

# Training Manual on Primary Rehabilitation Therapy

## Enabling Abilities



## Friends of the Disabled

## Hospital & Rehabilitation Centre for Disabled Children

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Training Manual on  
**PRIMARY REHABILITATION THERAPY**  
(Fourth Amendment)  
2016

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## **Preface**

This handbook of skill training in Primary Rehabilitation Therapy (PRT) is a manual designed for developing community based workforce to provide rehabilitation services to person with activity limitation and participation restriction in their community. This handbook covered basics of physiotherapy, orthopedic conditions, causes of disability, basic introduction to orthopedic appliances, community based rehabilitation and nursing management. We have tried to simplify the English language as much as possible.



## **Acknowledgement**

First of all, we would like to express our gratitude to senior consultant and EMT members to complete this Manual. We successfully complete this manual with the help from a head of Departments, Medical team, Internal and External trainers and other concerned personnel.

We convey our sincere gratitude to Mr. Krishna Prasad Bhattarai (SeniorConsultant), Dr. Bibek Banskota (Medical Director) and Mr. Bikash Man Singh (Director). Without their guidance, this manual would not have been possible. We extend our special thanks to Professor Dr. Ashok Kumar Banskota for his continued patronage for Primary Rehabilitation Therapy Training.



### **Message from the Chair**

It is my great pleasure to extend heartiest greetings and congratulation for making such a wonderful manual for Primary Rehabilitation Therapy (PRT) training. Hospital and Rehabilitation Centre for Disabled Children (HRDC) is organizing and conducting a month long Modular PRT and additional two months to make a full three months long PRT training every year. Volume of trainees who come to join this training is increasing every year. The trainees who have taken this training are involving in different CBR organizations and Hospitals as well as Clinics under the supervision from experts as Physiotherapist plus. This manual is being updated and modified periodically to make it user-friendly. The contents included in the manual are simple, easy to understand and applicable to the CBR, Physical rehabilitation perspectives. It has also served as for the trainees but for trainers as reference.

At last not the least, I personally thank everyone who supported and contributed to prepare this manual.

Prof. Dr. Ashok Kumar Banskota  
Chairman  
Friends of the Disabled



### **Message from the Senior Consultant**

It is my humble privilege to extend my greetings and heartfelt congratulation to staff of HRDC who were involved directly and indirectly to prepare this manual on Primary Rehabilitation Therapy. This is a useful manual which provides the basic skills on Primary Rehabilitation therapy. The training is highly appreciated by representatives from various sectors who received the training. Our Institution has been taking necessary steps to improve quality of training, standard of teaching, methods of assessment, development of hands-on skills to make beneficiaries progressively competent to deal with problems in Physical Rehabilitation. Therefore, I am sure that this manual will definitely be of value to both the trainees and trainers.

I am greatly thankful to staffs for their hard work and persistent effort in developing such a nice manual and special thanks to Mrs. Ganga Shakya, Mrs. Sumita Shrestha and others for their valuable effort and contribution.

Krishna Prasad Bhattarai  
Senior Consultant  
Friends of the Disabled  
Hospital & Rehabilitation Centre for Disabled Children



## Table of Contents

### Contents

#### Physiotherapy

1. Human Anatomy
2. Introduction to Physiotherapy
3. Occupational Therapy
4. Joint
5. Joint movement terminology
6. Joint action
7. Common deformities in Orthopaedic condition
8. Normal joint range of motion of upper/lower limbs
9. Goniometry
10. Manual Muscle Testing (MMT)
11. Principle of exercise
12. Therapeutic exercise
13. Gait analysis
14. Basic guidelines for physical assessment of patient
15. Physiotherapy treatment and advices
16. Physical assessment form
17. Treatment record form
18. Progress evaluation
19. Splint
20. Cast
21. Walking aids
22. Developmental Milestone
23. Heat Therapy
24. Modalities
25. Traction
26. Chest Physiotherapy

#### Orthopaedic Conditions

27. Congenital Talipes Equino Varus (CTEV)
28. Spina Bifida
29. Arthrogryposis
30. Cerebral Palsy
31. Poliomyelitis
32. Osteomyelitis
33. Juvenile Rheumatoid Arthritis
34. Osteoarthritis
35. Tuberculosis of the spine
36. Septic Arthritis
37. Burn
38. Fracture
39. Spinal Cord Injury
40. Rickets
41. Muscular Dystrophy
42. Amputation



- 43. Osteogenesis Imperfecta
- 44. Stroke
- 45. Low Back Pain
- 46. Lateral Epicondylitis
- 47. Volkman's Ischemic Contrature
- 48. Cervical Spondylosis
- 49. Developmental Dysplasia of Hip

### **Nursing**

- 50. Infection
- 51. Wound Care
- 52. Nutrition

### **Laboratory**

- 53. Blood
- 54. Bio-chemical tests & normal range
- 55. Bacteria
- 56. Parasites
- 57. Blood Grouping
- 58. Examination of Urine
- 59. Culture the specimen

### **Prosthetic and Orthotic**

- 60. General terms
- 61. Orthosis
- 62. Prosthesis
- 63. Orthoprosthesis
- 64. Basic Materials





## Human Anatomy

### Body systems

Our body consists of a number of systems that carry out specific functions which is necessary for our daily life. There are 12 systems in our body which are described below:

#### 1. Skeletal system

Skeletal system is made up of 206 individual bones. These bones are arranged in such way that divides upper limb and lower limb. The skeletal system grows throughout childhood and provides a framework for the rest of the body to grow along with it. It includes all the bones and joints of the body. Each bone is living organ which is made up of cells, proteins and minerals. The skeletal system acts as a framework which provides support and protects the soft tissues and vital organs of the body.

#### Functions

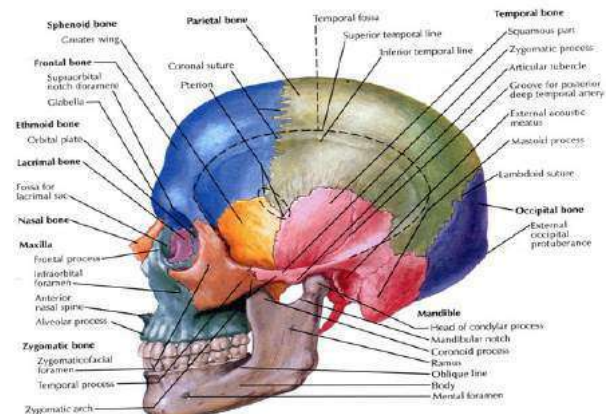
- Provides framework and support the body.
- Protects soft tissues and vital organs of the body.
- Provides attachment points for muscles.
- Allows movements of joints.
- Bones act as a warehouse for calcium, iron and energy in the form of fat.

#### The bones in the skeletal system are arranged into two major divisions:

1. Axial skeleton: It runs along the body's midline axis and is made up of 80 bones in the following regions: Skull, Hyoid, Auditory ossicles, Ribs, Sternum, Vertebral column.
2. Appendicular skeleton: It is made up of 126 bones in the following regions: Upper limbs, Lower limbs, Pelvic girdle, and Shoulder girdle.

#### Skull

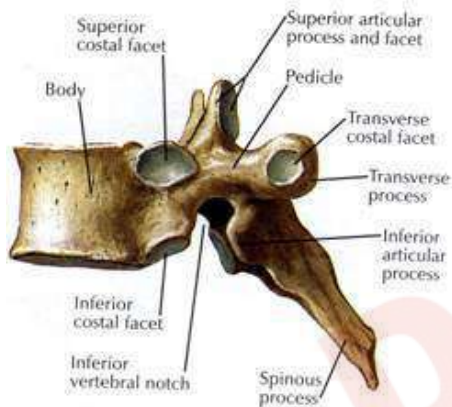
The skull is composed of 22 bones that are fused together except mandible. 21 fused bones are separate in children to allow the skull and brain to grow and give extra strength and protect as an adult.



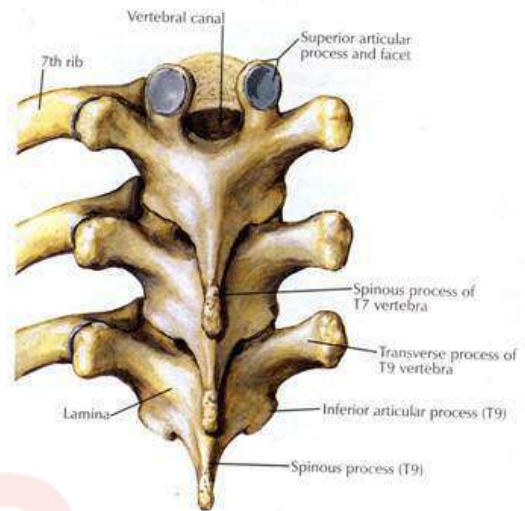
## Vertebrae

There are 26 vertebrae to form vertebral column or spinal column. They are named by region;

Cervical (neck)	- 7 vertebrae
Thoracic (chest)	- 12 vertebrae
Lumbar (lower back)	- 5 vertebrae
Sacrum	- 1 vertebra
Coccyx (tail bone)	- 1 vertebra

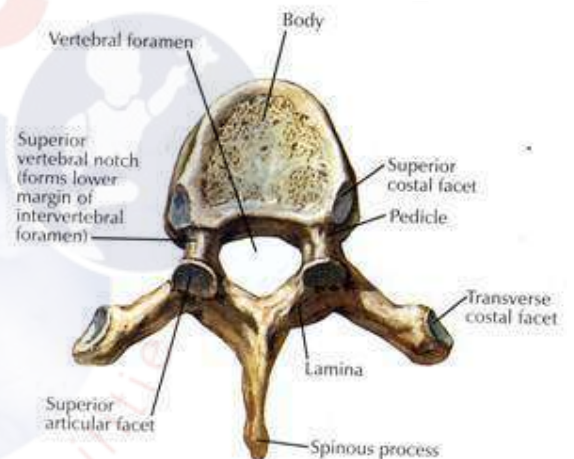
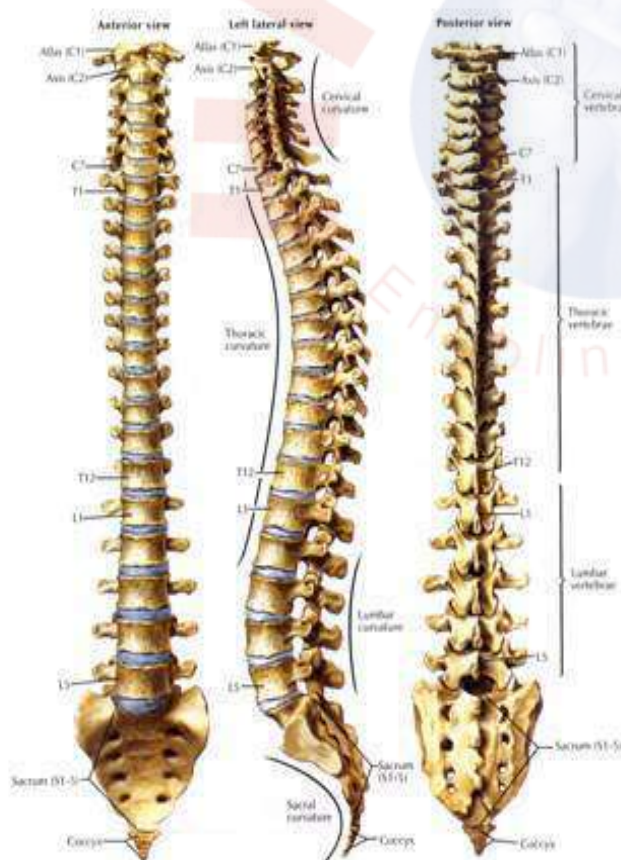


T6 vertebra:

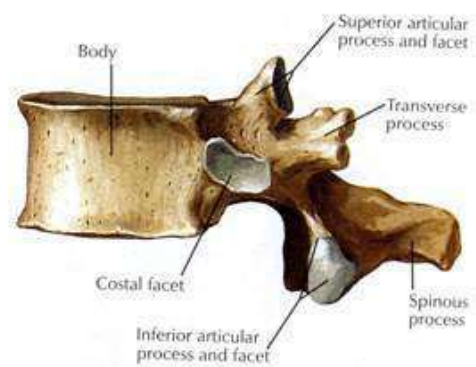


T7, T8 and T9 vertebrae: posterior view

### Vertebral Column



T6 vertebra: superior view



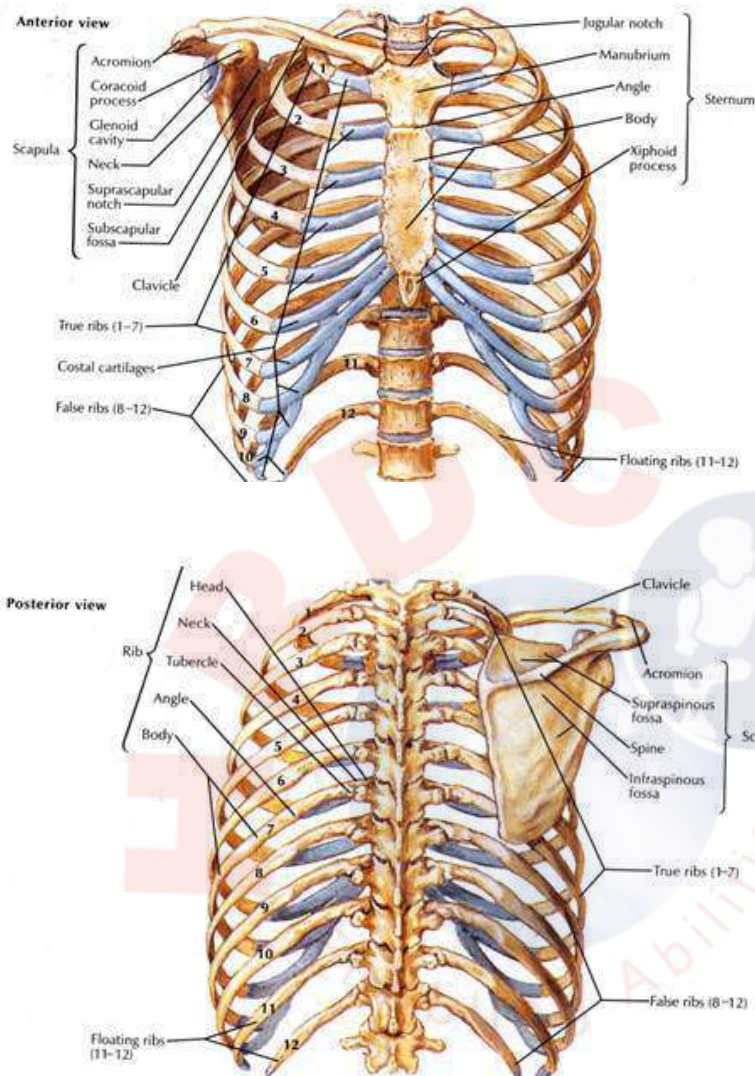
T12 vertebra: Lateral view

## Ribs and Sternum



The sternum also known as a breast bone which is thin, knife- shaped bone located at midline of the anterior part of thoracic region. The sternum connects to ribs by thin bands called costal cartilage.

There are 12 pairs of ribs that together with the sternum form the ribcage of thoracic region.



## Pectoral girdle

The pectoral girdle connects the upper limb bones to the skeleton and consists of the two clavicles and two scapulas.

## Upper limb

Humerus, radius, ulna and the carpal bones, metacarpals and phalanges are the upper limb. Humerus is also known as the upper arm bone. The radius and ulna are the two bones of the forearm. The ulna is on the medial side of the forearm and radius is on the lateral side of the forearm.

There are 8 small bones in lower arm which is called carpal bones. These carpal bones are connected to 5 metacarpal bones that form the bones of the hands and connect to

each finger. Each finger has 3 bones called phalanges, except for the thumb, which has only 2 phalanges.

## Upper limb

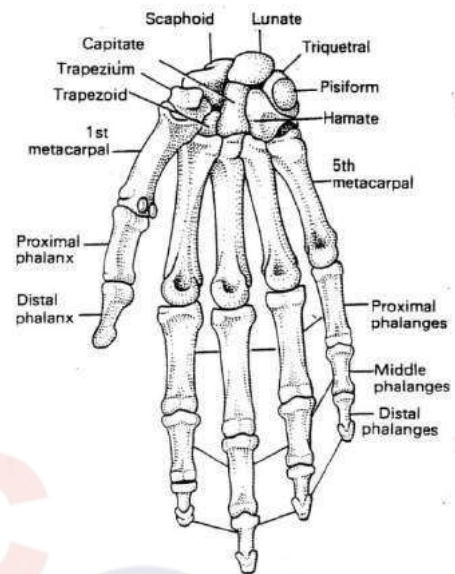
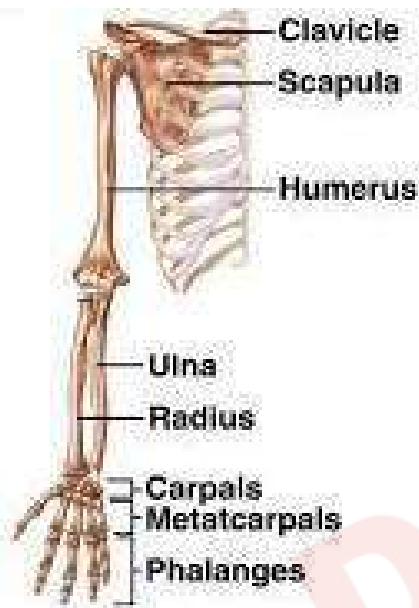


Figure The bones of the wrist, hand and fingers. Anterior aspect.

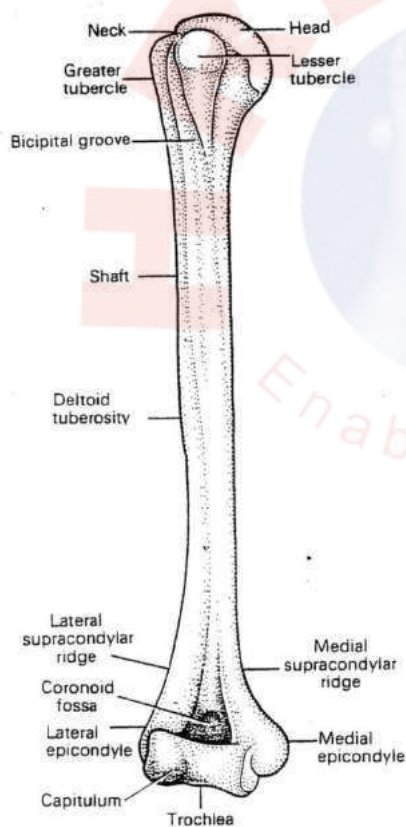


Figure The right humerus. Anterior view.

