

**STANDARD
TREATMENT
GUIDELINES FOR
ORTHOPAEDICS**

**Ministry of Health & Family
Welfare
Govt. of India**

Group Head Coordinates of Development Team

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THE INFECTION OF BONES AND JOINTS

The common infection of bones and joints are mainly due to pyogenic organisms, tuberculosis or rarely brucellosis.

1. When to suspect/recognize

A. Introduction

The common infection of bones and joints are mainly due to pyogenic organisms. It usually occurs in small children in the metaphysical regions of long bones, usually to a focus of infection elsewhere in the body through hematogenous/ lymphatic. The offending organisms are staphylococcus commonly: other organisms are less common like streptococcus, Ecoli etc.

The bacteria get lodged in the metaphysis where they continue to grow, block small vessels which causes necrosis of bone. Pus focus rapidly which may transverse laterally under the periostenum, form an abscess or may even burst on the surface. This is the tone when treatment should be started aggressively lest it should get converted into chronic osteomyelitus.

B. Definition

Osteomyelitus is an acute or chronic inflammatory process. Within bone, bone marrow and surrounding soft tissue that develops. Secondary to infection with bacterial organisms (and rarely fungi).

ii) Incidence of the condition in our country

It is very common condition in our country

iii) Differential diagnosis

- Cellulitis
- Ewing's Sarcoma
- Osteosarcoma
- Arthritis

iv) Prevention and counseling – early diagnosis and treatment

Can prevent considerable morbidity.

v) Optimal diagnostic criteria, investigation, treatment and Referral criteria.

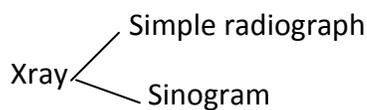
Situation 1:- At secondary hospital/Non-Metro situation: limited technology and resources.

a. Clinical Diagnosis

Signs of acute inflammation
High temperature
Rapid pulse
Extreme degree of pain (Rest/movement)
Local tenderness

b. Investigation

Complete hemogram, culture and sensitivity of aspirated material, ZN staining, Gram's staining.



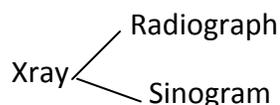
c. Treatment

- Rest – The limb of the patient to be put on rest
- Antibiotic – broad specters antibiotic to be started → to be Changed according to culture and sensitivity
- Out patient – if abscess is present regardless of the stage of disease effective drainage is to be done.
- Day Care – Multiple drill holes, rectangular window, thorough Debridement
- In patient – Immobilization, saucerisation, IV antibiotic, sequestrectomy
- Referral Criteria – No improvement in patients, general condition, deterioration of patients, conditions and other associated complications

Situation 2:- Super specialty facility in metro location where higher end technology is available.

a. Clinical Diagnosis – Signs of acute inflammation, high temperature, rapid pulse, extreme degree of pain, Local tenderness

b. Investigations:- Complete hemogram, Blood Culture, culture and sensitivity of aspirated material, ZN staining, Gram's staining.



Bone scan

CT Scan

ELISA against different antigens of organisms and antibody detection in serum

Histopathological study

i) FNAC

ii) Open Biopsy

MRI

Radioisotope labeled Leukocyte scanning

PET scanning

c. Treatment

- Rest – The limb of the patient to be put on rest
- Antibiotic – broad spectrum antibiotic to be started → antibiotics to be according to sensitivity
- Out patient – if abscess is present regardless of the stage of disease effective drainage is to be done.
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- Referral Criteria – No improvement in patients, general condition, deterioration of patients, conditions and other associated complications

Who does what:-

Doctor:- Early diagnosis and treatment

The diagnosis and treatment is to be started as early as possible. Delaying the treatment can only increase the severity of the disease. Sometimes patient need to be referred.

Nurse:- Patient care

The patient need to be hospitalized in the early stages of the disease to avoid chronicity of the disease for proper patient care.

Technician:- Investigation

In doubtful cases proper investigation to be done in quick time and in a proper way to avoid contamination of the samples.

OSTEOARTICULAR TUBERCULOSIS

INTRODUCTION

For purposes of description osteoarticular tuberculosis can be discussed under the following heads:

- Tuberculosis of joints
- Bone tuberculosis
- Spine tuberculosis

Infection of a joint or bone with *Mycobacterium tuberculosis* is almost always secondary to a primary focus, in the lymphatic glands or lungs or mesentery, from where it disseminates by hematogenous route. Malnutrition or any debilitating disease, poor environment increase the incidence of the disease. Patients with immunodeficiency disease or HIV infection are more prone to develop tuberculosis.

Involvement of any bone or joint in the body can be affected by tuberculosis. Case definition the lesion in the joint can be:

- i. Extra-articular
- ii. Intra-articular: It can originate in the bone (osseous lesion) or in the synovium (synovial disease).

Vertebral body involvement with tuberculosis is the most common and is nearly equal to tuberculosis of all other regions put together.

There may be a history of trauma, under the effect of which a small hematoma may form resulting in vascular stasis in that area. The hematoma may become a nidus for the tubercle bacilli to settle down and form a tuberculosis follicle with caseation, epithelioid cells, giant cells and fibrosis at the periphery.

The lesion in the bone is essentially a lytic lesion which is evident radiologically, unlike in pyogenic infection which is characterized by intense sclerotic activity. As the tuberculous lesions heal, sclerosis takes place. At certain sites like the short long bones and in hand and feet or the clavicle, there is intense sclerotic activity by layer of subperiosteal bone and is characteristic of a tuberculous lesion. The tuberculous pus formed in the medullary canal may travel distally or laterally thus lifting the periosteum, may form an abscess and even burst giving rise to a tuberculous sinus. Multifocal tuberculous is somewhat common and is occasionally.

The response to a tuberculous lesion is exudative and may form a cold abscess, which is nothing but a collection of necrotic material caseous tissue and the exudative reaction. These cold abscesses than track through the fascial planes or the neurovascular bundles and may present at a distant site. Since the abscess is away from the area of inflammatory activity, it has no signs of inflammation in the skin overlying the abscess. A superficial abscess may burst and result into a sinus or an ulcer.

Granulation tissue is almost always present in the tuberculous lesion. Ischemic necrosis of bone due to endarteritis and thromboembolic phenomenon in bone lead to formation of sequestra, which in osseous tuberculosis happen to be small. Isolated large sequestrate in oosteroarticular tuberculosis are rare.

Incidence of condition in our country

It is an extremely common condition in our country and is seen in all strata of society.

Differential Diagnosis

It can mimic almost any condition seen in bone like chronic osteomyelitis, osteoid osteoma, fibrous dysplasia, malignant/benign tremors.

Prevention and Counseling

In case of pain, swelling, night cries fever an orthopedics surgeon may be consulted.

Referral criteria

In case of the symptom like swelling discharging sinuses, paraplegia or the disease not responding to standard anti tubercular drugs the patient may be referred to a higher centre.

Situation 2:- Clinical Diagnosis

The tuberculosis of the joints mainly involves big joints. The common differential diagnosis includes pauciarticular juvenile chronic arthritis and septic arthritis. The involvement of joint may be osseous or synovial but if not treated, one would infect the other. Tuberculous synovitis leads to effusion in the joint and synovial membrane becomes edematous. At this stage the joint would look swollen and movements may be present or limited due to muscle spasm. The radiological picture may show an increased joint space.

Later on, the granulation tissue may extend from the periphery on to the articular cartilage or in the subchondral region in the form of a pannus thus eroding it. Once the articular cartilage is eroded there is tremendous muscle spasm and all movements are restricted. Because of the destruction of the articular cartilage the joint space on X-ray looks diminished.

When the lesion is osseous it involves the subchondral bone which also leads to erosion of the cartilage. The lesion may start from the epiphysis in children or may be metaphyseal in origin. When the disease begins to heal, fibrosis occurs across the joint leading to a fibrous ankylosis. At this stage the movements of the joint are restricted and may be painful. There is considerable

muscle spasm which may produce a deformity at the joint. Prolonged muscle spasm may lead to subluxation or dislocation of the joint causing further deformity and shortening. If sinus has formed, secondary infection may be superimposed on the tuberculous infection. Fibrous ankylosis may be converted into bony ankylosis either due to complete healing or new bone formation due to superadded pyogenic infection. There are no movements in the joint after bony ankylosis and it is also painless. Radiologically, in bony ankylosis the trabeculae are seen to be crossing the joint line.

CLINICAL FEATURES

It is characteristically insidious in onset, and starts as monoarticular or mono-osseous involvement. The child complains of pain in the joint, aggravated by movement, and often wakes 'up at night because muscle spasm gets reduced and causes pain. It is classically called as "night cries". Low- grade fever, loss of weight and appetite are some of the symptoms of generalized toxemia usually seen. Joint movements are painful and elicit muscle spasm on attempted movement. In later stages when the cartilage gets eroded, all movements get restricted. Muscle atrophy around the joint is a predominant feature and occurs early. Sometimes an abscess forms which bursts to form a sinus. It may get secondarily infected and may alter the radiological picture.

INVESTIGATIONS

i) Blood

A low hemoglobin, relative lymphocytosis and raised erythrocyte sedimentation rate (ESR) are often found in the active stage of the disease. The ESR is often used as a guide in monitoring the progress of the disease during treatment, though some people do not consider it a reliable investigation.

ii) Mantoux Test

A positive Mantoux test is seen in patients with active tuberculous lesion. A negative test may rarely be seen in severe or disseminated disease or in an immunocompromised patient.

iii) Radiographic Examination

It can be diagnostic in view of the typical radiological appearance of the tuberculous lesions. In early stage of the joint disease, capsular markings may become prominent. The earliest sign is widespread osteoporosis around a joint. Lytic lesion and periosteal reaction are seen, although latter is much more prominent in pyogenic infection.

In case of joints, small bone erosions occur near the capsular reflection. Joint space decreases due to cartilage erosion and lytic lesions are seen in the epiphyseal area. The radiological signs of a healing lesion are absence of rarefaction and bony ankylosis.

iv) Smear and Culture

Tuberculous pus, joint aspirate, granulation tissue, sputum etc. may be examined by smear and culture for tuberculous bacilli.

The culture and sensitivity tests for various anti tuberculosis drugs also help in giving appropriate chemotherapy in resistant cases or cases of multi-drug resistant tuberculosis; which are seen quite frequently in today's clinical practice.

FNAC (Fine Needle Aspiration Cytology)

Occasionally, even the most modern methods of imaging may not help the clinician to reach to a final diagnosis, and therefore FNAC or biopsy may be undertaken to obtain tissue diagnosis. FNAC is now available for the cytological diagnosis of vertebral tuberculosis. 'Biopsy is a safe and a quick diagnostic procedure with high accuracy in the hands of trained cytopathologists. It is recommended that it should be practiced in all diagnostic centres of our country, even for suspected vertebral tuberculosis.

BIOPSY

Biopsy may have to be done in cases where there is doubt about the diagnosis, particularly in the early stages of the disease. Biopsy from the bone or synovium can provide an early diagnosis for timely starting the treatment and preventing damage to the joint. Biopsy from a cystic lesion in bone or from synovium is more likely to be positive.

Investigations should also be done to find out the primary focus of the disease. An X-ray of the chest should always be done. Some other investigations may include: sputum smear examination and culture, routine urine examination for isolation of tubercle bacilli and an intravenous pyelogram for ruling out pulmonary and genitourinary lesions, respectively.

TREATMENT

The patient's response to treatment is variable as anywhere else in the body and is dependent upon the host resistance, severity of infection, and the stage of the disease when the diagnosis is first made and treatment started. Eradication of the disease and preservation of function are important both in osseous and joint diseases. In case of joints, joint mobility and stability are also the early goals to be achieved. It is possible only if treatment is started early, i.e. when the disease is limited only to synovium. In case the articular cartilage is eroded the joint becomes unsalvageable in terms of function, mobility and stability. In such a situation the aim of treatment is to achieve a sound bony ankylosis which is painless and gives stability, although the patient will not have movements at that joint.

GENERAL MEASURES

Good nutrition consisting of a high-calorie and high-protein diet is essential to build up the resistance. General rest and local rest to the specific bone and joint are essential parts of the treatment. Local rest can be provided by means of splints or plaster casts. However, in cases where the articular surface is not involved a judicious blend of rest and mobilization exercises have to be resorted for restoration of function.

CHEMOTHERAPY

Most of osteoarticular lesions would respond to antituberculous drugs if the therapy is started early.

However, in case of persistently draining sinuses which are secondarily infected, suitable broad spectrum antibiotics have to be given. About 15% of patients do not respond to chemotherapy alone if the lesion contains much caseation and sequestra. In such situations excision of the diseased focus not only removes the diseased toxic material but also increases vascularity and allows the anti-tuberculosis drugs to reach the site of the lesion.

A standard drug regimen is given which includes rifampicin, pyrazinamide, ethambutol, isoniazid, and in some cases even streptomycin. The latter is useful because it kills the rapidly multiplying extracellular tubercle bacilli in the lungs for the initial six months. After two clinically and radiologically, pyrazinamide is stopped and isoniazid, rifampicin and ethambutol are continued for one year. In some cases therapy may be required for 18 months for complete healing of the lesion. In case the infection is suspected to be with multidrug resistant ofloxacin, capreomycin, kanamycin, etc. may have to be given.

SURGICAL TREATMENT

Surgical treatment is an adjunct to the anti-tuberculosis drug therapy. It cannot be a substitute for the prolonged course of the drug therapy. Surgical treatment has become safe with the advent of powerful anti-tuberculosis drugs and one is no longer scared of a flare up of the lesion. However, a trail of conservative treatment must be given before surgical treatment is undertaken. The indications for surgery are specific and are as follows:

- Doubtful diagnosis requiring excision of the focus or curettage of the lesion.
- An abscess or a lesion increasing in spite of adequate chemotherapy.
- Synovitis not involving the articular cartilage; synovectomy should be done to prevent the latter from getting eroded.
- Curettage of a lesion in proximity of the articular cartilage to prevent the latter from getting involved.
- Spinal tuberculosis with paraplegia:

The surgical procedures generally performed in children are:

- Drainage of an abscess
- Excision of a focus
- Curettage of the lesion
- Synovectomy
- Costotransversectomy
- Anterolateral decompression

The general principle of surgery in tuberculosis demands that the abscess should be completely evacuated. In case of an osseous lesion, all sequestra, granulation tissue and caseous material should be removed till new bleeding bone is encountered, so that the antibiotics may reach the site of lesion better. The cavities so produced should be packed with autogenous bone grafts. Avoid dead spaces to prevent hematoma formation and close the wound primarily with or without suction.

Tuberculosis can involve any bone or joint of the body but in children it has a special predilection for the hip and knee joints commonly, and for ankle and elbow joints rarely. Tuberculosis of spine with or without paraplegia is extremely common. Long bones are rarely involved but the short long bone involvement is somewhat common.

Referral Criteria

No need to refer anywhere since the patient is already in a tertiary care hospital.

Who does What

Doctor – Diagnosis, chemo therapy advice and surgery

Nurse – General care like nutrition advise, care of the wounds.

Technician – Radiographic examination microbiological examination.

NAME OF CONDITION: Tuberculosis of Spine

I. WHEN TO SUSPECT/ RECOGNIZE?

Introduction: India is classified as a country with a high burden and the least prospects of a favourable time trend of the disease. The average prevalence of all forms of tuberculosis in India is estimated to be 5 per thousand. Skeletal tuberculosis is found in 1 to 3 % of these cases. Spine might be involved in upto 50% of these cases. Neurological complications and progressive deformity are the dreaded complications of tuberculosis of spine. It is imperative to diagnose this condition early and initiate early medical treatment while recognising and treating patients requiring surgical interventions for optimal outcomes.

Case definition:

For both situations of care (*mentioned below**)

II. INCIDENCE OF THE CONDITION IN OUR COUNTRY. The average prevalence of all forms of tuberculosis in India is estimated to be 5 per thousand. Skeletal system involvement occurs in 1% to 3% of the patients and up to 50% of these affected patients have TB of the spine

III. DIFFERENTIAL DIAGNOSIS

Tumours of spine

Traumatic conditions

Other infectious afflictions of spine like brucella, pyogenic .

IV. PREVENTION AND COUNSELING

Prevention would entail measures as for other forms of tuberculosis. Osteoarticular tuberculosis is always secondary, so primary infection should be treated effectively for sufficient time. Once diagnosed, close follow up, regular anti tubercular treatment and aggressive surgical approach may prevent dreaded complications

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

***Situation 1: At Secondary Hospital/ Non-Metro situation: Optimal Standards of Treatment in Situations where technology and resources are limited**

Clinical Diagnosis: The presentation depends on the following:

Stage of disease

Affected site

Presence of complications

Back pain is the earliest and most common symptom. Any back pain not responding to conservative treatment for more than 6 weeks and/or accompanied by constitutional symptoms should be investigated further

Neurologic abnormalities occur in 50% of cases and can include paraplegia, paresis, impaired sensation, nerve root pain.

Patients with cervical spine disease can present with dysphagia or stridor. Symptoms can also include torticollis, hoarseness, and neurologic deficits.

The examination should include the following:

Assessment of spinal deformity

Inspection of skin, with attention to detection of sinuses and subcutaneous mass indicating cold abscess

Meticulous neurologic examination

a) Investigations:

The erythrocyte sedimentation rate (ESR) is elevated. IgM for mycobacterium tuberculosis can be done. HIV status should be confirmed. Microbiology studies can be used to confirm diagnosis. Aspirates of cold abscesses can be obtained to stain for acid-fast bacilli (AFB).

The following are radiographic changes characteristic of spinal tuberculosis

- Paradiscal involvement with decreased disc space
- Increased anterior wedging
- Collapse of vertebral body

- Enlarged psoas shadow with or without calcification
- Fusiform paravertebral shadows suggest abscess formation.

b) Treatment: .

Goals of management in active tuberculosis

Eradication/ Control of Disease

Decompression of spinal cord

Prevention of progressive deformity and later neurological complications

Early mobilization of the patient.

- Treatment options

Chemotherapy alone (long course is preferred)

Surgery with Chemotherapy

Antero-Lateral Decompression

Antero-Lateral Decompression + post fusion

Antero-Lateral Decompression + strut grafting+post fusion

Ant. Decompression + strut grafting+posterior instrumentation

Ant. Decompression + strut grafting \pm instrumentation

Standard Operating procedure

a. In Patient

In patients without deficit, chemotherapy alone is sufficient if the risk of progressive deformity is not there. Inpatient care might be needed initially for patients who are undergoing treatment to ensure rest and monitor response to ATT.

A close watch on development of neurological symptoms is to be kept and at signs of deterioration, the patient may be referred.

b. Out Patient

Patients on ATT are to be followed closely for progression of deformity and deterioration of neurological deficit

c. Day Care

Patients needing drainage of cold abscess may be kept in day care.

c) Referral criteria:

Failure to respond to conservative treatment

Deformity/risk of progression

Recurrence of the disease

Doubtful diagnosis

Severe neurologic symptoms

Progressive neurologic symptoms inspite of ATT
Unsuccessful nonoperative treatment
Instability with spinal deformity,
Spinal tumour syndrome.

***Situation 2: At Super Specialty Facility in Metro location where higher-end technology is available**

a) **Clinical Diagnosis:** As described above in situation 1

b) **Investigations:**

Routine blood investigation, Tb-PCR, In MDR Tb-culture and sensitivity

MRI is the most effective imaging study for demonstrating neural compression. MRI is standard for evaluating disk-space infection and osteomyelitis of the spine and is most effective for demonstrating the extension of disease into soft tissues and the spread of tuberculous debris under the anterior and posterior longitudinal ligaments.

CT scanning provides much better bony detail of irregular lytic lesions, sclerosis, disk collapse, and disruption of bone circumference. CT guided biopsy maybe done in case of doubtful diagnoses.

c) **Treatment:**

Standard Operating procedure

a. In Patient

Tuberculosis spine with no neurological deficit

Chemotherapy alone is sufficient if there is no risk of progressive deformity

Efforts should be made to identify patients who are at risk of developing kyphosis in active disease. Growing children with dorsal and dorsolumbar caries with more than 3 body involvement or in which there is destruction more than 1.5 times the vertebral body height are at risk of kyphosis.

Indications of surgery

Failure to respond to conservative treatment
Deformity/risk of progression
Recurrence of the disease

Doubtful diagnosis

Tuberculosis spine with neurological deficit

Middle path regime

In patients with mild deficit trial of chemotherapy can be done, however a close observation is must

Indications for surgery for management of tuberculosis with deficit

Severe neurologic symptoms

Progressive neurologic symptoms

Unsuccessful nonoperative treatment

Instability with spinal deformity,

Spinal tumour syndrome.

Operative treatment of tuberculosis spine

- Anterolateral decompression alone will lead to control of disease and adequate decompression but there might be progression of kyphotic deformity
- ALD should ideally be accompanied by posterior fusion and anterior structural graft. By providing structural support and by its osteogenic potential, the graft may prevent progression of kyphosis.
- Anterior debridement and arthrodesis by graft only may result in permanent kyphotic deformity as a consequence of fracture of the graft, slippage of the graft out of its bed, resorption of the graft, or subsidence of the graft into the cancellous vertebral bodies. Anterior grafting procedure should be accompanied by instrumentation either anterior or posterior.
- Instrumentation has been shown to be safe in tuberculosis and it helps in stability of graft, early fusion and rapid mobilisation of the patient.
- Anterior structural graft that can be used are tricortical iliac crest, fibula, ribs or bone impregnated titanium mesh.
- Direct anterior approach (transthoracic, retroperitoneal) is a formidable procedure and intensive care facilities should be available.
- In a healed disease, severe kyphosis correction is fraught with danger as spinal cord has exhausted its reserve.

b. Out Patient

Regular follow up of operated patients as well as patients on conservative treatment. At each follow-up detailed neurological examination should be performed and serial x rays should be taken and deformity progression should be noted.

Regular biochemical investigations for monitoring ATT

c. Day Care

For drainage of cold abscesses when needed.

d) **Referral criteria:** Not applicable

VI. WHO DOES WHAT? and TIMELINES

a. Doctor

- Clinical diagnoses
- Investigations
- Clinical decision making
- Surgical procedure
- Maintenance of record and follow up

b. Nurse

- Counselling
- Surgical assistance

c. Technician

- Investigations
- Helps in surgery
- Orthosis

VII. FURTHER READING / REFERENCES

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4. AK Jain .Treatment of tuberculosis of the spine with neurologic complications. Clin Orthop Relat Res. 2002 May;(398):85-92.
5. Rajasekaran S: The problem of deformity in spinal tuberculosis. Clin Orthop Relat Res. 2002 May;(398):75-84.

**RESOURCES REQUIRED FOR ONE PATIENT / PROCEDURE (PATIENT
WEIGHT 60 KGS)**

**(Units to be specified for human resources, investigations, drugs and
consumables and equipment. Quantity to also be specified)**

Situation	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Orthopedic surgeon	X rays Microbiology and biochemistry labs	ATT Braces	
2	Team of surgeons with training in spinal surgery Nurses for OT assistance, ward work and OPD follow up	X rays CT MRI Microbiology with provision for advances culture techniques Biochemistry	ATT OT inventory Spinal instrumentation	Well equipped OTS with ICU backup.

DEGENERATIVE CERVICAL SPODYLOLYSIS

Clinical Diagnoses

Degenerative cervical spodylolysis may present as axial neck pain,cervical radiculopathy,cervical myelopathy or a combination of these.

Patient complaints should be carefully correlated with physical examination and imaging results for correct diagnosis and appropriate management

All differential diagonoses like peripheral neuropathy, motor neuron disease, amyotrophic lateral sclerosis, multiple sclerosis, CVA, syringomyelia, tumors: intrinsic to spinal cord or extrinsic must be ruled out.

Indications and Timing of surgery

There is a definite role of conservative management in neck pain and radiculopathy with minor sensory symptoms.

Patients with very mild and subtle signs of myelopathy can be managed conservatively but close observation and regular follow up is must.

Once moderate signs and symptoms of myelopathy develop patients are less likely to improve on their own and surgical intervention is required.

Manipulation and traction are not recommended in myelopathy because of potential risk of aggravating neurological deficit

Indications for surgery in degenerative disease of cervical spine

- Cervical spondylotic myelopathy
- Radiculopathy with a significant motor deficit
- Radicular pain not responding to conservative treatment
- Intractable Neck pain due to pseudarthrosis

Choice of Surgical approach

The decision of which surgical approach is to be used should be based on:

1. Source of spinal cord compression

2. Number of vertebral segments involved
3. Cervical alignment
4. Coexisting neck pain
5. Comorbidities
6. Previous surgeries
7. Surgical skill and facilities.

Primary focal ventral pathology causing cord compression is best treated by anterior approach.

Primary posterior compression related to facet hypertrophy and ligamentum flavum should be tackled by posterior approach

In multisegmental pathology(>3 levels)

In presence of lordotic spine either posterior approach or anterior approach should be considered.

In presence of kyphotic spine anterior approach is to be considered. Only posterior approach is contraindicated. Supplemental posterior procedure may be needed in multilevel corpectomy

Anterior approach

Anterior plating improves the rate of fusion, reduces the length and type of postoperative immobilization, reduces the prevalence of graft-related complications, and leads to less postoperative kyphosis, particularly in patients undergoing two or more levels of anterior cervical discectomy and fusion

Autograft is superior to allograft in terms of fusion rates, duration to fuse and graft collapse.

Long-term results will be needed before use of structural supports such as metallic cages or synthetic spacers in conjunction with local autograft or allograft can be unequivocally recommended..

Corpectomy may be preferable to multilevel ACDF especially in higher risk patients such as diabetics, smokers and revision cases.

In revision cases when a contralateral anterior approach is contemplated, preoperative laryngoscopy should be done to rule out subclinical vocal cord paresis on the previously treated side.

Cervical arthroplasty

A promising new technology that may improve patient outcome following anterior cervical decompression. Possible indications are:

1. Monosegmental radiculopathy with mild spondylosis
2. Myelopathy due to single level disc herniation in absence of facet joint or posterior disease.

Posterior approach

Indicated in multisegmental pathology in a lordotic spine or posterior pathology.

Only laminectomy without fusion is contraindicated as it might lead to sequelae such as segmental instability, kyphosis, swan neck deformity, perineural adhesions etc.

Laminoplasty or laminectomy with instrumented posterior fusion is the procedure of choice for cervical spondylotic myelopathy.

Significant preoperative neck pain is a relative contraindication to laminoplasty and laminectomy with fusion may be preferred.

The keyhole foraminotomy technique can be used for patients with unilateral radicular findings caused by a lateral or foraminal soft cervical disc herniation or foraminal stenosis

CSM is a disease of elderly and associated with significant postoperative morbidity and mortality. Patient and his/her attendants must be counselled regarding postop complications and possible requirement of ventilatory support.

DISTAL HUMERUS FRACTURES IN ADULTS

1. INCIDENCE:

- 3% of all fractures

2. CLASSIFICATION:

AO Classification is the easiest to follow and contemplate on management:

1.3.A – Extraarticular

- A.1 – Avulsion Fragment
- A.2 – Simple Fracture
- A.3 – Comminuted

1.3.B – Partly Articular

- B.1 – Lateral Condyle Fracture – Saggital Plane
- B.2 – Medial Condyle Fracture – Sagittal Plane
- B.3 – Fracture in Frontal Plane.

1.3.C – Articular Fracture

- C.1 – Articular Simple Metaphyseal Simple
- C.2 – Articular Simple Metaphyseal Multifragmentary
- C.3 – Articular Multifragmentary

3. Diagnosis:

History – Accident / Fall on Hand sustaining injury to Elbow.
Pain around elbow joint which increases on movement

Examination – Swelling, Deformity, Bruising, Tenderness, Crepitus, Instability.
Check for any signs of Compartment Pressure
Check for Distal Pulses & Neurological deficits, of Ulnar, Radial
and Median Nerves

4. Investigations:

X Ray – Elbow AP / Lateral View
Traction View

Special Tests – CT Scan – To delineate the fracture & plan Surgery especially in
Intraarticular fractures

Compartment Pressure Monitoring in suspicious cases

Ultrasound Doppler Study – to rule out vascular injury

Angiogram – If vascular injury is suspected
MRI – rarely needed

5. Treatment:

Initial Management – Splint the Limb with elevation & Ice Packs applc'n along with Anti-Oedema measures.

