Samara university
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Seminar on; Fracture and principles of its management

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OUTLINE

- Definition
- Classification
- Bone healing
- Approach to a patient with fracture
- Investigation and Diagnosis
- Management principles
- Complication
- Reference

FRACTURE

- Is a break in the structural continuity of the bone.
- Failure of the bone to respond to a high impact, which can be direct or indirect.
- Associated injuries to the adjacent soft tissues (ligaments, tendons, etc.)

CLASSIFICATION

- To recommend treatment
- Speak a common language
- Predict outcomes.

- Fracture can be classified according to
  - *The etiology*
  - *Communication to the exterior*
  - *The pattern of the fracture line*
  - *Extent of the fracture*
  - *Displacement*
  - *Management*

CONT…

According to Etiology

1. Traumatic fractures

- The mechanism of injury

A . Direct -the forces are concentrated at one site and, therefore, the bone fails at the point of impact.

- ✓ Are often comminuted and may be associated with significant soft tissue injuries

B .Indirect mechanisms

- Force causing the fracture is applied at a distance from site of fracture.
- Associated damage to soft tissues may not be much

2 .Pathological fractures

- Such fractures occur with trivial trauma
- The bones are already weakene by a disease process such as malignancy, infection ,metabolic disease, disuse, osteoporosis
- The patient may give a history o local pain or discomfort prior to fracture



CONT…

3 .Stress fractures

- caused by repetitive trauma, usually following unusual activities
- Pain, especially on weight bearing, is the commonest presenting complaint
- Can be treated with analgesia and rest

CONT…

According to Communication of the fracture with the exterior

1. Closed (simple) fracture

2. Open(compound) fracture

GUSTILO AND ANDERSON OPEN FRACTURES CLASSIFICATION

Type	Wound	Level of Contamination	Soft Tissue Injury	Bone Injury
I	<1 cm long	Clean	Minimal	Simple, minimal communition
II	>1 cm long	Moderate	Moderate, some muscle damage	Moderate communition
III				
A	Usually >10 cm long	High	Severe with crushing	Usually comminuted; soft tissue coverage of bone possible

B	**Usually >10 cm long**	**High**	**Very severe loss of coverage; usually requires soft tissue reconstructive surgery**	**Bone coverage poor; variable, may be moderate to severe comminution**
C	Usually >10 cm long	High	Very severe loss of coverage plus vascular injury requiring repair; may require soft tissue reconstructive surgery	Bone coverage poor; variable, may be moderate to severe comminution

TSCHERNE CLASSIFICATION OF CLOSED FRACTURES

- **Grade 0:** Injury from indirect forces with **negligible soft tissue damage**

- **Grade I:** Closed fracture caused by low to moderate energy mechanisms, with **superficial abrasions or contusions of soft tissues** overlying the fracture

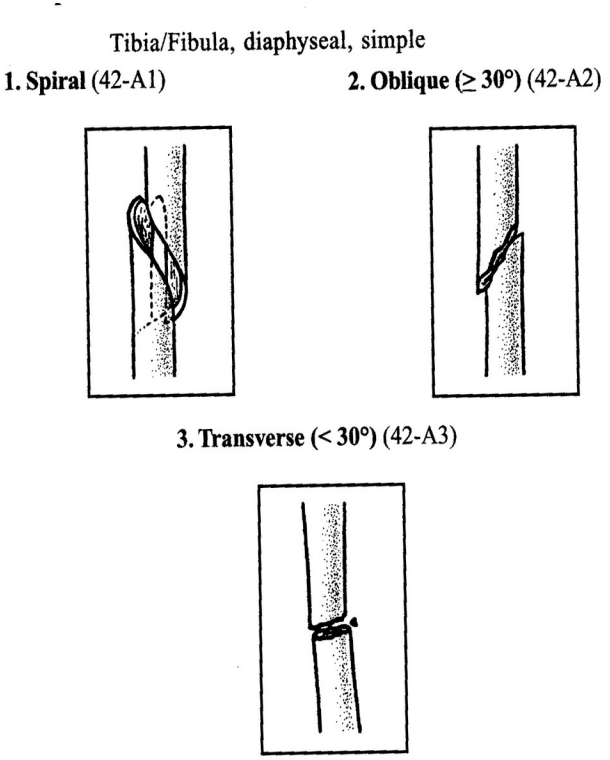
- **Grade II:** Closed fracture with **significant muscle contusion, with possible deep, contaminated skin abrasions** associated with moderate to severe energy mechanisms and **skeletal injury; high risk for compartment syndrome**

