4. **Dorsum of the foot** – over the **extensor tendons**.

Clinical Features

- **Painless swelling** over the wrist or hand.
- **Size fluctuation** – may enlarge with activity and shrink with rest.
- **Firm, well-circumscribed swelling** – round, smooth, and mobile.
- **Transillumination positive** – light passes through the cyst due to its fluid content.
- **Pain (if present)** – occurs due to compression of nearby nerves or tendons.

Investigations

1. **Clinical examination** – soft to firm swelling with transillumination.
2. **Ultrasound** – confirms cystic nature and differentiates from solid tumors.
3. **MRI (rarely needed)** – used for deep-seated or atypical ganglions.
4. **X-ray (optional)** – rules out arthritis or bony pathology.

Differential Diagnosis

- **Lipoma** – soft, non-transilluminating mass.
- **Synovial cyst** – similar but occurs in arthritis.
- **Giant cell tumor of tendon sheath** – solid, non-transilluminating.

Treatment

Non-Surgical Management (For asymptomatic ganglions)

- **Observation** – small, painless cysts can be left untreated.
- **Aspiration and steroid injection** – useful for temporary relief but **recurrence rate is high (50%)**.

Surgical Management (For painful or recurrent cases)

- **Surgical excision (Ganglionectomy)** – complete removal of the cyst along with its stalk.
- **Arthroscopic ganglionectomy** – minimally invasive option for wrist ganglions.

Prognosis

- **Recurrence rate after aspiration is high (~50%)**.
- **Surgical removal reduces recurrence risk** but may cause stiffness.
- **Most ganglions are harmless** and do not require intervention unless symptomatic.

▼ Carpal Tunnel Syndrome (CTS)

Definition

Carpal tunnel syndrome (CTS) is a compressive neuropathy caused by entrapment of the median nerve as it passes through the carpal tunnel of the wrist. It is the most common peripheral nerve entrapment syndrome and can lead to pain, numbness, and weakness in the thumb, index, middle, and lateral half of the ring finger.

Anatomy of the Carpal Tunnel

The **carpal tunnel** is a narrow passageway in the wrist formed by:

- **Floor and sides:** Carpal bones
- **Roof:** Flexor retinaculum (transverse carpal ligament)
- **Contents:**
  - Median nerve
  - Nine flexor tendons (four flexor digitorum superficialis, four flexor digitorum profundus, and flexor pollicis longus)

Since the **carpal tunnel is rigid**, any increase in pressure can **compress the median nerve**.

Etiology and Risk Factors

1. **Idiopathic** – most common cause.
2. **Repetitive wrist movements** – typing, knitting, playing musical instruments, and prolonged wrist flexion.
3. **Inflammatory conditions** – rheumatoid arthritis, tenosynovitis, synovial hypertrophy.
4. **Endocrine disorders** – hypothyroidism, diabetes mellitus, acromegaly, pregnancy (fluid retention).
5. **Trauma** – wrist fractures (Colles' fracture), dislocations.
6. **Mass lesions** – ganglion cysts, lipomas, tumors.

Pathophysiology

- Compression of the **median nerve** leads to **ischemia** and **impaired nerve conduction**.
- **Chronic compression** causes **demyelination**, followed by **axonal degeneration**, leading to motor and sensory dysfunction.
- **Prolonged compression** can lead to **permanent nerve damage**.

Clinical Features

- **Pain and paresthesia** – tingling, burning sensation in the **thumb, index, middle, and lateral half of the ring finger**.
- **Nocturnal symptoms** – symptoms worsen at **night** and may awaken the patient.
- **Wrist pain** – may radiate to the forearm or shoulder.
- **Weakness** – difficulty in gripping objects, dropping items.
- **Thenar muscle atrophy** – in severe cases, due to **denervation of the abductor pollicis brevis and opponens pollicis**.

Special Tests

1. **Tinel's Sign** – tapping over the carpal tunnel produces tingling or pain in the fingers.
2. **Phalen's Test** – holding the wrist in **maximum flexion** for 60 seconds reproduces symptoms.
3. **Durkan's Test (Carpal Compression Test)** – direct pressure over the carpal tunnel for 30 seconds elicits symptoms.

Investigations

1. **Nerve Conduction Studies (NCS)** – shows **delayed conduction velocity** in the median nerve.
2. **Electromyography (EMG)** – detects **denervation of thenar muscles** in advanced cases.
3. **Ultrasound (USG)** – shows **thickening of the median nerve** at the carpal tunnel.

4. **MRI (rarely needed)** – used for **mass lesions or complex cases**.

Differential Diagnosis

- **Cervical radiculopathy (C6-C7)** – affects a broader area, including the **forearm and arm**.
- **Pronator Teres Syndrome** – compression of the median nerve in the **proximal forearm**.
- **Thoracic Outlet Syndrome** – affects the **brachial plexus**, leading to **diffuse** hand and arm symptoms.

Treatment

Conservative Management

- **Activity modification** – avoid repetitive wrist movements.
- **Wrist splinting** – keeps the wrist in a **neutral position**, reducing pressure on the nerve.
- **NSAIDs and analgesics** – for pain relief.
- **Corticosteroid injection** – provides **temporary relief** but does not cure the condition.

Surgical Management

Carpal Tunnel Release Surgery (for severe or persistent cases)

- **Open release** – incision made over the palm, and the **flexor retinaculum is cut** to relieve pressure.
- **Endoscopic release** – minimally invasive, faster recovery.

Prognosis

- **Mild cases respond well to conservative treatment**.
- **Surgery has a high success rate**, but **thenar atrophy may not be reversible** in chronic cases.

▼ Adhesive Capsulitis of Shoulder (Frozen Shoulder)

Definition

Adhesive capsulitis, commonly known as **frozen shoulder**, is a **self-limiting condition** characterized by **progressive pain, stiffness, and restriction of both active and passive shoulder movements** due to **fibrosis and thickening of the joint capsule**.

Epidemiology & Risk Factors

- More common in **women** than men.
- Typically affects individuals **between 40-60 years of age**.
- More common in the **non-dominant arm**.
- **Risk factors**:
  - **Diabetes mellitus** (strongest association)
  - Hypothyroidism
  - Hyperthyroidism
  - Parkinson's disease
  - Stroke
  - Prolonged immobilization (e.g., after surgery, fracture)

Etiology & Pathophysiology

- **Primary (Idiopathic)**: No known cause; commonly associated with **diabetes mellitus**.
- **Secondary**: Occurs due to an underlying condition such as trauma, surgery, or systemic diseases.

Pathologically, there is:

1. **Thickening & contraction of the joint capsule**, leading to reduced joint volume.
2. **Inflammation & fibrosis of the capsule and synovium**, restricting shoulder movement.
3. **Adhesions** form inside the joint, further limiting mobility.

Clinical Features

- **Insidious onset** with **gradual progression** of symptoms.
- **Pain** – dull, aching, worst at **night**, and aggravated by movement.
- **Stiffness** – **marked restriction** in active & passive movements, especially **external rotation** and **abduction**.
- **Capsular pattern restriction**:
  - **External rotation → Most restricted**
  - **Abduction** → Moderately restricted
  - **Internal rotation** → Least restricted

Stages of Frozen Shoulder

1. **Freezing Stage (Painful Phase) (2-9 months)**
   - **Severe pain** at rest and with movement.
   - **Progressive stiffness** begins.
2. **Frozen Stage (Stiff Phase) (4-12 months)**
   - **Pain gradually subsides**, but **severe stiffness persists**.
   - **Marked loss of range of motion (ROM)**.
3. **Thawing Stage (Recovery Phase) (5-24 months)**
   - **Gradual improvement in ROM**.
   - **Pain diminishes**, and movements return slowly.

Diagnosis

Clinical Examination

- **Painful restriction of both active and passive movements**, especially **external rotation**.
- **Positive Apley's Scratch Test** – difficulty reaching behind the back.

- **Capsular pattern of restriction** (external rotation > abduction > internal rotation).

Imaging

- **X-ray**: Usually normal; helps rule out arthritis, fracture, or calcific tendinitis.
- **MRI**: Thickened **coracohumeral ligament and joint capsule**, synovial inflammation.
- **Ultrasound**: May show thickening of the **rotator interval and capsule**.

Differential Diagnosis

- **Rotator cuff tear** – painful ROM but passive motion is normal.
- **Glenohumeral arthritis** – crepitus and joint-space narrowing.
- **Cervical radiculopathy (C5-C6)** – pain radiates to the hand with positive **Spurling's test**.

Treatment

Non-Surgical (First-Line Treatment)

1. **Physical Therapy (Mainstay of Treatment)**
   - **Pendulum exercises**
   - **Capsular stretching (external rotation & abduction)**
   - **Strengthening exercises for rotator cuff & scapular stabilizers**
2. **Medications**
   - **NSAIDs** – for pain relief.
   - **Corticosteroid injections** – reduce inflammation, effective in the **freezing stage**.
3. **Hydrodilatation (Distension Arthrography)**
   - Injection of **saline + steroids** to expand the capsule.

Surgical Treatment (For Refractory Cases)

1. **Manipulation Under Anesthesia (MUA)** – passive stretching under anesthesia to break adhesions.
2. **Arthroscopic Capsular Release** – **gold standard** for resistant cases; involves **surgical cutting of the capsule**.

Prognosis

- **Self-limiting condition**, but may last **1-3 years**.
- **90% of cases recover with conservative treatment**, though mild restriction may persist.

This covers the **5 marks, 3 pages worth** of content in a structured format. Let me know if you need any modifications!

▼ Rotator Cuff Tear

Overview

A rotator cuff tear is a common injury involving partial or complete rupture of one or more tendons of the rotator cuff, leading to shoulder pain, weakness, and reduced mobility. The rotator cuff comprises four muscles: **supraspinatus, infraspinatus, teres minor, and subscapularis**, which stabilize the glenohumeral joint and facilitate movement.

