Fractures and Orthopedic Diseases

By:

Dr.Adel abaazim ahmed

Zagazig University

Second Year

2018/2019

Acknowledgments

This two-year curriculum was developed through a participatory and collaborative approach between the Academic faculty staff affiliated to Egyptian Universities as Alexandria University, Ain Shams University, Cairo University , Mansoura University, Al-Azhar University, Tanta University, Beni Souef University , Port Said University, Suez Canal University and MTI University and the Ministry of Health and Population(General Directorate of Technical Health Education (THE). The design of this course draws on rich discussions through workshops. The outcome of the workshop was course specification with Indented learning outcomes and the course contents, which served as a guide to the initial design.

We would like to thank **Prof.Sabah Al- Sharkawi** the General Coordinator of General Directorate of Technical Health Education, **Dr. Azza Dosoky** the Head of Central Administration of HR Development, **Dr. Seada Farghly** the General Director of THE and all share persons working at General Administration of the THE for their time and critical feedback during the development of this course.

Special thanks to the **Minister of Health and Population Dr. Hala Zayed and Former Minister of Health Dr. Ahmed Emad Edin Rady** for their decision to recognize and professionalize health education by issuing a decree to develop and strengthen the technical health education curriculum for pre-service training within the technical health institutes.

Contents

Course description 5

Chapter 1 Introduction to fractures and joint injuries.....9

Chapter 2 Fractures of cervical spine 14

Chapter3 Fractures of thoracolumbar spine 17

Chapter 4 fracture pelvis 21

Chapter 5 fracture femur 24

Chapter 6 knee injuries 27

Chapter 7 Leg and ankle fracture 31

Chapter 8 Bone deformities 36

Chapter 9 congenital orthopaedic disorders 40

Chapter 10 Bone tumors 43

Chapter 11 Low back pain 47

Chapter 12 foot disorders 51

Chapter13 hand disorders 54

جامعة /أكاديمية : المعاهد الفنية الصحية التابعة لوزارة الصحة والسكان
قسم : العظام

Course Specifications

توصيف مقرر دراسى

1- بيانات المقرر		
الرمز الكودى :	اسم المقرر :امرض وكسور العظام Orthopaedic diseases and fractures	الفرقة /المستوى :الثانية
التخصص : عظام	عدد الوحدات الدراسية : نظرى 2	

2- Overall Aim of Course: 2 هدف المقرر:	The purpose of this course is give both basic and applied clinical knowledge about various types of orthopaedic fractures and diseases with special focus on emergency situations
3- Intended learning outcomes of the course (ILOs): 3-المستهدف من تدريس المقرر	
i. Knowledge and Understanding: ا. المعلومات والمفاهيم :	<u>By the end of this course, students should</u> 1- Recognize basic science related to orthopaedic fractures and diseases. 2- Describe various orthopaedic fractures as regard pre management , first aid , patient follow up and post - operative care 3- Recognize various orthopaedic diseases with special emphasis of emergency conditions
ii. Intellectual Skills: ب- المهارات الذهنية :	<u>By the end of this course, students should:</u> 1. Identify various types of orthopaedic fractures and diseases 2. Recognize emergency conditions
III. Professional Skills: ج- المهارات المهنية الخاصة بالمقرر:	<u>By the end of this course, students should be able to:</u> 1. Use comprehensive knowledge in orthopaedic science to promote the quality of clinical practice in various orthopaedic disorders.

	2. Afford proper first aid for orthopaedic emergencies
IV. General and Transferable Skills: د- المهارات العامة :	<u>By the end of this course, students should be able to:</u> 1. Assess problems. 2. Work efficiently with others. 3. Practice independent learning by using information technology tools. 4. Evaluate information from various standard sources to improve professional skills.
4- Course content 4- محتوى المقرر:	

5- Teaching and Learning Methods: 5- أساليب التعليم والتعلم	1. Lectures. 2. Group discussions
6- Teaching and learning methods for students with limited abilities 6- أساليب التعليم والتعلم للطلاب ذوى القدرات المحدودة	
7- Student Assessment: 7- تقويم الطلاب :	
a- Assessment methods: أ- الأساليب المستخدمة	a. Class work: 1. Quizzes 2. Midterm theoretical 3. Assignments 4. Participation b. Final exam: Written theoretical
b- Assessment schedule: ب- التوقيت	a. Class work: 1. Quizzes: Quiz I (4th week) Quiz II (11th week) 2. Midterm theoretical (7th week) 3. Assignments 4. Participation b. Final exam

	written theoretical exam (15th week)
C-Weight of Assessments: ج- توزيع الدرجات	1. Quizzes and class work (10%), 10 marks 2. Mid term theoretical exam(10%), 10 marks. 3. Final written theoretical exam (80%), 80 marks. Total percentage 100%
7- List of References:	8- قائمة الكتب الدراسية والمراجع :
a- Course notes: أ- مذكرات	Lecture notes of orthopaedic diseases and fractures
b- **Essential books (text books)** ب- كتب ملزمة	1 - Louis Solomon (Editor), David Warwick (Editor), Selvadurai Nayagam (Editor) Apley's System of Orthopaedics and Fractures, Taylor & Francis. 9th. 2010. 2 - David Hamblen Hamish Simpson. Adams's Outline of Fractures, 12th Edition. Churchill Livingstone. 2007 3 - David Hamblen Hamish Simpson Adams's Outline of Orthopaedics 14th Edition Churchill Livingston.2009
c- Recommended books ج- كتب مقترحة	1 - Mark D. Miller MD (Author), Stephen R. Thompson MD MEd FRCSC (Author). Miller's Review of Orthopaedics 7th edition. Elsevier , 2015. 2 - S. Terry canale MD. James H. Beaty MD. Willis C. Campbell. Campbell`s operative orthopaedics , 12 edition. Philadelphia, PA: Elsevier, 2017
d- Periodicals, web sites, ,,,,, د- دوريات علمية أو نشرات ..... الخ	• ***Egyptian knowledge bank*** • **www.google.com** • **www.pubmed.com** • **Expert consult**

Course description

This course discusses different types of casts and splints in orthopaedic surgery. It involves description and indications of use of each type. The technique of application of every type is described. The complications and how to avoid them are also detailed

Core Knowledge

4- Recognize different types of casts and splints.
5- Identify the correct technique of application of each type of cast and splint
6- Identify various complications of orthopaedic casts and splints and how to prevent them and how to deal with them if occurred.

Core Skills

By the end of this course, students should be able to:

3. Identify types of cast and splints
4. Identify how to assist or share in application of different casts and splints
5. Recognize complications results from cast or splints application and how to prevent and manage them

Course Overview

Date	Subject
1st week	Introduction to orthopaedic fractures
2nd week	Fracture cervical spine
3rd week	Fracture dorsolumbar spine
4th week	Fracture pelvis
5th week	Fracture femur
6th week	knee injuries
7th week	Leg and ankle fractures
8th week	Bone deformities
9th week	Congenital orthopaedic disorders
10th week	Bone tumors
11th week	Back pain
12 week	Foot disorders
13th week	Hand disorders

Chapter 1

General principles of fractures and joint injuries

Objectives

Provide basic clinical knowledge about fractures and joint injuries

Overview

Orthopaedic disorders are divided into main categories fractures and disease. The fractures represent about 60% - 70% of the patients presented to hospitals and clinics

Definition: A fractures means any break in bone continuity either complete or incomplete (**Figure 1**)

Figure 1: incomplete and complete fractures

Aetiology of fractures

- Direct trauma: the trauma occurs at the fracture site (the fracture occurs at the site of the trauma

- Indirect trauma: the trauma occurs away from the fracture site (the fracture occurs away from the site of the trauma) e.g. fracture spine due to fall from a height on the feet or elbow fracture due to fall on the hand (Figure 2).