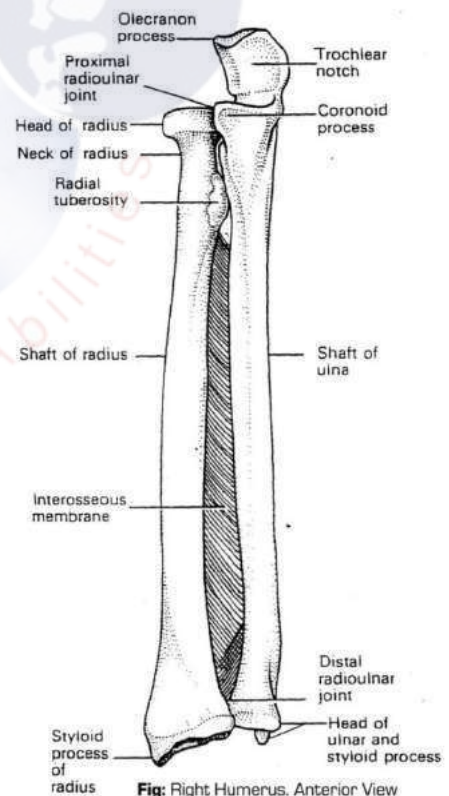
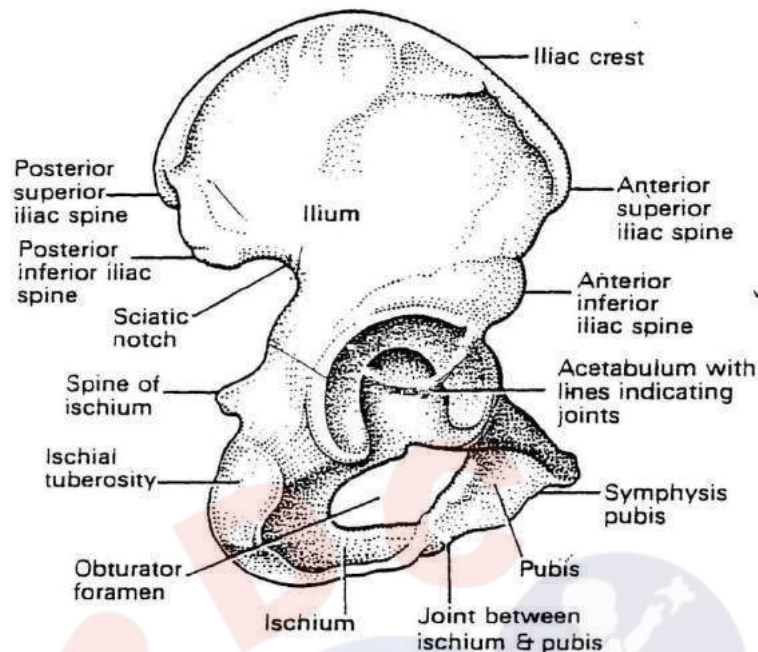


Fig: Right Humerus. Anterior View

## Pelvic girdle

It is formed by 2 hip bones also known as pelvic and connects the lower limb bones to axial skeleton.



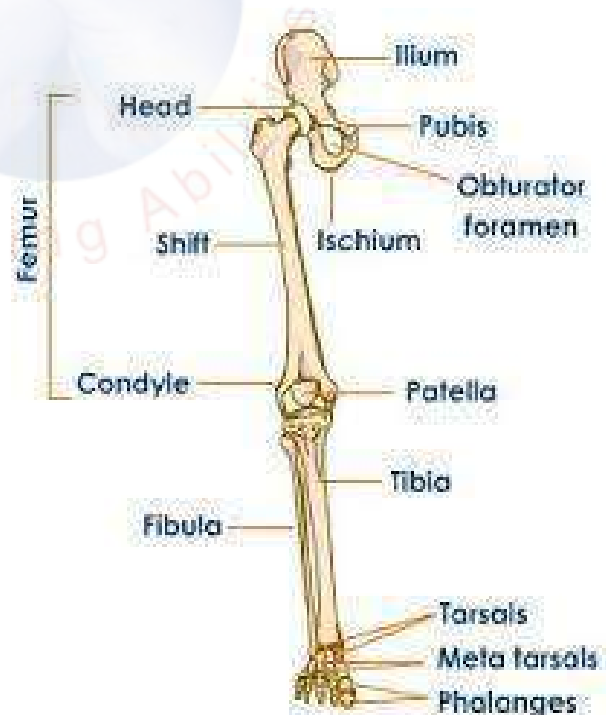
**Figure** The right innominate bone. Lateral view.

## Lower limb

The femur is the largest bone in the body and called thigh bone. The kneecap or the patella is a special bone and support for walking.

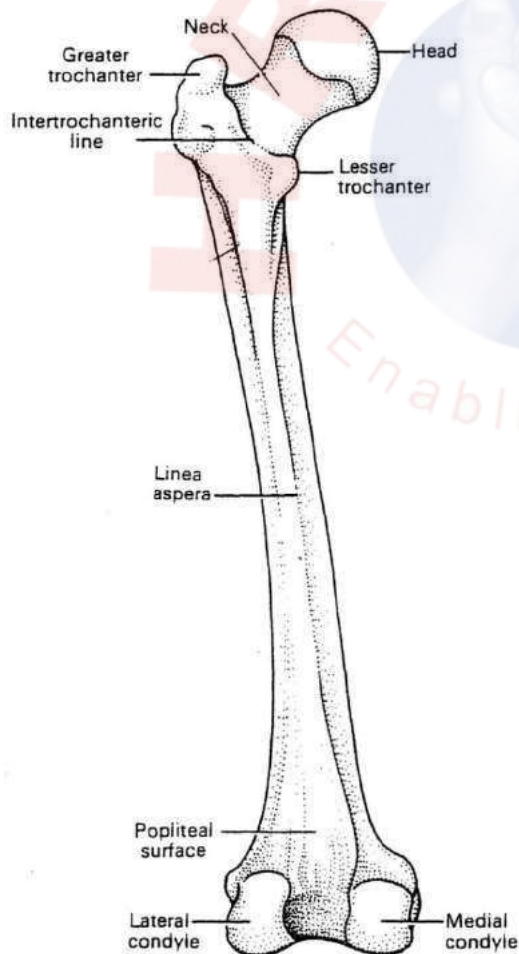
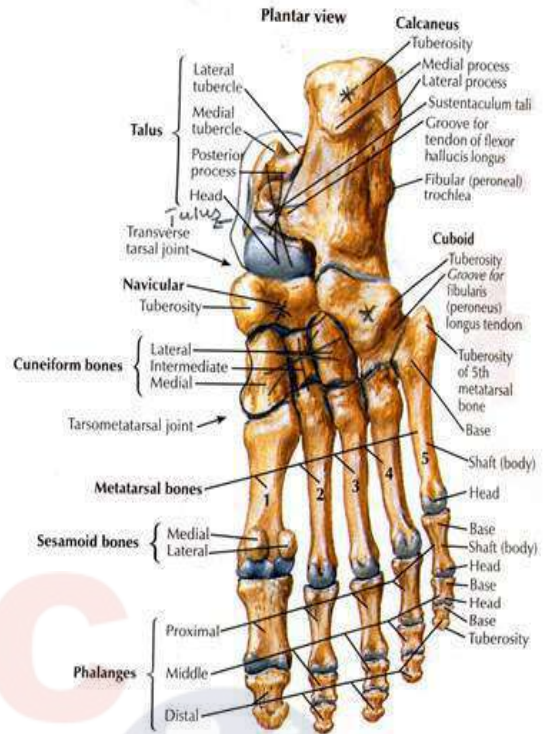
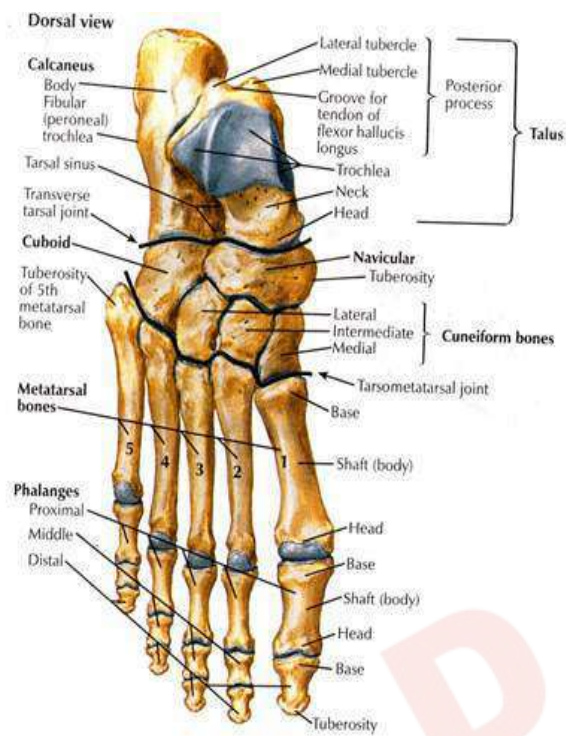
The tibia and fibula are the bones of lower limb. Tibia is longer than the fibula and bears almost all of the body weight.

There are 7 small bones in foot called tarsal bones. These bones are connected to metatarsal bones of foot. Then each of the metatarsals forms a joint with phalanges in the toes. Each toe has 3 phalanges except big toe, which has only 2 phalanges.

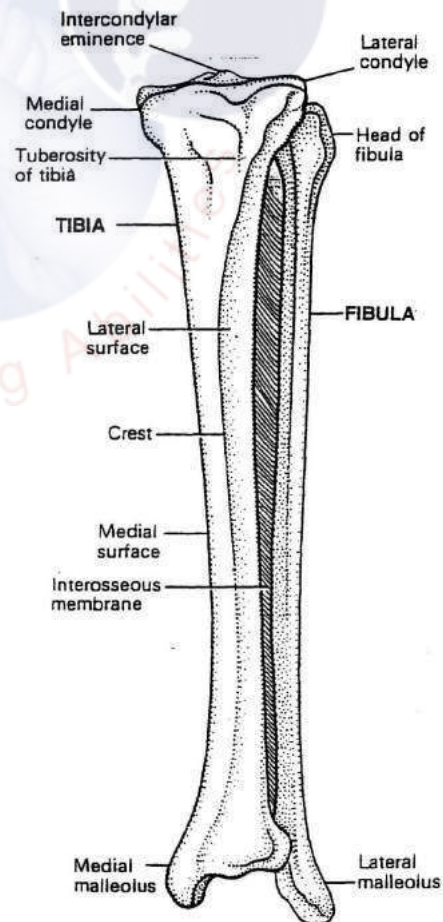




## Ankle and Foot



**Figure** The left femur. Posterior aspect.



**Figure** The left tibia and fibula with the interosseous membrane.



## Types of bone

### 1. Long bone

Long bones are longer and wider which located at major bones of the limbs. Examples of long bones are femur, tibia, fibula, humerus, radius, ulna, metatarsals and phalanges.

### 2. Short bones

Short bones are often cubed or round in shape. The carpal bones of the wrist and tarsal bones of the foot are examples of short bones.

### 3. Flat bone

Frontal, parietal, occipital, scapula and pelvic bones are the flat bones of the body.

### 4. Irregular bones

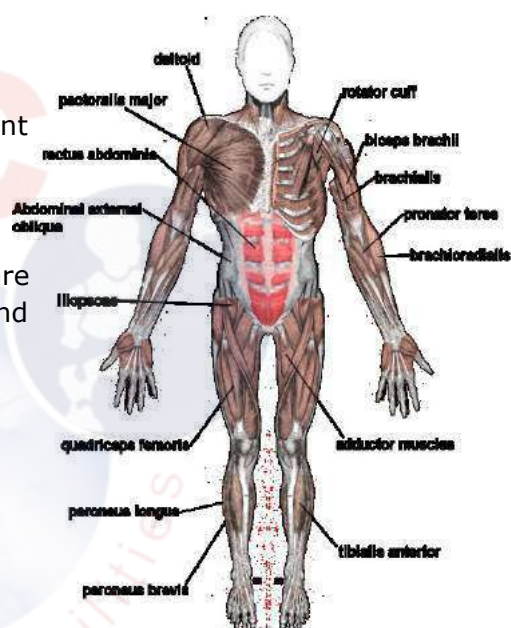
They have no definite size and shape. The vertebrae, sacrum and coccyx are the examples of the irregular bone.

## 2. Muscular system

The muscular system is responsible for the movement of the human body. Muscles are attached to the bones of the skeletal system. There are about 700 muscles that make up roughly half of a person's body weight. Such muscles are skeletal muscle tissue, blood vessels, tendons, and nerves.

### Function

- Generates heat
- Creates movement of the joint
- provide mobility of the body
- Maintains posture

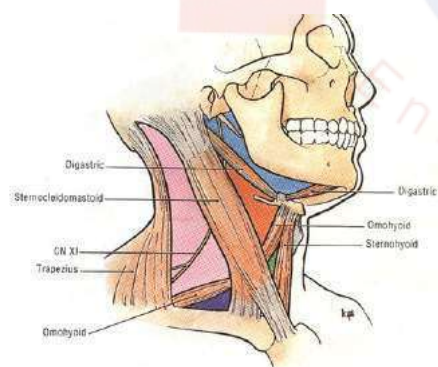
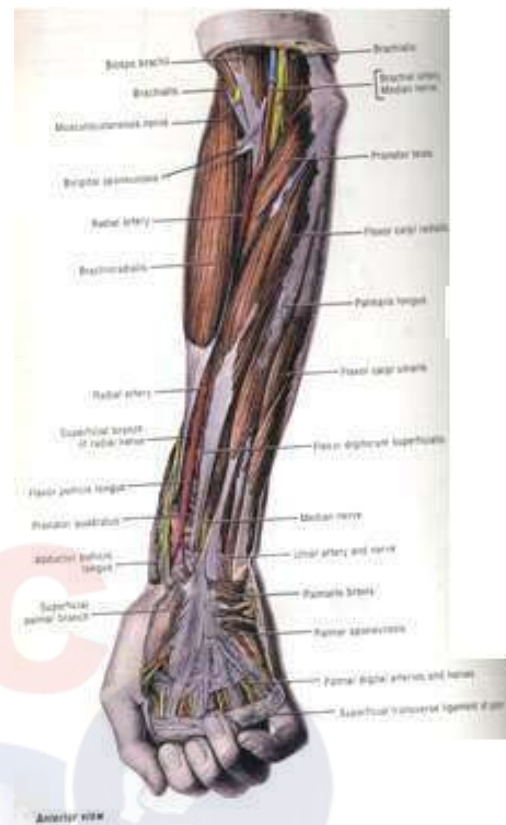
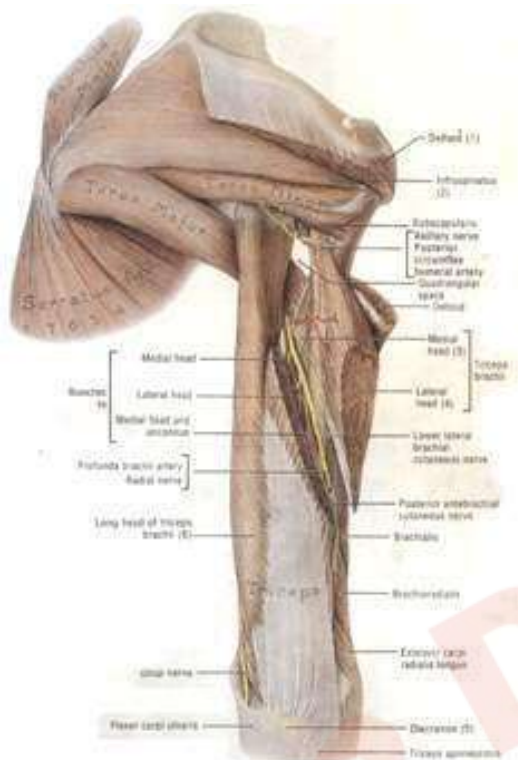


## Muscles and their action

### Upper limb muscle

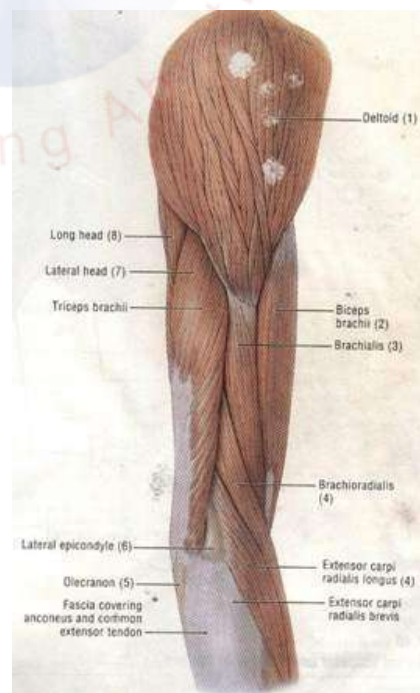
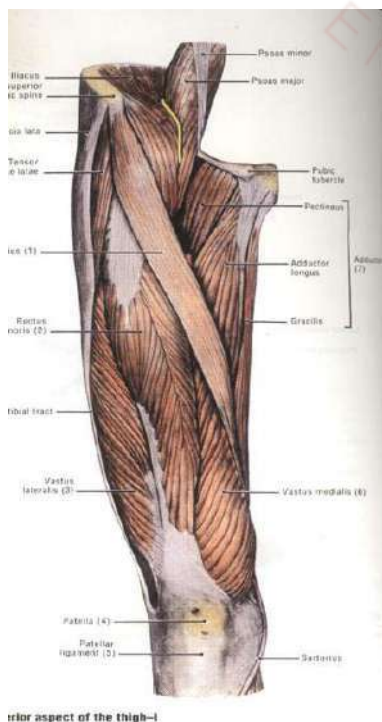
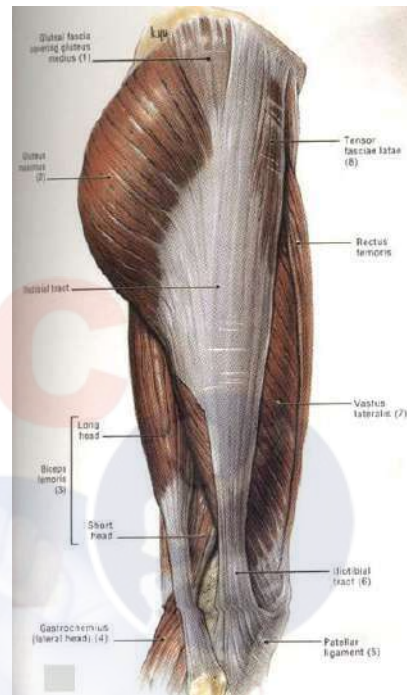
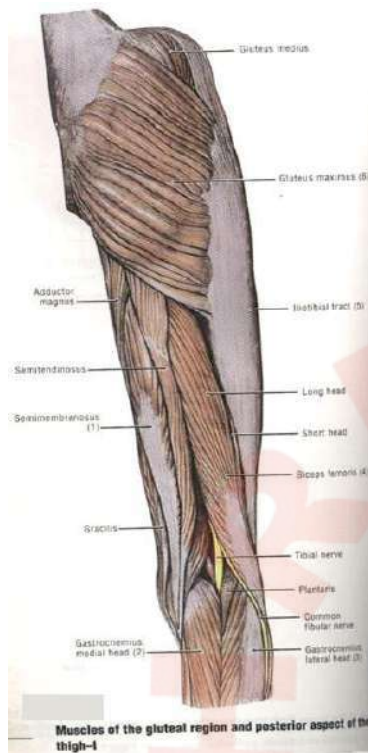
Muscle	Action
Neck	Flexor, extensors, side flexors, rotators
Trunk	Flexor, extensors, side flexors, rotators
Shoulder girdle	Elevators, depressors, protractors, retractors
Shoulder	Flexors, extensor, adductor, abductor, internal rotators, external rotators
Elbow	Flexors (Biceps brachi, brachio radialis), extensor (triceps)
Forearm	Supinator group, pronator group
Wrist	Flexors(flexor carpiradialis, flexor carpiulnaris, Palmaris longus), flexor extensors (extensor carpiradialis longus and brevis, extensor carpiulnaris)
Fingers	Flexors, extensors, abductors, adductors
Thumb	Flexors, extensors, abductors, adductors

## Upper limb muscle



## Lower Limb Muscle

Hip	Flexors (Iliopsoas), extensors (gluteus maximus), adductors (gluteus medius), abductors, external rotators, internal rotators
Knee	Flexors (hamstrings), extensors (quadriceps)
Ankle	Dorsiflexors (tibialis anterior), plantar flexors (gastrocnemius, soleus), Invertors (tibialis posterior), evertors (peronei)
Hallux	Flexors, extensors
Toes	Flexors, extensors



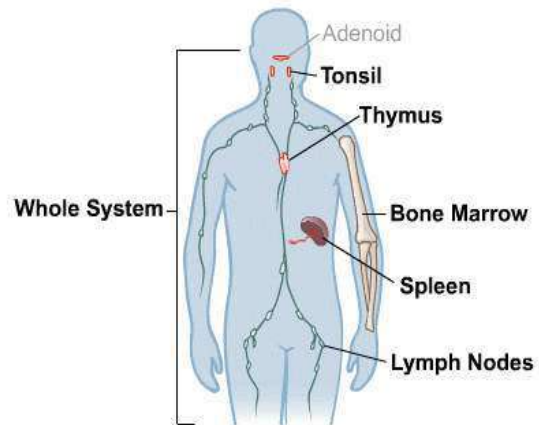


### 3. Immune system

The immune system is a system of many biological structures and processes within an organism that protects against disease. To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue.