Etiology (Causes)

Rotator cuff tears can result from **acute trauma** or **chronic degenerative changes**. The common causes include:

1. **Traumatic Causes:**
    - Falling on an outstretched hand
    - Lifting heavy objects suddenly
    - Direct impact or shoulder dislocation
2. **Degenerative Causes:**
    - Repetitive overhead activities (common in athletes like swimmers, tennis players)
    - Aging-related tendon degeneration
    - Poor vascular supply to tendons
    - Chronic impingement syndrome (supraspinatus tendon frequently affected)
3. **Other Risk Factors:**
    - Smoking (impairs tendon healing)
    - Diabetes mellitus
    - Genetic predisposition

Clinical Features

Patients present with the following symptoms:

- **Pain:**
  - Gradual onset, localized to the **anterolateral shoulder**
  - Worsens with overhead activities and lying on the affected side
  - **Night pain** is a characteristic feature
- **Weakness:**
  - Difficulty lifting objects, especially overhead
  - Weakness in **abduction and external rotation** (supraspinatus and infraspinatus involvement)
- **Limited Range of Motion (ROM):**
  - **Painful arc syndrome:** Pain between **60°–120° abduction**
  - Inability to initiate abduction (supraspinatus tear)
- **Clicking or catching sensation** when moving the shoulder

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Investigations

Clinical Tests:

1. **Jobe's test (Empty Can Test):**
   - Arm in **90° abduction and internal rotation** (thumbs down)
   - Resisted downward pressure causes pain or weakness (suggests **supraspinatus** tear)
2. **Drop Arm Test:**
   - Patient is asked to lower the arm slowly from 90° abduction
   - A **sudden drop** indicates a full-thickness tear
3. **External Rotation Lag Sign:**
   - Assesses **infraspinatus** function
   - Weakness indicates **posterior cuff involvement**
4. **Lift-off Test (Gerber's Test):**
   - Assesses **subscapularis**
   - Inability to lift hand off back suggests **subscapularis tear**

Imaging:

1. **X-ray:**
    - May show **humeral head migration superiorly** in chronic tears
    - Acromial spurs suggesting **impingement syndrome**
2. **Ultrasound:**
    - Identifies **partial and full-thickness tears**
3. **MRI (Gold Standard):**
    - Provides detailed visualization of **tendon damage, muscle atrophy, and fatty infiltration**

Treatment

Conservative Management (For Partial Tears & Elderly Patients):

- **Rest & Activity Modification** – Avoid overhead activities
- **NSAIDs (Ibuprofen, Naproxen)** – Pain relief
- **Physical Therapy:**
    - Strengthening of **deltoid, rotator cuff muscles, and scapular stabilizers**
    - Range of motion exercises to **prevent stiffness**
- **Corticosteroid Injections:**
    - For severe inflammation & pain relief

Surgical Treatment (For Full-Thickness Tears, Young & Active Patients):

- **Arthroscopic Rotator Cuff Repair:**
    - Minimally invasive
    - Faster recovery with lesser complications
- **Open Rotator Cuff Repair:**
    - Used for **large tears with tendon retraction**

- **Reverse Shoulder Arthroplasty:**
    - Indicated for **massive irreparable tears** with severe arthritis (cuff tear arthropathy)

Complications

- **Shoulder Stiffness (Frozen Shoulder)**
- **Persistent Pain & Weakness**
- **Tendon Retear**
- **Cuff Tear Arthropathy** (Progressive degeneration leading to arthritis)

▼ Tennis Elbow (Lateral Epicondylitis)

Overview

Tennis elbow, or **lateral epicondylitis**, is a common overuse injury characterized by pain and tenderness over the **lateral epicondyle** of the humerus. It results from repetitive microtrauma to the **extensor tendons of the forearm**, particularly the **extensor carpi radialis brevis (ECRB)**. Despite its name, it is not limited to tennis players and can affect individuals involved in repetitive gripping or wrist extension activities.

Etiology (Causes)

- **Repetitive overuse of the forearm extensor muscles** (e.g., tennis, badminton, weightlifting, painting, carpentry)
- **Microtears and degeneration** of the common extensor tendon, especially at the attachment to the lateral epicondyle
- **Poor wrist posture during lifting activities**
- **Weak forearm muscles or improper technique** in sports

Clinical Features

- **Pain and tenderness over the lateral epicondyle** of the humerus
- Pain worsens with:
  - **Resisted wrist extension** (lifting objects, shaking hands)
  - **Gripping activities** (turning a doorknob, holding a racket)
  - **Palpation of the lateral epicondyle**
- Weak grip strength in severe cases

Diagnosis

Clinical Tests:

1. **Cozen's Test:**
    - The patient makes a fist, extends the wrist against resistance
    - **Pain over lateral epicondyle** is a positive test
2. **Mill's Test:**
    - Passive wrist **flexion with elbow extension**
    - Pain at the lateral epicondyle suggests tennis elbow
3. **Maudsley's Test (Middle Finger Test):**
    - **Resisted middle finger extension**
    - Reproduces pain at lateral epicondyle

Imaging (For Chronic or Severe Cases):

- **X-ray:** To rule out arthritis, calcification at the tendon insertion
- **MRI:** For chronic cases with suspected **tendon tears or degeneration**

Treatment

Conservative Management:

- **Rest & Activity Modification** – Avoid repetitive wrist extension
- **Ice Application** – Reduces inflammation and pain
- **NSAIDs (Ibuprofen, Naproxen)** – Symptomatic relief
- **Physical Therapy:**
    - **Stretching & Strengthening Exercises** for wrist extensors
    - **Eccentric exercises** to improve tendon healing

Medical Interventions (For Persistent Cases):

- **Corticosteroid Injection** – Provides temporary relief but may weaken the tendon
- **Platelet-Rich Plasma (PRP) Therapy** – Stimulates tendon healing

Surgical Treatment (Rarely Needed):

- **Lateral Epicondyle Debridement or Release** – Only for refractory cases

▼ Trigger Finger (Stenosing Tenosynovitis)

Overview

Trigger finger, also known as **stenosing tenosynovitis**, is a condition where the flexor tendon of a finger becomes inflamed and **gets stuck while moving through the tendon sheath**. This results in a **painful locking or snapping** of the affected finger when attempting to flex or extend it. It commonly affects the **ring finger and thumb**, though any finger can be involved.

Etiology (Causes)

- **Repetitive gripping or hand use** (e.g., manual labor, musicians, diabetes)
- **Inflammation of the flexor tendon sheath** leading to **nodule formation**
- **Thickening of the A1 pulley** in the tendon sheath, restricting tendon movement
- **Associated conditions:** Diabetes, rheumatoid arthritis, gout

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Clinical Features

- **Pain and tenderness** at the base of the affected finger, near the palm
- **Snapping or clicking sensation** when flexing or extending the finger
- **Finger getting stuck in a bent position** and then suddenly releasing
- **Morning stiffness** and difficulty in movement
- **Palpable nodule** at the base of the affected finger

Diagnosis

- **Clinical Examination:**
  - **Pain over the A1 pulley**
  - **Triggering sensation** when patient flexes and extends the finger
  - **Locking of the finger in flexion**, requiring passive force to extend
- **Ultrasound or MRI** – Only used in unclear cases to assess tendon thickening

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Treatment

Conservative Management:

- **Rest & Activity Modification** – Avoid repetitive gripping
- **NSAIDs (Ibuprofen, Naproxen)** – Reduce pain and inflammation
- **Splinting the affected finger** – Prevents triggering and promotes healing
- **Stretching exercises & warm compresses**

Medical Interventions (For Severe or Persistent Cases):

- **Corticosteroid Injection** – Reduces inflammation, commonly used for relief
- **Percutaneous Release** – Minimally invasive needle procedure to release the A1 pulley

Surgical Treatment (For Refractory Cases):

- **Trigger Finger Release (Open Surgery)** – Cutting the A1 pulley to allow tendon movement

▼ Meralgia Paresthetica

Definition

Meralgia paresthetica is a condition characterized by **tingling, burning, numbness, or pain** in the **outer thigh** due to compression or entrapment of the **lateral cutaneous nerve of the thigh (L2-L3)**. This nerve is **sensory** and does not affect muscle movement.

Etiology (Causes)

- **Tight clothing, belts, corsets** (e.g., police belts, heavy tool belts)
- **Obesity or sudden weight gain**
- **Pregnancy**
- **Prolonged standing or walking**
- **Diabetes mellitus** (causing nerve damage)
- **Trauma or surgery near the inguinal ligament**
- **Nerve compression due to inflammation or local swelling**

Clinical Features

- **Tingling, burning, or numbness** on the **outer thigh**
- **Sharp, shooting pain** in the lateral thigh
- **Worsening symptoms with prolonged standing, walking, or hip extension**
- **Hyperesthesia (increased sensitivity) or hypoesthesia (reduced sensation) in the affected area**
- **No motor weakness** since it is a purely sensory nerve

Diagnosis

- **Clinical history & examination** (classic symptom distribution)
- **Tinel's Sign**: Tapping over the inguinal ligament may reproduce symptoms
- **Nerve conduction study (NCS)** – To assess nerve function in severe cases

- **MRI or ultrasound** – If an underlying mass or trauma is suspected

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Treatment

Conservative Management:

- **Avoid tight clothing, belts, or pressure on the nerve**
- **Weight reduction** if obesity is a factor
- **NSAIDs (Ibuprofen, Naproxen)** – Reduce pain and inflammation
- **Physical therapy** – Stretching exercises to relieve nerve compression

Medical Management:

- **Local corticosteroid injections** – If severe pain persists
- **Neuropathic pain medications** (Gabapentin, Pregabalin, Amitriptyline)

Surgical Treatment (Rare Cases):

- **Surgical decompression of the lateral cutaneous nerve** – If symptoms are persistent and disabling

37. Metabolic Bone Diseases

▼ Rickets - Clinical Features, Radiological Appearance, Investigations, and Treatment

Clinical Features:

Rickets is a disorder of growing bones due to defective mineralization, leading to soft and deformed bones. The clinical features include:

- **Cranial abnormalities:**
  - **Craniotabes:** Softening of the skull bones, giving a "ping-pong ball" sensation on palpation.
  - **Frontal and parietal bossing:** Prominent bulging of the skull due to defective mineralization.
- **Thoracic deformities:**
  - **Rachitic rosary:** Enlargement of the costochondral junctions, appearing like beads along the ribs.
  - **Harrison's sulcus:** A horizontal groove at the lower thoracic region due to diaphragmatic pull.
  - **Pigeon chest (pectus carinatum):** Protrusion of the sternum.
- **Limb deformities:**
  - **Widening of wrists and ankles** due to excessive osteoid deposition.
  - **Bowing of the legs:**
    - Genu varum (bow legs) in early childhood.
    - Genu valgum (knock knees) in older children.
  - **Delayed walking and muscle weakness** leading to a waddling gait.
- **Delayed dentition** and **dental caries** due to defective mineralization of teeth.
- **Growth retardation** and **short stature.**

Radiological Features:

Characteristic radiological findings include:

- **Delayed appearance of epiphyses** due to defective calcification.
- **Widening of growth plates** (epiphyseal plates) due to unmineralized osteoid accumulation.

- **Cupping and fraying of metaphyses**, commonly seen in the distal ends of the radius, ulna, and femur.
- **Splaying of metaphyses** due to pressure from unmineralized cartilage.
- **Looser's zones (pseudo-fractures)** – radiolucent bands seen in the femur, pubic rami, and scapula.

Investigations:

To confirm rickets and assess severity, the following investigations are performed:

- **Serum biochemistry:**
  - **Low serum calcium and phosphate levels.**
  - **Elevated serum alkaline phosphatase (ALP).**
  - **Parathyroid hormone (PTH) may be increased in nutritional rickets.**
- **Radiographs:** To detect classic bone changes.
- **Vitamin D levels:** To differentiate nutritional rickets from renal rickets.
- **Urinary calcium and phosphate excretion:** Helpful in metabolic and genetic causes of rickets.

Treatment:

Management of rickets depends on the underlying cause and severity of the disease.

1. Nutritional Rickets:

- **Vitamin D supplementation:**
  - 600,000 IU of vitamin D (cholecalciferol) given as a single intramuscular or oral dose.
  - Maintenance dose: 400 IU/day for infants and 600 IU/day for children.
- **Calcium supplementation** (500-1000 mg/day) to prevent hypocalcemia.
- **Adequate sun exposure** to enhance endogenous vitamin D synthesis.

2. Metabolic and Genetic Rickets:

- **Calcitriol (active vitamin D3)** in cases of renal rickets.
- **Phosphate supplements** in hereditary hypophosphatemic rickets.

- **Dietary modifications** to improve calcium and phosphate intake.

3. Orthopedic Management:

- **Splints and braces** for mild deformities.
- **Corrective osteotomies** for severe deformities like bow legs or knock knees.

▼ Osteomalacia

Definition:

Osteomalacia is a metabolic bone disorder characterized by defective mineralization of the bone matrix in adults, leading to soft and weak bones. It is the adult counterpart of rickets, which occurs in children.

