Early Complications (those that arise during the first few weeks following injury)

1. Local Visceral Injury
2. Vascular Injury
3. Nerve Injury
4. Compartment Syndrome
5. Haemarthrosis
6. Infection
7. Gas gangrene

**Local visceral Injury**

Fracture around the trunk are often Cx by injury to the adjacent viscera:
- Pelvic fracture → Bladder and urethral rupture
- Rib fracture → penetration to the lungs → Pneumothorax

**Vascular injury**

Most commonly – knee, femoral shaft, elbow, and humerus.
- Artery may be cut, torn, compressed or contused.
- Intima may be detached, thrombus block, artery spasm

Effect ?? ↓↓ bld flow coz Ischemia leads to tissue death & peripheral gangrene

**Common vascular injuries may associate with the following fractures.**

1. First rib or clavicle fracture (subclavian artery).
2. Shoulder dislocation (Axillary artery).
3. Humeral supracondylar fracture (brachial artery).
4. Elbow dislocation (Brachial artery).
5. Pelvic fracture (presacral and internal iliac).
6. Femoral supracondylar fracture (Femoral artery).
8. Proximal tibia (popliteal or its branches).

**Clinical features**

Pt with ischemia may have 5 P’s:
- paraesthesia/numbness
- pain
- pallor
- pulselessness
- paralysis

Investigate if suspect vascular injury : Angiogram

**Treatment**

Emergency treatment

All bandages/splints removed

The fracture X-Ray again
Circulation reassessed for next half hour
If no improvement, do vessels exploration
Suture torn vessels, vein grafting, if thrombosed do endarterectomy
Aim: to restore bld flow

**Nerve Injury**

Variable degree of motor and sensory loss along the distribution of the nerve
May be neurapraxia, axonotmesis or neurotmesis
Radial nerve is most frequently damaged nerves.
In closed injuries – nerve is seldom severed and spontaneous recovery should be awaited.

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Trauma</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axillary</td>
<td>Dislocation of shoulder</td>
<td>Deltoid paralysis</td>
</tr>
<tr>
<td>Radial</td>
<td># of humerus</td>
<td>Wrist drop</td>
</tr>
<tr>
<td>Median</td>
<td>Supracondylar # of humerus</td>
<td>Pointing index</td>
</tr>
<tr>
<td>Ulnar</td>
<td># medial epicondyl humerus</td>
<td>Claw hand</td>
</tr>
<tr>
<td>Sciatic</td>
<td>Post dislocation of hip</td>
<td>Foot drop</td>
</tr>
<tr>
<td>Common peroneal</td>
<td>Knee dislocation # neck of fibula</td>
<td>Foot drop</td>
</tr>
</tbody>
</table>

In open fractures – complete lesion(neurotmesis) : the nerve is explored during wound debridement and repaired.

**Compartment Syndrome**

**Definition**

Compartment syndrome involves the compression of nerves and blood vessels within an enclosed space, leading to impaired blood flow and nerve damage.

Fascia separate groups of muscles in the arms and legs from each other. Inside each layer of fascia is a confined space, called a compartment, that includes the muscle tissue, nerves, bones and blood vessels.

A rise in pressure within these compartments may jeopardize the blood supply to the muscles & nerves within the compartment.

**Causes:**
- any injury/infection leading to edema of muscle
- fracture haematoma within the compartment
- ischemia to the compartment leading to muscle oedema
- Due to tight bandages or casts

**Hallmark Symptoms:**
- severe pain that does not respond to elevation or pain medication.
- In more advanced cases, there may be decreased sensation, weakness, and paleness of the skin.

**Injuries with a high risk of developing Compartments synd:**

- # of the elbow
- # of the forearm bone
- # of the proximal third of the tibia

**The vicious cycle of Volkmann’s ischaemia**

A vicious cycle cont. until the total vascularity of the muscles and nerves is jeopardized. This result in ischaemic muscle necrosis and nerve damage. (within 12 hours). The necrotic muscle undergo healing with fibrosis, leading to Volkmann’s contracture. Nerve damage may result in motor and sensory loss. In extreme case → gangrene

**Clinically:**

- should be tested by stretching the muscles → when the toes or fingers are passively hyperextended there is ↑ pain in the calf or forearm.

Early preventing: limb elevation

Dx: confirmed by direct intracompartmental pressure measuring > 40mmHg is an indication of compartment decompression and fasciotomy.

