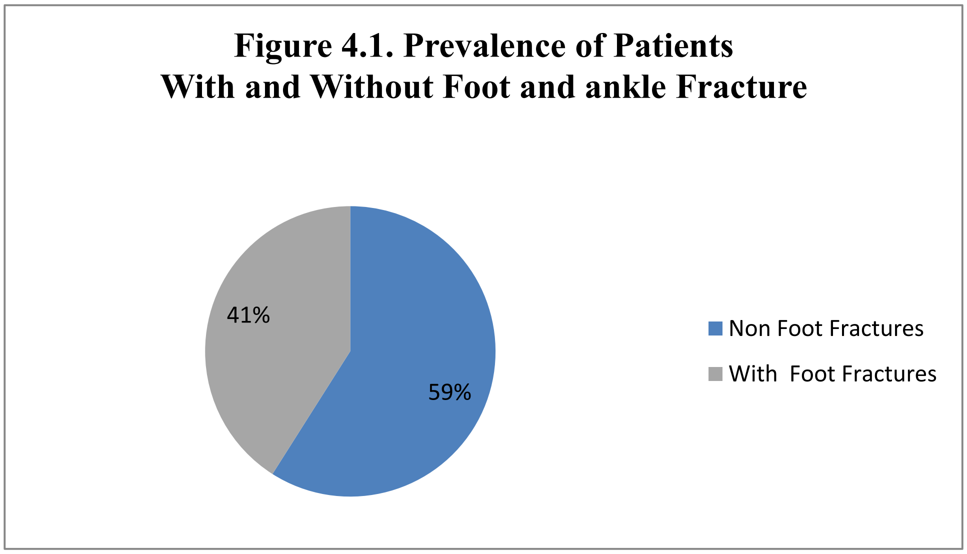
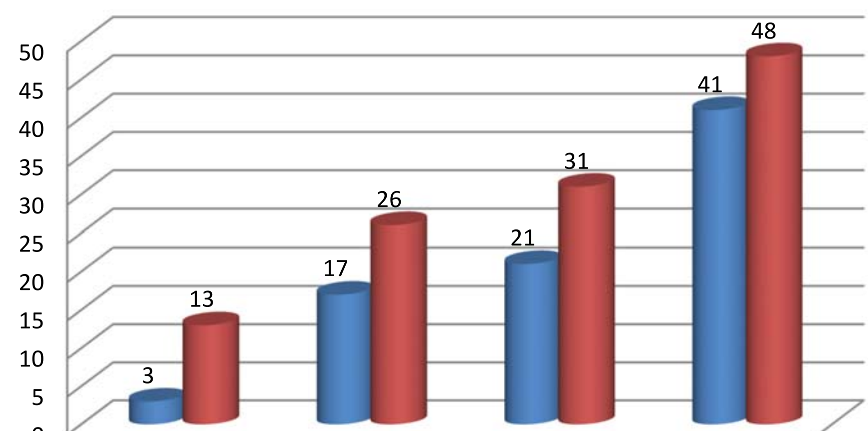


Figure 4.2:- Prevalence of patients with and without Foot and ankle Fractures



	0-5 years old	6-10 years old	10-15 years old	16-20 years old
Foot Fractures	3	17	21	41
Non Foot Fractures	13	26	31	48

Figure 4.3:-Incidence of Foot and ankle Fractures patient's in the age of 6 years old to 18 years old during study period.

