STANDARD TREATMENT GUIDELINES

ORTHOPAEDICS

DEPARTMENT OF HEALTH AND FAMILY WELFARE

GOVERNMENT OF KERALA

KERALA.HEALTH

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for
ORTHOPAEDICS

Foreword

At the outset, I appreciate the work done by the respective thematic teams and coordination done by the DME. The Standard Treatment Guidelines (STG) were prepared and published in 2021 in the thick of the Covid pandemic. On the last page of these volumes the road map was mentioned. The few points are mentioned here for the recall.

"The Department of Health has been taking a systematic approach of creating and enabling multiple initiatives with a focus on prevention along with improving health care services. Health care service delivery is one of the most important services and is always seen as a barometer to assess the Governance. While it is important to develop infrastructure, an essential prerequisite is to develop systems and processes to bring in standardization in management of patient care. ……The foundation is laid and we take up the challenge to work on the unfinished agenda."

It was mentioned in the road map to have institutional mechanism to ensure updation of Standard Treatment Guidelines. The next step that was suggested was to do analysis of Karunya Arogya Suraksha Padhati (KASP) and standard treatment guidelines to work on developing a Balance Score Card to give information regarding compliance from the Hospitals and to build a "feedback loop" to improve. These initiatives remained at concept level on the last page! But following detailed discussions with Dr Vishwanathan, Director Medical Education, some of the foundational things were prioritized and given an impetus to take it to finality. In this journey, many committed doctors from various Medical Colleges of respective specialties participated. The previous coordination team members and experts were also consulted and they also participated in discussions and these Standard Treatment Guidelines are prepared.

The standard treatment guidelines will be made available in the Kerala Health portal (health.kerala.gov.in). This will enable the resource book availability not only to people within the state but to all in the country and outside our borders as well. I am confident that it will be used by students and practicing doctors. We request inputs based on the research from the Specialists and Experts. The teams shall continue to update and make any required changes in the STG by doing periodic updates.

The most important thing we all need to internalize is to have a shared vision and

work as a team to reach to a state of 'excellence'. If we take a look at the preparation of the Directorate Medical Education Management Information System, documents of each Medical Colleges, it provides information regarding 'what we are, what we do and what we aspire to do', pandemic preparedness, AMR accreditation and many more such initiatives taken on scale, which are all outcomes of collective TEAM work. This has laid a foundation for involving all the stakeholders including undergraduate and postgraduate students. This should encourage the teams in Medical Colleges to believe in themselves and build future initiatives on such a sound platform.

I express my sincere thanks to Dr Vishwanathan for his patience and bearing with relentless follow ups! I also take this opportunity to thank each and every team and their members and everyone from Directorate Medical Education and Medical Colleges who supported these initiatives.

I would like to express my sincere gratitude to all those who have contributed to publish these Standard Treatment Guidelines.

I wish all the success to DME team to make Kerala MCH as a premier knowledge hub in Medical Science.

Dr Rajan Khobragade IAS

Additional Chief Secretary
Health & Family Welfare and
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Message

Patient care today demands evidence-based, standardized, and contextually relevant clinical practice. In this regard, the publication of the **Second Edition of the Standard Treatment Guidelines** marks an important step forward in strengthening the quality, consistency, and accountability of healthcare delivery in Kerala.

The first edition laid a strong foundation for uniform clinical practice across specialties and super specialties. Since then, advances in medical knowledge, evolving treatment modalities, and the growing need for periodic updating have made it essential to revisit and refine these guidelines. The present edition reflects this commitment to continuous improvement and clinical excellence.

I am pleased to note that subject experts from various disciplines of Government Medical Colleges, private institutions and professional bodies have contributed as resource persons in the preparation of these guidelines. Their academic expertise, practical insight, and dedicated involvement have greatly enriched this edition. I deeply appreciate the sincere efforts of all the conveners, contributors, and coordinators whose collective commitment and teamwork made this publication possible.

These guidelines will serve as a valuable reference for clinicians, teachers, trainees, and healthcare institutions, helping to promote evidence-based decision-making and improve patient outcomes. I am confident that this edition will further support standardization of care and contribute to the advancement of medical education and clinical practice in the State.

I congratulate everyone involved in this commendable effort and commend this publication to all healthcare professionals.

Dr. K. V. Viswanathan
Director of Medical Education
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Contents

1. Infections in orthopedics

Infections of bone are difficult to treat due to precarious blood supply. Most common is Hematogenous spread.

1.1. Osteomyelitis

Inflammation of the bone and its marrow by pyogenic organisms

1.1.1 Acute hematogenous osteomyelitis

- **Rapidly progressive infection of the bone involving**
    - Medullary cavity
    - Bone Marrow
    - Cortex
    - Periosteum
- Common in infancy & Childhood
- Common in males Male: Female 4:1
- Affect metaphysis of long bones
- Often there will be a focus of Infection –pyoderma
- History of trauma is often present

Organisms

- **Staph.Aureus**, Staph.epidermidis
- B. Streptococcus, gram negative coliforms are common in neonates (multiple lesions)
- Haemophilus influenzae is common in infants
- Recently there has been an increased incidence of MRSA and Kingella Kingae infections
- In children below 2 years blood vessels cross the physis and infection can spread to epiphysis and joint leading to septic arthritis. In older children physis act as a barrier preventing spread of infection

Diagnosis

- History of trauma or infection
- Sick and miserable child that resents and cries with any interference
- Febrile and toxic
- Does not move the affected limb
- Warm tender swelling
- Local bony tenderness
- Sympathetic effusion

Investigations

- ESR ELEVATED
- TC –Elevated or Normal
- PMN LEUCOCYTOSIS with shift to left
- procalcitonin
- C-REACTIVE PROTEINS are elevated
- X-rays - May be normal initially except for soft tissue swelling
- Radiological changes appear after 10-14 days
- Area of osteolysis and periosteal reaction
- USG scan helps to diagnose abscess. Aspiration of pus can be done under USG control
- MRI helps in early diagnosis
- CT SCAN is not very effective but SPECT and PET scans are very useful in diagnosis of doubtful cases
- ISOTOPE BONE SCAN can detect bone involvement early
- Aspiration and send the pus for culture and sensitivity
- Blood culture- to exclude Acute leukaemia, Rheumatic fever and Ewings sarcoma

Treatment

- SPLINTING
- IV ANTIBIOTICS

- IV FLUIDS
- SUPPORTIVE MEASURES

Surgical decompression

- If the child is seen early (< 48 hours) and pus has not been formed antibiotics can stop the inflammatory process and prevent pus formation
- The limb is immobilized in splint or traction
- Broad spectrum antibiotics (Cephalosporins and Aminoglycoside) are started after taking blood for culture and sensitivity.
- Rehydration, analgesics and supportive measures
- If the patient responds to these measures continue parenteral antibiotics for 2 weeks
- Then change to oral antibiotics for 6 weeks
- If the patient does not respond to antibiotic treatment exploration and evacuation of pus is necessary
- If requiring repeated surgery or atypical organism obtain specialist's consultation
- If the child is seen after 48 hours there is already a collection of pus within or outside the bone. Antibiotics are unable to destroy the organisms within the pus Surgical exploration and drainage of pus under a cover of antibiotics is the preferred treatment.

Antibiotic

- Preferred initial antibiotic is cephalosporin along with aminoglycoside. It is changed depending on culture and sensitivity report. Clindamycin or vancomycin is given when there is penicillin allergy

1.1.2. Osteomyelitis of neonates and early infancy

- Diaphyseal and metaphyseal blood vessels supply epiphysis
- Immature immune system
- Extensive destruction of bone
- Septic arthritis is almost always associated

Clinical features

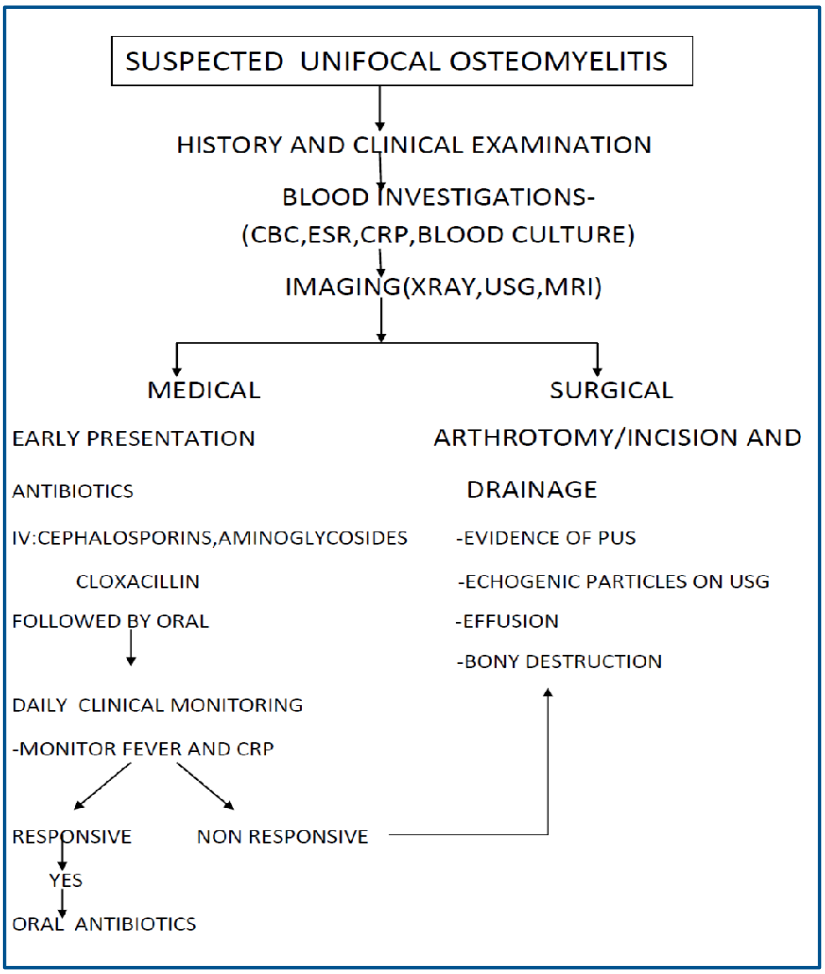
- Classical signs and symptoms may be absent
- Pseudoparalysis
- Swelling with increased local temperature
- Fever
- Nonspecific like irritability, vomiting, diarrhoea or anorexia

Investigations

- WBC and ESR
- Blood culture
- Xray
- MRI/ Isotope bone scan
- USG and USG guided aspiration with a wide bore needle
- Sent the pus for Gram stain, culture and sensitivity

Treatment

- Splinting
- Parenteral bactericidal antibiotics
- Change antibiotic depending on culture report
- Surgery – drainage of pus



1.2. Septic arthritis

1.2.1 Adult septic arthritis

Clinical features

- Rapid onset of pain, limited weight bearing and motion and warm joints with effusion and erythema
- Investigation
- Hemogram, TLC,DLC,ESR,CRP,Procalcitonin
- Blood culture

- Joint aspiration under aseptic precaution
- Aspiration should be done before the administration of antibiotics
- culture and sensitivity of the aspirate
- cell count and differential count of the aspirate(>50,000 leukocyte/µl & greater than 75 % PMN leukocytes
- crystal analysis of the aspirate
- PCR analysis of synovial fluid if identification of pathogen is difficult
- If adequate aspiration cannot be performed or if the joint is not readily accessible arthroscopic or open lavage is necessary

Treatment

- Initiation of empirical antibiotics active against S.aureus and Streptococcus species after joint aspiration
- After the organism is identified treatment should be microbe specific
- Drainage of affected joints
- Serial arthrocentesis
- Arthroscopic lavage
- Arthrotomy with or without synovectomy

1.2.2. Pediatric septic arthritis

- Clinical features; history and physical examination is the main stay in evaluation.
- Localised pain, limited range of movements, difficulty weight bearing or pseudoparalysis.
- Investigation
- Hemogram,ESR,CRP
- Joint aspirate
- USS

Treatment

- Iv antibiotics until clinical improvement is seen usually 5 to 7 days followed by oral agents upto 4 weeks
- Decompression of the joint by aspiration irrigation or arthrotomy

1.2.3. Chronic osteomyelitis

- Principles
- Debridement
- Stabilisation of bone
- Obtain intraop cultures
- Dead space management
- Soft tissue coverage

1.3. TB Of bone & joint

Bone is most common extra pulmonary site of infection of Mycobacterium Tuberculosis.

Site

Most common site is spine followed by hip and Knee. Commonly occurs in first three decades of life.

Agent:

Mycobacterium Tuberculosis.

Clinical features

a. Mono articular
b. History of night cries, loss of weight, anorexia.
c. Decreased joint movement.
d. Wasting of muscles.
e. Pain and Tenderness.
f. Cold abscess.

Investigations

a. HB,TLC, DLC & ESR. Mantoux.

b. X-ray: early De-calcification & Late Joint destruction.

c. Smear and culture of joint aspirate

d. Xray chest

e. Confirm diagnosis by biopsy or culture and start treatment.

f. MRI.

g. CBNAT with aspirated fluid to find Rifampicin resistance.

Principles of Treatment

a. General Support: Protein rich diet and Haematinics.

b. Chemotherapy-Anti-tuberculosis treatment as per RNTCP current guidelines

Local Treatment

Bed rest and Traction in acute and early stages, Splints and braces.

Operative

Indications for surgery;

- Doubtful diagnosis
- Abscess increasing or not responding to treatment

a. Capsulotomy.

b. Synovectomy.

c. Curettage.

d. Excision.

e. Arthrodesis of symptomatic joints.

f. Arthroplasty – excision/replacement in selected cases after completing chemo if indicated.

Abscess

Incision and drainage.

1.4. TB of spine

- Spinal tuberculosis (TB) is the most common extrapulmonary form of tuberculosis. Spinal TB, which most often affects the lower thoracic and thoracolumbar area, accounts for 50% of all musculoskeletal tuberculosis. Clinical results for the treatment of spinal TB are generally satisfactory when the disease is identified and treated early.
- The rise of MDR strains and lack of specifc micobiological /tissue/clinical/radiological diagnosis cause a threat to efficiency in treatment and results in under diagnosis of tb spine cases.

History;

- Localized back pain and tenderness more than 6 weeks duration
- Constitutional symptoms
    - Advanced case have spinal deformity , abscess, neurological complications.

Investigation

Diagnostic investigation in spinal TB.

Modality	Investigation	Sensitivity	Specifici
Imaging modalities	Plain radiograph	15%	NA
	MRI	100%	80%
	CT	100%	NA
	Nuclear scan; FDG-PET scan	NA	NA
Blood investigations	ESR > 20 mm	60%–90%	NA
	CRP	71%	NA
Skin test	Mantoux assay	40%–55%	75%
IGRA (Interferon-gamma release assay)	Quantiferon TB Gold (whole blood IGRA)	84%	95%
	T-SPOT TB assay (PBMC-based IGRA)	86%	96%
Microscopic diagnostics	Gram staining	25%–75%	99%
	Histopathology	53%–81%	NA
Bacterial culture	AFB Culture	47%	100%
	BACTEC	56%	100%
Molecular testing (NAA)	GeneXpert MTB/RI	82.9%	98%
	Xpert MTB/RIF Ultra	87.8%	94.8%
Line probe assay (LPA)	Genotype MTBDRplus	100%	94%
Serological test	Serum biomarkers	92%	72%

Newer Skin Test: Cy-TB test is a highly specific skin test for detecting latent tuberculosis (TB) infection, using Mycobacterium tuberculosis-specific antigens within 48-72 hours, and is used in India as a better alternative to older tests like the Mantoux test, even for people vaccinated with BCG.

Treatment:

- Medical treatment ; current RNTCP guidelines are followed usually given >12 months and depends on clinical and radiological healing
- Local treatment; bed rest, bracing to prevent deformities in initial period.
- General treatment taking care of the nutritional status of the patient.

Indications for surgery in spinal TB.

Indications for surgery in spinal TB
➢ *With neurological deficit:*
• Severe neurological deficit at presentation • New onset neurological deficit while on ATT • Worsening of the existing neurological deficit while on ATT • No neurological improvement after 6 weeks of ATT • Spinal tumor syndrome
➢ *Without neurological deficit:*
• Loss of one vertebra in the thoracic spine or 1.5 vertebrae in the lumbar spine • Children with "spine-at-risk" signs • Kyphosis of more than 30 degrees • Posterior lesion with pedicle destruction • Lack of clinical response with 6 weeks of ATT • Recurrence of disease with ATT
➢ *Other indications:*
• Large paraspinal abscess • Prevertebral abscess causing respiratory distress • Uncertainty of diagnosis

Rehabilitation of paraplegic patients needed

The objectives of treatment for spinal TB are eradication of the disease, prevention and/or correction of spinal deformity, and restoration of neurological function.Spinal TB surgery goals include decompression and debridement, stability maintenance and strengthening, and preventing the progression of deformity or correcting it in patients with healed disease

2. General fracture management

Immediate management of fractures of fracture and dislocations

General survey

ATLS protocol has to be strictly followed

Primary survey

- Adequate splintage of fracture

Guidelines:

- Immobilize one joint above and below.
- Usage of readily available materials such as umbrella, plaster of paris, folded paper, wooden stick.
- Splintage should neither be too tight or too loose.
- Do not transfer patient unless his vitals are stabilized.
- Resuscitation and assessment of neurovascular structures
- Limb elevation
- IV fluids and adequate hydration

Major long bone fractures/ spine fractures should be properly splinted before transport to ward or for investigations

Secondary survey if required ; do relevant medical and surgical consultations

Investigations

- Xray and other imaging studies
- Special views if necessary.
- Doppler, CT,MRI,USS
- RBE, Blood grouping.

Management

- Primary management for closed fracture for which closed manual reduction tried and patient put on appropriate Plaster of Paris splint for 3 - 4 weeks.
- For Undisplaced and stable fractures closed reduction and appropriate immobilisation is required
- Unstable and irreducible fractures depending upon the general condition and fracture pattern may require fixation

- Surgical management;
- Timing of surgery; optimise the patient condition for surgery

Initial management of open injuries

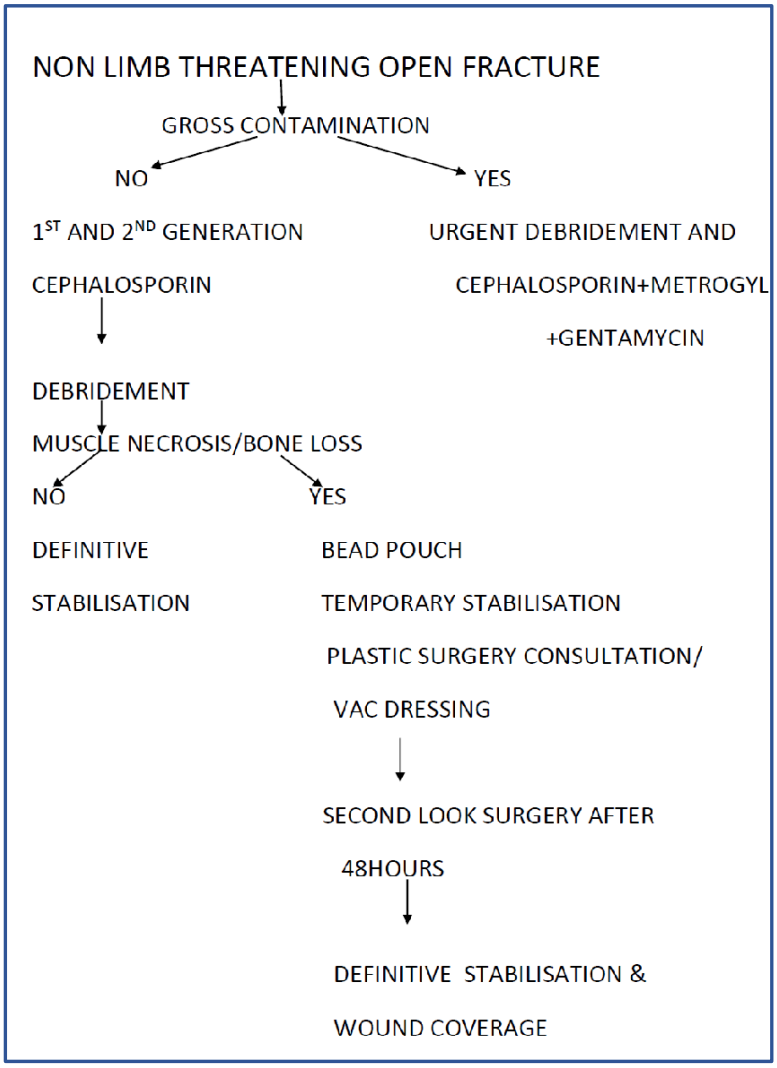
Hemodynamicaly stabilise the patient before transporting for further investigations

- Record vitals, start lifeline, I.V. fluids, I.V.antibiotics, analgesics.
- Appropriate medical and surgical consultation as required

Gustilo- Anderson classification of Open Fracture

- Type I Open fracture with wound < 1cm Bone is not exposed.
- Type II Wound > 1cm without extensive soft tissue damage / skin flaps avulsion.
- Type III A Open fracture with extensive soft tissue damage, but with adequate soft tissue coverage of bone. It also includes segmental fracture, comminuted fracture with laceration <1cm.
- Type III B Extensive soft tissue loss with periosteal stripping with bony exposure.
- Type III C Open fracture with an arterial Injury that require immediate repair regardless of size of the wound.
- Irrigate copiously with saline – Type I – 3 L saline, Type II – 6 L saline, Type III – 9 L saline.
- Immediately debride the contaminated wound preferably within 6 hours, look for 4C's Consistency, Colour, Contractility, Circulation
- Enlarge the wound if necessary for adequate debridement.
- Remove contamination in the medullary canal.
- If wound can be closed, suture the surgically created wound, put loose stitch for other wounds over a drain if necessary. If closure is not possible, leave the wound open or apply VAC dressings

- Type I II III can be treated by adequate debridement and surgical stabilisation depending upon the wound status.