#### Function

- Portions of many different systems which fight against disease.



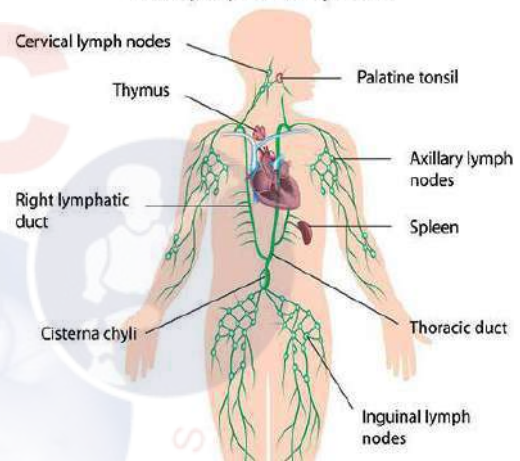
### 4. Lymphatic system

The lymphatic system is a network of tissues and organs that help rid the body of toxins, waste and other unwanted materials. The primary function of the lymphatic system is to transport lymph, a fluid containing infection-fighting white blood cells, throughout the body.

#### Function

- Picks up fluids leaked from the capillaries
- Supports immune systems: houses white blood cells

#### The Lymphatic System

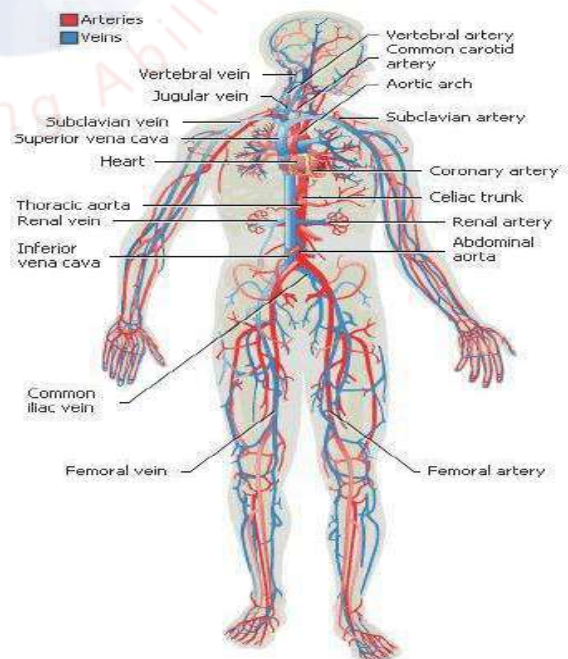


### 5. Cardiovascular system

The circulatory system, also called the cardiovascular system or the vascular system. It is system that permits blood to circulate and transport nutrients (such as amino acids and electrolytes), oxygen, carbon dioxide, hormones, and blood cells to and from the cells in the body to provide nourishment.

#### Functions

- Transportation of nutrients and gas waste
- Supports immune function

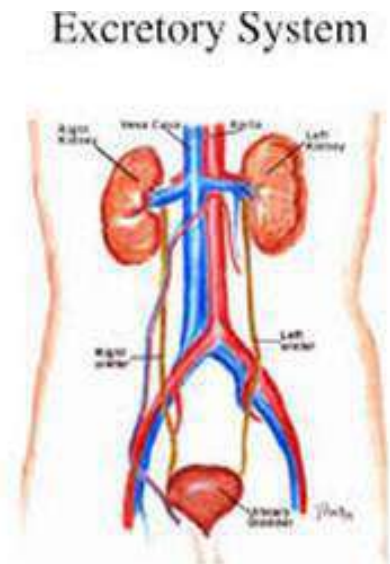


## 6. Urinary system

The urinary system is known as the renal system. It consists of the kidneys, ureters, bladder, and the urethra. Each kidney consists of millions of functional units called nephrons.

### Function:

- Removal of waste products from body.
- Regulation of electrolytes, fluid and pH balance
- Regulation of acid- base homeostasis
- Controlling blood volume and maintaining blood pressure

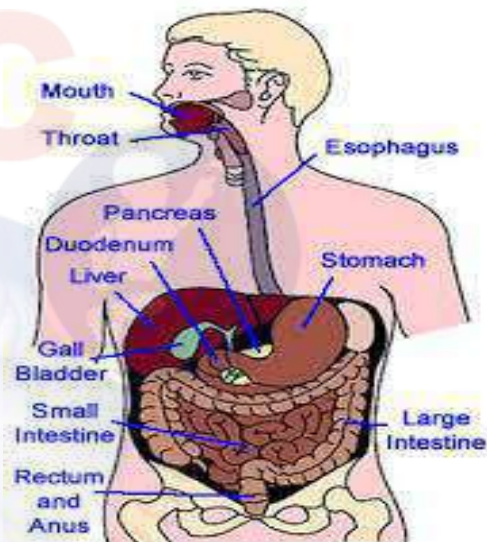


## 7. Digestive system

The digestive system is a group of organs working together to convert food into energy and basic nutrients to feed the entire body. Food passes through a long tube inside the body known as the alimentary canal or the gastrointestinal tract (GI tract).

### Function

- Breaks down food into the building blocks for the body



## 8. Respiratory system

The human respiratory system is a series of organs responsible for taking in oxygen and expelling carbon dioxide. The primary organs of the respiratory system are lungs, which carry out this exchange of gases as we breathe.

### Function

- Portions moisten and heats air
- Gas exchange

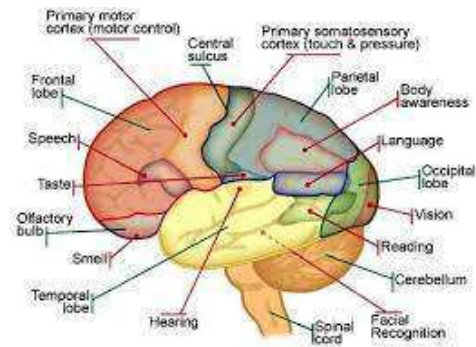


## 9. Nervous system

The nervous system is the part of an animal's body that coordinates its voluntary and involuntary actions and transmits signals to and from different parts of its body.

### Function

- Sensory input
- Interpretation of input or thought
- Elicit and signal responses
- Coordination of muscles

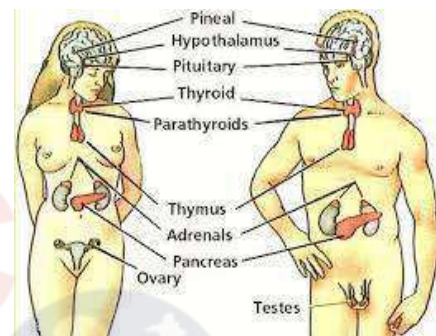


## 10. Endocrine system

The endocrine system refers to the collection of glands of an organism that secrete hormones directly into the system to be carried towards distant target organs.

### Function

- Secretes hormones that regulate growth, metabolism and general body function.

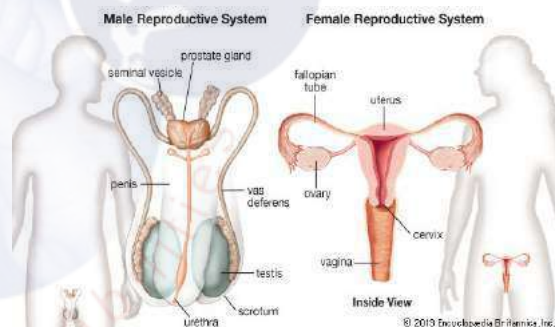


## 11. Reproductive system

The reproductive system or genital systemic is a system of sex organs within an organism which work together for the purpose of sexual reproduction. Many non-living substances such as fluids, hormones, and pheromones are also important accessories to the reproductive system.

### Function

- Production off spring
- Production of hormones

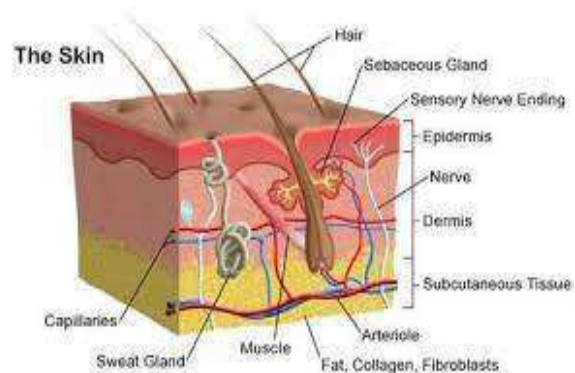


## 12. Integumentary syste

The integumentary system is an organ system consisting of the skin, hair, nails, and exocrine glands. The skin is only a few millimeters thick. It is the largest organ in the body.

### Function

- Largest sensory organ
- Vitamin D syntheses
- Protects deeper tissues
- Regulates fluid and blood loss





# Physiotherapy

## Introduction

Physiotherapy is a healthcare profession that assesses, diagnoses, treats, and works to prevent disease and disability through physical means. Physiotherapists are experts in movement and function who work in partnership with their patients, assisting them to overcome movement disorders, which may have been present from birth, acquired through accident or injury, or are the result of ageing or life-changing events.

Physiotherapists have in-depth knowledge of how the body works and specialized hands-on clinical skills to assess, diagnose, and treat symptoms of illness, injury and disability. Physiotherapy includes rehabilitation, as well as prevention of injury, and promotion of health and fitness. Physiotherapists often work in teams with other health professionals to help meet an individual's health care needs.

CBR facilitators, Physiotherapy technicians and social mobilizers who have a basic knowledge on physiotherapy can provide physiotherapy under the supervision of physiotherapist.

### **The main goal of physiotherapy is to improve clients' quality of life by:**

- Promoting optimal mobility, physical activity and overall health and wellness;
- Preventing disease, injury, and disability;
- Managing acute and chronic conditions, activity limitations, and participation restrictions;
- Improving and maintaining optimal functional independence and physical performance;
- Rehabilitating injury and the effects of disease or disability with therapeutic exercise programs and other interventions; and
- Educating and planning maintenance and support programs to prevent re-occurrence, re-injury or functional decline.

Many people think physiotherapy is only used for musculoskeletal (neck and back conditions). But the profession actually provides both preventative and rehabilitation treatment for an array of mobility issues, injuries and/or diseases. The following list is only some of the many different areas in which physiotherapy can help:

- Arthritis
- Asthma
- Back pain
- Cancer
- Cardiovascular Conditions (including post heart attack, Chronic Obstructive Pulmonary Disease (COPD), and pneumonia)
- Cerebral palsy
- Chronic Pain
- Critical care
- Dementia
- Developmental delay
- Diabetes
- Fractures
- High blood pressure
- Incontinence

- Neck pain
- Neurological Conditions (stroke, concussions, spinal injury, Parkinson's disease),
- Occupational Health
- Oncology-Related Conditions (including lymph edema)
- Osteoporosis
- Pregnancy-related Incontinence
- Rehabilitation

### **Physiotherapy Clinical Practice Areas include...**

- Cardiorespirology
- Seniors Health Sector
- Neurosciences
- Orthopedics
- Pediatrics
- Physiotherapy Management /Administration
- Community based rehabilitation (CBR)
- Private Practice
- Research
- Sports
- Women's Health

### **Activities of Physiotherapy**

The following are common treatment methods physiotherapists may use:

- exercise programs to improve mobility and strengthen muscles
- joint manipulation and mobilization to reduce pain and stiffness
- muscle re-education to improve control
- airway clearance techniques and breathing exercises
- soft tissue mobilization (massage)
- acupuncture
- hydrotherapy
- assistance with use of aids, splints, crutches, walking sticks and wheelchairs.

### **Physiotherapists work in:**

- hospitals or acute care facilities
- community based rehabilitation
- rehabilitation centers
- long term care facilities
- home care programs
- public health units
- private clinics
- schools
- child development centers
- industry
- recreation centres
- sports clinics and facilities
- universities



### **Physiotherapy techniques and approaches**

Physiotherapy can involve a number of different treatment and preventative approaches, depending on the specific problems experiencing.



At first appointment, have an assessment to help determine what help might need.

- education and advice
- movement and exercise
- manual therapy

### **Education and advice**

One of the main aspects of physiotherapy involves looking at the body as a whole, rather than focusing on the individual factors of an injury. Therefore, giving general advice about ways to improve wellbeing – for example, by taking regular exercise and maintaining a healthy weight for height and build – is an important part of treatment.

A physiotherapist can also give specific advice that can apply to everyday activities to look after and reduce risk of pain or injury.

For example, if back pain, may be given advice about good posture, correct lifting or carrying techniques, and avoiding awkward twisting, over-stretching or prolonged standing.

### **Movement and exercise**

Physiotherapists usually recommend movement and exercise to help improve mobility and function. This may include:

- **exercises designed to improve movement and strength in a specific part of the body** – these usually need to be repeated regularly for a set length of time
- **activities that involve moving your whole body**, such as walking or swimming – these can help if you're recovering from an operation or injury that affects mobility
- **exercises carried out in warm, shallow water (hydrotherapy or aquatic therapy)** – the water can help relax and support the muscles and joints, while providing resistance to help gradually strengthen
- **advice and exercises to help increase or maintain physical activity** – advice will be given on the importance of keeping active, and how to do this in a safe, effective way
- **providing mobility aids** – such as crutches or a walking stick to help to move around.

### **Manual therapy**

Manual therapy is a technique where a physiotherapist uses their hands to manipulate, mobilize and massage the body tissues.

It can help:

- relieve pain and stiffness
- improve blood circulation
- help fluid drain more efficiently from parts of the body
- improve the movement of different parts of the body
- promote relaxation

Manual therapy can be used to treat specific problems, such as back pain, but may also be useful for a range of conditions that don't affect the bones, joints or muscles. For example, massage may improve quality of life for some people with serious or long-term conditions by reducing levels of anxiety and improving sleep quality. Manual techniques are also used to help certain lung conditions.

## **Occupational Therapy**

Occupational therapy is a health care profession aimed at enabling people to live life to its fullest. Occupational Therapy, it is the application of purposeful, goal-oriented activity through different techniques, like in the evaluation, diagnosis and treatment of persons whose function is impaired by physical illness or injury, emotional disorder, congenital or developmental disability or the aging process, in order to achieve optimal functioning to prevent disability, and to maintain health.

Occupational therapy services include education and training in activities of daily living (ADL), designing, fabrication and application of splints, guidance in the selection and use of adaptive equipment, therapeutic activities to enhance functional performance, pre-vocational evaluation and training. These services are provided to individuals or groups, and to both inpatients and out patients.

The primary goal of occupational therapy is to enable people to participate in the activities of everyday life. Occupational therapists achieve this outcome by working with people and communities to enhance their ability to engage in the occupations they want to, need to, or are expected to do, or by modifying the occupation or the environment to better support their occupational engagement.

An occupational therapist can identify strengths and difficulties in everyday life, such as dressing or getting to the shops, and will help you work out practical solutions.

They can work to identify goals that can help to maintain, regain, or improve independence by using different techniques, changing environment, and using new equipment.

### **Benefit from occupational therapy**

- Occupational therapy is used when someone is having difficulty with everyday tasks. This could be because they have :
  - medical condition – for example, rheumatoid arthritis
  - learning disability
  - mental health condition
- Occupational therapists work with people of all ages and can look at all aspects of daily life, from the home to the school or workplace.
- The mastery of skills that help children develop, recover, or maintain daily living skills.
- to help individuals become independent, productive and satisfying lives. Daily living skills, such as toilet training, dressing, brushing teeth, and other grooming skills
- Fine motor skills required for holding objects while handwriting or cutting with scissors
- Gross motor skills used for walking, climbing stairs, or riding a bike
- Sitting, posture, or perceptual skills, such as telling the differences between colors, shapes, and sizes
- Awareness of his or her body and its relation to others
- Visual skills for reading and writing
- Play, coping, self-help, problem solving, communication, and social skills

## Occupational therapy techniques:

After identifying the difficulties a person has with everyday tasks, occupational therapists can help by either:

- practising the activity in manageable stages
- teaching a different way to complete the activity
- recommending changes that will make the activity easier
- providing devices that make activities easier

For example, after a hip replacement, someone may find it difficult to get in and out of the bath. Grab rails could be fitted in the bathroom to make this easier.

Someone with rheumatoid arthritis – a condition that causes pain and swelling in the joints – may find it hard to lift small objects. Special equipment, such as a wide-handled vegetable peeler, may be made available to make tasks easier.

The following are examples of conditions and injuries of the upper extremity (i.e., hand, wrist, elbow, shoulder girdle, rotator cuff, multiple joints) that are treated by occupational therapy practitioners.