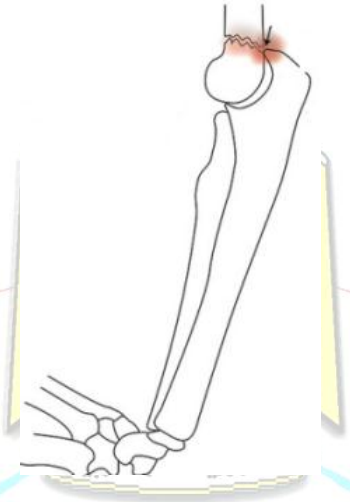


Figure 2: Indirect trauma, fall on the hand produces injury at the elbow

Classification of fractures
According to fracture shape (**Figure 3**)

- Transverse
- oblique
- Spiral
- Comminuted

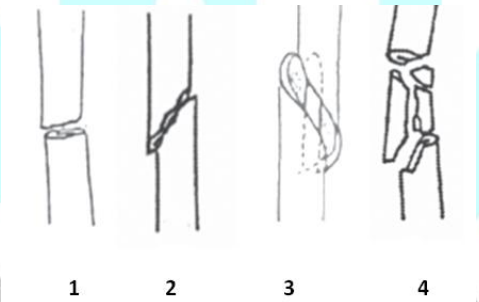


Figure 3: Different fracture shapes 1: Transverse fracture 2: Oblique fracture 3: Spiral fracture 4: Comminuted fracture

According to site of the fracture (**Figure 4**)

- Proximal: fracture occurs in the part near the upper end of bone
- Middle: fracture occurs in the middle segment of bone
- Distal: fracture occurs in the part near the lower end of bone

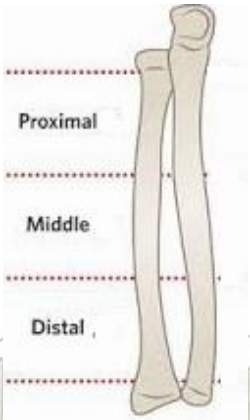


Figure 4: Types of fractures according to fracture location

Open and closed fractures

- Closed fractures are those fractures with intact overlying skin
- Open fractures are those with injures overlying skin communicating the bone with the external environment whatever the size of the wound
- According to condition of the underlying bone
- Traumatic fracture: The fracture occurs through a health bone
- Pathological fracture: The fracture occurs through a diseased bone e.g. fracture through a bone tumor

Diagnosis of fractures

1 - Clinical diagnosis: the following clinical manifestations are present following a fracture

- History of trauma
- Pain at the site of fracture
- Swelling at the site of fracture
- Bruises due to fracture hematoma
- Tenderness at the fracture site on palpation
- Crepitations at the fracture site due to movements of the fracture ends
- Inability to use the injured limb properly
- Radiological diagnosis
- Plain x- ray (**Figure 5**): is the most important tool for diagnosis of bone fractures. Plain x – ray should be done in two perpendicular view at least e.g. anteroposterior and lateral and should show the whole injured bone from its upper end to its lower end

Figure 5: Fracture radius

- CT : may be needed in certain fractures to show more accurate details about the fracture
- MRI: it is not commonly done for fracture diagnosis but may be needed to assess associated ligamentous injuries with the fracture or in cases of pathological fractures

2 - Laboratory diagnosis
Laboratory tests are not usually needed for fracture diagnosis in ordinary cases except if a pathological fracture is suspected e.g. bone tumor

Treatment
First aid treatment
- Control bleeding if present
- Wound debridement and dressing if there is any wound of the affected limb
- Splinting of the affected limb with the suitable splint

Definitive treatment
Fracture needs good stabilization to heal. The method of stabilization differs according to the site and types of the fracture. Different methods of fracture stabilization are present as casts, splints, external

Fixators, plates and screws and intramedullary nails (**Figure 6**)

1 2 3

Figure 6: Methods of bone fixation: 1- External fixator 2 - Plate and screws 3 - Intramedullary nail

Complications
Complications due to the trauma

- Skin injury occurs due to trauma by a sharp object that penetrated the skin from outside or a sharp spike from a fractured end penetrated the skin from inside
- Vascular injury : an artery or vein nearby the fracture can be injured
- Nerve injury : a nerve nearby the fracture can be injured
- Ligamentous injury
- Visceral injury : the trauma causing a fracture in the pelvic or chest region can cause injury to the abdominal organs or the lung

Complications related to fracture healing

- Delayed union: slow union progression
- Nonunion : failure of union
- Malunion: union in a wrong position

Complications due to immobilization

- Muscle atrophy
- Osteoporosis
- Joint stiffness

Joint dislocations

Dislocations occurs when the articulating bone ends come out from their position as a result of trauma either direct or indirect
Dislocation is considered when the articulating bone ends lost contact completely while sublaxation when the bone ends are still have some contact (**Figure 7**)

Figure 7: sublaxation and dislocation

Dislocations and sublaxations are manifested clinically by severe pain, swelling and loss of joint motions. Plain x- ray will ensure the diagnosis

Joint dislocations are an emergency. They should be reduced promptly by closed reduction or open reduction if closed reduction fails

Chapter2
Cervical spine fractures

Objectives

- Provide basic knowledge , diagnosis and management of cervical spine fractures

Overview

Cervical spine injuries are more serious that other injuries of the spine because it is associated with higher incidence of neurological injury. Neurologic injury occurs in 40% of patients with cervical spine fractures

Mechanism of injury

- Car accidents, falls from heights and blunt trauma account for the majority of cervical spine injuries.
- Forced flexion or extension is the mechanism for most cervical spine injuries.

Classification (Figure 1)

- Compression fracture (a)
- Burst fracture (b)
- Fracture dislocation (c)

Figure 1: classification of cervical spine fracture

Diagnosis

Clinical

►Urgent assessment of patient general condition: Breathing, blood pressure, pulse and level of consciousness
►Examination of the rest of the body chest, abdomen, limbs, head and neck
►Local examination of the neck: There will be tenderness over the fractures segment
►Neurological examination: complete motor and sensory examination

Radiology

Plain x- ray: Anteroposterior and lateral views
CT: shows more details about the fracture and shows any fracture fragment present in the neural canal pressing on the spinal cord (**Figure 2**)
MRI: shows details of the spinal cord and nerve roots (**Figure 3**)

Figure 2: CT fracture cervical spine

Figure 3: MRI fracture cervical spine with cord compression

Treatment
Emergency management
- Rigid cervical collar or halo traction for safe patient transport
- Airway or tracheal intubation: During intubation great care should be done to avoid excessive neck motions that will produce further injury to the patient. Manual stabilization should be maintained throughout the intubation process or nasotracheal intubation will be safer than tracheal intubation. If high cervical fracture instability is suspected tracheostomy can be done which will be safer than intubation

Definitive management
- Rigid cervical collar for stable fracture
- Surgical treatment by fracture reduction and cervical spine fixation in cases of unstable fractures or fractures associated with neural injury (**Figure 4**)

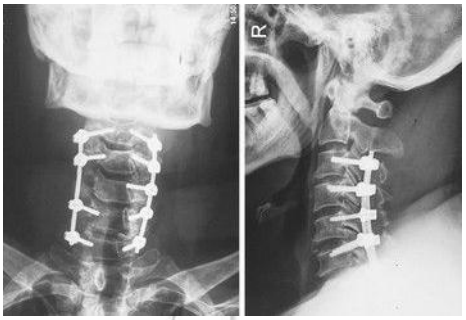


Figure 4: Fixation of cervical spine

Complications

Spinal cord injury is the most serious complication it may lead to quadriplegia, respiratory failure and death

Chapter 3
Dorsolumbar Fractrures

Objective

- **Provide basic knowledge , diagnosis and management of dorsolumbar spine fractures**

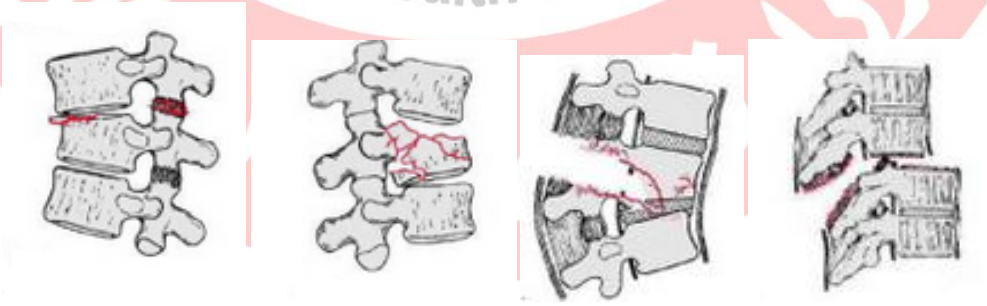
overview

Dorsolumbar fractures are serious injuries that can leave permanent patient handicapping. Proper and early management can provide complete cure or at least lessen further disabilities

Mechanism of injury: Dorsolumbar fractures occur as a result of high energy trauma as fall from a height or car accidents

Classification

- Compression type (wedge fracture) **(a)**
- Burst type **(b)**
- Seat belt type (flexion with distraction injury) **(c)**
- Fracture dislocation **(d)**



a **b** **c**

b

Figure 1: classification of dorsolumbar spine fracture

Diagnosis

Clinical

►Urgent assessment of patient general condition: Breathing, blood pressure, pulse and level of consciousness
►Examination of the rest of the body chest, abdomen, limbs, head and neck
►Local examination of the back: There will be tenderness over the fractures segment