Complications

Acute:

- Shock.
- ARDS.

- Thrombo-embolism.
- Neuro-vascular Injuries.
- Crush syndrome.
- DVT.
    - Dvt prophylaxis indicated in high risk cases
    - Drug therapy / mechanical prophylaxis can be given
        - Fat embolism.

Fat embolism

High index of suspicion required in patient having tachypnea, fever altered sensorium, haemoptysis in young patients with polytrauma/ long bone fractures/closed fractures.

Investigations

- ABG, CT chest, CT brain

Treatment

- Adequate hydration
- Supportive measures
- Splintage of fracture
- Circulatory and ventillatory support (PEEP)

Chronic:

- Delayed union, Non-union, Malunion.
- Growth disturbances.
- Joint stiffness.
- Volkmann's ischemic contracture.
- Myositis ossificans.
- Post-traumatic arthritis.

- Avascular necrosis.

Peculiar to open fractures are:

- Infection.
- Tetanus.
- Gas gangrene.
  - Osteomyelitis.
  - Hypovolemic shock.

2.1. Crush syndrome

Severe crush Injury of limbs and muscles results in release of myoglobin leading to renal failure.

Treatment is managing acute renal failure and maintain hydration.

2.2. Compartment syndrome

History

- High index of suspicion in high velocity injuries, proximal tibial fracture, multiple fractures involving hand and foot, unconscious patients, patients on anticoagulant drugs, forearm and leg fractures, supracondylar fractures of humerus and femur.
- It is due to ischaemic necrosis of structures of anterior compartment of fore-arm / legs usually.
- It is defined by the following signs (6 P's).
  - Pain out of proportion to injury
  - Pallor.
  - Paraesthesia.
  - Paralysis.
  - Pulselessness.
  - Positive Passive stretch.

Management

- It's a clinical diagnosis. Do not rely on pulselessness for diagnosis.
- Emergency surgical decompression by fasciotomy and monitor the patient.
- If needed external fixator.
- Delayed wound closure is done

0–8h: An injury with clinical signs of compartment syndrome should receive an urgent fasciotomy.

» 8-24h: It remains controversial whether fasciotomy will benefit the patient. Careful assessment should be done for signs of extremity viability (e.g. pain on passive stretching of compartment, some sensation, capillary refill) and how the patient has progressed before a decision is made regarding fasciotomy.

» 24h: injuries at this time point are treated by observation and splinting in a functional position, with slight elevation.

- **Delayed union**

  Union is considered delayed, when healing has not advanced at the average rate for the location and the type of fracture, usually 3 - 6 months. Conservative management with functional cast for additional 4 – 12 weeks or ORIF with appropriate implant with or without bone grafting.

- **Non-union**

  A diagnosis of Non-union is when healing has ceased, minimum of 9 months elapsed since Injury and the fracture healing has come to a standstill by clinically and radiologically and fracture will unite only when it is interfered.

Time period

- Fracture of long bone - 6 to 9 months.
- Fracture of neck of femur – 3 months.

Treatment

- Open reduction, rigid fixation, bone grafting
- Bone marrow injection
- Reamed intramedullary nailing in long bone fractures
- Pulsed ultrasound
- Electrical stimulation

- **Malunion**

  A malunited fracture is one that has healed with the fragments in a non - anatomical position.

Treatment

Corrective osteotomy with internal or external fixation with or without bone grafting.

- **Joint stiffness**

  Due to inappropriate fracture immobilization, intraarticular fractures, periarticular adhesion of soft

  tissues, capsules and muscle contractures.

Treatment

- Physiotherapy.
- Exercises.
- Manipulation under anaesthesia.
- Surgical excision and lengthening of contractures.

- **Myositis Ossificans**

  It is a reactive lesion (ossification) occurring in soft tissues and in stripped periosteum followed

by trauma and ill-advised massage.

Treatment

Prevention

- Prompt reduction of fractures and dislocations
- Avoid repeated manipulations
- Avoid massaging after removal of plaster

Drugs

- Low dose Indomethacin (25mg TDS) for 1month.

Mobilization and ROM excision till pain free joint range.

Rarely surgery –after maturation of the myositic mass if it produces mechanical block. High chance of recurrence.

Fractures of Necessity

For these fractures, surgery is always necessary.

Eg-

- Lateral humeral condyle fracture in children.
- Femoral neck fracture.
- Distal tibial epiphysis fracture.

2.3 Physeal Injuries

Salter and Harris classification of Physeal Injuries.

- **Type– I** Epiphyseal separation through physis only with or without displacement.
- **Type–II** Triangular metaphyseal spike attached to separated epiphysis. (Thurston Holland sign.)
- **Type–III** Physeal separation with fracture through the epiphysis into the joint. If there is displacement joint incongruity occurs.
- **Type–IV** Fracture through the metaphysis, physis,epiphysis

- **Type–V** Compression fracture of the physis producing growth arrest, diagnosed retrospectively.
- **Type–VI** Bruise or contusion to the periphery of the physis producing growth disturbances.

Management:

Majority of children's fracture are treated conservatively.

Few fractures require open reduction and internal fixation or closed pinning by minimal manipulation.

3. Polytrauma

- **Polytrauma is defined as**
  - Injury severity score (ISS) 16 or above.
  - Systolic blood pressure below 80 mm Hg.
  - Glasgow coma score less than 15.
  - Higher fluid resuscitation requirements.
  - Chest, head, abdominal organ Injuries.
  - Fractures of more than one long bone.

- **Stage of care**

  1. Acute Resuscitation Period :(1-3 hrs)

  - From the first point of contact with medical service to the control of acute life threatening conditions.
  - Rapid systemic assessment to identify life threatening conditions.
  - Then Airway, Breathing, Circulatory (ABC) support should be made. This involves airwaycontrol, thoraco-centesis, rapid control of external bleedings, vigorous fluid and blood replacement therapy.
  - Then complete diagnostic check-up if there is no acute life threatening situation.

2. Primary Stabilization Period :(upto 48 hrs)

- From the control of acute life threatening situation and complete Stability of respiratory, haemodynamic and neurologic symptoms.
- Here acute management of fractures associated with arterial Injuries and acute compartment syndrome are managed.
- Fractures are temporarily stabilized with external fixators and compartments.

3. Secondary Regeneration Period :(2 - 10 days)

- In this, general condition of the patient is Stabilized and monitored.
- Systemic inflammation and multiple organ dysfunction syndrome are managed.
- Tertiary reconstruction and rehabilitation period (weeks to months) after trauma.
- Necessary surgical procedures.
- Definitive treatment of complete mid-phase fractures.
- Specialized procedures to achieve fracture correction or joint reconstruction.

Golden Hour: First one hour after Injury, with threefold increase in mortality for every 30 minutes.

Follow ABCDE

- Airway.
- Breathing.
- Circulation.
- Disability.
- Exposure.

Initial Management of patient In Shock

- Direct control of obvious bleeding by direct pressure - (preferable), tourniquet clamping of blood vessels.

- Large-bore intravenous access.
    - Ringer lactate infusion.
    - Blood replacement as indicated, by serial haematocrit estimation and blood pressure.
- Traction with Thomas Splints or extremity splints to limit haemorrhage from unstable fractures
- Consideration of angiography or immediate operative intervention for Hemorrhage control.

Haemorrhagic Shock:

- Diagnosed by hypotension, tachycardia, seen in patients with large open wounds, active bleeding,
- pelvic and / femoral fractures and abdominal or thoracic trauma.
- In the absence of open hemorrhage bleeding into voluminous space (chest, abdomen, pelvis, thigh) must be ruled out.
- This may require peritoneal lavage, angiography, CT, MRI.
- Managed by aggressive fluid replacement, blood transfusion, Angiographic embolisation, operative intervention, fracture Stabilization, etc.

Preparation for massive bleeding

- Large bore intravenous (IV) access: Two peripheral IV (14/16 gauge) cannulae or special wide bore cannulae (insertion sheath) can be sited in neck veins such as the internal jugular vein. In emergency situations, cannulation of external jugular vein may be considered
- Warming devices: In-line fluid warmers and surface warmers
- Continuous core temperature monitoring
- Invasive arterial pressure monitoring

- Adequate amount of colloid (gelatins), crystalloid, infusion sets and IV calcium preparations
- Communication with blood bank about emerging massive blood loss situation
- Adequate manpower for sending samples for investigations and getting blood and blood products
- Point-of-care testing is highly desirable: Arterial blood gas (ABG) and thromboelastograph (TEG). ABG with haemoglobin (Hb), electrolyte and lactate levels, repeated hourly, are useful in directing therapy
- Rapid infusion pumps or pressure bags to speed the fluid infusion rate
- Postoperative intensive care: Mechanical ventilation and continuous haemodynamic monitoring are usually required due to occurrence of circulatory overload and haemodynamic/biochemical instability.

Blood Replacement:

- Fully cross matched blood is preferable.
- In case of life-threatening situations 'O'-negative blood can be used.
- Warming of blood prior to administrations prevents hypothermia.
- Monitor coagulation factors, platelets and calcium levels.
- Massive blood transfusion protocol can be tried if facilities are available.
- Massive blood transfusion is defined as:-
    - Replacement of one entire blood volume within 24 h
    - Transfusion of >10 units of packed red blood cells (PRBCs) in 24 h
    - Transfusion of >20 units of PRBCs in 24 h
    - Transfusion of >4 units of PRBCs in 1 h when on-going need is foreseeable
    - Replacement of 50% of total blood volume (TBV) within 3 h.

Massive transfusion protocols are activated by a clinician in response to massive bleeding. Generally, this is activated after transfusion of 4-10 units. MTPs have a predefined ratio of RBCs, FFP/cryoprecipitate and platelets units (random donor platelets) in each pack (e.g. 1:1:1 or 2:1:1 ratio) for transfusion. Once the patient is in the protocol, the blood bank ensures rapid and timely delivery of all blood components together to facilitate resuscitation. This reduces dependency on laboratory testing during the acute resuscitation phase and decreases the need for communication between the blood bank, laboratory and physician.

Targets of resuscitation in massive blood loss

- Mean arterial pressure (MAP) around 60 mmHg, systolic arterial pressure 80-100 mmHg (in hypertensive patients one may need to target higher MAP)
- Hb 7-9 g/dl
- INR <1.5; activated PTT <42 s
- Fibrinogen >1.5-2 g/L
- Platelets >50 × 10^9/L
- pH 7.35-7.45
- Core temperature >35.0°C
- Base deficit <3.0/lactates <2 mEq/L

Monitoring

- Clinical monitoring: Electrocardiogram, capnometry, pulse oximetry, arterial blood pressure, core temperature, and urine output.
- Hb, platelet count, prothrombin time, partial thromboplastin time (PTT), fibrinogen, potassium, ionized calcium, ABG for acid base status and central venous oxygen saturation/lactate as an indicator of tissue hypoperfusion.
- Invasive arterial pressure

Indications For Immediate Surgery

- Haemorrhages secondary to liver, splenic renal parenchymal Injury –Laparotomy.

- Aortic, caval or pulmonary vessel tears – Thoracotomy.
- Depressed skull fracture or acute intracranial – Craniotomy.
- Disablity (Neurologic Assessment).
    a. Assess level of consciousness by GCS.
    b. Pupillary response sensation.
    c. Motor response in all extremities.
    d. Rectal tone and sensation.
- GCS = Eye opening score + Verbal (intubated or non-intubated) score + Motor score.
- GCS if < 13, systolic BP < 90, RR< 10 / min or > 30 / min warrants Emergency trauma care.

Radiographic Evalution

- Trauma series including X ray chest, lateral view c spine, lateral decubitus view abdomen.
- Xray pelvis ,extremeties.
- Ultra sound abdomen. FAST
- CT after patient is haemodynamically stabilised

Assess the concomitant injuries such as head Injuries, thoracic Injuries, genitourinary Injuries.

4. Pelvic injuries

Introduction

- It is an emergency in orthopaedics which involves multispeciality intervention.
- Mode of Injury.
    a. High energy Injuries.
    b. Crush Injuries.

c. Impact Injuries.

- Associated with complications and other fractures.

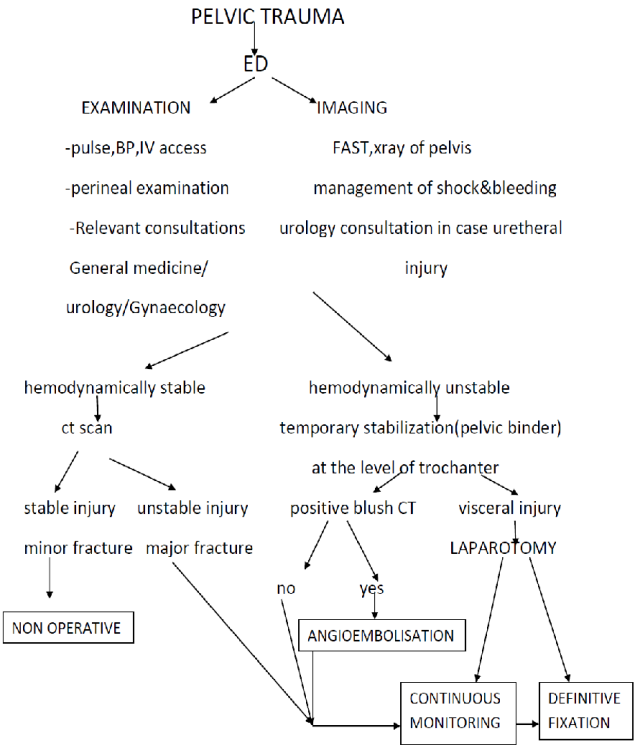
Clinical Features

- Pain and tenderness at affected site.
- Range of movements painful.
- Shock.
- Intra-abdominal / Urethral / Vascular Injuries.
- Morel-lavelle lesion.

Management

- Evaluate ABCDE and stabilize the patient.
- Evaluate for other associated Injuries head, chest, abdomen and spine.
- If haemodynamically stable, assess radiologically with X-ray pelvis AP view, inlet and outlet view.
- **Lines to look for in radiology**:
  - Iliopubic line
  - Ilioischial line
  - Tear drop
- If there is no or minimal displacement, treat conservatively with strict bed rest and analgesics.
- **Stable fractures**-single breaks in ring or peripheral fractures, usually as a result of moderate trauma.
- **Unstable fractures** –fractures of anterior and posterior arches.

Common fractures:



- **Stable**
  - solitary fractures of ischial rami.
  - unilateral fractures of both rami.
  - duverny fracture.
  - isolated sacral fracture.
- **Unstable**
  - malgaigne fractures
  - straddle fractures
  - pelvic dislocation

- bucket handle fracture

- Acetabular fractures
- Avulsion fractures
  - Ischial tuberosity(hamstrings)
  - Anterior inferior iliac spine (rectus femoris)
  - Anterior superior iliac spine (Sartorius)
  - Iliac crest

➢ If there is displacement with anterior opening (pubic diastasis) then assess the displacement.

- If it is < 2.5 cm – treat conservatively.
- If it is > 2.5 cm – external fixation or open reduction and internal fixation.

➢ If there is unstable Fracture with vertical displacement then treat with ORIF.

➢ If haemodynamically unstable, then stabilize the pelvis with external fixator at the earliest.

- **Associated Complications and Treatment**
  - Shock-blood transfusion and fluid replacement.
  - Embolisation of bleeding pelvic vessels. (intervention radiology)
  - Urethral ruputure - diagnosed by blood in urethra, perineal hematoma, distended bladder, managed by Urologist.
  - Bladder rupture-extravastation of urine-Urologist and Surgeon.
  - Bowel and intra-abdominal Injuries are managed by General surgeon.
  - Thrombosis - DVT prophylaxis, vascular opinion must be obtained.
  - Post operatative
    a. Infection rate (0-25%) managed accordingly.
    b. Thrombo-embolism.

c. Pin tract infection.

d. Death inevitable in certain situations.

5. Fractures of upper limb

Mode of Injury

a. Fall on Outstretch hand.
b. Road Traffic Accident.
c. Associated Poly Trauma.

1) Fracture of Hand:

a. Fracture of the base of the first metacarpal.
b. Fractures of the other metacarpal bones.
c. Fractures of the phalanges.

2) Fractures Around Wrist:

a. Fracture of the scaphoid bone.
b. Fractures of other carpal bones.
c. Dislocations of the carpal bones.
d. Fracture of the lower end of the radius.
e. Galeazzi fracture – dislocation.
f. Fracture – separation of the lower radial epiphysis.

3) Fracture of the shafts of the forearm bones.

4) Fractures Around Elbow:

a. Fracture of the head and neck of the radius.
b. Fracture of the upper end of the ulna with dislocation of the head of the radius (Monteggia fracture – dislocation).
c. Fracture of the coronoid process.
d. Fracture of the olecranon process.
e. Fractures of the epicondyles and condyles.
f. Supracondylar fracture.

5) Fracture Of the Humerus:

a. Fracture of the shaft.

b. Common Fracture of Proximal Humerus/Fracture of greater tuberosity.

6) Fractures Of the Shoulder Girdle

a. Fractures of the clavicle.

b. Fractures of the Scapula.

5.1. Fractures of hand

1. Fractures of base of the first metacarpal.

a) Bennett's Fracture

Intra-articular fracture through base of first metacarpal bone in which the fractured shaft is displaced laterally due to unopposed pull of Abductor Pollicis Longus

- **Investigation–**
  - X- ray of hand antero posterior and oblique views.
- **Treatment –**
  - Primary Stabilization in anatomical position with the help of available splinting material.
  - Closed or open reduction and internal Fixation with 'K' wire.
  - External fixation.
  - Mini fragment 'T' plate fixation.

b) Rolando Fracture

- It is a complete articular fracture of base of first metacarpal bone.
- Treatment similar to Bennet Fracture

2. Fracture of the other metacarpal bones

a) **Investigation -**X-ray of hand antero posterior and oblique views.

b) **Treatment –**

- Primary stabilization in anatomical position with the help of available splinting material.
- Conservative - cock up splint.

  - short arm slab in functional position

  - ball bandage.

- Immobilisation at functional position wrist in neutral to 10˚ dorsiflexion

  MCP in 90˚ flexion and PIP in 0˚
- Surgical – Close or open reduction and internal fixation with K wire or mini plate.
- External fixation for compound (open) fracture with the aid of finger JESS

3. Fractures of the phalanges

a) **Symptoms** - Pain & Swelling and bony deformity with loss of active movements.

b) **Signs** - Tenderness at Fracture site along with Crepitus and Abnormal Mobility.

c) **Investigation -** X- ray of hand AP and Oblique views**.**

d) **Treatment-**

- Primary stabilization in anatomical position with the help of available splinting material.
- Conservative - Buddy strapping, POP slab, finger splints.
- Proximal phalangeal fracture stabilised with ball bandage.

e) **Surgical** – K (Kirschner) wire or JESS (Joshi's External stabilization System) fixator.

5.2. Fractures around wrist:

1. Fracture of the scaphoid bone

It is common in young adults usually caused due to fall on outstretch hand, often overlooked.

a) Symptoms – Pain, swelling and restriction of wrist movement.

b) Signs – Tenderness in anatomical snuff box and impairment of wrist movement, grip strength decreased. More often initial radiological investigation will not be confirmatory for a scaphoid fracture and a high index of clinical suspicion should be there and indicated cases should be immobilised in a splint till next assessment.

c) Investigations - X-ray of wrist in AP, lateral and two oblique projections, ulnar deviation view.

d) Treatment - Primary stabilization in anatomical (glass holding) position with the help of available splinting material.