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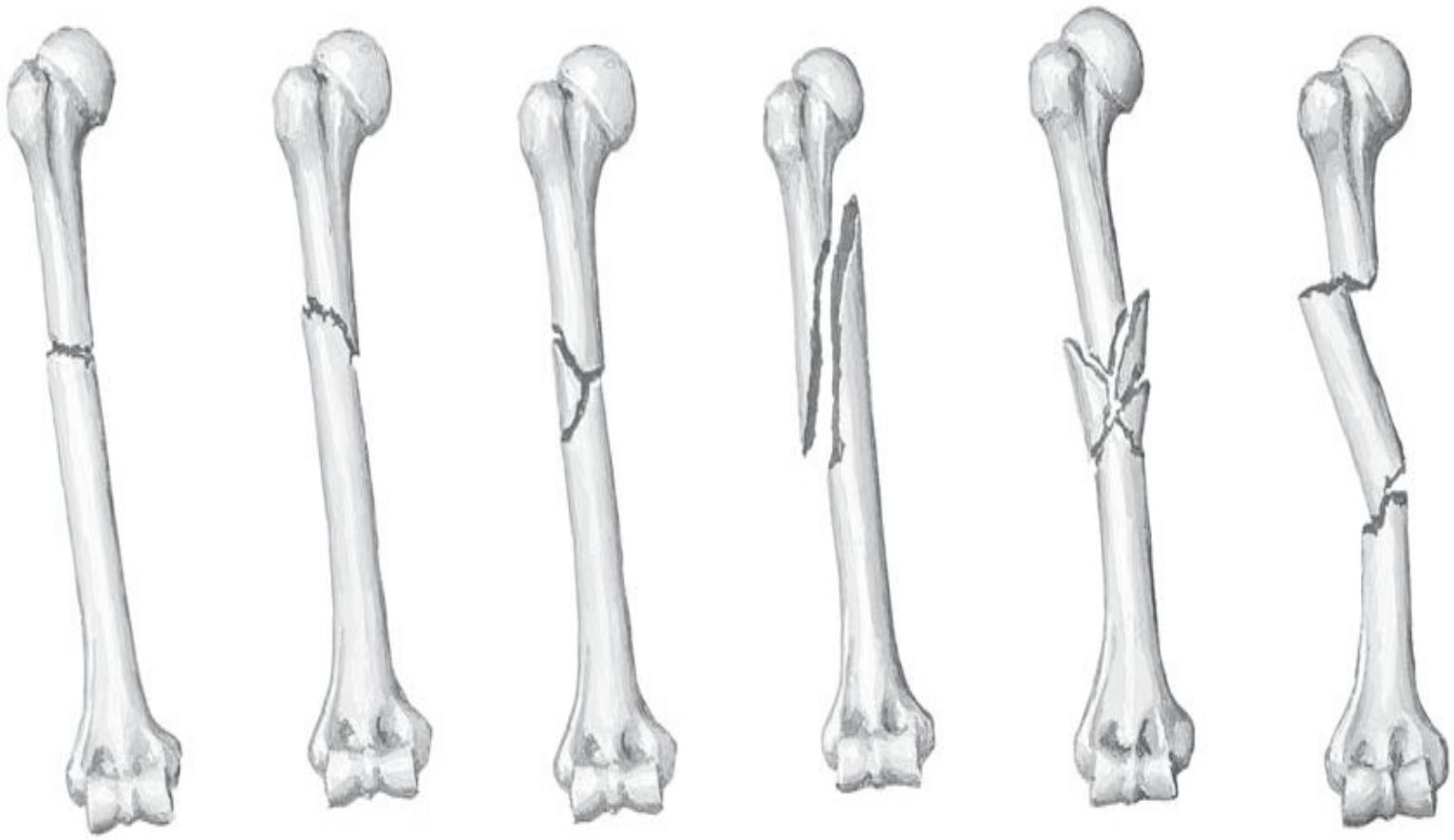
- **Grade III:**
  - **Extensive crushing of soft tissues**, with subcutaneous **degloving or avulsion**, and **arterial disruption or established compartment syndrome**

According to the pattern of the fracture line

- **Simple**
  - Transverse(less than 30
  - Oblique(greater than 30
  - Spiral
- **Wedge**
- **Complex**
  - Segmental
  - Communited



CONT…



Transverse oblique wedge

Spiral Communited segmental

CONT…

According to Extent of Fracture

1. Complete fractures
2. Incomplete fractures:
    - Fissure fracture
    - Greenstick fracture
    - Compression fracture