►Neurological examination: complete motor and sensory examination (**Figure 2 , 3**)

- Hip abduction: L1-2
- Knee extension : L3-4
- Knee flexion:L5 – S1
- Big toe dorsiflexion: L5
- Big toe planter flexion:S1

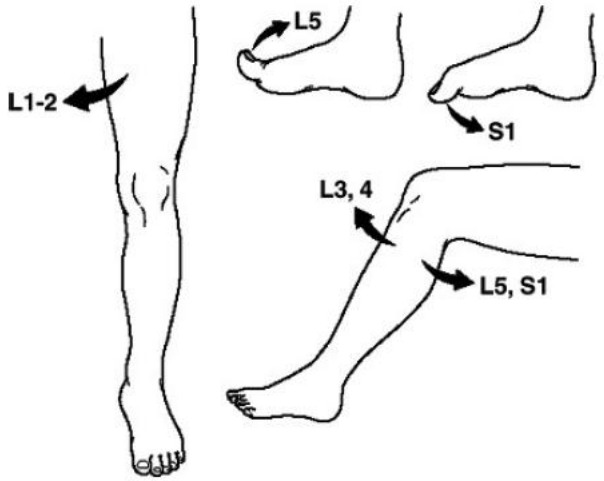


Figure 2: Motor examination of the lower limb

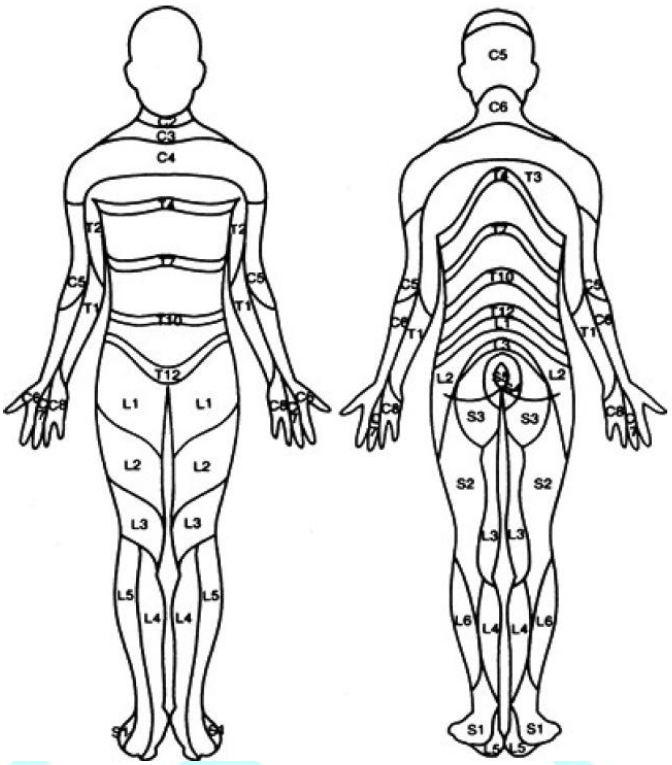
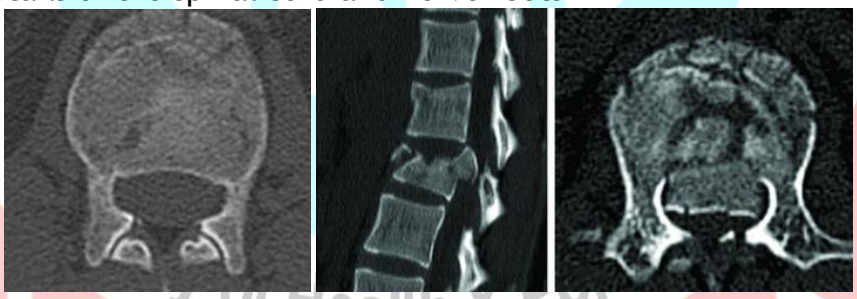


Figure 3: Sensory examination of the body

Radiology

Plain x- ray: Anteroposterior and lateral views
CT: shows more details about the fracture and shows any fracture fragment present in the neural canal pressing on the spinal cord
MRI: shows details of the spinal cord and nerve roots



a **b**

Figure 4: CT fracture lumbar spine with free neural canal (a) and bone fragment present in the neural canal (b)

Treatment

- Patient splint: the first step in management is stabilization of the fracture in a rigid back brace with great care during patient transport not to produce more injury to the patient. use hard flat board for patient transport to protect the spine
- All types needs surgical treatment by reduction of the fracture and spinal fixation (**Figure 5**) except cases of wedge fracture if the wedge is less than 50% of the height of the vertebra. In this condition bed rest and back brace for 1 – 2 months is indicated for treatment of that type

Figure 5: Fixation of fracture spine

Complications

- Injury to neural elements, the spinal cord or nerve roots with subsequent paralysis
- Associated injury of the thoracic or abdominal or pelvic organs

Chapter 4
Fracture pelvis

Objective

- **Provide applied clinical knowledge about pelvic fracture as regard diagnosis and management**
- **Special reference to emergency management of pelvic fractures**

Overview

Fracture pelvis can be a life threatening condition. It may be associated with fatal hemorrhage or serious injury to visceral organs. Urgent and proper management of these fractures is a must to reduce complications

The pelvis is composed of two hip bones united anteriorly at the symphysis pubis and posteriorly at the sacrum (**Figure 1**)

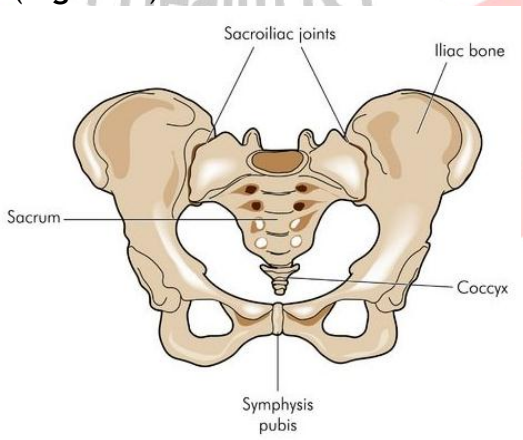


Figure 1: the bony pelvis

Mechanism of injury: Fracture pelvis is usually due to high energy trauma as fall from heights and road traffic accidents when the victim is entrapped between injurious objects or he may be crushed by a high speed moving object

Types (Figure 2)
A: avulsion fractures of the bony prominences or bones outside the pelvic ring
B: disruption of the symphysis pubis anteriorly (open book fracture)

C: disruption of the sacro iliac joints posteriorly

a b c

Figure 2: Types of pelvic fracture

Diagnosis

Clinical

- Assessment of vital signs: Breathing, pulse, blood pressure and temperature
- General examination: head and neck, chest, abdomen and general skeletal survey
- Assessment of motor and sensory functions of the lower limb
- Assess foot pulsations dorsalis pedis and posterior tibial artery

Radiology

- Plain x -ray Anteroposterior and pelvic inlet (oblique view where the tube directed caudally) and outlet view (oblique view where the tube directed cephalic) (**Figure 3**)
- CT : the best method to detect details of pelvic fractures

a b

Figure 3: inlet view a outlet view b

Treatment

Emergency treatment
Control shock if present as fracture pelvis may be associated with hypovolaemia and hypotension due to injury of pelvic veins, if present apply pelvic binder or sheet (**Figure 4**) if the binder is not available or apply external fixator to approximate parts of the pelvic ring and compress the bleeding pelvic veins

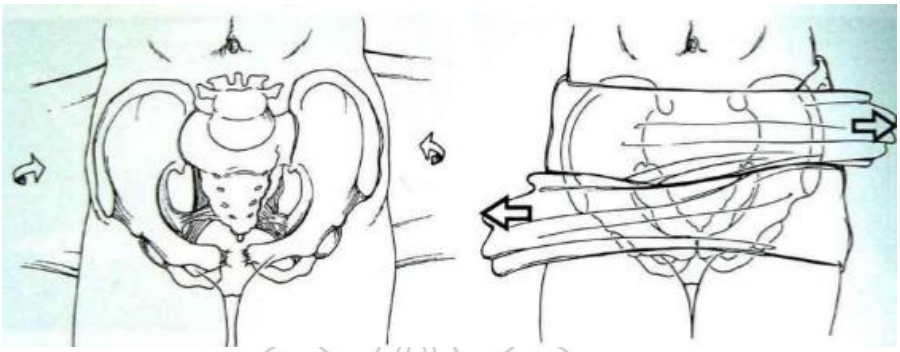
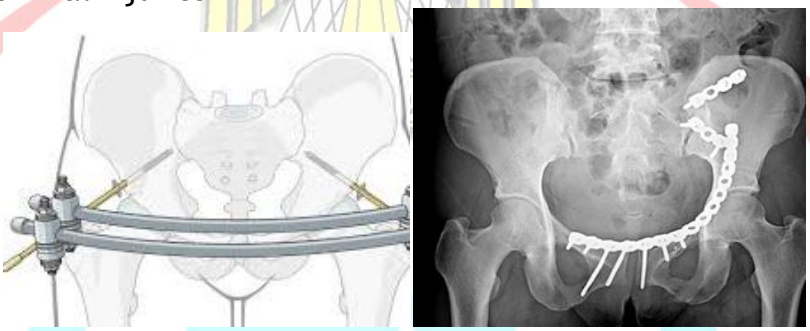