Proper Management –

a) Conservative – In Medically unfit patients – Cast / Bag of Bones Treatment

b) Surgical – External Fixator – in Open Fractures

Open Reduction & Internal Fixation (ORIF)

- 3.5mm LCDCP

- LCP – Anatomical Plates

Total Elbow Arthroplasty – In cases with extreme intraarticular comminution

6. Complications:

- Postoperative infection
- Nerve injury, especially ulnar nerve palsy
- Vascular injury
- Elbow stiffness
- Hardware prominence
- Loss of fixation
- Nonunion
- Malunion
- Heterotrophic bone formation

7. When to Refer :

- In cases with Polytrauma (Head / Chest / Abdominal / Pelvic Injuries) – “Life before Limb”
- In cases with Vascular Injury – for Vascular repair
- In cases with Neurological Injury – for Immediate / Delayed Nerve repair.
- Relatively in B and C fractures if the facilities are not available

Comments:

The common deficiency

- (a) The writing style is not consistent. Radial head fracture is given as 33% of elbow region while distal radius as 1/6 of fracture (not known) of what?

- (b) Imaging – just mentioned AP, Lateral and sometime oblique. Why and for what a particular special x-ray is needed?
- (c) Complication has been clubbed as most common to least common, early or late in one list. This will not help.
- (d) When to refer – Generally written type B & C to higher center. Can we make such guidelines in the issue.

The outcome of treatment depends on –

- a) Training of the surgeon.
- b) Infrastructure – operating theatre & available instrumentation

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UPPER LIMB FRACTURES
Fracture of both bones forearm in adults

INCIDENCE:

1% of all fractures

CLASSIFICATION:

AO CLASSIFICATION:

TYPE A FRACTURE: simple fracture

- A1- simple fracture of ulna and radius is intact
- A2- simple fracture of radius and ulna is intact
- A3- simple fracture of both radius and ulna

TYPE B FRACTURE: wedge fracture

- B1- wedge fracture of ulna and radius intact
- B2- wedge fracture of radius and ulna intact
- B3- wedge fracture of both radius and ulna

TYPE C FRACTURE: complex fracture

- C1- ulna complex fracture and radius simple fracture
- C2- radius complex fracture and ulna simple fracture
- C3- complex fracture of both radius and ulna

HISTORY:

Fall on an outstretched hand or direct impact.

DIAGNOSIS:

- Tenderness and swelling of the forearm
- Deformity
- Abnormal mobility and crepitus at fracture site.

INVESTIGATIONS:

- Routine radiographs of forearm with elbow and wrist in AP and LATERAL views are helpful in diagnosis and to rule out injuries of joint above and below.
- Other investigations such as BLOOD ROUTINE, CHEST RADIOGRAPHS, ECG and ECHOCARDIOGRAPHY performed for working up the patient for surgery.
- Doppler study done in case of suspected vascular injuries.
- Thorough neurological examination to rule out any injury to nerves.

TREATMENT: Mostly operative

NON OPERATIVE (in undisplaced fractures which are stable): If operative treatment is contraindicated because of the patient's poor general condition

1. Closed Reduction and Cast Immobilization
2. Functional Bracing for 6 weeks

OPERATIVE:

EXTERNAL FIXATORS- In case of open fractures with severe soft tissue damage and in maintaining length in fractures with severe bone loss. Later change into definitive fixation.

INTRAMEDULLARY NAILING- the anatomical reduction cannot be as accurate as can be achieved with plating. Plating of fractures of both bones is ideal either in LCDCP or LCP in osteoporotic fractures.

PLATING- Most commonly used and permits accurate reduction of fracture.

COMPLICATIONS:

- Compartment syndrome
- Malunion
- Non union
- Infection
- Radio-ulnar synostosis
- Plate removal and refracture
- Neurovascular complications

FRACTURES THAT NEED TO BE REFERRED TO HIGHER CENTRES:

- Open fractures with severe soft tissue loss
- Fractures associated with bone loss and vascular injuries
- Polytrauma patients after initial stabilization
- Complex fractures

Comments:

The common deficiency

(e) The writing style is not consistent. Radial head fracture is given as 33% of elbow region while distal radius as 1/6 of fracture (not known) of what?

(f) Imaging – just mentioned AP, Lateral and sometime oblique. Why and for what a particular special x-ray is needed?

(g) Complication has been clubbed as most common to least common, early or late in one list. This will not help.

(h) When to refer – Generally written type B & C to higher center. Can we make such guidelines in the issue.

The outcome of treatment depends on –

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FRACTURE OF SHAFT OF THE HUMERUS

INCIDENCE:

Fractures of the humeral shaft account for roughly 3% of all fractures.

CLASSIFICATION:

AO classification

Bone = humerus = 1

Segment = diaphysis = 2

Groups = A/B/C where

A: Simple fracture

B: Wedge fracture

C: Complex fracture

Subgroups:

A1: Simple fracture, spiral

A2: Simple fracture, oblique ($\geq 30^\circ$)

A3: Simple fracture, transverse ($< 30^\circ$)

B1: Wedge fracture, spiral wedge

B2: Wedge fracture, bending wedge

B3: Wedge fracture, fragmented wedge

C1: Complex fracture, spiral

C2: Complex fracture, segmental

C3: Complex fracture, irregular

HISTORY:

Fall from a height or a direct impact as in vehicular accidents.

DIAGNOSIS:

- Swelling, pain and bruising are common features.
- The arm may appear shortened and deformed if the fracture is significantly displaced.
- Inability to extend the wrist (wrist drop) and sensory deficit over the base of the thumb on the dorsal aspect indicates an associated injury of the radial nerve.
- A thorough assessment of the peripheral neurovascular status is essential in all humeral shaft fractures.
- Associated injuries to the shoulder and elbow joints are not uncommon.
- X-rays (AP and lateral) of the entire humerus including the shoulder and elbow joint should be taken to confirm the diagnosis.

- CT is rarely indicated.

COMPLICATIONS:

- *Nerve injury* - Radial nerve palsy (upto 10%) is the most important complication.
- *Vascular injury* - Injuries to the brachial artery have been reported in association with humeral shaft fractures. A careful assessment of the peripheral circulation is essential in all humeral fractures.
- *Non-union* - In general, spiral or oblique fractures heal better than the transverse or segmental fracture. Soft tissue interposition, excessive fracture mobility and infection are important factors responsible for non-union of a humeral shaft fracture.
- *Joint stiffness* - A proper rehabilitation programme is essential to prevent joint stiffness following injury.
- *Malunion* - This may be functionally inconsequential; arm musculature and shoulder, elbow, and trunk range of motion can compensate for angular, rotational, and shortening deformities.

INVESTIGATIONS:

- AP and lateral radiographs of the humerus should be obtained, including the shoulder and elbow joints on each view. ,
- Traction radiographs may aid in fracture definition in cases of severely displaced or comminuted fracture patterns.
- Computed tomography, bone scans, and MRI are rarely indicated except in cases in which pathologic fracture is suspected.

MANAGEMENT:

CONSERVATIVE:

- Most humeral shaft fractures (>90%) will heal with nonsurgical management.
- Twenty degrees of anterior angulation, 30 degrees of varus angulation, and up to 3 cm of bayonet apposition are acceptable and will not compromise function or appearance.

- Hanging cast: This utilizes dependency traction by the weight of the cast and arm to effect fracture reduction.
 - Indications include displaced midshaft humeral fractures with shortening, particularly spiral or oblique patterns. Transverse or short oblique fractures represent relative contraindications because of the potential for distraction and healing complications.
 - The patient must remain upright or semi upright most of the time with the cast in a dependent position for effectiveness.
 - It is frequently exchanged for functional bracing 1 to 2 weeks after injury.
 - More than 90% union is reported

OPERATIVE:

- Indications for operative treatment are:
 - Multiple trauma
 - Inadequate closed reduction or unacceptable malunion
 - Pathologic fracture
 - Associated vascular injury
 - Floating elbow
 - Segmental fracture
 - Intraarticular extension
 - Bilateral humeral fractures
 - Open fracture
 - Neurologic loss following penetrating trauma
 - Radial nerve palsy after fracture manipulation (controversial)
 - Nonunion

- **Open reduction and internal fixation**

The fracture site is exposed, fragments reduced and fixed with a compression plate (DCP, LCDCP, LCP) and screws, with an anterolateral approach or upper two thirds fracture and posterior approach for lower thirds fracture

- **Interlocking intramedullary nail**

An 'antegrade' or a 'retrograde' nail is introduced into the medullary cavity of the humerus after closed reduction of the fracture. The nail is then locked

proximally and distally to achieve rotational stability. This requires image intensification and is comparable to plating.

- **External fixation**

This method of treatment may be used in open or multiple fractures.

Percutaneous pins are threaded into the bone and then held together by an external frame.

Patients with associated neurovascular injury or in unstable fractures where facilities are not available for ideal internal fixation should be referred to higher centre.

Comments:

The common deficiency

- (i) The writing style is not consistent. Radial head fracture is given as 33% of elbow region while distal radius as 1/6 of fracture (not known) of what?
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RADIAL HEAD FRACTURE

INTRODUCTION-

Radial head fractures account for almost 33% of fractures of the elbow region. Radial head plays an important role in providing smooth movements of forearm (Pronation and Supination) and the elbow joint (flexion and extension at radiocapitular joint).

CLASSIFICATION-

Mason's classification- most widely followed

- 1- undisplaced or minimally displaced fracture. Displacement < 2mm
- 2- displaced fracture. Displacement > 2mm
- 3- comminuted fracture
- 4- fracture with dislocation of elbow

HISTORY-

Fall on an outstretched hand with a valgus strain.

DIAGNOSIS-

A) CLINICAL FEATURES -

- Pain and swelling over elbow region
- On examination- tenderness over the radial head with restriction of forearm and elbow movements

B) IMAGING TECHNIQUES –

X-RAY - AP, LATERAL, OBLIQUE VIEWS.

CT – rarely a CT and an MRI may be necessary to study the fragments and the stability of the joint

MANAGEMENT-

- A. (MASON TYPE 1) CONSERVATIVE TREATMENT– MAY BE DONE IF THERE IS NO RESTRICTION OF RANGE OF MOTION WITH AS ABOVE ELBOW PLASTER SLAB FOR 2 WEEKS.
- B. SURGERY-

- 1) IN ISOLATED RADIAL HEAD FRACTURES TREATED WITH OPEN REDUCTION & INTERNAL FIXATION WITH SCREWS. (MASON TYPE 2)
- 2) PROSTHETIC REPLACEMENT- IS USED TO PREVENT PROXIMAL MIGRATION OF THE RADIUS. (MASON TYPE 3 & 4) EVEN RADIAL EXCISION GIVES FAIRLY GOOD RESULTS.
- 3) RADIAL HEAD EXCISION-MAY BE USEFUL FOR OLDER PATIENTS WITH COMPLEX ISOLATED FRACTURES. LEVEL OF EXCISION IS PROXIMAL TO ANNULAR LIGAMENT THROUGH LATERAL KOCHER APPROACH.

COMPLICATIONS

- Primarily related to improperly placed hardware or loss of fixation. Late excision of the radial head may be necessary after other soft tissues have healed.
- Posterior interosseous nerve injury - treat with radial nerve splint. If it doesn't recover, Jones tendon transfer is to be done.
- Elbow stiffness - loss of extension common. No massaging is to be done.
- DRUJ instability.
- Post traumatic arthritis.
- Reflex sympathetic osteodystrophy.
- MCL insufficiency & consequent elbow instability.

ESSEX – LOPRESTI LESION

- Defined as longitudinal disruption of forearm interosseous ligament, usually combined with radial head fx and/or dislocation plus distal radioulnar joint injury
- Difficult to diagnose
- Treatment requires restoring stability of both elbow and DRUJ components of injury.
- Radial head excision in this injury will result in disabling proximal migration of the radius.

WHEN DO YOU REFER IT TO HIGHER CENTRE?

1. Essex Lopresti lesion
2. When the patient comes late
3. In Type 2 fractures when facilities are not available for fixation

Comments --- The common deficiency

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HAND INJURIES

Carpal Injuries

Scaphoid Fracture

Introduction: Fracture of the carpal scaphoid bone is the most common fracture of the carpus, and frequently diagnosis is delayed.

Incidence & classification: Scaphoid fracture accounts for about 50-80% of carpal injuries. It is most common in young men. It is caused by a fall on the outstretched palm, resulting in severe hyperextension and slight radial deviation of the wrist. Herbert's classification is most commonly used for scaphoid fracture:

A (Acute, Stable):	A1 Tubercle A2 Nondisplaced fracture of the waist
B (Acute, Unstable):	B1 Oblique, distal third B2 Displaced or mobile, waist B3 Proximal pole B4 Fracture Dislocation B5 Comminuted
C (Delayed Union)	
D (Established nonunion):	D1 Fibrous D2 Sclerotic

Diagnosis & Investigations: Clinical evaluation + X-rays (PA, Lateral, scaphoid view, clenched fist view), MRI, CT, bone scan may be used to diagnose occult scaphoid fractures

Complications: Delayed union, malunion, nonunion, osteonecrosis, CRPS

Management:

1. Tuberosity fractures and Nondisplaced distal third fractures: Conservative with scaphoid cast for 6-8 weeks
2. Other Non-displaced fractures: Conservative or Percutaneous fixation
3. Displaced but reducible fractures: Percutaneous fixation
4. Irreducible displaced fractures: ORIF

Reasons for referral to higher centre: Lack of expertise, lack of infrastructure, Fracture dislocations

Other carpal injuries: Triquetrum, trapezium, lunate are commonest after scaphoid fracture. Trapezoid, capitate, pisiform and hamate are relatively rare fractures. Specialized views or CT scan may be required for their diagnosis. Undisplaced fractures are treated conservatively; however displaced fractures may require ORIF. Complications can be osteonecrosis, missed dislocations, osteoarthritis, CRPS etc.

Hand Fractures:

Metacarpal and phalangeal fractures are common, comprising 10% of all fractures. There is a high degree of variation in mechanism of injury accounting for broad spectrum of patterns of fractures in hand.

Incidence & classification: Distal phalanx fractures are most common of all hand fractures (45%) followed by metacarpal fractures (30%), proximal phalanx (15%) and middle phalanx (10%). These fractures can be classified in various ways:

1. Location of fracture e.g. head, shaft, base
2. Open vs. closed
3. Displaced vs. Undisplaced
4. Extraarticular vs. Intraarticular
5. Stable vs. Unstable
6. Fracture pattern : transverse, comminuted, spiral, split

Diagnosis & Investigations: Clinical evaluation + X-rays (PA, latéral and oblique radiographs). CT may be required to assess the intraarticular fractures.

Complications: Delayed union, malunion, nonunion, CRPS, stiffness and loss of motion, infection, post-traumatic osteoarthritis etc.

Management:

Metacarpal fractures:

Metacarpal head: Undisplaced stable fractures can be treated conservatively with MCP joint immobilized at >70 degrees. Displaced fractures usually require ORIF with k-wires or mini-plates

Metacarpal neck: Stable fractures: Conservative
Unstable fractures: CRIF or ORIF (K-wires, mini-plates)

Metacarpal Shaft: Stable fractures: Conservative
Unstable fractures: CRIF or ORIF (K-wires, mini plates)

Metacarpal Base: Undisplaced: Conservative
Displaced: CRIF or ORIF

Proximal and middle phalanx

Intraarticular fractures: ORIF is preferred. For comminuted fractures, ligamentotaxis with external fixators or specialized reconstruction techniques can be used.

Extraarticular fractures: Stable fractures: Conservative
Unstable fractures: CRIF or ORIF (K-wires, mini plates)

Distal Phalanx

Intraarticular fracture (Mallet finger) : Extension block pinning for bony mallet finger, Extension splinting for soft mallet finger

Extraarticular fractures: Usually treated as soft tissue injury. If displaced widely, CRIF is recommended.

Reasons for referral to higher centre: Lack of expertise, lack of infrastructure, Fracture dislocations

Tendon Injuries

Extensor Tendon Injuries are usually treated with primary repair Flexor tendon injuries are treated according to zone of injuries:

Zone 1: Direct Repair, tenodesis or arthrodesis in some cases

Zone 2: Need expertise, primary repair or delayed grafting

Zone 3: primary repair

Zone 4: primary repair

Zone 5: primary repair

Complication include stiffness, rupture of the graft or repair site, bowstringing etc. referral should be made in case of lack of expertise or infrastructure.

Comments:

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LONG LIMB TRAUMA

Fracture Neck of Femur (Intra-capsular)

Fracture neck of femur is still the unresolved fracture as evident by the number of procedures available and practiced, thus none is universally applicable and the surgeon has to select one which would be ideal in a given situation. The treatment varies with the age of the patient, the level of the fracture and the displacement of the fragments. Also the duration of the fracture is a major deciding factor. If union of the fracture is not likely to be achieved then what alternative method should be adopted which will suit the patient, keeping in mind his age, life style, profession and economic status. Majority of our patients are not covered by health insurances, hence all the expenditure has to be born by the patient himself. It is therefore desirable on the part of treating orthopaedic surgeon to choose a method which these patients can afford.

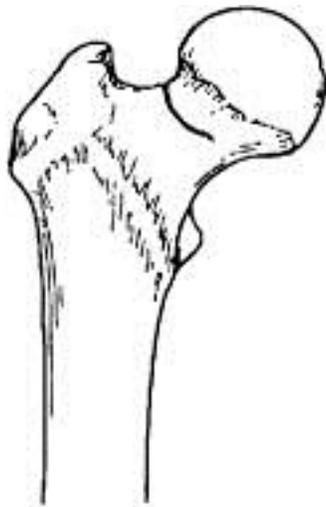
Fracture neck femur is commonly seen in old people but in our country quite a good number of patients are young adults. It is infrequent in children.

Fracture neck femur whether intra-capsular or extra-capsular can be diagnosed and differentiated by clinical examination and confirmed by the roentgenograms. Any underlying pathologic condition like metastasis or osteoporosis if present can also be identified on roentgenograms.

Fracture neck femur intra-capsular can be divided as per the following classifications:

(A) Garden Classification

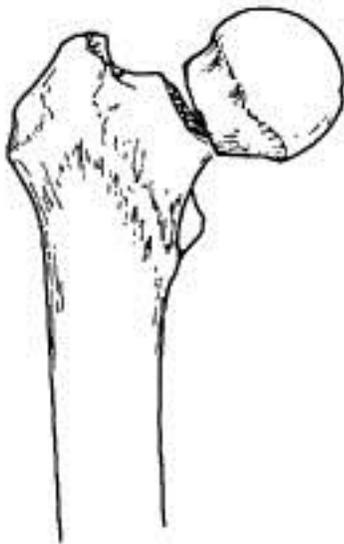
- Type 1 is a stable fracture with impaction in valgus.
- Type 2 is complete fracture but non-displaced.
- Type 3 is displaced (often rotated and angulated) with varus displacement but still has some contact between the two fragments.
- Type 4 is completely displaced and there is no contact between the fracture fragments.



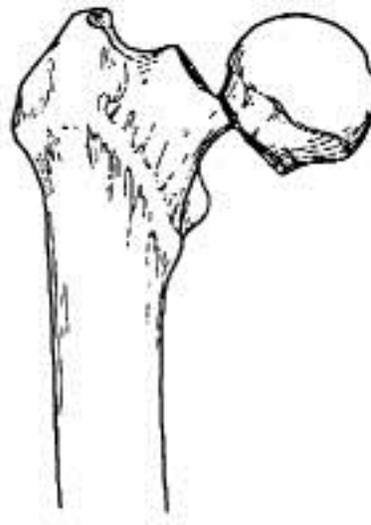
Type I



Type II



Type III



Type IV

(B) 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.

The aim of treatment is to achieve union of the fracture and a durable hip joint afterwards. Principles of management include:

- a. Osteosynthesis
 - i. Screws, Moore's Pins etc
 - ii. DHS, Blade Plate
 - iii. Internal Fixation + Fibular Grafting
 - iv. Muscle pedicle Graft + Internal Fixation
- b. Osteotomy
 - i. Pauwels valgus osteotomy
 - ii. McMurray's osteotomy
- c. Arthroplasty
 - i. Hemiarthroplasty
 - ii. Total Hip Replacement
 - iii. Excision Arthroplasty

The following points should be considered.

1. **Age of the patient:** Based on the age the following groups should be made.
 - a. 1-16 years before the closure of the upper femoral epiphysis
 - b. 16-50 years young adults
 - c. 50-60 years middle age group
 - d. Above 60 years (old age)
2. **Site of fracture:**
 - a. Sub-capital
 - b. Transcervical
 - c. Basicervical
3. **Displacement of fragments:**
 - a. Undisplaced fractures
 - b. Displaced fractures
4. **Duration of fracture:**
 - a. 1-21 days – Fresh
 - b. More than 21 days – Neglected fracture

Management: Primary health centre level: The doctor on duty should recognise the features of fracture and dislocation. Only first aid including the splintage and intravenous drip should be given. In open fractures Tetanus toxoid can be given. There is no need to

waste time in preparation of medico-legal formalities. The injured should be referred to the higher centre earliest feasible causing no further harm.

Community health centre and Civil hospital level: (Non Metro Hospital)

1. **Investigations:** X-rays of the pelvis including both hip and knee joint and of other areas if required, General Investigations and specific if required according to the status of the health of the patient.
2. **Treatment:**

FRESH FRACTURE

Age 1-16 years when growth plate is intact:

The implant used for internal fixation either should not cross the epiphyseal plate or the implant causing least possible damage should be used.

Sub-capital and transcervical fractures should be fixed with multiple Kirschner (K) wires or Moore's pins after closed reduction in valgus.

Basicervical fractures can be fixed either by K wires, Moore's pins or cancellous/cannulated lag screws. When screws are used they should not cross the preferably epiphyseal plate.

Age 16-50 years

Sub-capital fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws

Displaced: Closed reduction and fixation with Lag screws. Valgus osteotomy and fixation with double angled blade plate can also be done to convert shearing forces into compression forces.

Transcervical fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws

Displaced: Closed reduction and fixation with Lag screws. Valgus osteotomy and fixation with double angled blade plate can also be done to convert shearing forces into compression forces. If closed reduction fails open reduction is done followed by any of the above procedures.

Basicervical fractures:

Undisplaced: Internal fixation with Dynamic Hip Screw (DHS)

Displaced: Closed reduction and fixation with Lag screws or DHS. If closed reduction fails then open reduction and internal fixation (ORIF) with lag screws or DHS.

Age 50-60 years:

Sub-capital fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws

Displaced: Closed reduction and fixation with Lag screws. Valgus osteotomy and fixation with double angled blade plate can also be done to convert shearing forces into compression forces. Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

If closed reduction fails open reduction and fixation with any of the methods described above may be done or hemi/excision arthroplasty may be offered according to the need and requirement of the patient.

Transcervical fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws

Displaced: Closed reduction and fixation with Lag screws. Valgus osteotomy and fixation with double angled blade plate can also be done to convert shearing forces into compression forces. Arthroplasty including hemi or excision may be done according to the need and requirement of the patient. If closed reduction fails open reduction and fixation with any of the methods described above may be done or hemi/excision arthroplasty may be offered.

Basicervical fractures:

Undisplaced: Internal fixation with Dynamic Hip Screw (DHS)

Displaced: Closed reduction and fixation with Lag screws or DHS. If closed reduction fails then open reduction and internal fixation (ORIF) with lag screws or DHS. Hemi/excision arthroplasty may be offered.

Physiologic Age above 60 years:

Sub-capital fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws. Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

Displaced: Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

Transcervical fractures:

Undisplaced: Internal fixation with 2-3 cancellous/cannulated lag screws. Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

Displaced: Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

Basicervical fractures:

Undisplaced: Internal fixation with Dynamic Hip Screw (DHS)

Displaced: Arthroplasty including hemi or excision may be done according to the need and requirement of the patient.

3. Referral Criteria for Metro hospital

- a. Polytrauma patient.
- b. Patient with co-morbid conditions requiring multiple speciality care.
- c. Patients requiring Joint replacement.
- d. Non unions / Neglected fractures ie fractures more than 3 weeks duration.
- e. Pathological fractures.

- f. Suspected HIV positive cases.
- g. Fractures associated with any condition requiring higher investigations like CT Scan, MRI etc.

Metro hospital level:

1. **Investigations:** X-rays of the pelvis including both hips and knee and of other areas if required, General Investigations and specific if required according to the presence of any co-morbidity. Special investigations like MRI/CT scan if required.
2. **Treatment:** All the treatment as in **situation 1**

Treatment for the referred patients in the form of multispecialty approach.

FRACTURE MORE THAN 3 WEEKS DURATION

Osteosynthesis in such fractures has a high failure rate. Internal fixation has to be combined with some type of bone graft or osteotomy particularly in young patients in whom it is desirable to preserve the patient's own femoral head. In patients above the physiologic age of 60 years arthroplasty is the preferred treatment whether unipolar, bipolar, total hip or excision is as per the affordability and requirement of the lifestyle of the patient and condition of the hip joint (Osteoarthrosis).

Age 1-16 years:

Mc Murray's osteotomy and POP one and a half spica may be tried. Abduction osteotomy and internal fixation with angled paediatric blade plate. Care should be taken not to damage the epiphyseal plate. If the gap between the fragments is more than 1 cm free fibula with a screw may be tried but the chances of damage to the epiphyseal plate are very high leading to limb length discrepancy and deformity of head later on.

Age 16-55 years:

In this age group patients own hip should be joint should be preserved. Osteosynthesis is carried out aiming at union of fracture and obtaining a durable hip joint. The results of various procedures depend upon the changes which have already taken place at the site of fracture with passage of time. These changes are:

- a) Fracture surfaces get smoothed out.
- b) There is progressive absorption of the neck of femur resulting in increase in the gap between the fragments and decrease in the size of the proximal fragment.

c) The head of the femur may start showing signs of avascular necrosis.

A good quality X-ray of pelvis including both hip joints in as identical position as possible should be taken. CT scan or MRI of pelvis can be extremely useful in accurately measuring the gap between the fragments and the size of the proximal fragment. Sometimes the absorption of the proximal fragment is more marked in the centre than the periphery giving it the shape of a cup or moon. This may not be clearly seen on routine. AP view X-ray of the hip and can be better appreciated on CT scan or MRI. Avascular necrosis of the head of the femur may be seen earlier on MRI / CT scan than on plain X-ray of the hip.

Based on these changes the fracture can be allocated to one of the following 3 stages.

Stage I

- a) Fracture surfaces are still irregular (Fresh)
- b) The size of proximal fragment is 2.5 cm or more
- c) Gap between the fragments is 1 cm or less
- d) Head of the femur is viable. There is no sign of avascular necrosis on X-ray picture or MRI or CT Scan.

Stage II

- a) Fracture surfaces are smoothed out
- b) The size of the proximal fragment is 2.5 cm or more
- c) The gap between the fragments is more than 1 cm but less than 2.5 cm
- d) The head of the femur is viable.

If either of the feature a or c is present it is allocated to stage II.

Stage III

- a) Fracture surfaces are smoothed out
- b) The size of the proximal fragment is less than 2.5 cms
- c) The gap between the fragments is more than 2.5 cms
- d) The head of the femur shows signs of avascular necrosis

If any of the feature b, c or d is present the fracture is allocated to stage III.

Treatment

Stage I: In this stage the success rate of various procedures aimed at osteosynthesis is very high. The procedures which are useful are:

1. Closed reduction and internal fixation with one screw and double fibular graft or 2 screws and one fibular graft. If the neck of the femur is narrow then one screw and one fibular graft may be given.
2. Closed/open reduction Vascularised fibular graft along with screw/k-wire
3. Closed reduction or open reduction and bone muscle pedicle graft based on quadratus femoris or sartorius or tensor fascia femoris can be used.
4. Abduction osteotomy and osteosynthesis with double angled blade plate. This procedure is particularly useful when the fracture is situated more near the base and length of proximal fragment is 3.5 cms or more.