- Fractures
- Amputations
- Arthritis and rheumatic diseases
- Congenital anomalies
- Crush injuries or trauma
- Cumulative trauma
- Dislocations and subluxations
- Ligament injury and instability
- Muscle strains, tears, and avulsions
- Tendon injuries and conditions (e.g., lacerations, tendonitis, ruptures)
- Nerve injuries and conditions (e.g., neuropathies, palsies, nerve repair)
- Pain (e.g., complex regional pain syndrome, fibromyalgia)
- Replantation and revascularization
- Wounds and scars
- Thermal and electrical injuries
- Neuromuscular pathologies



## Interventions:

Occupational therapy interventions are designed to meet individual client needs and may include the following as part of a comprehensive plan of care:

- Therapeutic activities
- Therapeutic exercise
- Orthosis design, fabrication, fitting, and training
- Analyzing and fabricating various pieces of equipment's or devices to promote further independence and patient self management. E.g. Spoon handles for easy gripping and eating aids, toileting aids etc.
- Joint protection and/or energy modification in home, work, school, or leisure activities
- Sensory re-education



Modification of pen

- Mirror therapy
- Scar management
- Pain management
- Work conditioning or work hardening
- Training in activities of daily living and adaptive or assistive devices
- Activities of daily living (ADL) are defined as a self care and self management. Instructions should be given to increase skill level and further progress in areas of feeding, dressing, grooming/hygiene, bathing, toileting etc.

E.g. Feeding

Consider- Stabilization

- Plate adaptations
- Cup or Mug
- Utensils
- Positions
- Bilateral hand use
- Splints/ Other assistants



Glass modification

Dressing

- Balance (Sitting/ Lying)
- Position of body as well as clothing
- Strong side first

- Education for post-surgical or post-injury safety, including sensory loss

From a practical perspective, occupational therapy practitioners working in the area of upper-extremity rehabilitation achieve competency in adjunct areas of intervention, which may include:

- Design and fabrication of selected orthosis for post-surgical, post-injury, or long-term use.
- Ergonomic principles.
- Wound care.
- Application of physical agent modalities.
- Manual therapy.
- Taping techniques.

## Joints

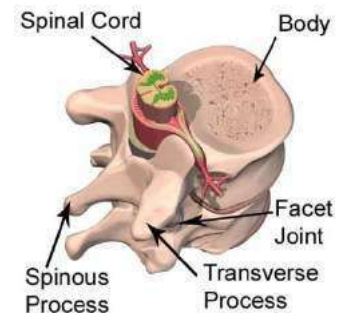
A joint is defined as the junction between two or more bones of the skeleton. Joints can be classified in one of two ways: by the movement they permit or by the tissue joining the bones of the joint. Each of these systems of classification provides useful information about the joint, but the systems do not necessarily correspond.

### Types of Joint

#### 1. Fibrous Joints

**Fibrous:** This type of joint is held together by only a ligament. Examples are where the teeth are held to their bony sockets and at both the radioulnar and tibiofibular joints.

**Cartilaginous:** These joints occur where the connection between the articulating bones is made up of cartilage. For example: between vertebrae in the spine.



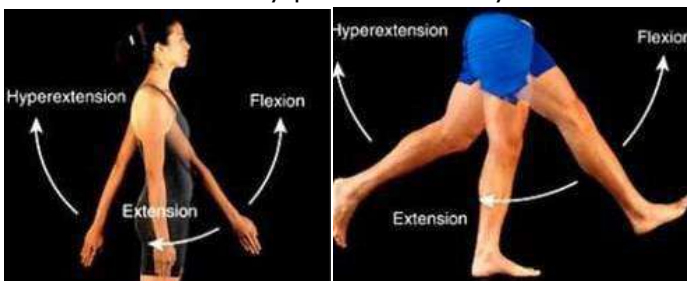
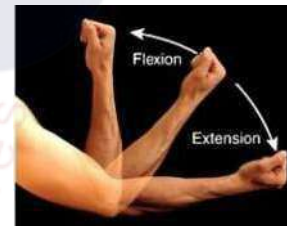
#### 2. Synovial Joints

**Synovial:** Synovial joints are the most common classification of joint within the human body. They are highly moveable and all have a synovial capsule surrounding the entire joint, a synovial membrane (the inner layer of the capsule) which secretes synovial fluid (a lubricating liquid) and cartilage known as hyaline cartilage which pads the ends of the articulating bones.

### Joint Movements Terminology

It is also known as anatomical movements.

- 1. Flexion:** Bending part at a joint so that the angle between them decreases and the parts come closer together, eg. Bending the lower limb at the knee.
- 2. Extension:** Straightening parts of a joint so that the angle between them increases and the parts move farther apart, eg straightening the knee.
- 3. Hyperextension:** A movement to increase the angle between the articulating bones to take a body part or limb beyond its normal range.



- 4. Abduction:** A movement away from the midline of the body, eg lifting the upper limb horizontally to form a right angle with the side of the body.
- 5. Adduction:** Moving parts towards the midline of the body, eg returning the upper limb from the horizontal position to the side of the body.



- 6. Circumduction:** A conical movement of a limb extending from the joint at which the movement is controlled. True circumduction allows for 360 degree of movement, eg moving the finger in a circular motion without moving the hand.
- 7. Rotation:** Moving a part around an axis. Twisting the head from side to side. Medial rotation involves movement towards the midline, whereas lateral rotation involves movement in the opposite direction.
- 8. Elevation:** The upward movement of structures of the body. Eg, elevation of shoulder girdle.
- 9. Depression:** The downward movement of structures of body. Eg, depression of shoulder girdle.
- 10. Protraction:** The movement of a body part in anterior direction, i.e. forwards.
- 11. Retraction:** The movement of a body part in posterior direction, i.e. backwards.
- 12. Eversion:** A movement in which the planter surface of the foot rotates away from the midline of the body. Another way to describe this movement is to say the planter surface (sole) of the foot turns laterally, ie turns outwards.
- 13. Inversion:** A movement in which the planter surface of the foot rotates towards the midline of the body. Another way to describe this movement is to say the planter surface (sole) of the foot turns medially, ie turns inwards.



Inversion and Eversion of the foot at the ankle

- 14. Dorsiflexion:** Bending in the direction of dorsum. Bending as of the hand or foot, ie the surface of the foot or hand that includes the toe nails or finger nails.



Dorsiflexion and Plantar flexion of the foot at the ankle

- 15. Plantarflexion:** Bending as of the hand or foot, ie flexion of the foot/ankle means rotating the toes downwards.
- 16. Pronation:** A movement that can be performed by the forearm or by the ankle/ foot. Pronation of forearm: Rotation of forearm turning the palm of the hands inward towards the body, ie turning the palm inferiorly/ posteriorly. Pronation of the foot is one of the normal movements made by the foot to absorb its impact on to the ground when walking or running.
- 17. Supination:** A movement that can be performed by the forearm or by the ankle/ foot. Supination of forearm: Rotation of forearm turning the palm of the hands outwards so that it faces away from the body, ie turning the palm superiorly/ anteriorly. Supination of foot is an excessive outward rolling motion of the foot and ankle when walking or running.

## Joints and their action

Joints	Type of movement
Neck	Flexion, extension, side flexion, rotation
Trunk	Flexion, extension, side flexion, rotation
Shoulder girdle	Elevation, depression, protraction, retraction
Shoulder	Flexion, extension, adduction, abduction, internal rotation, external rotation, circumduction
Elbow	Flexion, extension
Forearm	Supination, pronation
Wrist	Flexion, extension, adduction, abduction
Fingers	Flexion, extension, adduction, abduction
Thumb	Flexion, extension, adduction, abduction, opposition
Hip	Flexion, extension, adduction, abduction, internal rotation, external rotation
Knee	Flexion, extension
Ankle	Dorsiflexion, plantar flexion, slight circumduction, eversion
Hallux	Flexion, extension
Toes	Flexion, extension

## Types of Synovial Joint:

Synovial - Articulating bones moving freely along smooth lubricated articular cartilage.

## Classification

Types	Movement	Example
<b>Hinge:</b> Convex surface of one bone fitted into concave surface of other	Flexion and extension	Elbow, Interphalangeal joint, Knee and Ankle
<b>Pivot:</b> Rotates around the central axis (Rotational movement)	Supination, Pronation and rotations	Proximal radioulnar Joint, Atlanto - axial joint
<b>Ball and Socket:</b> Globe like head of one bone fitted unto cup like concavity of another bone	Flexion, extension, abduction, adduction, internal rotation, external rotation and circumduction	Shoulder joint, hip joint

### Muscles that move the thumb

Muscles	Action	Origin	Insertion	Nerve enervation
Flexor pollicis Brevis	Flexion of MP joint	Trapezium and adjacent region (Trapezoid and capitate bone)	Base of proximal phalanx of the thumb	Median Nerve
Flexor pollicis longus	Flexion of IP joint	Anterior surface of radius, interosseous thumb	Base of distal phalanx of thumb	Median Nerve
Opponent pollicis	Opposes the CMC joint of thumb	Flexor retinaculum and tubercle of trapezium bone	Entire length of first metacarpal bone (Radial side)	Median Nerve
Abductor pollicis brevis	Abduction of thumb ( Help in opposition)	Flexor retinaculum, scaphoid and trapezium bones	Base of proximal phalanx of thumb	Median Nerve
Abductor pollicis longus	Abduction of thumb ( Help in reposition)	Dorsal surface of ulna and radius	Base of first metacarpal	Radial Nerve

### MAIN MUSCLE OF LOWER EXTREMITY

#### Muscle that move the Hip

Muscles	Action	Origin	Insertion	Nerve enervation
Iliopsoas	Flexion of hip	Iliac fossa and transverse processes of all lumbar vertebrae	Lesser trochanter of femur	Femoral Nerve
Gluteus maximus	Extension of hip	Iliac crest (Posterior) , sacrum and coccyx	iliotibial tract of tensor fasciae latae and gluteal tuberosity of femur	Inferior Gluteal Nerve
Gluteus medius	Abduction of hip	Ileum	Greater trochanter of femur	Superior gluteal Nerve



Pectineus	Adduction of hip	Superior ramous of pubis	Pectineal line of femur (below the lesser trochanter)	Femoral and abtunat or Nerve
Piriformits	External rotation of hip	Sacrum	Greater trochanter of femur	









#### Muscles that move the knee


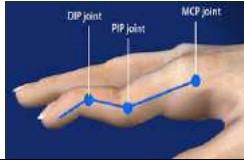







Muscles	Action	Origin	Insertion	Nerve enervation
Rectus femoris	Extension of knee with fixing the hip	Anterior superior iliac spine	Proximal border of patella and through patellar ligament to tuberosity of tibia	Femoral Nerve
Vastus lateralis	Extension of knee	Greater trochanter and linea aspera of femur	Proximal border of patella and through patellar ligament to tuberosity of tibia	Femoral Nerve
Vastus intermedius	Extension of knee	Proximal two-thirds of body of femur and linea aspera	Proximal border of patella and through patellar ligament to tuberosity of tibia	Femoral Nerve
Vastus medialis	Extension of knee	Distal one half of intertrachanteric line, linea aspera	Proximal border of patella and through patellar ligament to tuberosity of tibia	Femoral Nerve
Biceps femoris	Flexion of knee with slight lateral rotation	Long head - Ischinal tuberosity Short head - Linea aspera of femur	Head of febula and lateral condyle of tibia	Sciatic Nerve
Semitendinosus	Flexion knee with slight medial rotation	Ischial tuberosity	Medial condyle of tibia	Sciatic Nerve
semimembranosus	Flexion knee with slight medial rotation	Ischial tuberosity	Medial condyle of tibia	Sciatic Nerve









### Muscle that move the Ankle

<b>Muscles</b>	<b>Action</b>	<b>Origin</b>	<b>Insertion</b>	<b>Nerve enervation</b>
Soleus	Planter flexion of Ankle	Head of fibula, middle one third of medial border of tibia	Posterior surface of calcaneus	Tibial Nerve
Gastrocnemius	Planter flexion of Ankle	Posterior aspects of condyles	Posterior surface of calcaneus	Tibial Nerve
Peroneus longus	Eversion of foot with planter flexion	Head and proximal two thirds of lateral surface of fibula	Lateral side of base of fifth metatarsal and medial cuneiform bone	Superficial peroneal Nerve
Peroneus brevis	Eversion of foot with plater flexion	Distal two thirds of lateral surface of fibula	Tuberosity at base of fifth metatarsal bone ( Lateral side)	Superficial peroneal nerve
Tibialis anterior	Dorsi flexion and Inversion of foot	Lateral condyle and proximal one half of lateral surface of tibia	Medial and planter surface of medial cuneiform bone, base of first	Deep peroned Nerve
Tibialis posterior	Inversion of foot with planter flexion	Interossous membrane, lateral and posterior surface of tibia, proximal two thirds of medial surface of fibula	Base of second third and fourth metatarsal navicular, cuneiform	Tibial Nerve

### Common deformities in Orthopaedic condition

Deformities	Description	Picture
<b>Torticollis</b>	lateral flexion of the neck in one side and rotation in opposite side (Contracture of SCM muscles).	
<b>Scoliosis</b>	Lateral curvature of the spine.	
<b>Kyphosis</b>	Curvature of spine in which concavity faces forwards.	
<b>Lordosis</b>	Curvature of spine in which concavity faces backwards.	
<b>Cubitus varus</b>	Inward angulation of elbow.	
<b>Cubitus valgus</b>	outward angulation of elbow.	
<b>Madlung deformity</b>	congenital subluxation or dislocation of the lower end of the ulna from malformation of the bones.	
<b>Wrist drop</b>	flexion and slight radial deviation of wrist from weakness or paralysis of wrist extensors.	

<b>Radial club hand</b>	deviation of wrist in radial side due to partial or complete absence of radius bone.	
<b>Swan neck deformity</b>	Hyperextension of proximal interphalangeal joint and flexion of distal interphalangeal joint.	
<b>Boutonniere deformity</b>	Flexion of proximal interphalangeal joint and hyperextension of distal interphalangeal joint.	
<b>Mallet finger</b>	Flexion deformity of the distal interphalangeal joint due to injury to the extensor tendon.	
<b>Coxa vara</b>	If the normal angle of the neck and shaft of femur is less than 127°.	
<b>Coxa valga</b>	If the normal angle of the neck and shaft of femur is more than 127°.	
<b>Genu varum</b>	Inward angulation of knee	
<b>Genu valgum</b>	Outward angulation of knee	
<b>Genu recurvatum</b>	Hyperextension of knee	

<b>Pes planus</b>	Flat foot.	
<b>Pes cavus</b>	High arch.	
<b>Calcaneal deformity</b>	Descend heel.	
<b>Equinus</b>	Plantarflexion of ankle.	
<b>Claw toes</b>	Hyperextension of metatarso-phalangeal joint and flexion of interphalangeal joints.	
<b>Claw hand</b>	Hyperextension of metacarpo-phalangeal joint and flexion and proximal and distal interphalangeal joint.	
<b>Winged scapula</b>	Winging of the scapula due to weakness or paralysis of the serratus anterior muscle.	
<b>Sprengel's shoulder</b>	Congenital high scapula.	
<b>Dislocation</b>	Displacement of an organ or part.	

### NORMAL JOINT RANGE OF MOTION OF UPPER LIMBS

Joint	Action	Normal Range(In Degree)
Shoulder	Flexion Extension Abduction Adduction External Rotation Internal Rotation	0° -180° 0°- 50° 0°- 90°(Horizontal abduction 0°-45°) 0° - 45° 0°- 90° 0°-45°
Elbow	Flexion Extension	0° - 150° 10° hyper in male 20° hyper in female
Forearm	Supination Pronation	0°-90° 0°-80°
Wrist	Flexion Extension Radial Deviation Ulnar Deviation	0°-80° 0°-70° 0°-20° 0°-30°
Thumb (Metacarpal)	Flexion Extension Abduction	0°-50° 0° 0°-70°
(Interphalanges)	Flexion Extension	0°-80° 0°-45°
Fingers	Flexion Extension	0°-90° 10°
PIP	Flexion Extension	0°-100° 10°
DIP	Flexion Extension	0°-70° 10°

### NORMAL JOINT RANGE OF MOTION OF LOWER LIMBS

Hip	Flexion Extension Abduction Adduction External Rotation Internal Rotation	0°-130° 0°-35° 0°-45° 0°-30° 0°-45° 0°-40°
Knee	Flexion Extension	0°- 135° 0°-5° hyperextension
Ankle	Dorsiflexion Planterflexion Eversion Inversion	0°-20°(0°=90°-> Neutral position) 0°-45°(0°=90°-> Neutral position) 0°-20° 0°-35°

## **GONIOMETRY**

The term Goniometry is derived from two Greek words, gonio meaning angle and metron meaning measure. Thus, a Goniometry is an instrument used to measure angles. Within the field of physical therapy, Goniometry is used to measure the total amount of available motion at a specific joint.

Goniometry can be used to measure both active and passive range of motion. Goniometries are produced in a variety of sizes and shapes and are usually constructed of either plastic or metal.

The whole structure of the goniometry is known as body. It is designed like a protractor which may be a full or half circle. The scale can extend either from 0 degree to 180 degree and 180 degree for the half circle model or may be from 0 to 360 degree.

### **Measurement of joint motion**

It has three components:

- a) Stationary arm
  - b) Axis
  - c) Movable arm
1. The method of measuring and recording joint motion is based on the principles of the Neutral ZERO.
  2. All movements of extremities are measured in degree. Zero is the starting position and progress towards 180 degree.
  3. The Zero starting position for any single joint is identical to the anatomical position except for the radio-ulnar joint where the mid position is selected as 0 (Zero).
  4. The motion of extremity being examine should be compared to that of other extremity for comparison.
  5. Apply the Goniometry to the lateral side of the joint as much as possible.
  6. Place the "STATIONARY ARM" of the Goniometry parallel with the longitudinal axis of the fixed part.
  7. The "MOVABLE ARM" of Goniometry should be kept on the part of body which is moving.
  8. The AXIS of Goniometry is located at the prominent part of the bone laterally.
  9. The Goniometry should be held loosely.
  10. No extra weight or pressure put on the body when placing the Goniometry.
  11. It should be noted whether the motions are active or passive.
  12. The motion of a joint may be painful so handle the patient gently.
  13. The recording of joint motion should be accurate and clearly tabulated by the examiner.