- **Conservative** - Plaster immobilization usually till 2 to 3 months.
- **Surgical** – Closed or open reduction and internal fixation with a special compression screw (Herbert screw) or k wire fixation.

e) Complications

The incidence of complications is high.

- Delayed or non-union.
- Avascular necrosis
- SLAC wrist
- Osteoarthritis.

1. Perilunate dislocation and lunate dislocation

- Lunate fracture is the 2nd commonest. clinical features similar with grip strength decreased, tenderness on pressure over 3rd metacarpal.
- To see carpal bone alignment look for integrity of Gilula lines and shape of lunate in PA view of hand
- Ct scan is indicated in doubtful cases and massive swelling of hand.
- Initial management is closed reduction with splinting on functional position.
- In patient having median nerve compression symptoms decompression of median nerve is indicated
- Irreducible dislocations have to be reduced by open method and stabilisation.

2. Dislocations of the carpal bones

Complete dislocation of the wrist is very uncommon and incomplete carpal dislocation involve one or more of the carpal bones and are as follows:

❖ **Carpal Instability**

- Carpal instability dissociative (CID)
  - ➢ Dissociation within row - Scapholunate, lunotriquetral
- Carpal instability nondissociative (CIND)
  - ➢ Instability between carpal rows - Midcarpal instability, capitolunate instability, ulnar translocation
- Carpal instability complex (CIC)
  - ➢ Feature of CID and CIND - Perilunar injuries, axial carpal dislocations
- Carpal instability adaptive (CIA)
  - ➢ Extrinsic to wrist - Dorsal malunion of the distal radius that causes CIND

A. Symptoms – Pain, swelling, deformity and restriction of movement of the wrist joint.

B. Signs – Tenderness and loss of anatomical position of wrist and hand, Watson test, ballottement test.

C. Investigations

- X-ray of the wrist in AP, lateral and oblique views.
  - Special views –ulnar deviation view, clenched fist AP view.
  - To look for Terry Thomas sign ,VISI, DISI
- CT scan.

D. Treatment

Primary stabilization in anatomical (glass holding) position with the help of available splinting material.

- Conservative – Manipulative reduction under anaesthesia and plaster immobilization.

- Surgical –
  - Latest management is by arthroscopic reduction and repair or reconstruction of ligaments and percutaneous k wire fixation.
  - Temporary jess fixation
  - Open reduction fixation

E. Complications

- Avascular necrosis.
- Osteoarthritis.
- Injury to median nerve.

5.3 Fracture of the lower end of the radius:

a) Extra articular fracture

b) Intra articular fracture involving radiocarpal joint

c) Intra articular fracture involving distal radioulnar joint (DRUJ)

d) Intra articular fracture involving radiocarpal and DRUJ

Symptoms - Pain, swelling and bony deformity of the wrist with loss of active movements

Signs - Tenderness at fracture site along with or without crepitus and abnormal mobility

Also look for puncture wounds

Investigation -

- X-ray of forearm with wrist PA and Oblique views.
- X-ray Wrist in Ulnar deviation.
- CT scans to know the extent of intra articular involvement

Treatment –

- Close reduction and plaster immobilization.

- Close reduction with K wire fixation.
- Close reduction with K. wire fixation and external distractor application.
- Open reduction and internal fixation with multiple K wires, plate and screws.
- Minifragment fixation (Ellis plates)
- Open fractures should be explored, debrided and stabilised.

A. Galeazzi fracture – dislocation

A fracture of the radius may be combined with a dislocation of the DRUJ

A. Symptoms - Pain, swelling, deformity and shortening of the forearm.

B. Signs - Bony deformity & tenderness, crepitus & pain aggravated by passive stretching of wrist.

C. Investigation - X- ray forearm with elbow and wrist in AP and lateral projection.

D. Treatment –

- Primary stabilization in anatomical position by open reduction and internal fixation with compression plates and may need a DRUJ stabilisation procedure.
- Mostly needed for prevention of malunion as forearm is considered as a joint.

B. Fracture – separation of the lower radial epiphysis

It is seen in children before physeal fusion in which the epiphysis is fractured and separated from the metaphysis and results into gross deformity, if not treated adequately. The clinical features and management are same as that of fracture of lower end of radius in adults except surgical intervention which is rarely needed.

C. Fracture of the shafts of the forearm bones

The forearm bones, radius and ulna get fractured either single or both and are very common Injuries which result into gross deformity and functional restriction, if not treated.

a. Symptoms – Pain, swelling over forearm and bony deformity.

b. Signs - Tenderness, crepitus, abnormal mobility with or without signs of compartment syndrome.

c. Investigation - X-ray of the forearm with wrist and elbow in AP and lateral projections.

d. Treatment:

- Primary stabilization in anatomical position by long arm slab and patient needs an internal fixation as the definite treatment
- Closed reduction and plaster application in children can be tried.
- ORIF with compression plates and closed can be tried with square nails or TENS(titanium elastic nail system)
- External fixator application in case of open fractures.

D. Monteggia fractures

In diaphyseal and metaphyseal fractures of the ulna, a special focus has to lay on the PRUJ to detect dislocation and instability of the radial head. Bado classified it.

- **Symptoms -** Pain, swelling, deformity and shortening of the forearm with elbow dislocation.
- **Signs** - Bony deformity & tenderness, crepitus & pain aggravated by passive stretching of wrist.
- **Investigation** - X- ray forearm with elbow and wrist in AP and lateral projection.
- **Treatment** –
  - Primary stabilization in anatomical position by open reduction and internal fixation with compression plates.
  - Radial head reduction has to be checked after ulnar fixation and has to be relocated.
- **Paediatric Monteggia fractures**

  Has to be suspected in paediatric forearm and elbow injuries.

In doubtful cases x-ray of contralateral sides can be obtained.

Conservative management requires frequent serial Xrays

5.4. Fractures around elbow:

1. Fracture of the head and neck of the radius:

One of the commonest fractures of the upper limb in young adults.

- **Symptoms:** Pain and swelling on lateral aspect of elbow and restriction of movement.
- **Signs:**
  - Sharp local tenderness and impaired movements. (Flexion of elbow and pronation and supination)
  - Look for signs of terrible triad and assess intraoperatively for medial collateral ligament instability
- **Investigations**: X-ray of elbow joint with forearm in AP and lateral projections.
- **Treatmen**t:

  Primary stabilization in anatomical position (flexion at elbow and mid prone position of Forearm).

  Conservative – In case of slight damage to the radial head and neck with plaster immobilization.

Surgical

One accepted indication for operative treatment of a displaced partial radial head fracture (Mason II) is a block to motion.

A relative indication is displacement of a large fragment greater than 2 mm without a block to motion

- Open reduction and internal fixation in case of severe damage to the radial head and neck.
- Prosthetic replacement of radial head in severely damaged and displaced fractures.

- Excision of radial head is another option but nowadays not usually done.

2. Fracture of the coronoid process

- The coronoid process is seldom fractured unless in association with posterior dislocation of the elbow.
- Three types –Regan and Morrey
- Conservative treatment if undisplaced
- Type II and III fractures if displaced require open reduction
- Usually, patient will be having an unstable elbow if it is type 3 Regan (Terrible triad injury has to be ruled out).
- Primary immobilisation with long arm slab and later on if needed internal fixation with special screws /pull out sutures/suture anchors/min plate along with treatment of elbow dislocation.

5.5. Fracture of the olecranon process

- Direct: A fall on the point of the elbow or direct trauma to the olecranon typically results in a comminuted olecranon fracture.
- Indirect: A fall onto the outstretched upper extremity accompanied by a strong, sudden contraction of the triceps typically results in a transverse or oblique fracture

.Clinical feature

Same as fractures above with distinct disruption of three-point bony relation of the elbow. (It is a triangle formed by the tip of olecranon and the two epicondyles)

Investigations

X-ray of elbow, forearm with wrist AP and lateral view

May need a CT scan if it is a direct injury and severely comminuted.

Management

The treatment depends upon the type of fracture i.e. plaster immobilization in case of undisplaced fracture

If it is a simple fracture without any comminution then tension band wiring with k-wire and SS wire

If it is a comminuted fracture, depending on the size of the fragment, we can do an open reduction and internal fixation with hook plate or special anatomic plate.

5.6. Fractures of the humeral condyles and epicondyles:

Condylar fractures are relatively uncommon, but often troublesome and occur main in children.

A. Symptoms – Pain, swelling and restriction of movement of the elbow.

B. Signs

a. Marked tenderness and widening of the elbow.

b. Disruption of the three-point bony relation.

C. Investigations - X-ray and CT scan.

D. Treatment

a. **Conservative -** In case of simple unstable fracture, with plaster immobilization and followed by a course of mobilizing exercises.

b. **Surgical** – Displaced fractures must be treated with closed or open reduction and internal fixation to prevent disability.

E. Complications:

- Non-union.
- Deformity-Cubitus valgus or varus with instability.
- Osteoarthritis.

❖ **Epicondylar fractures**

- Occur in children
- Mostly treated conservatively in case of medial epicondyle which is undisplaced

- Lateral condyle fracture is a fracture of necessity - internal fixation by open or closed method to attain anatomical reduction.

❖ Supracondylar fracture

It is one of the commonest and most important fractures of the childhood and potentially dangerous because of the risk of Injury to the brachial artery near the metaphyseal region of the humerus.

A. Clinical Features-Are characteristic with lower fragment displaced and tilted backwards, but the three-point bony relation maintained. The brachial and radial artery pulsations should be confirmed all the time during the treatment and neurological deficit has to be ruled out, commonest is extension type of fracture and so median nerve has to be ruled out.

Look for compartment syndrome and vascular injury.

B. Treatment:

Discussed in detail in Paediatric Orthopaedic session

❖ Inter condylar fracture humerus

a. **Clinical features –** Pain, swelling and deformity.

b. **Investigation –** X-ray elbow, AP and lateral views.

c. **Treatment –**

- Conservative – plaster immobilization if undisplaced
- Surgical - Closed or open reduction and internal fixation with K wires or cancellous screws. And needs ORIF with plates and screws in case of adults usually associated with supracondylar fractures, 90 -90 plating or parallel plating can be done.

5.7 Racture of humerus (shaft and proximal part)

1. Fracture of the shaft

I. **Clinical Finding** – Pain and Swelling over arm abnormal mobility, crepitus, radial nerve injury has to be ruled out.

II. **Investigation** – X-ray of arm with shoulder & elbow AP and Lat.

III. **Treatment** –

- U slab is usually applied after closed manipulation and reduction.
- Long arm slab is also an option for distal fractures and associated forearm fractures.
- **Surgical** – Closed nailing by
  - Rush nail
  - Ender's nail Children
  - Flexible nail
  - Humerus Inter locking Nail.
  - Open reduction and internal fixation with plate & screws.
  - External fixator in case of open fractures.
- Watch for wrist drop. (radial nerve Injury pre and post reduction)

2. Common fracture of proximal humerus/ fracture of greater tuberosity

I. **Clinical Finding** –

a. Pain and Swelling over Shoulder.

b. Painful Movements of Shoulder.

c. Crepitus, Tenderness.

d. Usually as a result of high velocity trauma in case of younger patients and associated neurological deficit has to be ruled out.

e. Chest injury has to be ruled out.

II. **Investigation –** X-ray Shoulder AP & CT scan, chest x-ray AP.

III. **Treatment –**

Conservative – Arm to chest strapping.

Classified according to Neer.

Greater tuberosity fractures: If they are displaced more than 5 to 10 mm (5 mm for superior translation), they require ORIF with or without rotator cuff repair; otherwise, they may develop nonunion and subacromial impingement. Look for posterior displacement in Greater tuberosity fractures as this could be easily missed in an AP view X-ray.

Surgical neck fractures

- If the fracture is reducible and the patient has good-quality bone, one can consider fixation with percutaneously inserted terminally threaded pins.
    - Problems associated with multiple pin fixation include nerve injury (axillary), pin loosening, pin migration, and inability to move the arm.
- Irreducible fractures (usually interposed soft tissue) and fractures in osteopenic bone require ORIF with pins, intramedullary nails with or without a supplemental tension band, or plate and screws, Surgical –Cancellous screws or plate fixation(PHILOS), Primary shoulder replacement.

5.8. Ractures of the shoulder girdle

1) Fracture of clavicle

I. Clinical Finding –

a. Pain and swelling over shoulder.

b. Bony Deformity.

c. Crepitus, tenderness.

II. Investigation – X-ray Shoulder AP

III. Treatment –

i. Conservative – Figure of '8' bandage. (Clavicle brace) + arm pouch
ii. for clavicle shaft fractures, absolute indications for Surgical fixation includes
iii. open fracture / there is over-riding > 20 mm/ severely displaced and fracture fragment impinging on skin/ associated neurovascular injury.
iv. Lateral end clavicle fractures mostly tend to be displaced and need open reduction and internal fixation with locking plate/hook plate. If fracture is undisplaced, look for displacement in serial X-rays.
v. Needs surgical fixation in case of double disruptions of superior shoulder suspensory complex. (floating shoulder)

2) Fracture of scapula

Fractures of scapular are relatively uncommon and management is mainly conservative.

- -Clinical – Pain and Swelling over shoulder painful movements of shoulder, brachial plexus injury and chest injury has to be ruled out.
- -Investigation – X-ray Shoulder AP and chest x ray AP, axillary view, 3D CT shoulder
- -Scapula thoracic dissociation has to be looked for
    - Management is mainly conservative using arm pouches/immobilisers followed by early mobilisation.
    - **Rarely requires Open reduction and internal fixation, indications include -:**

a) Open fractures

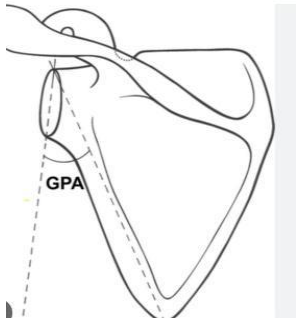
b) Scapular body Fractures if

- >20mm medialisation of lateral border

- <20-degree Glenopolar angle

- >40-degree angulation

c) Scapular neck fractures



- translation > 1cm

- <20 GPA

- >40-degree angulation

- double disruption of suspensory complex

d)Intraarticular Glenoid fractures

- >20-25% anterior or posterior glenoid involvement with subluxation

- >4mm articular step

Kuhn Acromial Fracture Classification		
Type I	Nondisplaced or minimally displaced	
Type II	Displaced but does not compromise the subacromial space	
Type III	Displaced and compromises the subacromial space	

e) Acromion Fracture-

- Kuhn Type 3 (with inferior tilt)

- Painfull non union, Symptomatic subacromial impingement, Displaced double disruption

f) Coracoid fracture

- Painfull Non union, >1cm displacement, Ogawa type 1 fractures(occurring proximal to CC ligaments)

3) Acromioclavicular injuries

All Type 1 and 2 and most type 3 Conservative management – Sling for 3 wks followed by mobilisation Type 4,5,6 and type 3 injuries in elite athletes – Open reduction and internal fixation

A lot of different methods are available and depends on surgeon preference including CC Dog button fixation, Hook plate fixation etc.

4) Rotator cuff injuries:

- Affects both young adults and old age population
- Can be traumatic or degenerative

Mode of injury:

- Young adults: traumatic commonly
- Advanced age: Trivial trauma- even pulling a sofa

Clinical features:

- Night pain – tends to sleep in couch
- Pseudoparalysis/ drop arm sign positive
- Empty can test positive
- Hornblowers test positive
- Gerbers test positive
- O'brein's, Speed's and Kim's to assess associated long head of biceps and Superior labrum anterior posterior (SLAP) lesions.
- Check for external rotational lag sign (If positive, cuff repair may fail and higher procedures like muscle transfers may be needed)
- Assess neurological status –cervical/brachial plexus/axillary nerve always

Investigations:

- Xray
- USG shoulder

- MRI shoulder to confirm the tendon torn, status of long head of biceps tendon, width and retraction of the tear, fatty infiltration status and atrophy, associated paralabral cyst or suprascapular nerve compression.
- Emg and NCV in indicated cases.

Treatment:

Partial Tears (<50% thickness tears) -Conservative – Physiotherapy – including Scapular stabilisation exercises and Rotator cuff strengthening exercises. Bursal tears can be more painfull and Subacromial steroid injection can be tried as an adjunct to physiotherapy.

Partial Tears (>50% thickness tears)

- Conservative management by physiotherapy and surgical management if it fails.
- Medications can be used as an adjunct to Physiotherapy and includes - :
  - Tab.Diclofenac sodium 50mg thrice a day for 1 week and SOS later Or
  - Tab. Indomethacin 25mg thrice a day for 1 week and SOS later Or
  - Tab.Ibuprofen 400mg thrice a day for 1 week and SOS Later
  - NSAIDs cause hyperacidity hence antacids such as Cap. Omeprazole 20mg or Tab. Pantoprazole 40mg once a day should be given.

Full thickness tears -:

Mini-open/ Arthroscopic rotator cuff repair with long head of biceps (LHB) tenotomy/ tenodesis

If muscle quality Is bad (>grade 4) and is severely retracted, advanced procedures such as Muscle transfer (LD/LT), Muscle advancement/slide, Superior Capsular reconstruction, Bio patch augmentation are necessary.

Recovery - After surgery, physical therapy is necessary to maintain the motion that was achieved with surgery. Recovery times range from 6 weeks to 3 months.

Commitment to therapy is the most important factor in returning to all pre-surgical activities.

Complications:

i. Retear/ failed repair/ rotator cuff arthropathy
ii. Surgery: Reverse total shoulder replacement.

6. Fractures of the lower limb

Mode of Injury –

1) Road Traffic Accident.

2) Associated Poly Trauma.

Type of Fracture–

- Fracture upper end femur.
  - i) Intra capsular.
  - ii) Extra capsular.
  - iii) Femur head fracture.
- Fracture shaft femur.
- Fracture Lower end femur.
  - i) Intra articular.
  - ii) Extra articular.
- Fracture Patella.
- Fracture Upper end tibia.
- Fracture shaft tibia.
- Fracture around ankle joint.
- Fracture of bones of foot.

All Patients who require prolonged bed rest/lower limb immobilisation requires anti DVT prophylaxis unless contraindicated.

6.1 Fracture neck of femur (intra-capsular)

Introduction-

Fracture neck of femur more common in old age due to Slip and fall.

Classification According to the site of fracture

- Subcapital.
- Transcervical.
- Basicervical.

Usually caused by trivial fall in the elderly due to presence of osteoporosis, however metastasis from malignancies can also lead to the pathologic fractures.

Investigation

- X-ray pelvis with both hip if x-ray negative
- Internal rotation views
- MRI
- Ct scan to diagnose occult fracture

Principles of management include:

Pre op regional anaesthesia for pain relief

Osteosynthesis in physiologically active young individuals.

i. Screws

ii. DHS, Blade Plate/FNS

iii. Internal Fixation

Arthroplasty

- Hemiarthroplasty.
- Total Hip Replacement.
- Excision Arthroplasty.

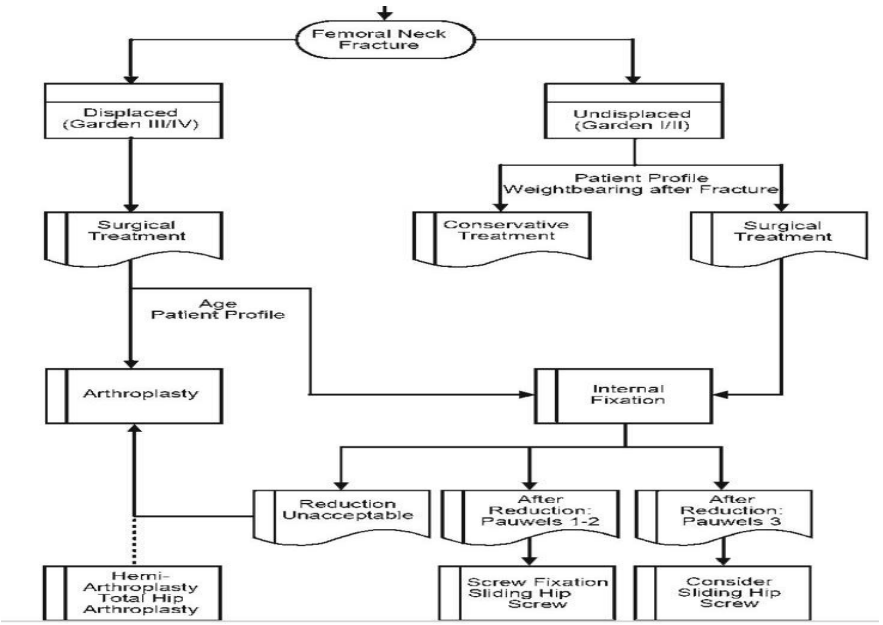
Clinical features

Pain and deformity of hip , usually limb will be externally rotated, associated injuries has to be ruled out especially in case of young patients and medical comorbidities and pathological fracture has to be ruled out in elderly.