5. McMurrays osteotomy with one and half POP hip spica.

Stage II: In this stage when the fracture surfaces are smoothed out (as in case of established nonunion) and the gap between the fragments is more than 1 cm various methods of osteosynthesis which have given good results are

1. Closed reduction and internal fixation with one screw and double fibular graft or 2 screws and 1 fibular graft.
2. Open reduction, freshening of fracture surfaces and internal fixation with 2 screws and one free fibular graft.
3. Closed/open reduction Vascularised fibular graft along with screw/k-wire
4. Open reduction and internal fixation with multiple screws and bone muscle pedicle graft based on quadratus femoris or sartorius or tensor fascia femoris.
5. Other methods of treatment which can be useful (although they will not achieve union of fracture but improve the function of hip) are
 - a. McMurrays osteotomy
 - b. Osteotomy with internal fixation
 - c. Bachelor's or Girdlestone procedure

Stage III: In this stage when the size of the proximal is less 2.5 cms, it cannot give good hold to the implant as well as the graft or there is a gap of more than 2.5 cm between the fragments or femoral head is showing signs of avascular necrosis, chances of union are less. Osteosynthesis is likely to have very high failure rate. The treatment options available are

1. Total hip arthroplasty - - if the patient can afford and his life style permits. It may preferably be non-cemented or may be cemented.
2. Bipolar or hemi arthroplasty
3. McMurray's osteotomy
4. Subtrochantric osteotomy with internal fixation
5. Excision hip Girdlestone's or Bachelor's procedure
6. Patient may be left alone if the patient is poor and cannot afford treatment or is unfit for surgery. He can start walking with the support of a walker or crutches. Later on he can walk with the support of stick or even without than in about 3-4 months time. They are often able to squat or sit in cross legged position (Budha position).

After the age of 55 years

1. Replacement arthroplasty : if the patient can afford or his life style permits. It may be total hip replacement or bipolar or hemi-arthroplasty.
2. Osteosynthesis if the patient wants it and is prepared to wait for 5 - 7 months for independent walking. This should be carried out only in stage I and stage II.
3. Excision hip (Girdlestone procedure or Bachelor's procedure)
4. Osteotomy with internal fixation
5. Leave him alone.

There are rough guidelines to help the orthopaedic surgeon to manage fracture neck of femur in different age groups and fracture at different levels of neck for fresh as well as neglected cases. The decision regarding the choice of operative procedure rests with the surgeon depending upon the patient's requirements, his life style, profession and financial position. It also depends upon the training of the Orthopaedic surgeon and facilities available to him. Use of free fibular graft/vascularised fibula in addition to internal fixation with screws particularly where there is posterior comminution improve the chances of union and may be carried out in such cases. If the reduction of the fracture is less than anatomical but otherwise satisfactory addition of free fibular graft can improve the chances of union.

If the patient is suffering from a generalized disease like diabetes mellitus, congestive heart failure, chronic kidney or liver disease, malignancy etc., or is taking steroids adversely affecting the chances of union of fracture, replacement arthroplasty may be a better option even in younger.

Trochanteric fractures (Extra-capsular fracture neck femur)

Hip fractures in the elderly are frequent, and their number is increasing fast. The intertrochanteric and the subtrochanteric fractures pose a number of management dilemmas depending on the fractures configuration and status of the bones. A number of different treatment modalities for management of these fractures have been proposed and tried with varying results for both intertrochanteric and subtrochanteric fractures of proximal femur.

Intertrochanteric hip fractures account for approximately half of the hip fractures in the elderly; out of this more than 50% fractures are unstable. Unstable pattern occur more commonly with increased age and with low bone mineral density. The fracture commonly occurs through bone affected by osteoporosis. The presence of osteoporosis in intertrochanteric fractures is important because fixation of the proximal fragment depends entirely on the quality of cancellous bone present, Unstable intertrochanteric fractures are those in which comminution of posteromedial buttress exceeds a simple lesser trochanteric fragment or those with subtrochanteric extension. The results of unstable fractures are less reliable and have a high rate of failure - 8%-25%.

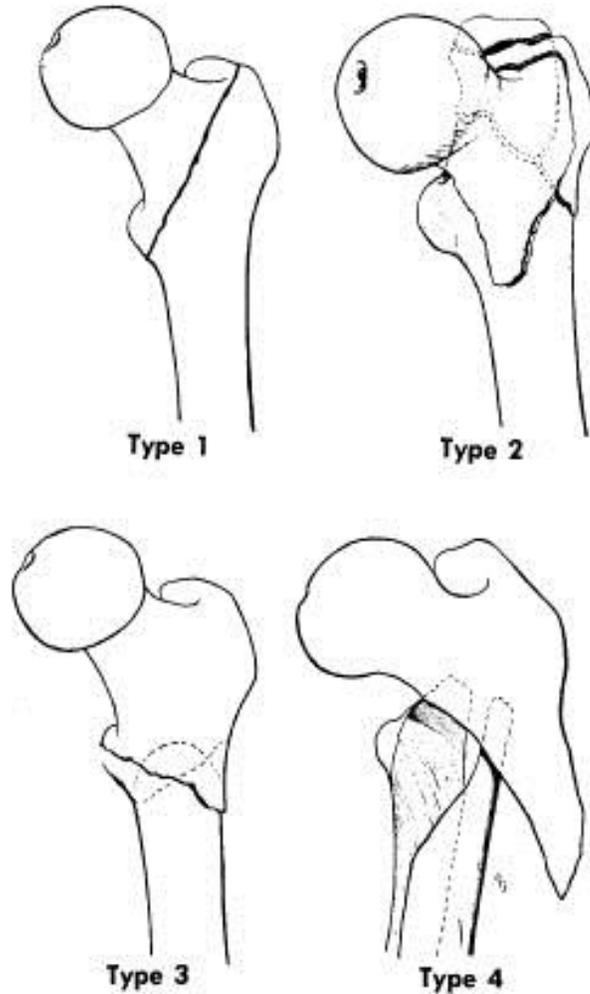
The goal of treatment of any intertrochanteric fracture in the elderly is to restore mobility safely and efficiently while minimizing the risk of medical complications and technical failure and to restore the patient to preoperative status. Unstable intertrochanteric fractures are technically much more challenging than stable fractures; a stable reduction of an intertrochanteric fracture requires providing medial and posterior cortical contact between the major proximal and distal fragment to resist varus and posterior displacing forces. Hence Surgeons must understand implant options available and should strive to achieve accurate realignment and proper implant placement.

Subtrochanteric fractures occur 'between lesser trochanter and a point 5 cm distally and are seen as independent entities or as an extension of intertrochanteric fractures. The common problem for these fractures has been malunion, delayed union or non-union. Many newer designs of implants has been designed for fixation of subtrochanteric fractures. The newer implants were designed to avoid bending, breakage of plates and nails, the loosening of screws and inadequate fixation. After the failure of A O angled blade plate many implants were designed like dynamic hip compression screw, dynamic condylar screw, modifications of axial compression screw devices like Medoff's device.

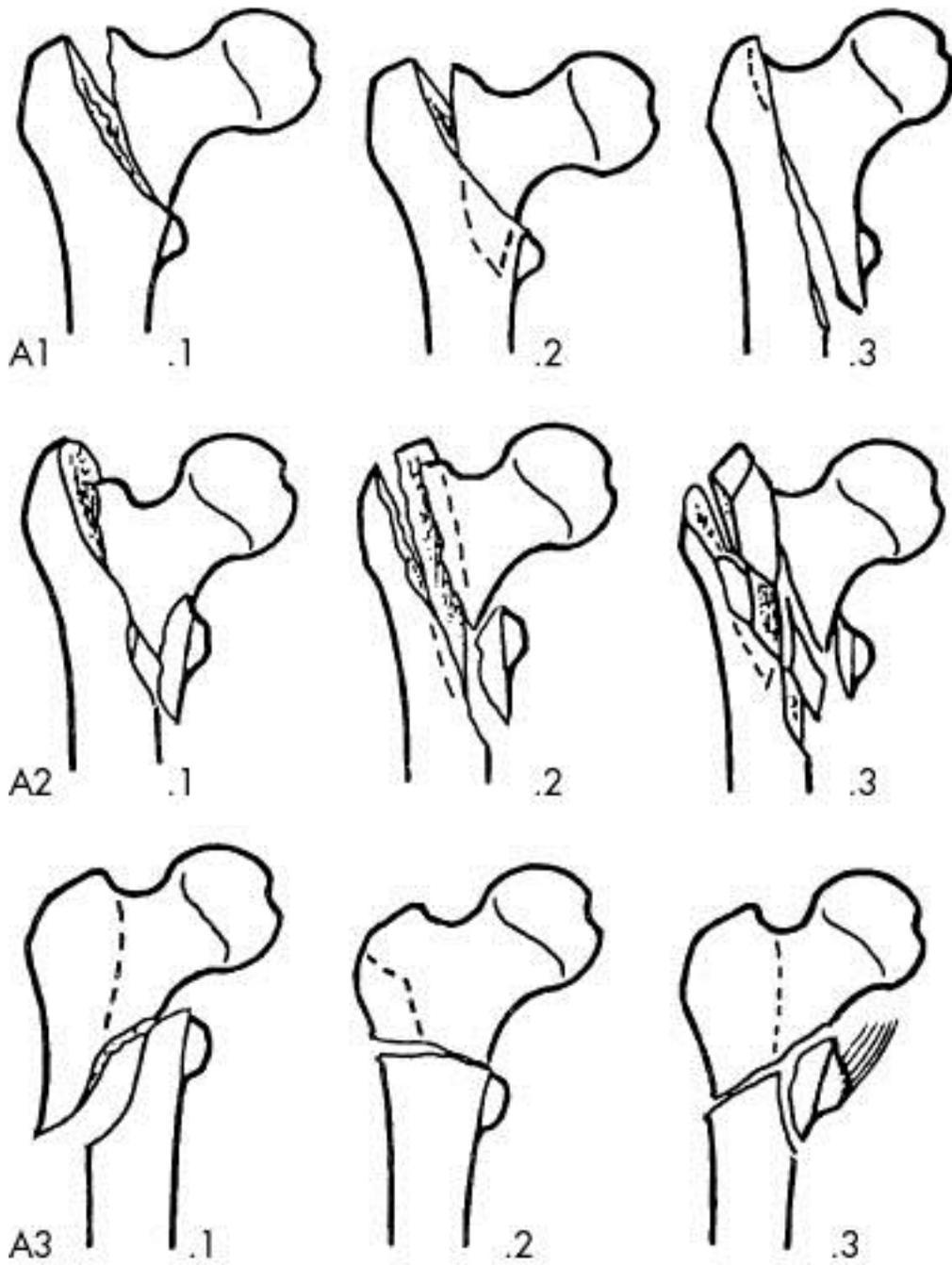
Most of the hip fractures in the elderly results from simple fall from standing. This is mainly because elderly people are unable to dissipate energy as compared to the young person, and diminished ambulatory speed. Their protective responses are also

diminished because of slow reaction time, weakness, disorientation and the side effect of medication. Elderly people also lack shock absorbers such as pad of fat or muscles over the trochanteric region and finally diminished bone strength because of osteopaenia allows fractures to occur with trivial fall.

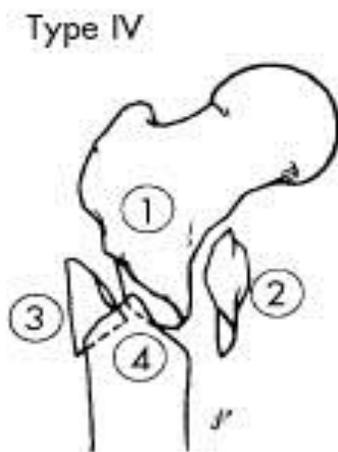
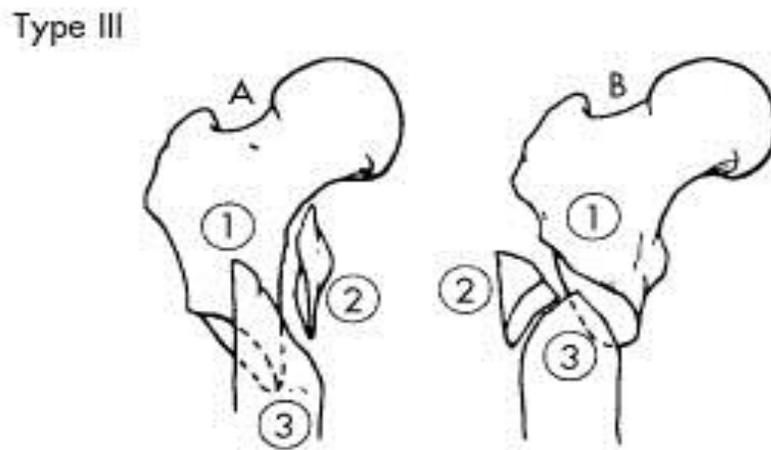
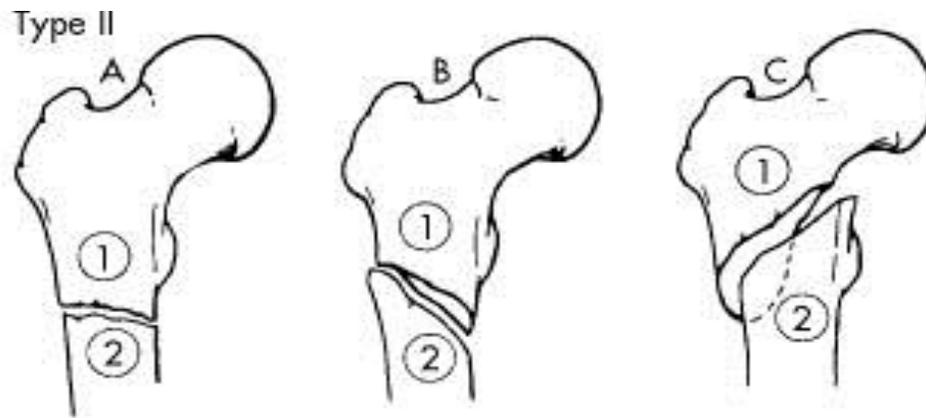
Trochanteric fractures can be classified as:



Boyd and Griffin classification



AO Classification of Intertrochanteric fractures



Seinsheimer's classification of subtrochanteric fractures

Management: Primary health centre level:

The doctor on duty should recognise the features of fracture and dislocation. Only first aid including the splintage and intravenous drip should be given. In open fractures Tetanus toxoid can be given. There is no need to waste time in preparation of medico-legal formalities. The injured should be referred to the higher centre earliest feasible causing no further harm.

Non Metro Hospital (CHC and Civil Hospital level):

- 1. Investigations:** X-rays of the pelvis including both hips and knee joint and of other areas if required, General Investigations and specific if required according to the status of the health of the patient.

- 2. Treatment:**

Closed reduction and DHS is the standard modality for most of the Trochanteric fractures. If closed reduction fails open reduction can be done. In unstable Trochanteric fractures Proximal Femoral Nail (PFN), Intramedullary Hip Screw can also be done depending upon the facilities and the expertise of the operating surgeon. Where there is comminution at the site of entry for the DHS, Dynamic Condylar Screw (DCS) may be used.

For subtrochanteric fractures a DCS is the implant of choice after closed or open reduction. Other modalities like PFN, Angled blade plate, Reconstruction nail or Modified Kuntscher's nail may also be used as per the preference of the surgeon.

- 3. Referral Criteria** for Metro hospital

- a. Polytrauma patient.
- b. Patient with co-morbid conditions requiring multiple speciality care.
- c. Patients requiring Joint replacement.
- d. Non unions / Neglected fractures ie fractures more than 3 weeks duration.
- e. Pathological fractures.
- f. Suspected HIV positive cases.
- g. Fractures associated with any condition requiring higher investigations like CT Scan, MRI etc

Metro hospital level

- 1. Investigations:** X-rays of the pelvis including both hips and knee and of other areas if required, General Investigations and specific if required according to the

presence of any co-morbidity. Special investigations like MRI/CT scan if required.

2. **Treatment:** All the treatment as in CHC/Civil hospital level along with multidisciplinary approach as required for other co-morbid conditions of the patient. In very osteoporotic patients cement augmentation along with DHS should be done to decrease chances of cut through. In few selected ones with either osteoarthritis of hip joint or in those patients in whom union is suspected we can go for arthroplasty.

Since lots of co-morbidities are common in geriatric population, a thorough preoperative medical evaluation is necessary. The detailed preoperative work up directly affects the timing of surgery and the operative procedure. Majority of these fractures should be treated operatively for ease of nursing care, rapid mobilisation, decreased mortality, decreased hospitalization and restoration of function. The operative treatment should be considered urgently, but not as an emergency procedure.

The optimal time for surgical intervention appears to be after the patient is evaluated medically and any transient medical ailment corrected i.e. electrolyte and fluid imbalance. However it should not be delayed more than 48-72 hours unless intervention significantly decreases the operative risk.

Also most of these patients are osteoporotic and have a high chance of getting fracture in the opposite side, so anti osteoporotic treatment should be started in all of these patients and so is the early mobilization as osteoporosis will increase if they stay in bed waiting for the union to occur.

Resources required for patient and procedure

Situation	Human Resources	Investigations	Drugs and consumables	Equipment
1	Doctor, Nurse and other paramedics	None	None except for first aid	No surgical set up
2	Doctor, Nurse, Physiotherapist and technicians	X-rays, Complete Haemogram, Bleeding time, Clotting time, Complete urine examination for pre-anaesthetic check up	Plaster of Paris bandages Anaesthetic drugs Thromboprophylaxis	Theatre set up for Surgeries with all Basic equipments C-arm image intensifier
3	Doctor, Physiotherapist, Nurse, orthotist, Prosthetist, and technicians	As situation 1 CT Scan, MRI	As situation 1	As situation 1, Surgical Operating Microscope, ICU, and major physiotherapy set up for rehabilitation

FRACTURE SHAFT OF FEMUR

Fractures of the shaft of the femur are the result of high-energy trauma and therefore can be both life-threatening injuries and causes of severe permanent disability. Isolated injuries can occur with repetitive stress and may occur in the presence metabolic bone diseases, metastatic disease, or primary bone tumors.

The femur is very vascular and fractures can result in significant blood loss into the thigh. Up to 40% of isolated fractures may require transfusion, as such injuries can result in loss of up to 3 units of blood. This factor is significant, especially in elderly patients who have less cardiac reserve.

Most femoral diaphyseal fractures are treated surgically with intramedullary nails or plate fixation. The goal of treatment is reliable anatomic stabilization, allowing mobilization as soon as possible. Surgical stabilization is also important for early extremity function, allowing both hip and knee motion and strengthening. Injuries and fractures of the femoral shaft may have significant short- and long-term effects on the hip and knee joints if alignment is not restored.

The 3 types of femoral shaft fractures are as follows:

- Type I - Spiral or transverse (most common)
- Type II - Comminuted
- Type III - Open

Primary health centre level: The doctor on duty should recognise the features of fracture and dislocation. Only first aid including the splintage and intravenous drip should be given. In open fractures Tetanus toxoid can be given. There is no need to waste time in preparation of medico-legal formalities. The injured should be referred to the higher centre earliest feasible causing no further harm.

Non-Metro Hospital(CHC and Civil Hospital level):

- 1. Investigations:** X-rays of the part including hip and knee and of other areas if required, x-ray of pelvis with both hips is must. General Investigations and specific if required according to the status of the health of the patient.
- 2. Treatment:** Conservative management of fractures in children in spica cast or with skeletal traction, Kuntscher's nail for isthmic fractures, Interlocking Nailing in comminuted fractures, Plating for lower third fractures, Plating of shaft femur fracture in children.

Referral Criteria

- a. Polytrauma patient.

- b. Patient with co-morbid conditions requiring multiple speciality care.
- c. Non unions / Neglected fractures.
- d. Pathological fractures.
- e. Open fractures requiring Plastic surgery or with Large gaps due to bone loss
- f. Non unions / Neglected fractures and failed osteosynthesis.
- g. Fractures associated with neurovascular injuries/Suspected Fat Embolism.
- h. Suspected HIV positive cases.
- i. Fractures associated with any condition requiring higher investigations like CT scan, MRI etc.

Metro Hospital -Higher referral centre:

1. **Investigations:** X-rays of the part and of other areas if required, x-ray of pelvis with both hips is must. General Investigations and specific if required according to the presence of any co-morbidity. Special investigations like MRI/CT scan or angiography if required.
2. **Treatment:** All the treatment given at situation 1, Closed/Open Interlocking Nailing, DCS/Distal femoral Nail or Plate for Supracondylar/Intercondylar fractures, External fixator/Enders/solid undreamed Nail for open fractures, Fibular grafting with plating and cancellous bone grafts for non unions, Illizarovs Ring Fixator, Rail road fixator for gap defects, Plastic/Vascular surgeon assistance.

Resources required for patient and procedure

Situation	Human Resources	Investigations	Drugs and consumables	Equipment
1	Doctor, Nurse and other paramedics	None	None except for first aid	No surgical set up
2	Doctor, Nurse, Physiotherapist and technicians	X-rays, Complete Haemogram, Bleeding time, Clotting time, Complete urine examination for pre-anaesthetic check up	Plaster of Paris bandages Anaesthetic drugs Thromboprophylaxis	Theatre set up for Surgeries with all Basic equipments C-arm image intensifier
3	Doctor, Physiotherapist, Nurse, orthotist, Prosthetist, and technicians	As situation 1 CT Scan, MRI	As situation 1	As situation 1, Surgical Operating Microscope, ICU, and major physiotherapy set up for rehabilitation

FRACTURE OF TIBIA/FIBULA

1. Introduction /description

Lower leg fractures include fractures of the tibia and fibula. Of these two bones, the tibia is the main weight bearing bone. Fractures of the tibia generally are associated with fibula fracture, because the force is transmitted along the interosseous membrane to the fibula.

The skin and subcutaneous tissue are very thin over the anterior and medial tibia and as a result of this; a significant number of fractures to the lower leg are open. Even in closed fractures, the thin, soft tissue can become compromised. In contrast, the fibula is well covered by soft tissue.

Fractures of the tibia can involve the tibial plateau, tubercle, shaft, and plafond.

2. Incidence:

Fractures of the tibia are the most common long bone fractures. The most common fracture of the lower limb occurs at the tibial diaphysis. Isolated mid-shaft or proximal fibula fractures are uncommon.

3. Mode of injury

Tibial plateau fractures occur from axial loading with valgus or varus forces, such as in a fall from a height or collision with the bumper of a car. The lateral tibial plateau is fractured more frequently than the medial plateau.

Tibial tubercle fractures usually occur during jumping activities.

Mechanisms of injury for tibia-fibula fractures can be divided into 2 categories:

- Low-energy injuries such as ground levels falls and athletic injuries and in osteoporotic patients
- High-energy injuries such as motor vehicle injuries(esp motor cycle accidents, pedestrians struck by motor vehicles, and gunshot wounds

Tibial plafond fractures refer to fractures involving the weight-bearing surface of the distal tibia. This type of injury usually results from high-energy axial loading but may result from lower-energy rotation forces.

4. Clinical presentation:

Patient may complain of severe pain, swelling and bruising down the broken leg, deformity of bones and inability to ambulate with tibia fracture. Tibial plateau fractures often present with a knee effusion. Approximately 20% of tibial plateau fractures are associated with ligamentous injuries.

Limb loss may occur as a result of severe soft-tissue trauma, neurovascular compromise, popliteal artery injury, compartment syndrome, or infection such as gangrene or osteomyelitis. Popliteal artery injury is a particularly serious injury that threatens the limb.

5. MANAGEMENT:

5.1 Primary health centre level:

The doctor on duty should recognise the features of fracture and dislocation. Only first aid including the splintage and intravenous drip should be given. In open fractures Tetanus toxoid can be given. There is no need to waste time in preparation of medico-legal formalities. The injured should be referred to the higher centre earliest feasible causing no further harm.

5.2 CHC and Civil Hospital level:

Trauma patient should be managed by addressing airway, breathing, and circulation. Check and document neurovascular status. Apply sterile dressing to open wounds. Apply gentle traction to reduce gross deformities; splint the extremity. After first aid, pain management and splintage, PRICE therapy (Protection, rest/immobilise the limb, ice therapy, compression and elevation) should be started.

Investigations: Perform radiographs of the knee, tibia/fibula, and ankle as indicated and of other areas if required, General Investigations and specific if required according to the status of the health of the patient. In patients with tibial plateau fractures and tibial plafond fractures, computed tomography can help further evaluate the extent of the fracture. In tibial plateau fractures, radiographs may underestimate the degree of articular depression when compared with computed tomography. This is important because articular depression of greater than 3 mm may be considered for surgery.

Treatment: soft tissue envelope is the most important component in the evaluation and subsequent care of tibial fractures. Compartment syndrome can develop in fractures of the lower leg. Signs of compartment syndrome include crescendo symptoms- **(5 P's)** puffiness/oedema, pain out of proportion with passive stretch of involved muscles, paresthesias, and pallor, and a very late finding is pulselessness and paralysis. Increased compartment pressure is present during compartment syndrome; therefore, external palpation frequently aids in the diagnosis. However, a soft extremity on palpation does not rule out compartment syndrome.

Compartment syndrome must be treated promptly with an emergency surgical ***fasciotomy***

Open fractures must be diagnosed and treated appropriately. Tetanus vaccination should be updated, and appropriate antibiotics should be given in a timely manner. This should involve antistaphylococcal coverage and consideration of an aminoglycoside for

more severe wounds. Adequate wound debridement and wound care. Fractures with tissue at risk for opening should be protected to prevent further morbidity. External fixator should be applied in non comminuted fractures.

All simple both bone leg fractures, minimally displaced fractures in children / adults should be managed with closed reduction and above knee cast. In displaced fractures closed reduction and interlock nailing in shaft fractures should be done, Plating should be done for lower third fractures. Post closed reduction (pop cast) or open reduction and fixation adequate limb elevation is required and patient is encouraged to do passive exercises to avoid edema of limb, deep vein thrombosis and to aid in adequate wound healing.

Tibial plateau fracture : Immobilize un-displaced fractures and keep the patient non-weightbearing for 3 months.

Tibial tubercle fracture- For un-displaced fractures, immobilize the knee.

Isolated midshaft or proximal fibula fracture- Immobilization in a long leg cast generally is not required. Recommend a few days without weight-bearing activity until swelling resolves, followed by weight-bearing activity as tolerated. In some case, immobilization in above knee cast is done

Some of the complications that may arise in treatment are:

- A tendency to displace the fragments when swelling subsides, particularly in oblique and spiral fractures
- Cosmetic and sometimes functional disability if the alignment or rotational position of the fragment is imperfect
- Conspicuous disfigurement if apposition of the fragments is imperfect
- Slow union as a result of severity of the fracture, poor blood supply to one fragment, and sometimes distraction of the bone fragments

- Occasional limitation of joint movement in the knee, ankle and foot, usually caused by associated joint, soft tissue, or vascular injury
- The common peroneal nerve crosses the fibular neck. This nerve is susceptible to injury from a fibular neck fracture or the pressure of a splint,

Referral Criteria for higher centre (Medical College / Tertiary centre)

- a. Open fractures requiring Plastic surgery or with Large gaps due to bone loss.
- b. Comminuted fractures, Fractures requiring Interlocking Nail, proximal intra-articular fractures, distal pilon fractures, open fractures
- c. Polytrauma patient.
- d. Patient with co-morbid conditions requiring multiple speciality care.
- e. Non unions / Neglected fractures and failed osteosynthesis.
- f. Pathological fractures.
- g. Fractures associated with neurovascular injuries/Suspected Fat Embolism.
- h. Suspected HIV positive cases

5.3 Metro Hospital or Higher centre level

At Medical College / Tertiary centre the goal of management of these include in addition to situation 1.

3. Investigations: computer tomography of concerned joint, colour Doppler studies of limb and CT- angiography if required.