Etiology:

The main causes of osteomalacia include:

- **Vitamin D deficiency** (due to poor diet, lack of sunlight exposure, malabsorption).
- **Chronic renal failure** leading to disturbances in calcium and phosphate metabolism.
- **Gastrointestinal disorders** such as celiac disease, Crohn's disease, or after gastrectomy.
- **Drugs** (e.g., anticonvulsants, phosphate binders).

Clinical Features:

- **Bone pain** – Diffuse skeletal pain, commonly in the lower back, pelvis, ribs, and legs.
- **Muscle weakness** – Especially in the proximal muscles, leading to difficulty in standing and walking.
- **Fractures** – Pathological fractures due to poor mineralization, commonly in the ribs, pelvis, and femur.
- **Waddling gait** due to muscle weakness and bone deformities.

Investigations:

- **Serum calcium and phosphate:** Low or normal.
- **Serum alkaline phosphatase (ALP):** Elevated due to increased bone turnover.
- **Serum vitamin D:** Reduced in nutritional osteomalacia.

- **Radiological findings:**
  - **Looser's zones (pseudo-fractures)** – Radiolucent bands in the cortex of bones, commonly in the pubic rami and ribs.
  - **Generalized osteopenia** with cortical thinning.

Treatment:

- **Vitamin D supplementation** – 600,000 IU of vitamin D orally or intramuscularly.
- **Calcium and phosphate supplements** to improve bone mineralization.
- **Management of underlying conditions** (e.g., renal disease, malabsorption).
- **Sunlight exposure** to enhance endogenous vitamin D production.

▼ Osteoporosis

Definition:

Osteoporosis is a metabolic bone disease characterized by decreased bone mass and deterioration of bone microarchitecture, leading to increased bone fragility and susceptibility to fractures. It occurs when bone resorption exceeds bone formation.

Etiology:

Osteoporosis can be **primary** or **secondary**.

- **Primary Osteoporosis:**
  - **Postmenopausal osteoporosis (Type I):** Estrogen deficiency accelerates bone loss.
  - **Senile osteoporosis (Type II):** Age-related bone loss due to decreased osteoblast activity.
- **Secondary Osteoporosis:**
  - **Endocrine disorders:** Cushing's syndrome, hyperthyroidism, hyperparathyroidism.
  - **Nutritional deficiencies:** Calcium, vitamin D deficiency, malnutrition.
  - **Drugs:** Chronic corticosteroid use, anticonvulsants, heparin.
  - **Immobilization and inactivity:** Prolonged bed rest, spinal cord injury.

Clinical Features:

Osteoporosis is often **asymptomatic** until a fracture occurs. Common presentations include:

- **Fractures:**
  - **Vertebral compression fractures** – leading to loss of height and kyphosis ("dowager's hump").
  - **Hip fractures** – commonly in the femoral neck, causing significant morbidity.
  - **Colles' fracture** – distal radius fracture due to minimal trauma.

- **Back pain** – Due to microfractures in the vertebrae.
- **Loss of height** – Due to vertebral compression fractures.
- **Kyphosis (hunched posture)** – Progressive spinal deformity due to multiple vertebral fractures.

Investigations:

1. Radiological Features:

- **X-rays:**
  - Generalized osteopenia (decreased bone density).
  - **Codfish vertebrae** – biconcave vertebral bodies.
  - **Vertebral compression fractures.**
- **DEXA (Dual-energy X-ray Absorptiometry) Scan:**
  - **Gold standard for diagnosis.**
  - Measures **bone mineral density (BMD)** at the spine and hip.
  - **T-score interpretation:**
    - **Normal:** T-score ≥ -1
    - **Osteopenia:** T-score between -1 and -2.5
    - **Osteoporosis:** T-score ≤ -2.5

2. Blood Investigations:

- **Serum calcium, phosphate, and alkaline phosphatase** – Usually normal.
- **Vitamin D levels** – May be low in nutritional osteoporosis.
- **Parathyroid hormone (PTH)** – Elevated in secondary hyperparathyroidism.

Treatment:

1. Lifestyle Modifications:

- **Weight-bearing exercises** (walking, jogging, resistance training) to improve bone strength.

- **Adequate calcium and vitamin D intake:**
  - **Calcium**: 1000-1200 mg/day
  - **Vitamin D**: 800-1000 IU/day
- **Sunlight exposure** to enhance vitamin D synthesis.
- **Avoidance of risk factors** – Smoking cessation, limiting alcohol intake.

2. Pharmacological Therapy:

- **Bisphosphonates (Alendronate, Risedronate):** First-line therapy, inhibit osteoclast activity.
- **Selective Estrogen Receptor Modulators (SERMs) (Raloxifene):** Used in postmenopausal osteoporosis.
- **Denosumab:** Monoclonal antibody against RANKL, used in high-risk patients.
- **Teriparatide (PTH analog):** Stimulates bone formation, used in severe osteoporosis.

3. Surgical Management:

- **Vertebroplasty/Kyphoplasty** for painful vertebral fractures.
- **Hip replacement surgery** in case of femoral neck fractures.

▼ Rachitic Rosary

Definition:

Rachitic rosary refers to the **beaded appearance of the costochondral junctions** seen in rickets. It results from the overgrowth of cartilage due to defective mineralization of the growing bones.

Pathophysiology:

- Rickets is caused by **vitamin D deficiency**, leading to defective **calcium and phosphate metabolism**, impairing bone mineralization.
- The costochondral junctions of the ribs become **prominent, widened, and soft**, resembling a string of beads—hence the term "**rosary**".
- The defective mineralization also leads to **osteoid accumulation**, causing soft and weak bones.

Clinical Features:

- **Palpable, bead-like swelling** at the costochondral junctions.
- Commonly seen in infants and young children with **nutritional rickets**.
- **Soft, pliable ribs**, which may lead to chest wall deformities.
- Associated features of rickets, such as **bow legs, frontal bossing, and Harrison's sulcus** (a groove at the lower ribs due to diaphragm pull).

Investigations:

- **Serum calcium & phosphate** – Low in rickets.
- **Serum alkaline phosphatase** – Elevated.
- **Vitamin D levels** – Reduced.
- **X-ray chest** – Shows widening of costochondral junctions and decreased bone mineralization.

Treatment:

- **Vitamin D supplementation (600,000 IU single dose or daily maintenance doses).**
- **Calcium and phosphate supplementation.**
- **Adequate sunlight exposure** to enhance endogenous vitamin D synthesis.
- **Nutritional correction** in case of dietary deficiency.

▼ Brown Tumor

Definition:

A **brown tumor** is a localized, osteolytic bone lesion that occurs in **hyperparathyroidism** due to excessive **osteoclastic activity and bone resorption**. It is not a true neoplasm but rather a reactive process caused by **prolonged elevated parathyroid hormone (PTH) levels**.

Pathophysiology:

- **Excess PTH stimulates osteoclasts**, leading to **increased bone resorption**.
- Bone loss results in areas of **fibrous tissue replacement**, hemorrhage, and hemosiderin deposition, giving the lesion a characteristic **brown color**.
- Commonly seen in **primary, secondary, or tertiary hyperparathyroidism**.

Clinical Features:

- Affects **long bones (femur, tibia), ribs, mandible, pelvis, and skull**.
- **Swelling, pain, and pathological fractures** due to bone weakening.
- May be associated with **osteitis fibrosa cystica**, an advanced form of hyperparathyroid bone disease.

Investigations:

- **Serum PTH** – Elevated in hyperparathyroidism.
- **Serum calcium** – Increased in primary hyperparathyroidism.
- **Serum alkaline phosphatase** – Elevated due to increased bone turnover.
- **X-ray** – Shows **lytic, expansile bone lesions** with **cortical thinning**.
- **Histology** – Reveals **fibrous tissue, giant cells, hemorrhage, and hemosiderin-laden macrophages**.

Treatment:

- **Surgical removal of parathyroid adenoma/hyperplasia** in primary hyperparathyroidism.
- **Medical management of secondary hyperparathyroidism** with vitamin D, phosphate binders, and calcium supplements.
- **Orthopedic intervention** in case of pathological fractures or severe bone involvement.

38. Miscellaneous Affecting the Bone

▼ Paget's Disease of Bone (Osteitis Deformans)

Definition:

Paget's disease of bone is a **chronic, progressive disorder** characterized by **abnormal bone remodeling** due to **excessive bone resorption followed by disorganized bone formation**. This leads to structurally weak, thickened, and deformed bones.

Etiopathogenesis:

- The exact cause is **unknown**, but **genetic and environmental factors** play a role.
- Mutations in the **SQSTM1 gene** have been associated with **abnormal osteoclast function**.
- **Viral infection hypothesis**: Paramyxovirus (e.g., measles virus) may trigger excessive osteoclast activity.
- **Increased osteoclast activity** leads to **uncontrolled bone resorption**, followed by **compensatory bone formation**, resulting in **woven bone with poor mechanical strength**.

Clinical Features:

- Usually occurs in **patients over 40 years old**.
- **Commonly affected sites**: Skull, spine, pelvis, femur, tibia.
- **Bone pain**: Dull, deep aching pain, aggravated by weight-bearing.
- **Bone deformities**: Bowing of long bones, skull enlargement, kyphosis.
- **Pathological fractures**: Due to structurally weak bone.
- **Nerve compression**: Enlarged skull bones can compress cranial nerves, leading to **deafness and vision impairment**.

Radiological Features:

- **X-ray**:
  - **Lytic lesions** in the early phase (osteoclastic activity).
  - **Sclerotic, thickened bone** in the later phase (osteoblastic activity).
  - **Cotton wool appearance** in the skull.
  - **Blade of grass sign** in the long bones.
- **Bone scan**: Increased uptake in affected areas.

Investigations:

- **Serum alkaline phosphatase** – **Elevated** due to increased bone turnover.
- **Serum calcium and phosphate** – Usually normal.
- **Urinary hydroxyproline** – Increased due to high collagen turnover.

Complications:

- **Pathological fractures** – Common in weight-bearing bones.
- **Osteoarthritis** – Due to deformities altering joint mechanics.
- **Malignant transformation** – Osteosarcoma in **less than 1%** of cases.
- **Neurological deficits** – Compression of cranial nerves (e.g., hearing loss).

Treatment:

- **Bisphosphonates (e.g., Zoledronic acid, Alendronate)** – First-line therapy to suppress osteoclastic activity.
- **Calcitonin** – Alternative therapy for patients who cannot tolerate bisphosphonates.
- **Pain management** – NSAIDs for bone pain.
- **Orthopedic interventions** – For fractures or severe deformities.

▼ Perthes Disease (Coxa Plana, Pseudocoxalgia)

Definition:

Perthes disease is a **childhood osteochondritis** affecting the **epiphysis of the femoral head**, leading to **avascular necrosis and deformity** of the femoral head. It typically occurs between the ages of **5-10 years** and is more common in **boys**.

Etiology & Pathogenesis:

- The exact cause is **unknown**, but it is believed to be due to **recurrent ischemic episodes** affecting the femoral head.
- Possible **precipitating factors** include:
  - **Transient synovitis**
  - **Repetitive microtrauma**
  - **Coagulation abnormalities**
  - **Genetic predisposition**
- Pathological Stages:
  1. **Stage of synovitis** – Initial inflammation.
  2. **Stage of trabecular necrosis** – Avascular necrosis of the femoral head.
  3. **Stage of healing and revascularization** – Bone remodeling and repair.

Clinical Features:

- **Age Group**: 5-10 years, with a male predominance.
- **Pain in the hip**, often **radiating to the knee**.
- **Limping gait**.
- **Hip stiffness**, particularly with **limited abduction and internal rotation**.
- **Trendelenburg sign** may be positive due to weak hip abductors.