According to amount of displacement

- Un displaced
- Displaced
    - Minimally
    - Completely

CONT…

According to Management

1. Stable fracture E.g. a transverse fracture

2. Unstable fracture E .g. a comminuted fracture

OTHER CLASSIFICATIONS

- ***Location:*** proximal , middle , distal , or neck, trochanteric , condoyle

- **Articular (joint) involvement** : intra articular, or extra articular

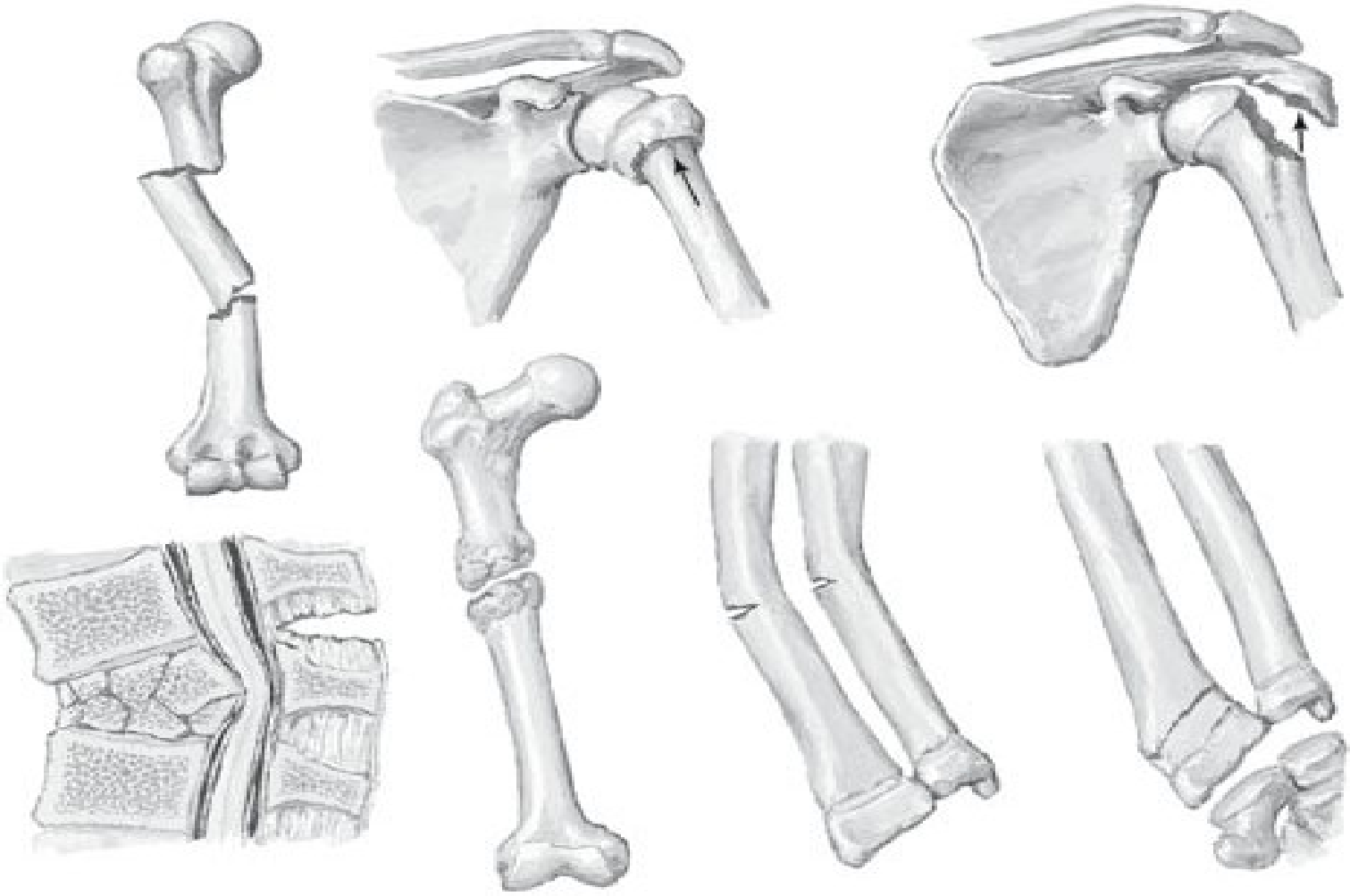
SPECIAL TYPES OF FRACTURE

- Incomplete Fractures -typical in a child, it traverses only a portion of the bone. Two variations have been described:

1. Greenstick fracture: This occurs on the tension side of the bone and involves the diaphysis or cortical bone.

2. Torus or buckle fracture: Known by either name, this occurs on the compression side of bending and involves cancellous bone.

CONT…



Greenstick fracture **Buckle fracture**

DESCRIPTION

A good description needs the following components:

1) Name the injured bone;
2) Give the region of the bone;
3) Is the fracture simple or multi fragmentary;
4) Describe the direction of the fracture line: transverse, oblique or spiral;
5) Are the fragments displaced or un displaced;
6) If displaced, describe the alignment, length and rotation;
7) Note any evidence of pre-existing pathology;
8) Any associated joint dislocation

FRACTURE MODE OF LOADING

- Bending loading produces a transverse fracture
- Torsional loading produces a spiral fracture
- Axial loading produces a compression or impacted fracture
- Tensile loading produces an avulsion fracture
- Combined loading, such as bending and axial loading, which together produce an oblique fracture.

BONE HEALING

Direct (primary) bone healing

- Occurs without callus formation.
- It is part of the normal process of remodelling with cutting cones crossing the fracture and new lamellar bone being laid down behind them.
- Occur when the fracture ends are closely opposed and there is no relative movement between them.
- This occurs after rigid internal fixation of fractures and takes up to a year to complete.