Figure 4: pelvic sheet

Definitive fracture treatment (**Figure 5**)

External fixation: in cases of open fracture or fracture complicated with urinary bladder or abdominal injuries



a **b**

Figure 5 : Pelvic external fixation a internal fixation b

Internal fixation with plates and screws for closed fractures

Complications

- Shock: Hypovolaemic shock due to haemorrhage or neurogenic shock due to severe pain
- Injury to urinary bladder or urethera
- Injury to rectum
- Injury to abdominal organs as liver or intestine
- Associated fracture spine
- Peineal tear
- Pelvic infection
- Fracture non union

Chapter 5

Fracture femur

objectives

- **Provide applied clinical knowledge about femoral fracture as regard diagnosis and management**
- **Special reference to emergency management of femoral fractures**

Overview

The femur is the strongest bone in the body. Fracture shaft femur can occur after major trauma as fall from heights and road traffic accidents

Mechanism of injury

- Direct trauma to the femur
- Indirect trauma as fall from a height on the knee or the foot with the force transmitted to the femur

Classification

I - According to the state of the overlying soft tissue covering the femur (**Figure 1**)

- Closed fracture: Intact soft tissue covering
- Open fracture: Injured soft tissue covering

II - According to fracture location

- Proximal shaft fractures
- Mid shaft fractures
- Distal shaft fractures

a **b** **c**

Figure 1: Proximal fractures **a** mid-shaft fractures **b** distal fracture **c**

III - According to the shape of the fracture

- Transverse fracture
- Oblique fractures
- Spiral fracture
- Comminuted fracture

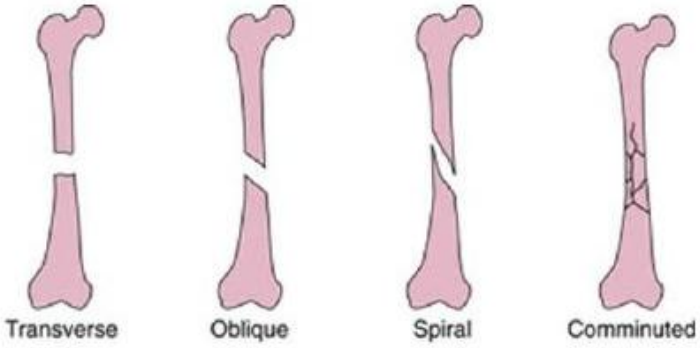


Figure 2: Classification according to fracture shapes

Diagnosis

Clinical diagnosis

History: you can identify the cause of injury and the type of the trauma

Complaint:

- Severe pain
- Inability of weight bearing

Examination

- General examination: assess vital signs (pulse – blood pressure – pallor)
- Thigh swelling
- Limb deformity: Mainly limb shortening and external rotation
- Tenderness and crepitus at the fracture site
- Assess distal pulsations in the foot
- Assess motor function of the limb (motions of the foot and toes)
- Assess the integrity of the skin overlying the fracture

Radiological diagnosis

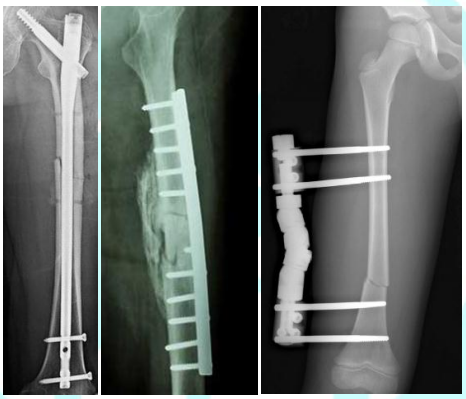
Plain x –ray

- It should include the whole shaft from the hip joint to the knee joint
- Two views are required to show fracture details , anteroposterior and lateral

Treatment

I - Emergency treatment
- Splinting : immediate application of Thomas splint for fracture stabilization
- Immediate correction of shock due to pain or blood loss if present
- Wound debridement in cases of open fractures

I- Definitive treatment (**Figure 3**)
Fracture femur needs surgical treatment
- Closed fractures are treated by internal fixation with intra medullary nails or plates and screws according to fracture shape and location. Shaft fractures are treated by nails while distal fractures are treated with plates
- Open fractures are treated by external fixators.



a b c

Figure 3: Fracture femur fixed with nail (a) plate and screws (b) external fixator (c)

Complications
- Shock: The fracture itself can lead to blood loss up to one liter in closed fractures leading to hypovolaemic shock
- Vascular injury: injury to the femoral artery or vein by a fracture spike
- Nerve injury: sciatic nerve injury can occur with femoral shaft fractures
- Delayed union and nonunion: delayed union is slow union progression while nonunion is failure of union up to 9 months
- Malunion: union in deformed position leading to limb shortening, angulation or rotation.

Chapter 6

Knee injuries

Objectives

Provide applied clinical knowledge about the commonest knee injuries

Overview

Knee injuries are commonly sports related or work related injuries. Recently better outcome of management of these injuries are available since the advent of new methods of diagnosis and arthroscopic management

Cruciate ligaments and menisci play an important role in knee joint function. Injury of these structures is common during participation in sports activities

Tears of the menisci
The knee has two menisci medial and lateral (**Figure 1**). They are 2 pieces of fibrocartilage present between the tibial and femoral condyles. They have important functions as shock absorption and knee stabilization

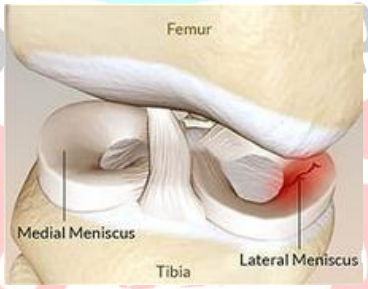


Figure 1: knee menisci

Mechanism of injury: Meniscus tear commonly occurs with knee twisting (the body rotates on the knee with the foot fixed on the ground). The medial meniscus is more fixed than the lateral meniscus so injury to the medial meniscus is more common than the lateral one.

Types (**Figure 2**)
- Longitudinal tear

- Radial tear
- Horizontal tear

Figure 2: Types of meniscal tears

Diagnosis

Clinical

- History of twisting injury
- Recurrent knee pain and effusion
- Locking (catching) : inability to extend the knee completely , this occurs when a torn meniscus segment is entrapped inside the knee joint
- Tender joint line
- Positive Mc Murray test (**Figure 3**): knee pain or click felt at the joint line when the examiner extend the flexed in with applying valgus and external rotation force when testing the medial meniscus and the reverse when testing the lateral meniscus

Figure 3: Mc Murray test

Radiology: MRI clearly defines the meniscal tear

Treatment: done only for symptomatic cases (**Figure 4**)

- Arthroscopic partial menisectomy with removal of only the torn segment is the best current treatment
- Meniscal suturing can be done only for recent tears if the tear is at or near the junction of the meniscus with the joint capsule (outer part) because this part have

good blood supply while the other inner parts have no enough blood supply to heal after repair

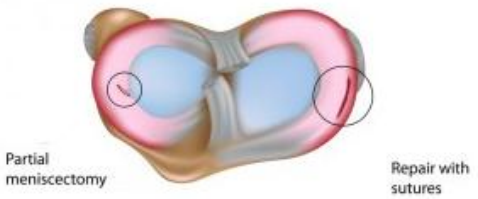


Figure 4 treatment of meniscal tears

Anterior cruciate ligament (ACL) tear

It is a common injury in athletes and manual workers subjected to falls on the ground The anterior cruciate ligament runs obliquely in the middle of the knee (**Figure 5).** It prevents anterior translation of the tibia off the femur and provides rotational stability to the knee.