4. Treatment: All Closed/Open (upto 3A as per gustilio Anderson classification) should managed with iterlocking Nailing. All proximal tibial intra-articular fractures esp. depressed fractures should be internally fixed with LCP/LCDCP. Distal pilon fractures should be operated and internally fixed with plating.

Open fractures should be managed by cupious washing of wound, wound debridement and application of External fixator/Enders/nails. In fractures with bone loss various options available are;

-tiblisation of fibula and fixation with plating/ k-wires

- Ilizarovs Ring Fixator and Rail road fixator for gap defects and limb lengthening.

-in case of smaller gaps, compression at fracture site and ORIF with plate/nail with cancellous bone grafts

Vascular surgeon assistance (vessel repair or grafting) and plastic surgeon assistance (flap or skin grating) in case of vessel injury and skin or soft tissue loss respectively should be taken.

Resources required for patient and procedure

Situation	Human Resources	Investigations	Drugs and consumables	Equipment
1	Doctor, Nurse and other paramedics	None	None except for first aid	No surgical set up
2	Doctor, Nurse, Physiotherapist and technicians	X-rays, Complete Haemogram, Bleeding time, Clotting time, Complete examination for pre-anaesthetic check up	Plaster of Paris Bandages Tetanus Toxoid immunoglobulins Anaesthetic drugs Thromboprophylaxis	Theatre set up for Surgeries with all Basic equipments C-arm image intensifier

PROTOCOL FOR THE MANAGEMENT OF PELVIC FRACTURE

I. WHEN TO SUSPECT/ RECOGNIZE?

a) Introduction:

Pelvic fracture are predominantly (10% -20%) present in blunt multiple trauma and represent a significant source of morbidity and mortality. Major forces are required to fracture the normal pelvis. Pelvic ring disruptions, more than any other fracture of the body, can lead to severe complications, including massive bleeding and organ injuries. Exsanguinating hemorrhage is the most dreaded acute complication of pelvic fracture. In addition, because of its function as a bony basin for different organs, the cauda equina and essential nerves for the lower limbs, serious injuries of those structures significantly increases the total trauma impact of the multiply injured patient with pelvic injury. The unstable untreated pelvis enforces immobility and does not allow appropriate positioning of those patients with chest and brain injuries for their necessary intensive care.

History suggestive of pelvic fracture

- motorcycle collision
- car vs. pedestrian
- fall from more than 15ft height
- lateral impact injuries
- MVC with vehicle incompatibility (i.e., car/motorcycle, pedestrian/motor vehicle)
- Crushing injury (e.g., falling tree, wall)
- Gun shot and projectile related

b) Case definition:

c)

For both situations of care (*mentioned below**)

A patient having injury of the pelvic ring, a break in the continuity of fibro-osseous ring. For management purpose these injuries are classified into subgroups.

Classification of pelvic fracture, (AO/ASIF-OTA-SICOT)

Type A: Stable, posterior arch intact

A1: Posterior arch intact, fracture of innominate bone (avulsion)

A1.1: Iliac spine

A1.2: Iliac crest

A1.3: Ischial tuberosity

A2: Posterior arch intact, fracture of innominate bone (direct blow)

A2.1: Iliac wing fractures

A2.2: Unilateral fracture of anterior arch

A2.3: Bifocal fracture of anterior arch

A3: Posterior arch intact; transverse fracture of sacrum caudal to S-2

A3.1: Sacrococcygeal dislocation

A3.2: Sacrum undisplaced

A3.3: Sacrum displaced

Type B: Incomplete disruption of posterior arch, partially stable, rotation

B1: External rotation instability, open-book injury, unilateral

B1.1: Sacroiliac joint, anterior disruption

B1.2: Sacral fracture

B2: Incomplete disruption of posterior arch, unilateral, internal rotation (lateral compression)

B2.1: Anterior compression fracture, sacrum

B2.2: Partial sacroiliac joint fracture, subluxation

B2.3: Incomplete posterior iliac fracture

B3: Incomplete disruption of posterior arch, bilateral

B3.1: Bilateral open-book

B3.2: Open-book, lateral compression

B3.3: Bilateral lateral compression

Type C: Complete disruption of posterior arch, unstable

C1: Complete disruption of posterior arch, unilateral

C1.1: Fracture through ilium

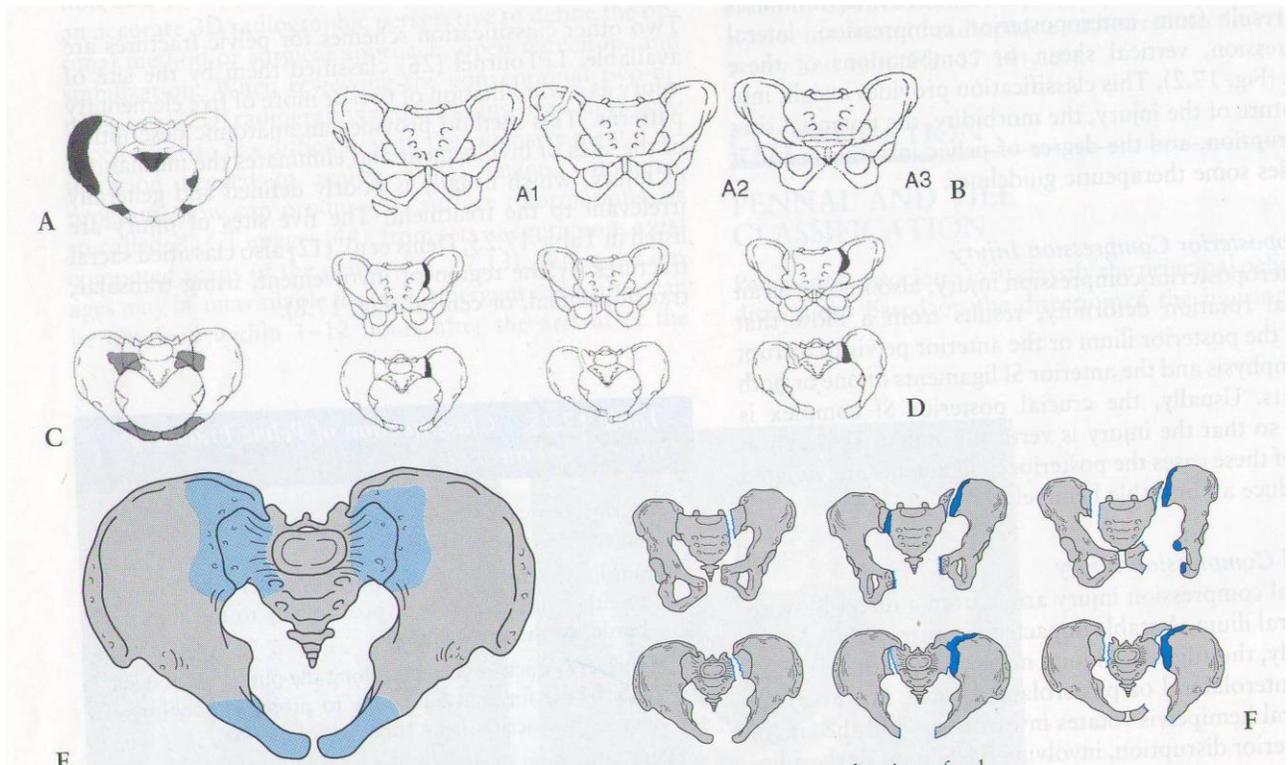
C1.2: Sacroiliac dislocation and/or fracture-dislocation

C1.3: Sacral fracture

C2: Bilateral injury, one side rotationally unstable, one side vertically unstable

C3: Bilateral injury, both sides completely unstable

From: Tile M, Helfet DL, Kellam JF, et al. Comprehensive Classification of Fractures in the Pelvis and Acetabulum. Berne, Switzerland: Maurice E. Müller Foundation, 1995.



Schematic view of the AO-OTA-SICOT alphanumeric classification of pelvic fractures. A: Sites of type 61-A stable injuries. B: type 61-A subcategories by injury sites. C: Sites of type 61-B partially unstable injuries. D: type 61-B subcategories by injury sites and displacement. E: Sites of type 61-C completely unstable injuries. F: type 61-C subcategories by injury sites.

II. INCIDENCE OF THE CONDITION IN OUR COUNTRY

Accidents in India are definitely on an increase. The exact number of pelvic fractures in our country is not known. But, indirect estimates point to a very high incidence.

As per the data from the National Crime Records Bureau, 467,537 persons died due to injury and violence in 2009. Injury and violence deaths increased from 246,277 in 1998 to 467,537 by 2009 (NCRB, 1998 & 2009 a, b). During the same period the non fatal injuries also increased correspondingly to 1,070,302 in 2009. Injury deaths are only tip of the iceberg. For every death, it is estimated that nearly 30-50 persons are hospitalized and 50-100 are likely to receive emergency care.

The data from the recently completed million death study by the Registrar General of India indicates that injuries contributed for 10% of deaths and was the leading cause in younger age groups (RGI, 2009). Of urban population deaths leading causes were RTI's (47%), suicides (34%) and assault (10%). Leading causes of injuries were falls (27%), RTI's (27%) and burns (7.3%) (G Gururaj)

From above figures it can be estimated that the number is quit high.

III. DIFFERENTIAL DIAGNOSIS

In all cases of trauma, especially in cases with a history suggestive of pelvic injuries should be actively looked for pelvic fracture or dislocation after initial resuscitation (ABC's).

IV. PREVENTION AND COUNSELING

Accidents don't just happen; they are caused. Majority (>90 %) of them are directly or indirectly due to human error, natural (< 10 %) causes account for very few deaths. All the causes should be identified by epidemiological methods. Since accidents are multifactorial, they call for an intersectoral approach to both prevention and care of the injured.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

***Situation 1: At Secondary Hospital/ Non-Metro situation: Optimal Standards of Treatment in Situations where technology and resources are limited**

a) Clinical Diagnosis:

After assessment ABC's

Gross inspection (open wounds, deformities)

- Extensive echymosis and soft tissue swelling
- Disruption of the subcutaneous fat along with echymotic skin and potentially deep fascia (Morelle-Levelle lesion)
- open wounds around the pelvis
 - Perineal laceration or puncture wound
 - Presacral laceration.

Deformities

- Disturbed relationship of ASIS, iliac crest,
- Limb length discrepancies

Instability

Comprehensive neurovascular assessment

Urogenital and rectal examination

b) Investigations:

Chest, pelvic and cervical spine radiograph
 Focused abdominal ultrasonography for trauma (FAST),
 Diagnostic peritoneal lavage (DPL)

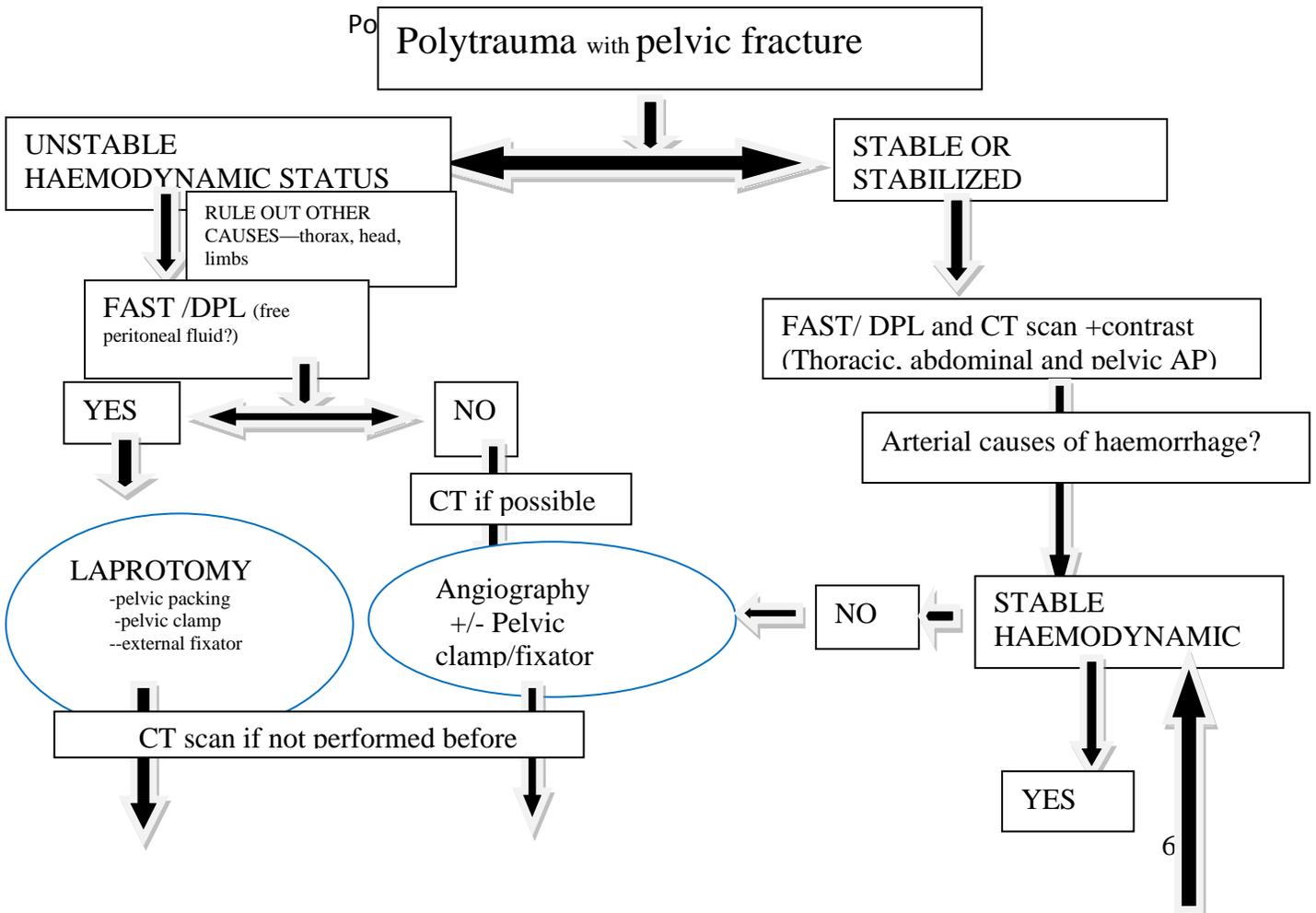
Dependent on specific injuries
 -- CT of head, ECG, retrograde urethrogram etc

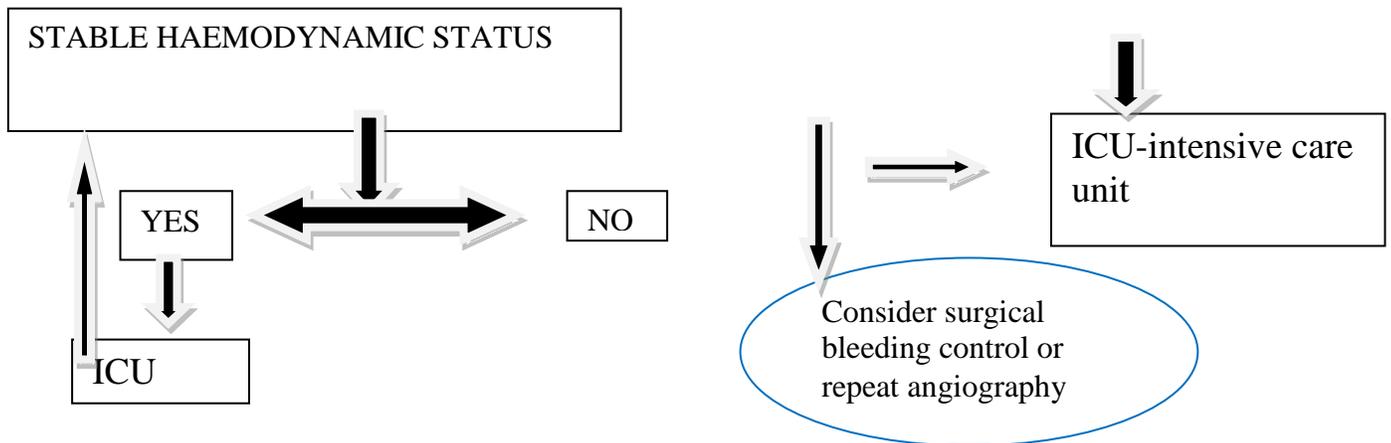
CT Pelvis with 3D reconstruction

c) Treatment:

The primary objective in the initial care of the multiply injured patient is survival with normal cognitive functions. The first hour after admission to the emergency room is most critical in terms of survival and reduction of morbidity. Multiply injured patients should have immediate evaluation of their vital organ functions, resuscitation, focused and rapid diagnostic procedures, and appropriate surgical treatment, including damage control followed by stabilization of their vital organ functions in the intensive care units (ICU), as per ATLS Protocol (Reference ATLS)

Algorithm for management of haemorrhagic shock in pelvic fracture





FAST—focused abdominal ultrasonography for trauma,
DPL—diagnostic peritoneal lavage

Standard Operating procedure

Pelvic binder / pneumatic antishock garment,
Pelvic external fixator / C-clamp
Skeletal traction in Type –C injuries

- a. **In Patient**) all patient of pelvic injuries are high energy trauma
- b. **Out Patient**) they need in patient treatment for at least 24 hrs
- c. **Day Care**) to exclude other serious injuries.

d) Referral criteria: Depending upon the resources at the centre patients are referred timely preferably after an attempt at stabilizing the patient .Sometimes only few minutes are there for decision to operate for control of bleeding, (damage control and than referral).

Excessive requirement for blood,
Polytrauma with additional injuries
If adequate OT facilities are not available
For arterial bleeding ,angiography requirement

*Situation 2: At Super Specialty Facility in Metro location where higher-end technology is available

e) **Clinical Diagnosis:**

Same as situation 1

b) **Investigations:**

Blood gas analysis
 Chest, pelvic and cervical spine radiograph
 Focused abdominal ultrasonography for trauma (FAST),
 Diagnostic peritoneal lavage (DPL)

Dependent on specific injuries
 -- CT of head, ECG, ECHO, retrograde urethrogram etc
 -- CT pelvis with 3D reconstruction
 -- CT abdomen
 -- Angiography

f) **Treatment:**

Same as situation 1

Once the patient is stable than the definite management of pelvic fracture is undertaken usually after 5th day and before end of 2nd week.

Timing of secondary surgical procedure		Physiologic status	surgical
intervention	timing		
Response to resuscitation	-ve	life saving surgery	D-1 →
	?	“Damage control”	
	+ve	delayed primary surgery	
Hyperinflammation		“second look” only	D2-4 →
Window of opportunity		scheduled definitive surgery	D5-14
Immunosuppression		no surgery!	Wk 3 →
Recovery			

Secondary survey & assessment of pelvic fracture
(stability and personality)

In Secondary “regeneration “period (i.e., 2-10 days)
Once the patient is haemodynamically stabilized detailed assessment of the personality of the fracture and stability should be determined. To assess this

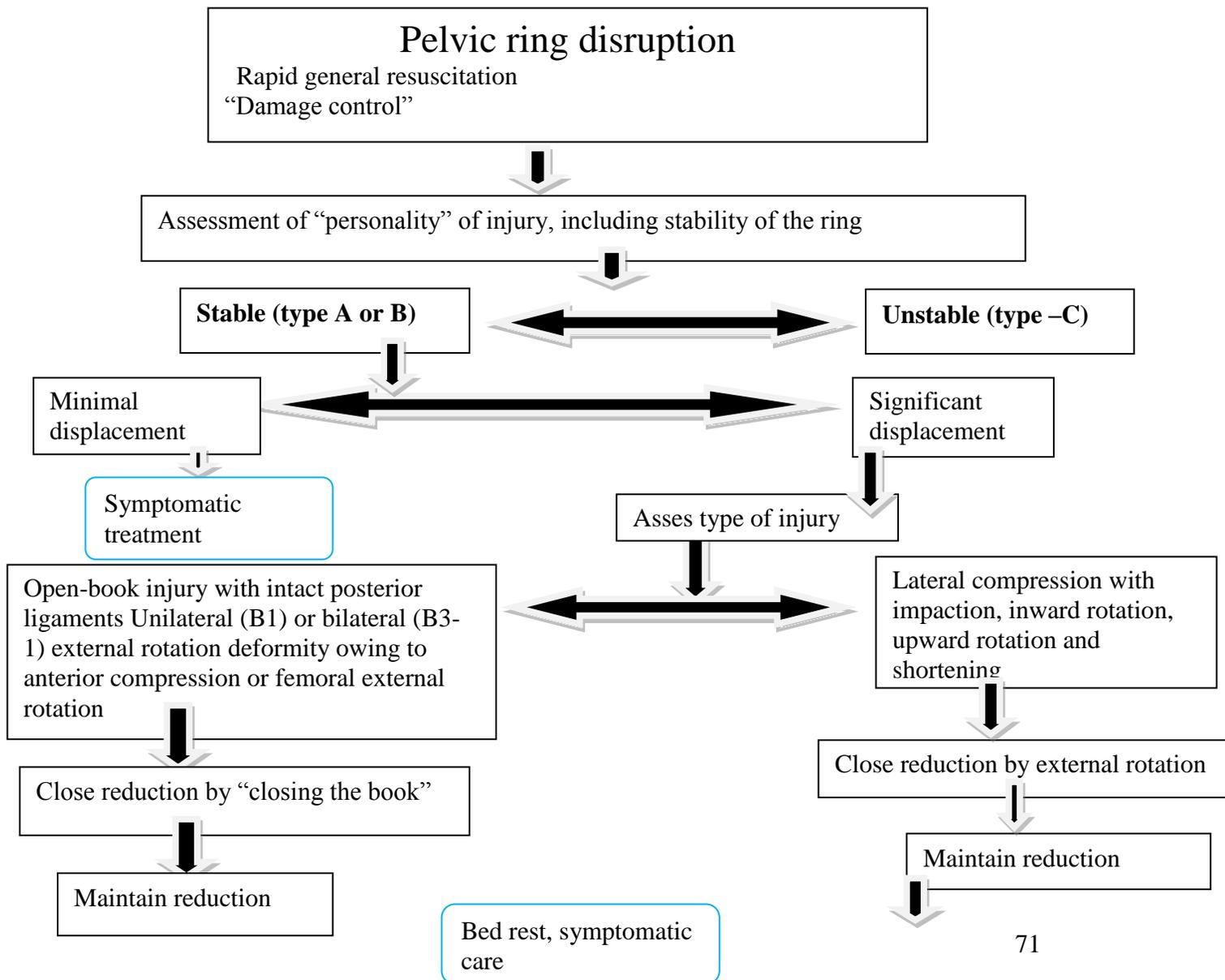
Secondary diagnostic procedures are undertaken

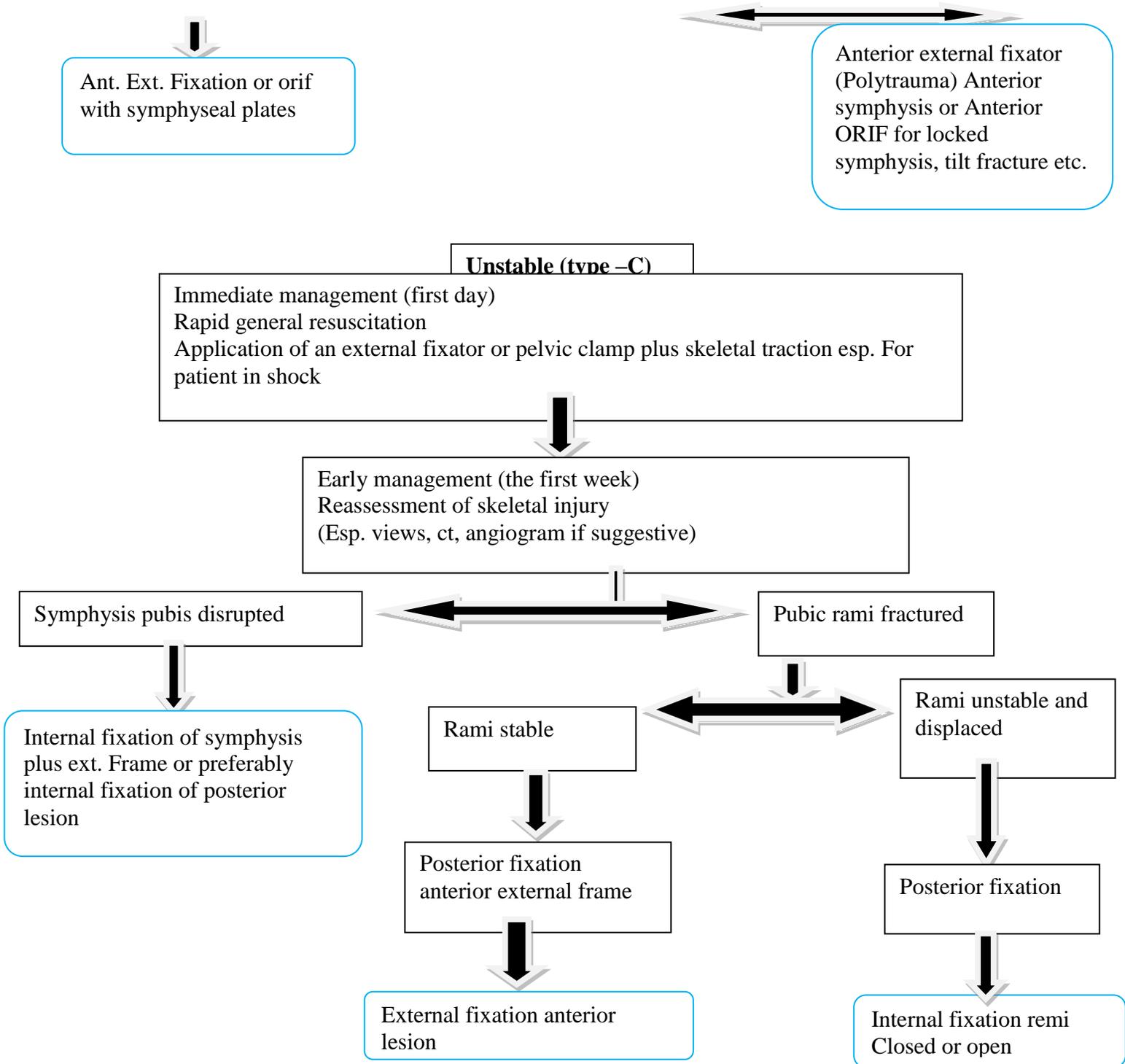
AP, inlet, outlet and Judet view of pelvis

CT scan (with contrast), fluoroscopy and stress view

3D CT, MRI, bone scan, U/S, Angiography

Once this is determined **definitive pelvic fracture management** is done depending upon the type of injury as described below in flow charts.





Indications for ORIF of unstable pelvic disruptions (type C)

ANTERIOR (symphysis or remi)

-to improve pelvic stability in association with laprotomy acutely (no faecal contamination or suprapubic tube) or simplified fracture management (acute or semi acute phase)

- Remi fracture associated with lesion of femoral artery or nerve
- bone protruding into perineum (tilt # in female)
- asso. Ant acetabular fracture that require ORIF

POSTERIOR

-Inadequate reduction of posterior SI complex, esp. SI jt dislocation > 1 cm displacement or >30* ext rotation

- open fracture with a posterior wound (rarely for perineal wound)
- associated posterior acetabular fracture that requires ORIF

Standard Operating procedure

- a. **In Patient**) all patient of pelvic injuries are high energy trauma
- b. **Out Patient**) they need in patient treatment for at least 24 hrs
- c. **Day Care**) to exclude other serious injuries.

g) **Referral criteria:** not applicable for tertiary centre unless some facilities are missing.

VI. WHO DOES WHAT? and TIMELINES

a. Doctor

- Monitors and supervises the treatment and performs any procedures on urgent basis, coordinates with other departments
- Arranges interhospital transfer in time

b. Nurse

Carry out all the treatment and maintains the formulary (drugs and consumables and equipment)

c. Technician

Helps in resuscitation, transport , immobilization etc.