Investigations:

1. **Radiological Examination**:
    - **Early stage**: Increased **joint space**, subchondral fractures, and sclerosis.
    - **Late stage**: **Flattening, fragmentation, and sclerosis** of the femoral head.
    - **X-ray (Frog-leg lateral view)**: Best to assess femoral head involvement.
    - **Bone scan**: Shows **decreased uptake** in the early stages.
    - **MRI**: Most sensitive to detect **early avascular necrosis**.
2. **Catterall Classification**:
    - Classifies disease severity based on **extent of femoral head involvement**.
    - Helps in prognostication and treatment planning.

Treatment:

- **Goal**: Maintain femoral head within the acetabulum and allow revascularization while preventing deformity.

1. **Conservative Management** (for mild cases):
    - **Activity restriction** to reduce stress on the hip.
    - **Non-weight bearing with crutches**.
    - **Physiotherapy** to maintain range of motion.
    - **Bracing** (Scottish-Rite brace) to contain the femoral head.
2. **Surgical Treatment** (for severe cases or older children):
    - **Containment osteotomy** – To keep the femoral head inside the acetabulum.
    - **Shelf acetabuloplasty** – To improve femoral head coverage.
    - **Varus femoral osteotomy** – To realign the femoral head within the joint.

Prognosis:

- **Better prognosis** in **younger children (<6 years old)** with minimal femoral head involvement.
- **Poorer prognosis** in **older children** or those with **severe femoral head collapse**.

▼ Avascular Necrosis of the Hip

Definition:

Avascular necrosis (AVN), also known as osteonecrosis, is a pathological condition characterized by the death of bone tissue due to insufficient blood supply. It commonly affects the femoral head and can lead to joint destruction if untreated.

Etiology and Risk Factors:

1. **Traumatic Causes:**
    - Hip dislocation
    - Femoral neck fractures
    - Surgical procedures involving the hip
2. **Non-Traumatic Causes:**
    - Chronic corticosteroid use (e.g., in autoimmune diseases, transplant patients)
    - Alcoholism
    - Sickle cell disease
    - Gaucher’s disease
    - Hypercoagulable states
    - Radiation therapy
    - Idiopathic causes

Pathogenesis:

- AVN occurs due to the disruption of the blood supply to the femoral head, leading to:
    1. **Ischemia:** Initial lack of oxygen leads to cellular death.
    2. **Bone Necrosis:** Osteocytes and bone marrow cells die due to lack of nutrients.
    3. **Microfractures:** Necrotic bone weakens, leading to structural collapse.
    4. **Articular Collapse and Secondary Osteoarthritis:** If untreated, it results in loss of joint function and severe pain.

Clinical Features:

- **Early Stage:**
    - Asymptomatic or mild hip pain on exertion.
    - X-rays may appear normal.
- **Intermediate Stage:**
    - Groin pain radiating to the knee.
    - Pain worsens with weight-bearing and movement.
    - Stiffness and limited range of motion.
    - Possible mild limp.
- **Advanced Stage:**
    - Persistent pain, even at rest.
    - Joint deformity and collapse of the femoral head.
    - Progressive osteoarthritis.

Investigations:

1. **X-ray Findings:**
    - Early stages: Normal or subtle radiolucencies.
    - Late stages: Subchondral collapse, crescent sign (subarticular radiolucency), femoral head flattening.

2. **MRI (Gold Standard):**
    - Detects early ischemic changes before X-ray abnormalities.
    - Shows bone marrow edema and necrotic areas.
3. **Bone Scan:**
    - Increased uptake in early AVN.
    - Cold spots in advanced necrosis.
4. **CT Scan:**
    - Useful for assessing subchondral fractures and joint collapse.

Treatment:

1. Non-Surgical Management:

- Indicated in early AVN before femoral head collapse.
- **Bisphosphonates**: May slow bone resorption.
- **NSAIDs**: For pain relief.
- **Restricted weight-bearing**: Reduces stress on the femoral head.
- **Physiotherapy**: Maintains joint mobility.

2. Surgical Management:

- **Core Decompression:** Removes necrotic bone and promotes revascularization.
- **Bone Grafting:** Fibular or muscle-pedicle grafting to restore bone structure.
- **Osteotomy:** Realignment of weight-bearing stress to healthy bone.
- **Total Hip Replacement (THR):** Final option for advanced AVN with joint destruction.

Complications:

- Femoral head collapse
- Severe secondary osteoarthritis
- Chronic pain and disability
- Need for total hip replacement

▼ Marfan Syndrome

Definition:

Marfan syndrome is an **autosomal dominant** connective tissue disorder caused by mutations in the **FBN1 gene** that encodes **fibrillin-1**, a key component of the extracellular matrix. It primarily affects the **skeletal, cardiovascular, and ocular systems**.

Etiology:

- **Genetic Mutation:** Mutation in the **FBN1 gene** on chromosome **15q21.1**.
- **Inheritance:** Autosomal dominant (75% familial, 25% de novo mutations).
- **Pathophysiology:** Defective fibrillin-1 leads to **weakened connective tissues**, resulting in excessive elasticity and fragility in affected organs.

Clinical Features:

1. Skeletal Manifestations: (Most noticeable features)

- **Tall stature** with long limbs (dolichostenomelia).
- **Arachnodactyly** (long, slender fingers, 'spider fingers').
- **Joint hypermobility** due to increased ligamentous laxity.
- **Pectus deformities**:
  - **Pectus excavatum** (sunken chest).
  - **Pectus carinatum** (protruding chest).
- **Scoliosis** or kyphosis.
- **Pes planus** (flat feet).
- **High-arched palate** and dental crowding.
- **Positive wrist and thumb signs** (Steinberg's sign, Walker-Murdoch sign).

2. Cardiovascular Manifestations: (Most life-threatening)

- **Aortic root dilation** → predisposes to **aortic dissection** (major cause of death).

- **Mitral valve prolapse (MVP)** → leads to **mitral regurgitation**.
- **Aortic regurgitation**.
- Increased risk of **sudden cardiac death** due to dissection or arrhythmias.

3. Ocular Manifestations:

- **Ectopia lentis** (lens dislocation, superiorly).
- **High myopia**.
- **Retinal detachment**.
- **Increased risk of glaucoma and cataracts**.

4. Pulmonary Manifestations:

- Increased risk of **spontaneous pneumothorax** due to lung bullae.
- **Restrictive lung disease** due to chest wall deformities.

5. Neurological Manifestations:

- **Dural ectasia** (enlarged spinal dura) → can cause low back pain, headaches.
- **Increased risk of scoliosis-related complications**.

Diagnosis:

1. Ghent Criteria (Revised 2010):

- Diagnosis is based on:
  - **Aortic root dilation (Z-score ≥ 2)**
  - **Ectopia lentis**
  - **Systemic skeletal involvement (≥7 systemic features)**
  - **FBN1 mutation analysis**
  - **Family history**

2. Investigations:

- **Echocardiography**: To assess **aortic root size** and **valve function**.
- **Slit-lamp examination**: To detect **lens subluxation**.

- **X-rays/CT/MRI**: To evaluate **skeletal abnormalities** and **dural ectasia**.
- **Genetic Testing**: Confirms **FBN1 mutations**.

Management:

1. Cardiovascular Management (Most Critical):

- **Beta-blockers (e.g., propranolol, atenolol)**: Reduce aortic stress.
- **Angiotensin receptor blockers (ARBs) (e.g., losartan)**: Slow aortic dilation.
- **Regular Echocardiography**: Every 6 months if aortic dilation is present.
- **Aortic Surgery**: If aortic diameter >50 mm, consider **elective aortic root replacement** (Bentall procedure).

2. Skeletal Management:

- **Orthopedic bracing** for scoliosis.
- **Corrective surgery** for severe **pectus deformities**.
- **Physical therapy** to strengthen muscles.

3. Ocular Management:

- **Spectacles/contact lenses** for myopia.
- **Surgical lens extraction** if ectopia lentis affects vision.
- **Regular eye check-ups**.

4. Lifestyle Modifications:

- **Avoid contact sports** (risk of aortic rupture).
- **No heavy lifting**.
- **Pregnancy counseling**: High-risk pregnancy due to aortic complications.

Complications:

- **Aortic dissection/rupture** (life-threatening).
- **Severe mitral regurgitation → heart failure**.

- **Spontaneous pneumothorax**.
- **Retinal detachment → blindness**.
- **Scoliosis → respiratory dysfunction**.

Prognosis:

- **Early diagnosis + strict cardiovascular monitoring = increased lifespan**.
- **With proper management, patients can live into their 70s+**.
- **Without treatment, life expectancy is significantly reduced (due to aortic dissection).**

▼ Exostosis

Definition:

Exostosis is a benign bony outgrowth arising from the surface of a bone, commonly covered by cartilage. It may develop due to genetic factors, chronic irritation, or repetitive stress.

Types of Exostosis:

1. **Osteochondroma (Multiple Hereditary Exostoses):**
   - Most common type.
   - Involves cartilage-capped bony projections from long bones.
   - Can cause **deformity, pain, and restricted movement**.
   - Risk of **malignant transformation** (chondrosarcoma) in multiple hereditary exostoses.
2. **Subungual Exostosis:**
   - Occurs beneath the toenails or fingernails.
   - Often associated with chronic irritation.
3. **Buccal and Mandibular Exostosis:**
   - Bony overgrowths in the **oral cavity** (jawbone).
   - Commonly seen in dental conditions.
4. **Surfer's Ear (External Auditory Exostosis):**
   - Results from **chronic exposure to cold water/wind**.
   - Leads to narrowing of the ear canal.

Clinical Features:

- Hard, **painless** bony swelling.
- May cause **pain or nerve compression** if large.
- **Restricted joint movement** in some cases.
- Cosmetic concerns in **visible locations**.

Diagnosis:

- **X-ray:** Shows bony outgrowth.
- **CT Scan/MRI:** Used for complex cases or suspected malignancy.

Treatment:

- **Observation:** If asymptomatic.
- **Surgical Excision:** If painful, growing, or causing complications.

39. Miscellaneous Regional Diseases

▼ Torticollis (Wry Neck)

Definition:

Torticollis, commonly known as **wry neck**, is a condition where the **head and neck are twisted or tilted to one side**. It can be **congenital or acquired**, and may be **temporary, permanent, or spasmodic**.

Causes of Torticollis

Torticollis can arise due to various **muscular, neurological, or skeletal** causes. Some common causes include:

1. Congenital Causes:

- **Sterno-mastoid tumor (Congenital Muscular Torticollis):**
  - Fibrosis of the sternocleidomastoid (SCM) muscle.
  - Possibly due to **ischemic injury at birth**.
  - Presents with a **palpable lump** in infancy.
- **Bony abnormalities:**
  - Klippel-Feil syndrome (congenital fusion of cervical vertebrae).

2. Acquired Causes:

- **Infectious:**
  - Tonsillitis, otitis media, or retropharyngeal abscess.
  - Atlanto-axial infections (e.g., tuberculosis).
- **Neurological:**
  - Spasmodic torticollis (dystonia-related muscle spasm).
  - Parkinson's disease, cerebral palsy.
- **Ophthalmologic:**
  - Compensation for **squint (ocular torticollis)**.
- **Postural/Reflexive:**
  - Acute disc prolapse (cervical spondylosis).

- **Rheumatologic:**
  - **Rheumatoid arthritis**, ankylosing spondylitis.

Pathogenesis of Congenital Torticollis

- Occurs due to **fibrosis and shortening** of the **sternocleidomastoid (SCM) muscle**.
- **Ischemic necrosis** of the muscle during birth leads to **scar formation**.
- A **fibrotic, non-stretchable muscle** prevents normal neck movement, leading to **progressive deformity**.
- Facial **asymmetry and skull deformation** can develop over time.