### Placement of Goniometry in measurement of the joints

Joints	Action	Axis	Stationary Arm	Movable Arm
Shoulder	Flexion Extension	Lateral aspect of the glenohumeral joint 1 inch below the acromion process	Parallel to the lateral midline of the trunk	Parallel to the longitudinal axis of the humerus on the lateral aspect
	Abduction	Posterior aspect of the glenohumeral joint	Parallel to the lateral trunk	longitudinal axis of the humerus
	Horizontal abduction and adduction	On the tip of the acromion process	longitudinal axis of the humerus (perpendicular to the body)	Parallel to the longitudinal axis of the humerus
	Internal and external rotation	Olecranon process of the ulna	Perpendicular to the floor and parallel to the lateral trunk	Parallel to the longitudinal axis of the ulna
Elbow	Flexion extension	Lateral epicondyle of humerus	Parallel to the longitudinal axis of the humerus on the lateral side	Parallel to the longitudinal axis of the radius
Forearm	Supination	Parallel to the longitudinal axis of the forearm (medial aspect of ulna)	Perpendicular to the floor	Across the distal Radius and ulna on the palmar surface
	Pronation	Longitudinal axis of the forearm (outward) toward the ulnar side	Perpendicular to the floor	Across the distal radius and ulna on the dorsal surface
Wrist	Flexion extension	Over the ulnar styloid process	Parallel to the longitudinal axis of the ulna	Parallel to the longitudinal axis of the fifth metacarpal.
	Radial and ulnar deviation	On the dorsal aspect of the wrist joint lined with the base of the third metacarpal	Along the midline of the forearm on the dorsal surface	Along the midline of the third metacarpal.
Thumb	Metacarpal (MP) phalangeal flexion, extension	On the dorsal aspect of the MP joint	On the Dorsal aspect midline of the first MP metacarpal	On the dorsal aspect midline of the proximal phalanx of the thumb



	Abduction	On the radial side of the wrist at the junction of the first and second metacarpals	Second metacarpal on the lateral aspect	Dorsal aspect of first metacarpal.
Finger metacarpal phalangeal	Flexion, Extension	On the dorsal surface of the MP joint of the finger being measured	On the dorsal surface along the midline of the metacarpal of finger being measured	On the dorsal surface along the midline of the proximal phalanx of the finger being measured
Hip	Flexion, Extension	On the lateral aspect of the hip about 1 inch inferior from greater trochanter	Perpendicular to the Anterior Superior iliac spine	Midline of the femur lateral aspect of thigh pointing toward the lateral condyle of the femur.
	Abduction, Adduction	On the anterior superior iliac spine of the side being measured	On a line between the two anterior superior iliac spine	Parallel to the midline of the femur on the anterior side of thigh pointing toward the patella.
	Internal and external rotation	Centred on the knee joint over the patella	Perpendicular to the floor	Midline of the tibial shaft
Knee	Flexion, extension	Lateral condyle of tibia	Midline of the femur on the lateral aspect of thigh	Lateral midline of the lower leg pointing toward the lateral malleolus.
Ankle	Dorsiflexion, Planterflexion	On the lateral aspect of the Ankle joint approximately one inch below the lateral malleolus	Midline of the lateral aspect of lower leg pointing forward the head of fibula	Parallel to the fifth metatarsal.

## MANUAL MUSCLE TESTING (MMT)

Manual Muscle Testing is a part of physical examination. It provides useful information in diagnosis, prognosis and treatment of neuro-muscular and muscular-skeletal disorders. One of the reasons of muscle weakness is peripheral nerve damage, but in some cases it is generalized therefore it is important to test individual muscles to find out the degree of muscle weakness and the degree of paralysis of muscles.

Strength of the muscles can be tested by different methods, such as dynamometer, or manual resistance. In HRDC, we are now talking about manual muscle Test, which is the application of resistant by the therapist to the voluntary contraction of the patients' muscles.

### Purpose

Muscle testing is indicated in any patient with suspected or actual impaired muscle performance, including strength, power, or endurance. Identification of specific impaired muscles or muscle groups provides information for proper treatment.

### Precautions

It is important to determine the patient's ability to withstand the force to be applied. Proper positioning is important; as is instruction in breathing techniques (avoid the Val Salva). Remember to assess surrounding area for ability to sustain muscle test. In the case of a recent fracture, post-surgical, or other tissue healing, consider post-poning muscle test.

MMT is widely used in the physical therapy setting. Patients are asked to hold a position against a therapist's resistance.

- stabilize proximal part of the area being tested to reduce compensatory action by muscles other than those being tested
- resistance needs to be applied gradually ("meet my resistance" or "don't let me move you") in the opposite direction of muscle being tested
- both sides should be tested to provide a comparison

### Muscle Testing Grading System

0 (zero)	Paralysis (no muscle contraction)
1 (Trace)	Flicker muscle contraction but no motions occurs at that joint
2 (Poor)	The part moves through full range of motion on a gravity elimination position.
3 (Fair)	The part moves through full range of motion against the gravity with no resistance.
4 (Good)	The part moves through full range of motion against the gravity moderate resistance.
5 (Normal)	The part moves through full range of motion against the gravity with maximum resistance

(It is different for persons on different ages, sexes, and occupations)

(Always compare with normal limb)

### Suggested positions for Muscle Testing

#### Supine:

Joints	Muscles	Grade
Neck	Flexor	All tests
Trunk	Flexor Rotator	All tests All tests except poor
Pelvic	Elevator	All tests
Hip	Flexor Abductor, Adductor, Internal, External Rotator	Trace and Zero Poor Trace and Zero
Knee	Extensor	Trace and Zero
Scapula	Protractor	Fair, good, normal
Shoulders	Flexor Abductor Adductor (horizontal)	Trace and Zero Poor, Trace and Zero Normal, good and fair
Elbow	Flexor Extensor	Poor, Trace and Zero All tests

#### Prone Lying:

Joints	Muscles	Grade
Neck	Extensor	All tests
Trunk	Extensor	All tests
Hip	Extensor	All tests except poor
Knee	Flexor	All tests except poor
Ankle	Planter flexor	All tests except poor
Scapula	Retractor Elevator Depressor	Fair, Good and Normal Poor, Trace and Zero All tests
Shoulders	Extensor Horizontal abductor External Rotator Internal Rotator	All tests Normal, good and Fair All tests All tests

**Sidelying:**

<b>Joints</b>	<b>Muscles</b>	<b>Grades</b>
Hip	Flexor Extensor Abductor Adductor	Poor Poor Fair, Good, Normal Fair, Good, Normal
Knee	Flexor Extensor	Poor Poor
Ankle	Planterflexor	Poor, Trace & Zero
Foot	Evertor	Fair, Good, Normal

**Sitting**

<b>Joints</b>	<b>Muscles</b>	<b>Grades</b>
Trunk	Flexor	Poor
Hip	Flexor External Rotator Internal Rotator	Fair, Good, Normal Fair, Good, Normal Fair, Good, Normal
Knee	Extensor	Fair, Good, Normal
Ankle + Foot	Dorsiflexion with inversion	Zero, Trace, Fair, Good, Normal
Cross Leg Sitting	Ankle Dorsiflexion	Poor
Ankle	Plaster Flexor	Zero, Trace & Zero
Scapula	Protractor Retractor Elevator	Poor, Trace & Zero Poor, Trace & Zero Fair, Good, Normal
Shoulder	Flexor (to 90°) Abductor (10° - 90°) Horizontal Abductor Horizontal Adductor	Fair, Good, Normal Fair, Good, Normal Poor, Trace and Zero Poor, Trace and Zero
Elbow	Flexor	Fair, Good and Normal

- \* All tests for Forearm, Wrist, Fingers, and Thumb should be given in the sitting position with Forearm and hand resting on a table.

**Standing:**

<b>Joints</b>	<b>Muscles</b>	<b>Grades</b>
Elevator of Pelvic		Alternate Fair
Ankle	Planter Flexor	Fair, Good, Normal

## PRINCIPLES OF EXERCISE

The following principles are applied to ALL form of exercise.

1. Patient must be in comfortable position without pain.
2. Proximal joint must be stabilized to eliminate other joints motion.
3. All motions should be done smoothly throughout the ROM.
4. Avoid over exercises which cause pain.
5. Several short exercise periods are better than one prolonged period.
6. Periodic follow-up and progress evaluation.
7. Patient must understand the purpose of exercise and how it is done.
8. Exercise should be done slowly.
9. Exercise should always be done under control.

## Proper Body Mechanics

DO's	DON'Ts
Do lift your legs	Don't lift your arms
Do push objects	Don't pull objects
Do keep your back straight	Don't twist
Do keep your knees bent while lifting an objects	Don't keep knees straight
Do keep feet apart	Don't keep them together
Do hold the object close to you	Don't hold them away from your body
Do face the direction of movement	Don't rotate the trunk
Do ask for help, if necessary	Don't ignore the problem



## THERAPEUTIC EXERCISES

### A. Range of Motion (ROM) Exercise

Movement of a body segment moves with the help of muscles or any external forces. Bones move each other in the joint. The structure of the joint affects the amount of the motion that can occur between any two bones. The full motion is called the Range of Motion (ROM). The amount of movement which can be obtained at each joint in the body is called ROM.

#### Types

- a. Passive ROM exercise
- b. Active - assistive ROM exercise
- c. Active ROM exercise

#### a. Passive ROM Exercise

Movement which is produced or done by external force or by somebody is called passive ROM. There are no voluntary muscle contractions.

##### Indications

- Unconscious Patient
- Paralyzed Patient

##### Goals

- To prevent joint contractures
- To improve circulations
- To help in maintaining the awareness of movement
- To maintain the joint and soft-tissue mobility



#### b. Active - Assistive ROM Exercise

A type of active ROM in which assistance is provided by an outside force (somebody), either manually or mechanically.



#### c. Active ROM Exercise

Movement which is produced by an active contractions of the muscles crossing the joint.



#### Contra-Indications of Range of Motion

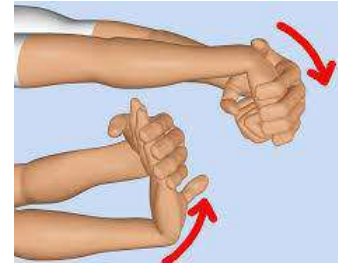
- A. Both passive and active ROM is contraindications in some cases, such as
  - recent tear of ligaments and tendons
  - unhealed fracture
  - immediately following surgical procedures to tendon ligaments and skin
- B. Active ROM is contraindicated when the cardiovascular condition of a patient is unstable.

## **Limitation of Range of Motion Exercise**

- A. Limitations of passive Range of Motions. True passive relaxed motion may be difficult to obtain when patient is conscious.
- B. Passive ROM will not
  - prevent muscle atrophy
  - decrease strength

## **B. Stretching Exercise**

Mobility and flexibility of the soft tissues which surround a joint such as muscles, connective tissues and skin and adequate joint mobility, are necessary for normal range of motions. Sometimes some factors may produce to decrease stretching of muscles around the joint e.g. prolonged immobilization, restricted mobility, any diseases, trauma or congenital deformities. For the proper joint mobility they have to stretch. Stretching is a term used to describe any therapeutic exercises designed to lengthen shortened soft tissues and to increase range of mobility.



### **Types**

#### **a. Passive Stretching Exercise**

This is done by any external force or manual to lengthen the shortened tissues. During the passive stretching, patient should be in relaxed position.

#### **b. Active Stretching Exercise**

The patient participates to stretch the tight muscles.

### **Indications**

1. Limited ROM caused by contractures, adhesions, scar tissues.
2. Skeletal structural deformities
3. Tight muscles

### **Goals**

The main goal of stretching is to re-gain or re-establish normal range of motions of joints and mobility of soft tissues that surround a joint.

### **Specific Goals are**

- Prevent contractures
- Increase the flexibility of joint

### **Contraindications**

- Bony blocks in joint
- Acute inflammatory or infection process
- Acute pain
- Recent fracture
- Hematoma
- Myositis ossificans

When contractures or shortened soft tissues are the basis for increase functional abilities, particularly in patient with paralysis or severe muscle weakness.

### **Contracture**

Contracture refers to a marked decrease in the length of soft tissues leading to a significant loss of joint mobility. For example: If a patient has tight elbow flexors and cannot fully straighten the elbow, he is said to have an elbow flexion contracture.

### **C. Strengthening Exercise**

Strengthening Exercise is one of the therapeutic muscle strengthening exercises. Muscles may be weak from disuse, immobilization or disease. The main goal of the Strengthening Exercise is to maintain the muscle power and increase the strength of weak muscles.



#### **Types**

Strengthening Exercise can be divided into two types:

- a) Isometric Strengthening Exercise
- b) Isotonic Strengthening Exercise

#### **a) Isometric Strengthening Exercise**

It is a static form of exercise that occurs only muscle contracts without changes in length of the muscles or without visible joint motion. This type of exercise is useful in those patients who have long leg cast, patients with fracture of bones of upper and lower limb acute inflammation, weak muscle of body etc.

#### **b) Isotonic Exercise**

Isotonic Exercise is a dynamic form of exercise that is carried out with resistance. In this exercise, we can gain resistance manually or weight or equipment. Manual Resistance exercise is an active resistance strengthening Exercise in which resistance is given by Therapist.

#### **Goals**

- Increase strength
- Increase endurance

#### **Contraindications**

- Inflammation
- Severe pain

## GAIT ANALYSIS

Human gait refers to locomotion achieved through the movement of human limbs. Human gait is defined as bipedal, biphasic forward propulsion of center of gravity of the human body, in which there are alternate simultaneous movements of different segments of the body with least expenditure of energy. Different gait patterns are characterized by differences in limb movement patterns, overall velocity, forces, kinetic and potential energy cycles, and changes in the contact with the surface (ground, floor, etc.).

### Gait components

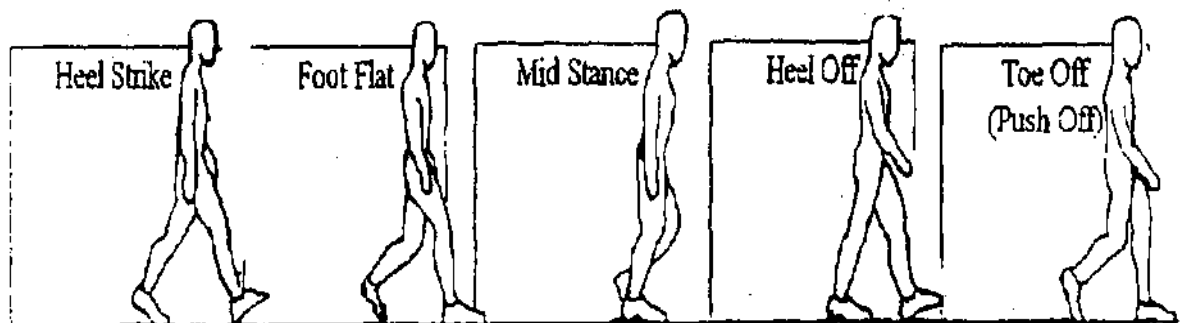
- Average step width : 8cm. (2" -4")
- Average step length: 14-16"
- Cadence- Rate of walking
- Average 112 steps/ minute
- When one leg is in stance phase the other leg is in swing phase

### Phases of normal gait

#### A. The stance phase

This forms 60 percent of the gait and the foot is on the ground. it is further divided into:

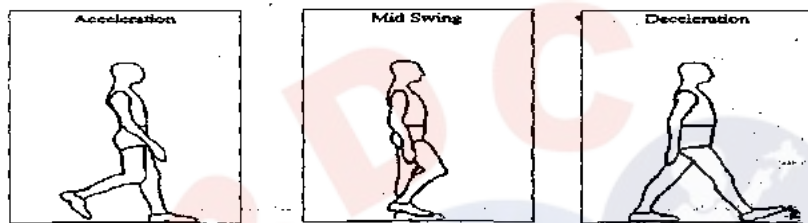
1. Heel strike: Initial contact, heel striking on the ground. Observed 30 degree of hip flexion and full extension of knee. The ankle moves from neutral.
2. Foot flat: Pre- Loading response. Hip moves slowly into extension. Knee flexion to 15 degree to 20 degree.
3. Mid stance: In mid-stance, hip moves from 10 degree flexion extension by contraction of gluteus muscle. Knee reaches maximal flexion and then extension. Ankle becomes 5 degree of dorsiflexion.
4. Heel off: Begins when the heel leaves the floor. in this phase, 10 degree to 15 degree of hip hyperextension, then goes into flexion. Knee becomes flexed from 0 degree to 5 degree.
5. Toe off: Pre-Hip becomes less extended. Knee flexed 35 degree to 40 degree and ankle planter flexion to 20 degree. Also known as toes leave the ground.



## B. The swing phase

This forms 40 percent of the gait cycle and here the foot is not contact in the ground. It is further divided into 10 degree then into flexion due to contraction of Iliopsoas muscle.

1. Acceleration: Leg is in front of the body. Hip extends to 10 degree then in flexion due to contraction of Iliopsoas muscle.
2. Mid swing/swing through: leg continues to swing forward. Hip flexes to 30 degree, ankle becomes dorsiflexion due to contraction of Tibialis anterior. The knee flexes 60 degree but then extends approximately 30 degree.
3. Deceleration: Late swing slows down and the heel is ready for the strike. Hip flexion goes to flexion up to 25 degree to 30 degree. Locked extension of knee and neutral position of ankle.



In the normal gait, each leg alternatively goes through a stance phase and a swing phase. Thus the body is carried forward in normal walking in these rhythmical cycles.

### Types of abnormal gait

1. Antalgic gait : Duration of stance phase decreased any painful lesion of foot, knee, hip, etc.
2. Gluteus medius gait : Lurch of the body towards the affected side during every stance phase, eg; weak or paralysis of gluteus medius muscle.
3. Gluteus maximus gait : Backward lurch, eg; Poliomyelitis.
4. High stepping gait : To clear the dropped foot from the ground, eg; Foot drop.
5. Scissor gait : Legs cross while walking, eg; Cerebral Palsy.
6. Short leg gait : when shortening is > 2 inch, eg; Limb shortening might be from congenital or acquired.
7. Stiff hip gait : No flexion at hip, eg; septic arthritis of hip.
8. Quadriceps gait : Limping gait with hand on knee, eg; Poliomyelitis
9. Trendelenburg gait : Pelvis drop on opposite side of the hip, eg; dislocation of hip joint.
10. Calcaneus gait : No push off, walks on heel, eg; weak gastro-soleus muscles.
11. Stiff knee gait : Pelvis raised during swing phase, eg; Stiff knee.
12. Ataxic gait : Child walks with leg apart, eg; Cerebellar ataxia, Cerebral Palsy.



## **Gait Analysis**

It is the systematic study of human locomotion, more specifically the study of human motion, using the eye and the brain of observers, augmented by instrumentation for measuring body movements, body mechanics, and the activity of the muscles. Gait analysis is used to assess, plan, and treat individuals with conditions affecting their ability to walk. It is also commonly used in sports biomechanics to help athletes run more efficiently and to identify posture-related or movement-related problems in people with injuries.

### **Factors and parameter**

The gait analysis is modified by many factors, and changes in the normal gait. The factors can be of various types:

- Extrinsic : such as terrain, uneven surface, footwear, clothing, Intrinsic: sex (male or female), weight, height, age, etc.
- Physical : such as weight, height, physique.
- Psychological : personality type, emotions.
- Physiological : anthropometric characteristics, i.e, measurements and proportions of body.
- Pathological : for example trauma, neurological diseases, musculoskeletal anomalies, psychiatric disorders.

**The parameters are taken into account for the gait analysis is as follows:**

- Step length
- Stride length
- Cadence
- Speed
- Base of support
- Foot Angle
- Hip Angle

### **Pathological gait**

Pathological gait is an altered gait pattern due to deformities, weakness or other impairments, for example, loss of motor control or pain. Alterations can broadly be divided into neurological or musculoskeletal causes.