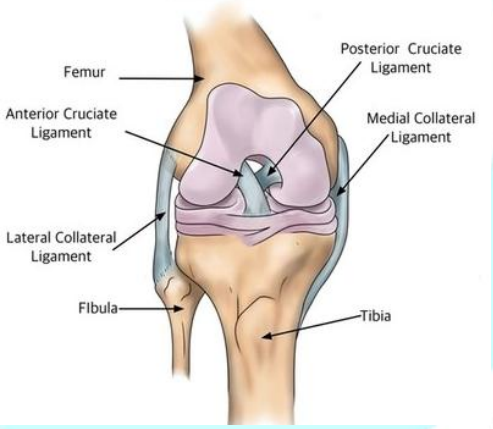


Figure 5: anatomy of the anterior cruciate ligament

Mechanism of injury (Figure 6)

- Sudden change in the direction
- Sudden stopping while running
- Incorrect land from jumping leading to knee twisting

Figure 6: ACL mechanism of injury

Diagnosis

Clinical

- History of trauma
- Knee giving way
- Positive anterior drawer test (**Figure 7**)

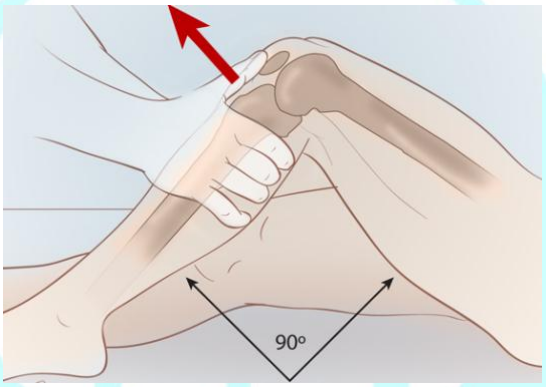


Figure 7: Anterior drawer test

Radiology

MRI is the best method to confirm ACL tear

Treatment

Treatment is indicated only for symptomatic cases presented with knee giving way. Arthroscopic ACL reconstruction of new ACL using semitendinosus and gracilis tendons as a graft is the current best treatment.

Chapter 7

Leg and ankle injuries

Objectives

Provide applied clinical knowledge about the commonest keg and ankle injuries and the best methods of management

Overview

Ankle and leg fractures are critical as any changes in their alignment of ankle joint congruity will lead to persistent disability due limb angulation and shortening or ankle arthritic changes.

Fracture tibia

Mechanism of injury

Direct trauma: Direct blow to the leg as in car accidents or fall of a heavy object on the leg
Indirect trauma: as twisting injuries

Classification (Figure 1)

According to fracture shape
- Transverse fracture
- Oblique fracture
- Spiral fracture
- Comminuted fracture

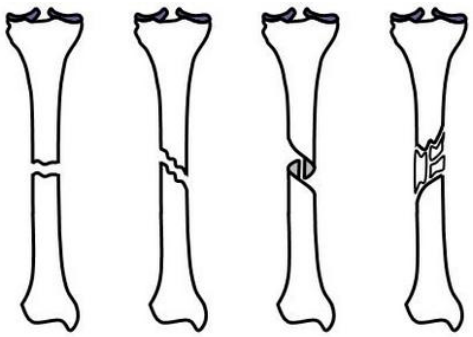


Figure 1: classification of fracture tibia

According to the condition of the overlying skin and soft tissue

- Closed fracture
- Open fracture

Diagnosis

Clinical picture

- History of trauma
- Pain
- Swelling at the fracture site
- Limb deformity: angulation and external rotation of the limb
- Tenderness at the fracture site
- Assess distal pulsations : Dorsalis pedis and posterior tibial pulsations to exclude vascular injury
- Assess motor and sensory function of the limb :sensation distal to the fracture and motions of the ankle and toes should be examined to exclude nerve injury caused by the trauma

Radiology

Plain x –ray (**Figure 2**)

- X –ray film should include the whole leg from the knee joint to the ankle joint
- Two views at least must be done anteroposterior and lateral views

Figure 2: x- ray of fracture tibia

Treatment

Emergency treatment

- Splinting is essential first step in fracture management to stabilize the fracture to decrease pain and prevention of further fracture displacement and soft tissue injury by the fracture fragment
- Wound irrigation and debridement in cases of open fractures

Definitive treatment (**Figure 3**)
- Cast: above knee cast in stable non displaced fractures
- Internal fixation by intra medullary nail or plate and screws for displaced fractures
- External fixation for open fractures

a b c

Figure 3: methods of fixation of fracture tibia (a) intramedullary nail (b) plate and screw (c) external fixator

Complications

- Vascular injury: injury to the anterior or posterior tibial artery by a fracture spike
- Nerve injury: common peroneal nerve or posterior tibial nerve injury can occur with leg fractures
- Delayed union and nonunion: delayed union is slow union progression while nonunion is failure of union up to 6 months
- Malunion: union in deformed position leading to limb shortening, angulation or rotation.

Malleolar fracture (pott`s fracture)

This type of fracture includes fracture of the medial malleolus or lateral malleolus or both

Mechanism of injury (Figure 4)

- Twisting ankle injuries
- Inversion ankle injuries
- Eversion ankle injuries

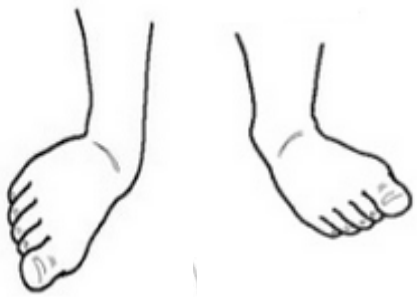


Figure 4: Mechanism of ankle fractures (a) eversion injury (b) inversion injury

Diagnosis

Clinical

- History of trauma
- Pain and tenderness at the fracture site
- Ankle swelling
- Inability of weight bearing
- Examine skin carefully to detect open fractures

Radiology (**Figure 5)**

- Plain x –ray: Anteroposterior and lateral views
- CT is needed in some cases as comminuted fractures for more details about the fracture

Figure 5

Treatment

- Initial patient splinting to decrease pain , swelling and prevent further fracture displacement
- Wound irrigation and debridement in cases of open fractures
- Surgical treatment by open reduction and internal fixation of the fracture is needed in most cases (**Figure 6)**

Figure 6: internal fixation of ankle fracture with plate and screws

Complications

- Delayed union or nonunion
- Improper reduction leading to malunion and later ankle osteoarthritis

Chapter 8

Bone deformities

Objectives

Provide applied clinical knowledge about various bone deformities as regard the etiology and the diagnosis

Overview

Numerous bony deformities exist. They should be identified, well diagnosed and corrected to prevent later handicapping with growing

In the human body both the upper limb and the lower limbs are straight except some mild physiological variations present near the joints. Any disturbances in this alignment results in limb deformities
Limb deformities are either

1. Angular
2. Rotational
3. Limb shortening

Angular deformities

In the frontal plane: valgus and varus deformities (**Figure 1**)
Varus deformity is present when there is lateral agulation at the site of the deformity and the limb distal to the deformity is deviated medially
Valgus deformity is present when there is medial agulation at the site of the deformity and the limb distal to the deformity is deviated laterally

a b c

Figure 1: a normal alignment b valgus alignment c varus alignment

Common examples of frontal plane deformities are genu (knee) valgum and varum and cubitus (elbow) valgum and varum

In the sagittal plane: procurvatum and recurvatum deformities (**Figure 2**)
Procurvatum deformity is present when there is anterior agulation at the site of the deformity and the limb distal to the deformity is deviated posteriorly
Recurvatum deformity is present when there is posterior angulation at the site of the deformity and the limb distal to the deformity is deviated anteriorly

a b

Figure 2: Recurvatum (a) and Procurvatum deformities (b)

Common examples of sagittal plane deformities are leg recurvatum and procurvatum

Common cause of angular deformities

1. Malunited fractures
2. Bone softening diseases as rickets
3. Abnormal growth due to injury or infections of the growth plate since childhood

Rotational deformities

Normally humans walk in straight line and there may be mild external rotation of the lower limb during walking. This is physiological variation. Any deviation from this is called rotational deformity which may be external rotation or internal rotation deformity.
Foot progression angle (**Figure 3**): it is the angle between the line of progression of walking and the straight line. Normally it is zero or externally rotated up to 15 degrees.