Clinical Features

- **Head tilt** to one side with the **chin rotated to the opposite side**.
- **Restricted neck movement**.
- **Palpable, firm, non-tender mass** in the SCM muscle in congenital cases.
- **Facial asymmetry** and secondary skull deformities in long-standing cases.
- In acquired torticollis, **pain and muscle spasm** may be present.

Diagnosis

- **Clinical examination:**
  - Head tilt with SCM tightness.
  - Passive movement restriction.
- **Radiology:**
  - **X-ray of the cervical spine** to rule out **bony abnormalities**.
  - **MRI** in cases of suspected neurological causes.
- **Ophthalmologic assessment** for suspected **ocular torticollis**.

Treatment

1. Non-Surgical Management: (For mild cases)

- **Passive stretching** exercises (in infants).
- **Physiotherapy** and muscle relaxation.
- **Neck braces** in postural cases.
- **Botulinum toxin (Botox) injections** in **spasmodic torticollis**.

2. Surgical Management:

- **Indicated in severe congenital cases** where physiotherapy fails.
- **Sternocleidomastoid muscle release or Z-plasty**.
- **Cervical spine surgery** in cases of bony abnormalities.

Complications

- **Permanent facial asymmetry**.
- **Cervical spine deformities**.
- **Restricted neck mobility**.
- **Chronic pain and stiffness** in adults with spasmodic torticollis.

Prognosis

- **Early treatment (physiotherapy)** leads to **excellent recovery**.
- **Severe untreated cases** may require **surgical intervention**.

▼ Cervical Rib

Definition:

A cervical rib is an **extra rib arising from the seventh cervical vertebra (C7)**. It is a congenital anomaly, usually **unilateral but can be bilateral**, and is **more common on the right side**. This extra rib may be fully developed or present as a **fibrous band**.

Etiology and Pathogenesis:

- **Congenital anomaly** due to abnormal development of the **costal process of C7**.
- May remain **asymptomatic** or cause **compression of nearby neurovascular structures**, leading to **thoracic outlet syndrome (TOS)**.
- More common in **females**.

Clinical Features:

1. Asymptomatic Cases:

- Most cases are **incidentally detected** on **X-ray**.
- No functional impairment.

2. Symptomatic Cases: (Compression of structures)

A. Neurological Symptoms (Brachial Plexus Compression)

- **Tingling, numbness, and weakness** along the distribution of the **T1 dermatome**.
- **Clumsiness in hand movements**, difficulty in fine motor tasks.
- **Wasting of hand muscles** (Gilliatt-Sumner hand).

B. Vascular Symptoms (Subclavian Artery Compression)

- **Cold, pale hands** due to arterial insufficiency.
- **Claudication** (pain in hand with arm use).
- **Raynaud's phenomenon**.
- **Distal embolization** → leads to **gangrene of fingertips**.

C. Local Symptoms

- A **tender lump** above the **clavicle** (supraclavicular fossa).

- **Bony hard swelling on palpation**.

Diagnosis:

1. **X-ray (AP View of the Neck & Chest)**
   - Shows an **extra rib** articulating with **C7**.
   - May be **fully formed** or just an elongated transverse process.
2. **MRI/CT Scan**
   - Used to visualize **soft tissue** compression.
3. **Doppler Study or Angiography**
   - To check for **vascular compression**.
4. **Electromyography (EMG) & Nerve Conduction Studies**
   - Confirms **brachial plexus involvement**.

Differential Diagnosis:

Cervical rib symptoms must be differentiated from:

- **Carpal tunnel syndrome:** Median nerve compression.
- **Cervical spine lesions:** Disc prolapse affecting nerve roots.
- **Spinal cord lesions:** Syringomyelia, tumors.
- **Ulnar neuritis:** May mimic lower brachial plexus compression.

Treatment:

1. Conservative Management:

- **Physiotherapy**: Shoulder shrugging, stretching exercises.
- **Postural correction**: Avoid prolonged overhead work.
- **Analgesics & muscle relaxants** for pain relief.

2. Surgical Management (Indicated in severe cases):

- **First rib/cervical rib excision**: Done if there is **severe neurovascular compression**.
- **Scalene muscle resection** to relieve pressure.

Complications:

- **Chronic pain & muscle wasting**.
- **Severe ischemia & gangrene** of the fingers.
- **Recurrent symptoms even after surgery**.

Prognosis:

- **Asymptomatic cases require no treatment**.
- **Mild cases improve with physiotherapy**.
- **Severe cases may require surgical intervention** for relief.

▼ Bow Legs (Genu Varum)

Definition:

Bow legs, or **genu varum**, is a **lower limb deformity** in which the **knees remain apart when the ankles are touching**. This results in an outward curvature of the legs, resembling a **bow shape**. It is commonly seen in infants and young children but may persist due to **pathological causes**.

Etiology and Causes

1. Physiological (Normal Variant):

- Common in infants due to **fetal positioning in the womb**.
- Usually **resolves by age 2-3 years** as the child starts walking.

2. Pathological Causes:

A. Bone Softening Disorders

- **Rickets** (Vitamin D deficiency) – most common cause.
- **Osteomalacia** in adults.
- **Renal osteodystrophy** (chronic kidney disease).

B. Growth Plate Disorders

- **Blount's disease** (tibia vara) – progressive bowing due to **abnormal medial tibial growth**.
- **Achondroplasia** (genetic dwarfism).

C. Post-Traumatic Causes

- **Fractures affecting the growth plate**.
- **Growth plate infections (osteomyelitis)**.

D. Neuromuscular Disorders

- **Cerebral palsy**.
- **Muscular dystrophies**.

Pathophysiology:

- In **physiological cases**, **weight-bearing forces** cause the legs to straighten as the child grows.
- In **pathological cases**, **abnormal forces or weakened bones** cause persistent outward curvature of the legs.

Clinical Features:

1. Physical Examination:

- **Knees apart when feet are together**.
- **Increased inter-knee distance** (>6 cm may indicate pathology).
- **Waddling gait** in severe cases.

2. Associated Symptoms:

- **Pain in legs** (especially in rickets or Blount's disease).
- **Difficulty in walking or running**.
- **Limb length discrepancy** in unilateral cases.

Diagnosis:

1. Clinical Examination:

- Measurement of **intercondylar distance**.

2. Radiological Investigations:

- **X-ray of lower limbs (standing AP view)** → Confirms bowing and detects **growth plate abnormalities**.

- **MRI/CT Scan** → Used in complex cases to assess **tibia and femur involvement**.

3. Blood Tests:

- **Serum Calcium, Phosphorus, and ALP** → To diagnose **rickets or metabolic bone disease**.
- **Renal function tests** for **renal osteodystrophy**.

Management & Treatment:

1. Conservative Management (For Physiological Cases):

- **Observation** → Most cases **resolve by age 2-3 years**.
- **Nutritional correction** → Adequate **Vitamin D and calcium supplementation**.

2. Bracing (For Mild Pathological Cases):

- **Knee-ankle-foot orthosis (KAFO)** in **Blount's disease**.

3. Surgical Management (Severe or Progressive Cases):

- **Guided growth surgery (hemiepiphysiodesis)** → Temporary **growth plate stapling** to correct alignment.
- **Osteotomy** → Bone cutting and realignment in **severe deformities**.

Complications:

- **Persistent gait abnormalities**.
- **Early osteoarthritis of the knee**.
- **Limb length discrepancies**.

Prognosis:

- **Physiological genu varum resolves spontaneously**.
- **Pathological cases require early intervention** for optimal outcomes.

▼ Morant-Baker’s Cyst (Popliteal Cyst)

Definition:

A **Baker’s cyst**, also known as a **popliteal cyst**, is a **fluid-filled sac** located in the **popliteal fossa (behind the knee)**. It results from the **accumulation of synovial fluid**, often due to **underlying knee pathology** such as arthritis or meniscal injuries.

Etiology and Causes:

1. Primary Baker’s Cyst:

- Occurs **without an underlying joint disorder**.
- More common in **children**.
- Due to **excess synovial fluid production** by the gastrocnemio-semimembranosus bursa.

2. Secondary Baker’s Cyst: (More common in adults)

Associated with **knee joint pathology**, including:

- **Osteoarthritis (most common cause in adults)**.
- **Rheumatoid arthritis**.
- **Meniscal tears** (medial meniscus > lateral meniscus).
- **Synovitis or joint effusion**.
- **Gout or pseudogout**.
- **Trauma or intra-articular injuries**.

Pathophysiology:

- The **synovial membrane of the knee** produces excess fluid due to **inflammation or injury**.
- This **fluid accumulates** in the **gastrocnemio-semimembranosus bursa**, leading to **cyst formation**.

- The cyst may **increase in size**, causing **compression of surrounding structures**.
- In some cases, the cyst **ruptures**, leading to **pain and calf swelling** (mimicking deep vein thrombosis).

Clinical Features:

1. Symptoms:

- **Swelling behind the knee** (soft or firm, varies with knee position).
- **Pain or discomfort** (especially with knee extension).
- **Stiffness and reduced knee mobility**.
- **Feeling of fullness or tightness** in the **popliteal fossa**.

2. Signs on Examination:

- **Palpable cystic swelling** in the **popliteal fossa**.
- **Fluctuation test positive** (fluid-filled nature).
- **Transillumination negative** (as it contains synovial fluid).
- **Foucher's Sign:**
  - The cyst becomes **less prominent on knee flexion** and **more prominent on knee extension**.
- **Complications:**
  - **Cyst rupture** → Severe calf pain, redness, and swelling (mimics DVT).
  - **Compression of popliteal vein** → Can cause **venous stasis** and **leg swelling**.
  - **Nerve compression** → **Tibial nerve involvement** may cause **numbness or weakness**.

Diagnosis:

1. Clinical Examination:

- **Popliteal mass with restricted knee movement**.

- **Foucher's sign positive**.

2. Imaging Studies:

- **Ultrasound (Initial Investigation of Choice)**
  - Confirms the presence of a **fluid-filled cyst**.
  - Differentiates from **solid tumors or vascular pathologies**.
- **MRI (Gold Standard for Diagnosis)**
  - Identifies **cyst size, location, and underlying joint pathology**.
  - Detects **meniscal tears, arthritis, or synovitis**.
- **X-ray**
  - Usually normal but may show **associated osteoarthritis**.
- **Doppler Ultrasound**
  - If **DVT is suspected**, to rule out **vascular compression**.

Treatment:

1. Conservative Management (For Small, Asymptomatic Cysts):

- **Observation** → Small cysts **resolve spontaneously**.
- **NSAIDs (e.g., ibuprofen, naproxen)** → Pain relief and inflammation control.
- **Physiotherapy** → Strengthening exercises to **reduce joint stress**.
- **Compression Bandages** to reduce swelling.

2. Interventional Management (For Large or Symptomatic Cysts):

- **Aspiration of the cyst** → Temporary relief but high recurrence.
- **Corticosteroid injection** → Reduces inflammation, especially in **rheumatoid arthritis-associated cysts**.

3. Surgical Management (For Persistent or Complicated Cysts):

- **Arthroscopic debridement** (if meniscal tear is present).
- **Open cyst excision** (if cyst is large, recurrent, or causing severe compression).

Complications:

- **Rupture of the cyst** → Causes **severe calf swelling and pain**.
- **Venous compression** → **Mimics DVT**.
- **Persistent pain and stiffness** in chronic cases.