Investigations

X ray pelvis with both hip AP, lateral view and AP view of affected hip, spine X rays, CT scan may be needed in young patients to assess the fracture pattern and to assess the posteromedial comminution.

Management



Primary management is by skin traction . no definit evidence for skin traction

Timing of surgery; in elderly as early as possible with optimisation of medical factors.

Definitive treatment is by hemiarthroplasty in elderly patients – bipolar prosthesis , modular bipolar, AMP in case of severely ill patients.

Nondisplaced fractures operative treatment typically produces reproducible results

Younger patients are treated by osteosynthesis prior to it reduction has to be achieved either by closed (Lead better tech.) or open manner. Implants used are 7 mm screws in an inverted triangle manner , DHS in case of basicervical or with a comminution. MHS (modular hip screw) is another implant used. FNS (femoral neck system) is another new implant.

Pauwel's Osteotomy is indicated in type fractures for high angles type 3 fractures.

6.2 Trochanteric fractures

Fracture of Greater Trochanter

This is isolated fracture of greater trochanter due to fall on the side of pelvis, usually minimally displaced and managed with pelvic stripping and non-weight bearing.

Fracture of Intertrochanteric Region

Intertrochanteric hip fractures are more common in road traffic accidents in young adults and trivial

fall in elderly.

Fracture of Subtrochanteric Region

Occur between lesser trochanter and a point 5 cm distally and are seen as independent entities or as an extension of intertrochanteric fractures.

Classification

Trochanteric fractures are classified according to **Boyd and Griffin** classification:

Subtrochanteric fractures are classified according to **Seinsheimer's** classification:

Clinical features:

- **Symptoms** - Pain, swelling, bruising, shortening of the limb and inability to stand or walk.
- **Signs** -

  i) Severe tenderness and swelling around hip region.

ii) Shortened and externally rotated lower limb.

iii) Inability to do straight leg raising.

- **Investigations:**

i) X-ray of pelvis with both hips in AP view and affected hip in axial view.

ii) CT Scan.

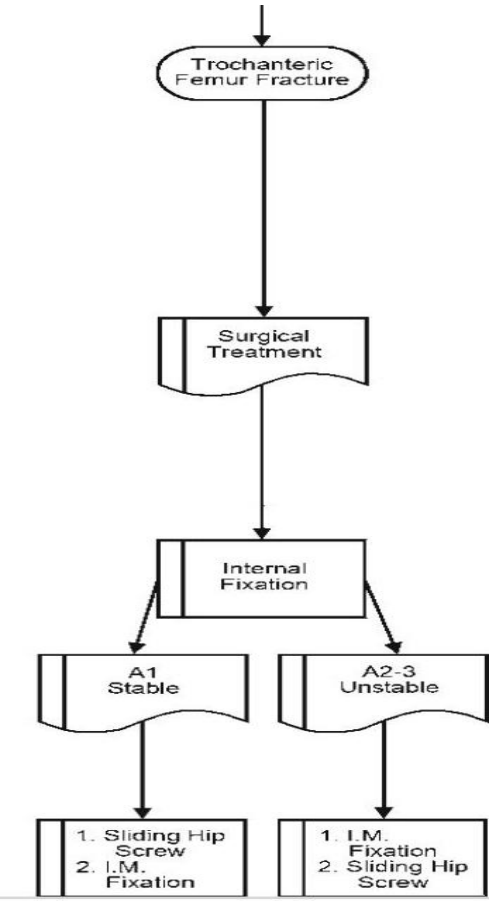
- **Treatment:**

i) Conservative – initial traction and immobilization in DRB (Derotation Boot) in undisplaced fracture.

ii) Surgical

Stable trochanteric fracture sliding hip screw are used.

- Closed reduction and internal fixation with Dynamic Hip Screw and plate (DHS).
- Proximal femoral nail (cephalomedullary fixation)
- Intramedullary Hip Screw.
- Dynamic Condylar Screw (DCS).



For subtrochanteric fractures proximal femoral nail (cephalomedullary fixation) DCS, Angled blade plate, Reconstruction nail may also be used as per the preference of the surgeon.

6.3 Fracture shaft of femur

Fractures of the shaft of the femur are mostly due to high-energy trauma.

Types Of Femoral Shaft Fractures Are As Follows as per their pattern

- Type I - Spiral or transverse. (most common)

- Type II – Comminuted.
- Type III – Open.

Look for shock and fat embolism.

Investigations

X-ray shaft femur with X-ray of pelvis and knee for associated Injuries.

Treatment

Conservative management

Conservative management of fractures in children in spica cast or with skeletal traction.

Surgical management

- Intramedullary nailing in comminuted fractures preferably CRIF
- Intramedullary nail
- Plating of shaft femur fracture in children and TENS is also used in children.

Blood transfusion if needed and correct hypovolemic shock. Adequate hydration should be ensured.

6.4 Fractures of distal femur

- High velocity injuries
- Often compound
- Look for neurovascular injury.
- Result in considerable functional result because of comminution and intra articular extension

Management

Open anatomical reduction and internal fixation using Lateral Locking plates/ retrograde femoral nails/dual plating followed by early mobilization of knee

External fixators in compound fractures as a primary management followed by definitive internal fixation

6.5 Fracture of proximal tibia

Clinical features

Swelling, pain, deformity, compartment system has to be ruled out also look for neurovascular injury.

Investigations

X-ray of knee with leg AP and lateral view,

CT scan is needed to assess the comminution and fracture pattern and to decide on fixation (Schatzker classification).

Management

Initially long leg slab is given and can be continued if it is undisplaced, severely comminuted fractures may require a lower tibial skeletal traction.

Fractures with severe skin compromise may require two stage surgical procedure – initially by an external fixator application followed by definite fixation.

Definitive management is by ORIF with plate and screws (proximal tibial locking plates), unicondylar or bicondylar.

6.6 Fracture of tibia/fibula

Signs /symptoms

Pain, swelling, tenderness, deformity

Investigation

X-ray of Tibia along with X-ray of knee and ankle joint.

Treatment

Conservative - In Undisplaced fracture, closed reduction and above knee cast for 6 weeks followed by PTB cast for 6 weeks.

Surgical – Displaced fracture, Interlocking nail is used or plating depending on fracture anatomy, or both.

Bimalleolar fractures and pilon fractures

a. Commonest among the ankle fractures and depending on the fracture pattern and injury pattern appropriate fixation can be done with plate and screws.
b. Suprasyndesmotic injuries needs syndesmotic stabilisation
c. Conservative management in the case of undisplaced fractures.
d. In case of Bimalleolar fractures with diabetic neuropathy additional Transarticular stabilisation can be considered.
e. In Trimalleolar fractures, indications for fixing posterior malleolus includes fragments with 25-30% tibial size, >2mm displacement/articular step, with Talar subluxations.
f. Initial treatment depends on soft tissue condition.
g. Fibular fixation along with ankle spanning external fixator as temporary measure
h. Definitive fixation of tibia can be considered after restoration of soft tissue integrity.

6.7 Fracture calcaneum

Mode

Fall from height.

Sign /Symptoms

Swelling, oedma, pain, tenderness, deformity

Examine the patient for spine fractures and proximal long bone fractures.

Look for evidence of compartment syndrome.

Investigation

X-ray of ankle lateral view , calcaneum axial view,x rays of spine. CT scan for intra articular fractures(sanders classification)

Treatment

- Conservative (Below knee Cast). Strict non-weight bearing till fracture heals up to 3 months
- Open calcaneal fractures has to be debrided immediately.
- Open reduction is advisable after resolution of edema(wrinkle sign)
- Intra-articular fractures of calcaneum involving subtalar joint should preferably treated with restoration of anatomical fracture geometry.
- Diabetic/ POVD/smoker if surgery is indicated minimally invasive incision has to be adapted if possible

6.8 Fracture talus

Second most commonest of the tarsal fractures usually needed a ct scan to assess the fracture pattern(Hawkins classification).

Definite surgical management is by internal fixation with screws, plates or both.

Displaced fractures has to be fixed as early as possible.

6.9 Lisfranc injury

This injury that has to be ruled out in case of metatarsal fractures and needs fixation with screws, K wires and plates (A lateral view of foot should be included in the trauma series of foot)

Look for evidence of compartment syndrome.

7 Dislocations

Loss of alignment of joint surfaces which should be treated as emergency.

Look for associated fracture and neurovascular injuries

7.1 Shoulder dislocation

- Most common dislocation.

Types

- Anterior (90%)
- Posterior.
- Inferior. (luxatio erecta)

Brachial plexus and axillary nerve has to be looked for and documented.

Mechanism:

- Most commonly indirect / direct violence
- Posterior dislocation is common in electric shock and convulsions.

Clinical Features:

Deformity is specific usually, neurologic deficit has to be ruled out (axillary nerve), vascular deficit and associated injury to chest

Anterior

- Patient comes with injured shoulder in abduction and external rotation.

Posterior

- No striking deformity, shoulder in adduction and internal rotation.
- High index of suspicion for posterior dislocation has to be kept in mind for patients with h/o epilepsy/electrocution.
- Absence of passive abduction and external rotation in posterior dislocation has to be suspected and special views or CT scan is advised.

Luxatio erecta

- Salute position abduction forward elevation.
- Severe pain, neuro vascular deficit, more with latter two.

Investigation:

- X-ray - AP, Scapular view, Axillary view, West Point axillary, Hill-Sachs view, Stryker notch view, CT scan

Treatment:

- Reduction (from ER under IV sedation)
- For Anterior dislocation - Traction – Counter Traction, Abduction, extension, external rotation – reduction. Followed by short 2-3 weeks immobilisation in a sling.
- For posterior Dislocation – inline traction –internal rotation – head manipulation by gentle push anteriorly – gentle external rotation when the head dislodges. Followed by immobilization in an external rotation brace (ideal)- or restrict internal rotation.
- For inferior dislocation – mainly inline traction and cephalad countertraction.

IF unsuccessful, Proceed for Closed Reduction Under General Anesthesia

Surgery Indications –

- Irreducible dislocation by closed methods
- Displaced fracture dislocation (ORIF)

Complications:

- Recurrent dislocation.
- Axillary nerve and artery Injury.
- Brachial plexus Injury.
- Stiffness.

Instability cases in opd

History – Ask for

- when was the first episode (90% chances for redislocation if first episode is before 20 years) and whether it was traumatic or not
- last episode – may overestimate instability if last episode is within three weeks
- Total number of dislocations (to have an idea about the already happened cartilage damage and bone erosion)
- Any history of sleep dislocations (Highly indicative of bone loss predominantly in glenoid)

- Athletic level(those in contact sports and all requires more robust treatment options)

Examination –

- Look for Apprehension , Crank and jobe relocation Test (for anterior instability), Kim and Jerk test (for posterior instability) O brien test(for SLAP)
- Look for apprehension in Midrange (less than 90 degree abduction) – highly indicative of Glenoid bone loss
- Look for rotator cuff function
- Look for axillary nerve sensation and assess Deltoid function.

Investigations- :

- X-rays – true AP, Axillay and Stryker notch view, MRI to assess soft tissue and CT to quantify bone loss.
    - Anterior instability without bony defect – Arthroscopic bankart repair
    - Anterior instability with humeral bony defect – Arthroscopic bankart repair +/- Remplissage [based on on/off track lesions]
    - Anterior instability with anteroinferior glenoid bone defect < 20% - Arthroscopic bankart/ bankart plus (DAS) procedure +/- remplissage
    - Anterior instability with anteroinferior glenoid bone > 13% in sports personnel or >20% in normal adults – Latarjet Procedure (open/Arthroscopic)
    - Anterior instability with anteroinferior glenoid bone loss > 30% - Illiac crest bone grafting (ICBG) +/- remplissage.

7.2 Elbow dislocation

- Most common is Posterior Dislocation of elbow

Mechanism:

- Posterior - elbow hyperextension, valgus stress, arm abduction, fore-arm supination.
- Anterior-direct force over posterior fore-arm with elbow in flexed position.

Clinical Features:

- Gross instability.
- Swelling.
- Three point bony relation altered.
- Associated Injuries - radial head and coronoid

  Fracture.

  Neurovascular deficit

Investigation:

- X-ray elbow AP and lateral. CT and MRI as per irreducibility and unstable even after reduction.
- Look for features of terrible triad.

Treatment

- Closed manual reduction under IV Sedation/GA, followed with above elbow posterior slab more than 90 degree flexion.(can even try an arm pouch if its stable)

  Repeated weekly follow up with x-ray and mobilisation

Operative Indications:

- Redislocation.
- Non-concentric reduction.
- Surgery: Open reduction and repair of soft

  Tissues (suture anchor) hinged external fixation, pinning of the joint are indicated in unstable reductions.

Complications:

- Loss of motion.
- Neurologic compromise.
- Vascular Injury.

- Compartment syndrome.
- Redislocation.
- Myositis ossificans.

Hip dislocation

Types of dislocation:

Posterior: Posterior dislocation

Is the most common type of dislocation. Occurs

mainly due to high velocity trauma like RTA, fall from height etc

Anterior: Anterior dislocation Occurs because of blow to the back in squatting position.

Central fracture dislocation: Associated fracture of the acetabulum. (Thomson and Ebstein classification)

Clinical Features:

Posterior

- Limb in flexion, adduction, internal rotation, limb shortening
- Sciatic nerve Injury.

Anterior

- Limb in flexion, abduction, external rotation, and limb lengthened
- Injury to femoral nerve.

Investigation:

- X-ray.
- Hip AP and lateral.
- CT.

Management:

- Resuscitate, CPR attempted with in-line traction with patient lying supine, under general anaesthesia.
- Methods used are the classical Watson-jones, Allis, and Bigelow and reverse Bigelow, Stimson gravity method.
- Maintain it with skeletal traction.
- If irreducible, non-concentric, ipsilateral neck Fracture or acetabular fracture then open reduction is done. Associated fracture of acetabulum and proximal femur fractures has to be checked for.

Complications:

- Osteonecrosis.
- Post-traumatic osteoarthritis.
- Recurrent dislocation.
- Neurovascular Injury.
- Femoral head fractures.
- Heterotopic ossification.
- Thromboembolism.

7.3 Fracture of acetabulum.

Introduction

Fractures of acetabulum occurs by impact of femur head with acetabular articular surface.

Depending upon the position of limb and the direction of force the the pattern of acetabular fracture varies

Associated injuries can be life threatening or limb threatening and has to be carefully looked for-

Associated fracture of extremity, Head injury, Chest injury, nerve palsy, abdominal injury, genitourinary Injury, injury of spine.

Sign and symptoms

Physical examination of any patient who has sustained high energy trauma should follow ATLS protocol.

Complete evaluation of musculoskeletal system with peripheral nerves has to be done.

Look for Morel lavalle lesions and adequate debridement (percutaneous or open) with delayed wound closure and delayed fracture fixation may be required.

Look for sign of dislocation.

Investigations

X ray pelvis AP two 45˚ oblique views(obuturator and iliac)

CT scan to define fracture pattern.

Classification

- Elementary fracture patterns.
  - Posterior wall
  - Posterior column
  - Anterior wall
  - Anterior column
  - Tranverse
- Associated fracture pattern.
  - Posterior column with posterior wall
  - Tranverse with posterior wall
  - Anterior column and posterior hemitranverse
  - T shaped
  - Both column

Treatment

- Stable concentrically reduced acetabular fractures not involving the dome can be managed conservatively with bed rest with joint mobilisation as soon as symptoms allow and eventual progression to weight bearing activity after 6 to 12 weeks.
- AP & oblique x-ray taken at weekly for first 4 weeks.
- Operative treatment for fracture causing hip joint instability and/or joint incongruence.
- Operative treatment include ORIF, percutaneous fixation depending upon fracture pattern

Timing

Usually not an emergency, treat the underlying medical problems and associated injuries.

Indications for emergency fixation

- Recurrent hip dislocation despite traction
- Irreducible hip dislocation
- Progressive sciatic nerve deficit following fracture or closed reduction
- Associated vascular injury requiring repair
- Open fracture
- Ipsilateral femoral neck fracture

7.4 Knee dislocation

- Mode of Injury: high energy / low energy.
- Hyperextension with or without varus / valgus.

Clinical features:

- Gross knee distortion is present.
- **A neurovascular examination must be done.**

Investigations:

- X-rays AP and lateral, 45 degree oblique, patellar skyline views.
- MRI.
- Assess the ligament Injuries.

Treatment:

- Immediate closed reduction, avoid direct pressure over the popliteal fossa after reduction,splint at 20 - 30 degrees of flexion.
- Preferable to admit the patient after reduction and monitor vascularity with an arterial Doppler scan.
  - Operative indications:
    - Unsuccessful closed reduction.
    - Residual soft issue interposition.
    - Open injuries.
    - Vascular injuries.

External fixator is used in case of unstable and open injuries, vascular injuries.

Reconstruction of ligaments at later setting.

Complications:

- Limited range of movements.
- Ligamentous laxity and instability.
- Vascular compromise.
- Nerve traction Injury.

8 Ligamentous injuries of knee

History

Mode of Injury

Indirect, Twisting Or Bending Forces On The Knee.

Clinical features:

Pain, swelling, tenderness, loss of range of motion and positive patellar tap,popping sensation, giving away sensation, locking, inability to bear weight, inability to return to play.

Lachman test, drawer test, effusion, swelling,

Pivot shift test, joint line tenderness.

Investigation

- XRAY associated bony injuries
- MRI

Management

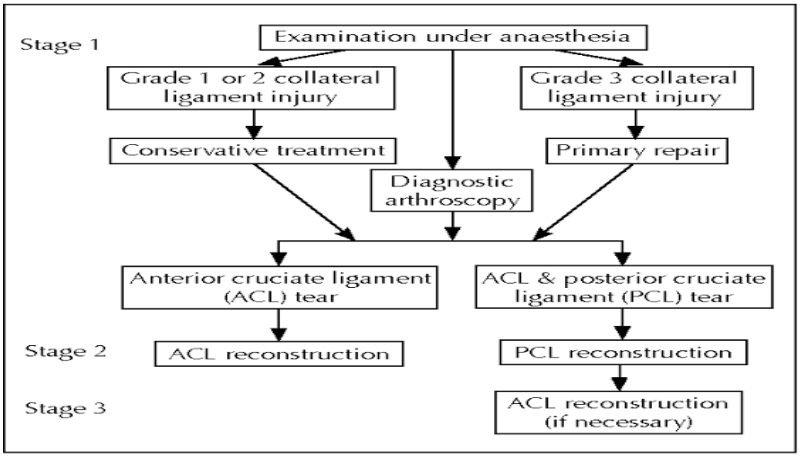
Treatment

Initial management with brace/splint and NSAIDs

Conservative management with bracing and physiotherapy

Bracing for 2 weeks followed by MRI

Operative: arthroscopic ligament reconstruction or meniscal repair later(exception is associated fractures)



- ACL injury in paediatric individuals: Surgical reconstruction using physeal sparing methods in grade3 instability.

9 Spinal trauma

Spinal Cord Injury (SCI)

Is An Insult to the Spinal Cord Resulting in Either Temporary Or Permanent injury. Identify whether patient is in spinal shock or not.

Clinical Diagnosis:

After the ABC have been taken care of, the patient is gently log rolled and whole of the spine is palpated for tenderness or a palpable step-off deformity.

Neurogenic shock, incontinence of bowel, bladder and penile erection indicate severe spine Injury. A

careful and detailed neurological examination is then performed and meticulously documented.

Assessment of motor function

C3-5 Diaphragm

C4- Shoulders Shrug

C5 Elbow flexors (biceps, brachialis)

C6 Wrist extensors (extensor carpi radialis longus and brevis)

C7 Elbow extensors (triceps)

C8 Finger flexors (flexor digitorum profundus to the middle finger)

T1 Small finger abductors (abductor digiti minimi)

L2 Hip flexors (iliopsoas)

L3 Knee extensors (quadriceps)

L4 Ankle dorsiflexors (tibialis anterior)

L5 Long toe extensors (extensor hallucis longus)

S1 Ankle plantar flexors (gastrocnemius, soleus

Assessment of sensory function

Deltoid area C5

Thumb C6

Middle finger C7

Little finger C8

Nipple T4

Xiphoid T8

Umbilicus T10

Symphysis T12

Anterior thigh L2

Anterior knee L3

Antero-lateral ankle L4

Dorsum of great and 2nd toe L5

Lateral side of foot S1

Posterior calf S2

Perianal sensation S2-5

Asia grade

A-Complete: No motor or sensory function is preserved in the sacral segments S4-S5.