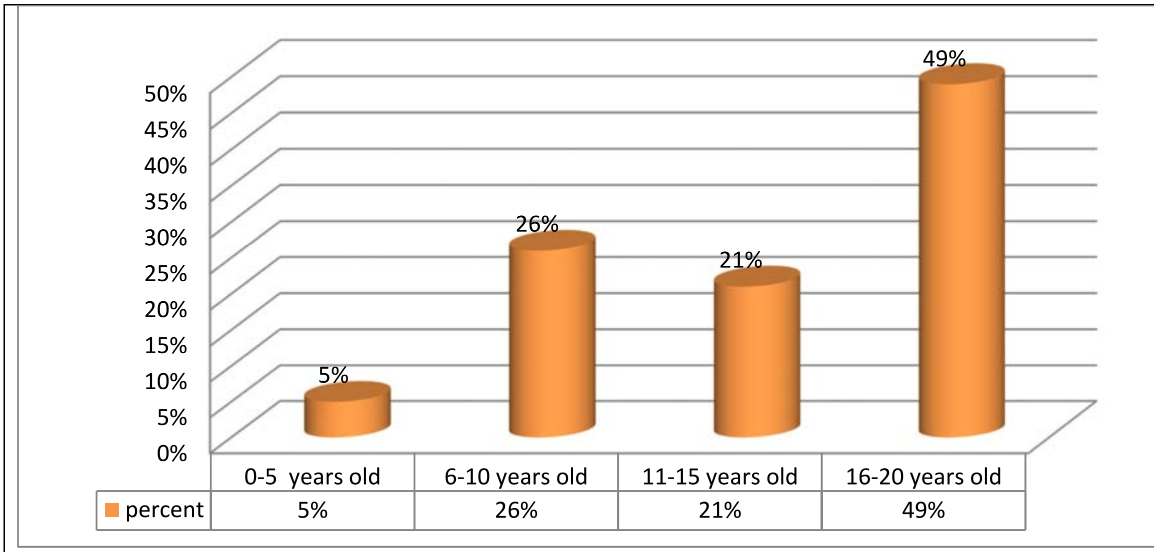


Figure4.4: - Age Distribution of Foot and ankle Fractures patients (Experimental group of male patients).

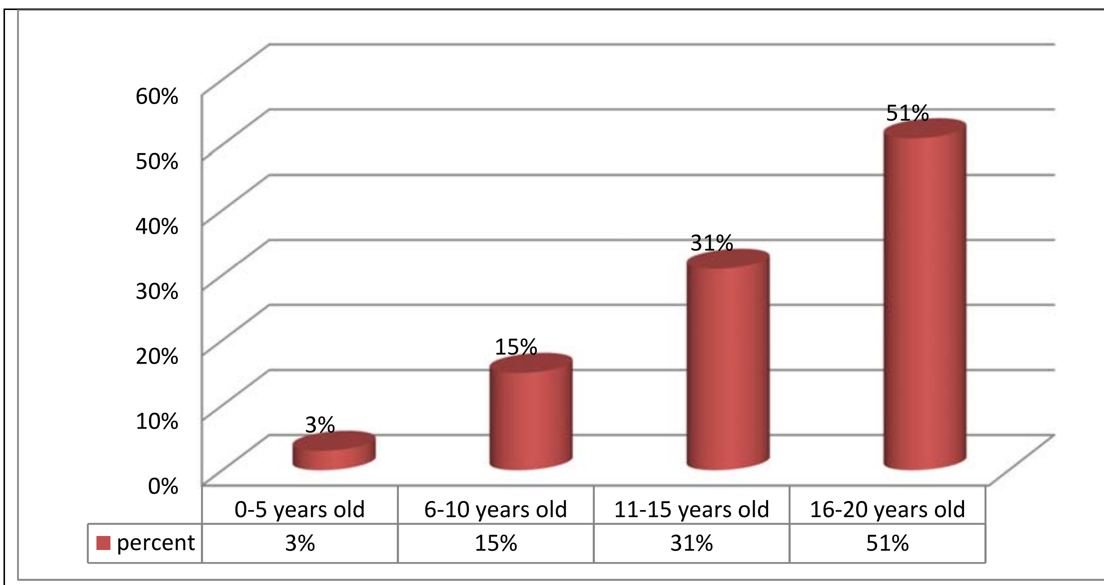


Figure4.5 Age Distribution of Foot and ankle Fractures patients (Experimental group of female patients).