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*RESOURCES REQUIRED FOR ONE PATIENT / PROCEDURE (PATIENT WEIGHT 60 KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)*

Situati on*	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Orthopaedic surgeon, Anesthetist Staff nurses -2, Technician	Routine blood investigations (cbc, biochemistry including blood gas analyzer, serum lactate estimation) ,Rhoent genogram, CT-scan, Ultrasound (Doppler)	Emergency room with all resuscitation drugs and fluids (crystalloids & colloids),OT gases (O ₂ ,N ₂ O), strecher, consumables , pelvic binder, implants, c-clamp/external fixator Et tube ,Ryles Tube, Foleys catheter, syringes i.v.canulla, central line, dressing materials for large dressings Blood storage facility with availability of few units of bloods	Emergency room multi-para-monitor, infusion pumps, anaesthesia machine (+/- ventilator) Blood storage refrigerator , Operation room with C-arm and compatible OT table. X-ray machine Ultrasound machine (Doppler)
Situati on* 2 Gener al surge on	Orthopaedic surgeon, Anaesthetist any other sub specialist as required at odd hours(e.g. neurosurgeon/interv entional radiologist/vascular surgeon) Staff nurses –for ER-2,OT-2 Technician for ER-1, OT -1	Routine blood investigations (cbc, biochemistry including blood gas analyzer, serum lactate estimation) ,Rhoenghtogram, Ultrasound machine (Doppler) CT-scan, MRI DSA with facility of interventional angiography	Emergency room with all resuscitation drugs and fluids (crystalloids & colloids),OT gases (O ₂ ,N ₂ O), strecher, consumables , pelvic binder, implants, c-clamp/external fixator Et tube ,Ryles Tube, Foleys catheter, syringes i.v.canulla, central line, dressing materials for large dressings Blood storage facility with availability of few units of bloods	Emergency room Monitor, anaesthesia machine (+/- ventilator) Blood storage refrigerator with fully equipped blood bank with all facilities (components and factors), Ultrasound machine (Doppler),ct scan, MRI facilities , Operation room with C-arm and compatible with OT table ICU back-up with intensive monitoring CT-scan,

				Cath lab with facility of interventional angiography Rhoengtogram, Ultrasound machine (Doppler) CT-scan, MRI
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SPINAL INJURY

I. WHEN TO SUSPECT/ RECOGNIZE?

d) Introduction:

With an estimated annual incidence of 300 per crore population, approximately 40,000 new spine injury cases are added every year in India. 40% of these are complete lesions i.e. tetra or paraplegia. The socio economic impact of spinal injuries is huge with 85% of victims being male in the age group of 15 to 35 years. Management of patients who have sustained spinal cord injury requires careful assessment and management. Inadequate assessment and management of these injuries may lead to worsening of existing spinal cord injury or the production of a new cord injury.

b) Case definition: For both situations of care (mentioned below*)

Spinal cord injury (SCI) is an insult to the spinal cord resulting in a change, either temporary or permanent, in its normal motor, sensory, or autonomic function.

II. INCIDENCE OF THE CONDITION IN OUR COUNTRY:

In the absence of a national spinal cord injury registry in India, the exact incidence is not known. Approximately 30 cases per million population. Approximately 40% of these will be complete. Majority of the cases are due to road side accidents or fall from height.

III. DIFFERENTIAL DIAGNOSIS:

All trauma patients should be assumed to have a spinal injury and treated as such till a detailed clinical examination and radiological investigations has been performed. Potential spinal cord injury should be suspected in following situations:

- a. Altered mental status.
- b. Evidence of intoxication.
- c. Associated head injury, extremity fracture
- d. Focal neurological deficit.
- e. Spinal pain or tenderness
- f. Mechanism of injury e.g fall from height, fall on head, whiplash injuries, high energy injuries

IV. PREVENTION AND COUNSELING :

All trauma patients should be assumed to have a spinal injury and treated as such, until this can be confidently excluded. Full spinal immobilisation should be employed including a collar, spinal board and blocks. Tape can be used to secure the head to the blocks. This should be done as soon as physically possible and prior to moving the patient to a site of definitive care.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

***Situation 1: At Secondary Hospital/ Non-Metro situation: Optimal Standards of Treatment in Situations where technology and resources are limited**

a) 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:

Diaphragm	C3-5
Shrug shoulders	C4
Deltoids/elbow flexion	C5
Extend wrist	C6
Extension of elbow/ flexion of wrist	C7
Abduct fingers	C8
Active chest expansion	T1-T12
Hip flexion	L2
Knee extension	L3-4
Ankle dorsiflexion	L5-S1
Ankle plantar flexion	S1-2

Assessment of sensory function

Deltoid area	C5
Thumb	C6
Middle finger	C7
Little finger	C8
Nipple	T4
Xiphoid	T8
Umblicus	T10
Symphysis	T12
Anterior thigh	L2
Anterior knee	L3
Antero-lateral ankle	L4
Dorsum of great and 2 nd toe	L5
Lateral side of foot	S1
posterior calf	S2
perianal sensation	S2-5

Frankel's grades : Spinal Cord Injury is most commonly graded using Frankel's grades (A to E).

A; Complete motor and sensory loss

B: Sensation only present below lesion

C: Sensations present and motor function is present but useless

D: Motor useful but not normal

E: No neurological deficit.

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 bulbocavernosus 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.

b) Investigations:

All patients with suspected spinal injury should have radiographic evaluation.

1. 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
2. Additional Open-mouth views should be done to evaluate odontoid injury.
3. Whole spine should be evaluated with a patient of spinal injury.
- d. The patient should be referred for advanced diagnostic modalities only when the patient is stable:

CT Scan: CT scan cervical spine in all cases of head injuries or intoxication at the same time as the brain CT. CT should be done when plain X-Ray is inadequate particularly upper cervical spine injuries and C7-T1 junction.

MRI: MRI is essential for evaluating injury to the soft tissues and ligaments, discs, intrinsic cord damage (oedema, hematoma, or contusion) and Para vertebral soft tissues. MRI is particularly useful in scenarios such as central cord syndrome where plain radiographs will not show any fractures or dislocations. If possible MRI should be done before the cervical traction is applied. In patients with pre-injury morbidities such as Ankylosing Spondylitis, CT and MRI should be done to rule out occult instability even if x-rays are normal.

b) Treatment:

Standard Operating procedure

a. In Patient

1. 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.
2. Adequate number of personnel should be employed for logrolling during patient repositioning, turning and transfers.
3. Secure ABC
 - a. Airway: If intubation is required rapid sequence intubation with manual inline stabilisation should be done. Awake fiberoptic intubation is ideal in a cooperative patient and if facilities are available.
 - b. Prevent and treat hypotension
 - i. Look for other causes of hypotension such as abdominal, chest and pelvic injury
 - ii. Look for Neurogenic shock i.e. hypotension with bradycardia in cervical spine and high thoracic injuries.
 - b. Monitor and regulate temperature
4. Perform a baseline neurological assessment on any patient with suspected spinal injury. Determine a neurological level and the completeness of injury (as described above). Perform serial examinations as indicated to detect neurological deterioration or improvement. The neurological examination should be done as per an objective system such as ASIA scoring system and documented properly. Perform serial examinations as indicated e.g. after each intervention to detect neurological deterioration or improvement
5. Once initial resuscitation is done, complete a comprehensive tertiary trauma survey in the patient with potential or confirmed spinal cord injury.
6. In the patient with acute spinal cord injury, particularly higher cervical injury, assess and document early and frequently any evidence of traumatic brain injury (TBI) in the form of loss of consciousness and posttraumatic amnesia

7. Screen for thoracic and intra-abdominal injury in all patients with spinal cord injury.

8. No clinical evidence exists to definitively recommend the use of any neuroprotective pharmacologic agent, including steroids, in the treatment of acute spinal cord injury to improve functional recovery. However high dose methyl-prednisolone may be used as per NASCIS III recommendations (Methylprednisolone: Bolus dose of 30 mg/kg of body weight over 15 minutes, followed by a 45-minute pause, and then a 23-hour continuous infusion of 5.4 mg/kg/hr, If patient presents between 3 and 8 h, give the above steroid infusion for total of 48 h) if the patient presents within 8 hours of injury. The risk of complications such as higher infection and sepsis rates, respiratory complications and gastrointestinal hemorrhage should be kept in mind while administering steroids.

9. Genitourinary Tract :

- i. Place an indwelling urinary catheter as part of the initial patient assessment unless contraindicated
- ii. Leave indwelling urinary catheters in place at least until the patient is haemodynamically stable
- iii. CIC should be taught to patient or the relatives as soon as the patient is stable

10. Gastrointestinal Tract

Initiate stress ulcer prophylaxis.

Evaluate swallowing function prior to oral feeding in any acute SCI patient

11. Measures to prevent bed sores:

- i) Assess areas at risk for skin breakdown frequently.
- ii) Place the patient on a pressure-reduction mattress or a mattress overlay depending on the patient's condition.
- iii) Use a pressure-reducing cushion when the patient is mobilized out of bed to a sitting position.
- iv) Reposition to provide pressure relief or turn at least every 2 hours while maintaining spinal precautions.

- v) Keep the area under the patient clean and dry and avoid temperature elevation.
- vi) Assess nutritional status on admission and regularly thereafter.
- vii) Inspect the skin under pressure garments and splints.
- viii) Educate the patient and family on the importance of vigilance and early intervention in maintaining skin integrity.

b. Out Patient care

A secondary hospital is expected to provide outpatient care to the spinal cord injury patients who may be referred back from specialized centers after definitive treatment. This may be in form of

- 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
- iv. Care of bed sores

c. Day Care

Day care might be needed for situations like debridement of bed sores.

c) Referral criteria:

1. The patient should be hemodynamically stable and fully resuscitated at the time of referral
2. All the patients who need surgery (indications discussed in the next section) need to be referred to a specialized tertiary care centre.
3. The decision of need for surgery can only be made by an experienced spinal surgeon either orthopedic or neurosurgeon. In absence of these all patients with proven or suspected spine injury should be referred to a higher center.
4. It is desirable to have a two way communication with higher center while referring a patient.

***Situation 2: At Super Specialty Facility in Metro location where higher-end technology is available**

h) Clinical Diagnosis: As described above (in situation 1)

i) Investigations:

Radiographic evaluation of patients with spinal injury.

1. Initial screening can be done by conventional antero-posterior and lateral x-rays.
 2. Additional Open-mouth views should be done to evaluate odontoid injury.
 3. Special views like swimmer's view and oblique views can be done to see junctional areas
 4. CT scan of the whole spine should be done if in presence of clinical suspicion but fractures cannot be demonstrated on x rays or if junctional areas are not visualised.
 5. MRI should be done to evaluate ligamentous injury, spinal cord injury.
- In patients with pre-injury morbidities such as AS, DISH, stiff spine CT and MRI should be done to rule out occult instability even if x-rays are normal.
6. Whole spine should be evaluated with a patient of spinal injury.

j) Treatment:

Standard Operating procedure

a. In Patient

1. 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.
2. Secure ABC

- a. Airway: If intubation is required rapid sequence intubation with manual inline stabilisation should be done. Awake fiberoptic intubation is ideal in a cooperative patient and if facilities are available.
 - b. Prevent and treat hypotension
 - i. Look for other causes of hypotension such as abdominal, chest and pelvic injury
 - ii Look for Neurogenic shock i.e. hypotension with bradycardia in cervical spine and high thoracic injuries.
 - c. Monitor and regulate temperature.
3. Perform a baseline neurological assessment on any patient with suspected spinal injury . Determine a neurological level and the completeness of injury. Perform serial examinations as indicated to detect neurological deterioration or improvement. The neurological examination should be done as per an objective system such as ASIA scoring system and documented properly. Perform serial examinations as indicated e.g. after each intervention to detect neurological deterioration or improvement. ASIA score is very elaborate, one can follow TLISS/ TCLISS (as recommended by STSG)
4. No clinical evidence exists to definitively recommend the use of any neuroprotective pharmacologic agent, including steroids, in the treatment of acute spinal cord injury to improve functional recovery. However high dose methyl-prednisolone may be used as per NASCIS III recommendations (Methylprednisolone: Bolus dose of 30 mg/kg of body weight over 15 minutes, followed by a 45-minute pause, and then a 23-hour continuous infusion of 5.4 mg/kg/hr, If patient presents between 3 and 8 h, give the above steroid infusion for total of 48 h) if the patient presents within 8 hours of injury. The risk of complications such as such as higher infection and sepsis rates, respiratory complications and gastrointestinal hemorrhage should be kept in mind while administering steroids, It is basically a treatment option, not standard care.
5. Once initial resuscitation is done, complete a comprehensive tertiary trauma survey in the patient with potential or confirmed spinal cord injury.

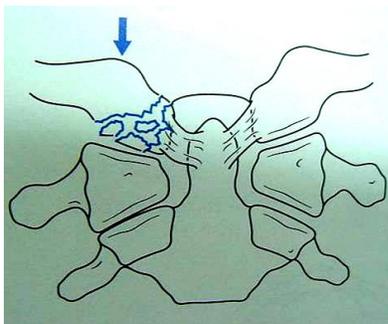
6. In the patient with acute spinal cord injury, particularly higher cervical injury, assess and document early and frequently any evidence of traumatic brain injury (TBI) in the form of loss of consciousness and posttraumatic amnesia
7. Screen for thoracic and intra-abdominal injury in all patients with spinal cord injury.
8. Perform early stabilization of extraspinal fractures. Perform this surgery as early as possible to facilitate early rehabilitation and concomitantly with any required spinal stabilization if the patient is medically stable.
9. Surgical treatment
 - a. Perform a closed or open reduction as soon as permissible on patients with bilateral cervical facet dislocation in the setting of an incomplete spinal cord injury
 - b. Consider early spinal stabilization where indicated
 - c. Consider early surgical spinal canal decompression direct or indirect in the setting of a deteriorating spinal cord injury as a practice option that may improve neurologic recovery, although there is no compelling evidence that it will.

The following algorithms may be followed as a guide to help in decision making in operative treatment of spine injuries. These algorithms are meant as a guide and the treatment plan for each patient needs to be individualised

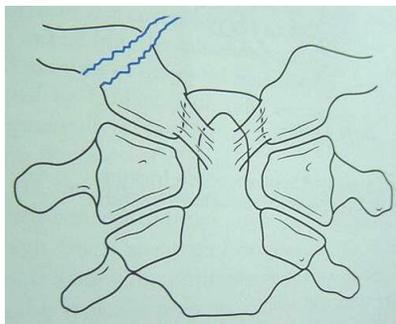
i) Upper cervical injuries

a) Occipital condyle fractures:

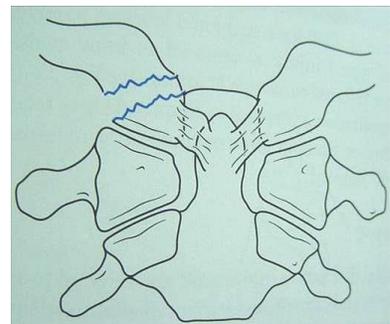
Type III injuries require surgical stabilisation if associated with craniocervical instability



Type I : Comminuted



Type II : Impaction



Type III : Avulsion

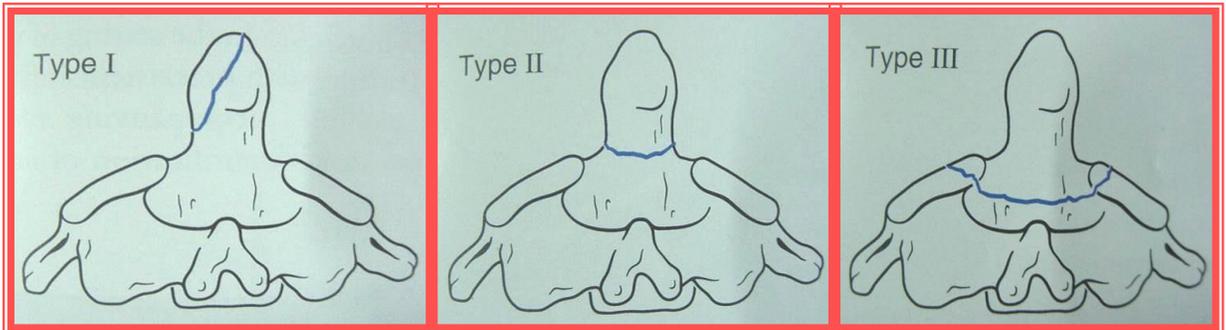
b) Atlas fractures

Surgical stabilisation if:

- neurologic symptoms,
- instability is more than 5 mm on dynamic radiographs
- significant pain is present with the evidence of nonunion.

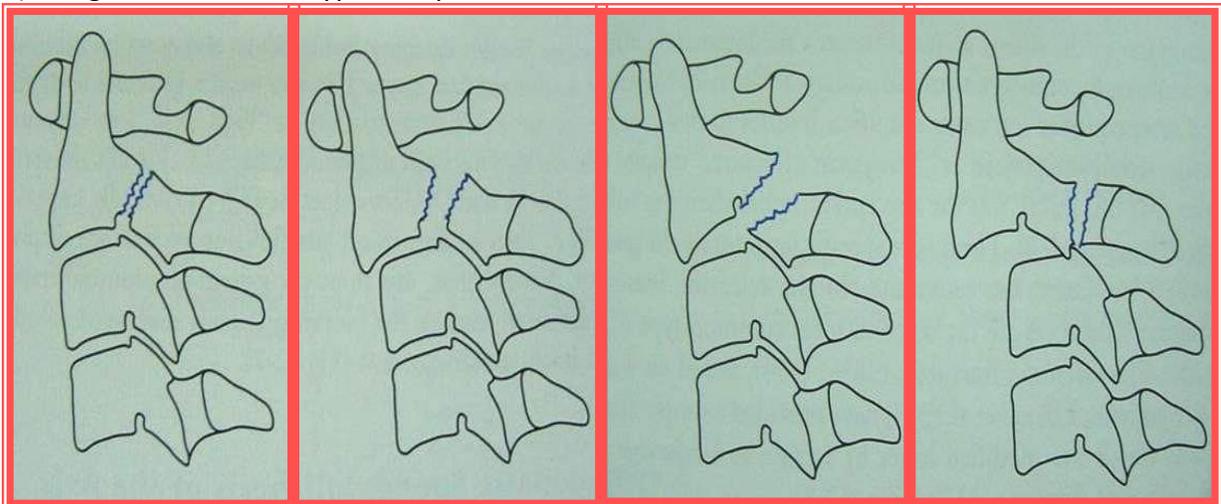
The surgical procedure is stabilization of C1-C2 or occiput-C2

c) Odontoid fractures:



- Anterior screw fixation in type 2 fractures. This is contraindicated in TAL injury, Comminuted fracture, Anterior oblique fractures, Nonunion > 3 months Osteoporosis, Barrel chest. Posterior arthrodesis can be done in such cases.

d) Hangman fractures: Type 3 require stabilization.



Type I

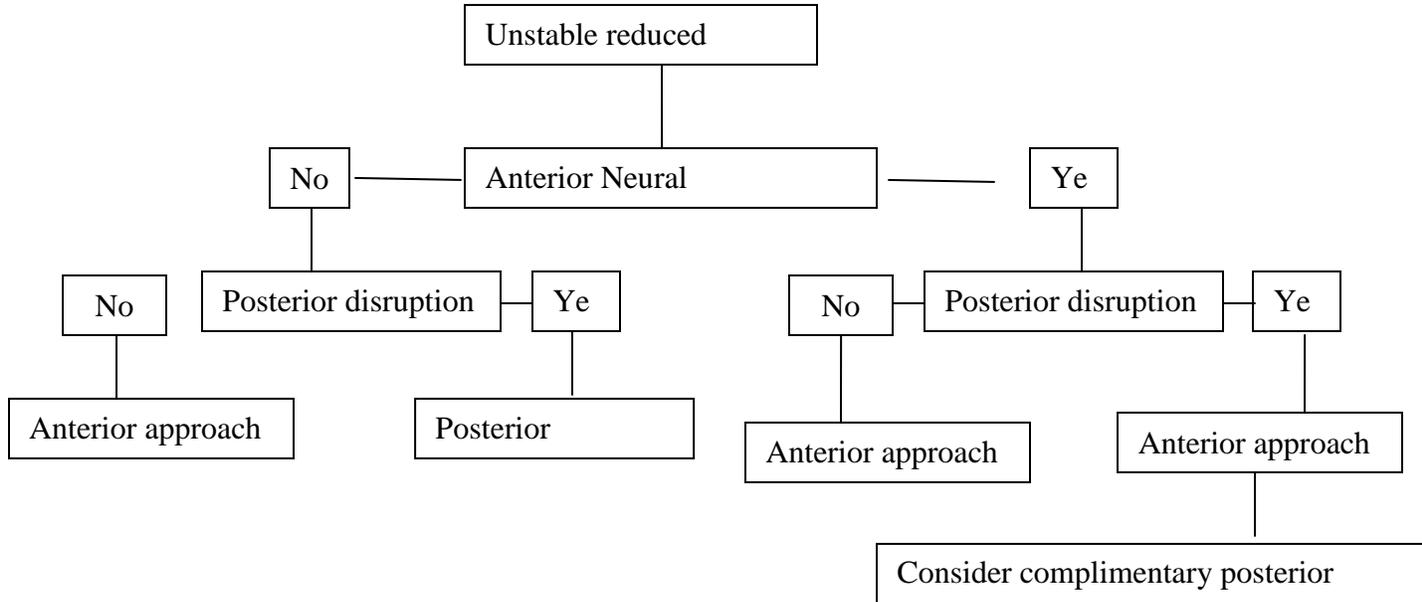
Type II

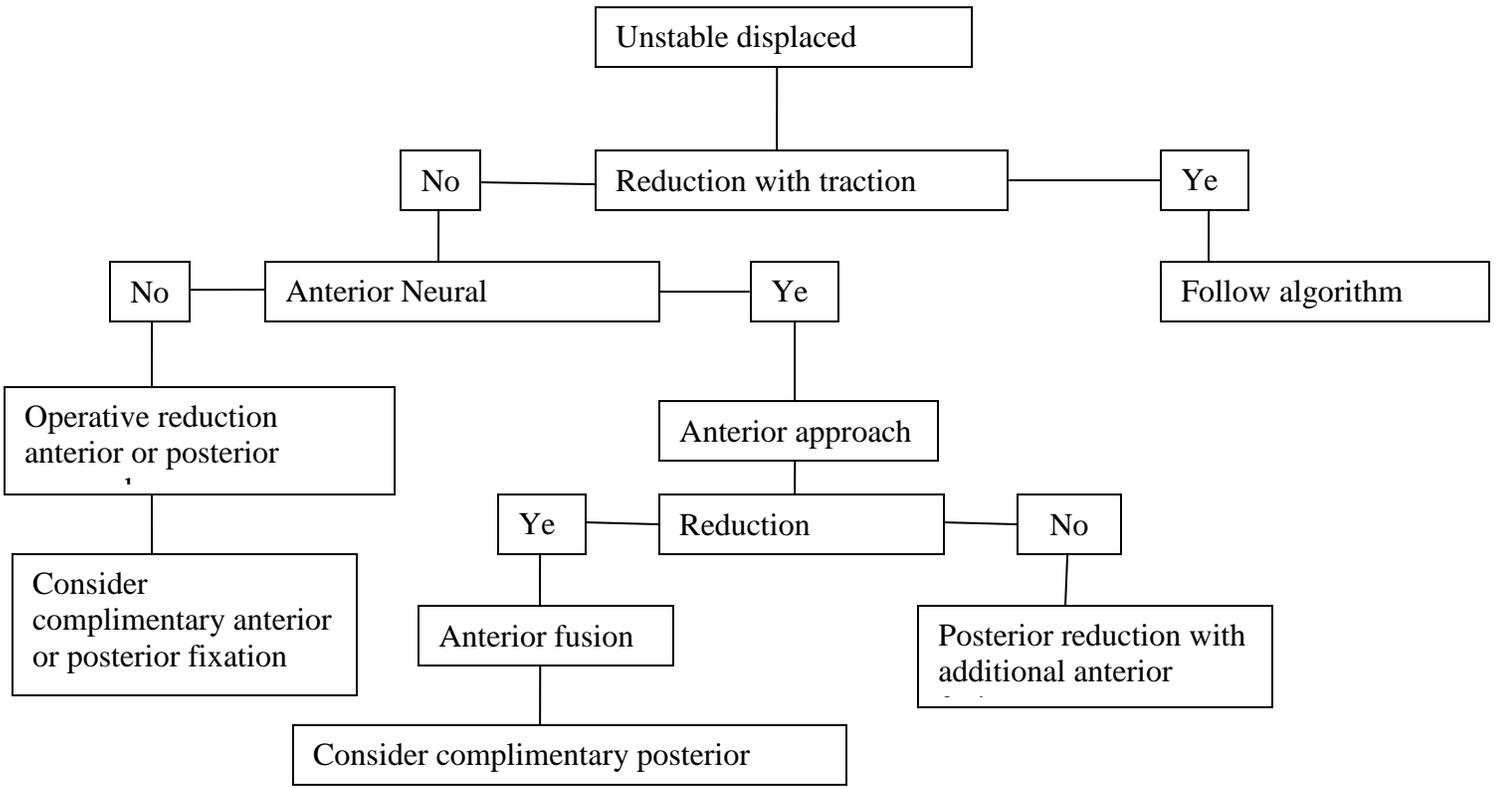
Type II a

Type III

ii) Subaxial Cervical Spine Injuries

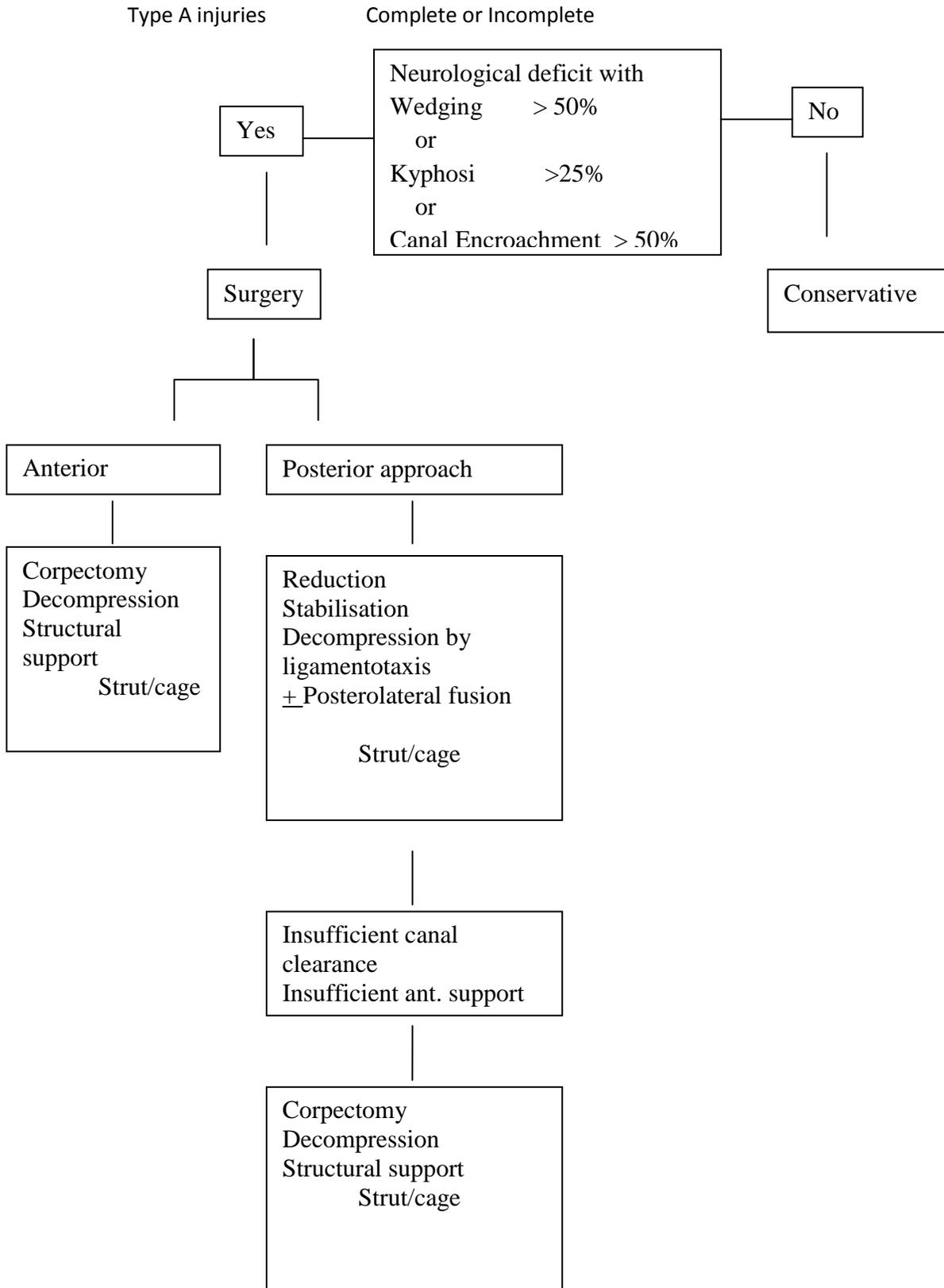
Following algorithms might be used to treat subaxial spine injuries





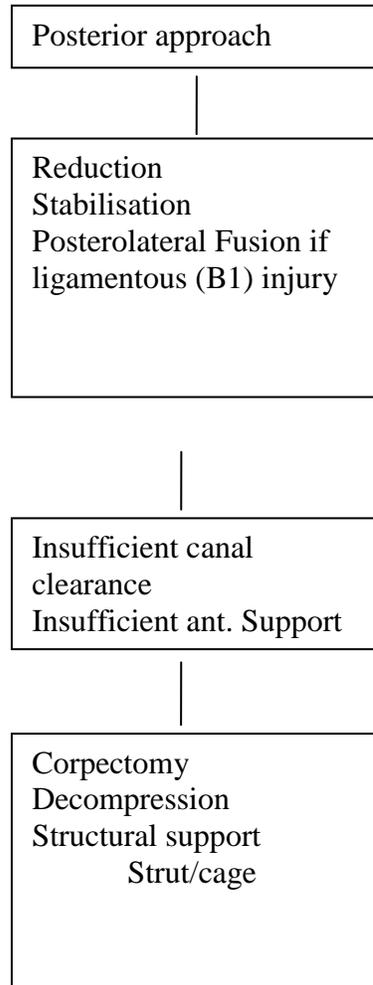
iii) Surgical treatment of thoracolumbar and lumbar injuries

AO classification (annexure) provides a useful guide in planning the surgical treatment.