B-Incomplete: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.

C-Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.

D-Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.

E-Normal: Motor and sensory function are normal

Spinal Cord Injury is most commonly graded using the ASIA grading.

After the motor and sensory examination, presence of sacral sparing may be noted by voluntary rectal sphincter tone and toe flexor contractions.

Presence of sacral sparing indicates a better neurological prognosis.

Although spinal shock is over by 24 hours, rarely it may be prolonged. A positive bulbocavernous reflex or a positive anal wink indicates the end of spinal shock. If no motor or sensory function can be documented at this stage, a complete spinal cord Injury is present**.**

Investigations:

All patients with suspected spinal Injury should have radiographic evaluation.

The National Emergency X-Radiography Utilization Study (NEXUS) criteria are a set of guidelines used to determine if a trauma patient needs cervical spine imaging:

- **Alertness**: The patient is alert and oriented to person, place, time, and event
- **Intoxication**: There is no evidence of intoxication

- **Neurological deficit**: There is no focal neurological deficit
- **Midline tenderness**: There is no posterior midline cervical tenderness
- **Distracting injury**: There is no painful distracting injury, such as a long-bone fracture

A radiological examination is unwarranted if the patient fulfil the NEXUS criteria

a) Initial screening can be done by conventional antero-posterior and lateral x-rays. The cervical spine radiographs must include the C7-T1 junction to be considered adequate

b) Additional Open-mouth views should be done to evaluate odontoid Injury.

c) Whole spine should be evaluated with a patient of spinal Injury.

The patient should be referred for advanced diagnostic modalities like CT and MRI only when the patient is stable.

Treatment

Primary immobilisation in the form of CASH brace , Philadelphia collar, soft collar, hard cervical collar.

Treatment: Standard Operating procedure

(a) On arrival in emergency room:

Once the patient with a potential spinal Injury reaches the emergency, the patient should be transferred off the backboard onto a firm padded surface while maintaining spinal alignment. A baseline skin assessment can be performed at the time of shifting the patient from spine board to hospital bed. Adequate number of personnel should be employed for logrolling during patient repositioning, turning and transfers.

No clinical evidence exists to definitively recommend the use of any neuro protective pharmacologic agent, including steroids, in the treatment of acute spinal cord Injury to improve functional recovery. However high dose methylprednisolone may be used as per NASCIS III recommendations (*30 mg/kg loading dose and then 5.4 mg/kg for 24*

hours if started within 3 hours, for 48 hours if started within 8 hours. Steroids have no benefit if they are started more than 8 hours after)

The risk of complications as infection, sepsis, respiratory complications and gastrointestinal haemorrhage should be kept in mind while administering steroids.

(b) Once initial resuscitation is done, complete a comprehensive tertiary trauma survey in the patient with potential or confirmed spinal cord Injury.

In the patient with acute spinal cord Injury, particularly higher cervical Injury, assess frequently and document early any evidence of traumatic brain Injury (TBI) in the form of loss of consciousness and posttraumatic amnesia .

Screen for thoracic and intra-abdominal Injury in all patients with spinal cord Injury. Perform early stabilization of extraspinal fractures.

Surgical stabilisation of the fracture by anterior or posterior approach is the definitive surgical treatment

Perform this surgery as early as possible to facilitate early rehabilitation and concomitantly with any required spinal stabilization if the patient is medically stable.

stabilization if the patient is medically stable.

TLICS	3 independent predictors			
1	**Morphology** immediate stability	- Compression - Burst - Translation/rotation - Distraction	1 2 3 4	- Radiographs - CT
2	**Integrity of PLC** longterm stability	- Intact - Suspected - Injured	0 2 3	- MRI
3	**Neurological status**	- Intact - Nerve root - Complete cord - Incomplete cord - Cauda equina	0 2 2 3 3	- Physical examination
Predicts		- **Need for surgery**	0 – 3 4 > 4	- nonsurgical - surgeon's choice - surgical

Subaxial Injury Classification (SLIC) and Severity Score			
Category	***Parameter***	***Description***	***Points***
1	Injury morphology	Compression	1
		Burst	2
		Distraction	3
		Rotation/translation	4
2	DLC* integrity	Intact	0
		Suspected disruption	1
		Disruption	2
3	Neurological status	Intact	0
		Nerve root injury	1
		Complete cord injury	2
		Incomplete cord injury	3
		Persistence cord injury"	+1

* DLC = discoligamentous complex
" Neuro modifier = continuous cord compression in the setting of a neurologic deficit

Total points	Management
1-3	Non-surgical
4	Surgical or non-surgical
5-10	Surgical

The TLISS and SLIC gives a general guideline regarding the indication for surgical management of thoracolumbar and subaxial cervical spine injuries

(c) Day Care

i. physiotherapy for passive mobilisation of all joints and active exercises for muscles

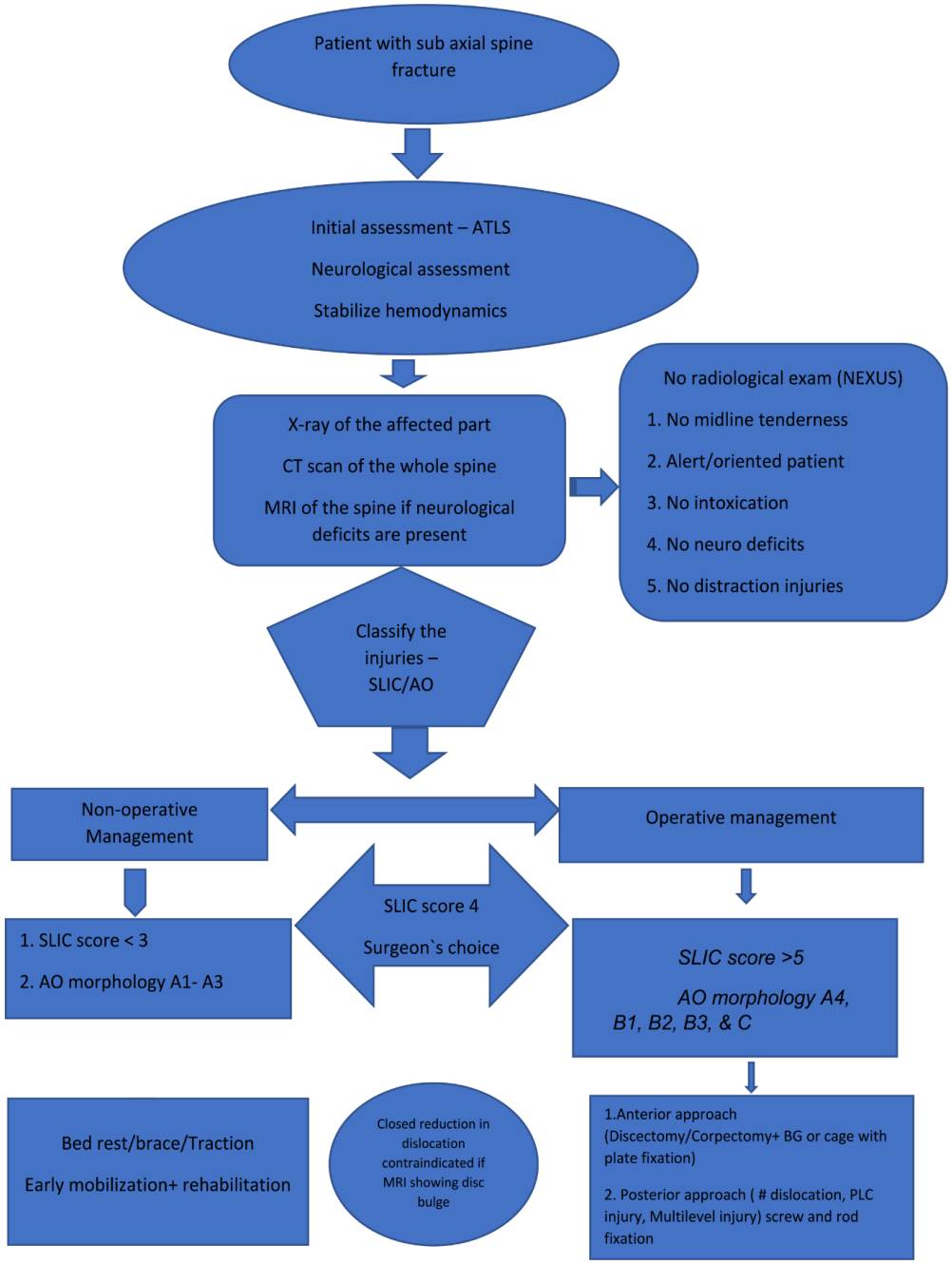
ii. Teaching of clean intermittent catheterisation

iii. Counselling of the patient and attendants

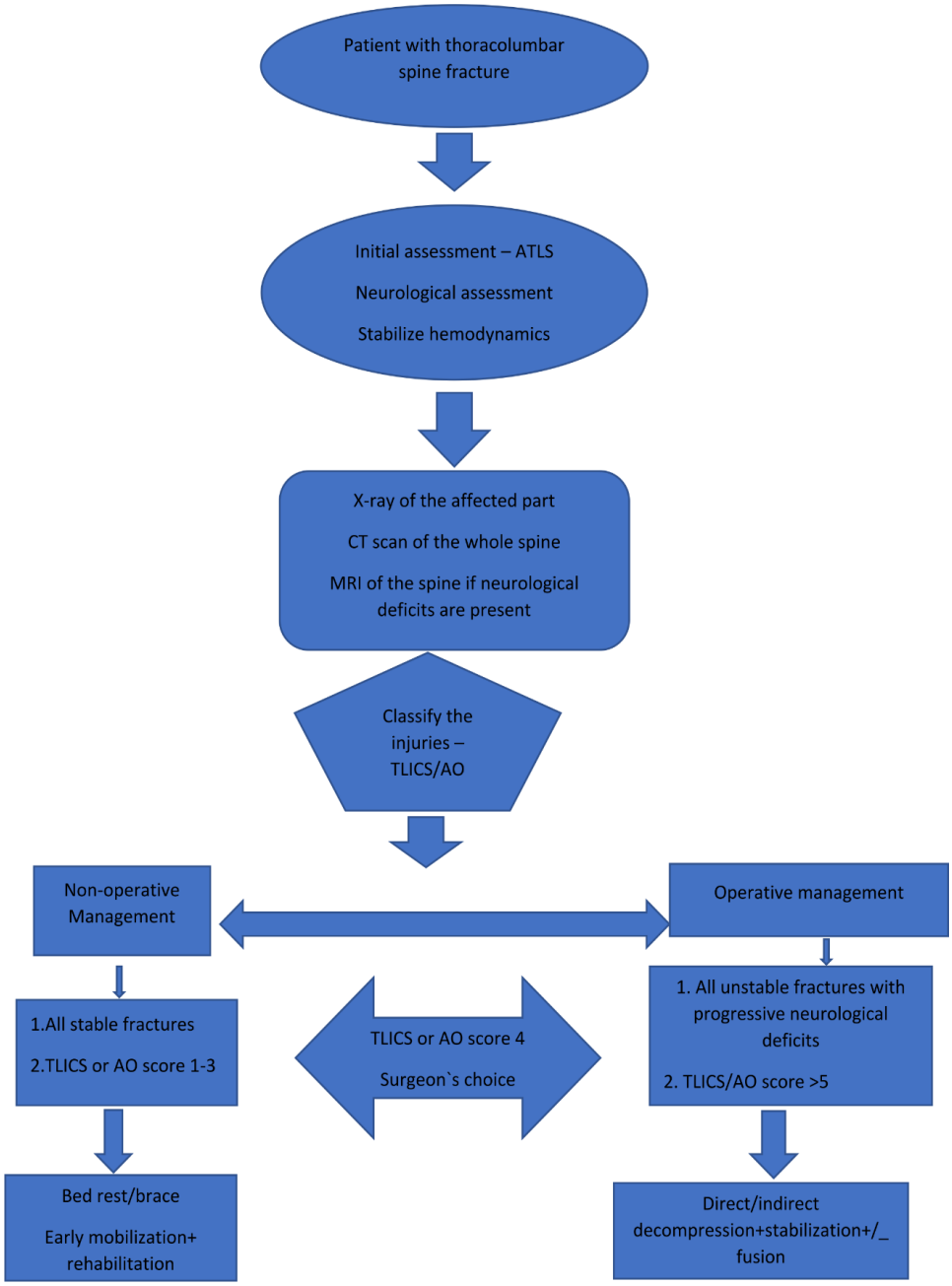
iii. Care of bed sores

Some Algorithms are –

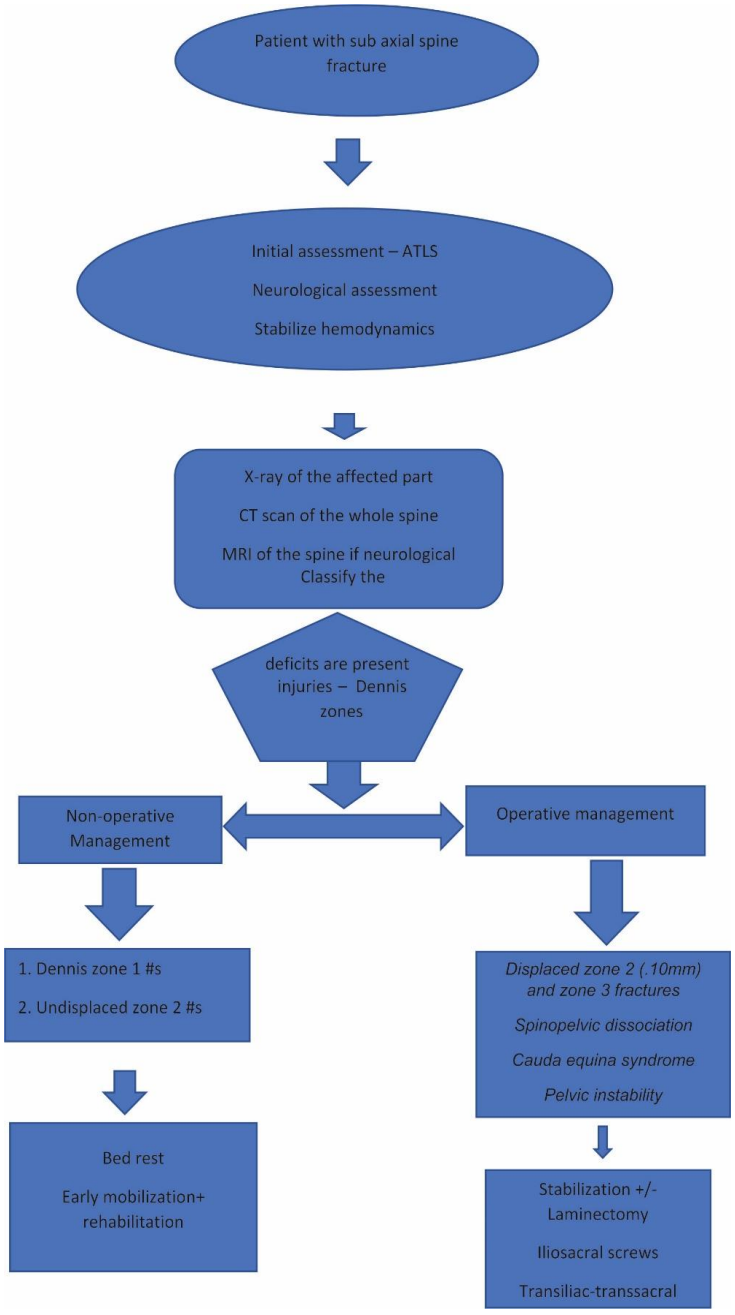
Management of sub axial cervical spine fracture - an algorithm



Management of thoracolumbar spine fracture - an algorithm



Management of sacral fracture - an algorithm



Mangled extremities (amputation)

Introduction

Most of RTA involve trauma to extremities to varying level and these type of injuries are also commonly occurring in RTA.

Work site accident are another common mode.

At PHC/Sub Center level

- Follow ATLS guidelines of A B C D E
- After Stabilization of patient, examine for other associated Injuries such as pelvis and spine which are common in poly trauma
- If absent then grade the Injury according to MESS (Mangled Extremity Severity Score) which is useful for decision making regarding definitive surgical treatment (Salvage or Amputation of the limb).
- Wash the wound primarily with normal saline, diluted (1:3) iodine solution and diluted (1:3) Hydrogen Peroxide till all visible contamination in removed.
- Stop any active bleed with help of compression bandage or tourniquet or at times ligation.
- Avoid Excessive handling of injured limb to avoid neurovascular complications.
- Infuse IV fluids and Blood
- Inject first dose of antibiotics (usually given are cefuroxime, gentamycin and metronidazole)
- Give Inj. TT. O.5 ml intra muscular and 250 IU of tetglob (120 IU in children)

Informed consent

- Two surgeons should certify that the limb needs amputation
- Consent of the patient (if conscious and cooperative) should be taken
- Consent of Relative should be taken if patient is non responsive
- Detailed informed consent in their local language should be taken

Technique of transportation of amputated part for reimplantation

- Amputated part should be cleaned with saline or running water and put in clean plastic cover or container.
- This should be kept in ice box
- Amputated part shouldnot be in direct contact with ice
- No saline or any liquid should be used for transportation.
- Transport to centre were reimplantation is done.

Indications for amputation

- Haemodynamically and physiologically unstable
- Unreconstructable bony injury
- Unreconstructable vascular injury
- Unreconstructable soft tissue injury

Pre operative care

- Pain management
- Clinical assessment (serial monitoring)
- Decision making
- Discharge planning
- Record keeping

Peri operative care

- The scheduling of operations
- Operation undertaken
- Antibiotic prophylaxis
- Thromboprophylaxis

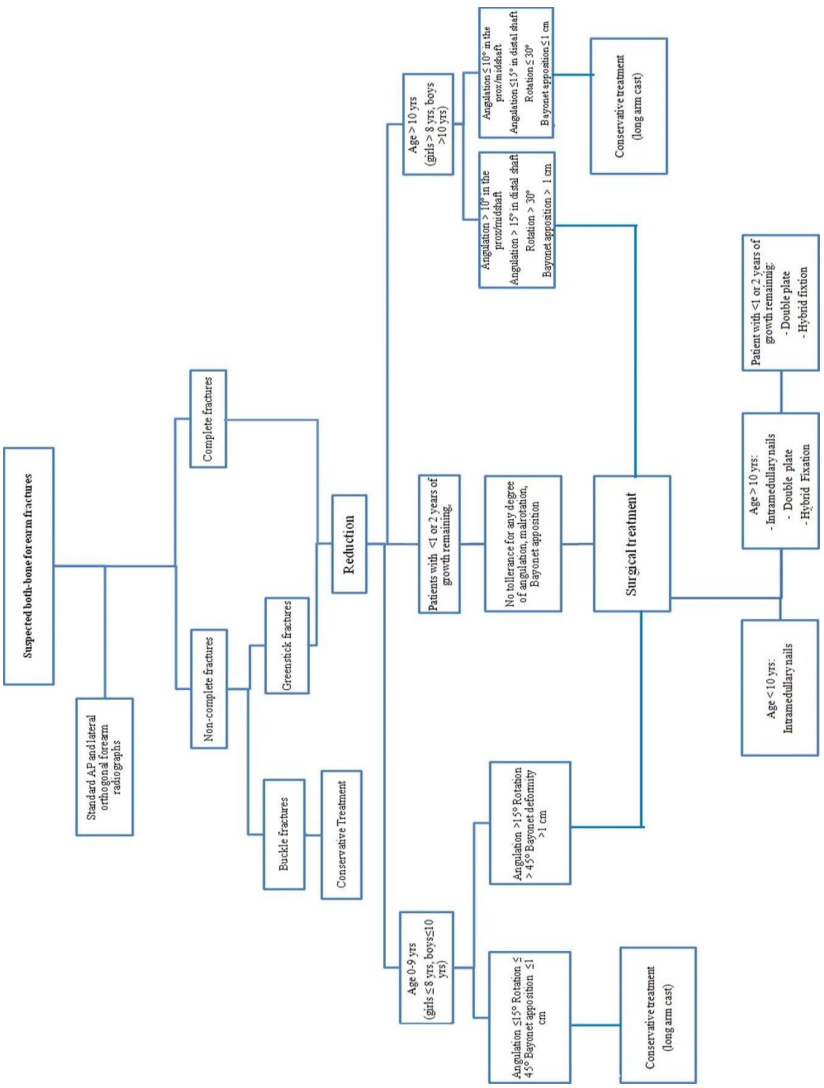
Post operative care

- Pain management
- Wound care
- Rehabilitation

10 Common fractures in children

10.1forearm fractures

Management is in the following flowchart.