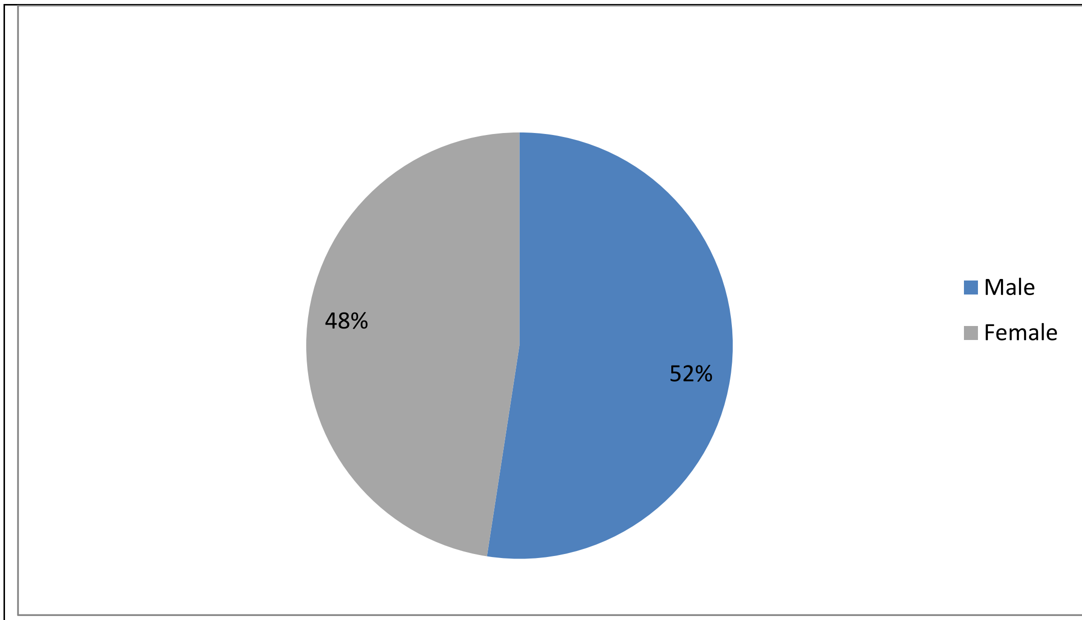


Figure4.6 Prevalence of Foot and ankle Fractures were diagnosed by X-Rays

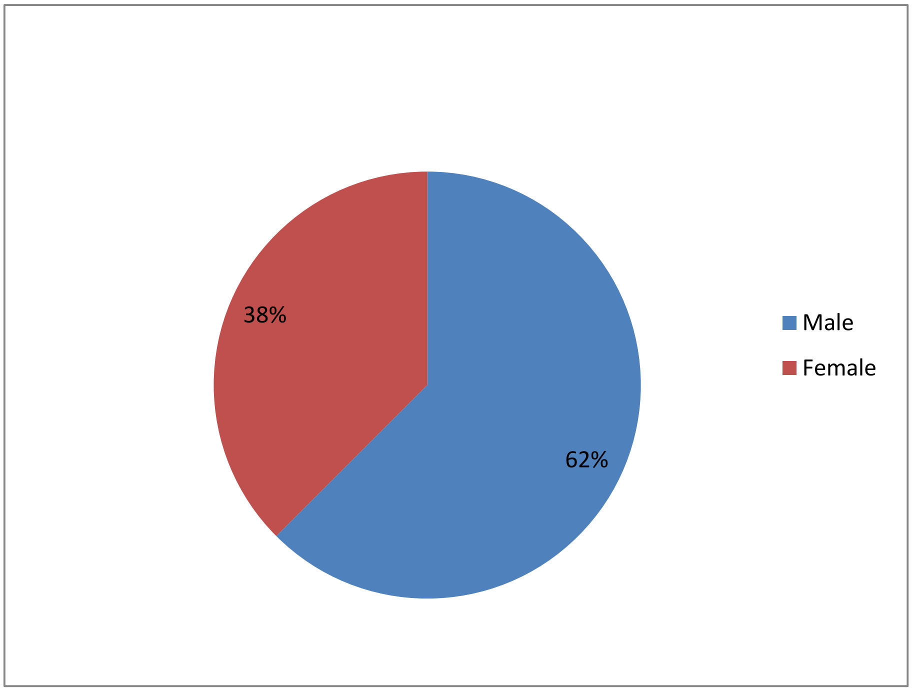


Figure4.7 Prevalence of Foot and ankle Fractures were diagnosed by Computer Tomography Scan
(CT-scan)

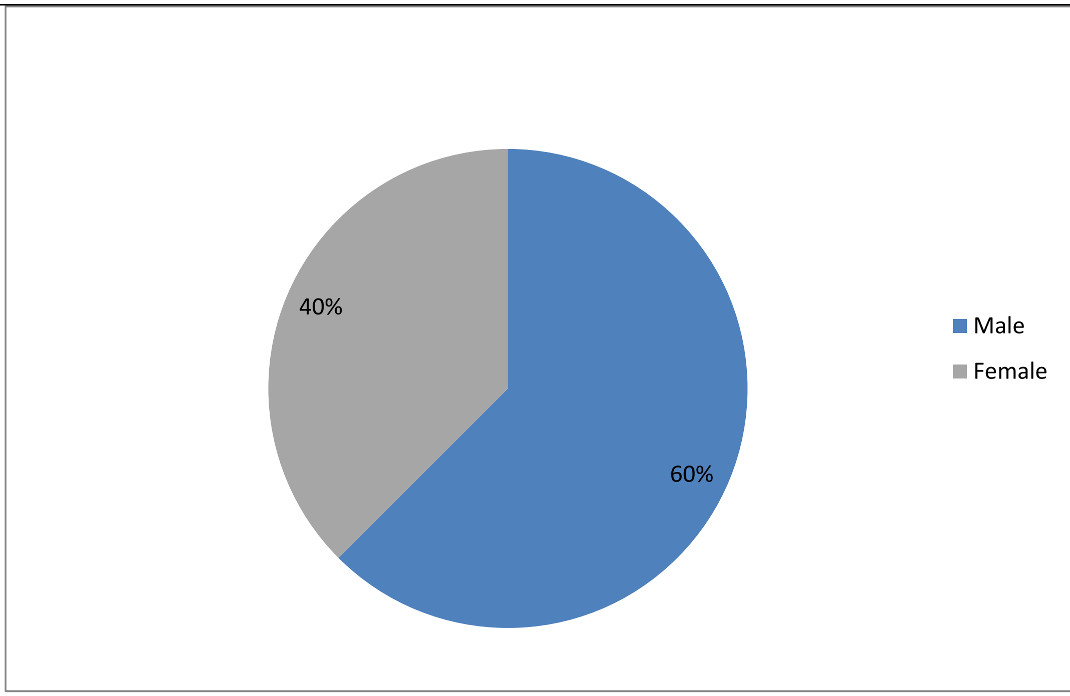


Figure4.8:- Prevalence of Foot and ankle Fractures were diagnosed by Magnetic Resonance Imaging