**Treatment**

First removed all the bandages & dressing.

Fasciotomy is performed.

The wound should be left open and inspected 2 days later.

If there is muscle necrosis → debridement

If muscle is healthy → suture (w/o tension)/ skin grafted / simply heal by 2° intention.
Haemarthrosis
Fractures involve joints, leads to acc. of blood within the joints.
C/Feature:The joint is swollen and tense and patient will resist any movement.
Tx: the blood should be aspirated before dealing with the fracture.

Infection
Causes:
Open fracture (common)
Use of operative method in the Tx of #
Wound becomes inflamed and starts draining seropurulent fluid.
Infection may be superficial, moderate (osteomyelitis), severe (gas gangrene).
Post-traumatic wound infx is most common cause of chronic osteomyelitis →union will be slow and ↑ chance of refracturing.

Treatment:
Antibiotic
Excising all devitalised tissue
If Sx of acute infx and pus formation: tissue around the fracture should be opened & drained

Gas gangrene
Produced by anaerobic orgs: Clostridium sp infections.
These orgs can survive in ↓ O₂ tension
Toxins produced will destroy the cell wall and leads to tissue necrosis
C/feature: within 24hr. Pt complains:
- intense pain
- swelling around the wound
- brownish discharge
- gas formation
- pyrexia
- characteristic smelling
- PR ↑
- toxaemic → coma → death
Inability to recognize may lead to unnecessary amputation for the non-lethal cellulitis.

Prevention:
deep penetrating wound in muscular tissue are dangerous; should be explored, all dead tissue should be completely excised, and if there doubt about the tissue viability should left open the wound

Treatment:
Early Dx is life saving
General measures:
Fluid replacement & IV Antibiotic (immediate)
Hyperbaric O₂ (limiting the spread of gangrene)
Mainstay: prompt decompression & remove dead tissue

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**LATE COMPLICATIONS**

1. Delayed union
2. Non-union
3. Malunion
4. Joint stiffness
5. Myositis ossificans
6. Avascular necrosis
7. Algodystrophy
8. Osteoarthritis
9. Joint instability
10. Muscle contracture (Volkmann’s contracture)
11. Tendon lesions
12. Nerve compression
13. Growth disturbance
14. Bed sores

**DELAYED UNION**

Fracture takes more than the usual time to unite.

**Causes**

- Inadequate blood supply
- Severe soft tissue damage
- Periosteal stripping
- Excessive traction
- Insufficient splintage
- Infection

**PERKINS’ TIME TABLE**

<table>
<thead>
<tr>
<th></th>
<th>Upper Limb</th>
<th>Lower Limb</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Callus visible</strong></td>
<td>2-3 wks</td>
<td>2-3 wks</td>
</tr>
<tr>
<td><strong>Union</strong></td>
<td>4-6 wks</td>
<td>8-12 wks</td>
</tr>
<tr>
<td><strong>Consolidation</strong></td>
<td>6-8 wks</td>
<td>12-16 wks</td>
</tr>
</tbody>
</table>

**Clinical features**

- Fracture tenderness (Esp when subjected to stress)
X-Ray
- Visible fracture line
- Very little callus formation or periosteal reaction

Treatment
Conservative
- To eliminate any possible cause
- Immobilization
- Exercise

Operative
- Indication:
  - Union is delayed > 6 mths
  - No signs of callus formation
- Internal fixation & bone grafting

NON-UNION
Condition when the fracture will never unite w/o intervention
Healing has stopped.
- Fracture gap is filled by fibrous tissue (pseudoarthrosis)

Causes
- Improper Tx of delayed union
- Too large a gap
- Interposition of periosteum, muscle or cartilage between the fragments

Clinical features
- Painless movement at the fracture site

X-Ray
- Fracture is clearly visible
- Fracture ends are rounded, smooth and sclerotic
- *Atrophic non-union*: - Bone looks inactive (Bone ends are often tapered / rounded)
  - Relatively avascular
  - *Hypertrophic non-union*: - Excessive bone formation
  - on the side of the gap
  - Unable to bridge the gap

Treatment
- Ununited scaphoid fracture → asymptomatic
- Hypertrophic non-union (Esp long bone)
  → Rigid fixation (internal / external)
    sometimes need bone grafting
Atrophic non-union
→ Fixation & bone grafting

**MALUNION**
Condition when the fragments join in an unsatisfactory position (unaccepted angulation, rotation or shortening)

**Causes**
- Failure to reduce a fracture adequately
- Failure to hold reduction while healing proceeds
- Gradual collapse of comminuted or osteoporotic bone.