Prognosis:

- **Small cysts often resolve spontaneously**.
- **Large or symptomatic cysts may require intervention**.
- **Treatment of underlying joint pathology is crucial to prevent recurrence**.

▼ Loose Bodies in Joints

Definition:

Loose bodies are **small fragments of bone or cartilage** that become **detached and freely float within a joint space**. These can lead to **joint locking, pain, swelling, and restricted movement**.

Etiology and Causes:

Loose bodies commonly result from **joint injuries, degenerative conditions, or synovial disorders**. Common causes include:

1. Traumatic Causes

- **Osteochondral fractures** due to **acute trauma**.
- **Repetitive microtrauma** in athletes.
- **Post-surgical complications** (after arthroscopy or ligament repair).

2. Degenerative Joint Diseases

- **Osteoarthritis** → Cartilage breakdown releases small fragments into the joint.
- **Avascular necrosis** → Dead bone fragments dislodge.

3. Synovial Disorders

- **Synovial chondromatosis** (formation of cartilaginous nodules within the joint).
- **Pigmented Villonodular Synovitis (PVNS)**.

4. Other Causes

- **Tuberculosis (joint TB)** leading to loose sequestra.
- **Gout or pseudogout** → Crystal-induced cartilage damage.

Pathophysiology:

- **Cartilage or bone fragments detach** due to injury or disease.

- The **free fragments** move within the joint, interfering with smooth movement.
- The body may **attempt to encapsulate these loose bodies**, leading to **synovial irritation, inflammation, and effusion**.

Clinical Features:

1. Symptoms:

- **Intermittent locking of the joint** (sudden inability to move).
- **Pain and swelling** (worsened with movement).
- **Catching or clicking sensation**.
- **Occasional relief when the loose body moves away** from the articulating surfaces.

2. Signs on Examination:

- **Joint effusion** (swelling due to fluid accumulation).
- **Restricted range of motion**.
- **Palpable loose body** in superficial joints (like the knee or elbow).

Commonly Affected Joints:

- **Knee joint** (most common).
- **Elbow joint**.
- **Hip joint**.
- **Ankle and shoulder (less common)**.

Diagnosis:

1. Radiological Investigations:

- **X-ray:** Detects **calcified loose bodies**.

- **MRI (Best Imaging Modality):** Identifies **cartilaginous loose bodies** and **associated pathology**.
- **CT Scan:** Useful for **bony fragments** and **joint damage**.
- **Ultrasound:** Can detect **floating loose bodies** in superficial joints.

Treatment:

1. Conservative Management (For Small, Asymptomatic Cases)

- **Observation** → If there are **no major symptoms**.
- **NSAIDs (e.g., ibuprofen, diclofenac)** → To reduce pain and inflammation.
- **Physiotherapy** → Strengthening exercises to prevent stiffness.

2. Surgical Management (For Symptomatic or Large Loose Bodies)

- **Arthroscopic Removal (Preferred Method)**
  - Minimally invasive.
  - Effective in **knee, shoulder, or elbow joints**.
- **Open Surgery (Arthrotomy)**
  - Required for **deeply embedded loose bodies**.
  - Used in **hip joint** where arthroscopy may be difficult.

Complications:

- **Persistent joint locking**.
- **Secondary osteoarthritis** due to chronic irritation.
- **Chronic pain and stiffness**.

Prognosis:

- **Early removal of loose bodies** provides **good symptom relief**.

- **Neglected cases may develop degenerative arthritis**.

▼ Genu Valgum (Knock Knees)

Definition:

Genu valgum, commonly known as **knock knees**, is a **lower limb deformity** where the knees touch while the ankles remain apart when standing. It is a common condition in children but may persist or develop due to **pathological causes**.

Causes:

1. Physiological (Normal Variant):

- **Common in children aged 2-6 years**.
- Usually **self-corrects** by **age 7** without treatment.

2. Pathological Causes:

- **Rickets (Vitamin D deficiency)** – most common pathological cause.
- **Renal osteodystrophy** (chronic kidney disease).
- **Obesity** – increased stress on knee joints.
- **Genetic conditions** (e.g., Down syndrome).
- **Post-traumatic deformities** (improper healing after fractures).

Clinical Features:

- **Knees touch while feet remain apart** (>8 cm inter-malleolar distance).
- **Waddling gait** in severe cases.
- **Pain or discomfort** in long-standing cases.
- **Early osteoarthritis** risk if untreated.

Diagnosis:

- **Clinical examination** – measuring the **inter-malleolar distance**.

- **X-ray (standing AP view of lower limbs)** – assesses bone alignment.
- **Blood tests (calcium, phosphorus, ALP, Vitamin D)** – if rickets is suspected.

Treatment:

1. Conservative Management (For Mild/Physiological Cases):

- **Observation** – resolves spontaneously in most cases.
- **Nutritional correction** – adequate Vitamin D and calcium.
- **Weight management** in obese children.

2. Surgical Management (For Severe Cases):

- **Guided growth surgery (hemiepiphysiodesis)** – temporary growth plate modulation.
- **Corrective osteotomy** – for severe, persistent deformities.

Prognosis:

- **Physiological cases resolve by age 7**.
- **Pathological cases need early intervention** to prevent joint complications.

▼ Genu Recurvatum

Definition:

Genu recurvatum is a **knee deformity** characterized by **hyperextension of the knee joint**, causing the tibia to shift excessively **backward relative to the femur**. This results in a **backward bending (hyperextension) posture** of the knee when standing.

Causes:

1. Congenital Causes:

- **Laxity of ligaments** (common in hypermobile individuals).

- Volkmann’s Ischemic Contracture (VIC)

15. Injuries of the Forearm and the Wrist

- Colles’ Fracture
- Monteggia Fracture-Dislocation
- Galeazzi Fracture-Dislocation
- Smith’s Fracture
- Fracture of the Scaphoid Bone

16. Hand Injuries

- Bennett’s Fracture-Dislocation
- Mallet Finger

17. Pelvic Fractures

18. Injuries around the Hip

- Posterior Dislocation of the Hip
- Fracture Neck of Femur
- Avascular Necrosis (AVN) of the Femoral Head

19. Fracture Shaft of Femur

20. Injuries around the Knee

- Knee Bursae
- Fracture of the Patella

- Genu Recurvatum
- Flat Foot (Pes Planus)

40. Amputations, Prosthesis and Orthotics

- Disarticulation
- Above-Knee Amputation (AKA)
- Below-Knee Amputation (BKA)
- Syme’s Amputation
- Crutches
- Jaipur Foot
- Ankle-Foot Orthosis (AFO)
- Cervical Collar

41. Arthroscopic Surgery

▼ Arthroscopy

Definition:

Arthroscopy is a **minimally invasive surgical technique** used to diagnose and treat **joint disorders**. A **small camera (arthroscope)** is inserted into the joint through a **tiny incision**, allowing real-time visualization and surgical intervention.

Indications for Arthroscopy:

1. Knee Joint:

- **Meniscal injuries** (partial or complete meniscectomy).
- **Loose body removal**.
- **Chondroplasty** (cartilage repair).
- **Ligament reconstruction** (ACL/PCL injuries).
- **Synovial biopsy for inflammatory conditions**.
- **Arthrolysis (release of a stiff knee joint)**.

2. Shoulder Joint:

- **Recurrent shoulder dislocation (Bankart repair)**.
- **Rotator cuff repair**.
- **Subacromial decompression** (for impingement syndrome).
- **Synovectomy in inflammatory arthritis**.

3. Other Joints:

- **Ankle joint:** Correction of **anterior impingement, chondroplasty, and arthrodesis**.
- **Elbow joint:** Removal of **loose bodies and synovectomy**.
- **Wrist joint:** Diagnosis and treatment of **ligament injuries and cartilage damage**.

Advantages of Arthroscopy:

- **Minimally invasive** (small incisions, less pain, faster recovery).
- **Day-care procedure** (patient discharged the same day).
- **Better cosmetic outcome** (barely visible scars).
- **Faster rehabilitation** with early return to function.
- **Lower risk of infection compared to open surgery**.

Surgical Procedure of Arthroscopy:

1. Preoperative Preparation:

- **Patient positioning** depends on the joint being operated on.
- **Spinal or general anesthesia** is used.
- **A tourniquet may be applied** in knee arthroscopy for better visualization.

2. Steps of Arthroscopy:

1. **Portals (Incisions):**
    - **Small incisions** are made around the joint.
    - **Arthroscope inserted through one portal**, surgical instruments through another.
2. **Joint Visualization:**
    - **Saline or gas distention** to improve visibility.
    - Real-time **examination of intra-articular structures**.
3. **Surgical Correction (If Needed):**
    - **Meniscus trimming, ligament reconstruction, or cartilage repair**.
    - Removal of **loose bodies or inflamed synovium**.
4. **Closure and Postoperative Care:**
    - **Minimal sutures or adhesive strips**.
    - **Early mobilization encouraged**.

Limitations of Arthroscopy:

- **Not suitable for advanced osteoarthritis**.
- **High surgical expertise required** (steep learning curve).
- **Cannot repair extensive cartilage loss**.

Complications of Arthroscopy:

- **Infection (septic arthritis, rare but serious)**.
- **Hemarthrosis (bleeding into the joint)**.
- **Deep vein thrombosis (DVT)** due to immobilization.
- **Instrumental damage to cartilage or ligaments**.

Prognosis and Rehabilitation:

- **Rapid recovery with early return to daily activities**.
- **Physiotherapy plays a crucial role in regaining joint strength**.
- **Success rates are high in meniscus and ligament injuries**.

42. Joint Replacement Surgery

▼ Hemiarthroplasty

Definition:

Hemiarthroplasty is a **partial joint replacement** where **only one side of a joint is replaced** with a prosthetic component while the other side remains intact. The most common example is **replacement of the femoral head** while retaining the natural acetabulum in hip fractures.

Indications:

- **Fracture neck of femur** in elderly patients.
- **Avascular necrosis of the femoral head** (early stages).
- **Hip joint arthritis (if acetabulum is intact)**.
- **Failed internal fixation of hip fractures**.

Types of Hemiarthroplasty:

1. **Monopolar Prosthesis:**
    - A single-piece femoral head prosthesis.
    - Less movement between components.
2. **Bipolar Prosthesis:**
    - Two-piece prosthesis where movement occurs between the prosthesis head and acetabulum, reducing acetabular wear.
    - Preferred in younger, more active patients.
3. **Cemented vs. Uncemented Prosthesis:**
    - **Cemented:** Uses bone cement for fixation (preferred in elderly).
    - **Uncemented:** Relies on natural bone growth for fixation (preferred in younger patients).

Surgical Procedure:

1. **Hip is exposed and dislocated**.
2. **Femoral head is resected** and replaced with a prosthesis.
3. **Prosthesis is secured with or without cement**.
4. **Hip is reduced and wound closed**.

Advantages:

- **Less invasive than total hip replacement**.
- **Shorter recovery time**.
- **Lower risk of dislocation compared to total hip replacement**.

Complications:

- **Dislocation of prosthesis**.
- **Aseptic loosening** over time.
- **Deep vein thrombosis (DVT)**.
- **Periprosthetic fracture**.

Prognosis:

- Good functional recovery with **early mobilization and physiotherapy**.
- Suitable for elderly patients with **low activity levels**.

43. Imaging Modalities in Orthopedics

Clinical Methods

▼ Trendelenburg Gait and Trendelenburg Test

Trendelenburg Gait (Gluteus Medius Gait)

Definition:

Trendelenburg gait is an **abnormal walking pattern** caused by **weakness of the gluteus medius and minimus muscles**, which are responsible for hip stabilization.