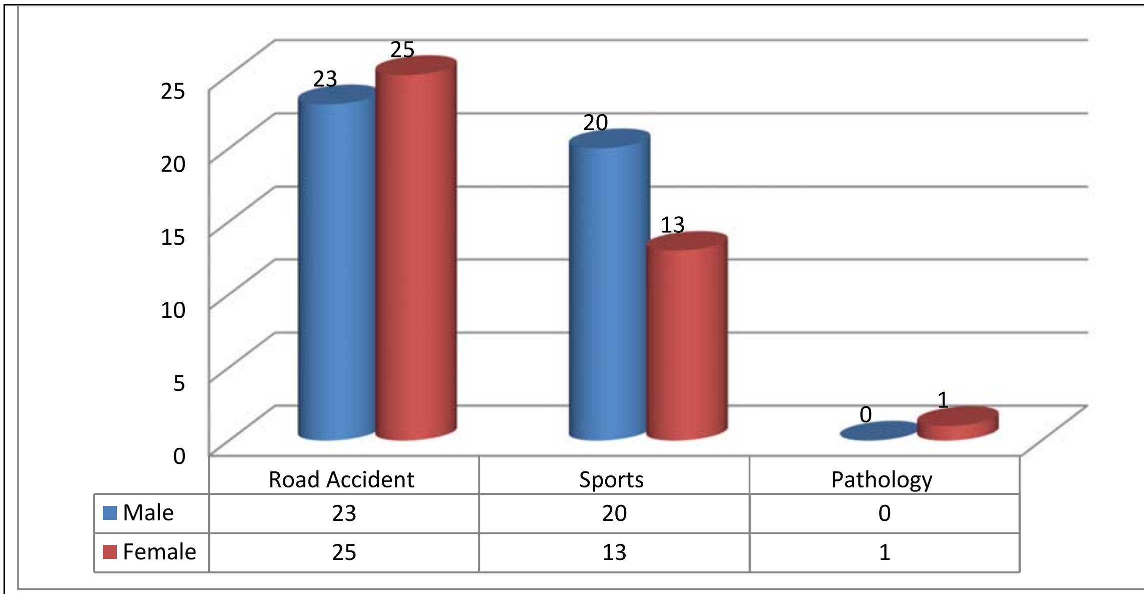


Figure 4.9:- Gender distribution of fractures in cases of road traffic accidents, sports and pathologies.

Chapter 5

Discussion, Conclusion and Recommendations

Chapter 5

Discussion, Conclusion and Recommendations

5.1 Discussion:-

Fractures are common in children and adolescence and an increase in incidence has been suspected.Proplems are usually related to skeletal maturity and are fairly specific to age of the child. Evaluation and management is a challenging and requires a thorough history and physical exam, and understanding of specific pediatric skeleton.Useing the different imaging modalities ultimately will help the doctors to rule in or rule out foot and uncle fractures and thus aid them to manage these cases properly.X-Ray is the most common way to evaluate a fracture with clear image of bone while CT scan help in diagnosing fractures not seen by X-Ray.MRI is especially useful when fracture extend in to the ligament . In this study most of patient had fractures duo to car accident and the most of them were between 16 and 20 years and being mostly of male gender.

A study done by Kishore (2010) showed predominance of male patients and being most of them duo to road traffic accidents in agreement with this study which showed the same conclusion.

Another study done byWasim Khan et al (2010) concluded that fracture foot and uncle also mainly due to car accident in agreement with this study but the main age is between 8 and 12 years in disagreement with this study duo that this age group play in open play ground near the streets.

In a study done by McConkey(2009) concluded that uncle fractures are more common than foot fractures and the most common cause is ankle sprains in sports in agreement with this study .

Another study done by Kiuru MJ et al(2004) showed that computed tomography is superior to X-Ray in diagnosing complex fractures and to diagnose foot fractures which have been excluded using X-rays and hence supporting the importance of doing computed tomography for all patients suspected to have fracture foot and ankle .

In a study done byVille Haapamaki(2004) showed that the most common cause of fracture foot and ankle are falling from height followed by simple fall followed by rood traffic accident being the third in the list of causes in disagreement with this study which showed predominance of rood traffic accidents. The calcanous was the most common bone fracture and about 50-72% of the fractures were diagnosed using conventional X-RAY and the rest were referred to CT imaging for diagnosis.

A study done by Daly PJ et al . Showed that fracture foot and uncle are twice common in males than females. About 40% are duo to sport activites, 30% in traffic and 20% at home while only 5% at school and 5%in others in agreement with this study.