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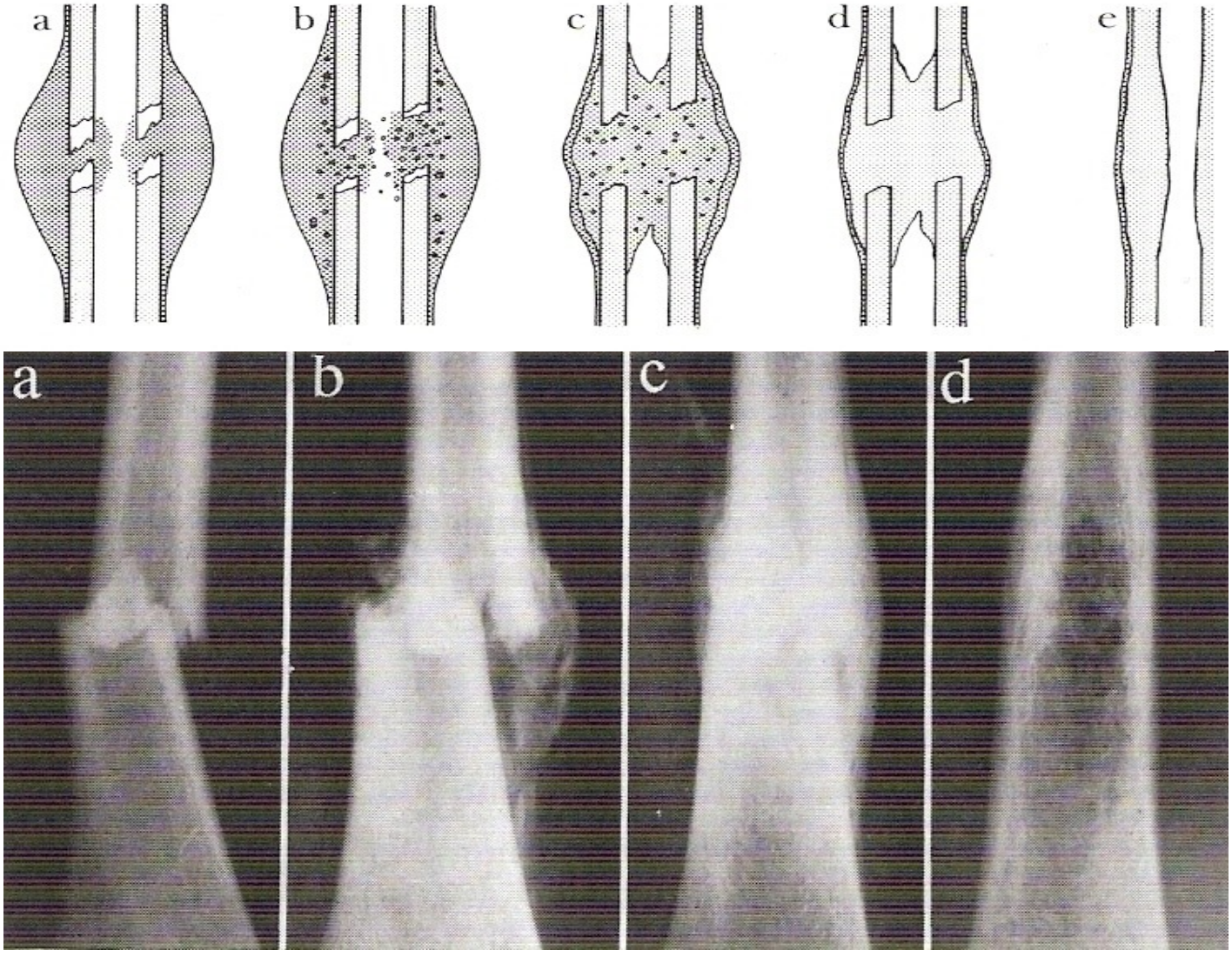
Indirect (secondary) bone healing

- occurs with a callus precursor
- Is referred to as enchondral ossification.
- It tends to occur when the bone ends are not perfectly aligned and when there is some movement at the fracture site during the healing process.
- Such secondary bone healing is broadly characterized by following phases:

PHASES OF FRACTURE HEALING:

- Tissue death and hematoma formation
- Inflammation and cellular proliferation
- Callus formation
- Consolidation & Remodeling

FRACTURE HEALING



FACTORS INFLUENCING FRACTURE HEALING

Local:

- Infection
- Movement
- Inter positioning of soft tissue or foreign body b/n fracture ends
- Local blood supply

  E.g. femoral neck fracture

Systemic:

- Age
- Anemia
- Nutritional deficiency

  E.g. Vitamin C
  vitamin D
- Metabolic disorders like DM
- Peripheral arterial disease
- Hypertension
- Drugs,smooking

APPROACH TO PATIENT WITH FRACTURE

- Principles of Trauma management -Advanced trauma life support (ATLS)

1.The primary survey and resuscitation

A. Air way ,cervical spine

B. Breathing

C. circulation

D. Disability -neurological exam-

- ***level of consciousness(GCS)***
- ***pupil exam (size and reaction)***
- ***Deformity/weakness***

E. Exposure/Environment

CONT…

2 . **The secondary survey**

- History

- Physical examination

- Investigations

- Definitive treatment

- The patient should be optimally resuscitated before any fracture treatment is considered

CONT…

HISTORY

- ✓ Age
- ✓ Sex
- ✓ Occupation
- ✓ History of Trauma
  - **Mechanism of injury**
  - **Pattern and site**
  - **Degree of violence**
  - **Concomitant injuries (head injuries)**
- ✓ Pain ,Swelling and inability to use the affected limb (weakness)
- ✓ Loss of consciousness and bleeding

CONT…

- History of chronic disease
- Drug use
- Immunization history

CONT…

PHYSICAL EXAMINATION

- General appearance
- Vital signs
- HEENT
- Systemic examination

MSS:

A. LOOK :

- For any obvious injury
- Bruising of Overlying skin
- spinal injury
- swelling, bleeding
- Deformity, Limb shortening
- Muscle fasciculation
- Adjacent joint

B. FEEL

- **Peripheral sensation**
  - Temperature
  - Pain
  - Touch
  - pressure
  - Peripheral pulses
- **Tenderness**
- **Swelling**

c. MOVE:

- **Active and passive**

  - No attempt should be made to elicit abnormal mobility in a fractured bone

  - Joint movements should only be tested if patients can perform them actively without much discomfort

- Measure(true , real , and apparent length)
- Compare

CONT…

- *Real Length:*
  - This is a measure from two prominent points of a single bone.
  - Shows real shortening of that specific bone.

- *True Length:*
  - This is a measurement from two prominent points of the lower limb, e.g. the anterior superior iliac spine and the medial malleolus of the same limb in a supine position.