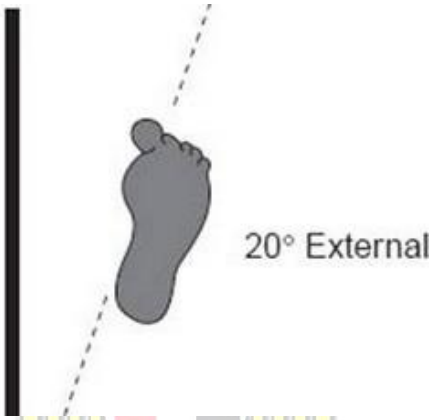


Figure 3: Foot progression angle

Common examples of rotational deformities are in toe and out toe gait in children

Common causes of rotational deformities

1. Malunited fractures
2. Congenital

Limb shortening

In humans both lower limbs should be exactly similar in length. Difference in length is known as limb length discrepancy. Minor variations in limb length up to 1.5 cm can be compensated by the lumbar spine and the pelvis while limb length discrepancy more than 1.5 cannot be compensated and abnormal gait will occur.

The short limb cannot reach the ground at the same time as the healthy limb, to do that the spine should deviate laterally and the pelvis should drop (**Figure 4**) to allow the short limb to touch the ground at the same time as the normal limb, with time this will case chronic low back pain and back deformity

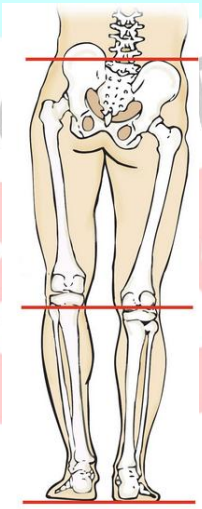


Figure 4: Body compensation for limb length discrepancy

Common causes of limb length discrepancy

1. Malunited fracture in shortening
2. Growth arrest due to trauma or infection of the growth plate

Chapter 9

Congenital Orthopaedic Disorders

Objectives

Provide applied clinical information about the most common congenital orthopaedic disorders

Overview

Many congenital anomalies can affect the skeletal system. They are responsible for handicapping of a large number of populations. Any part of the skeleton can be affected. There are many anomalies which are common as club foot and developmental hip dysplasia

Club foot (Talipes Equino Varus)

It is foot deformity present at birth with incidence of 1:1000
It is more common in conditions that make the uterus tight as first child and twins
It is composed of (**Figure 1**)

- Inversion of the heel
- Equines (flexion) of the hind foot due to tight and short Achilles tendon
- Adduction of the forefoot

Figure 1: Foot deformities of club foot

Types

According to the severity of the deformity it is classified into three types
I – mild deformity that can be fully corrected passively by hand
II – moderate deformity that is only partially corrected by hand
III – severe deformity which is not corrected passively

Pathology: The condition occurs due to short ligaments and tendons of the foot not due to bony abnormalities

Treatment

In the first three months manual correction of the deformity by derail stretching and casting. This method of treatment is valid till the age of three months after that manual stretch will be harmful to the patient
After three months surgery is indicated. Surgery is done by tendon lengthening and ligament release with realignment of the abnormally positioned bones to correct the deformity
It is preferable to delay surgery till after the age of nine months for the tight structures to be more developed to facilitate surgery

Developmental dysplasia of the hip (DDH)

It is abnormal formation of the femoral head or acetabulum making one or both of them of abnormal size or orientation to be engaged with each other
This condition may be present before birth (congenital) or after birth (developmental)

Diagnosis
Clinical
- Shortened limb if the case is unilateral
- Asymmetric thigh folds (**Figure 2**)
- Abnormal gait

Figure 2: asymmetric thigh folds

Radiology
- Ultrasound can diagnose early hip dislocation before plain x- ray
- Plain x- ray is helpful after 3 months which can show hip dislocation (**Figure 3**)

Figure 3: dislocated hip joint

Treatment

At birth: use double napkins or abduction brace (**Figure 4**) that keep both thighs widely abducted to help to reduce the femoral head in the acetabulum

Figure 4: abduction brace

In the first six months: closed reduction and application of cast to maintain the reduction of the femoral head within the acetabulum

After 6 months; surgical treatment is indicated by open reduction of the femoral head

Chapter 10

Bone tumors

Objectives

Provide applied clinical knowledge about different types of bone tumor with special emphasis on differentiation benign form malignant lesions

Overview

Not all bone tumors are lethal with the introduction of the recent methods of diagnosis , chemortherapy and radiotherapy and better surgical techniques life expectancy of patients with malignant bone tumors much improves

Introduction

► Origin of bone tumors

- Primary bone tumors: Tumors arising from bones
- Secondary bone tumors: tumors arising elsewhere in the body and spread to bone e.g. liver tumor (hepatoma) spreads to bone producing secondary bone tumor

► Classifications

Bone tumors are classified as benign, benign with aggressive nature and malignant

- Benign bone tumors do not spread outside the diseased segment of bone
- Malignant tumors are able to spread to other parts of the affected bone and outside the bone to various body organs (**Bone metastasis**) as liver, kidney, lungs and bone marrow
- Benign tumors with aggressive nature : they are benign lesions (cannot spread) but they have rapid growth and can cause significant local destruction much more than ordinary benign lesions

► Location of bone tumors (Figure 1)

Each bone tumor has specific location in bone. This location is characteristic for that lesion

- Epiphyseal tumors: Giant cell tumor and chondroblastoma

- Metaphyseal tumors : osteosarcoma and aneurismal bone cyst
- Diaphyseal tumors : Ewing sarcoma and fibrous dysplasia

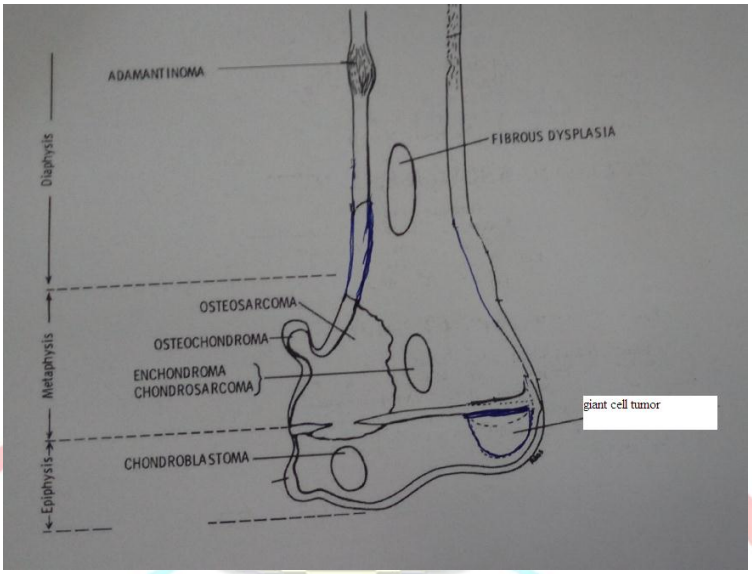


Figure 1

► **Diagnosis of bone tumors**

Clinical picture

- Pain: variable according to the type of the tumor. It may be mild pain in benign lesions to severe agonizing pain in malignant lesions
- Swelling: present at the site of the lesion
- Fracture: due to bone weakening at the site of the lesions
- Systemic manifestations : pallor , weakness , hematuria , hemoptysis , ascitis or jaundice in cases of metastasis of malignant lesions

Radiological diagnosis (**Figure 2**)

Plain x – ray: it can show

- The site of the lesion: Epiphyseal , Metaphyseal or Diaphyseal
- The number of lesions: single or multiple
- The nature of the lesions: benign lesions are usually well defined with well-marked borders with no extension outside the bone while malignant lesions are ill defined , the borders are faint and are commonly destructive and extends outside the bone

a b

Figure 2: (a) Benign bone tumor (b) malignant bone tumor

CT (computerized tomography): shows better details about the nature of the lesion as regard location and limits within the bone (**Figure 3**)

Figure 3: CT of benign lesion

MRI: It is important to show the extension of the lesion into the soft tissue surrounding the bones as muscles and ligaments, so it is important to differentiate benign from malignant lesions (**Figure 4**)

Figure 4: MRI of benign lesion shows no extension of the lesion outside the bone

Bone scan: injection of radioactive dye intravenous and tracing it throughout the skeleton special camera (gamma camera). It helps to detect bone metastasis (**Figure 5**)