### **Musculoskeletal cause**

Pathological gait patterns resulting from musculoskeletal are often caused by soft tissue imbalance, joint alignment or bony abnormalities. Infliction of these on one joint often then impacts on other joints, affecting the gait pattern as a result. The common deviation can be categorized broadly are:

- Hip pathology
- Knee pathology
- Foot and ankle pathology
- Leg length discrepancy
- Pain

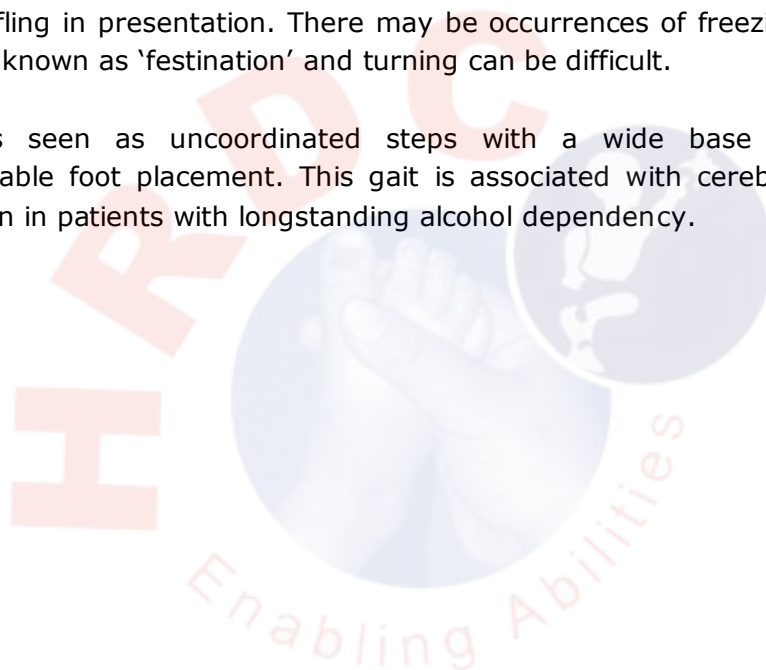
## **Common Neurological gait**

**Hemiplegic Gait**, often seen as a result of a stroke. The upper limb is in a flexed position, adducted and internally rotated at the shoulder. The lower limb is internally rotated, knee extended and the ankle inverted and plantar flexed. The gait is likely to be slow with circumduction or hip hiking of the affected limb to aid floor clearance.

**Diplegic Gait**, Spasticity is normally associated with both lower limbs. Contractures of the adductor muscles can create a 'scissor' type gait with a narrowed base of support. Spasticity in the lower half of the legs results in plantar flexed ankles presenting in 'tip toe' walking and often toe dragging. Excessive hip and knee flexion is required to overcome this.

**Parkinson's Gait** often seen in Parkinson's disease or associated with conditions which cause Parkinson. Rigidity of joints results in reduced arm swing for balance. A stooped posture and flexed knees are a common presentation. Bradykinesia causes small steps which are shuffling in presentation. There may be occurrences of freezing or short rapid bursts of steps known as 'festination' and turning can be difficult.

**Ataxic Gait** is seen as uncoordinated steps with a wide base of support and staggering/variable foot placement. This gait is associated with cerebella disturbances and can be seen in patients with longstanding alcohol dependency.



## **BASIC GUIDELINES FOR PHYSICAL ASSESSMENT OF PATIENT**

### **1. OBSERVATION**

#### **I. General appearance:**

- Healthy or malnourished.
- Clean or dirty.
- Well cared or neglected.
- Child playing with other children participates in family work or isolated?

#### **II. Skin**

- Anaemic / Pale
- Wounds
- Sores

### **2. HISTORY TAKING (Subjective)**

Ask questions to patient or guardian on the following areas:

- Main problems of the child.  
(Pain, weakness, deformity, walking ADL)
- When did it start? How did it happen?
  - a) From birth?
  - b) From trauma?
  - c) From febrile illness?
- Pre and post natal history
- Developmental history
- Previous treatment done eg. Surgery, Dhama, Jhankri, Baidhya etc.
- Medications
- Previous condition (Find out if there has been previous treatment taken for the problem and what result at the treatment was)
- Family history
- Vaccination
- Home environment
- Expectation

**Pain assessment:** (Numerical pain rating scale)

### **3. OBJECTIVE**

#### **Observations:**

- General Health
- Atrophied muscles of limbs and trunk
- Deformities
- Shortening of limbs (upper or lower)
- Skin colour and condition

## **PALPATION**

Skin temperature - inflammation

Soft tissues tightness or contractures or bony abnormalities (ankylosed), limitations and hyper mobile of joints.

Range of motion

- a) Active ROM
- b) Passive ROM

Chest

- SOB
- Apical breathing.
- Lat. costal breathing.
- Diaphragmatic breathing.

Leg length

- True
- Apparent

Posture / Body

- Kyphosis
- Scoliosis
- Lordosis

Hand functions

- Pulp to pulp
- Key pinch
- Grasp
- Hook grasp
- Spherical grasp

Sensation

- Hot and Cold
- Light touch
- Ball pen prick (Adapted)

Neurological Assessment

- Muscle Tone
  - Spastic
  - Flaccid
  - Normal
- DTR
  - Normal
  - Increased
  - Decreased

- Developmental Level
  - Head and neck control
  - Rolling
  - Sitting
  - Crawling
  - Standing
  - Walking
- Body Balance
  - Sitting
  - Standing
  - Walking

#### Activities of Daily Living (ADL)

- Feeding
- Dressing and undressing
- Personal hygiene
- Buttoning and unbuttoning
- Tying "Pyjama String" and Shoe laces.
- Toileting and cleaning after toilet

#### Functional Mobility

- Stairs up and down
- Squatting
- Cross leg sitting

#### Transfer (from bed to floor and floor and bed)

#### Gait Pattern:

- Equines
- Limping
- Foot Drop
- Spastic
- other

#### Distance (in meter)

#### Duration (in minute)

#### **Assistive devices being used:**

- Sticks/Cane
- Walker
- Crutches
- Wheel chair etc.



### Equipment / Orthopaedic Appliances:

- Club shoes
- AFO
- KAFO
- Spinal Brace
- Prosthesis
- Splints/slabs.

### 4. ANALYSIS

List out the problems with priority:

- Pain
- Wound
- Swelling
- Limitation of joint mobility/decrease range of motion of joint
- Decrease muscle strength/weakness of muscles of limb
- Posture problem
- Delayed developmental milestone
- Hand function problem
- ADL problem ( be specific)
- Ambulatory (walking) problem

### 5. PLAN

Short Term Goal	Long Term Goal
<ul style="list-style-type: none"><li>• Decrease Pain</li><li>• Control Infection</li><li>• Decrease swelling</li><li>• increase joint mobility</li><li>• increase muscle strength</li><li>• improve development level</li><li>• improve hand function</li><li>• Upgrade ADL</li><li>• Improve the posture</li><li>• Improve ambulation</li><li>• Consultation with Doctors</li><li>• Elective Date if necessary</li></ul>	<ul style="list-style-type: none"><li>• Fully plantigrade of feet and independent ambulation.</li><li>• Straighten the leg/legs, fit with outhouses then independent ambulation</li><li>• Independent ambulation without outhouses.</li><li>• Independent ambulation with prosthesis.</li><li>• To gain the proper hand function and help in ADL.</li><li>• Bi-manual use of both hands and independent in ADL.</li><li>• Independent wheel chair mobility</li><li>• Improve developmental Level etc.</li></ul>

## PHYSIOTHERAPY TREATMENT AND ADVICES

<b>Aims</b>	<b>Methods</b>
Decrease Pain	Rest, Elevation, Splint
Decrease swelling	Elevation, Active ROM exercise
Increase the joint motion	Active assistive and passive stretching exercise
Maintain joint mobility + prevention from deformities	Active, Active assistive and passive ROM exercise, Splint
Increase muscle strength	Isometric or isotonic strengthening exercise
Maintain the strength of limb	Isometric and isotonic strengthening exercise
Improve the hand function	Hand functioning activities - picking up different objects and game therapies.
Improve the developmental level	Developmental exercise. eg. Head and neck control.
Ambulation Training	Progressive ambulation parallel bar to walker to crutch to without crutch

## **SPLINT**

### **Definition**

Splint is an external assistive device which is used to a person's body to assist in a certain way. Splinting plays a major role in the management of musculoskeletal injuries, particularly those involving extremity fractures and joint dislocations. Immobilization of the extremity through splinting decreases pain and bleeding and prevents further soft tissue, vascular, or neurologic compromise. Splinting may provide definitive treatment for some injuries. Compared with casts; splints permit swelling and may prevent neurovascular compromise. The clinician should perform splinting immediately after the injury and maintain splinting or casting until the injury has healed completely.

Splinting techniques are used to treat musculoskeletal system abnormalities. The main indications for splinting are to temporarily immobilize a limb for pain and spasm, to decrease swelling, and to minimize further potential soft tissue or neurovascular injuries associated with contusions, sprains, lacerations, fractures, dislocations, or painful joints due to inflammatory disorders.

### **Functions**

- To immobilize the affected part.
- To prevent the deformities and contractures.
- To support the weak muscles.
- To decrease the pain and swelling.
- To promote the relaxation.

### **Indications**

Indications for splinting include the following:

- Temporary immobilization of sprains, fractures, and reduced dislocations
- Control of pain

### **Contraindications**

There are no absolute contraindications to the use of splints in the emergent setting or in the field to stabilize for transport. For use as a temporary immobilizing device either until follow-up (eg, for stable fractures) or until definitive treatment can be performed (e.g. ankle fractures), relative contraindications include the following:

- Open fractures
- Impending compartment syndrome
- Neurovascular compromise

### **Basic principle**

Basic rule of splinting is that the joint above and below the broken bone should be immobilized to protect the fracture site. For example, if the lower leg is broken, the splint should immobilize both the ankle and the knee. Pulses and sensation should be checked below the splint at least once per hour. If the person complains of tightness, tingling, or numbness, the wrapping material should be released completely, and the splint should be rewrapped more loosely.

## Types

- a) Static Splint
- b) Dynamic Splint

### a) STATIC SPLINT



### b) DYNAMIC SPLINT



## Classification

1. Spinal Splint
  - Neck collar
  - Spinal Braces
2. Upper Limb Splint
  - Axillary (Aeroplane) Splint
  - U Slab (for shoulder joint)
  - Elbow Splint
  - Wrist Splint
  - Thumb Spica (C - Bar)
  - Finger Splint
3. Lower Limb Splint
  - Hip Splint/ T- Splint
  - Knee Splint
  - Ankle/Foot Splint ( Short leg Splint )

## How to make Splint?

Splints can be made from different materials:-

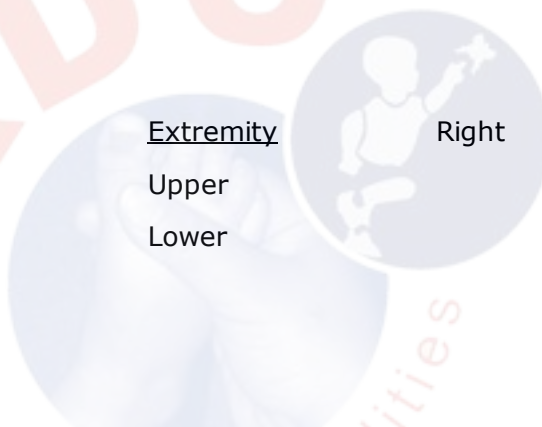
- Thermoplast
- Plaster of Paris (POP)
- Others: Card Board, wires, bamboo, metal, plastic pipe, old x-ray etc.

## Procedure

- Measurement (Wastage)
- Out Figure (Shape)
- Hot water/ warm water (depends on the materials)
- Cut the material (modification)
- Put modified material on the part.
- Correction of joints/parts.
- Finalize (Edges- smooth)
- Bandaging/ Velcro
- Proper fit / Adjust
- Watch for sign of tightness.

## How to use splint?

Depends on:

<u>Site</u>	<u>Direction</u>	<u>Extremity</u>	Right	Left
Anterior	Proximal	Upper		
Posterior	Distal	Lower		
Medial				
Lateral				

## Precautions

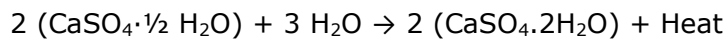
- Check for swelling.
- Redness at edges blisters.
- Well fitted / small / broken
- Cleanliness ( Wash - depends on materials )
- Remove splint in between the exercise.
- Adjust the splint as necessary.
- Home advice/ family education.



## CAST

An orthopedic cast, body cast, plaster cast, or surgical cast, is a shell, frequently made from plaster or fiberglass, encasing a limb (or, in some cases, large portions of the body) to stabilize and hold anatomical structures, most often a broken bone (or bones), in place until healing is confirmed. It is similar in function to a splint.

Plaster bandages consist of a cotton bandage that has been combined with Plaster of Paris, which hardens after it has been made wet.



The setting of unmodified plaster starts about 10 minutes after mixing and is complete in about 45 minutes; however, the cast is not fully dry for 72 hours.

Nowadays bandages of synthetic materials are often used, often knitted fiberglass bandages impregnated with polyurethane, sometimes bandages of thermoplastic. These are lighter and dry much faster than plaster bandages. However, plaster can be more easily moulded to make a snug and therefore more comfortable fit. In addition, plaster is much smoother and does not snag clothing or abrade the skin.

### Types

#### 1. Upper extremity casts

- i. Shoulder spica
- ii. Long arm cast
- iii. Below elbow cast / Short arm cast (Colles cast)
- iv. Thumb spica



#### 2. Lower extremity casts

- i. Hip spica
- ii. Long leg cast
- iii. Above knee cast
- iv. Cylindrical cast
- v. Patello tendon bearing cast
- vi. Below knee cast



## **Mobility and hygiene**

Mobility is severely restricted by the hip spica cast and walking without crutches or a walker is impossible because the hips cannot bend. There is a serious danger of falling if the patient in a hip spica cast tries to get upright to walk without assistance because they lack the ability to control their balance.

Patients are normally confined to a bed or reclining wheelchair, or children's stroller. Children in spica casts can sometimes learn to get mobile by scooting around on skateboards, or pulling themselves across the floor. Some children even learn to walk by holding themselves up against furniture. A child in a spica cast must always be supervised and safety must always be considered when they are at a mobile phase of their healing to prevent reinjury or damage to the cast.

Many spica casts have a spreader bar between the legs to help strengthen the cast and support the legs in the proper positions. It is important when moving the casted patient to not lift them by this spreader bar, as it may break and this could cause injury to the patient. To facilitate toileting or diaper changing and hygienic cleaning, an opening is created in the cast at the groin. The opening is normally referred to as the "perineal opening". It is formed either during cast application or after cast application by cutting the hole with the cast saw.

The opening must then be lined to keep this area of the cast clean and dry. Because the hips cannot bend, using a toilet is difficult, if not impossible. It is therefore necessary for the patient to use a diaper, bedpan, or catheters to manage bodily waste eliminations. Bathing must be done by sponge baths. Hair may be shampooed by using plastic wash basins under the head. To shampoo wash the hair of a child, the child can be lifted and placed on a kitchen counter top and their head held over the kitchen sink.

## **Sign/symptoms of tight cast**

- Severe pain on passive extension of fingers or toes.
- Swelling
- Paleness, progress into bluish colour
- Paraesthesia (change in sensation)
- Paralysis (may or may not)

## **Complications**

- Cast sores / Pressure sore
- Compartment Syndrome (Volkman's Ischaemic Contracture)

## **Other complication**

- Cast become too tight or too loose
- Skin is red or raw around cast
- Excessive swelling under the cast.
- Pain in the affecting limb.
- Burning sensation under the cast.
- Inability move finger or toes of the affective part.
- Foul smell from the cast.

### **Loose cast**

- Not maintain joint in correct position.
- Not stretch soft tissues as required.
- Not immobilize the fracture site.
- Falls down.

### **Physiotherapy Management**

#### **Aim**

- To prevent from muscle atrophy and muscle weakness on affected limb.
- To maintain the strength and joint mobility of unaffected part.
- To prevent bedsores.
- To encourage bed mobility and functional mobility.

#### **Treatment Methods**

- Isometric strengthening exercise for affected part.
- Resisted strengthening exercise for unaffected part.
- Pressure release exercise and positioning.
- Gait training.
- ADL encouragement.

#### **Instructions and home advices**

- Elevation
- ROM strengthening exercise according to the type of cast.
- General strengthening exercise. (Breathing exercise, upper extremity, trunk and abdominal strengthening exercise.)
- Functional exercises (ADL, Games, and ambulation).

## WALKING AIDES

Walking aids are tools use to maintain mobility and independence. It is used to:

- Decrease the effort and energy required to walk.
- Decrease the weight on an injured, fragile or weak leg.
- Compensate for a lack of balance.
- Reduce the risk of fall.

### Types of walking aids

#### 1. Parallel Bars

Parallel Bars are rigid and do not have to move by the patient. It can be made easily from metal pipe, wood or bamboo. Parallel bars are often used when the patient is not stable or initially to develop a particular pattern of gait. Patient is taught the correct sequence of arm and lower limb movement.

##### Advantage :

- Maximum support
- Comfortable
- Rigid and stable

##### Disadvantage :

- Takes large space
- Unmovable
- Increase dependency



#### 2. Walkers

Walking frames tend to be used by those with poor balance and/ or weak legs. A walking stick can off-load 25 percent of the user's weight compared to a frame which can transfer 64 percent of the user's weight through the arms. This weight re-distribution from legs to arms can help reduce leg pain.

Once the patient is confident to walk on a parallel bar, he/she was taught to walk on a walker. If parallel bars are not available, walker is very useful initially when a patient is unstable and fearful of falling.

- With wheel
- Without wheel

##### Advantage :

- Wide base
- Mobile
- Stable
- Light and cheap
- Can used by neurological patient.

##### Disadvantage :

- Difficulty in up and down the stairs
- Takes large space
- Not strong
- Cannot used by fat patient



#### 3. Crutches

There are different ways of using crutches such as two point gait, three points, four point and swing-to and swing-through gait, so it is not appropriate for us to give guidance on use, you need individual advice. There are three main types of crutches axillary, elbow and forearm crutches. It can be made by metal, wood or bamboo. During the use of the axillary crutch, it should be "3" fingers below the armpit, so that it does not press under the armpit.

#### Advantage:

- Easy mobility
- Able to up and down the stairs
- Like a natural gait
- Light and cheap
- Looks better than a walker

#### Disadvantage:

- Less support
- Can cause nerve palsy
- May cause trauma if in slippery or watery place
- Cannot used by fat patient

#### **During use of crutch we should follow the following instructions**

- The strength of muscles of upper limb and trunk.
- A good sense of balance.
- Familiarity with the crutches and their maintenance.
- The correct crutch stance.
- How to stand and balance with crutches before taking any steps.
- The pattern of gait.
- Initial gait training on parallel bar if necessary.
- Instructions and practice in walking.

#### **Crutch walking**

There are four different patterns of gait

1. Swinging crutch gait
  - swing to
  - Swing through
2. Four- point crutch gait- Full weight bearing (FWB)
3. Two- point crutch gait- Non weight bearing (NWB)
4. Three -point crutch gait- Partial weight bearing.



#### **Walking on stairs with Cane or crutch to go up the stairs**

- Strong leg first on first stairs.
- Bring weak leg up to the same stair with raising the body up with strong leg.
- Then bring Crutch/Cane up to same stair together.
- Repeat same procedure for another step.

#### **To go down the stair**

- Crutch /Cane first on first stair.
- Bring weak leg in the same stair raising the body
- Then bring the strong leg in the same stair.
- Repeat the process



#### **4. Canes /stick**

Walking cane tend to be used by those with moderately reduced balance. The hand they should be held in will depend on whether you have one leg or side stronger than the other and on whether you are right or left handed so you need individual advice on this. Likewise, there are also different ways of using them such as stick and involved legs moved first or stick first.