- *Apparent Length:*
  - This is a measure with a reference taken from the midline by using the umbilicus to a fixed bony landmark such as the medial malleolus. It measures a discrepancy in pathologic conditions of the hip without a difference in true leg length

SURE SIGNS OF FRACTURE:

- DEFORMITY
- LENGTH DESCRIPANCY
- VISIBLE FRACTURE
- ABNORMAL MOVEMENT
- CREPITUS

INVESTIGATION:

- CBC, BLOOD GROUP ,RH, cross match , random blood sugar , urinalysis

- **Skeletal X- RAY**

Rule of two:

- ✓ *Two views (AP & Lateral)*
- ✓ *Two Joints*
- ✓ *Two Occasions(before and after manipulation)*
- ✓ *Two Limbs(in children b/se growth may seem fracture)*

- CT –for unstable thoracolumbar spine

- Angiography

- Arthroscopy

PRINCIPLES OF FRACTURE MANAGEMENT

- Five ‘R’
  - **Resuscitation**
  - **Recognize**
  - **Reduction**
    - Open
    - Closed
      - Manipulation
      - Traction
      - Gravity
  - **Retention**
    - Traction /Gravity
    - External splints
    - Internal fixation
    - External fixation
  - **Rehabilitation**

CON…

- The basic principles of fracture treatment are appropriate **reduction**, **immobilization, follow fracture healing,** and **early rehabilitation**

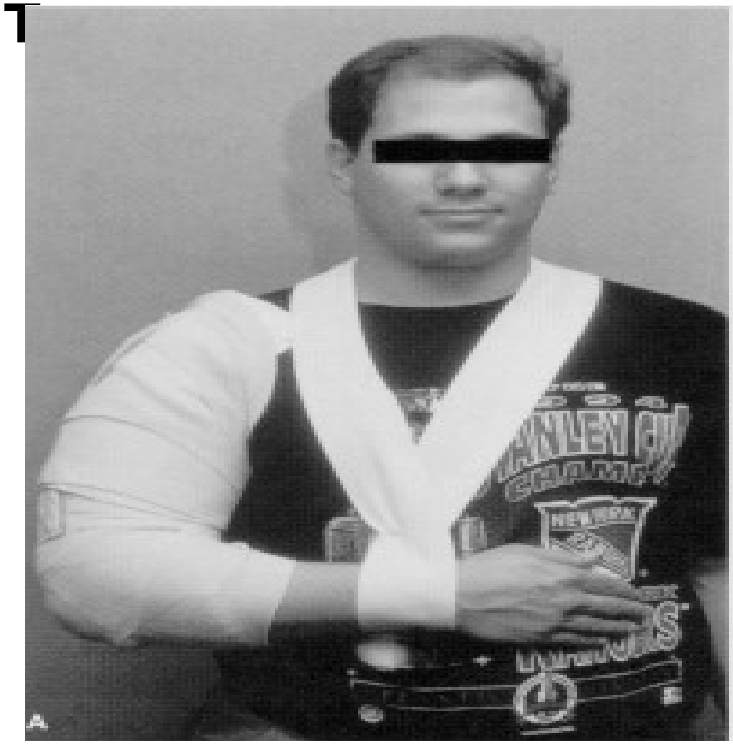
Benefits	Risks
Pain relief Prevention of infection Restoration of anatomy Early movement of the limb Early movement of the patient Improved function Reduced risk of secondary Arthritis Financial cost (time off work)	Anaesthesia Introduction of infection Damage to soft tissues and neurovascular structures Need for implant removal Devitalizing bone Financial cost (cost of treatment)

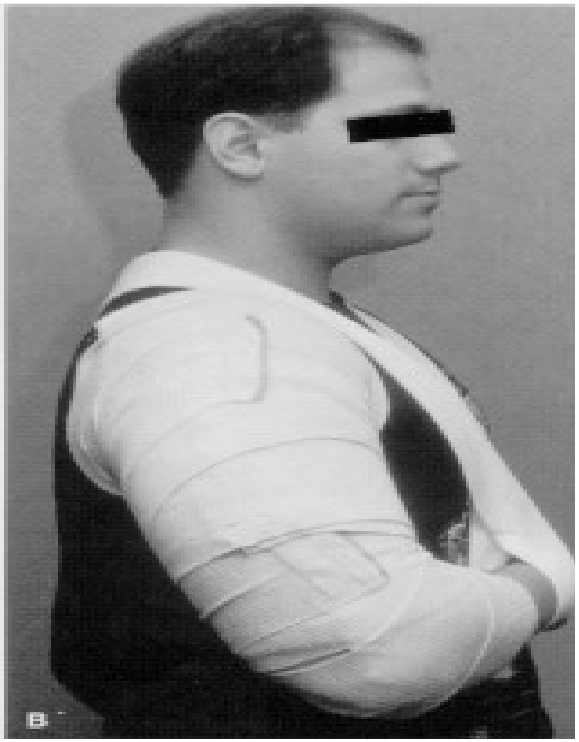
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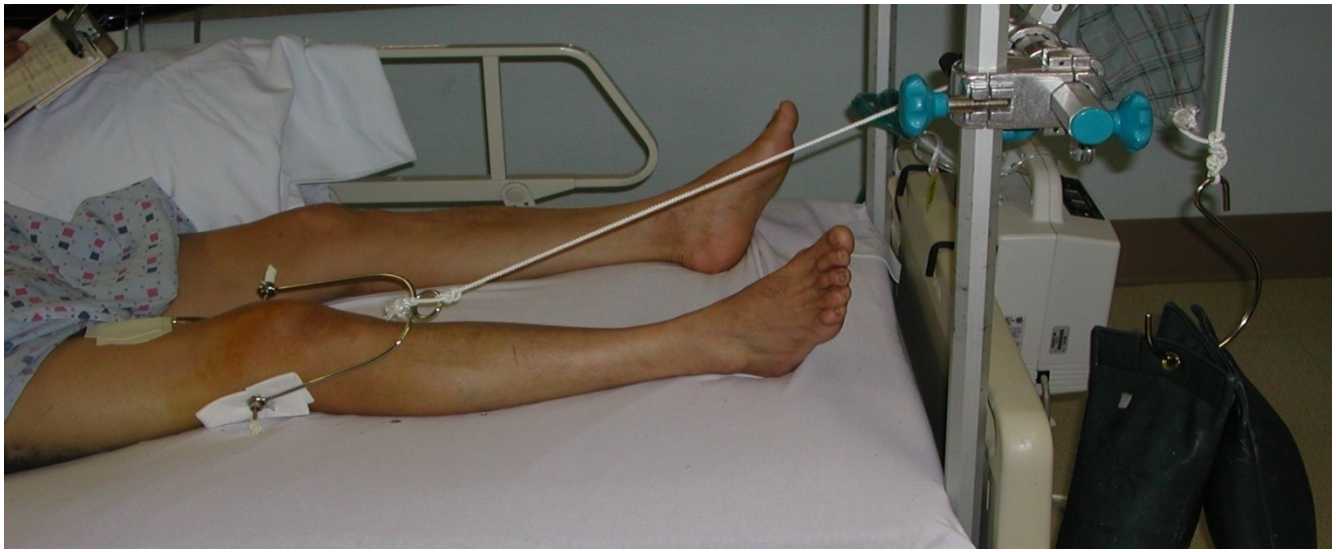
Conservative treatment