5.2 Conclusion:

The integrity of the physical, articular surface and soft tissues are all equally important in treating these injuries.

The lifetime prevalence of fracture foot in the Abu Dhabi city of UAE at the time of the survey was significantly great.

As from the above mentioned results it seems that the fracture foot and ankle are more commonly due to car accidents.

The prevalence of foot and ankle fractures were found to be higher in male patients, whom were practicing sports and driving cars.

Patients aging between 16-20 years old had high percentage of fractures.

5.3 Recommendations

1. Doctors should send all patients with suspected foot and ankle fracture to the radiology imaging department, with using different imaging modalities for more accurate diagnosis.
2. Doctors should be aware about the Salter-Harris five types of fractures.
3. Maintaining a good education of children and drivers is playing a great role in preventing the occurrence of foot fractures.
4. Using safety measurements when practicing sports.

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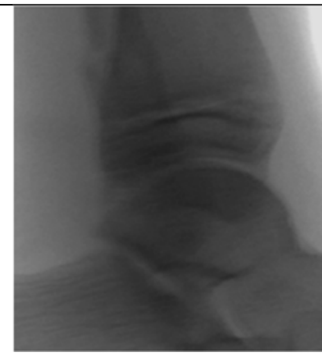
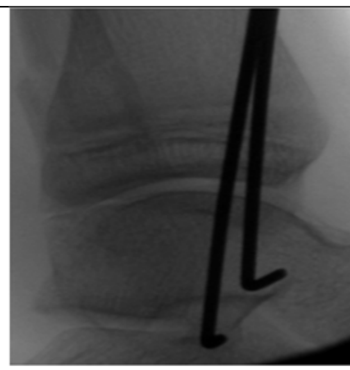
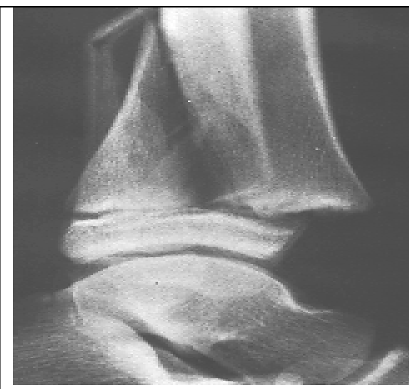
Appendices

 **Salter I Fracture Distal Tibia**		
Figure5.1: - Salter I Distal Tibia Fractures: Treatment	**Figure 5.2**:- Salter I Fracture Distal Tibia Antro posterior	**Figure 5.3**:- Salter I Fracture Distal Tibia Lateral Ankle

		
Figure 5.4:- Salter I Fracture Distal Tibia Antro posterior during Operation	**Figure 5.5**:- Salter I Fracture Distal Tibia Lateral Ankle during Operation	**Figure 5.6**:- Salter-Harris Type II fractures: Treatment

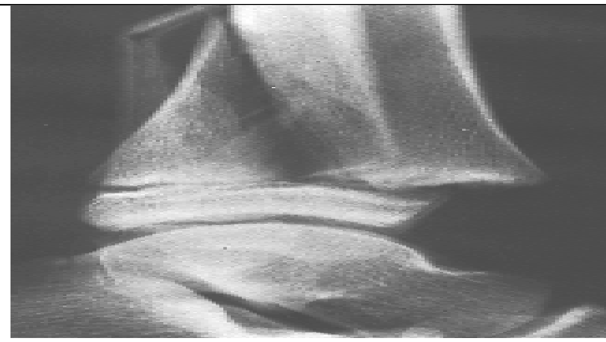


Figure 5.7:- Salter-Harris Type II Fractures Anteroposterior view

Figure 5.8:- Salter-Harris Type II fractures Lateral view

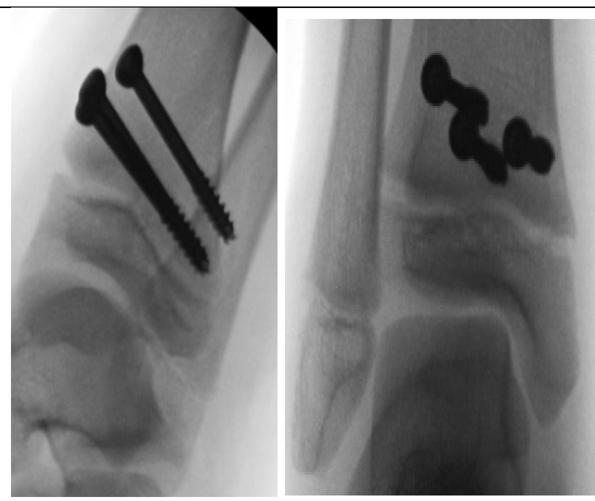


Figure 5.9:- Salter II Fracture of the Distal Tibia Anteroposterior & Lateral View