10.2 Fractures around elbow

- **Supracondylar fractures**

  Always look for vascular and distal neurologic status

  Conservative management – (immobilise in a above elbow slab in less than 90 degree flexion)

  - All Type 1 Fractures
  - Type 2 fractures with no medial comminution and in which anterior humeral line is intersecting capitulum.

Surgical management – Closed reduction and percutaneous pinning

- All type 3,4 and type 2 with medial comminution/collapse
- Flexion type injuries.

Timing of Surgery depends on neurovascular status

- Good neurovascular status without much edema – can wait
- Emergency surgery indicated in – in neurovascular compromise, increased edema, Brachialis sign(buttonholing of proximal fragment), floating elbow

  a) Pulseless well perfused hand – Emergency surgery and observation for 2 days

  b) Pulseless poorly perfused hand – Try Closed reduction from ER and assess perfusion(arterial Doppler) – if ok, proceed with surgical fixation : If vascularity not returning, ask for Vascular opinion.

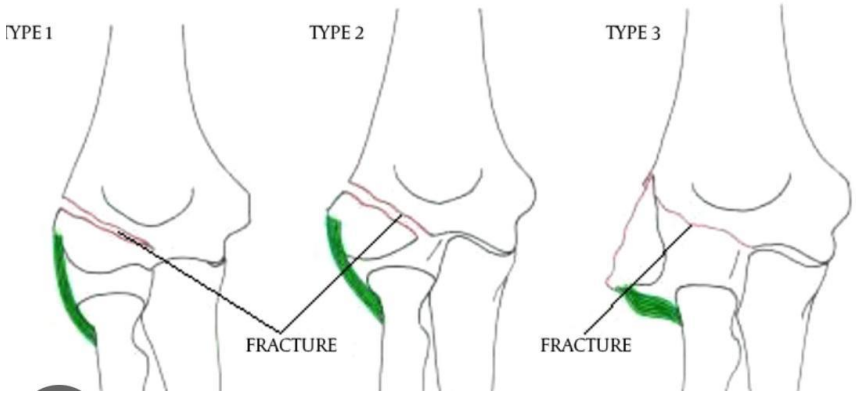
  c) Pulse less white hand – may need emergency vascular exploration (emergency closed reduction and splinting in 20-30 degree flexion/extension and referral)

- **Fracture lateral condyle humerus**

  AP- internal rotation views and oblique view to visualise displacement of fracture

  In doubtful cases contralateral side xray can be compared.

Management depends on displacement and intactness of medial hinge of cartilage.(Weiss classification)



- Conservative management – Type 1 fractures
- Closed reduction and Pinning – Type 2 fractures
- Open reduction and pinning – Type 3 fractures

- **Fracture medial epicondyle humerus –**
  - Conservative management usually
  - Surgical management – IF fracture is grossly displaced, entrapment into the joint, if fracture is extending to medial condyle, in open fractures or ulnar nerve ivolvement

- **Fracture clavicle**

Conservative management - Figure of 8 bandage and arm pouch.

- **Shaft of femur fractures**
  - Femoral Shaft Fractures are one of the most common pediatric orthopedic fractures and are the most common reason for pediatric hospitalization due to orthopedic injury.
  - Diagnosis is made with plain radiographs of the femur.
  - Management generally depends on age

- <6 months – Pavlick Harness/Gallows traction followed by spica
- 6 months – 5 years –

-Stable fracture – Hip Spica casting

- Unstable fracture – Traction followed by delayed Hips spica casting

- 5 years – 12 years

-Less than 49 kg - Flexible elastic nails

-More than 49 kg – Plate fixation

- >12 years – Rigid intramedullary nails/Plate fixation

- **Epiphyseal injury around hip and knee**

Closed reduction and immobilization in splints

Surgical treatment – Indicated in displaced injuries, open reduction and internal fixation with multiple cancellous screws or mini-DHS plate for Fractures around hip and k wires and screws in case of knee.

Proper counselling shoulder be made to the parents regarding chances of future deformities and limb length discrepancies.

- **Tibial fractures**

Mostly conservative management.

Surgery indicated only in grossly displaced fractures and open fractures.

11 Tumours in orthopedics

11.1 Sarcomas

Clinical features –

- Non mechanical pain and swelling
- Key features - Location deep to deep fascia, Size >5cm, increase in size,painfull.

Investigations

a) X-rays – new bone formation/periosteal reaction/bone destruction/soft tissue swelling

The joint above and below should be included.

b) MRI Scan -

I. Patient with a known focal bone lesion on a radiograph

A. Start with a large field of view (FoV) study to include both limbs and the joint above and below in the body coil.

B. If the lesion looks aggressive on the radiograph and will likely need surgery, then a whole limb survey is indicated to allow accurate measurements and to detect other lesions.

II. Patient without a known focal bone lesion on a radiograph

A. The whole limb or whole bone screening will be done after the focal lesion /body part has been scanned

c) CT scan

The indications are limited and would involve -

1. Staging for pulmonary metastasis
2. Patients with contraindication to MRI
3. Patients with metallic implants
4. For pre-surgical planning of complex bone lesions with or without angiography
5. High index of suspicion or an MRI diagnosis of osteoid osteoma
6. For establishing the nature of some equivocal chondroid lesions
7. Cortical involvement in some soft tissue lesions in close proximity with bone

d) PET Scan –

The indications are limited and would include:

1. Staging and post-treatment evaluation of patients with osteosarcoma and Ewing sarcoma

2. Evaluation of patients with equivocal cartilage lesions in some settings

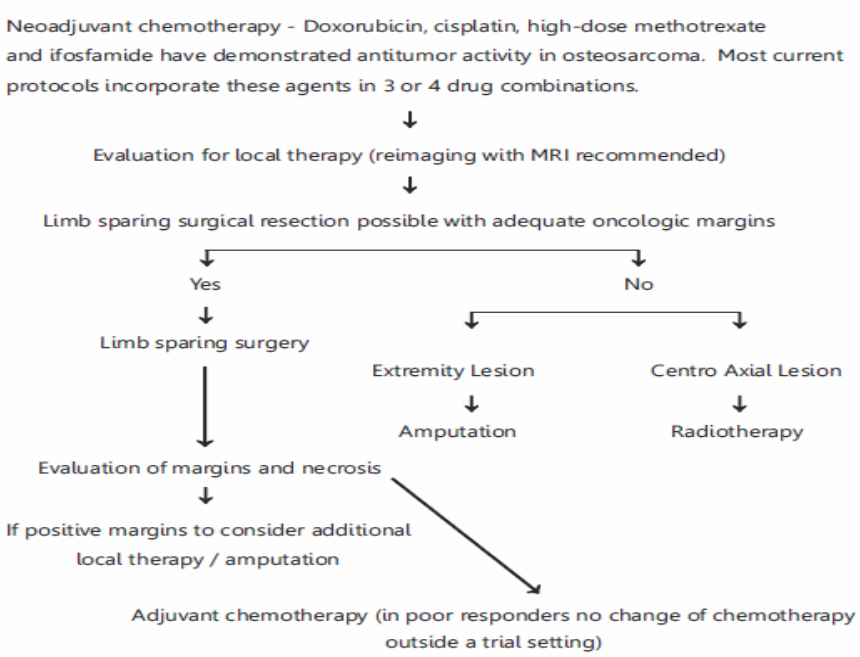
3. Looking for extent of disease and other lesions, in patients above the age of 45 and where there is a strong suspicion of metastases, myeloma and lymphoma

e) BIOPSY

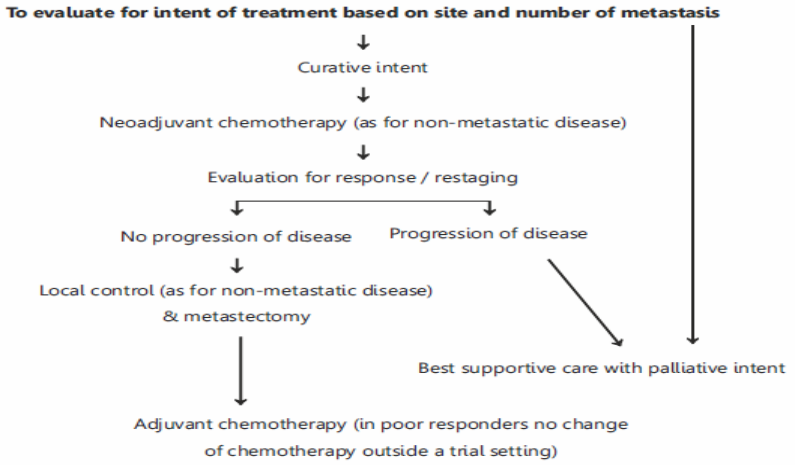
- Biopsy should be regarded as the final diagnostic procedure, not as a shortcut to diagnosis. It should be performed after all the imaging studies have been performed.
- Ideally, the biopsy must be performed by or under the supervision of the surgeon who will be carrying out the final treatment. (if a trained tumour surgeon is not available in a centre, biopsy shoulder be done after seeking advice from the same from a referral centre)
- **No** transverse incisions in the extremities because the site of the incision cannot be excised en bloc with the longitudinally directed segments of bone musculoaponeurotic compartments. Therefore, a longitudinal biopsy incision must be used in the extremity.
- **Avoid** the major neurovascular structures because if they are contaminated during the biopsy they may have to be sacrificed during the definitive procedure that follows
- **Avoid** inter-compartmental planes as these offer paths of least resistance and may increase the area of potential contamination through a hematoma during and after biopsy.
- **Do not** traverse a normal anatomical musculoskeletal compartment in order to reach a compartment that is involved by tumor, so that it will not be ecessary to remove both compartments at the time of the definitive procedure.
- **Do not** biopsy through the adjacent joint.
- **Avoid** biopsy heavily calcified or ossified and necrotic areas.

11.2 Osteosarcoma

a) High Grade Osteosarcoma – Non Metastatic in presentation

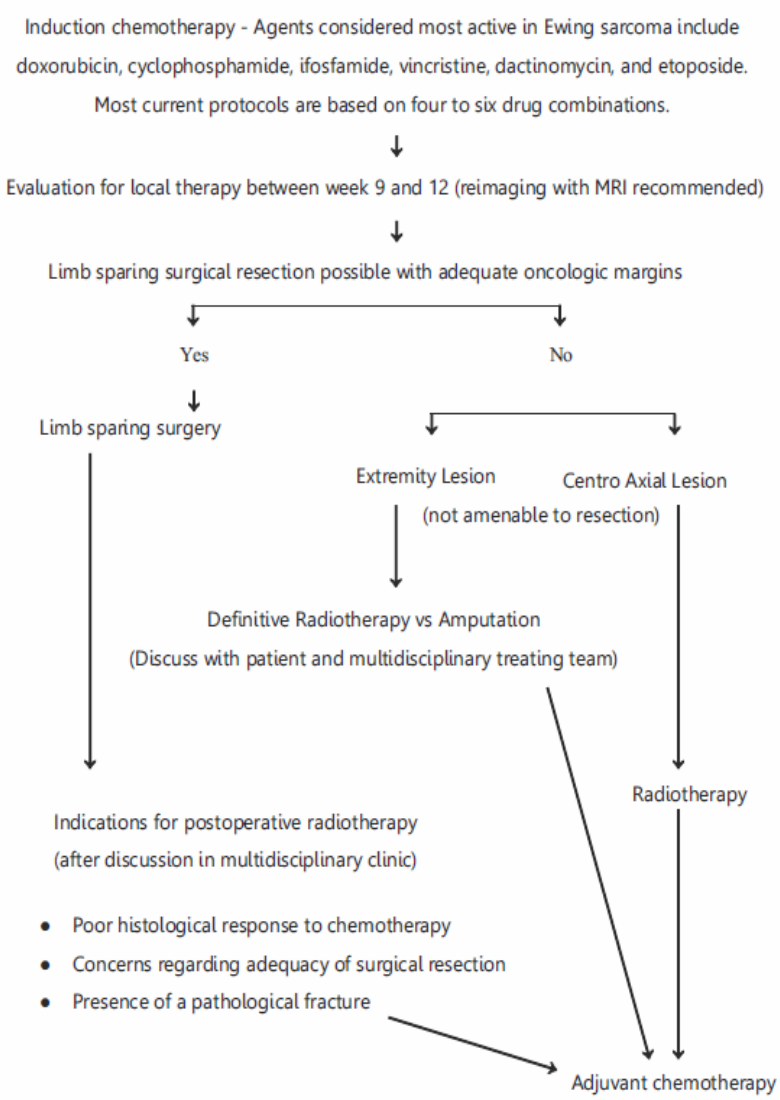


b)) High Grade Osteosarcoma – Metastatic in presentation

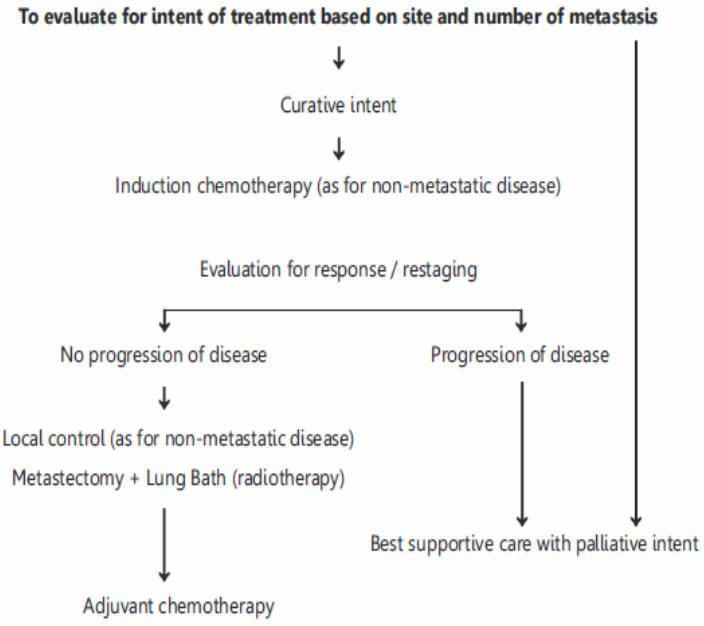


11.3 Ewings sarcoma

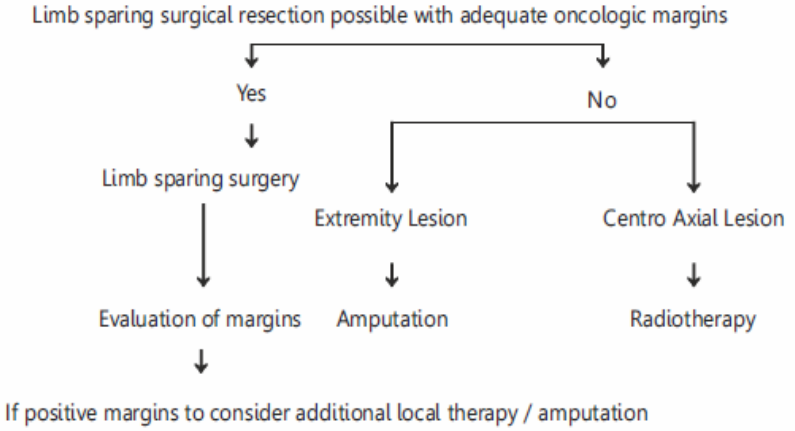
A) Non metastatic at presentation



B) Metastatic at presentation

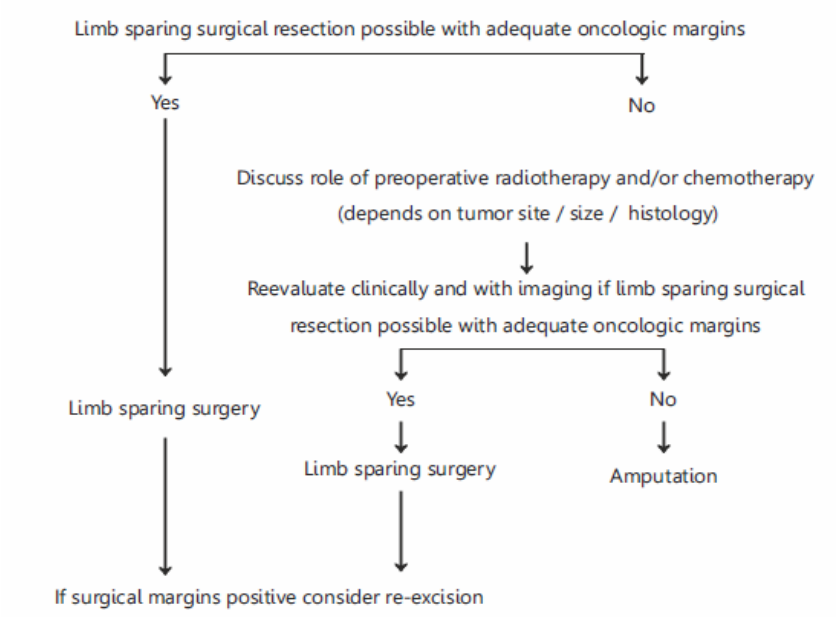


11.4 Chondrosarcoma



11.5 Extremity soft tissue sarcomas

a) Non metastatic at presentation

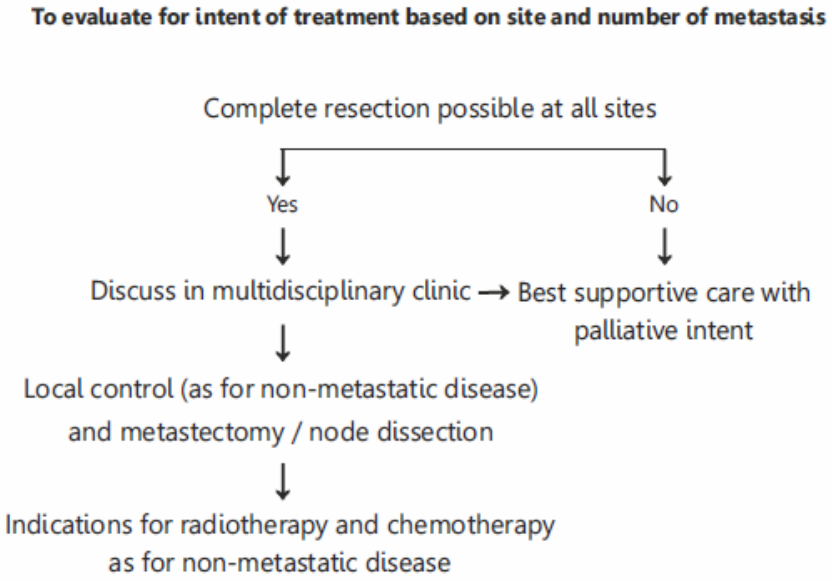


Indications for radiotherapy

- High grade lesions
- Recurrent lesions
- Deep seated /or ≥ 5cm /or margin +

Chemotherapy may be offered to patients with high grade lesions > 5cm or recurrent lesions after discussion in multidisciplinary clinic

b) Metastatic at presentation



11.6 Giant cell tumour

Clinical features

- Persistent, localized bone pain — mechanical in nature
- Swelling, bony expansion or deformity over epiphysis/metaphysis
- Hard or soft-tissue mass adjacent to joint (due to cortical breach)
- Limited joint motion, joint effusion
- Red Flag signs – Severe pain + swelling with risk of pathological fracture, Neurological symptoms (if spine or sacrum involved), Rapid enlargement of swelling, Suspected malignant transformation (rare)

Investigations

- X-ray of involved bone
  - Eccentric, lytic, epiphyseal lesion
  - No sclerotic rim; cortical thinning; subchondral extension

- Basic blood tests:
  - CBC, ESR, CRP
  - Serum acid phosphatase (may be elevated)
- **MRI**
  - Defines extent, soft-tissue mass, subchondral invasion
  - Homogeneous signal; T1 low, T2 intermediate-high
  - Hemosiderin low signal areas
- **CT scan**
  - For cortical breach, articular extension, and surgical planning
- **Chest CT**
  - To detect pulmonary metastasis (1–5% of cases)
- **Bone scan / PET-CT** (if multifocal disease suspected)

Definitive - Biopsy

- Image-guided core needle biopsy
- Avoid contamination of joint and soft tissue planes
- Send for histopathology + immunohistochemistry

Key Diagnostic Marker

- **H3.3A G34W mutation: highly sensitive & specific for GCT**

Management

STEP 1 — Determine extent of disease

Campanacci Grading (for planning)

- **Grade I** – well-defined margin, intact cortex
- **Grade II** – cortical thinning/expansion

- **Grade III** – cortical destruction + soft-tissue extension

STEP 2 — Surgical management

A. Intralesional Curettage (Standard of Care) Indicated for:

- Most Grade I & II lesions
- Small to medium epiphyseal lesions

Technique

1. Extended curettage
2. Use of adjuvants
    - High-speed burr
    - Phenol
    - Liquid nitrogen
    - Hydrogen peroxide
    - Cementation (PMMA)
3. Cavity filling with bone graft or cement

Recurrence risk ~15–35% (lower with adjuvants)

B. Wide Resection

Indicated for:

- Recurrent cases
- Massive bone destruction
- Sacrum, pelvis, spine (when feasible)
- Joint involvement precluding curettage

Reconstruction Options

- Endoprosthetic replacement

- Arthrodesis
- Structural allografts

STEP 3 — Medical management (adjuvant / neoadjuvant)

A. Denosumab (RANKL inhibitor)

Indications

- Unresectable GCT (spine, sacrum)
- Neoadjuvant therapy to shrink lesion
- Recurrent/metastatic disease
- Extensive lesions needing joint preservation

Mechanism

Targets RANKL expression on stromal cells → suppresses osteoclast-like giant cells

Caution

- Rebound recurrence on discontinuation
- Osteonecrosis of jaw
- Hypocalcemia
- Dense bone rim may complicate surgery

B. Bisphosphonates

- May reduce recurrence by inducing apoptosis of stromal and giant cells.