Gait Pattern:

- When the patient **bears weight on the affected side**, the **opposite side of the pelvis drops** instead of remaining level.
- The patient may **lean toward the affected side** to compensate for the hip instability.

Causes:

- **Gluteus medius and minimus weakness** (due to superior gluteal nerve injury).
- **Hip joint pathology** (e.g., hip dislocation, fracture neck of femur).
- **Congenital hip conditions** (e.g., developmental dysplasia of the hip, congenital coxa vara).

Trendelenburg Test

Purpose:

- Assesses **gluteus medius and minimus muscle function**.
- Detects **hip instability or abductor muscle weakness**.

Procedure:

1. The patient is asked to **stand on one leg** (lifting the opposite leg off the ground).
2. The examiner observes the **position of the pelvis**.
3. **Normal result:** The pelvis on the **lifted side remains level or slightly elevates**.

4. **Positive Trendelenburg Sign:** The pelvis on the **lifted side drops** due to weak hip abductors on the **stance side**.

Interpretation:

- **Positive Trendelenburg sign on the right → Weak left gluteus medius/minimus.**
- **Positive Trendelenburg sign on the left → Weak right gluteus medius/minimus.**

Clinical Significance:

- Important in **diagnosing hip joint disorders** and **nerve injuries**.
- Helps in **preoperative evaluation before hip replacement surgery**.
- Indicates **muscle rehabilitation needs** for hip stability.

▼ McMurray’s Test

Definition:

McMurray’s test is a **clinical examination maneuver** used to detect **meniscal tears** in the knee joint. It is particularly useful for diagnosing **medial and lateral meniscus injuries**.

Indications:

- **Suspected meniscal tear** due to trauma or degenerative changes.
- **Symptoms of knee locking, clicking, or pain**.
- **Post-sports injury assessment** in athletes.

Procedure:

1. **Patient Position:**
   - The patient lies **supine** on the examination table.
2. **Examiner’s Position:**
   - The examiner stands beside the affected knee.
   - One hand **firmly holds the heel/foot**.
   - The other hand **stabilizes the knee** by palpating the joint line.
3. **Test Maneuver:**
   - The knee is **fully flexed**.
   - **External rotation + valgus stress** → Tests **medial meniscus**.
   - **Internal rotation + varus stress** → Tests **lateral meniscus**.
   - The knee is then **slowly extended** while maintaining rotation.
4. **Positive McMurray’s Test:**
   - A **painful click or popping sensation** over the joint line.
   - Indicates a **meniscal tear**, with pain location suggesting **medial or lateral meniscus involvement**.

Interpretation:

- **Medial Meniscus Tear:** Pain/clicking with **external rotation + valgus stress**.
- **Lateral Meniscus Tear:** Pain/clicking with **internal rotation + varus stress**.

Clinical Significance:

- **Highly specific** for **detecting meniscal tears**.
- Often **combined with Apley's grinding test** for confirmation.
- Helps in deciding **conservative vs. surgical management**.

Orthopedic Instruments

▼ Austin-Moore Prosthesis

Definition:

The **Austin-Moore prosthesis** is a **partial hip replacement implant** used for **femoral head replacement** in **elderly patients** with a **fracture of the neck of the femur**.

Indications:

- **Intracapsular fracture neck of femur** (especially in elderly patients).
- **Avascular necrosis of the femoral head**.
- **Failed internal fixation of hip fractures**.

Design and Features:

- **Made of metal (stainless steel or cobalt-chromium alloy)**.
- **Small head and neck with a long stem**.
- **Available in different head sizes (35–59 mm, odd numbers)**.
- **Has fenestrations (holes) in the stem** → Allows **bone ingrowth** for biological fixation.
- **Small hole at the top of the stem** → Used for hook attachment during removal.

Fixation Method:

- **Used without cement** to allow **bone ingrowth** through fenestrations.
- **Press-fit technique** helps in natural fixation.

Advantages:

- **Simple and cost-effective**.
- **Less invasive than total hip replacement**.
- **Provides early pain relief and mobility**.

Limitations:

- **Higher risk of loosening over time**.
- **Not suitable for young, active patients**.
- **Increased chance of periprosthetic fracture**.

Prognosis:

- Best suited for **elderly patients with low activity levels**.
- **Requires good bone quality for proper fixation**.

▼ Kirschner Wire (K-Wire)

Definition:

Kirschner wire (K-wire) is a **thin, straight stainless steel wire** used for **internal fixation of fractures** and **skeletal traction**. It has a **diameter of 1–3 mm** and is commonly used in **orthopedic and trauma surgeries**.

Indications:

- **Internal fixation of small bone fractures** (e.g., fingers, toes, wrist fractures).
- **Percutaneous pinning** for **metacarpal and phalangeal fractures**.
- **Traction applications** (e.g., olecranon traction, femoral traction in children).
- **Temporary stabilization** in fracture management before definitive fixation.

Types of K-Wire Fixation:

1. **Smooth K-Wires:**
   - Used for **temporary fixation**.
   - Can be **easily removed** after healing.
2. **Threaded K-Wires:**
   - Provide **better grip** within the bone.
   - Reduce the risk of **migration**.

Technique of K-Wire Insertion:

1. The fracture is **reduced** under **fluoroscopic guidance**.
2. The K-wire is inserted using a **drill or manually with a T-handle**.
3. The wire is **cut and bent** to prevent migration.
4. **Removal is done after fracture healing**, usually after **3–6 weeks**.

Advantages:

- **Minimally invasive** (reduces soft tissue damage).
- **Cost-effective** and easy to use.
- **Quick and simple fracture stabilization**.

Limitations:

- **Less rigid fixation compared to plates and screws**.
- **Risk of K-wire migration**.
- **Infection risk if exposed** outside the skin.

Prognosis:

- Provides **good fracture stability** for small bones.
- Often used **temporarily** before definitive fixation.

Miscellaneous

- Ainhum

Definition:

Ainhum is a **progressive, constrictive fibrous band formation** around the base of the **fifth toe**, leading to **autoamputation** over time. It primarily affects individuals in **tropical regions** and is idiopathic in origin.

Causes and Risk Factors:

- **Unknown exact cause** (Idiopathic).
- More common in **African and South American populations**.
- Associated with **chronic trauma, barefoot walking, and poor circulation**.

Clinical Features:

- **Painful groove or constriction** around the **fifth toe**.
- Progressive **fibrosis leading to ischemia**.
- **Ulceration, necrosis, and autoamputation** in advanced cases.
- **No systemic symptoms**, affecting only the toe.

Diagnosis:

- **Clinical examination** (classic constriction band around the fifth toe).
- **X-ray:** Shows progressive bone resorption and eventual separation.
- **Doppler ultrasound:** To assess blood flow if vascular compromise is suspected.

Treatment:

Early Stages:

- **Avoid trauma and pressure** (wear protective footwear).
- **Moisturizing agents** to reduce skin thickening.

- **Surgical excision of the constriction band** to prevent progression.

Advanced Stages:

- **Toe amputation** in cases of **severe ischemia or necrosis**.

Prognosis:

- **Slow progression over months to years**.
- **Early intervention can prevent autoamputation**.

▼ Synovial Fluid

Definition:

Synovial fluid is a **viscous, clear, or slightly yellowish fluid** found within **synovial joints**, providing **lubrication, shock absorption, and nutrient supply** to the articular cartilage.

Composition:

- **Water (95%)** – Provides hydration and joint lubrication.
- **Hyaluronic Acid** – Responsible for viscosity and elasticity.
- **Lubricin** – Reduces friction between cartilage surfaces.
- **Proteins (albumin, globulin)** – Maintains joint homeostasis.
- **Glucose and Electrolytes** – Similar to plasma but slightly lower glucose levels.
- **Cells (WBCs, macrophages)** – Normally **<200 cells/µL**, helps in immune defense.

Functions:

1. **Lubrication** – Reduces friction between joint surfaces.
2. **Shock Absorption** – Cushions joints from impact forces.
3. **Nourishment of Cartilage** – Provides essential nutrients to avascular cartilage.
4. **Waste Removal** – Eliminates metabolic waste products.

Synovial Fluid Analysis (Diagnostic Importance):

- **Normal:** Clear, viscous, WBC <200/µL.
- **Inflammatory Arthritis (RA, Gout):** Cloudy, increased WBCs, crystals may be present.
- **Septic Arthritis:** Purulent, WBC >50,000/µL, positive culture.
- **Traumatic Hemarthrosis:** Bloody appearance.

Clinical Significance:

- Synovial fluid aspiration (**arthrocentesis**) helps diagnose **arthritis, infections, and joint disorders**.
- **Viscosity changes** indicate **rheumatoid arthritis or infection**.

▼ Laser Therapy

Definition:

Laser therapy is a **non-invasive treatment** that uses **focused light energy** to **stimulate tissue healing, reduce pain, and decrease inflammation**. It is commonly used in **orthopedics, dermatology, and physiotherapy**.

Types of Laser Therapy:

1. **Low-Level Laser Therapy (LLLT)** (Cold Laser)
   - Used for **pain relief, wound healing, and inflammation reduction**.
   - Common in **arthritis, tendonitis, and soft tissue injuries**.
2. **High-Intensity Laser Therapy (HILT)**
   - Used in **surgical procedures and deep tissue penetration**.
   - Effective in **cutting, coagulation, and vaporization of tissues**.

Mechanism of Action:

- **Photobiomodulation:** Laser light stimulates **cellular repair and ATP production**.
- **Increases blood circulation**, enhancing **oxygen and nutrient supply**.
- **Reduces inflammation and pain** by modulating **nerve activity**.

Indications:

- **Musculoskeletal disorders** (arthritis, tendonitis, sprains).
- **Wound healing and ulcer management**.
- **Nerve regeneration (neuropathy, sciatica)**.
- **Post-surgical pain management**.

Advantages:

- **Non-invasive and painless**.
- **Fast recovery with minimal side effects**.
- **Can be used alongside conventional therapies**.

Limitations:

- **Not effective for deep-seated tumors or advanced diseases**.
- **Requires multiple sessions for optimal results**.
- **Contraindicated in malignancies and pregnant women**.

▼ Biomechanics of the Knee Joint

Definition:

The knee joint is a **hinge-type synovial joint** that allows **flexion, extension, and slight rotation**, playing a crucial role in **weight-bearing and movement**.

Components of Knee Biomechanics:

1. Movements and Range of Motion (ROM):

- **Flexion:** 0° to 135° (e.g., bending the knee).
- **Extension:** 0° (full straightening).
- **Internal Rotation:** ~10° (when flexed).
- **External Rotation:** ~30° (when flexed).

2. Load Transmission:

- The knee **bears 3-5 times body weight** during activities like walking or running.
- **Menisci distribute loads** to reduce stress on cartilage.

3. Stability Mechanisms:

- **Ligaments:**
  - **ACL (Anterior Cruciate Ligament):** Prevents **anterior tibial translation**.
  - **PCL (Posterior Cruciate Ligament):** Prevents **posterior tibial translation**.
  - **MCL & LCL (Medial & Lateral Collateral Ligaments):** Provide **side-to-side stability**.
- **Muscles:**
  - **Quadriceps:** Controls knee extension.
  - **Hamstrings:** Assist flexion and stabilize against anterior tibial movement.
- **Patellofemoral Joint Mechanics:**
  - The **patella increases the leverage of the quadriceps**, improving knee extension efficiency.

4. Screw Home Mechanism:

- During full extension, the tibia **externally rotates** on the femur for a **locked and stable knee**.