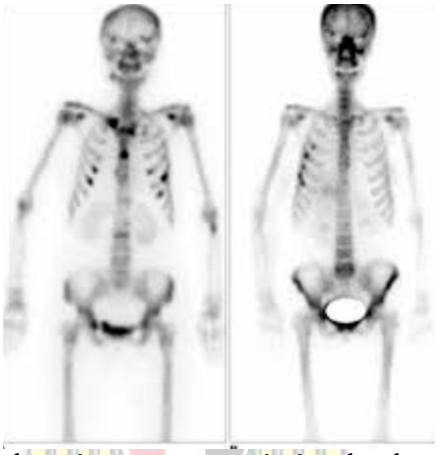


Figure 5: Bone scan showing metastasis in the bones of the chest wall

Laboratory diagnosis

- CBC : Bone marrow depression in malignant tumors can lead to anaemia or pancytopenia
- Liver functions: Disturbed liver functions can occur in cases of metastasis to the liver
- Kidney functions: Disturbed liver functions can occur in cases of metastasis to the liver
- Urine analysis: Marked proteinuria can occur in some bone marrow tumors as multiple myeloma
- Serum calcium : It is elevated in bone destructive lesions which result in freeing of calcium to the circulation

Treatment of bone tumors

Treatment differs according to the nature of the lesion whether benign or malignant

- Benign lesion are treated by curettage with or without bone graft
- Malignant lesions are treated by excision of the lesion with safety margin with or without chemotherapy or radiotherapy according to the nature of the lesion

Chapter 11
Low back pain

Objectives

Identify different types of back pain, diagnosis and management of each type

Overview

Back pain is a common disabling disorder. It accounts for high percent of sick leave and retirement among workers all over the world.

The lumbar spine is composed of 5 vertebrae separated from each other by the intervertebral disc. The vertebra is composed of vertebral body, spinous process, transverse process, pedicle, lamina and facet joints (**Figure 1**)

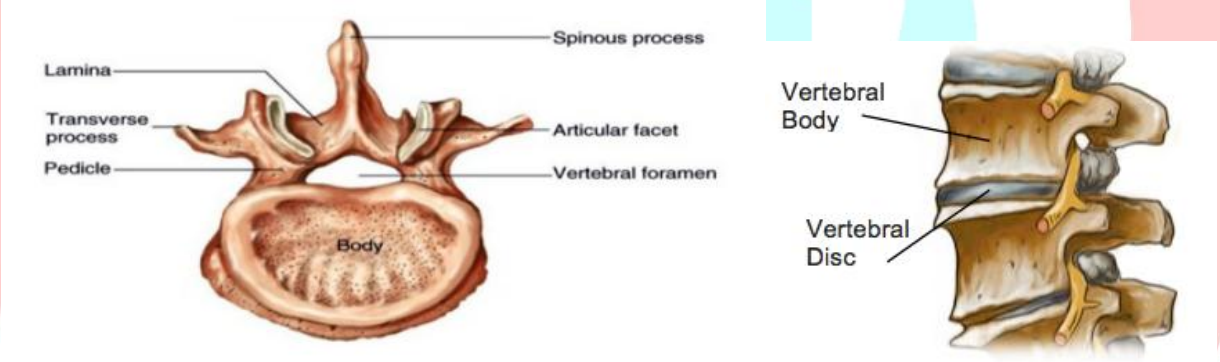


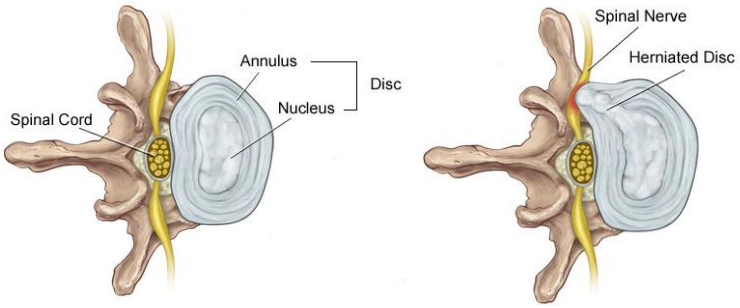
Figure 1: The lumbar vertebra and disc

Back pain is a common disabling disorder. It accounts for high percent of sick leave and retirement among workers all over the world.
Common causes of back pain are

- Disc prolapsed
- Spondylosis
- Spondylolysis and spondylolisthesis

Lumbar disc prolapsed

Painful back disorder caused by rupture of the intervertebral disc. Disc rupture is common after minor trauma as leaning of lifting heavy objects. Disc rupture (**Figure 2**) is often predisposed by disc degeneration.



a b

Figure 2: (a) normal disc (b) disc prolapsed

Diagnosis: The patient is usually presented by low back pain either acute or gradual over a long time. There is usually lower limb pain unilateral or bilateral with tingling and numbness.
Positive straight leg raising test is an important diagnostic sign
MRI is essential for diagnosis of disc prolapse (**Figure 3**)

a **b**

Figure 3: Normal disc a **Disc prolapse b**

Treatment
Conservative treatment: Rest, back support, anti-inflammatory medications and physical therapy
Surgery: is indicated with failure of conservative treatment, in presence of motor weakness due to nerve root compression by the disc or disc prolapsed complicated by urine retention (cauda equine syndrome)

Lumbar spondylosis

Arthritic changes in the vertebral bodies and facet joints. Arthritic changes occur as the result of aging or due to heavy work as in manual workers
With aging or heavy work the disc loses its water content so it becomes stiff and loses its height. Stiff disc leads to loss of its shock absorbing function leading to damage of other components of the vertebra as vertebral bodies and facet joints leading to arthritic changes and osteophyte formation (small bony spurs formed at the areas of degeneration)
Loss of disc height leads to narrowing of the disc space with nerve root compression

Diagnosis

Clinical

- Low back pain usually after exertion
- Back stiffness in the morning after getting up from sleep or after a period of rest
- Lower limb pain, tingling and numbness if there is nerve root compression due to disc space narrowing

Radiology

Plain x- ray: shows narrowing of the disc spaces and osteophyte formation (**Figure 4**)
MRI: can show disc degenerative changes as loss of water content and height loss

Figure 4: x- Ray of lumbar spondylosis showing narrowing of the disc spaces and osteophytes formation

Treatment
Conservative: rest, back brace, physical therapy and medical treatment as anti-inflammatory drugs and muscle relaxants
Surgical treatment: nerve root decompression by removal of the compressing osteophytes if there is nerve root compression

Spondylolisthesis

It is forward displacement of a vertebra over the lower one

Causes

- Isthmic: Presence of a gap or defect in a part of the vertebra called pars inter articularis (**Figure 5**) allowing forward displacement of the vertebra. The presence of this defect without vertebral displacement is known as spondylolysis
- Degenerative: occurs due to facet joint degeneration and sublaxation allowing forward displacement of the vertebra
- Congenital: under developed facet joints allowing forward displacement

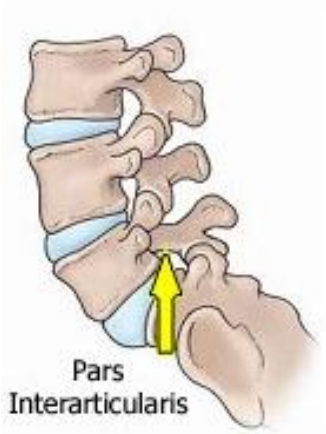


Figure 5 : pars inter articularis

Diagnosis

Clinical

- Low back pain, mechanical in nature that increases by activity and relieved by rest
- Increase lumbar lordosis due to abnormal forward displacement of the vertebra
- Lower limb tingling and numbness if there is nerve root compression due to associated disc herniation

Radiology

Plain x- ray: shows vertebral displacement and can show pars defect (**Figure 6**)

CT: is the best method to show pars defect

MRI: shows disc changes and root compression associated with spondylolithesis

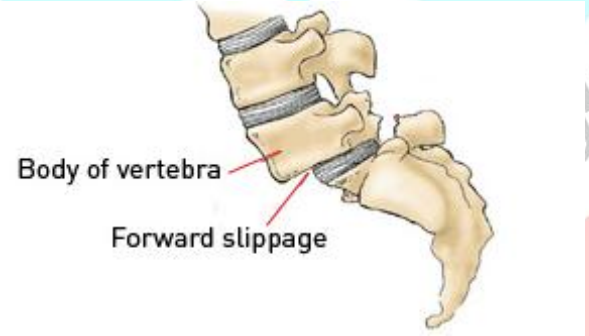


Figure 6: Forward slipping of a vertebra with pars defect

Treatment

- Conservative treatment; weight reduction , muscle strengthening , physical therapy and anti -inflammatory medications
- Surgical treatment in case of failure

Chapter 12
Foot Disorders

Objectives

Provide basic and clinical information of common types of foot disorders as regard their pathology, diagnosis and treatment