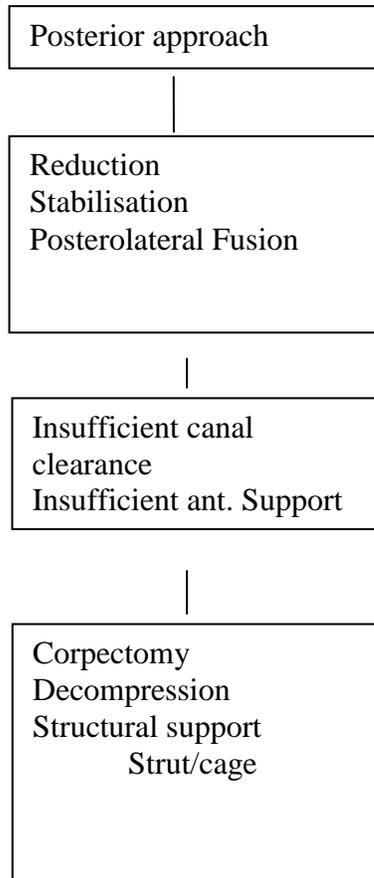


1) MRI confirmed PLC injury may need posterior stabilization only

Type B Injuries



Type C Injuries



10. Adjunctive measures:

- c. Assess areas at risk for skin breakdown frequently.
- d. Place the patient on a pressure-reduction mattress or a mattress overlay depending on the patient's condition.
- e. Use a pressure-reducing cushion when the patient is mobilized out of bed to a sitting position.
- f. Reposition to provide pressure relief or turn at least every 2 hours while maintaining spinal precautions.
- g. Keep the area under the patient clean and dry and avoid temperature elevation.
- h. Assess nutritional status on admission and regularly thereafter.
- i. Inspect the skin under pressure garments and splints.
- j. Educate the patient and family on the importance of vigilance and early intervention in maintaining skin integrity.

11. Genitourinary Tract

Place an indwelling urinary catheter as part of the initial patient assessment unless contraindicated

Leave indwelling urinary catheters in place at least until the patient is haemodynamically stable

CIC should be taught to patient or the relatives as soon as the patient is stable

12. Gastrointestinal Tract

- Initiate stress ulcer prophylaxis.
- Evaluate swallowing function prior to oral feeding in any acute SCI patient with cervical spinal cord injury, halo fixation, cervical spine surgery, prolonged intubation, tracheostomy.

b. Out Patient

Out patient care is needed for non surgically treated patients on ambulatory care and Surgically treated patients. This will entail:

Prescription of appropriate orthoses

Physiotherapy services

Counselling: social, psychological,vocational

c. Day Care

k) **Referral criteria:**

Surgically treated patients may be referred back to secondary hospitals for physiotherapy, and care of back, bladder and bowel.

VI. WHO DOES WHAT? and TIMELINES

a. Doctor

Primary assessment and resuscitation

Clinical diagnosis

Ordering and interpretation of investigations

Clinical decision making

Surgical procedures

b. Nurse

Primary resuscitation can be performed by a nurse

Prevention of bed sores

Maintenance of inventory(drugs,consumables etc.)

Operating room assistance

c. Technician

Pre trauma technicians do primary immobilization and do safe transport to hospitals

Primary resuscitation can be performed by technicians

Appropriate radiological investigations

Physiotherapy

FURTHER READING / REFERENCES

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8. Amar AP, Levy ML. Pathogenesis and pharmacological strategies for mitigating secondary damage in acute spinal cord injury. Neurosurgery 1999; 44:1027-39.
9. Practice Management Guidelines for the Screening of Thoracolumbar Spine Fracture The Journal of TRAUMA_ Injury, Infection, and Critical Care Volume 63 • Number 3 709-713

RESOURCES REQUIRED FOR ONE PATIENT / PROCEDURE (PATIENT WEIGHT 60 KGS)

(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

Situation	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Orthopaedic surgeon, Anesthetist Staff nurses -2, Technician	Routine blood investigations (cbc, biochemistry including blood gas analyzer, serum lactate estimation) ,Roentgenogram, CT-scan	Emergency room with all resuscitation drugs and fluids (crystalloids & colloids),OT gases (O2 ,N2O), spine immobiliser, hard cervical collars, Et tube ,Ryles Tube, Foleys catheter, syringes i.v.canulla, central line, Blood storage facility with availability of few units of bloods	Emergency room multi-para-monitor, infusion pumps, anaesthesia machine (+/- ventilator) Blood storage refrigerator , Operation room with C-arm and compatible with OT table
2	Team of Orthopaedic surgeons with at least one with training in spine surgery, Anaesthetist Staff nurses –for ER-3,OT-3, wards-4 Technician for ER-1, OT -1 Physiotherapists-2	Routine blood investigations (cbc, biochemistry including blood gas analyzer, serum lactate estimation) ,Roentgenogram, CT-scan, MRI	Emergency room with all resuscitation drugs and fluids (crystalloids & colloids),OT gases (O2 ,N2O), strecher, consumables, spine boards and cervical collars , Et tube ,Ryles Tube, Foleys catheter, syringes i.v.canulla, central line, Air Mattresses	Emergency room Monitor, anaesthesia machine (+/- ventilator) Blood storage refrigerator with fully equipped blood bank with all facilities (components and factors), Ultrasound machine (Doppler),ct scan, MRI

			Blood storage facility with availability of few units of bloods	facilities , Operation room with C-arm and compatible with OT table ICU back-up with intensive monitoring
--	--	--	--	---

ASIA SCORE

Patient Name _____

Examiner Name _____ Date/Time of Exam _____



STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY



MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5	<input type="checkbox"/>	<input type="checkbox"/>	Elbow flexors
C6	<input type="checkbox"/>	<input type="checkbox"/>	Wrist extensors
C7	<input type="checkbox"/>	<input type="checkbox"/>	Elbow extensors
C8	<input type="checkbox"/>	<input type="checkbox"/>	Finger flexors (distal phalanx of middle finger)
T1	<input type="checkbox"/>	<input type="checkbox"/>	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) + = (25) (25) (50)

Comments:

L2	<input type="checkbox"/>	<input type="checkbox"/>	Hip flexors
L3	<input type="checkbox"/>	<input type="checkbox"/>	Knee extensors
L4	<input type="checkbox"/>	<input type="checkbox"/>	Ankle dorsiflexors
L5	<input type="checkbox"/>	<input type="checkbox"/>	Long toe extensors
S1	<input type="checkbox"/>	<input type="checkbox"/>	Ankle plantar flexors

LOWER LIMB TOTAL (MAXIMUM) + = (25) (25) (50)

SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH		PIN PRICK	
	R	L	R	L
C2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S4-5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

TOTALS: + = (MAXIMUM) (58) (58) (58) (58)

Legend: 0 = absent, 1 = impaired, 2 = normal, NT = not testable

Any anal sensation (Yes/No)

PIN PRICK SCORE (max: 112)

LIGHT TOUCH SCORE (max: 112)

• Key Sensory Points

NEUROLOGICAL LEVEL <small>The most caudal segment with normal function</small>	<table border="0"> <tr><td>SENSORY</td><td>R</td><td>L</td></tr> <tr><td>MOTOR</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> </table>	SENSORY	R	L	MOTOR	<input type="checkbox"/>	<input type="checkbox"/>	COMPLETE OR INCOMPLETE? <input type="checkbox"/> <small>Incomplete = Any sensory or motor function in S4-S5</small>	ZONE OF PARTIAL PRESERVATION <input type="checkbox"/> <small>Caudal extent of partially innervated segments</small>	<table border="0"> <tr><td>SENSORY</td><td>R</td><td>L</td></tr> <tr><td>MOTOR</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> </table>	SENSORY	R	L	MOTOR	<input type="checkbox"/>	<input type="checkbox"/>
SENSORY	R	L														
MOTOR	<input type="checkbox"/>	<input type="checkbox"/>														
SENSORY	R	L														
MOTOR	<input type="checkbox"/>	<input type="checkbox"/>														
ASIA IMPAIRMENT SCALE <input type="checkbox"/>																

ANNEXURE 2

AO classification of thoracolumbar fractures

- Type A:
 - Vertebral body compression- injury patterns of the vertebral body
- Type B:
 - Anterior and posterior element injuries with distraction, characterized by transverse disruption either anteriorly or posteriorly
- Type C:
 - Anterior and posterior injuries with rotation, injury patterns resulting from axial torque

THE NEUROLOGICAL DISORDERS: POLIOMYELITIS AND CEREBRAL PALSY.

Standard treatment guidelines for Poliomyelitis

1. Introduction/Definition/Description

Poliomyelitis is an acute viral infection caused by polioviruses (three antigenic types I, II, and III). The poliovirus is an enterovirus. All three viruses can cause paralysis; however it occurs **most commonly by type I** followed by type III and very rarely by type II.

2. Incidence of the condition

Due to intensive pulse polio immunization along with routine immunization has reduced its incidence to negligible and it almost near eradication in our country. But there are still a reasonable number of patients of residual paresis who need some sort of surgical correction either for proper fitting of orthosis or for the proper use of the extremity.

3. Differential diagnosis

The cases of cerebral palsy, myopathies and the neuropathies like motor neuron disease, Gullain-Barre syndrome etc need to be differentiated from poliomyelitis.

4. Clinical features

Three types of cases occur: **Inapparent** infections (95% cases), **non-paralytic** infections (about 5%) and **paralytic** cases 0.5% cases. The acute attack can cause death in 2-10% of case. The non-paralytic infection is manifested by fever, sore throat, headache, nausea, vomiting, diarrhea and rigidity of the neck and back lasting for 2-10 days. The paralytic attack is manifested by acute flaccid paralysis of the muscles of the limb or the trunk and face followed by maximum recovery within 6 months. Broadly and conventionally these are **acute** attack and the **residual** paresis and paralysis.

5. Management

5.1 Primary Health centre level:

No surgical treatment is expected at this level. Only referral to higher centre. One should recognize the features of flaccid or lower motor neuron level disorder and its residual effects.

5.2 CHC and Civil Hospital level:

The acute poliomyelitis is managed by pediatricians and the orthopedics management include only the splintage of the extremity in the functional and proper resting position till the phase of convalescence.

For **residual motor weakness**: The goal of the treatment at the non metro clinic or small hospital is: Evaluation of the motor weakness by muscle power charting by Medical Research Council (MRC) grading system (Grade 0 to5). X-rays of the affected area as per the requirement.

Following can be done at this level:

Prescription of orthosis/calipers and its fitting;

-corrective cast application; -Simple corrective procedures like-

tenotomy for the tight tendo-achillis; lengthening of tendon etc -arrangement of polio corrective surgery camps (but the team of surgeons from teaching Medical Institute/College should evaluate the cases and supervise the surgeries).

-Additionally at the district level hospital the patients can provided the orthosis and walking aids (like sticks, crutches, walkers etc), and wheel chair/tricycles from the district level charitable agencies (Governmental/Non-governmental).

-They can be issued the disability certificates for their financial benefits for various schemes run by the Government.

Criteria for referral: The cases who need investigations like nerve conduction studies and electromyographies. Those who need tendon transfers, correction of deformity at multiple joints and in different planes. Any case where the non metro level surgeon is in doubt in decision making of the type of surgery should be referred.

5.3 Situation 3

At the metro or the medical college level hospital the goal of management of these cases include: In addition to the situation 1- If required the electromyographic studies, nerve conduction studies.

Then all surgeries for the correction of deformity

-by **tendon transfer (dynamic)**

-the osteotomies/tenodesis,

-tendon lengthening,

tenotomies, capsulotomies and arthrodesis as per the indication and after the careful evaluation of the individual. The goal of the treatment is focused on the independent walking (for lower limb) or the proper use of the upper extremity with/without orthosis.

The lower extremity should be with plantigrade foot with no or minimal residual deformity at various joints and the limb should be suitable for fitting of the orthosis/calipers.

The upper extremity should be made for the independent usage with/without support.

Various common surgical procedures include:

Tendo-achillis lengthening-for equinus correction,

Jone's Teno-suspension- for dropped first metatarsal and sub-luxed

1st metatarsophalangeal joint,

Tibialis posterior tendon transfer- for foot drop,

Dorsal bony wedge resection (Japa's) and Steindler' release for cavus foot deformity correction,

Osteotomy for deformity correction (e.g. supra-condylar osteotomy),

Tendon lengthening/tenotomies and capsulotomies-for contracture release,

Tripple arthrodesis for talipes equino-varus correction in mature feet etc.

All the surgeries should be performed by the experienced surgeon and standard text book on the subject should be available in the operation theatre for the reference.

Resources required for patient and procedure

Situation	Human Resources	Investigations	Drugs and consumables	Equipment
1	Doctor, Nurse and other paramedics	None	None	No surgical intervention except first aid
2	Doctor, Nurse, and technicians	X-rays, Complete Haemogram, Bleeding time, Clotting time, Complete urine examination for pre-anaesthetic check up	Plaster bandage, PVC splints and Braces, Calipers	Theatre set up for Surgeries with all Basic equipments
3	Doctor, Physiotherapist, Nurse, orthotist, Prosthetist, and technicians	As situation 1	As situation 1 and tricycle, wheel chair etc	As situation 1 and major physiotherapy set up for rehabilitation

References:

1. WHO. The initiative for global eradication of poliomyelitis- a guide to clinicians. Geneva: WHO; 1994.
2. GOI, Evaluation of Pulse polio Immunization India 1996-97. New Delhi: MOH and FW; 1997.
3. Warner WC, Jr. Paralytic disorders. In: Campbell's Operative Orthopaedics. Eleventh Eds; 2008. pp.1401-98.
4. Turek SL. Orthopaedics-Principles and Their Application. 4th Eds. In: Orthopaedics Neurology. 1998. Pp.464-595.

STANDARD TREATMENT GUIDELINES FOR *CEREBRAL PALSY*

1. Definition: Cerebral palsy is defined as the **non-progressive motor impairment (motor neurological deficit)** due to the insult to the developing brain; affecting the movements and posture, however, no sensory impairment.

The involvement of the brain most commonly occurs between the time of conception and the age 2 years (the time of major motor development). After 8 years of the age, the development of the immature brain is almost complete; its affection is just like adults. This is very common disorder in the child hood and its incidence is on rise.

2. Types: As per the time of affection of the brain this is categorized as **prenatal, perinatal and post natal**. Most common is prenatal and only less than 10% cases are affected during the delivery time i.e. perinatal.

3. Management

For the management, the complete and proper evaluation of the individual as whole and the affected part is mandatory. Some times in the situation of spasticity it is difficult to judge the muscle power and the treatment can be worsening rather than improving the functions and there can also be recurrence of the deformity. Therefore, whenever in doubt, the peripheral surgeon can refer the patient to the medical institute or to the metro hospital for the treatment after evaluation.

These patients apart from motor power evaluation may require the gait analysis; MRI of the brain and electromyography. The treatment of the some rare types of cerebral palsy is really difficult and very much demanding even at the level of the medical institute or the metro hospital. At the metro hospital the **team approach** involving the paediatrician, the orthopedic surgeon, psychiatrist, physiotherapist and psycho-social workers is required for the better outcome in such patients.

3.1 Situation 1

No surgical intervention is expected at this level. One should refer the patient to the higher centre.

3.2 CHC/Civil Hospital level: At the non-metro hospital only simple surgeries like tendo-achillis tenotomy and adductor tenotomy for equines and the scissoring gait respectively can be tried and that too if the operating surgeon has the confidence and has reasonable experience. Otherwise it is better to refer the patient.

3.3 The goal of the treatment at the non metro clinic or small hospital is: Evaluation of the motor weakness by muscle power charting by Medical Research Council (MRC) grading system (Grade 0 to5).

Following can be done at this level:

Prescription of orthosis/calipers and its fitting;

-corrective cast application;

-Simple corrective procedures like- tenotomy for the tight tendo-achillis; lengthening of tendon and adductor tenotomy etc.

3.4-Arrangement of camps for providing orthosis and walking aids-Additionally at the district level hospital the patients can be provided the walking aids (like sticks, crutches, walkers etc), and wheel chair from the district level charitable agencies (Governmental/Non-governmental). They can be issued the disability certificates for their financial benefits from various schemes run by the Government.

Criteria for referral: The cases that need special investigations like nerve conduction studies, electromyographies and MRI/CT scans. Those who need tendon transfers, correction of deformity at multiple joints and in different planes; and need care of multiple specialists under one roof. Any case where the non metro level surgeon is in doubt in decision making of the type of surgery should be referred.

3.2Situation 2

At the metro or the medical college level hospital the goal of management of these cases include: In addition to the situation 1- If required the **electromyographic studies, nerve conduction studies, MRI and CT scan** of brain as per indication..

The non surgical treatment like botulinum injection can be given to relieve the spasticity.

Then all surgeries for the correction of deformity

-by tendon transfer

-the osteotomies/tenodesis,

-tendon lengthening,

-tenotomies, capsulotomies and arthrodesis as per the indication and after the careful evaluation of the individual. The goal of the treatment is focused on the independent walking (for lower limb) or the proper use of the upper extremity with/without orthosis. The lower extremity should be with plantigrade foot with no or minimal residual deformity at various joints and the limb should be suitable for fitting of the orthosis/calipers and if feasible for independent walking. The upper extremity should be made suitable for fitting of orthosis and for the use in daily day to day routine like self eating, bathing; cleansing after toilet etc.

Various common surgical procedures include:

Tendo-achillis lengthening-for equinus correction,

Adductor tenotomy – to correct scissoring gait

Split tibialis anterior transfer for inversion foot

Tibialis posterior tendon transfer- for foot drop,

Egger's operation/Fractional release of hamstrings (Tendon lengthening/tenotomies and capsulotomies)-for knee contracture release,

Triple arthrodesis for talipes equino-varus correction in mature feet.

Flexor pronator release and transfer of flexor carpi ulnaris to the wrist dorsiflexors for contracture of flexor and pronator muscle group.

Sever's and Fairbank operation and **derotation osteotomy** of humerus- for internal rotation contracture at shoulder etc

All the surgeries should be performed by the experienced surgeon and standard text book on the subject should be available in the operation theatre for the reference.

Resources required for patient and procedure

Situation	Human Resources	Investigations	Drugs and consumables	Equipment
1	Doctor, Nurse, and paramedi	None	None	No surgical intervention except first aid.
2	Doctor, Nurse, and technicians	X-rays, Complete Haemogram, Bleeding time, Clotting time, Complete urine examination for pre-anaesthetic check up	Plaster bandages PVC splints and Braces, Calipers	Theatre set up for Surgeries with all Basic equipments
3	Doctor, Physiotherapist, Nurse, orthotist prosthetist and technicians	As situation 1 and CT scan, MRI facilities	As situation 1 and wheel chair, tri-cycles etc	As situation 1 and major physiotherapy set up for rehabilitation

References:

1. Sawyer JR. Cerebral Palsy. In: Campbell's Operative Orthopaedics. Eleventh Eds. 2008. pp. 1333-99.
2. Turek SL. Orthopaedics-Principles and Their Application. 4th Eds. In: Orthopaedics Neurology. 1998. pp.464-595.

ANKYLOSING SPONDYLITIS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

A form of spondyloarthritis, is a chronic, inflammatory arthritis and autoimmune disease. It mainly affects joints in the spine and the sacroiliac joint in the pelvis, and can cause eventual fusion of the spine.

b. Case Definition:

The typical patient is a young male, aged 20–40, however the condition also presents in females. The condition is known to be hereditary. Symptoms of the disease first appear, on average, at age 23 years. These first symptoms are typically chronic pain and stiffness in the middle part of the spine or sometimes the entire spine, often with pain referred to one or other buttock or the back of thigh from the sacroiliac joint.

II. INCIDENCE OF CONDITION IN OUR COUNTRY

Three men are diagnosed with AS for every one woman; the overall prevalence is 0.25%. Many rheumatologists believe the number of women with AS is underdiagnosed, as most women tend to experience milder symptoms.

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of Ankylosing Spondylitis include

1. Rheumatoid Arthritis
2. Other Spondylo arthropathies

IV. PREVENTION AND COUNSELLING

As no direct cause for the disease has been identified the preventive measures could not be established.

Patient needs to be counselled regarding the chronic nature of the disease and need for regular treatment, possible complications and possible treatment options and chances of improvement.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

*** SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited**

a. Clinical diagnosis:

chronic pain and stiffness in the middle part of the spine or sometimes the entire spine, often with pain referred to one or other buttock or the back of thigh from the sacroiliac joint. Post inactivity stiffness and morning stiffness. In 40% of cases, ankylosing spondylitis is associated with an inflammation of the eye (iritis and uveitis), causing redness, eye pain, vision loss, floaters and photophobia. This is thought to be due to the association these two conditions have with inheritance of HLA-B27. Other common symptoms are generalized fatigue and sometimes nausea.

b. Investigations:

1. X Ray
2. CT Scan
3. MRI
4. Complete Blood Picture
5. ESR
6. CRP
7. Liver function test
8. Renal function test
9. HLA B27

c. In a patient complaining of back pain of more than 12 weeks duration:

1. Morning stiffness of > 30 minutes
2. Improvement in back pain with exercise but not with rest.
3. Awakening because of back pain during the second half of the night only .
4. Alternating buttock pain.
5. Peripheral assymetrical large joint involvement.
6. Plain X Ray showing features of sacroilitis.
7. Absence of RA factor.

Any 2 out of first four criteria strongly indicate presence of Ankylosing Spondylitis even in the absence of xray and lab investigations.

d. Treatment:

Standard Operating Procedure

i. In Patient :

1. Surgery
 - a. Joint Replacement for hip and knee.

ii. Out Patient :

1. NSAIDs: First line therapy to relieve symptoms.
 2. DMARDs such as cyclosporin, methotrexate, sulfasalazine, and corticosteroids, used to reduce the immune system response through immunosuppression;
DMARDs are useful only for peripheral arthritis & not for axial skeleton involvement.
- iii. Physical Therapy – Patients to be encouraged to undertake active and passive range of motion exercises for all joints to maintain and prevent the progression of loss of mobility. Deep breathing exercises (Pranayaam) should be promoted to improve chest function.
- iv. **Day Care**
1. Injectable medications

d. **Referral criteria:**

For further evaluation and management of cases not responding to conventional therapy.