Clinical Relevance:

- **ACL injuries** affect knee stability.
- **Osteoarthritis leads to cartilage wear** and biomechanical imbalance.
- **Patellar tracking issues** cause anterior knee pain.

Anesthesia

▼ Spinal Anesthesia

Overview

Spinal anesthesia is a regional anesthesia technique where a local anesthetic is injected into the subarachnoid space to block nerve impulses, resulting in loss of sensory, motor, and autonomic function below the level of injection. It is widely used for lower limb, abdominal, pelvic, and perineal surgeries due to its rapid onset, effective analgesia, and minimal systemic effects.

Mechanism of Action

- Local anesthetic blocks **nerve conduction in the spinal cord** by inhibiting **sodium channels**.
- **Sympathetic block** occurs **three segments higher** than the sensory block.
- **Motor block** occurs **three segments lower** than the sensory block.
- Causes **vasodilation, hypotension, and muscle relaxation**.

Indications of Spinal Anesthesia

- **Lower abdominal surgeries** – Hernia repair, appendectomy, cesarean section.
- **Pelvic surgeries** – Gynecological and urological procedures.
- **Lower limb surgeries** – Orthopedic procedures like hip and knee replacements.
- **Perineal and anorectal surgeries** – Hemorrhoidectomy, fistula repair.

Contraindications

Absolute Contraindications

- **Cardiac disease** (Severe aortic/mitral stenosis, hypovolemia).
- **Increased intracranial pressure** (Risk of brainstem herniation).
- **Sepsis or infection at the injection site**.
- **Allergy to local anesthetic drugs**.

Relative Contraindications

- **Spinal tumors or neurological disorders (syringomyelia, multiple sclerosis)**.
- **Severe kyphoscoliosis or spinal deformities**.
- **Bleeding disorders or anticoagulant therapy** (risk of spinal hematoma).

Positioning for Spinal Anesthesia

- **Lateral decubitus position** – Patient lies on the side with knees **fully flexed** and **chin tucked** to open the interlaminar space.
- **Sitting position** – Used in **obese patients** or those undergoing lower limb surgery.

Landmark:

- The **highest point of the iliac crest corresponds to the L4 vertebra**, used for needle insertion.

Drugs Used

- **Lignocaine 5% in 6% dextrose** (2 mL) – Short-acting anesthetic.
- **Bupivacaine 0.5% in 5% dextrose** (3 mL) – Long-acting anesthetic.
- **Cinchochaine 0.5% in 6% dextrose** (2 mL) – Used in **obstetric anesthesia**.

Procedure & Technique

1. **Preparation**
   - Ensure **aseptic precautions**.
   - Identify **L3-L4 or L4-L5 intervertebral space**.
   - Use a **24-26G spinal needle with a stylet**.
2. **Needle Insertion**
   - Pass the needle through **the interspinous ligament and ligamentum flavum**.
   - A **loss of resistance and free CSF flow confirms correct placement**.

3. **Drug Injection**
    - **Rotate the needle 360 degrees** and inject the drug **slowly** (0.5 mL/sec).
    - Patient is **repositioned supine** for uniform spread.
4. **Onset & Duration**
    - **Onset:** 15 minutes.
    - **Duration: 2-4 hours** (depends on the drug used).

Types of Spinal Anesthesia

1. **Caudal (up to L5)** – Used in **pediatric anesthesia**.
2. **Low spinal (up to L1)** – Used for **perineal and urological surgeries**.
3. **Mid-spinal (up to T10)** – Used for **lower abdominal surgeries**.
4. **High spinal (up to T6)** – Used for **cesarean sections and upper abdominal surgeries**.
5. **Unilateral spinal** – Used for **limb surgeries to minimize hemodynamic effects**.

Advantages of Spinal Anesthesia

- **Economical** – Lower cost compared to general anesthesia.
- **Rapid onset with profound anesthesia**.
- **Reduces intraoperative bleeding** due to sympathetic vasodilation.
- **Less risk of aspiration and respiratory complications**.
- **Adequate muscle relaxation** for surgical procedures.

Disadvantages and Complications

1. Early Complications

- **Hypotension and bradycardia** – Due to sympathetic blockade.
- **Total spinal anesthesia** – Can cause **respiratory paralysis** requiring ventilation.

- **Headache (Post-Dural Puncture Headache - PDPH)** – Due to **CSF leakage**.
- **Nausea and vomiting** – Secondary to hypotension.

2. Late Complications

- **Infection (Meningitis, Abscess formation)** – Due to **poor aseptic technique**.
- **Spinal hematoma** – Risk in **anticoagulated patients**.
- **Neurological deficits (extremely rare)** – Persistent nerve damage.

Comparison: Spinal vs Epidural Anesthesia

Feature	**Spinal Anesthesia**	**Epidural Anesthesia**
Injection Site	Subarachnoid space	Epidural space
Needle Used	24-26G needle	Touhy needle
Onset	Rapid (5-15 min)	Slow (20-30 min)
Duration	2-4 hours	Can be prolonged
Motor Block	Complete	Partial
Hemodynamic Effects	More pronounced	Less severe
Indications	Short procedures	Long/continuous anesthesia

Saddle Block (A Variant of Spinal Anesthesia)

- **Used for perineal and anorectal surgeries** (e.g., hemorrhoidectomy).
- **Limited to lower sacral roots**, causing **anesthesia of the perineum while sparing the lower limbs**.

Management of Complications

1. **Hypotension** – Administer **IV fluids, vasopressors (ephedrine, phenylephrine)**.
2. **Bradycardia** – **Atropine IV** if severe.

3. **Post-Dural Puncture Headache (PDPH)** –
    - **Hydration, caffeine, analgesics**.
    - If persistent, **epidural blood patch** is used.
4. **Neurological Injury** – Immediate **neurology consultation and MRI**.

▼ Regional Anesthesia

Overview

Regional anesthesia involves the administration of **local anesthetic agents** to block nerve conduction in a **specific region of the body**, providing **analgesia and muscle relaxation** while maintaining consciousness. It is commonly used for **surgical, obstetric, and pain management procedures** as an alternative to **general anesthesia**.

Mechanism of Action

- Local anesthetics work by **blocking sodium channels**, preventing the propagation of **nerve impulses**.
- This leads to **loss of sensory, motor, and autonomic function** in the affected area.
- The degree of block depends on **nerve fiber type**, **local anesthetic concentration**, and **site of injection**.

Advantages of Regional Anesthesia

- **Avoids risks of general anesthesia** (airway complications, nausea, and vomiting).
- **Provides superior postoperative pain relief**.
- **Less blood loss during surgery** due to vasodilation.
- **Faster recovery and early mobilization**.
- **Reduced opioid requirement** postoperatively.

Types of Regional Anesthesia

1. Peripheral Nerve Blocks

A specific nerve or group of nerves is anesthetized to provide **localized anesthesia** for surgeries.

Common Nerve Blocks

- **Dental Block** – Inferior alveolar and lingual nerve block for tooth extraction.
- **Digital Nerve Block** – Used for **finger and toe surgeries**.
- **Intercostal Nerve Block** – For **rib fractures and thoracic surgeries**.
- **Ankle Block** – Provides anesthesia to the **foot**.
- **Brachial Plexus Block (Winnie's Block)** – Used for **upper limb surgeries**, given through:
  - **Interscalene approach**.
  - **Supraclavicular approach** (most common).
  - **Axillary approach**.
- **Cervical Plexus Block** – Used for **neck surgeries**.
- **Femoral and Sciatic Nerve Block** – Used in **lower limb surgeries**.

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2. Intravenous Regional Anesthesia (Bier's Block)

- Used for **short procedures on the upper or lower limbs**.
- A tourniquet is applied to **occlude blood flow**, and **local anesthetic is injected intravenously**.
- Provides **good analgesia for up to 2 hours**.

Precautions

- **Xylocaine with adrenaline should not be used**.
- **Sudden release of the tourniquet** can cause **hypotension, convulsions, or death**.

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3. Spinal Anesthesia

- **Injection of local anesthetic into the subarachnoid space**, causing **temporary loss of motor, sensory, and autonomic function** below the level of injection.
- Commonly used for **lower abdominal, pelvic, and lower limb surgeries**.

Technique

- **Patient Position:** Lateral decubitus with head, hips, and knees flexed.
- **Injection Site: L3-L4 or L4-L5 intervertebral space**.
- **Needle: 24-26 gauge spinal needle with a stylet**.
- **Onset:** 15 minutes, **Duration:** 2-4 hours.

Drugs Used

- **Lignocaine 5% in 6% dextrose** – Short-acting.
- **Bupivacaine 0.5% in 5% dextrose** – Long-acting.
- **Cinchochaine 0.5% in 6% dextrose** – Used in **obstetric anesthesia**.

Complications

- **Hypotension and bradycardia** due to sympathetic block.
- **Post-dural puncture headache (PDPH)**.
- **Neurological injury (rare)**.

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4. Epidural Anesthesia

- **Injection of local anesthetic into the epidural space**, allowing **continuous or repeated administration** of anesthetic agents.
- Used for **labor analgesia, postoperative pain relief, and long-duration surgeries**.

Technique

- **Touhy needle** is used for needle placement.
- **Epidural catheter** is inserted for **continuous drug administration**.

Advantages

- **Can be kept for several days** for prolonged pain relief.
- **Less hemodynamic instability compared to spinal anesthesia**.
- **Ideal for labor analgesia and postoperative pain control**.

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5. Caudal Anesthesia

- **Injection of local anesthetic into the sacral epidural space via the sacral hiatus**.
- Used for **pediatric surgeries, perineal surgeries, and hemorrhoidectomy**.

Complications

- **Intravascular injection** causing systemic toxicity.
- **Failure of caudal block**.

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6. Field Block

- A **ring of anesthesia is created around the surgical site**.
- Used in **inguinal hernia repair and thyroid surgery**.

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7. Infiltration Block

- **Direct injection of local anesthetic under the skin** for **small surgical procedures** (suturing, minor excisions).

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8. Topical Anesthesia

- **Applied as spray, gel, ointment, or solution** to **mucosal surfaces**.
- Used in **bronchoscopy, cystoscopy, and minor ENT procedures**.

Drugs Used in Regional Anesthesia

- **Lignocaine (Lidocaine)** – Most commonly used, **rapid onset, short duration**.
- **Bupivacaine (Marcaine)** – **Longer duration**, used for **spinal and epidural anesthesia**.
- **Ropivacaine** – Similar to bupivacaine but with **less cardiac toxicity**.
- **Procaine, Cocaine, Cinchocaine** – Less commonly used.

Complications of Regional Anesthesia

1. Immediate Complications

- **Hypotension and bradycardia** – Due to **sympathetic block** in spinal/epidural anesthesia.
- **Allergic reactions** to local anesthetics.
- **Respiratory depression** (high spinal block).
- **Toxicity (Bupivacaine-induced cardiac arrest in high doses)**.

2. Delayed Complications

- **Post-dural puncture headache (PDPH)** – CSF leakage after spinal anesthesia.
- **Infection (Meningitis, Epidural Abscess)** – Due to poor aseptic technique.
- **Nerve damage (rare)** – If needle damages a major nerve.

Comparison of Spinal vs Epidural Anesthesia

Feature	**Spinal Anesthesia**	**Epidural Anesthesia**
Injection Site	Subarachnoid space	Epidural space
Needle Used	24-26G needle	Touhy needle
Onset	Rapid (5-15 min)	Slow (20-30 min)
Duration	2-4 hours	Can be prolonged
Motor Block	Complete	Partial
Hemodynamic Effects	More pronounced	Less severe
Indications	Short procedures	Long/continuous anesthesia

▼ Epidural Anesthesia