  Used in selected cases as adjuvant therapy

C. Radiotherapy

Reserved for

- Unresectable spinal/sacral tumors

- Poor surgical candidates

Risk

- Malignant transformation (rare but recognized)

STEP 4 — Management of pathological fracture

- Do NOT fix until biopsy confirms diagnosis
- After diagnosis:
  - Joint salvage with curettage + internal fixation if feasible
  - Wide resection for unstable/intra-articular fractures

STEP 5 — Follow-up protocol

Clinical & Radiologic Surveillance

- Every 3 months for 2 years
- Then every 6 months for 3 years
- Annually thereafter up to 10 years
- Chest CT for metastasis screening

Recurrence usually occurs within first 2–3 years.

In a nutshell,

Grade I–II, resectable

→ Extended curettage + adjuvants ± graft/cement

Grade III or major destruction

→ Wide resection + reconstruction

Unresectable (spine, sacrum, pelvis)

→ Denosumab ± RT

Recurrent disease

→ Repeat curettage or resection

→ Consider denosumab

Metastatic disease (lung)

→ Surgical metastasectomy + systemic therapy

12 Miscellaneous

1. Frozen shoulder (adhesive capsulitis)

Significant restriction of both active and passive shoulder motion

1.1. Clinical Features

- Night pain
- Inability to reach overhead and reach away from the body.
- Restriction of both active and passive movements. Loss of external rotation is the first and must have criteria

1.2. Investigations

- X-ray.
- Blood - rule out metabolic causes.
- Ultrasound (Dynamic ultra sound).
- MRI (Thickness of the capsule and synovium>4mm) to rule out other pathology.

1.3. Treatment

- Supportive - Diathermy, Ultrasound, TENS.
- Medications
  - Tab.Diclofenac sodium 50mg thrice a day for 1 week and SOS later Or
  - Tab. Indomethacin 25mg thrice a day for 1 week and SOS later Or
  - Tab.Ibubrufen 400mg thrice a day for 1 week and SOS Later

  - NSAIDs cause hyperacidity hence antacids such as Cap. Omeprazole 20mg or Tab. Pantoprazole 40mg once a day should be given.

- Intra- articular steroids. – Inj.Hydrocortisone acetate 40mg once every 3 months.
- Physiotherapy -Stretching exercises.
- External rotation — passive stretch. Stand in a doorway and bend your affected arm's elbow to 90° to reach the doorjamb. Keep your hand in place and rotate your body. Hold for 30 seconds. Relax and repeat.
- Forward flexion — supine position. Lie on your back with your legs straight. Use your unaffected arm to lift your affected arm overhead until you feel a gentle stretch. Hold for 15 seconds and slowly lower to start position. Relax and repeat.
- Sleeper Stretches - Lie on the shoulder you want to stretch (your affected side), with your body stacked. Bring the affected arm straight out from your shoulder (90 degrees of shoulder flexion). Bend your elbow to 90 degrees, so your fingers point towards the ceiling.Use your top hand (the one not on the floor) to gently push your lower forearm down towards the floor for internal rotation and otherwise for external rotation.Go as far as comfortable without pain, feeling a stretch in the back of the shoulder or upper back. Hold for 20-30 seconds. Do 3-5 repetitions.
- Crossover arm stretch. Gently pull one arm across your chest just below your chin as far as possible without causing pain. Hold for 30 seconds. Relax and repeat.
- Manipulation under general anesthesia (if symptomatic > 6 months).
- Surgical Release (If not response to above treatment).Open or Arthroscopic capsular (including anterior band of Inferior glenohumeral ligament) release
- Recovery - After surgery, physical therapy is necessary to maintain the motion that was achieved with surgery. Recovery times range from 6 weeks to 3 months. Commitment to therapy is the most important factor in returning to all pre-surgical activities. Although uncommon, frozen shoulder can come back, especially if a contributing factor like diabetes is still present.

2. Tennis elbow:

- Lateral epicondylitis due to repetitive stress Injury Commonly seen in housewives and players.
- Wrist dorsiflexion and resisted supination in complete elbow extension will cause exacerbation of symptoms. [Cozen's test positive]

2.1 Investigations

- X ray
- EMG
- MRI to assess tendon damage, other nerve compression pathology
- MRI neck to rule out cervical pathology may be ordered.

2.2 Treatment:

Medical treatment

1) Tab. Diclofenac sodium 50mg thrice a day for 1 week and SOS later Or
2) Tab. Indomethacin 25mg thrice a day for 1 week and SOS later Or
3) Tab. Ibubrufen 400mg thrice a day for 1 week and SOS Later.

NSAIDs cause hyperacidity hence antacids such as Cap. Omeprazole 20mg or Tab. Pantoprazole 40mg once a day should be given.

- Ice pack application
- Physical and occupational therapy
- Local Steroids/ Platelet rich plasma – Inj. Hydrocortisone acetate 40mg once every 3 months.
- Supportive splints/braces

Surgical release

- Open/Arthroscopic release with or without excision of bursa.
- Rehabilitation

- Immobilize for 2 weeks followed by slow stretching exercises for 2 months. Strengthening exercises at 2 months, return to sports after 6 – 9 months.

3. Golfers elbow: Management is same as discussed above.

13 Joint replacements

13.1 Total knee replacement (TKR)

It is a common surgical procedure aimed at relieving pain and improving function in individuals with severe knee arthritis or other degenerative knee conditions. The standard treatment guidelines for TKR encompass preoperative, intraoperative, and postoperative care. These guidelines are based on recommendations from major orthopedic societies and clinical research. Here's an overview of the standard treatment guidelines:

1. Preoperative Care:

a. Patient Selection:

Indications for TKR:

- Severe pain and functional limitations due to osteoarthritis (OA), rheumatoid arthritis, or post-traumatic arthritis.
- Failure of conservative management (medications, physical therapy, injections) for above indications.
- Significant joint deformity or instability.
- Radiographic evidence of severe joint destruction (preferably bone-on-bone arthritis on weight bearing radiographs).

Contraindications:

Absolute

- Active local infection/ Presence of active infection elsewhere in body
- Uncontrolled comorbidities (e.g., uncontrolled diabetes, cardiovascular disease).
- Unfit for anesthesia

Relative

- Neuropathic joint
- Poor overlying skin condition
- Morbid obesity
- Noncompliance due to major psychiatric disorder, alcohol, or drug abuse
- Insufficient bone stock for reconstruction
- Poor patient motivation or unrealistic expectation
- Severe peripheral vascular disease

b. Preoperative Evaluation:

- **Medical Optimization**:
  - Assess comorbid conditions such as hypertension, diabetes, and cardiovascular health.
  - Optimize medications, particularly anticoagulants and other relevant treatments.
  - Rule out other active focus of infection like dental / urologic/ gynecological foci
- **Preoperative Imaging**:
  - X-rays (weight-bearing AP, lateral, skyline , Rosenberg views, three joint hip knee ankle scannogram).
  - CT / MRI may be considered in complex cases (e.g., assessment of soft tissues or bone loss).
- **Laboratory Testing**: Basic blood tests, including complete blood count (CBC), electrolytes, renal function,liver function and coagulation profile.

c. Patient Education:

- Discuss the surgical procedure, expected outcomes, risks, and rehabilitation – shared decision making on surgery.
- Preoperative physical therapy to improve muscle strength , range of motion and teach postop rehab techniques .

d. Antibiotic Prophylaxis:

- Administration of prophylactic antibiotics (typically cefazolin) 30–60 minutes prior to surgery to prevent infection. Dosage based on body weight and repeated if surgery prolongs more than 2 hours.

e. Thromboprophylaxis:

- Depending on the patient's risk profile, use of pharmacological anticoagulation (e.g., low-molecular-weight heparin, direct oral anticoagulants, aspirin) or mechanical methods (e.g., sequential compression devices).

2. Intraoperative Care:

a. Anesthesia:

- General anesthesia or regional anesthesia (e.g., spinal or epidural block) is commonly used. The choice depends on the patient's health and surgeon's preference.

b. Surgical Technique:

- The approach is usually a medial parapatellar/ midvastus or subvastus based in surgeons preference. Lateral parapatellar approach may be used for valgus knees. Additional techniques like rectus snip/ tibial tubercle osteotomy etc may be performed in complex cases.
- Mechanical alignment is the most commonly used technique. Recent advances like kinematic / reverse kinematic/ constitutional / anatomic / functional alignment

philosophies may be used based on the surgeons preference and training in navigated / robotic surgery.

- The surgeon removes damaged bone and cartilage and replaces them with a metal prosthesis (CoCr/ titanium/Gold/ ceramic) and poly. Additional stems (cemented/ uncemented) and wedges may be used for complex primary cases .
- The prosthesis may be cemented or press-fit, cruciate retaining / substituting, mobile bearing /fixed bearing , patella resurfaced / non resurfaced depending on the type of implant, bone quality and surgeon preference.
- Intraoperative pain relief cocktail may be given at the surgical site.
- Revision cases / neuropathic joints requires use of constraint / hinged poly, additional augments like cones/ Sleeves/tantalum augments depending on the bone loss and collateral stability.

c. Soft Tissue Management:

- Careful attention is given to preserving the surrounding muscles, ligaments, and soft tissues while ensuring proper alignment and stability of the knee.
- Sliding medial and lateral condylar osteotomy may be added for achieve stability in complex cases.
- Water tight closure is advisable.

d. Pain Management:

- Use of multimodal analgesia (combination of systemic opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), local anesthesia, or nerve blocks) to manage post-surgical pain.

3. Postoperative Care:

a. Recovery and Monitoring:

- Immediate postoperative care in a recovery unit with monitoring of vital signs and assessment of surgical site.
- Anticoagulation therapy to prevent deep vein thrombosis (DVT) based on patient risk profile .
- Prophylactic antibiotics may be continued for 24–48 hours or more if deemed necessary by the treating surgeon based on patient health profile.

b. Pain Control:

- Pain management should include a multimodal approach, using medications, nerve blocks, ice therapy, and elevation of the leg.

c. Physical Therapy:

- Early mobilization is crucial. Encourage patients to begin gentle range-of-motion exercises and gradually increase activity.
- Focus on strengthening the quadriceps and improving flexibility and functional movement.
- Continuous passive motion (CPM) devices are used in some cases, though their use is debated.
- Weight-bearing status is typically allowed as tolerated, depending on the surgeon's preference and implant type with support.

d. Wound Care:

- Close monitoring for signs of infection, including redness, warmth, and discharge from the surgical site.
- Wound closure can be achieved with sutures, staples, or skin glue, and they are typically removed in 10-14 days.

- Patients should avoid submerging the incision site in water until it is fully healed.

e. Discharge Planning:

- Discharge is typically within 2-3 days if the patient is stable and pain is manageable.
- Patients should be provided with instructions on managing medications, activity levels, and wound care at home.

4. Long-Term Rehabilitation:

a. Rehabilitation Goals:

- Improve range of motion and strength.
- Achieve functional recovery, including walking without assistance and performing activities of daily living.

b. Physical Therapy Post-Discharge:

- Outpatient physical therapy is often recommended for 6–12 weeks after surgery.
- Progressively increase exercises focusing on knee strength, stability, and functional movement.

c. Follow-up Visits:

- Typically scheduled at 6 weeks, 3 months, 6 months, and annually thereafter to monitor progress, assess implant function, and detect complications.
- X-rays are taken periodically to evaluate prosthesis alignment and condition.

5. Complications :

- **Infection**: Superficial or deep infections may occur, requiring antibiotics or further surgery.
- **Deep vein thrombosis (DVT)**: Blood clots are a common concern post-surgery.

- **Implant Loosening or Failure**: Over time, the prosthesis may loosen or fail, necessitating revision surgery.
- **Stiffness or Loss of Range of Motion**: Scar tissue formation can limit joint mobility.
- **Neurovascular Injury**: Rare but possible damage to surrounding nerves or blood vessels.
- **Fracture**: Periprosthetic fractures can occur, especially in the setting of weak bones.

6. Long-Term Care:

- Patients should be advised to avoid high-impact activities (e.g., running, jumping) that can wear out the prosthesis early.
- Maintain a healthy weight to reduce stress on the knee.
- Encourage appropriate physical activity to maintain joint health and function.
- Report immediately on finding any features of local / distant infective foci

These guidelines serve as a general framework, and treatment may vary depending on individual patient factors and surgeon preferences. Regular follow-up and rehabilitation are key to optimizing long-term outcomes after total knee replacement surgery.

13.2 Unicondylar knee arthroplasty (UKA)

Also known as partial knee replacement, is a surgical procedure where only one compartment (medial or lateral) of the knee joint is replaced, typically due to osteoarthritis. The goal is to relieve pain and improve function while preserving as much of the natural knee as possible. Below are the standard treatment guidelines for UKA:

1. Indications for UKA

- **Unicompartmental Osteoarthritis (OA)**: Typically, patients with isolated medial or lateral compartment osteoarthritis.

- **Failure of conservative treatments**: When non-surgical treatments like physical therapy, medications, injections, or lifestyle modifications fail.
- **Knee deformity**: Mild to moderate varus (medial compartment) or valgus (lateral compartment) deformities.
- **Age**: UKA is generally considered for patients younger than 65 years who are active but not candidates for total knee arthroplasty. It may be performed in older age patients with unicompartmental knee arthritis.
- **Good ligament function**: The patient should have intact anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) and collaterals , though some cases of ACL deficiency may still be considered.

2. Preoperative Assessment

- **Clinical Evaluation**: Detailed history of symptoms, functional limitations, and examination to assess range of motion, deformities, and ligament stability.
- **Imaging**:
  - **X-rays**: Weight-bearing anteroposterior (AP), lateral, and merchant views to assess joint space narrowing, stress views, three joint scannogram.
  - **MRI/CT scans**: In some cases, for precise assessment of soft tissues and bone deformities.

3. Surgical Technique

- **Approach**: A small, minimally invasive incision is made over the affected compartment (medial or lateral).
- **Resection**: Damaged cartilage and bone are removed from the affected compartment, and the femoral and tibial components of the prosthesis are implanted.
- **Implant Selection**: Choice of implant depends on the manufacturer, but modern UKA systems include fixed or mobile bearing designs.

- **Bone Preparation**: Careful alignment and positioning of the prosthetic components are crucial to avoid long-term complications.
- **Ligamentous Stability**: Ensure the knee maintains stability, with balanced tension in the ligaments postoperatively. Minimal soft tissue release adviced.
- **Patella Preservation**: The patella is not resurfaced in most UKA procedures unless there is patellofemoral involvement.

4. Postoperative Care

- **Early Mobilization**: Begin physiotherapy with weight-bearing as tolerated, typically within 1-2 days post-surgery.
- **Pain Management**: Use a multimodal approach including oral analgesics, regional blocks,patches and possibly cryotherapy.
- **Monitoring for Complications**: Watch for signs of infection, deep vein thrombosis (DVT), or bleeding.
- **Range of Motion Exercises**: Gradual increase in range of motion, focusing on knee flexion and extension.
- **Strengthening**: Focus on quadriceps and hamstring strengthening as part of rehabilitation.

5. Postoperative Rehabilitation

- **Phase 1 (0–6 Weeks)**:
  - Begin with gentle range of motion exercises.
  - Focus on improving weight-bearing status and early quadriceps strengthening.
- **Phase 2 (6–12 Weeks)**:
  - Increase functional activities like walking and low-impact aerobic exercises.
  - Continue strength training and proprioception exercises.

- **Phase 3 (3–6 Months)**:
  - Progress to more advanced strengthening exercises.
  - Return to low-impact activities such as cycling or swimming.
- **Phase 4 (6 Months and Beyond)**:
  - Return to normal functional activities and sports (low-impact).

6. Complications

- **Infection**: As with any surgical procedure, infection is a risk.
- **Implant Failure**: Although rare, prosthesis loosening or wear can occur.
- **Persistent Pain**: If the knee does not improve or if symptoms worsen, revision surgery may be necessary.
- **Venous Thromboembolism**: Prophylaxis for deep vein thrombosis (DVT) should be used.

7. Follow-up

- **Short-term (6 weeks)**: Follow-up to assess recovery, remove sutures, and check for signs of complications.
- **Mid-term (6 months to 1 year)**: X-ray and clinical assessment to check for proper alignment and function.
- **Long-term (annual)**: Long-term monitoring for prosthesis longevity, joint function, and complications.

8. Outcomes

- **Pain Relief**: Most patients experience significant pain relief.
- **Function**: UKA allows for quicker rehabilitation compared to total knee arthroplasty, with earlier return to activities of daily living and moderate exercise.

- **Longevity**: Typically, UKA can last 10-15 years, though outcomes depend on the patient's age, activity level, and other factors.
- **Satisfaction**: High satisfaction rates among patients with isolated unicompartmental arthritis, especially when indicated properly.

9. Alternatives

- **Total Knee Arthroplasty (TKA)**: If the damage is too widespread for UKA, a total knee replacement may be indicated.
- **Osteotomy**: In younger patients with deformities but no advanced arthritis, an osteotomy can be a viable alternative to UKA.

13.3 Total hip replacement (THR)

It is a surgical procedure in which the damaged or worn-out parts of the hip joint are replaced with artificial components to relieve pain and improve function. The standard treatment guidelines for total hip replacement cover preoperative, intraoperative, and postoperative care. These guidelines are based on evidence from clinical practice and research, with input from orthopedic societies. Here's an overview of the standard treatment guidelines for total hip replacement:

1. Preoperative Care:

a. Patient Selection:

- **Indications for THR**:
  - Severe pain and functional limitations due to osteoarthritis (OA), rheumatoid arthritis, post-traumatic arthritis, avascular necrosis or other degenerative painful hip conditions.
  - Failure of conservative management (medications, physical therapy, injections) for above indications.
  - Significant joint deformity, instability, or severe functional limitations.

- Radiographic evidence of severe joint destruction (e.g., joint space narrowing, bone-on-bone contact).

- **Contraindications**:

- **Absolute** :
  - Active hip infection.
  - Systemic infections.
  - Unfit for anesthesia

Relative :

- Younger, active patients who may require other treatment options, such as joint preservation.
- Severe obesity or other comorbidities that prevent safe surgery.

b. Preoperative Evaluation:

- **Medical Optimization**:
  - Comprehensive assessment of the patient's comorbid conditions (e.g., cardiovascular, respiratory, diabetes, or obesity).
  - Optimize medications (e.g., management of anticoagulants, blood pressure control).
  - Control of distant active foci of infection like UTI, dental infection

- **Preoperative Imaging**:
  - X-rays (AP & Lateral views of the hip with femur, sitting and standing lateral view of LS spine with pelvis).
  - CT or MRI may be used in complex cases (e.g., acetabular defects, hip dysplasia).

- **Laboratory Testing**:
  - Blood tests to assess CBC, renal function, liver function tests, electrolytes, blood sugar, nutritional status, blood group and coagulation profile.