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

a. **Clinical diagnosis:**

As in situation 1

b. **Investigations:**

As in situation 1

c. **Treatment:**

Standard Operating Procedure

i. **In Patient** : as in situation 1. Others include

1. Corrective surgeries for spinal deformity

ii. **Out Patient** : As in situation 1. In addition to that

1. TNF α blockers (antagonists) such as etanercept, infliximab, golimumab and adalimumab (also known as biologics), are indicated for the treatment of and are effective immunosuppressants in AS as in other autoimmune diseases.

iii. **Day Care:** As in situation 1

d. **Referral criteria:**

VI. WHO DOES WHAT? AND TIMELINES

a. **Doctor**

Early diagnosis and appropriate treatment. Counsel the patient for prevention of deformities and dietary advice.

b. **Nurse**

counseling the patient. Injectable treatment

c. **Technician**

Appropriate bracing manufacturing and application of braces
Physiotherapy

VII. FURHTER READING / REFERENCES

1. Garrett S, Jenkinson T, Kennedy L, Whitelock H, Gaisford P, Calin A (1994). "A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index". *J Rheumatol* **21** (12): 2286–91
2. Jiménez-Balderas FJ, Mintz G. (1993). "Ankylosing spondylitis: clinical course in women and men". *J Rheumatol* **20** (12): 2069–72
3. Khan MA. (2002). *Ankylosing spondylitis: The facts*. Oxford University Press
4. Reveille JD (2006). "Major histocompatibility genes and ankylosing spondylitis". *Best Practice & Research Clinical Rheumatology* **20** (3): 601–609

RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	1. X Ray 2. CT Scan 3. MRI 4. Complete Blood Picture 5. ESR 6. CRP 7. Liver function test 8. Renal function test 9. HLA B27	a. DMARDs b. NSAIDs c. Steroid d. Consumables for surgery	Lab equipment Imaging equipment Exercise equipments Equipments for Operating Room
2 (In Addition to Situation 1)			Biologic Agents	Spinal Fixation implants

BONE TUMOURS, TUMOUROUS CONDITIONS & DEVELOPMENTAL DISORDERS MIMICKING BONE TUMOURS

1) *Name of the condition:* Benign Bone Tumours - *Ivory Osteoma*

- I. **When to suspect / recognize :**
Introduction: Benign bone tumour arising from osteoblasts, Bony (ivory) hard in consistency, 1 or 2 cm in size, over a flat bone, usually frontal bone asymptomatic unless the deeper extension is pressing on the brain which is very unusual
- II. **Incidence:** Not worked out in our country, not very common
- III. **Differential Diagnosis:** None
- IV. **A)Prevention:** Nil
- V. **B) Counselling:** to report if symptomatic
- VI. **Situation 1.** Non-metro Hospital
- VII. a) Clinical Diagnosis: Hard painless swelling over frontal bone
 b) Investigation: X-ray
- VIII. c) Treatment : Usually left alone; can be excised for cosmetic reasons
 d) referral criteria: If enlarging in size or symptoms of compression on brain
- Situation 2.** Metro location hospital
- a) Clinical Diagnosis; same as situation1
- b) Investigation: X-ray, CT Scan if necessary
- c) Treatment: Asymptomatic lesions left alone, Excision of symptomatic ones or for cosmetic reasons

Resources Required:

Situation 1. Doctor, X-ray machine

Situation 2: Doctor (Orthopedic Surgeon / Neuro surgeon), X-ray machine, CT Scanner

2) *Name of the condition:* Benign Bone tumour – *Osteoid Osteoma*

- I. **Introduction:** Benign bone tumour, vascular and very painful, about 1 cm in size; elicits sclerotic reaction by the parent bone when the lesion is in the cortical bone; In cancellous bone the lesion is limited by a thin rim of sclerotic bone; in the spine it can cause scoliosis; if the lesion is in the metaphysis which is intraarticular can produce symptoms of arthritis; If the lesion is in the evolving stage it may not be seen routine plain radiography.
- II. **Incidence:** Not uncommon; 10% of benign bone tumours
- III. **Differential Diagnosis:** usually None in cortical bone, occasionally chronic osteomyelitis; In the cancellous bone – Brodie’s abscess, arthritis, unusual form of tuberculosis
- IV. **Prevention:** Nil
- V. **Situation 1:** Non metro hospital:

- a) clinical diagnosis may be difficult
- b) Investigation X-ray
- c) Treatment may be difficult
- d) referral criteria – suspicion, inability to diagnose

Situation 2. Metro hospital a) clinical diagnosis as per description in introduction b) Investigation: X-ray, CT scan, MRI if necessary c) Treatment: Excision in toto (enbloc in cortical bone); curettage in cancellous bone; In inaccessible locations – radiofrequency / laser ablation under CT guidance; curetted/excised material sent for histopathology

Resources required:

Situation 1: Doctor, x-ray machine

Situation 2: Orthopedic surgeon, Interventional Radiologist, X-ray machine, CT Scanner, MRI scanner, Radiofrequency ablator / Laser machine. Histopathologist, Facilities for surgery

3) Name of the condition: Benign Bone tumour – ***Osteoblastoma***

I. Introduction: Benign bone tumour arising from osteoblasts

II. Incidence: Very rare

III. Differential Diagnosis: Other tumorous conditions like Aneurysmal bone cyst, Fibrous dysplasia

IV. Prevention: Nil

V. Situation 1. Non metro Hospital

a) clinical diagnosis – nothing specific

b) Investigation – X-ray

c) Referral criteria: If facilities and know-how are not available for curettage and bone grafting

Situation 2: a) clinical Diagnosis is difficult. Diagnosis is usually radiological – multi loculated lytic expansile lesion with some new bone formation b) Investigations: Plain X-ray and CT scan c) Treatment: curettage and bone grafting; material sent for histopathology

Resources required:

Situation 1: Doctor, X-ray machine

Situation 2: Orthopedic surgeon, operating facilities, Histopathologist

3) Name of the condition: Benign Bone tumour ***Osteochondroma***

I. Introduction: Benign tumour arising from Chondroblasts of the growth plate; it can be of two types – pedunculated or sessile; the lesions grow as long as the skeleton grows and stop when the growth plates fuse

II. Incidence: most common benign tumour from bone; 30 to 50 % of benign bone tumours, 10 to 15 % of all bone tumours

III. **Differential diagnosis:** Chondrosarcoma (secondary), parosteal sarcoma may be mistaken for osteochondroma

IV. **Prevention:** Nil

V. **Situation 1.**

a) clinical diagnosis – hard painless swelling in the metaphysis with negligible growth in recent past

b) Investigations- X-ray

c) Treatment – excision in toto if the lesion is solitary

d) referral criteria – recent fast growth, recent onset of pain, nerve palsy distal to tumour or interference with mobility of neighbouring joint

Situation 2. a) clinical diagnosis – same as above b) Investigations – plain X-ray, CT scan, MRI c) Treatment – differentiation between benign and malignant transformation; if benign excision in toto; if malignant – investigate for lung metastasis followed by wide excision / amputation as the case may be

5) Name of the condition: Benign Bone tumour *Enchondroma*

I. **Introduction:** Benign bone tumour arising from chondroblasts; usually present in the small bones of hands and feet and asymptomatic for long time; patient presents usually with a pathological fracture or sometimes pain.

II. **Incidence:** not uncommon; 25 % of all benign tumours, most common primary tumour in the hand

III. **Differential Diagnosis:** Aneurysmal bone cyst, Tubercular dactylitis, Giant cell tumour, clear cell chondrosarcoma & acrometastases. The latter two are extremely rare.

IV. **Prevention:** Nil

V. **Situation 1.** a) clinical diagnosis: swelling small bones of hands with minimal pain or a pathological fracture b) Investigations: X-ray c) Treatment: may not be possible in non metro scenario d) referral criteria: lytic lesion in small bones where diagnosis & treatment are not possible at non metro level hospital

Situation 2. a) clinical diagnosis: same as above b) Investigations: X-ray of the part, X-ray of chest, Needle Biosy, Mantoux test if necessary, Blood for Quanteferon Gold test, c) Treatment: curettage and auto/allo cancellous bone grafting, if there is a pathological fracture – needs fixation with plate and screws.(small fragment set)

6) Name of the condition: Benign Bone Tumours – *Benign Chondroblastoma*) & *Chondromyxoid Fibroma*

I. **Introduction:** Benign cartilaginous tumours; the former is also called “Codman’s Tumour”. They may show specks of calcification signifying their cartilaginous origin. The latter can be aggressive; ends of bone are commonly involved especially tibia , proximal humerus and proximal femur

II. **Incidence:** rare tumours; less than 1 % of all primary bone tumours

III. **Differential Diagnosis:** Aneurysmal bone cyst, GCT

IV. Prevention: Nil

V. Situation 1. a) clinical diagnosis – pain and vague swelling, restricted movements of the neighbouring joints due to reflex spasm b) Investigation – X-ray c) Treatment –Plaster slab application; further management may not be possible in non-metro scenario d) referral criteria – for precise diagnosis and further management

Situation 2. a)clinical diagnosis – same as above b)Investigation X-ray, MRI, wide bore needle biopsy c)Treatment – curettage and bone grafting (auto or allo)

7) Name of condition: Benign Bone tumour – ***Non-ossifying Fibroma***

I. Introduction: Benign bone tumour arising from fibroblasts. Usually seen in the metaphyseal region of immature skeleton and most of the times it is asymptomatic. It may be an incidental finding in a x-ray taken for some other purpose or bigger lesions may present as pathological fractures. They have a characteristic radiological appearance of serpiginous margins which have pencil lined sclerotic borders.

II. Incidence: not uncommon

III. Differential Diagnosis: none

IV. Prevention: nil

V. Situation 1. a) clinical diagnosis may not be possible b) Investigation – plain x-ray
c) Treatment: asymptomatic, small and incidental lesions are left alone and observed. d) Referral criteria: big lesions and pathological fractures

Situation 2. a) clinical diagnosis may not be possible. Big lesions are curetted prophylactically to prevent pathological fractures and bone grafted. Once they present with a pathological fracture – either they are immobilized in plaster cast till the fracture unites and then curetted and bone grafted or the fracture is openly reduced and internally fixed and at the same time the lesion is curetted and bone grafted.

8) Name of condition: Benign tumourous conditions – ***Simple Bone Cyst, Aneurysmal Bone cyst & Fibrous Dysplasia***

I. Introduction: These lesions mimic tumours and they look alike. Usually occur in adolescents. Lytic lesions with clear cut zones of transition. ABC may show fluid levels in MRI; Fibrous dysplasia has ground glass matrix They may present with pain and swelling or with pathological fracture.

II. Incidence : not very common

III. Differential Diagnosis: GCT, cartilaginous tumours

IV. Prevention: Nil

V. Situation 1. a) clinical – nothing specific except pain]in ful swelling, not large or may present with pathological fracture.

b) Investigation: x-ray

c) referral criteria – Lytic lesion in bone seen on x-ray picture with or without pathological fracture

d) Treatment plaster slab and referral to higher centre

Situation 2. a) clinical: same as above

b) Investigations – X-ray, CT scan / MRI, needle biopsy

c) Treatment – curettage and bone grafting; if the patient has a pathological fracture, either the limb is immobilized in plaster cast till the fracture unites and then curettage and bone grafting carried out or the lesion is curetted and bone bone grafted and at the satime the fracture is internally fixed.

9) Name of condition: Benign Tumourous condition – **Fibromatosis**

I. Introduction: A benign very slow growth of in the subcutaneous tissue or intermuscular connective tissue – does not metastasise but recurrence rate after excision is very high.

II. Incidence: rare

III. Differential Diagnosis: Other malignant soft tissue tumours like synovial sarcoma or fibrosarcoma.

IV. Prevention Nil

V. Situation 1. a) clinical: Firm swelling in the soft tissue of long duration, minimally painful b) Investigations – x-ray- may not reveal any information c) Treatment: cannot be treated in small centres – to be referred to higher centres

Situation 2. a) clinical : same as above b) Investigations: plain x-ray, CT scan, MRI, CT chest, Trucut needle biopsy c) Treatment: wide excision with a little surrounding soft tissue to prevent recurrence

10) Name of condition: Benign developmental disorders mimicking bone tumours: **SMultiple Osteochondromatosis, Muliple enchondromatosis, Ollier's disease**

I. Introduction: Freak outgrowths from the growth plates – multiple osteochondromatosis- which is familial and producing remodeling and growth abnormalities and ten times more potent for malignancy than its solitary counterpart. Freak inclusions of cartilaginous masses from growth plates into the metaphysic producing streaks of lucency is Ollier's disease – usually present in one side of the body and produces marked growth anomalies. Proliferation of cartilage in the medullary substance of small bones of hands and feet producing globular swellings is multiple enchondromatosis. This condition is not familial and is also associated with growth disturbances.

II Incidence: The former is quite common whereas the other two are rare; multiple osteochondromatosis is 10 times less common than solitary osteochondroma.

III. Differential Diagnosis: usually none; One has to be vizilant to look for a malignant transformation in one of the lesions - the more proximal the lesion is to the axial skeleton more are the chances of malignancy.

IV. Prevention: prevent consanguineous marriages

V. Situation 1. a) clinical: multiple hard swellings in the metaphyseal regions of long bones or on the flat bones or multiple globular swellings in the short long bones of hands and feet with growth disturbances. Recent increase in size and onset of pain to be enquired. Mechanical restriction of motion of a neighbouring joint or compression of a nearby nerve are to be looked into b) Investigation – Only plain x-ray is possible d) referral criteria – all cases to be referred to higher centres.

Situation 2. a) clinical – same as above b) Investigation : Plain x-ray, CT scan, MRI, wide bore needle biopsy; Caution: Histology cannot be relied upon in diagnosing malignancy in cartilaginous lesions; One has to rely on clinical findings like pain and fast growth to diagnose malignancy. A cartilaginous cap of more than 1 cm thickness as seen in MRI is suggestive of malignancy. c) Treatment: Lesions with complications should be excised. Lesions very proximal to the axial skeleton should be excised prophylactically

11) Name of condition: Benign Aggressive tumour – **Giant Cell Tumour (Osteoclastoma)**

I, Introduction: .A benign bone tumour arising from undifferentiated connective tissue cells of bone marrow. Occurs in the mature skeleton usually around knee and at wrist. It is an aggressive tumour and the chances of recurrence following curettage are very high. A small percentage might even metastasise to lungs.

II. Incidence: much more common in India, especially South India (4 to 6 times), than the western world.

III. Differential Diagnosis: Aneurysmal bone cyst, Benign Fibrous histiocytoma and aggressive chondromyxoid fibroma., Hyperparathyroidism

IV. Prevention: Nil

V. Situation 1. a) clinical: a globular eccentric swelling in a mature skeleton around the knee bones or lower radius. Other sites are less common. Swelling may start before pain. The patient may present with a pathological fracture. b) Investigation – x-ray. c) Treatment not possible in non metro hospitals. d) referral criteria- all suspected cases must be referred to higher centre.

Situation 2. a) clinical: same as above b) Investigations: Plain x-ray, CT scan, MRI, wide bore needle biopsy c) Treatment: Curettage with high speed burr, curettage with usage of adjuvants like phenol or liquid nitrogen (cryosurgery) have been in usage. However, extended curettage has the least chances of recurrence. Excision in toto is ideal if the bone involved is expendable (like lower ulna, proximal fibula). In instances like lower radius, excision and reconstruction using proximal fibula is practiced. In weight bearing bones like distal femur or proximal tibia, when the the bone is totally destroyed, resection arthrodesis (Enneking procedure) is ideal if the patient belongs lower socioeconomic group. But if the patient belongs to higher strata where the load demands are less, excision and custom mega prosthesis may be practiced. In fungating cases or after repeated recurrences, an amputation may be the last resort.

12) Name of condition: Malignant bone tumour: **Osteosarcoma & its variants**

I. Introduction: occurs in second decade of life.

II. Incidence: most common malignant tumour in the immature skeleton

III. Differential Diagnosis: Early lesions are difficult to diagnose unless one has high index of suspicion. Any pain in the metaphyseal region following a minor injury and disproportionate to the injury or if the pain is slowly increasing day by day after minor injury and especially without fever should lead the clinician to suspect this sinister disease. If it occurs after skeletal maturity, Giant cell tumour also must be thought of.

IV. Prevention: Genetic engineering is under trial to prevent the lesion in children who are genetically prone to suffer.

V. Situation 1. a) clinical: as described earlier in diff. diag. In late cases pain preceding a spindle shaped swelling in the metaphysis of long bone must give suspicion of osteosarcoma. b) Investigations: plain x-ray c) referral criteria: any suspicion that the swelling is malignant.

Situation 2.

a) clinical: same as above
b) Investigations: plain x-ray, x-ray chest, Serum alkaline phosphatase, MRI of lesion, CT Chest, needle biopsy
c) Treatment: In early cases – chemotherapy for 6 weeks followed by limb sparing surgery (excision of tumour in toto and replacement by custom mega prosthesis), after histological examination of the excised tumour for tumour necrosis, the chemotherapy may be suitably altered. Patient followed at frequent intervals for local recurrence and lung metastases. In cases of late presentation where tumour excision is not feasible a course of chemotherapy is followed by amputation of the limb – chemotherapy is continued. Where lung metastases are present amputation of the limb is palliative.

13) Name of condition: Malignant bone tumour – **Chondrosarcoma**

I. Introduction: Chondrosarcoma is a malignant bone tumor arising from chondroblasts. The lesion may arise de novo (primary chondrosarcoma) or there may be malignant transformation of an existing benign cartilaginous lesion - osteochondroma / enchondroma (secondary chondrosarcoma). Thus the lesions may be central or peripheral. The lesions are frequently calcified (c-shaped or o-shaped calcifications)

II. Incidence: not rare; third most common bone malignancy; 25 % of all sarcomas

III. Differential Diagnosis: Non aggressive lesions may be mistaken for benign tumours especially Fibrous Dysplasia.

IV. Prevention: Secondary chondrosarcomata may be prevented by proper treatment of primary cartilaginous lesion.

V. Situation 1. a) clinical: nothing specific. Recent fast growth and onset of pain in a primary cartilaginous lesion should make one suspect secondary Chondrosarcoma

b) Investigations: x-ray., needle biopsy c) referral criteria – inability to treat at the primary centre

Situation 2. a) Clinical: same as above b) Investigations: CT scan of part involved, CT scan Chest, MRI, Isotope bone scan, Needle Biopsy c) Treatment: Chondrosarcomata are resistant to chemo and radiotherapies. Hence excision in toto, short of amputation, is the only alternative. Secondary and peripheral chondrosarcomata may be amenable for excision. Primary or secondary chondrosarcomata of the limb girdle may be difficult to treat surgically but excision and reconstruction may be tried depending on the situation. Custom made prostheses may be tried for chondrosarcomata of proximal humerus and femur if the lesions are intracompartmental. Inoperable tumours need disarticulation.

14) Name of condition: Malignant bone tumour – **Ewing's sarcoma**

I. Introduction: A malignant bone tumour where the cell of origin is uncertain; usually occurring in the diaphyses of children. It can also occur in the metaphyseal regions. When the tumour occurs in adults the ilium is more commonly involved. It is a fast growing tumour with a lot of soft tissue swelling.

II. Incidence – Rare

III. Differential Diagnosis: Osteomyelitis is a major competitor for diagnosis not only clinically but also radiological and histological. Other round cell tumours of bone also should be thought of.

IV. Prevention – Nil

V. Situation 1. a) clinical: Painful, spindle shaped swelling in the diaphysis of of a child without trauma should be viewed with suspicion. Fever points a finger at osteomyelitis but acute diaphyseal osteomyelitis is very uncommon. b) Investigations: x-ray, blood counts and ESR. c) Treatment- not possible in non-metro situation d) referral criteria: suspicion of tumour

Situation 2. a) clinical: same as above b) Investigations: x-ray, CBP & ESR, MRI of the part, CT scan of chest, wide bore needle aspiration – material must be sent for histopathology and culture of pyogenic organisms as well. The dictum “culture a tumour and biopsy an infection” holds good here. c) Treatment: Though earlier on Radiotherapy was best suited for Ewing’s sarcoma, present day sheet anchor is Chemotherapy. After an initial course of chemotherapy, wherever feasible, the tumour is resected and reconstruction done (appropriate surgery). For a recurrence of the tumour radiotherapy is preferred since the recurrence is from cells which are resistant to chemotherapy given earlier. Where resection of the tumour is not possible amputation is performed.

15) Name of condition: Malignant bone tumour *Plasmacytoma/Multiple myeloma*

I. Introduction: It is a malignant tumour of the marrow elements where plasmacytes multiply cancerously in an elderly individual. The condition must be suspected when an elderly individual complains of vague pains all over the body and not responding to usual analgesics

II. Incidence: not rare; 10 % of hematological malignancies., 1 % of all forms of cancer.

III. Differential Diagnosis: The main contender is osteoporosis with compression fractures; Multiple metastases especially from prostate in males and breast in females should be thought of; Osteomalacia in late adulthood and Fibromyalgia syndrome are also to be differentiated.

IV. Prevention: Nil

V. Situation 1. a) clinical: a high index of suspicion in the elderly is very important when the patient complains of generalized body aches of sufficiently long duration not responding to analgesics. Sternal tenderness is an important sign in multiple myeloma.

c) Treatment: Once suspected the patient must be referred to a metro level hospital both for confirmation of diagnosis and management d) referral criteria: Undiagnosed generalized body aches which are not responding to usual analgesics

Situation 2. a) clinical – same as above

b) Investigations: CBP, ESR, S.Calcium, Phosphorus, Alkaline phosphatase, Bone marrow examination (sternal puncture), serum protein electrophoresis

c) Treatment: Chemotherapy and cortisones

16) Name of condition: Malignant bone tumour – **Metastatic Bone Tumours**

I. Introduction: Tumours metastatic to bone are usually from Prostate, Female genital organs, Breast, Lungs, Kidney, Thyroid and GIT. Patients usually complain of either localized or generalized pains. Patient may also present with a pathological fracture with no other symptoms. It is important to note that symptoms due to the primary disease are often lacking and only the secondary deposits cause symptoms. It is also interesting to note that quite often one fails to locate the primary lesion in spite of investigations

II. Incidence: Not uncommon

III. Differential Diagnosis: Multiple myeloma, osteoporosis, hyperparathyroidism etc

IV. Prevention. Nil

V. Situation 1. After suspecting a metastatic deposit, after x-ray examination patient has to be referred to a metro level hospital.

Situation 2. a) clinical: Localised or generalized pains in an elderly individual not responding to analgesics must be investigated. They have a pathology unless proved otherwise. A detailed clinical examination of the systems from which a primary is likely to occur should be carried out b) Investigations: CBP, ESR, x-ray chest, CT chest, Serum Ca, P, ALP, PTH, Serum protein electrophoresis, wide bore needle aspiration biopsy of the lytic lesion detected on x-ray. Other blood investigations to detect cancers of the respective organs (like PSA , Ca 128 etc.) are to be carried out c) Treatment: of the primary depends on the cause. For a pathological fracture (or an impending fracture), curettage of the lesion, filling with bone cement and internal fixation preferably with an intramedullary nail is palliative and gives comfort for the rest of the life.

STANDARD TREATMENT GUIDELINES FOR CONGENITAL ORTHOPEDIC ANOMALIES

Of the many congenital anomalies of Orthopedic interest, only two conditions which are common are discussed here – they are **CTEV (Congenital Talipes Equino Varus)** and **(Congenital Dislocation of Hip)**. Others are to be treated in specialized centres.

1) Name of Condition: CTEV (Congenital Talipes Equino Varus)

I. Introduction: The most common congenital anomaly seen in Orthopedics also referred to as **CLUB FOOT**. The deformity can be unilateral or bilateral. The common question that needs to be answered by the primary clinician is whether the foot is normal at birth – when dorsiflexed the dorsum of the neonatal foot touches the shin of tibia. If it does not , there is mild equinovarus deformity. In CTEV, the foot has four components of the deformity – plantar flexion at ankle, inversion of foot at subtalar joint, varus of the forefoot at the midtarsal joints and internal torsion of tibia.

II. Incidence: most common congenital anomaly in orthopedics

III. Differential Diagnosis: Other conditions which produce the talipes equino varus deformity should be thought of – meningomyelocele (or spina bifida occulta in adolescents as revealed by external tell tale scars like fibrofatty nodule in the lumbar

spine, tuft of hair or pigmented skin patch), Cerebral palsy of lower limbs, Arthrogryposis congenita, nerve injuries to lateral popliteal nerve, anterior poliomyelitis.

IV. Prevention: Avoiding consanguineous marriages might prevent, at least partly, the incidence of congenital anomalies

V. Situation 1. Non metro hospitals.

a) clinical – minimal deformity in neonates can be diagnosed as explained in Introduction. Deformities of bigger magnitude are obvious. Clinician has to examine to find out a cause for the deformity as explained in differential diagnosis. Depending on how much deformity is passively correctible, it can be classified as mild, moderate and severe. The child must be examined for the presence of other congenital anomalies – orthopedic and non-orthopedic

b) Investigations: x-ray in an older child.

c) Treatment: the clinician has to familiarize himself with the technique of manipulation and serial plaster casting. Otherwise the patient has to be referred to metro hospitals.

d) Referral criteria – if the clinician does not know the technique of manipulation and plaster cast application; if there is no progress in correction of deformity after 6 to 8 manipulations ; if the child presented for the first time at the age of one year or the complication of rocker bottom foot has developed.

Situation 2: metro hospital:

a) clinical: same as above

b) in a bigger child- x-ray of the part and x-ray of spine, x-ray pelvis to rule out DDH if suspected clinically

c) Treatment: manipulation of foot, preferably by Ponseti technique, even if the child is more than one year age to make the foot supple before surgery. Serial plaster casts applied. If the improvement is not satisfactory by 8 months of age surgery in the form of posteromedial release is suggested followed by serial plaster casts. Once correction is achieved and the child is not yet walking a Denis-Browne splint is prescribed. Corrective shoes are to be given after the child starts walking. If the heel varus is persisting even at 6 yrs age, Dwyer's calcaneal osteotomy is advised. For persisting round contour of the lateral border of the foot one of the lateral column shortening operations is performed. A supramalleolar osteotomy of tibia is indicated for persisting excessive tibial torsion. If the surgeon is conversant JESS application is a viable alternative. In neglected cases beyond 12 yrs of age a triple arthrodesis may be performed.

2) Name of condition: Developmental Dysplasia of Hip

I. Introduction: In teratological conditions, the hip is found dislocated at birth. In other conditions of DDH, the hip is lax and waiting to dislocate if some forces act on it – the dislocatable hip or the hip is found dislocated and can easily be reduced – reducible hip. If the child comes late with a dislocated hip, it cannot be reduced by closed manipulation and needs surgery

II. Incidence: The exact incidence in India is not worked out though the condition is not very rare.

III. Differential Diagnosis: Proximal Femoral Focal Deficiency (PFFD), Congenital short femur, sequelae of septic arthritis of hip

IV. Prevention: prevention of consanguinous marriages might reduce incidence.

V. Situation 1. non-metro hospital

a) Clinical: Barlow's and Ortolani's signs to diagnose dislocatable or reducible hips. Dislocated hip has a short limb, increased creases on the inner aspect of thighs, femoral head present anteriorly, abduction of hip is restricted and telescoping positive.

b) Investigations: X-ray of pelvis – normal view and von Rosen's view

c) whether the hip is dislocatable or dislocated, closed manipulation performed to reduce the hip and a POP spica applied in human position.

d) if the diagnosis is doubtful or hip cannot be reduced by closed manipulation the patient must be referred to higher centre.

Situation 2. metro hospitals:

a) clinical –same

b) investigations: plain x-ray of pelvis for both hips; Ultrasound examination of hip if the child is 6 months or less of age. In failed closed reductions an arthrogram of the hip may be performed. CT & MRI are very rarely indicated.

c) Treatment: in an infant closed manipulation of hip and plaster spica in human position. In a slightly older infant, a preliminary traction might help closed reduction. In an older infant, open reduction may be required followed by plaster spica. If the acetabular coverage is not enough, Salter's innominate osteotomy is indicated. If the acetabulum is roomy, Pemberton osteotomy may be performed. In a slightly older child, in addition femoral shortening derotational osteotomy may be beneficial. A shelf operation to augment acetabular coverage may be required.

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GOUTY ARTHRITIS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Gout characterized by recurrent attacks of acute inflammatory arthritis—a red, tender, hot, swollen joint. The metatarsal-phalangeal joint at the base of the big toe is the most commonly affected (approximately 50% of cases). However, it may also present as tophi, kidney stones, or urate nephropathy. It is caused by elevated levels of uric acid in the blood which crystallize and are deposited in joints, tendons, and surrounding tissues.

b. Case Definition:

Affluent males are the usual victims. It very rarely affects premenopausal women & such a patient should be viewed with suspicion if a diagnosis of gout is made.

Gout can present in a number of ways, although the most usual is a recurrent attack of acute inflammatory arthritis. The metatarsal-phalangeal joint at the base of the big toe is affected most often, accounting for half of cases. Other joints, such as the heels, knees, wrists and fingers, may also be affected. Joint pain usually begins over 2–4 hours and during the night. Other symptoms that may occur along with the joint pain include fatigue and a high fever.

Long-standing elevated uric acid levels (hyperuricemia) may result in other symptomatology, including hard, painless deposits of uric acid crystals known as tophi. Extensive tophi may lead to chronic arthritis due to bone erosion. Elevated levels of uric acid may also lead to crystals precipitating in the kidneys, resulting in stone formation and subsequent urate nephropathy.

II. INCIDENCE OF CONDITION IN OUR COUNTRY

Gout affects around 1–2% of the Western population at some point in their lifetimes, and is becoming more common. A number of factors have been found to influence rates of gout, including age, race, and the season

of the year. In men over the age of 30 and women over the age of 50, prevalence is 2%

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of Gout include

3. Septic Arthritis
4. Pseudo Gout
5. Rheumatoid Arthritis

IV. PREVENTION AND COUNSELLING

Both Dietary and lifestyle changes can decrease uric acid levels.

- i. reducing intake of food such as meat and seafood,
- ii. consuming adequate vitamin C,
- iii. limiting alcohol and fructose consumption
- iv. avoiding obesity.
- v. Coffee, but not tea, consumption is associated with a lower risk of gout.

OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

* SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited

a. Clinical diagnosis:

Usual presentation is acute inflammatory arthritis—a red, tender, hot, swollen joint. The metatarsal-phalangeal joint at the base of the big toe is the most commonly affected (approximately 50% of cases). However, it may also present as tophi, kidney stones, or urate nephropathy. It is caused by elevated levels of uric acid in the blood which crystallize and are deposited in joints, tendons, and surrounding tissues.

Investigations:

1. X Ray
2. Serum Uric Acid Level (Suggestive; to be confirmed by 3 below)
3. MSU crystals in Synovial fluid and tophi (Essential for diagnosis)

4. Complete Blood Picture
5. ESR
6. CRP
7. Renal function test

a. **Treatment:**

Standard Operating Procedure

ii. **In Patient :**

1. Surgery
 - a. Excision of symptomatic tophi

vi. **Out Patient :**

3. Acute Attack
 - a. NSIADS
 - b. Colchicine
 - c. Steroids
4. Chronic (No role in acute attack)
 - a. Allopurinol
 - b. Febuxostat
 - c. Probenacid
5. Physical Therapy

vii. **Day Care**

1. Injectable medications
2. Intra articular Steroid Injection

e. **Referral criteria:**

For further evaluation and management of cases not responding to conventional therapy.