Figure 5.10:- Salter II Fracture of the Distal Tibia Anteroposterior & Lateral View During Operation

Figure5.11:- Closed reduction with incomplete reduction because of interposed soft tissues – removed at ORIF

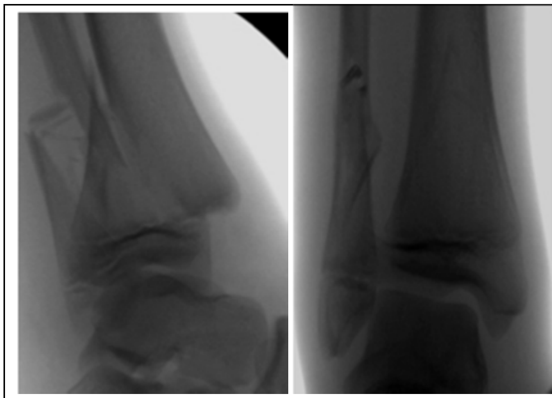


Figure 5.12:-Other Salter II Fracture of the Distal Tibia Anteroposterior Before Operation

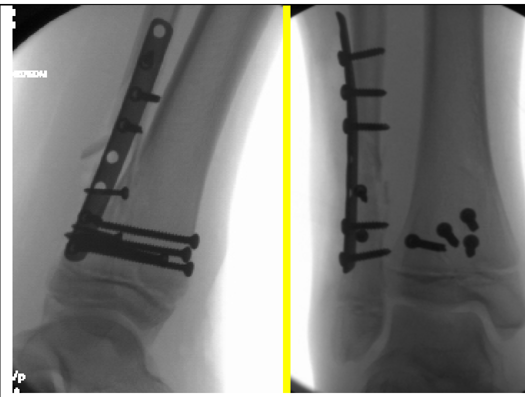


Figure 5.13:-Other Salter II Fracture of the Distal Tibia Anteroposterior during Operation

Figure 5.14:- Salter IV Minimally Displaced Distal Tibia Fracture before and after operation

Figure 5.15:- Salter III Injury- Closed reduction with percutaneous internal fixation before and after operation