- Many fractures require only symptomatic treatment
- Adequate analgesia
- Un displaced or minimally displaced fractures can be treated non-operatively
  - plaster immobilization (e.g. ankle fractures)
  - Slings (elbow and shoulder fractures)
  - Strapping (e.g. phalange fractures)
  - Traction (e.g. pediatric femoral shaft fractures)

CONT







CONT…

- **POP** (Gypsum + water → Hardening)
  - Paded
  - Circular
  - Un paded
  - Slabs -posterior

- ✓ Easy
- ✓ No risk of infection
- ❑ BUT
  - ✓ Damage to vessels & nerves by compression

CAST

- The goal is semi rigid immobilization with avoidance of pressure or skin complications.
- It is often a poor choice in the treatment of acute fractures owing to swelling and soft tissue complications
- Until swelling subsides posterior slap is applied

CONT…

Application

- Long arm POP
- Short leg Pop (below knee)
- Short arm POP
- Long leg POP(above knee)

CONT…

- However, Significantly displaced fractures may require reduction before immobilization
- Closed or Open
- Closed reduction is usually achieved with manipulation under anesthetic or intravenous sedation.
- The injured limb can be immobilized in a plaster, if the fracture displacement has satisfactorily been corrected

CONT…

- Plaster immobilization may be discontinued after 4 to 6 weeks in the upper limb and 10 to 12 weeks in the lower limb, if clinical and radiological signs of union are present

- Pediatric fractures need much shorter periods of immobilization

CONT…

- ***Clinical union-*** fracture site stable and pain-free.

- ***Radiographic union*** is present when plain radiographs show bone trabeculae or cortical bone crossing the fracture site

TRACTION

- The aim of traction is to apply an axial pull at the fracture site in order to keep the fractured fragments in a reasonable alignment by appropriate muscle contraction

- Achieved with ‘skin traction’ (e.g. femoral fractures in children) or ‘skeletal traction’

CONT…

- Skin traction involves application of a sustained pull on the limb through weights suspended from a special bandage (tape or kit) applied to the skin.
- In skeletal traction, a pin is inserted into the bone and traction is applied by weights through a mechanism of pulleys

CONT…

• Skin Traction

- Indication
  1. – Pediatric age group
  2. – Temporary Reduction needed for few days for preoperative period
  3. – The weight needed to maintain traction is less than 5kg
  4. – To prevent contracture in COM and Septic arthritis
  5. – Post reduction of Hip Dislocation
  6. – Femoral Fracture (children)
- Complication
  - vascular injury
  - Nerve injury
  - Skin laceration and necrosis
- Contraindications
  - Weight needed >5Kg.
  - Skin damage requiring dressing
  - Traction needed for long term

CONT…

- **Skeletal Traction**
  - Indication
    - Adult requiring >5kg for traction
    - Skin Damage
    - Long term traction needed
  - Complication
    - Soft tissue injury neuromuscular injury
    - Pin site infection
    - Delayed union

OPERATIVE TREATMENT

- Should be aware of the risks (infection, stiffness, nerve or vessel damage, anaesthetic complications, etc.) associated with operative intervention

CONT…

- Common indications for operative stabilization of a fracture include:
  - **Failure of conservative treatment**
  - **Early mobilization in order to prevent complications like chest infection, bed sores,etc.**
  - **Open fractures**
  - **Poly trauma**
  - **Associated vascular injury requiring exploration**
  - **Displaced intra-articular fractures.**

OPEN REDUCTION

- The principles of open reduction and internal fixation of fractures are;
  - Anatomical reduction
  - Rigid internal fixation
  - Early rehabilitation