* **SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

e. **Clinical diagnosis:**

As in situation 1

f. **Investigations:**

As in situation 1

g. **Treatment:**

Standard Operating Procedure

iv. **In Patient** : as in situation 1.

v. **Out Patient** : As in situation 1.

vi. **Day Care:** As in situation 1

h. **Referral criteria:**

VIII. WHO DOES WHAT? AND TIMELINES

a. **Doctor**

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

b. **Nurse**

counseling the patient. Injectable treatment

c. **Technician**

Appropriate bracing

Physiotherapy

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	1. X Ray 2. MSU crystals in Synovial fluid and tophi 3. Serum Uric Acid Level 4. Complete Blood Picture 5. ESR 6. CRP 7. Renal function test	e. NSAIDs f. Colchicine g. Steroid h. Uric acid lowering agents i. Consumables for surgery	Lab equipment Imaging equipment Exercise equipments Equipments for Operating Room
2 (In Addition to Situation 1)				

OSTEOARTHRITIS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Osteoarthritis (OA) also known as degenerative arthritis or degenerative joint disease is a group of mechanical abnormalities involving degradation of joints, including articular cartilage and subchondral bone. A variety of causes—hereditary, developmental, metabolic, and mechanical—may initiate processes leading to loss of cartilage. When bone surfaces become less well protected by cartilage, bone may be exposed and damaged. As a result of decreased movement secondary to pain, regional muscles may atrophy, and ligaments may become more lax.

b. Case Definition:

Osteoarthritis can be classified into either primary or secondary depending on whether or not there is an identifiable underlying cause.

Primary osteoarthritis is a chronic degenerative disorder related to aging. A number of studies have shown that there is a greater prevalence of the disease among siblings and especially identical twins, indicating a hereditary basis. Up to 60% of OA cases are thought to result from genetic factors

Secondary Osteoarthritis is caused by other factors such as

- Congenital disorders of joints
- Diabetes.
- Inflammatory diseases (such as Perthes' disease), (Lyme disease), and all chronic forms of arthritis (e.g. costochondritis, gout, and rheumatoid arthritis). In gout, uric acid crystals cause the cartilage to degenerate at a faster pace.
- Injury to joints, as a result of an accident
- Septic arthritis
- Ligamentous deterioration or instability may be a factor.
- Developmental disorder resulting into mal-alignment of extremities.

II. INCIDENCE OF CONDITION IN OUR COUNTRY

Osteoarthritis affects nearly 27 million people in the United States, accounting for 25% of visits to primary care physicians, and half of all NSAID prescriptions. It is estimated that 80% of the population have radiographic evidence of OA by age 65, although only 60% of those will have symptoms.

III. PREVENTION AND COUNSELLING

Life style modification , weight control, regular exercise

Patient needs to be counselled regarding the nature of the disease and need for treatment, possible treatment options and chances of improvement.

IV. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

* SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited

a. Clinical diagnosis:

The main symptom is pain, causing loss of ability and often stiffness. "Pain" is generally described as a sharp ache, or a burning sensation in the associated muscles and tendons. OA can cause a crackling noise (called "crepitus") when the affected joint is moved. It commonly affects the hands, feet, spine, and the large weight bearing joints, such as the hips and knees, although in theory, any joint in the body can be affected. As OA progresses, the affected joints appear larger, are stiff and painful, and usually feel better with gentle use but worse with excessive or prolonged use. In smaller joints, such as at the fingers, hard bony enlargements, called Heberden's nodes (on the distal interphalangeal joints) and/or Bouchard's nodes (on the proximal interphalangeal joints), may form, and though they are not necessarily painful, they do limit the movement of the fingers significantly. OA at the toes leads to the formation of bunions, rendering them red or swollen.

b. Investigations:

1. X Ray - Particularly standing xrays for knees in which eccentric joint space reduction is the diagnostic criterion as compared to inflammatory where there is concentric space reduction.

c. **Treatment:**

Standard Operating Procedure

iii. **In Patient :**

1. Surgery
 - a. Arthroscopy joint debridement
 - b. Joint Replacement

ii. **Out Patient :**

6. Life style modification
7. Physical therapy
8. Analgesics
 - a. Oral
 - b. Topical
9. Steroids
 - a. Systemic
 - b. Intra articular
10. Glucosamine (controversial)

iii **Day Care**

1. Injectable medications
2. Intra articular Steroid injection
3. Intra articular hyaluronic acid injection

f. **Referral criteria:**

For further evaluation and management of cases not responding to conventional therapy.

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

i. **Clinical diagnosis:**

As in situation 1

j. **Investigations:**

As in situation 1 .

k. Treatment:

Standard Operating Procedure

vii. In Patient : as in situation 1.

viii. Out Patient : As in situation 1.

ix. Day Care: As in situation 1

l. Referral criteria:

X. WHO DOES WHAT? AND TIMELINES

a. Doctor

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

b. Nurse

counseling the patient. Injectable treatment

c. Technician

Appropriate bracing manufacturing and application of braces
Physiotherapy

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	1. X Ray 2. Complete Blood Picture 3. ESR	j. NSAIDs k. Steroid l. Consumables for surgery	Lab equipment Imaging equipment Exercise equipments Equipments for Operating Room
2 (In Addition to Situation 1)				

OSTEOMALACIA

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Osteomalacia is a generalized bone condition in which there is inadequate mineralization of the bone. Many of the effects of the disease overlap with the more common osteoporosis, but the two diseases are significantly different. There are two main causes of osteomalacia: (1) insufficient calcium absorption from the intestine because of lack of dietary calcium or a deficiency of or resistance to the action of vitamin D; and (2) Phosphate deficiency caused by increased renal losses

b. Case Definition:

Osteomalacia is the softening of the bones due to defective bone mineralization secondary to inadequate amounts of available phosphorus and calcium. It may show signs as diffuse body pains, muscle weakness, and fragility of the bones. The most common cause of the disease is a deficiency in vitamin D, which is normally obtained from the diet and/or sunlight exposure

II. INCIDENCE OF CONDITION IN OUR COUNTRY

In the US and Europe, more than 40% of the adult population older than age 50 are vitamin D deficient, this being the most prominent cause of osteomalacia. <http://bestpractice.bmj.com/best-practice/monograph/517/resources/references.html> - ref-4 In developing countries vitamin D deficiency leading to clinical rickets is described in 60% of infants. In the Middle East, a high prevalence of rickets and osteomalacia has been described in Muslim women and their infants, perhaps due to increased clothing coverage of the skin.

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of osteomalacia include

- Osteoporosis
- Pagets disease

IV. PREVENTION AND COUNSELLING

Ensuring adequate sunlight exposure and dietary intake of fortified foods containing vitamin D, calcium, and phosphorus may help avoid osteomalacia

It is recommended that maintenance dosing in adults <50 years age should be 400-800 International Units (IU) of vitamin D daily, and that adults ≥50 years age should get 800-1000 IU of vitamin D daily. Adults should also take 1.2 g of elemental calcium in the diet or as a supplement.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

*** SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited**

a. Clinical diagnosis:

Osteomalacia in adults starts insidiously as aches and pains in the lumbar (lower back) region and thighs, spreading later to the arms and ribs. The pain is symmetrical, non-radiating and is accompanied by sensitivity in the involved bones. Proximal muscles are weak, and there is difficulty in climbing up stairs and getting up from a squatting position.

Physical signs include deformities like triradiate pelvis and lordosis. The patient has a typical "waddling" gait. However, those physical signs may derive from a previous osteomalacial state, since bones do not regain their original shape after they become deformed. May present as pathological fracture.

b. Investigations:

Serum Calcium
Serum Phosphate
Alkaline Phosphatase
Serum urea creatinine
24 Hr urinary calcium
X rays of the deformed part

c. Treatment:

Nutritional osteomalacia responds well to administration of 10,000 IU weekly of vitamin D for four to six weeks. Osteomalacia due to malabsorption may require treatment by injection or daily oral dosing of significant amounts of vitamin D

Standard Operating Procedure

- i. **In Patient** : For corrective surgery
- ii. **Out Patient** : supplementation and bracing
- iii. **Day Care**: Injectable form of Vit D

d. **Referral criteria:**

For evaluation and management of cases not responding to conventional therapy.

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

m. **Clinical diagnosis:**

As in situation 1

n. **Investigations:**

As in situation 1 . Others are
1,25 – dihydroxy- Vit D level
Parathormone level
DXA
Bone Biopsy with double tetracycline labelling
Technitium Bone scan

o. **Treatment:**

Standard Operating Procedure

- i. **In Patient** : as in situation 1

UV-B radiation

Tanning beds and other UV-B radiation devices have been used to treat vitamin D deficiency in the elderly and in malabsorptive disorders.

ii. **Out Patient** : As in situation 1

iii. **Day Care**: As in situation 1

p. **Referral criteria**:

VI. WHO DOES WHAT? AND TIMELINES

a. Doctor

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

b. Nurse

Counselling the patient

c. Technician

Appropriate bracing manufacturing and application
Physiotherapy

VII. FURHTER READING / REFERENCES

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	Serum calcium Serum phosphorus Alkaline phosphatase Serum urea creatinine 24 Hr urinary calcium X Ray	Calcium supplement Phosphorus supplement Vit D supplement Inj Vit D Braces Consumables for surgery	Lab equipment X Ray equipment Equipments for Operating Room
2 (In Addition to Situation 1)		25 hydroxy – Vit D level 1,25 – dihydroxy-Vit D level Parathormone level DXA Bone Biopsy with double tetracycline labelling Technitium Bone scan	UV B Radiation	DXA Bone Scan Histopathology with tissue labelling

OSTEOPOROSIS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Osteoporosis is a disease of bones that leads to an increased risk of fracture. In osteoporosis the bone mineral density (BMD) is reduced, bone microarchitecture is deteriorating, and the amount and variety of proteins in bone is altered.

b. Case Definition:

Osteoporosis is defined by the World Health Organization (WHO) as a bone mineral density that is 2.5 standard deviations or more below the mean peak bone mass (average of young, healthy adults) as measured by DXA; the term "established osteoporosis" includes the presence of a fragility fracture. The disease may be classified as primary type 1, primary type 2, or secondary. The form of osteoporosis most common in women after menopause is referred to as primary type 1 or **postmenopausal osteoporosis**. Primary type 2 osteoporosis or **senile osteoporosis** occurs after age 75 and is seen in both females and males at a ratio of 2:1. Finally, secondary osteoporosis may arise at any age and affects men and women equally. This form of osteoporosis results from chronic predisposing medical problems or disease

II. INCIDENCE OF CONDITION IN OUR COUNTRY

The exact incidence of osteoporosis in India is not known. However, according to one study, approximately 6-7 crores of Indian population is suffering from osteopenia / osteoporosis

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of Osteoporosis include

6. Multiple myeloma
7. Osteomalacia
8. Chronic kidney disease
9. Primary hyperparathyroidism
10. Metastatic bone malignancy
11. Vertebral deformities

IV. PREVENTION AND COUNSELLING

a. Risk factors for Osteoporosis includes following

- i. Prior fragility fracture
- ii. Female gender
- iii. White ancestry
- iv. Old age
- v. Low BMI
- vi. Loss of height
- vii. Sec amenorrhoea
- viii. Primary hypogonadism
- ix. Smoking
- x. Excessive alcohol use
- xi. Prolonged immobilization
- xii. Low calcium intake
- xiii. Vit D deficiency
- xiv. Glucocorticoid excess
- xv. Corticosteroid use
- xvi. Hyperthyroidism
- xvii. Heparin use
- xviii. Anticonvulsant use
- xix. Weight loss

b. Prevention

Change in life style, diet, exercise. Amongst the various risk factors for osteoporosis modifiable risk factors can be modified to prevent development of osteoporosis. Medications to prevent development of osteoporosis.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

*** SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited**

a. Clinical diagnosis:

Osteoporosis itself doesn't have any symptom.

Symptoms develop once the fragility fracture occurs. Symptoms develop according to the site of fracture. Pain may or may not be there due to osteoporotic fracture. Vertebral compression fracture at times may present with neural symptoms.

b. Investigations:

1. Plain X-ray of spine
2. Dual energy X ray absorptiometry (DXA) BMD
3. Renal function test
4. Calcium
5. Albumin
6. Phosphorus
7. Urinary calcium level

c. Treatment:

Standard Operating Procedure

iv. In Patient :

1. Surgery
 - a. Vertebroplasty
 - b. Open surgical spinal stabilization

ii. Out Patient : supplementation and bracing

11. Pain control
 - a. Bed rest
 - b. Analgesics
 - c. Brace
12. Antiresorptive agents
 - a. Bisphosphonates
 - b. Estrogen analogs
 - c. Raloxifen
 - d. Calcitonin
13. Bone anabolic agent
 - e. Teriparatide
 - f. Calcium salts
 - g. Sodium fluoride
14. Nutrition
 - h. Calcium
 - i. Vitamin D
 - j. Vitamin K
15. Exercise
 - k. Aerobics
 - l. Weight bearing
 - m. Resistance exercise
16. Orthosis
 - n. Spinal orthoses
17. Long term Osteoporosis prophylaxis

iv. Day Care: Injectable medication

g. Referral criteria:

For further evaluation and management of cases not responding to conventional therapy.

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

q. Clinical diagnosis:

As in situation 1

r. Investigations:

As in situation 1 . Others are

1. QCT (quantitative computer tomography)
2. Quantitative Ultrasound
3. Biochemical markers of bone resorption (increased urinary excretion of C- telopeptides)
4. Vit D level
5. Testosterone level
6. Urinary free cortisol
7. Serum protein electrophoresis

s. Treatment:

Standard Operating Procedure

i. In Patient : as in situation 1. In addition to that

1. Surgery
 - a. Vertebroplasty
 - b. Kyphoplasty

ii. Out Patient : As in situation 1. In addition to that

1. Other agents
 - a. RANKL inhibitors
 - b. Strontium ranelate

iii. Day Care: As in situation 1

t. Referral criteria:

XII. WHO DOES WHAT? AND TIMELINES

a. Doctor

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

b. Nurse

counseling the patient

c. Technician

Appropriate bracing manufacturing and application of braces
Physiotherapy

XIII. FURHTER READING / REFERENCES

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	4. Dual energy X ray absorptiometry (DXA) BMD 5. Renal function test 6. Calcium 7. Albumin 8. Phosphorus 9. Urinary calcium level	m. Bisphosphonates n. Estrogen analogs o. Raloxifen p. Calcitonin q. Teriparatide r. Calcium salts s. Sodium fluoride t. Calcium u. Vitamin D v. Vitamin K w. Spinal braces x. Consumables for surgery	Lab equipment Imaging equipment Exercise equipments Equipments for Operating Room
2 (In Addition to Situation 1)		1. QCT (quantitative computer tomography) 2. Quantitative Ultrasound 3. Biochemical markers of bone resorption (increased urinary excretion of C-telopeptides) 4. Vit D level 5. Testosterone level 6. Urinary free cortisol 7. Serum protein electrophoresis	RANKL inhibitors Strontium ranelate	Equipments for vertebroplasty and kyphoplasty

RHEUMATOID ARTHRITIS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disorder that may affect many tissues and organs, but principally attacks synovial joints. The process produces an inflammatory response of the synovium (synovitis) secondary to hyperplasia of synovial cells, excess synovial fluid, and the development of pannus in the synovium. The pathology of the disease process often leads to the destruction of articular cartilage and ankylosis of the joints. Rheumatoid arthritis can also produce diffuse inflammation in the lungs, pericardium, pleura, and sclera, and also nodular lesions, most common in subcutaneous tissue. Although the cause of rheumatoid arthritis is unknown, autoimmunity plays a pivotal role in both its chronicity and progression, and RA is considered a systemic autoimmune disease.

b. Case Definition:

Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disorder that may affect many tissues and organs, but principally attacks synovial joints. It can be a disabling and painful condition, which can lead to substantial loss of function and mobility if not adequately treated. It is a clinical diagnosis made on the basis of symptoms, physical exam, radiographs (X-rays) and labs, although the American College of Rheumatology (ACR) and the European League Against Rheumatism (EULAR) publish diagnostic guidelines

These new classification criteria overruled the "old" ACR criteria of 1987 and are adapted for early RA diagnosis. The "new" classification criteria establish a point value between 0 and 10. Every patient with a point total of 6 or higher is unequivocally classified as an RA patient, provided he has synovitis in at least one joint and given that there is no other diagnosis better explaining the synovitis. Four areas are covered in the diagnosis:

1. joint involvement, designating the metacarpophalangeal joints, proximal interphalangeal joints, the interphalangeal joint of the thumb, second through third metatarsophalangeal joint and wrist as *small joints*, and elbows, hip joints and knees as *large joints*:
 - a. Involvement of 1 large joint gives 0 points
 - b. Involvement of 2-10 large joints gives 1 point

- c. Involvement of 1-3 small joints (with or without involvement of large joints) gives 2 points
 - d. Involvement of 4-10 small joints (with or without involvement of large joints) gives 3 points
 - e. Involvement of more than 10 joints (with involvement of at least 1 small joint) gives 5 points
2. serological parameters – including the rheumatoid factor as well as ACPA – "ACPA" stands for "anti-citrullinated protein antibody":
 - a. Negative RF *and* negative ACPA gives 0 points
 - b. Low-positive RF *or* low-positive ACPA gives 2 points
 - c. High-positive RF *or* high-positive ACPA gives 3 points
 3. acute phase reactants: 1 point for elevated erythrocyte sedimentation rate, ESR, or elevated CRP value (c-reactive protein)
 4. duration of arthritis: 1 point for symptoms lasting six weeks or longer

II. INCIDENCE OF CONDITION IN OUR COUNTRY

About 1% of the world's population is afflicted by rheumatoid arthritis, women three times more often than men. Onset is most frequent between the ages of 40 and 50, but people of any age can be affected. The incidence of RA is in the region of 3 cases per 10,000 population per annum. It is up to three times more common in smokers than non-smokers, particularly in men, heavy smokers, and those who are rheumatoid factor positive. First-degree relatives prevalence rate is 2–3% and disease genetic concordance in monozygotic twins is approximately 15–20%.

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of Rheumatoid Arthritis include

12. Crystal induced arthritis
13. Osteoarthritis
14. SLE
15. Psoriatic Arthritis
16. Lyme Disease
17. Reactive Arthritis

IV. PREVENTION AND COUNSELLING

As no direct cause for the disease has been identified the preventive measures could not be established.

Patient needs to be counselled regarding the chronic nature of the disease and need for regular treatment, possible complications and possible treatment options and chances of improvement.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

*** SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited**

a. Clinical diagnosis:

Rheumatoid arthritis typically manifests with signs of inflammation, with the affected joints being swollen, warm, painful and stiff, particularly early in the morning on waking or following prolonged inactivity. Increased stiffness early in the morning is often a prominent feature of the disease and typically lasts for more than an hour.

For diagnosis and management of other body system involvement by RA Physician needs to be consulted.

Clinical diagnosis can be made as per the guidelines given by ACR & EULAR.

b. Investigations:

1. X Ray
2. Complete Blood Picture
3. ESR
4. CRP
5. Liver function test
6. Renal function test
7. Rheumatoid Factor (RA)
8. Anti-citrullinated protein antibodies (ACPAs) or anti-CCP

c. Treatment:

Standard Operating Procedure

v. In Patient :

1. Surgery
 - a. Arthroscopy Synovectomy in early stage
 - b. Joint Replacement in late stages

ii. Out Patient : supplementation and bracing

18. Disease modifying anti-rheumatic drugs (DMARDs)

- a. First Line DMARDs:

- i. Methotrexate
- ii. Hydroxychloroquine
- iii. Sulfasalazine
- iv. Leflunomide

b. Second Line

- i. Azathioprine
- ii. cyclosporin (cyclosporine A)
- iii. D-penicillamine
- iv. gold salts (Oral & Parenteral)
- v. minocycline

19. Anti-inflammatory agents and analgesics

a. Anti-inflammatory agents include:

- i. glucocorticoids
- ii. Non-steroidal anti-inflammatory drug (NSAIDs, most also act as analgesics)

b. Analgesics include:

- i. Paracetamol
- ii. Opiates
- iii. Diproqualone
- iv. Lidocaine topical

20. Bed rest during acute flare ups

21. Physiotherapy

iii

Day Care

1. Injectable medications
2. Intra articular Steroid injection

h. Referral criteria:

For further evaluation and management of cases not responding to conventional therapy.

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

u. Clinical diagnosis:

As in situation 1

v. Investigations:

As in situation 1 . Others are

1. Anti-MCV assay (antibodies against mutated citrullinated Vimentin).
2. point-of-care test (POCT) for the early detection of RA has been developed. This assay combines the detection of rheumatoid factor and anti-MCV for diagnosis of rheumatoid arthritis and shows a sensitivity of 72% and specificity of 99.7%

w. Treatment:

Standard Operating Procedure

iv. In Patient : as in situation 1.

v. Out Patient : As in situation 1. In addition to that

1. Biological agents (biologics) include:

- a. tumor necrosis factor alpha (TNF α) blockers – etanercept (Enbrel), infliximab (Remicade), adalimumab (Humira), certolizumab pegol (Cimzia), golimumab (Simponi)
- b. Interleukin 1 (IL-1) blockers – anakinra (Kineret)
- c. monoclonal antibodies against B cells – rituximab (Rituxan)
- d. T cell costimulation blocker – abatacept (Orencia)
- e. Interleukin 6 (IL-6) blockers – tocilizumab (an anti-IL-6 receptor antibody) (RoActemra, Actemra)

vi. Day Care: As in situation 1

- a. **Referral criteria:** Window of opportunity DMARDs exists within 4 to 6 months of the onset of disease. Early diagnosis & institution of right therapy is thus crucial.

VI. WHO DOES WHAT? AND TIMELINES

b. Doctor

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

c. Nurse

counseling the patient. Injectable treatment

d. Technician

Appropriate bracing manufacturing and application of braces
Physiotherapy

VII. FURHTER READING / REFERENCES

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	10. X Ray 11. Complete Blood Picture 12. ESR 13. CRP 14. Liver function test 15. Renal function test 16. Rheumatoid Factor (RA) 17. Anti-citrullinated protein antibodies (ACPAs) or anti-CCP.	y. DMARDs z. NSAIDs aa. Steroid bb. Consumables for surgery	Lab equipment Imaging equipment Exercise equipments Equipments for Operating Room
2 (In Addition to Situation 1)		1. <u>Anti-MCV</u> assay 2. <u>point-of-care test</u> (POCT)	Biologic Agents	

RICKETS

I. WHEN TO SUSPECT / RECOGNIZE?

a. Introduction:

Rickets is a softening of bones in children due to deficiency or impaired metabolism of vitamin D, phosphorus or calcium, <http://en.wikipedia.org/wiki/Rickets> - cite note-0 potentially leading to fractures and deformity. Rickets is among the most frequent childhood diseases in many developing countries. The predominant cause is a vitamin D deficiency, but lack of adequate calcium in the diet may also lead to rickets (cases of severe diarrhea and vomiting may be the cause of the deficiency). Although it can occur in adults, the majority of cases occur in children suffering from severe malnutrition

b. Case Definition:

The primary cause of rickets is a vitamin D deficiency. Vitamin D is required for proper calcium absorption from the gut. Sunlight, especially ultraviolet light, lets human skin cells convert Vitamin D from an inactive to active state. In the absence of vitamin D, dietary calcium is not properly absorbed, resulting in hypocalcaemia, leading to skeletal and dental deformities and neuromuscular symptoms

Types:

- Nutritional Rickets
- Vitamin D Resistant Rickets
- Vitamin D Dependant Rickets
 - Type I
 - Type II
- Congenital Rickets

II. INCIDENCE OF CONDITION IN OUR COUNTRY

In developed countries, rickets is a rare disease <http://en.wikipedia.org/wiki/Rickets> - cite note-6 (incidence of less than 1 in 200,000). Children ages 6 months to 24 months are at highest risk, because their bones are rapidly growing. Mother's milk gives adequate calcium and vitamin-D so nutritional rickets develops once breast feeding is stopped. Renal or vitamin-D resistant rickets develops in children of 5-8 years of age.

III. DIFFERENTIAL DIAGNOSIS

Differential diagnosis of rickets include

- Hypophosphatasia
- Metaphyseal dysplasia
- Blounts disease

IV. PREVENTION AND COUNSELLING

A sufficient amount of ultraviolet B light in sunlight each day and adequate supplies of calcium and phosphorus in the diet can prevent rickets. Recommendations are for 400 international units (IU) of vitamin D a day for infants and children.

V. OPTIMAL DIAGNOSTIC CRITERIA, INVESTIGATIONS, TREATMENT & REFERRAL CRITERIA

*** SITUATION 1: At Secondary Hospital / Non Metro situation : Optimal standards of Treatment in situations where technology and resources are limited**

a. Clinical diagnosis:

Signs and symptoms of rickets include:

- Bone pain or tenderness, dental problems, muscle weakness (rickety myopathy or "floppy baby syndrome" or "slinky baby", increased tendency for fractures
- Skeletal deformity
 - Genu varum, Genu Valgum, Cranial, spinal, and pelvic deformities
- Growth disturbance
- Tetany, Craniotabes, Costochondral swelling "rickety rosary", Harrison's groove
- Double malleoli sign due to metaphyseal hyperplasia
- Widening of wrist raises early suspicion, it is due to metaphyseal cartilage hyperplasia.

b. Investigations:

Alkaline Phosphatase
Serum Calcium
Serum Phosphorus

X rays of the deformed part

c. Treatment:

The goals of treatment are to relieve symptoms and correct the cause of the condition.

Replacing calcium, phosphorus, and vitamin D, Exposure to moderate amounts of sunlight is encouraged. Positioning or bracing may be used to reduce or prevent deformities. Skeletal deformities may require corrective surgery later on.

Standard Operating Procedure

- i. **In Patient** : For corrective surgery
- ii. **Out Patient** : supplementation and bracing
- iii. **Day Care:** Injectable form of Vit D

d. Referral criteria:

Vitamin D resistant Rickets
Hypophosphatemic Rickets

*** SITUATION 2: At Super Specialty facility in Metro Location where higher end technology is available**

x. Clinical diagnosis:

As in situation 1

y. Investigations:

As in situation 1 . Others are
25 hydroxy – Vit D level
1,25 – dihydroxy- Vit D level
24 hours urinary Ca and Phosphorus levels

z. Treatment:

Standard Operating Procedure

- i. **In Patient** : as in situation 1 and Recombinant Growth hormone therapy for Hypophosphatemic rickets
- ii. **Out Patient** : As in situation 1
- iii. **Day Care:** As in situation 1

aa. **Referral criteria:**

VI. WHO DOES WHAT? AND TIMELINES

a. Doctor

Early diagnosis and appropriate treatment. Counsel the patient for prevention and dietary advice.

b. Nurse

Counselling the patient

c. Technician

Appropriate bracing manufacturing and application
Physiotherapy

VII. FURHTER READING / REFERENCES

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RESOURCES REQUIRED FOR ONE PATIENT /PROCEDURE (PATIENT WEIGHT 60KGS)
(Units to be specified for human resources, investigations, drugs and consumables and equipment. Quantity to also be specified)

SITUATION	HUMAN RESOURCES	INVESTIGATIONS	DRUGS & CONSUMABLES	EQUIPMENT
1	Doctor Nurse Technician	Alkaline phosphatase Serum calcium Serum phosphorus X Ray	Calcium supplement Phosphorus supplement Vit D supplement Inj Vit D Braces Consumables for surgery	Lab equipment X Ray equipment Equipments for Operating Room
2 (In Addition to Situation 1)		25 hydroxy – Vit D level 1,25 – dihydroxy-Vit D level 24 hours urinary Ca and Phosphorus levels	Recombinant Growth Hormone therapy	