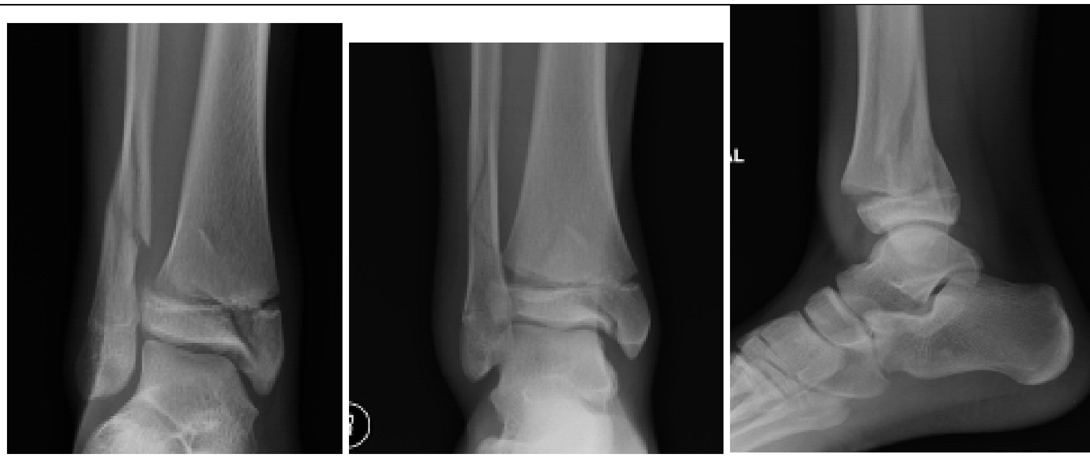


Figure 5.16:- Salter IV Distal Tibia Fracture before operation

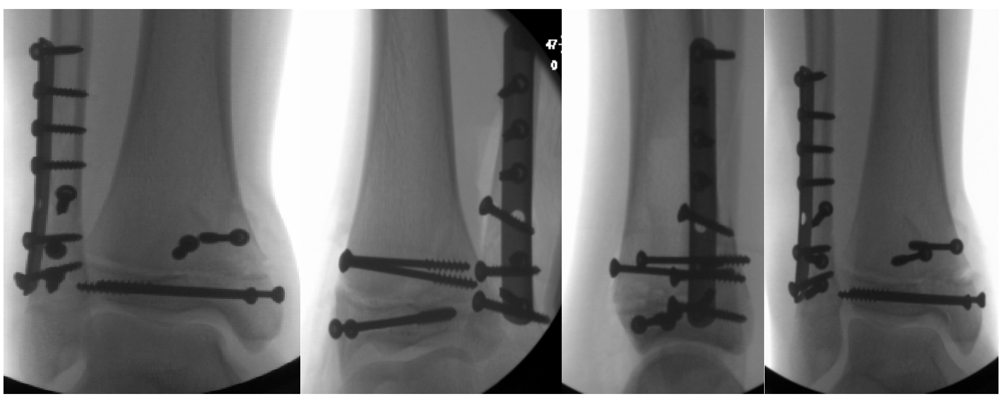


Figure 5.17:- Salter IV Distal Tibia Fracture after operation

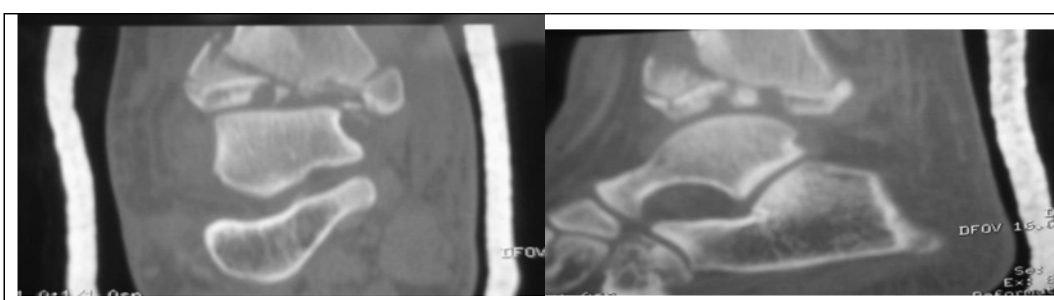


Figure 5.18:- CT scan demonstrates significantly comminuted articular surface and anterior subluxation of talus

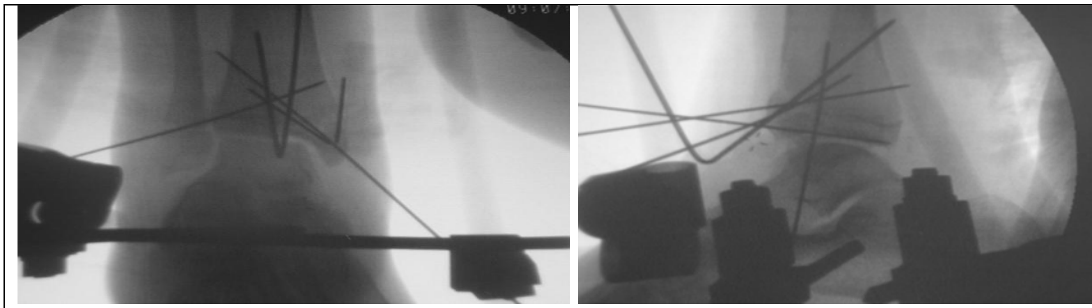


Figure 5.19:- During operation views – bridging external fixation and ORIF with pin fixation

Figure5. 20 1:- 12 Year Old – High Velocity GSW
– loss of tibial epiphysis/anterior soft tissues/tendons - bridging external fixator
- latissimus free flap
-ankle fusion

Figure 5.20-2 :- 12 Year Old – High Velocity GSW
– loss of tibial epiphysis/anterior soft tissues/tendons - bridging external fixator
- latissimus free flap
-ankle fusion

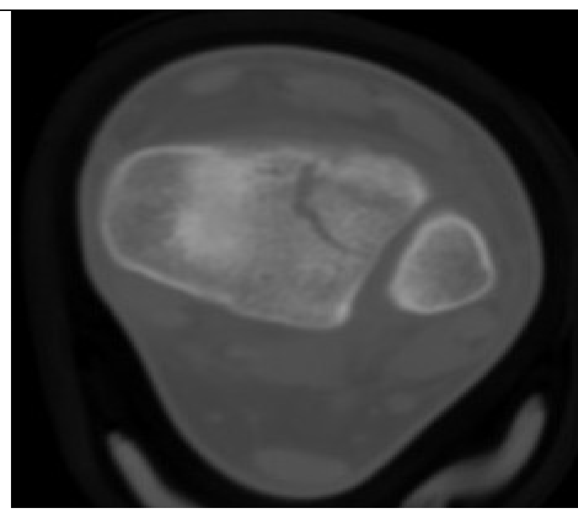
Figure 5.20-3 :- Patient 12 Year Old – High Velocity GSW
– loss of tibial epiphysis/anterior soft tissues/tendons - bridging external fixator
- latissimus free flap
-ankle fusion after operation

Figure 5.21:- X-ray anteroposterior view and CT-Scan cross section and Sagittal view Transitional Fractures

Figure 5.22:- Triplane Fractures Anteroposterior & lateral view before operation

Figure 5.23:- Triplane Fractures CT-Scan sagittal & Cross section views

	
Figure 5.24:- Triplane Fractures CT-Scan sagittal & Cross section views Reconstruction scan	**Figure 5.25:-** same patient of Triplane Fractures Anteroposterior & lateral view after operation