**Clinical features**
- Deformity & shortening of the limb
- Limitation of movements

**Treatment**
- Angulation in a long bone (> 15 degrees)
  → Osteotomy & internal fixation
- Marked rotational deformity
  → Osteotomy & internal fixation
- Shortening (> 3cm) in 1 of the lower limbs
  → A raised boot OR Bone operation

**JOINT STIFFNESS**
Common complication of fracture Tx following immobilization

**Common site** : knee, elbow, shoulder, small joints of the hand

**Causes**
- Oedema & fibrosis of the capsule, ligaments, muscle around the joint
- Adhesion of the soft tissue to each other or to the underlying bone (intra & peri-articular adhesions)
- Synovial adhesions d/t haemarthrosis

**Treatment**
- Prevention :
  - Exercise
  - If joint has to be splinted → Make sure in correct position
- Joint stiffness has occurred:
  - Prolonged physiotherapy
  - Intra-articular adhesions
    → Gentle manipulation under anaesthesia followed by continuous passive motion
- Adherent or contracted tissues
  → Released by operation

### MYOSITIS OSSIFICANS

Heterotopic ossification in the muscles after an injury

Usually occurs in

- Dislocation of the elbow
- A blow to the brachialis / deltoid / quadriceps

**Causes**

- (thought to be due to) muscle damage
- w/o a local injury (unconscious / paraplegic patient)

**Clinical features**

- Pain, soft tissue tenderness
- Local swelling
- Joint stiffness
- Limitation of movements
- Extreme cases: - Bone bridges the joint
  - Complete loss of movement (extra-articular ankylosis)

**X-Ray**

- Normal
- Fluffy calcification in the soft tissue

**Treatment**

- Early stage : Joint should be rested
- Then : Gentle active movements
- When the condition has stabilized : Excision of the bony mass
- Anti-inflammatory drugs may ↓ joint stiffness

### AVASCULAR NECROSIS

Circumscribed bone necrosis

**Causes**

- Interruption of the arterial blood flow
- Slowing of the venous outflow leading to inadequate perfusion

**Common site**:

- Femoral head
- Femoral condyls
- Humeral head
- Capitulum of humerus
- **Scaphoid** (proximal part)
- Talus (body)
- Lunate

**Conditions a/w AVN**
- Perthes’ disease
- Certain fractures
- Epiphyseal infection
- Sickle cell disease
- Caisson disease
- Gaucher’s disease
- Alcohol abuse
- High-dosage corticosteroid

**Clinical features**
- Joint pain, stiffness, swelling
- Restricted movement

**X-Ray**
- ↑ bone density
- Subarticular fracturing
- Bone deformity

**Treatment**
- Avoid weight bearing on the necrotic bone
- Revascularisation (using vascularised bone grafts)
- Excision of the avascular segment
- Replacement by prostheses

**ALGODYSTROPHY (COMPLEX REGIONAL PAIN SYNDROME)**

Previously known as Sudeck’s atrophy
Post-traumatic reflex sympathetic dystrophy
Usually seen in the foot / hand (after relatively trivial injury)

**Clinical features**
- Continuous, burning pain
- Early stage: Local swelling, redness, warmth
- Later: Atrophy of the skin, muscles
- Movement are grossly restricted

**X-Ray**
- Patchy rarefaction of the bones (*patchy osteoporosis*)

**Treatment**
- Physiotherapy (elevation & active exercises)
- Drugs
  - Anti-inflammatory drugs
  - Sympathetic block or sympatholytic drugs (Guanethidine)

**OSTEOARTHRITIS**

Post-traumatic OA
- Joint fracture wt severely damaged articular cartilage
- Within period of months

2° OA
- Cartilage heals
- Irregular joint surface may caused localized stress → 2° OA
- Years after joint injury

**Clinical features**
- Pain
- Stiffness
- Swelling
- Deformity
- Restricted movement

**Treatment**
- Pain relief: Analgesics (Anti-inflam agent)
- Joint mobility: Physiotherapy
- Load reduction: wt reduction
- Realignment osteotomy (young pt)
- Arthroplasty (pt > 60yr)

[Look at the PowerPoint for the images.]