INDICATIONS FOR OPEN REDUCTION

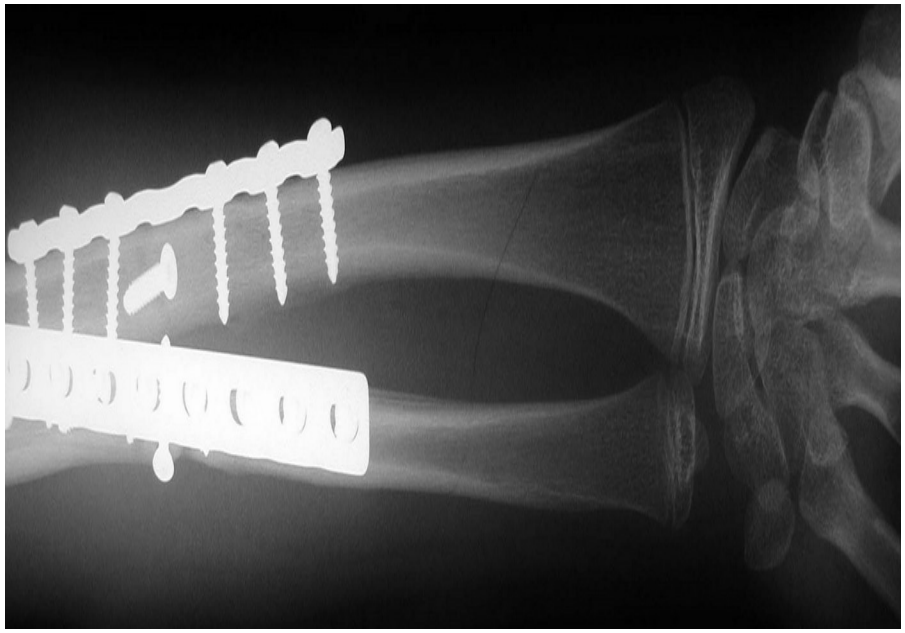
- When closed reduction fails
- When there is large articular fragment that needs accurate positioning
- For traction fractures in which the fragments are held apart
- Open fractures
- Avulsion fractures
- Displaced intra articular fracture

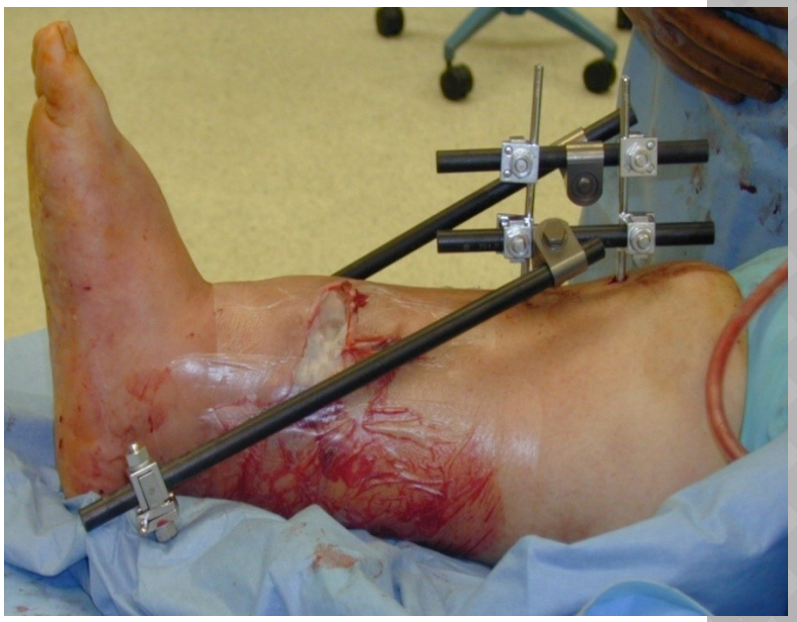
- **External Fixation**
  - Indication
    - Compound Fracture
    - Fractures associated with severe soft tissue damage
    - Nerve damage
    - Severe comminuted and unstable fractures
    - Fracture of Pelvis
    - Infected fractures (**internal fixation is contraindicated**)
  - Complication
    - Pin tract infection
    - Delayed union

- **Internal Fixation**
  - Indication
    1. Fracture that can not be reduced
    2. Unstable fractures **P**rone to displacement
    3. Fractures that unite **P**oorly
    4. **P**athological Fractures
    5. **P**olytrauma (Multiple fractures)
    6. Patients who **P**resent nursing difficulties
    7. Associated vascular injuries
    8.
  - Complications
    - Infection
    - Non union
    - Implant failure
    - Re fracture
    - Mal union

CONT…

- Average time for external fixator -6wks followed by cast.
- Average time for internal fixator-one and half yrs





REHABILITATION

- Restoration of function of the body part or joint is the prime reason for the treatment of any fracture
- Physical exercises - aimed to strengthen muscles and stretch ligaments
- Certain adjuncts such as hydrotherapy, trans dermal electric nerve stimulation and continuous passive motion machines may be used to achieve a full functional recovery

COMPLICATIONS OF FRACTURE

A . Systemic

- **Hypovolemic shock** –hemorrhage and decreased blood volume
- **Fat embolism syndrome/ ARDS**-long bone fracture, Within 48 hours
- **Crush syndrome** -Breakdown product released in circulation-renal failure
- **DVT**
- **Tetanus -**if no prophylaxis within last 5 year ,not known , incomplete
- **Growth retardation -** Type III–V injuries
- **Psychosocial problem**

CONT…

B .Local

- **EARLY** complications -Affect mainly the soft tissues
- **LATE** complications - Months after injury , affect mainly bones and joints

LOCAL COMPLICATIONS

EARLY

- **Visceral injury** –rib , pelvic fracture
- **Vascular injury** - cut , torn, compressed or contused
- **Compartment syndrome**
- **Nerve injury**
- **Haemarthrosis**
- **Infection** chronic osteomyelitis

CONT…

Vascular injury

- ✓ Paraesthesia
- ✓ Cold and pale or cyanosed
- ✓ Pulse weak or absent

COMPARTEMENT SYNDROME

- Increased pressure with in a space
- Combination of physical signs and symptoms
- Classical signs of impending compartment syndrome are:(The 5 p's).
  - **Pain**
  - Pallor
  - Parasethesia
  - Paralysis
  - Pulselessness

- **High index of suspicion**
- If this occurs the limb will be non-viable.