## **Types of walking stick**

### **1. Wooden**

These traditionally have a crook handle and are cut to the correct height. They are available in various diameters and strengths which are designed to take different loads. They are not as adaptable for use by different people as metal sticks.

### **2. Metal**

These tend to be stronger than wooden walking sticks. Some are fixed length, others are height adjustable. Metal sticks are available with right angled handles, crook shaped handles or anatomically shaped handgrips. The ferrules of metal sticks must incorporate a metal disc to prevent the end of the stick cutting into the rubber.

## **Factors involved in choosing walking aids:**

- Age of patient
- Disability
- Physical condition

## **Purpose of walking aids**

Walking aides are usually used for one of two purposes:

- as a part of rehabilitation program, when a person is recovering from an injury or surgery;
- as a long-term aide to mobility, when a user has permanent difficulty with walking.

## **Function**

- Provide stability and balance by providing a wider support base
- Facilitate walking pattern in terms of speed and evenness of stride.
- The aids may also help maintain an upright body posture
- Increase confidence in walking ability
- Weight redistribution - some of the weight carried through the legs when walking is transferred through the arms of the frame or stick as it is leant on for support. This may help reduce pain in the joints, muscles and ligaments in the lower limb shaking aid may improve your mobility.

## **Correct selection of a walking aid for a particular patient is very important and depends upon**

- Stability of the patient.
- Strength of the patient's upper limb lower limbs and trunk muscles.
- Degree of coordination of movement of upper and lower limb.
- Degree of relief from weight bearing required.

## **Muscles those are used during use of walking aids**

- Flexors of the fingers and thumb to hold the hand grip firmly.
- Wrist Extensors to stabilize the wrist in extension.
- Extensors (Triceps) of elbow to stabilize the elbow slight flexion when the body weight is taken through the upper limb.
- Flexors of the shoulder to move the walking aid forward.
- Depresses of the shoulder girdle to support the body weight.

### **Safe use of walking aids:**

- Walking equipment may improve your mobility but, if an inappropriate walking device is used, if incorrect techniques are adopted. Advice about walking aids from the professionals. Other factors that should be looked at to minimize the risk of falling whilst using a walking device include:

### **Home environment**

Loose rugs, trailing flex, a cluttered floor area are all potential hazards.

### **Stairs**

If you have stairs in your house and use a walking frame obtain a second one and keep one upstairs and one downstairs. Do NOT attempt to take a walking frame up and down stairs.

### **Standing from a chair**

Do not attempt to use a walking frame to rise from a chair as you may pull the frame on top of yourself. You should push up with your hands on the arms of the chair and only hold the frame once standing. If necessary ask to practice this with a health care professional.

### **Wet floors**

Walking equipment should not be used in wet floor areas.

### **Footwear**

Footwear should be appropriate and supportive.

### **Maintenance of the walking aids**

All walking equipment should be checked regularly for signs of wear and tear. Particularly vulnerable parts include the ferrules, which must be replaced if the slip-resistant rings or bobbles on their underside lose their definition, or if the rubber shows signs of cracking. Equipment that is height adjustable can show signs of stress at the height setting after prolonged use. Handgrips can also become worn.

Replacement ferrules are usually available from the issuing department, for example the hospital physiotherapy department or. If we feel that walking device is structurally no longer safe to use, inform the issuing department which may provide with a replacement. If we have bought our walking device privately, then we are responsible for maintenance and upkeep. Replacement parts are usually available from the commercial outlet from which we bought the equipment, ferrules are widely available.

### **Learning to use walking aids**

Users with reduced cognitive functioning may not be able to learn, or remember how to use a frame. Hence an assessment with a health care professional is very important.

### **Progression of walking**

1. Parallel bar
2. Walker
3. Crutches; Forearm crutch/ elbow crutch
4. 2 cane
5. 1 cane
6. No cane

## Developmental Milestone

Developmental milestones are easily identifiable skills that the baby can perform, such as rolling over, sitting up, and walking. These milestones are usually classified into three categories:

- motor development,
- language development, and
- social/emotional development

**Table of milestones**

Developmental Milestones				
Age	Motor	Speech	Vision and hearing	Social
1–1.5 months	When held upright, holds head erect and steady	Coos and babbles at parents and people they know	Focuses on parents.	<ul style="list-style-type: none"> <li>• Loves looking at new faces</li> <li>• Starts to smile at parents</li> <li>• Startled by sudden noises</li> </ul>
1.6–2 months	When prone, lifts self by arms; rolls from side to back.	Vocalizes; Coos (makes vowel-like noises) or babbles.	Focuses on objects as well as adults	<ul style="list-style-type: none"> <li>• Loves looking at new faces</li> <li>• Smiles at parent</li> <li>• Starting to smile</li> </ul>
2.1–4.5 months	Rolls from tummy to side Rests on elbows, lifts head 90 degrees Sits propped up with hands, head steady for short time	<ul style="list-style-type: none"> <li>• Changes sounds while verbalizing, "eee-ahhh"</li> <li>• Verbalizes to engage someone in interaction</li> <li>• Blows bubbles, plays with tongue</li> <li>• Deep belly laughs</li> </ul>	Hand regard: following the hand with the eyes. Color vision adult-like.	Serves to practice emerging visual skills. Also observed in blind children.
3 months	Prone: head held up for prolonged periods. No grasp reflex	Makes vowel noises	Follows dangling toy from side to side. Turns head round to sound. Follows adults' gaze (joint attention). Sensitivity to binocular cues emerges.	Squeals with delight appropriately. Discriminates smile. Smiles often. Laughs at simple things. reaches out for objects

5 months	Holds head steady. Goes for objects and gets them. Objects taken to mouth	Enjoys vocal play;		Noticing colors Adjusts hand shape to shape of toy before picking up
6 months	Transfers objects from one hand to the other. Pulls self up to sit and sits erect with supports. Rolls over prone to supine. Palmar grasp of cube hand to hand eye coordination	Double syllable sounds such as 'mumum' and 'dada'; babbles (consonant-vowel combinations)	Localizes sound 45 cm lateral to either ear. Visual acuity adult-like (20/20). Sensitivity to pictorial depth cues (those used by artists to indicate depth) emerges.	May show Stranger anxiety
9–10 months	Wiggles and crawls. Sits unsupported. Picks up objects with pincer grasp	Babbles tunefully	Looks for toys dropped	Apprehensive about strangers
1 year	Stands holding furniture. Stands alone for a second or two, then collapses with a bump	Babbles 2 or 3 words repeatedly	Drops toys, and watches where they go	Cooperates with dressing, waves goodbye, understands simple commands
18 month	Can walk alone. Picks up toy without falling over. Gets up/down stairs holding onto rail. Begins to jump with both feet. Can build a tower of 3 or 4 cubes and throw a ball	'Jargons'. Many intelligible words	be able to recognize their favorite songs, and will try to join in.	Demands constant mothering. Drinks from a cup with both hands. Feeds self with a spoon. Most children with autism are diagnosed at this age.
2 years	Able to run. Walks up and down stairs 2 feet per step. Builds tower of 6 cubes	Joins 2–3 words in sentences		Parallel play. Dry by day

3 years	Goes up stairs 1-foot per step and downstairs 2 feet per step. Copies circle imitates hand motions and draws man on request. Builds tower of 9 cubes	Constantly asks questions. Speaks in sentences.		Cooperative play. Undresses with assistance. Imaginary companions
4 years	Goes down stairs one foot per step, skips on one foot. Imitates gate with cubes, copies a cross	Questioning at its height. Many infantile substitutions in speech		Dresses and undresses with assistance. Attends to own toilet needs
5 years	Skips on both feet and hops. Draws a man and copies an hexagonal based pyramid using graphing paper. Gives age	Fluent speech with few infantile substitutions in speech		Dresses and undresses alone
6 years	Copies a diamond. Knows right from left and number of fingers	Fluent speech		

### Physical Growth

Age	Average length/height (cm)	Length growth	Average weight	Weight gain	Respiration rate (per minute)	Normal body temperature	Heart rate (pulse) (per minute)	Visual acuity (Snellen's chart)
<b>1–4 month</b>	50–70 cm (20–28 in)	2.5 cm (0.98 in) per month	4–8 kg (8.8–17.6 lb)	100–200 g per week	30 to 40	35.7–37.5 °C		
<b>4–8 month</b>	70–75 cm (28–30 in)	1.3 cm (0.51 in) per month	(doubling birth weight)	500 g per month	25 to 50	body temperature	heart rate	
<b>8–12 month</b>	Approx. 1.5 times birth length by first birthday		9.6 kg (21 lb) Nearly triple the birth weight by first birthday	500 g per month	20 to 45	body temperature	heart rate	20/100
<b>12–24 month</b>	80–90 cm (31–35 in)	5–8 cm (2.0–3.1 in) per year	9–13 kg (20–29 lb)	130–250 g per month	22 to 40	body temperature	80 to 110	20/60



## Primitive reflexes

Primitive reflexes are reflex actions originating in the central nervous system that are exhibited by normal infants, but not neurologically intact adults, in response to particular stimuli. Primitive reflexes are repetitive, automatic movements that provide the foundation for all motor coordination skills. Primitive reflexes are essential during infancy to develop head control, muscle tone, sensory integration and visual development. Integration of these reflexes is necessary for a child's development of spontaneous postural movement and proper visual-motor development.

### Moro Reflex



- 1) The reflex is initiated by pulling the infant up from the floor and then releasing him
- 2) He spreads his arms
- 3) He pulls his arms in
- 4) He cries (10 seconds)

The Moro reflex serves as a baby's primitive fight or flight reaction. It is usually inhibited by around 4 months of post-natal life and replaced by an adult "startle" reflex. When the Moro reflex is retained in an older child it becomes an automatic uncontrollable overreaction to any type of stimulus, therefore overriding the higher decision making center of the brain. Retention of the Moro reflex can present the following challenges: hyperactivity, extreme sensitive to sudden movement, noise or light, sleeping problems, impulsive behaviors, inappropriate behavioral responses, food sensitivities, emotional and social immaturity, and poor adaptation skills.

### Walking/stepping reflex

The walking or stepping reflex is present at birth, though infants this young cannot support their own weight. When the soles of their feet touch a flat surface they will attempt to walk by placing one foot in front of the other. This reflex disappears at six weeks due to an increased ratio of leg weight to strength. It reappears as a voluntary behavior around eight months to one year old.



### Rooting reflex

The rooting reflex is present at birth and disappears around four months of age, as it gradually comes under voluntary control. The rooting reflex assists in the act of breastfeeding. A newborn infant will turn its head toward anything that strokes its cheek or mouth, searching for the object by moving its head in steadily decreasing arcs until the object is found. After becoming used to responding in this way (if breastfed, approximately three weeks after birth), the infant will move directly to the object without searching.



## Sucking reflex

The sucking reflex is common to all mammals and is present at birth. It is linked with the rooting reflex and breastfeeding. It causes the child to instinctively suck anything that touches the roof of their mouth, and simulates the way a child naturally eats. There are two stages of the action:

1. **Expression:** activated when the nipple is placed between a child's lips and touches their palate. They will instinctively press it between their tongue and palate to draw out the milk.
2. **Milking:** The tongue moves from areola to nipple, coaxing milk from the mother to be swallowed by the child.

## Tonic neck reflex

ATNR (asymmetrical tonic neck reflex) - The ATNR reflex is activated by turning the head to the left or right side. As the head is turned, the arm and leg on the same side will extend while the opposite limbs bend. If not fully integrated, the ATNR reflex can cause difficulties with: hand-eye coordination, written expression, crossing midline, visual tracking, and bilateral integration (use of both sides of the body simultaneously), and hand-dominance.



STNR (symmetrical tonic neck reflex) - The STNR reflex causes the arms to bend and the legs to extend when the head is bent down and causes the opposite - legs bent, arms straight - when the head is bent backwards. If the STNR reflex remains present in an older child, it can cause difficulty with: integration of upper and lower portions of the body, sitting posture, typical muscle tone development, and poor hand-eye coordination.

TLR (tonic labyrinthine reflex) - The TLR is associated with balance and coordination of the extremities. This reflex is activated by bending the head forward or backwards (head forward - the body and limbs curls inwards, head backwards - the body and torso straighten and *extend*). If not fully integrated the alignment of the head with the rest of the body will be uncoordinated. Proper head and neck alignment is necessary for balance, visual tracking, auditory processing and organized muscle tone.

## Palmar grasp reflex

The palmar grasp reflex appears at birth and persists until five or six months of age. When an object is placed in the infant's hand and strokes their palm, the fingers will close and they will grasp it with a palmar grasp. To best observe this reflex, on a bed where the child could safely fall onto a pillow, offer the infant two opposing little fingers (as index fingers are typically too large for the infant to grasp), and gradually lift. The grip is strong but unpredictable; though it may be able to support the child's weight, they may also release their grip suddenly and without warning. The reverse motion can be induced by stroking the back or side of the hand.



**Plantar reflex**

A plantar reflex is a normal reflex that involves plantar flexion of the foot, which moves toes away from the shin and curls them down. An abnormal plantar reflex (Babinski sign) occurs when upper motor neuron control over the flexion reflex circuit is interrupted. This results in a dorsiflexion of the foot (foot angles towards the shin, big toe curls up). This also occurs in babies under child 1 year. The Babinski reflex is a sign of neurological abnormality in adults (e.g., upper motor neuron lesion)

**Galant reflex**

The Galant reflex, also known as Galant's infantile reflex, is present at birth and fades between the ages of four to six months. When the skin along the side of an infant's back is stroked, the infant will swing towards the side that was stroked. If the reflex persists past six months of age, it is a sign of pathology.

**Swimming reflex**

The swimming reflex involves placing an infant face down in a pool of water. The infant will begin to paddle and kick in a swimming motion. The reflex disappears between 4–6 months. Despite the infant displaying a normal response by paddling and kicking, placing them in water can be a very risky procedure. Infants can swallow a large amount of water while performing this task; therefore caregivers should proceed with caution.

**Parachute reflex**

This reflex occurs in slightly older infants when the child is held upright and the baby's body is rotated quickly to face forward (as in falling). The baby will extend their arms forward as if to break a fall, even though this reflex appears long before the baby walks.

**Primitive reflexes in high-risk newborns**

The term high-risk newborns refer to neonates with a significant chance of mortality or morbidity, especially within the first month of being born. High-risk newborns will often show abnormal responses of primitive reflexes, or lack a response entirely. Performance of primitive reflexes in high-risk newborns will often vary in response depending on the reflex (e.g., normal Moro reflex may be present, while the walking reflex is absent or abnormal). Normal performance of primitive reflexes in newborns can be linked to a greater likelihood of having higher Apgar scores, higher birth weight, shorter hospitalization time after birth, and a better overall mental state.

## Primitive Reflexes

Primitive Reflex	Purpose	What the Reflex Looks Like in a Baby	When it Appears	Should Integrate by:	Sign of Retention
FPR Fear Paralysis Reflex	protective mechanism, response to perceived threat	Freezing reaction - similar to deer in headlights	5 <sup>th</sup> to 8 <sup>th</sup> week in Utero	before birth	anxiety, poor self esteem, sleep/eating disorders, aggression, fear of failure or embarrassment, phobias.
Moro	Infant arousal of survival systems	Automatic reaction to a sudden change in sensory stimuli. Startle response. Primitive fight or flight reaction	birth	2 to 4 months	hyper sensitivity, hyper reactivity, poor impulse control, sensory overload, social and emotional immaturity.
Rooting Reflex	to assist baby to find food, breastfeeding	Baby automatically turns head towards touch on their cheek	birth	3 to 4 months	picky eater, thumb sucking, dribbling, speech and articulation problems.
Palmar Reflex	to assist baby's grasp development	Hand closes when object is placed in the palm	birth	5 to 6 months	poor fine motor skills, poor manual dexterity, poor handwriting.
ATNR Asymmetrical Tonic Neck	to assist baby through birth canal and to develop cross pattern movements	Activated by turning the head to the left or right side. As the head is turned, the arm and leg on the same side will extend while the opposite limbs bend.	birth	6 months	Difficulty with: eye-hand coordination, handwriting, crossing vertical midline, visual tracking.
STNR Symmetrical Tonic Neck Reflex	preparation for crawling	Arms bend and legs extend when the head is bent down. Arms straighten; legs bend when the head is bent backwards.	6 to 9 months	9 to 11 months	tendency to slump while sitting, poor muscle tone, W-sitting, poor eye-hand coordination, inability to sit still and concentrate.
TLR Tonic Labrynthine Reflex	head management and postural stability	Forward TLR: Head bends forwards cause body and limbs flexion. Backwards TLR: Head bent backwards causes body and limb extension.	In utero	3 <sup>1/2</sup> years	poor muscle tone, W-sitting, toe-walking, poor balance, motion sickness, spatial orientation issues, gravitational insecurity.
Spinal Galant Reflex	assists baby with birth process, crawling and creeping	Hip rotation when back is touched on either side of the spine.	birth	3 to 9 months	unilateral or bilateral posture issues, fidgeting, bedwetting, clothing issues, poor concentration, poor short term memory.

## Heat Therapy

Heat therapy, also called thermotherapy, is the use of heat in therapy, such as for pain relief and health. It can take the form of a hot cloth, hot water, ultrasound, heating pad, hydrocollator packs, whirlpool baths, cordless FIR heat therapy wraps, and others.

1. Dry heat, such as electric heating pads and saunas, draw out moisture from the body and may leave the skin dehydrated. However, some people feel that dry heat is the easiest to apply and feels the best.
2. Moist heat, such as hot baths, steamed towels or moist heating packs can aid in the heat's penetration into the muscles, and some people feel that moist heat provides better pain relief.

### Benefits of moist heat therapy

- The warm temperature radiates from your heat source, and dilates the blood in the area where it is applied. This increases the flow of oxygen and nutrients to the joints and muscles, making blood flow smoother and increasing ease of movement.
- The increased flow of oxygen and nutrients to the joints helps heal the damaged tissue.
- Moist heat helps stretch the soft tissues around connective tissue and joints, decreasing stiffness and increasing flexibility in tendons and ligaments.
- Heat stimulates the sensory receptors in the skin, which means that applying heat can decrease the pain signals transmitted to the brain, helping to relieve discomfort.
- The warmth from heat therapy decreases muscle spasms and can increase range of motion.

### How to use moist heat safely

There are many different ways to apply moist heat to ease joint pain. Here are some common options:

- a. Hot water bottle: tends to stay warm for 20 to 30 minutes.
- b. Electric heating pad: maintains a constant level of heat as long as it is plugged in, but delivers dry heat, not moist heat.
- c. Heat wraps. Different types of wraps are available for the lower back and waist, which you can wear under clothing to provide several hours of low level heat application.
- d. Hot bath, hot tub, sauna, steambath: To stimulate general feelings of comfort and relaxation, warm baths help reduce muscle spasms and pain. A whirlpool jet directed at certain body parts can add the benefit of a light massage.

### Dry Heat

Common forms of dry heat include electric heating pads and heat wraps. Some heating pads automatically turn off after a set amount of time passes. Heat wraps do not plug into the wall and therefore present a more portable, convenient dry heat option. These wraps adhere to clothing and press directly against the skin; the heat level remains low but relatively constant and may last up to eight hours.