Overview

There are many foot disorders that cause foot pain and interfere with normal walking. These disorders may be related to foot deformities as flat foot, inflammatory conditions as gout, and degenerative changes as planter fasciitis or foot arthritis and foot tumors

Planter fasciitis

Planter fasciitis is the commonest cause of heel pain in adults
It occurs due to degeneration of the planter fascia at its attachment with the calcaneus (**figure 1a**). It occurs as the result of overuse due to prolonged standing especially when using hard shoes. The condition is predisposed by obesity
Repeated traction of the planter fascia on the calcaneus leads to appearance of bony spur at the inferior aspect of the calcaneus known as calcaneal spur (**figure 1b**)

a **b**

Figure 1: a planter fasciitis b calcaneal spur

Diagnosis
Heel pain is commonly in the morning on the first steps after getting up from sleep. This pain is relived after short distance of walking but re-appears again after prolonged standing and walking

Tender inferior heel at the site of attachment of planter fascia to the calcaneus
Radiology
Plain x- ray may show no abnormality or show calcaneal spur of variable size

Treatment
Conservative: soft shoes, anti- inflammatory drugs and local corticosteroid injection
Surgical: division of part of planter fascia with removal of the spur. Surgical treatment is rarely needed

Flat foot

It is depression or absence of the arch of the foot so that the medial border of the foot touches the ground (**Figure 2**)

a **b**

Figure 2: a normal arch b flat foot

Causes

- Hyper laxity of the ligaments of the foot
- Destruction of the joints of the mid foot by trauma or diseases as rheumatoid arthritis
- Diabetic foot

Diagnosis
Absent medial arch of the foot (**Figure 3a**)
Foot pain on prolonged standing and walking
Valgus alignment of the heel (medial angulation of the heel) (**Figure 3b**)

a **b**

Figure 3

Treatment
Conservative treatment: weight reduction, muscle strengthening and arch support (**Figure 4**)

Figure 4: Arch support

Surgical treatment
It is indicated if conservative treatment fails. Realignment of the foot and fusion of the damaged joints is the surgical method of choice in most cases

Gout

It is deposition of uric acid crystals elsewhere in the body. The foot is a common site for gout

Causes

- Increase uric acid production secondary to defect in protein metabolism (over production)
- Decrease uric acid excretion by the kidney (under excretion)

Diagnosis
Clinical picture

- The commonest site affected is the metacarpo phalangeal joint of the big toe , other parts of the foot can be affected as the heel , other toes and the ankle joint
- Inflammatory signs of the affected joints are present as pain, tenderness , swelling , redness and swelling

Laboratory

- Increase serum uric acid levels above normal (Normal 3 – 7)
- Increase ESR in acute conditions

Treatment

- Diet control: Reduce types that increase uric acid as meat, beans, coffee and cola
- Drugs that lower uric acid production and increase uric excretion
- Analgesics and anti - inflammatory medications in cases of acute attack
- Wide and soft shoes.

Chapter 13
Hand Disorders

Objectives

Provides basic and applied clinical information about common hand disorders as regard their pathology, diagnosis and treatment

Overview

The hand has the most critical functions of the skeletal system. It has a tactile function, fine and coarse motor functions.

Carpal tunnel syndrome

Median nerve compression in the carpal tunnel (**Figure 1**)

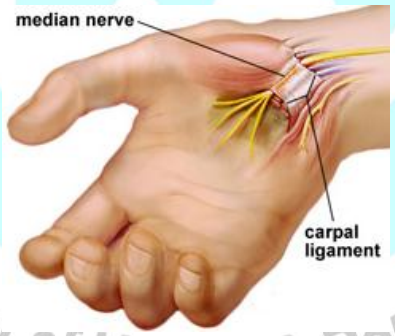


Figure 1: The median nerve within the carpal tunnel

Causes

- Tendon inflammation (tenosynovitis) and swelling in the carpal tunnel around the median nerve
- Space occupying lesions as lipoma or ganglion in the carpal tunnel
- Soft tissue edema as in pregnancy

Diagnosis

Tingling and numbness are present in the fingers supplied by the median nerve (**Figure 2**) (thumb, index and ring fingers and half of the ring finger). Tingling increase by night and may awaken the patient from sleep and also increase with repetitive hand activities

Diagnosis is confirmed by nerve conduction velocity testing and electromyography
The condition should be differentiated from cervical disc prolapse causing pressure on c6 nerve root and peripheral neuropathy which can cause similar symptoms

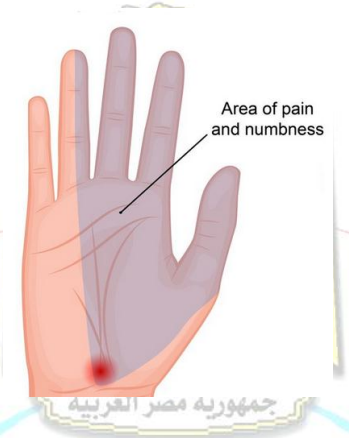


Figure 2: area supplied by the median nerve

Treatment

- Conservative treatment: hand rest , medical treatment as anti - inflammatory drugs and neurotonics , night splint and local corticosteroid injection
- Surgical treatment: release of the carpal tunnel if conservative treatment fails

Trigger fingers

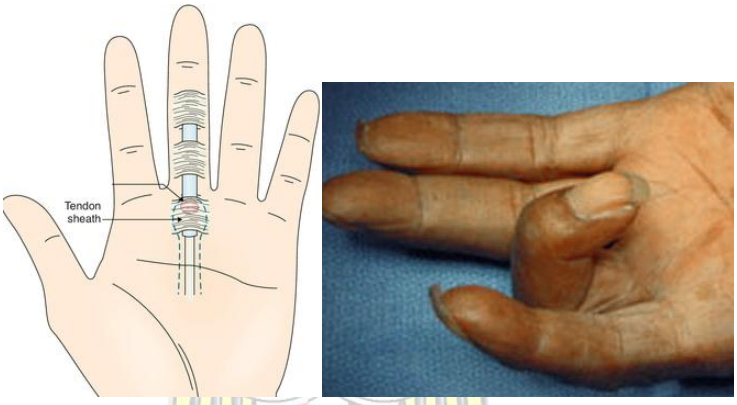
It is thickening and constriction of the tendon sheath interfering with normal gliding motion of the tendon

Causes

- Idiopathic
- Overuse
- Rheumatoid arthritis

Diagnosis

- Pain and tenderness over the thickened tendon sheath commonly over the palmer aspect of the metacarpophalangeal joint
- Finger triggering



a b

Figure 3: (a) inflamed tendon sheath (b) locked finger in flexion

Treatment

- Conservative treatment; rest, medical treatment as anti-inflammatory drugs and local corticosteroid injection
- Surgical treatment: release of the constricting tendon sheath

De Quervain disease

It is pain over the radial styloid process due to fibrosis and constriction of the sheath of abductor pollicis longus and extensor pollicis brevis tendons passing over the radial styloid process (**Figure 4**)

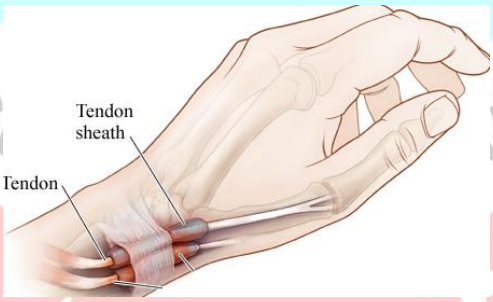


Figure 4: inflamed tendon sheath over the radial styloid process

Causes

- Idiopathic
- Overuse
- Rheumatoid arthritis

Diagnosis

- Pain over the radial styloid aggravated by wrist ulnar deviation with thumb flexion and adduction (Figure 5)
- Tender nodule over the radial styloid

Figure 5

Treatment
Conservative: rest, thumb brace, anti-inflammatory medications, local corticosteroid injection
Surgical: surgical release if conservative treatment fails.

Ganglion

Cystic swelling commonly presents at any part of the wrist or hand but commonly on the dorsum of the wrist. This cyst contains viscous clear fluid and has a wall of fibrous tissue (**Figure 6**)

Figure 6: Ganglion on the dorsum of the wrist

Causes: It is a benign tumor of the tendon sheath or joint capsule

Diagnosis

- Cystic swelling, sometimes it feels tense if it is full of fluid
- Mild pain around the ganglion

Treatment

- Usually no treatment is needed unless with large ganglion causing pain or compression a nearby nerve
- Treatment is done by ganglion aspiration or excision

Book Coordinator ; Mostafa Fathallah

General Directorate of Technical Education for Health