- **Assessment of Hip Function**:
  - Detailed history, physical examination, and assessment of range of motion, strength, limb length discrepancy and functional limitations.

c. Patient Education:

- Discuss the procedure, expected outcomes, and potential risks and come to a shared decision on surgical treatment.
- Educate the patient on the rehabilitation process and the need for physical therapy.
- Discuss the use of mobility aids postoperatively (e.g., walker, crutches), need for raised toilets/ sitting arrangements etc.

d. Antibiotic Prophylaxis:

- Administer prophylactic antibiotics (typically cefazolin) 30-60 minutes before surgery to prevent infection. May be repeated if surgery gets prolonged.

e. Thromboprophylaxis:

- Use of pharmacological (e.g., low-molecular-weight heparin, aspirin) or mechanical (e.g., compression devices) methods to prevent deep vein thrombosis (DVT).

2. Intraoperative Care:

a. Anesthesia:

- General anesthesia, regional anesthesia (e.g., spinal or epidural block), or a combination of both may be used, depending on the patient's health and the surgeon's preference.

b. Surgical Technique:

- **Approach**:
  - The common surgical approaches are the posterior, anterolateral or anterior approaches to the hip. The choice of approach depends on the surgeon's preference, the patient's anatomy, and any preexisting conditions (e.g., hip dysplasia or deformity).
- **Procedure**:
  - The femoral head is removed, and the acetabulum (hip socket) is reamed to accommodate the new prosthetic components. The femoral stem is inserted into the femur, and femoral head is placed on top of the stem. The acetabular component is placed in the pelvis.The femoral head is made of metal or ceramic.
  - The replacement components may be cemented / press-fit /hybrid depending on the implant type, patient's pathology and bone quality.
  - Revision procedure requires use of longer distally fixing stems, advanced acetabular cup options like multihole / jumbo / trabecular metal cups , use of trabecular metal augments, cages etc. revision procedure may be staged depending on the status of infection / bone quality.

c. Pain Management:

- Multimodal pain management is used to optimize pain control postoperatively. This includes the use of local anesthesia, nerve blocks, opioids, patches and NSAIDs.

d. Blood Loss Management:

- Strategies to minimize blood loss, such as intraoperative blood salvage or antifibrinolytic agents, may be used.

3. Postoperative Care:

a. Recovery and Monitoring:

- Immediate postoperative care involves monitoring vital signs, assessing pain control, and managing fluid balance.
- If regional anesthesia is used, the patient should be monitored for any sensory or motor deficits in the lower extremities.
- Regular monitoring for signs of infection, DVT, and complications such as bleeding.

b. Pain Control:

- Continue multimodal pain management strategies, including opioids, NSAIDs, patches, nerve blocks, and/or local anesthetic infusion pumps.

c. Wound Care:

- Close monitoring for infection or wound complications.
- The wound is usually closed with sutures, staples, or glue. Sutures or staples are removed 10–14 days postoperatively, depending on the surgeon's preference.
- The patient should be instructed to keep the surgical area clean and dry.

d. Thromboprophylaxis:

- Continue anticoagulation therapy postoperatively for DVT prevention, typically for 4–6 weeks.
- Mechanical prophylaxis (e.g., compression stockings, pneumatic compression devices) may also be used if necessary.

e. Physical Therapy:

- Early mobilization is encouraged, starting with assisted walking on the first postoperative day if patient is deemed fit for mobilization by the treating surgeon.

- Begin range-of-motion exercises and strengthening exercises to restore muscle function and improve mobility.
- Use of a walker or crutches for the first 6–8 weeks postoperatively until weight-bearing restrictions are lifted.
- Progressively increase the intensity of rehabilitation as tolerated.
- Avoid squatting positions and extremes of adduction / internal rotation and flexion of the operated hip.

f. Patient Education Postoperatively:

- Advise on avoiding hip dislocation positions , especially in the early postoperative period.
- Instruct on precautions for hip positioning (e.g., avoid crossing legs, excessive bending of the hip beyond 90 degrees, sitting down .
- Provide instructions on wound care, signs of infection, and when to contact the healthcare team.

g. Discharge Planning:

- Discharge typically occurs within 2–4 days postoperatively if the patient is stable, pain is manageable, and mobility has improved.
- If needed, arrange for home health services or inpatient rehabilitation to assist with mobility and daily activities.
- Antibiotics and analgesics may be continued based on surgeon discretion.

4. Long-Term Rehabilitation and Follow-Up:

a. Physical Therapy and Rehabilitation:

- Continue outpatient physical therapy to strengthen muscles, restore function, and improve mobility.

- Focus on improving flexibility, walking, and overall strength. Specific exercises for the hip joint, quadriceps, and hip abductors are important.

b. Return to Normal Activities:

- Most patients are encouraged to resume light activities (e.g., walking, swimming) within 6–8 weeks.
- Avoid high-impact activities (e.g., running, jumping) to reduce stress on the prosthetic joint.
- Recommendations on driving, work, and recreational activities should be tailored based on individual recovery.

c. Follow-up Visits:

- Initial follow-up is generally scheduled at 6 weeks, followed by annual check-ups for several years.
- X-rays are taken to assess the position and stability of the implant, monitor for signs of wear, and detect complications like loosening or infection.

5. Complications:

- **Infection**: Superficial or deep infections may occur, requiring antibiotics or further surgery.
- **Deep Vein Thrombosis (DVT)**: Blood clots can form in the veins of the leg postoperatively, so thromboprophylaxis is essential.
- **Dislocation**: Hip dislocation can occur, particularly early postoperatively, depending on the surgical approach and postoperative care.
- **Fracture**: Periprosthetic fractures or femoral fractures can occur, particularly in older patients with osteoporotic bone.
- **Implant Wear or Loosening**: Over time, the prosthetic components may wear down or become loose, requiring revision surgery.

- **Neurovascular Injury**: Damage to surrounding nerves or blood vessels, though rare, can occur.
- **Leg Length Discrepancy**: A slight leg length discrepancy may occur, which can be corrected if clinically significant.

6. Long-Term Care:

- Patients should be advised on maintaining a healthy weight to reduce stress on the hip implant.
- Continue appropriate low-impact exercises (e.g., walking, swimming) to keep the hip joint functional.
- Regular follow-up visits to monitor the status of the implant and the patient's functional level.

These guidelines serve as a general framework, but specific treatment protocols may vary depending on individual factors, surgeon preference, and institutional protocols. Close follow-up and physical therapy are crucial for achieving optimal outcomes after total hip replacement surgery.

13.4 Total ankle arthroplasty (TAA)

Also known as total ankle replacement, is a surgical procedure aimed at treating advanced ankle arthritis and other severe ankle disorders. The standard treatment guidelines for total ankle arthroplasty involve the following aspects:

1. Indications for Total Ankle Arthroplasty (TAA)

TAA is typically recommended for patients who:

- Have severe, disabling end stage ankle arthritis, usually osteoarthritis or post-traumatic arthritis.
- Are typically aged 50–75 years (though it can be considered in younger and older patients depending on their overall health and activity level).
- Have a well-aligned and stable ankle joint and hind foot .

- Have failed conservative treatments (e.g., physical therapy, bracing, corticosteroid injections) and are experiencing significant pain, decreased mobility, and poor quality of life.
- Do not have major deformities or instability in the ankle that would preclude a successful outcome from TAA.

Contraindications

- Active infection
- Peripheral vascular disease/ peripheral neuropathy
- Inadequate soft-tissue envelope
- Charcot arthropathy
- Insufficient bone stock
- Severe osteoporosis
- Osteonecrosis of the talus

2. Preoperative Assessment

- **Medical Evaluation**: Comprehensive preoperative evaluation to ensure the patient is healthy enough for surgery. This includes evaluating comorbidities (e.g., diabetes, cardiovascular disease) and ensuring the absence of infections or other contraindications.
- **Imaging**: X-rays (weight-bearing AP and lateral views of the ankle) , CT scans, and/or MRI to assess the joint's condition, alignment, bone quality, and surrounding soft tissues.
- **Functional Assessment**: Evaluate the patient's ability to walk, their level of pain, and functional limitations.
- **Patient Education**: Informing the patient about the procedure, potential benefits, and risks. Discussing realistic expectations for postoperative recovery and functional outcomes. Shared decision making is ideal.

3. Surgical Approach

- **Anesthesia**: General or regional anesthesia (e.g., spinal anesthesia) may be used, depending on patient preference and the surgeon's protocol.
- **Incision**: A typical anterolateral or anteromedial approach is used to access the ankle joint.
- **Prosthesis Selection**: The surgeon will choose from various types of prostheses (e.g., fixed-bearing, mobile-bearing) depending on the patient's needs and the surgeon's expertise. Now third generation implants are commonly used like STAR, INBONE,AGILITY etc
- **Bone Preparation**: The damaged surfaces of the tibia, talus, and fibula are prepared to accommodate the implant.
- **Implantation**: The prosthetic components are inserted and fixed into place, ensuring proper alignment and stability.
- **Wound Closure**: Soft tissues and skin are closed after ensuring proper alignment of the joint.

4. Postoperative Care

- **Immediate Postoperative Period**:
  - The patient will typically remain in the hospital for 1–2 days, depending on their recovery.
  - The ankle may be immobilized in a cast or splint initially.
  - Pain management using oral or intravenous analgesics.
  - Elevation of the foot to reduce swelling and promote healing.
  - Early mobilization with weight-bearing precautions, typically using crutches or a walker.

- **Physical Therapy**:
  - Gradual introduction of physical therapy to improve joint mobility, strength, and function. Initially, passive range-of-motion exercises may be done, progressing to active exercises over time.
  - Weight-bearing typically begins between 6 to 8 weeks post-surgery, depending on the patient's healing and the surgeon's guidelines.

5. Recovery and Rehabilitation

- **Initial Weight-bearing**: After the first 6–8 weeks, the patient can gradually begin weight-bearing as tolerated, with crutches or a walker.
- **Full Weight-bearing**: Full weight-bearing is usually achieved by 12 weeks post-surgery, depending on the surgeon's protocol and the patient's healing progress.
- **Strengthening**: Emphasis is placed on strengthening the calf, foot, and ankle muscles to restore function.
- **Postoperative Follow-up**: Regular follow-up appointments to monitor for complications (e.g., infection, implant failure, malalignment) and to track the patient's recovery.

6. Potential Complications

While total ankle arthroplasty can be very effective, potential complications include:

- Infection
- Implant loosening or failure /subsidence
- Nerve or vascular injury
- Persistent pain and stiffness
- Periprosthetic Fractures
- Osteolysis

7. Outcomes and Expectations

- **Functional Outcome**: Most patients experience significant pain relief and improved function after TAA. The majority of patients report being able to walk longer distances, resume activities of daily living, and participate in low-impact activities.

14 Neuropathic joints

Charcot Foot Syndrome (CFS) (Acute Charcot arthropathy) is a rare but debilitating Acute Foot Emergency in patients with Diabetes Mellitus and Peripheral Neuropathy. It is a progressive condition that often results in acute fractures, joint dislocation and destruction in the acute phase and change in shape of foot and architecture during the healing process. This often results in changes in the dynamics of body weight transmission in pressure points in the feet resulting in life long vulnerability to foot ulcers due to abnormal and non-natural pressure points in the feet. CFS results in the reduction of longevity of an approximate 10-14 years.

Patients presenting with Red swollen joint

Clinical features -:

- Erythema, Warmth, Pain (only in 50%), Deformity, localised swelling

Assess For

- Peripheral neuropathy, Distal Vascularity, Difference in Temperature, Trauma history, long standing DM, Previous c/l Neuropathic joints.

Immediate Management

- Pressure Offloading – TCC/walker boot
- Weight bearing X-ray/ MRI if Xray is non conclusive

Active charcot foot syndrome confirmed?

Yes	No
Diagnostic criteria	**Diagnosis Inconclusive**
1. Clinical symptoms	1. Continue Immobilisation
2. >2o C at corresponding locations	2. MRI
3. Conclusive Radiology features	3. Consider serological tests And other DDs.

Confirmed active charcot foot syndrome

Management

- MRI for full confirmation of diagnosis (if x-ray normal)
- Continue immobilisation
- Initial TCC to be removed and re-casted after 3/7 due to significant reduction in swelling
- Education
- Ensure contra-lateral footwear is appropriate with offloading insole to prevent bi-lateral Charcot
- Review 1-2/52 to:
- Re-assessl temperatures
- Re-cast TCC / re-assess walker fit

Confirmed Inactive Charcot

- Clinical signs / symptoms completely resolved
- < 2 C temperature difference at corresponding locations for 4 - 6 consecutive weeks
- Partial / full Weight bearing x-ray confirming remodelling phase and to assess chronic deformity (see table)

Long- term management

- Gradual step down to partial weight bearing as required
- Footwear offloading :
  - Nil deformity: Appropriate footwear + offloading orthotics
  - Moderate deformity: Custom footwear + offloading orthotics
  - Severe Deformity + rearfoot or ankle Charcot: surgical Options.

Surgical Options

1) Resection of bony prominences and Tendoachilles lengthening.

   Indications – bracable foot in equines with bony prominences

   The primary aim here is to achieve a plantigrade foot without skin compromises.

2) Deformity correction/Arthrodesis/Osteotomies

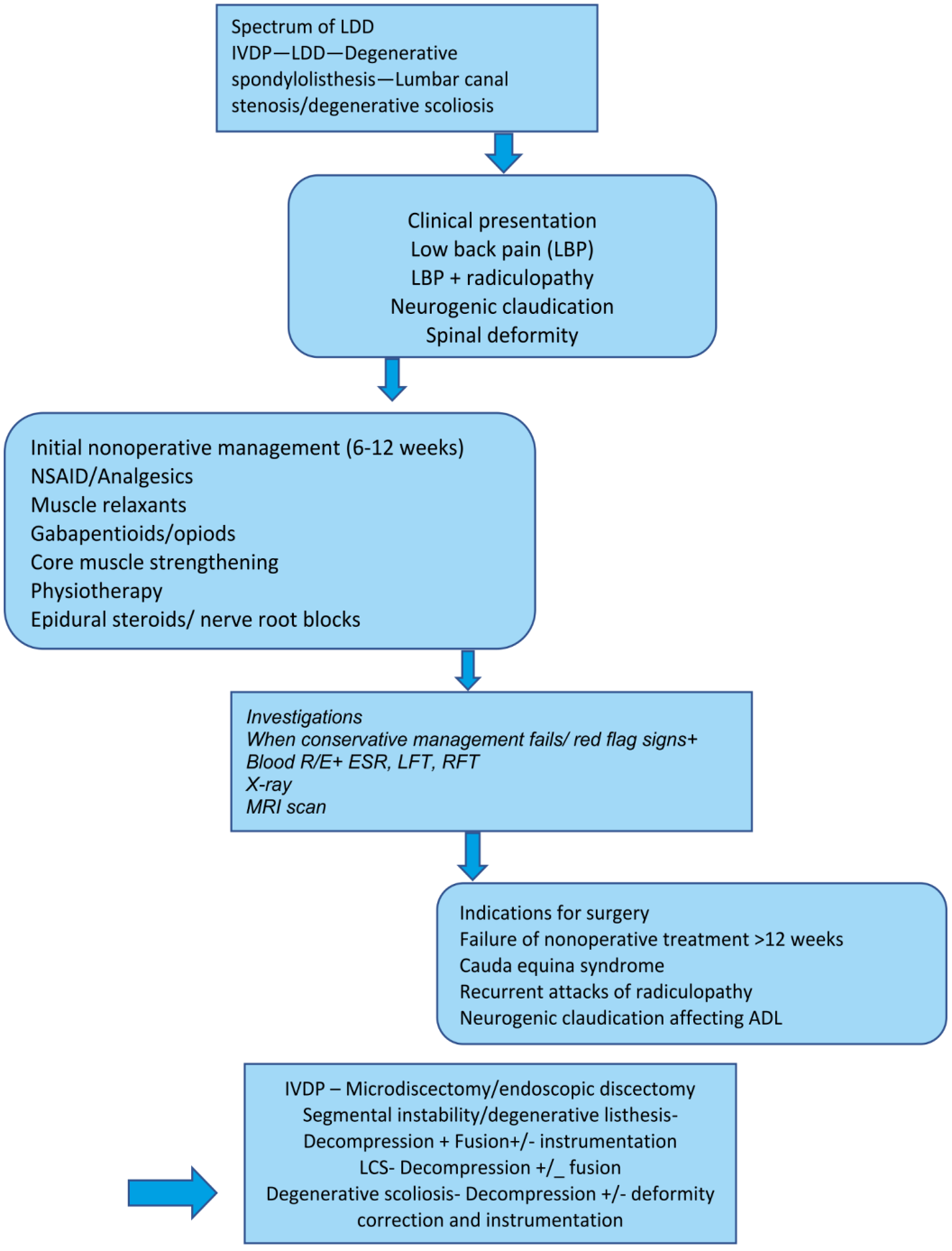
   For those foot which are not bracable

   High complication rates.

3) Amputation

   Failed previous surgeries, Recurrent infections, unstable arthrodesis.

Algorithm for management of lumbar degenerative disc disease



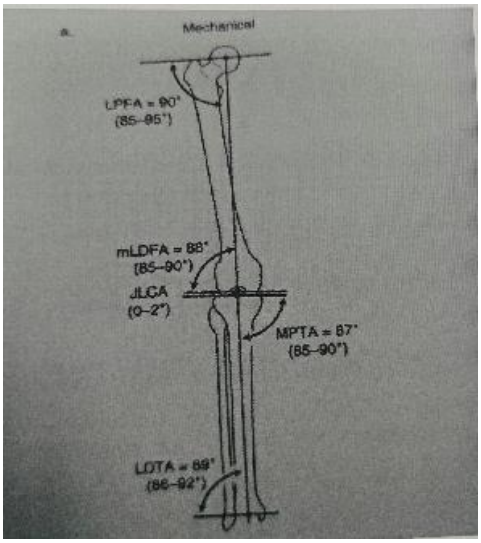
Principles of deformity correction

Mechanical and anatomical axes

- The anatomic axis of a bone is the mid diaphyseal line. The mechanical axis is a straight line connecting two joint centers.
- In the tibia, mechanical and anatomical are parallel.
- In the femur, the mechanical and anatomic axes are different and converge distally. The femoral anatomic-mechanical angle (AMA) is 7+/-2 degrees

Joint Orientation angles

- The angle formed between the joint line and either the mechanical or anatomical axis is called joint orientation angle.
- The commonly used joint orientation angles and their normal values are shown in figure.



mLPFA - mechanical lateral proximal femoral angle

mLDFA - mechanical lateral distal femoral angle

MPTA - Medial proximal tibial angle

LDTA - Lateral distal tibial angle

JLCA - Joint Line Convergence Angle

CORA Concept

A deformed and angulated bone can be divided into proximal and distal segments. Each segment will have its own anatomical and mechanical axes.

The point of intersection of the proximal and distal axes is called center of rotation of angulation(CORA). It is the focal point around which osteotomies and deformity correction is planned.

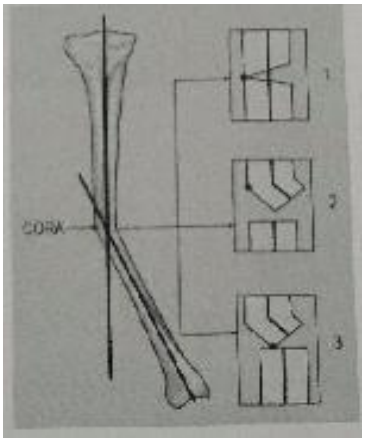
Osteotomy Rules

Rule 1 : If the osteotomy line and the axis of correction pass through the CORA, the bone bone ends will angulate without translation. The axes of the proximal and distal segments will become collinear post correction.

Rule 2 : If the axis of correction lies at the CORA but the osteotomy does not pass through this point, the axes become collinear but the bone ends will angulate and translate with respect to each other.

Rule 3 : When the axis of correction and the osteotomy are at a different level from the CORA, the proximal and distal axes of the bone will be parallel but translated to each other when the angulation is corrected.

Schematic representation of the three osteotomy rules are given below.



Osteotomies around the knee

High Tibial Osteotomy(HTO) for medial compartment osteoarthritis of the knee is the most common deformity correction surgery in adults.

Guidelines for HTO patient selection

- Isolated MCOA
- Age 40-60 years
- Full range of knee movements present
- Magnitude of varus < 15 degrees
- Flexion contracture, if present, should be < 15 degrees
- Normal lateral and patellofemoral compartments
- Normal ligament balance

Surgical techniques

- Lateral closing wedge HTO
- Medial opening wedge HTO
- Focal dome osteotomy

Acute correction can be achieved using locking plates (Locking T plates, Tomofix)

Gradual correction using an LRS fixator or Ilizarov ring fixator.

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- **MILLER'S REVIEW IN ORTHOPEDICS**