	
Figure 5.26:- Anteroposterior View of Tillaux Fracture Example x –ray	**Figure 5.27:-** CT-Scan cross section View of Tillaux Fracture Example same patient

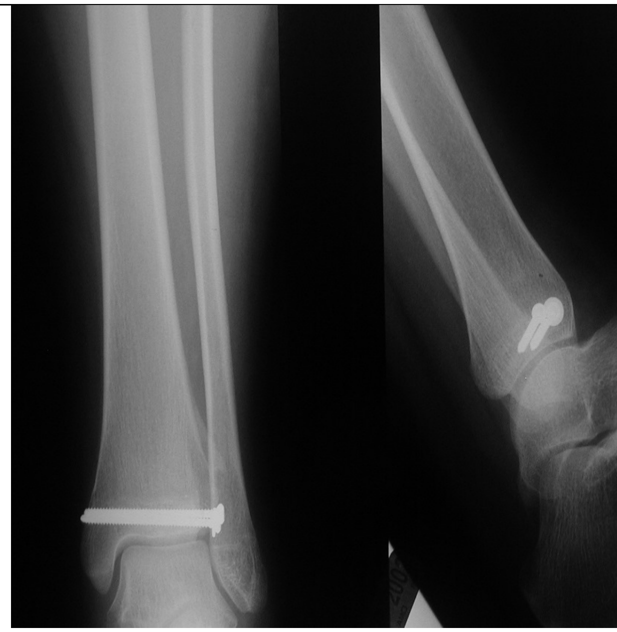
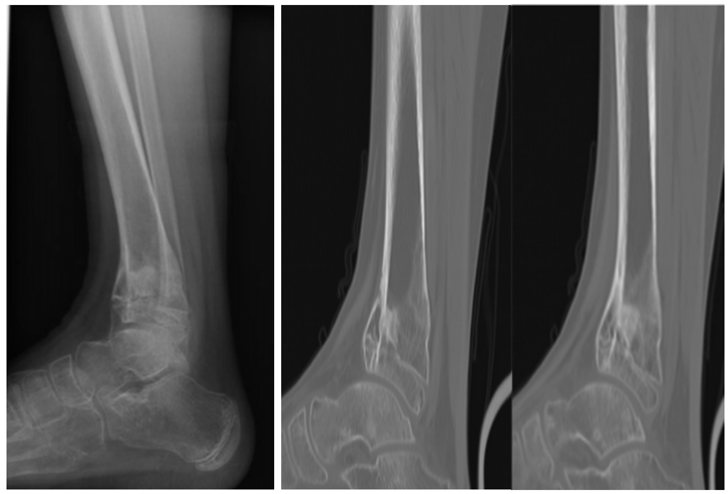
	
Figure 5.28:- Tillaux Fracture Example anteroposterior & lateral x-ray before operation	**Figure 5.29:-** Tillaux Fracture Example anteroposterior & lateral x-ray after operation

Figure 5.30:- Salter I Distal Fibula typical “goose egg” swelling over distal fibula with tenderness over distal fibular physis	**Figure 5.31: -** Same patient Salter I Distal Fibula typical “goose egg” swelling over distal fibula with tenderness over distal fibular physis X- ray

	
Figure 5.32:- Ankle Fractures	**Figure 5.33:-** Physeal Injury Simulating Bone Tumor

	
Figure 5.34:- Other Complications of Ankle Fractures	**Figure 5.35:-** Fracture lower tibia and fibula at the area of Ankle joint

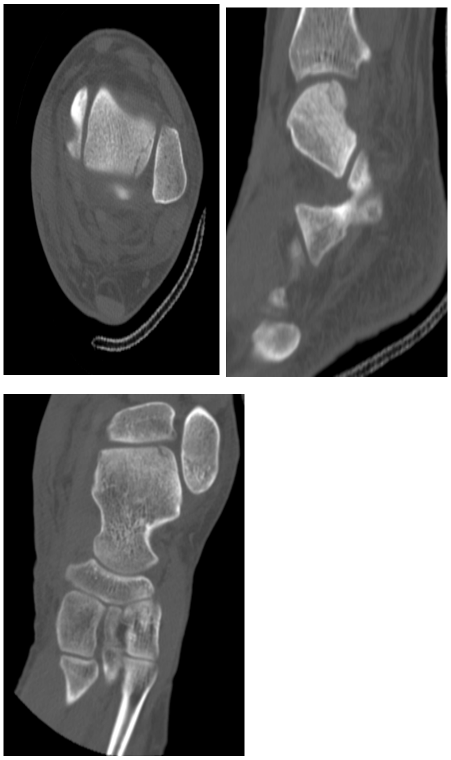


Figure5.36:- Talar Dome Fracture	**Figure 5.38**:- Some Patients from Emergency Units Before operations