NERVE INJURIES

- Trauma
- Iatrogenic nerve injury - due to Improper casting Technique ,Traction, during surgery

- ***Neurapraxia :***

  Damage is minimal, transient lesion with spontaneous recovery: Few days- weeks

- ***Axonotmesis:***

  Axons damaged, but nerve sheath intact. Recovery is delayed but likely

- ***Neurotmesis:***

  Anatomic disruption of the nerve itself, needs surgical repair

CONT…

LATE

- **Delayed union** –A fracture that has not healed in the usual statistical time frame
- **Non-union** –a fracture that has not healed and will not heal because it has lost its “biological drive” (a pseudo arthrosis, or “false joint ,” develops).
- **Mal union –** healing in poor position for function.
- **Joint stiffness--** edema, fibrosis of capsule, ligaments and muscles around the joint
- **Myositis ossificans** - Heterotopic ossification in muscle

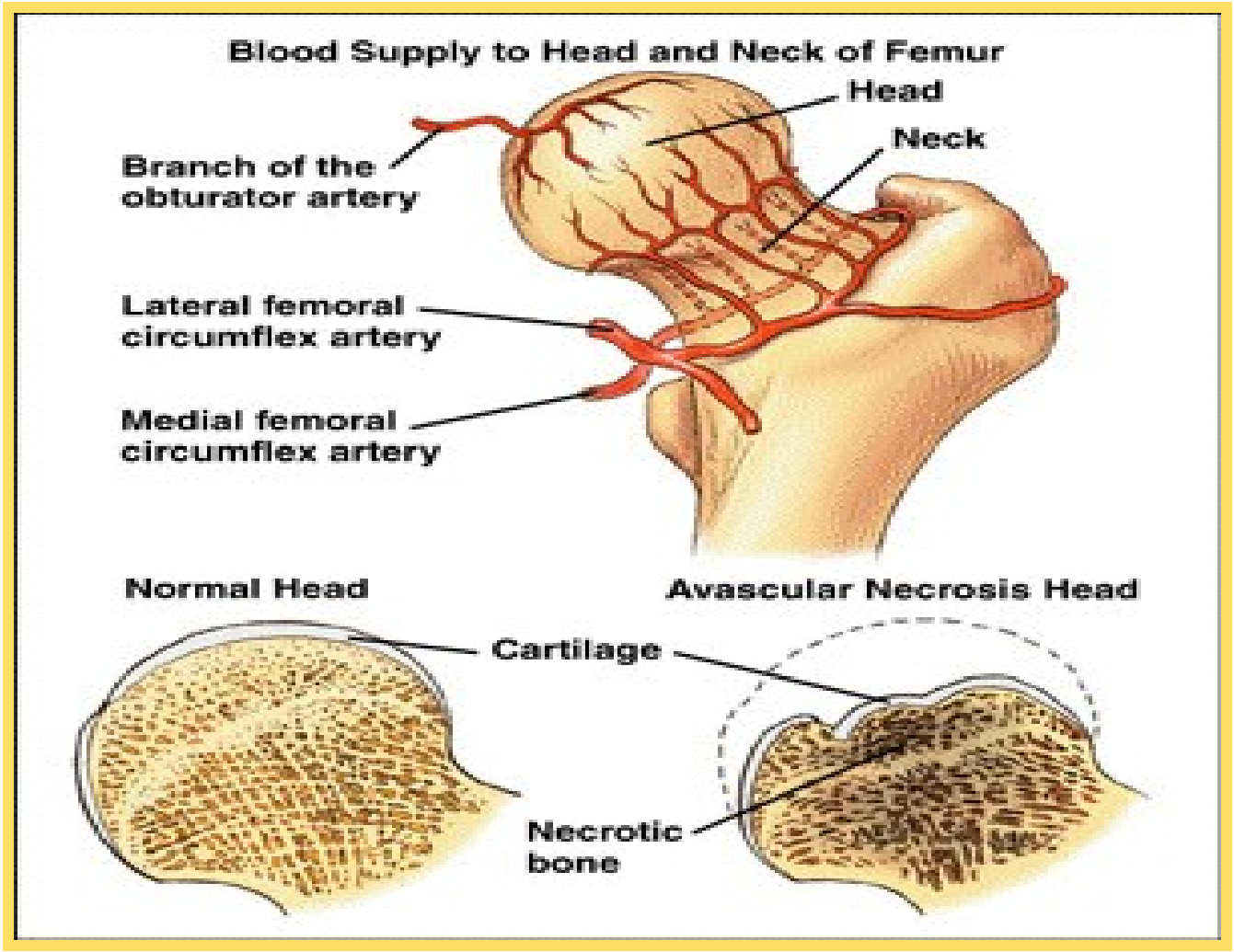
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- ***Post-traumatic arthritis***

- ***Chronic regional pain syndrome (CRPS or Sudek's dystrophy) -***
  - Painful condition that usually affects the hands or feet
  - Due to sympathetic vasomotor phenomenon induced by an injury

- **Avascular necrosis**-common in Head of the femur, Proximal part of scaphoid, Body of the talus

CONT…


Blood Supply to Head and Neck of Femur
Head
Neck
Branch of the obturator artery
Lateral femoral circumflex artery
Medial femoral circumflex artery
Normal Head
Avascular Necrosis Head
Cartilage
Necrotic bone

REFERENCE

- Bailey short practice of surgery 26th edition
- Essential of orthopedic surgery 3rd edition
- Hand book of fracture 3rd edition
- Schwartz’s principles of surgery

THANK YOU!