### When to Use Hot and Cold Therapy

Heat and cold are the two most common types of noninvasive pain-relief therapies for muscle and joint pain. Which depends on whether the pain is acute or chronic. In



general, acute injury will cause inflammation and possibly swelling. Ice will decrease the blood flow to the injury, thereby decreasing inflammation and swelling. Pain that recurs can be treated with heat, which will bring blood to the area and promote healing.

## **Heat Therapy**

### **What does heat therapy do?**

Heat opens up blood vessels, which increases blood flow and supplies oxygen and nutrients to reduce pain in joints and relax sore muscles, ligaments, and tendons. The warmth also decreases muscle spasms and can increase range of motion. Applying superficial heat to your body can improve the flexibility of tendons and ligaments, reduce muscle spasms, and alleviate pain.

### **How is it applied?**

Sources of heat can supply either dry or moist warmth. Dry heat sources may dry the skin. Moist heat may penetrate better. Heat can be applied by an electric or microwavable heating pad, hot water bottle, gel packs, or hot water baths. The heat should be warm, not too hot, and should be maintained at a consistent temperature, if possible. Ask your doctor or physical therapist which heat source would be best for you.

### **When do you use it?**

Apply heat if you have stiff joints or chronic muscle and joint pain.

### **How can I use it safely?**

Don't apply it directly to skin. Instead, wrap the hot device in a thin towel.

Here are other tips:

- Don't apply heat for longer than 20 minutes, unless your doctor or physical therapist recommends longer.
- Don't use heat if there's swelling. Use cold first, then heat.
- Don't use heat if you have poor circulation or diabetes.
- Don't use heat on an open wound or stitches.
- Don't lie down on a heating pad; you could fall asleep and burn your skin.

## **Cold Therapy**

### **What does cold therapy do?**

Cold slows down blood flow to an injury, thereby reducing pain and swelling. Cold therapy slows circulation, reducing inflammation, muscle spasm, and pain. It should be used if the area is swollen or bruised.

### **How is it applied?**

Cold is applied by an ice or gel pack.

### **When do you use it?**

Any cold treatment should be used for 24 to 48 hours after an injury. Cold therapy is good for sprains, strains, bumps, and bruises that may occur in sports or lifting. Apply cold packs or ice bags to injured areas for no more than 20 minutes at a time, removing the cold for 10 minutes and reapplying it again.



### **How can I use it safely?**

Don't apply it for longer than 20 minutes. Also, wrap ice or ice packs in a thin towel before applying.

### **Electrical Modalities**

An electrical modality is a type of electrical energy that causes physiological changes. It is used to relieve pain, improve circulation, decrease swelling, reduce muscle spasm, and deliver medication in conjunction with other procedures. Typical types of modalities include electrical muscle stimulation, ultrasound, heat, ice and traction.

### **Ultrasound (US)**

Therapeutic ultrasound is a modality that has been used by physiotherapists since the 1940s. Ultrasound is applied using the head of an ultrasound probe that is placed in direct contact with your skin via a transmission coupling gel.

Therapeutic ultrasound has been shown to cause increases in:

- healing rates
- tissue relaxation
- tissue heating
- local blood flow
- scar tissue breakdown
- promotes circulation

### **Contraindications of ultrasound**

- Local malignancy,
- Metal implants below the area being treated,
- Local acute infection,
- Vascular abnormalities, and directly on the abdomen of pregnant women.
- Over active epiphyseal regions (growth plates) in children,
- Over the spinal cord in the area of a laminectomy,
- Over the eyes, skull, or testes

### **Indications of ultra Sound:**

- Soft tissue
- Release contractures
- Healing of fracture
- Infection control
- Decrease pain and muscle spasm
- Healing of scar tissues

### **Transcutaneous Nerve Stimulation (TENS)**

TENS is the use of electric current produced by a device to stimulate the nerves for therapeutic.

### **Purposes**

Use of low voltage electrical current through surface electrodes that overrides the sensation of pain.

## **Indications**

- Musculoskeletal pain – Acute postoperative pain and acute post traumatic pain (rheumatoid arthritis, osteoarthritis, etc.)
- Chronic low back pain:
- Painful diabetic neuropathy
- Neuropathic pain
- Visceral pain and dysmenorrhea

The benefits from TENS treatment can include:

- Pain relief.
- Increase circulation and healing.
- Improve sleep patterns.
- Decrease use of pain relievers or other analgesic drugs.
- Increase motion and function.

## **Interferential Therapy (IFT)**

Interferential therapy is a modality that applies currents at around 4000 Hz through the affected area of a patient. Four electrodes are placed in such a way that allows two currents to cross each other and penetrate deep within a joint or body area.

### **Indications**

- Pain relief / anesthetic effect by stimulating the release of endorphins and blocking the transmission of pain impulses (pain gate mechanism).
- Increase in blood flow to promote tissue healing and reduce swelling/inflammation.
- Muscle stimulation to activate weak muscles and overcome muscle inhibition caused by the injury.

### **Contraindications**

- Patients with pacemakers
- Near the low back or abdomen of pregnant women
- Local malignancy

### **Effects of Interferential therapy**

- Short term pain relief.
- Make patients wakeful and relaxed.
- Stimulates the production of endorphins and results in longer term pain relief and some local anesthesia.
- Increase the blood supply

### **Interferential Therapy can be used to treat pain associated with:**

- Back, Neck, Shoulder and Knee injuries or problems
- Fibromyalgia
- Joint injuries
- Overuse injuries and surgical procedures
- Edema, Inflammation
- Carpal Tunnel Syndrome
- Tennis Elbow
- Sports injury

**The whole treatment may include:**

- Exercises to stretch injured muscles
- Exercises to move stiff joints
- Exercises to strengthen muscle groups to support the joints



## Traction

Traction is defined as a pulling force exerted on a skeletal structure by means of a special device. In orthopedic medicine, traction refers to the set of mechanism for straightening broken bones or relieving pressure on the spine in any skeletal system.

### Indications

- To reduce the fracture or dislocations.
- To maintain the reduction.
- To correct the deformity.
- To reduce the pain and muscle spasm.

### Contraindications

- Abrasions and skin laceration of skin in the area of traction applied.
- Impairment of sensation and circulation.
- Dermatitis.
- Marked shortening of bony fragments

### Advantages of Traction

- Decrease pain.
- Minimize muscle spasm.
- Reduce deformity.
- Increase space between opposing surface.

### Function

- Allows more joint mobility than plaster
- Less risk of infection at fracture site
- Bone reduced and held by soft tissue
- To reduce the muscle spasm
- To correct the deformity
- To maintain the reduction
- To reduce the fracture or dislocation

### Two types of traction

#### 1. surface traction(Skin Traction)

The traction force is applied over a large area of skin Adhesive/ Non-adhesive skin tractions. Some examples are: Buck's traction, involving skin traction. It is widely used for femoral fractures, low back pain, acetabular fractures and hip fractures. Skin traction rarely causes fracture reduction, but reduces pain and maintains the length of the bone. Dunlop's traction – humeral fractures in children



Skin Traction

## 2. Skeletal traction

Skeletal traction Applied directly to the bone either by a pin or wire through the bone. (eg- Steinmann pin, Denham pin or Kirschner wire).



Single skeletal traction



Balanced skeletal traction

### The purpose of traction is to:

- regain normal length and alignment of involved bone
- lessen or eliminate muscle spasms
- relieve pressure on nerves, especially spinal and
- prevent or reduce skeletal deformities or muscle contractures

### Consideration

- Type of traction
- Amount of weight to be applied
- Frequency of neurovascular checks if more frequent than every four hours
- Site care of inserted pins, wires, or tongs
- The site and care of straps, harnesses and halters
- The inclusion of any other physical restraints / straps or appliances (e.g., mouth guard)
- the discontinuation of traction

### General complications of traction

- Loss of skin sensation.
- Compression of nerves, eg; Common peroneal nerve palsy in lower extremity.
- Ischemia of antecubital fossa in forearm.
- Pressure sores on bony prominent area.
- Deformities and contracture of joints.
- Muscle atrophy and muscle weakness.
- Bed sores.
- Chest complications.
- Infection

### Specific complications of traction

#### Skin traction

- Allergic reaction
- Laceration of skin from slipping of strapping
- Pressure sores around the bony prominent part
- Can be compressed peroneal nerve

## **Skeletal traction**

- Infection into bone leads to osteomyelitis.
- Incorrect placement of pin.
- Distraction of Fracture site.
- ligamentous damage if a large traction force is applied
- Damage to growth plate when used in children.
- Depressed scars

### **Management of patient in traction:**

- Care of the patient.
- Care of the traction suspension.
- Radiography examination.
- Physiotherapy.
- Diet/ nutrition

### **Care of the patient:**

- Pain
- sensation
- Skin irritation
- Swelling
- Joint deformities and contractures
- Muscular weakness.

### **Physiotherapy:**

#### **Aim of treatment:**

- To maintain joint range of movement.
- To maintain the strength of muscles of limbs.
- To prevent the pressure sores and decubitus ulcers.
- Maintain or increase the circulation.
- To prevent the chest complications.
- To facilitate and motivate in bed activities.

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#### **Procedures:**

- Active or active assisted range of motion of joints.
- Isometric or isotonic strengthening exercise for upper and lower limb.
- Bridging exercises and changing of positions.
- Active ankle pumping exercise.
- Deep breathing and thoracic expansion exercise.
- Motivation and encouragement for ADL and bed activities.



## **Chest Physiotherapy**

Chest Physical therapy is the term for a group of treatments designed to improve respiratory efficiency, promote expansion of the lungs, strengthen respiratory muscles, and eliminate secretions from the respiratory system.

### **Purpose**

The purpose of chest physiotherapy, is to help patients breathe more freely and to get more oxygen into the body. Chest physical therapy includes postural drainage, chest percussion, chest vibration, positioning, deep breathing exercise, and coughing.

Chest physical therapy can be used with newborns, infants, children, and adults. People who benefit from chest physical therapy exhibit a wide range of problems that make it difficult to clear secretions from their lungs.

### **Precautions**

Chest physical therapy should not be performed on those children with the following:

- bleeding in the lungs
- head or neck injuries
- fractured ribs
- collapsed lungs
- acute asthma
- pulmonary embolism
- active hemorrhage
- some spinal injuries

### **Risks**

The risks and complications associated with chest physical therapy are dependent upon the health of the child. Although chest physical therapy normally poses few problems, in some patients it may cause the following problems:

- oxygen deficiency if the head is kept lowered for drainage
- increased intracranial pressure
- temporary lowering of blood pressure
- bleeding in the lungs
- pain or injury to the ribs, muscles, or spine
- vomiting
- inhalation of secretions into the lungs
- heart irregularities

### **Description**

Chest physical therapy can be performed in a variety of settings including critical care units, hospitals, nursing homes, outpatient clinics, and at the patient's home. Depending on the circumstances, chest physical therapy may be performed by anyone from a respiratory care therapist to a trained member of the patient's family. Different patient conditions warrant different levels of training.

Chest physical therapy consists of a variety of procedures that are applied depending on the patient's health and condition. Hospitalized patients are reevaluated frequently to

establish which procedures are most effective and best tolerated. Patients receiving long term chest physical therapy are reevaluated about every three months.

### **Turning (Positioning)**

Turning from side to side permits lung expansion. Patients may turn themselves or be turned by a caregiver. The head of the bed is also elevated to promote drainage if the patient can tolerate this position. Critically ill patients and those dependent on mechanical respiration are turned once every one to two hours around the clock.

### **Coughing**

Coughing helps break up secretions in the lungs so that the mucus can be suctioned out or expectorated. Patients sit upright and inhale deeply through the nose. They then exhale in short puffs or coughs. Coughing is repeated several times a day.

### **Deep breathing**

Deep breathing helps expand the lungs and forces better distribution of the air into all sections of the lung. The patient either sits in a chair or sits upright in bed and inhales, pushing the abdomen out to force maximum amounts of air into the lung. The abdomen is then contracted, and the patient exhales. Deep breathing exercises are done several times each day for short period.

### **Aims:**

- To promote a normal relaxed breathing pattern (where possible)
- To assist the removal of secretions
- To mobilise the thoracic cage
- To expand the lung tissues
- To adapt the good posture

### **Postural drainage**

Postural drainage uses the force of gravity to assist in effectively draining secretions from the lung and into the central air way where they can either be coughed up or suctioned out. The patient is placed in a head or chest down position and is kept in this position for up to 15 minutes. Critical care patients and those depending on mechanical ventilation receive postural drainage therapy four to six times daily. Percussion and vibration may be performed in conjunction with postural drainage.

### **Contraindications to Postural drainage**

- Head injury
- Cerebral Vascular Accident
- Headache
- Eye surgery - up to post op 4 weeks
- Cor pulmonale
- Tachycardia (heart rate over 150/minute)
- Severe hypertension
- Obstruction of blood vessels
- Cardiac problems
- Nausea and vomiting

- Severe dyspnoea (shortness of breath) even at rest.
- Haemoptysis (coughing up blood)
- Pulmonary oedema
- Facial oedema from burn

### **Percussion**

Percussion is rhythmically striking the chest wall with cupped hands. It is also called cupping, clapping, or tapotement. The purpose of percussion is to break up thick secretions in the lungs so that they can be more easily removed. Percussion is performed on each lung segment for one to two minutes at a time.

### **Contraindications:**

- Painful chest
- Osteoporosis
- Weak patients
- Shortness of Breath

### **Normal results**

The patient is considered to be responding positively to chest physical therapy if some, but not necessarily all, of these changes occur:

- increased volume of sputum secretions
- changes in breath sounds
- improved vital signs
- improved chest x ray
- increased oxygen in the blood as measured by arterial blood gas values
- patient reports of eased breathing

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- vomiting
- inhalation of secretions into the lungs
- heart irregularities

## **Chest assessment**

### **I. Read patients chart**

a. Identify present problems (chief complaint)

- How did the problem develop?
- Any previous treatment

b. Check daily

- Temperature (98.6° F) Pulse (80/minute)
- Respiration ( 16/ minute)
- Blood pressure (120/80mm of Hg)
- Nurse's report
- Doctor's progress notes
- Doctor's order sheet

### **II. History (listen the patient's own story):**

#### **Ask**

- When and how did it happen?
- Sequence of symptoms
- Does he have
  - shortness of breathing?
  - does it limit activities
- Does he have cough? When? And what starts it?
- Is the cough productive?
- Sputum
  - quantity?
  - colour?
- Blood? -? Thick/Thin
- Occupation
  - How much s/he can do?
  - Limitations?
- Does s/he have pain? Where? What type? And what starts it?
- Does s/he smoke? How many per day? And has he stopped smoking?
- Pain assessment (Numerical pain rating scale)

### **III. Observation**

#### **A. WHILE TALKING WITH THE PATIENT**

1. General attitude

- Cooperative, motivated
- Cheerful
- Anxious

2. General appearance

- General body build, weight loss
- Looks sick or well

- Short breathing (during activity or resting), difficulty in talking

### 3. Respiration

- breathes fast
- breathing sounds noisy, wheezes or crepitation
- cough

### 4. Posture of head, neck, shoulder and thorax

### 5. Breathing pattern

- Apical
- Lateral costal
- Diaphragmatic

## B. INSPECTION

### 1. Count pulse

### 2. Count respiratory rate

### 3. Hands clubbing of nail

### 4. Look at legs

- Oedema
- Varicose veins

### 5. Check sputum container - volume, colour, consistency

### 6. Cyanosis

## C. PALPATIONpalpitation

### 1. Chest movement

- Apical } -Symmetrical
- Lateral costal } - Asymmetrical
- diaphragmatic

### 2. Trachea - is it central?

### 3. Scalenes - are they active?

### 4. Oedema in legs - Check for pitting oedema

## D. PERCUSSION

### Flat sound

- Over thigh muscles
- No air

Dull sound

- Over heart, liver (Right)
- Partial air

Resonant

- Clear
- Over normal lung

E. **AUSCULTATION** auscultation

**Auscultate** over both lungs (Wheezes, crepitations)

F. MEASUREMENT

1. Chest expansion:

- At level of xiphoid process

2. Exercise tolerance

- Distance
- Time





Part - 2

**Orthopedic Condition**



## CONGENITAL TALIPES EQUINO VARUS (CTEV)

Congenital talipes equino varus is the commonest congenital anomaly with an incidence of one to two per 1000 live births. Clubfoot is one of the most common congenital orthopedic anomalies and was described by Hippocrates on 400 BC. It affects approximately 1 in every 1,000 newborns in the US each year. It is more common in males. Club foot may affect one or both feet. In 30% to 50% of affected children, it involves both feet. This condition sometimes runs in families. If one child in the family has club foot, the likelihood of another child having this condition increases to 10%.

### Meaning of the words

Congenital	: By birth
Talipes	: Ankle and foot
Equines	: Ankle in planter flexion
Varus	: Inward bending



### CTEV has three anatomical components

Fore – foot	: adduction	}	C = Cavus
Mid – foot	: supination		A = Adduction
Hind – foot	: Equino varus		V = Varus
			E = Equinus

### Etiology

The exact cause of club foot is not known (Idiopathic). An abnormality of the tendons and ligaments in the foot causes an abnormal structure and position of the foot. In some children, bones may also be abnormal in terms of shape, size, or position. There may be a link to maternal smoking during pregnancy.

### Associated Syndrome

Although a CTEV is usually idiopathic (unknown cause), the deformity has been reported in many other congenital as well as non – congenital skeletal problems such as Spina bifida, Myelomeningocele, Muscular dystrophy, Arthrogryposis, Post polio residual paralysis etc.

### Possible causes

- Elevated intrauterine pressure during pregnancy.
- Abnormal peroneus brevis muscles.
- A primary germ plasm defect. Defects in the cartilage.
- Anatomical abnormalities of foot



### Signs and symptoms

- Foot twists downwards and inwards.
- The arch is more pronounced and the heel turns inward.
- The calf muscles are generally underdeveloped.
- If only one foot is affected, it is usually slightly shorter than the other (especially the heel).
- Dorso- lateral bursa may be present on walking child.
- Affected foot is bean shaped.

## Patho- Anatomy

The pathology of the individual bones contributes to the clubfoot deformity. The multiple abnormalities in the talus include and flattening of the talar head. Additionally, the inferior surface of the talus is characterized by hypoplasia. The calcaneus is involved in all of the components of the deformity. The navicular is displaced medially and its proximal concavity is flattened as a result of it having never articulated with the talus. The cuboid moves medially with the anterior end of the calcaneus and this causes the lateral convexity of the foot.

## Types

According to the degree (severity) of deformity, it can be classified into three categories:

- a. Supple : In supple all the components of foot deformity can be corrected by passive force. (Stretching exercise)
- b. Resistant : In resistant except equinus deformity all the components of deformity can be corrected by passive force. But there is resistance against the force while doing stretching exercise.
- c. Rigid : In rigid, any component of deformity (surgery is needed) cannot be corrected by passive force.

## Treatment procedures

The short term goal	The long term goal is
To correct the deformity so that the ankles assume plantigrade position.	To make a club foot functional, painless, and stable, especially for walking.  The long term goal was to maintain the corrected ankle in situ and follow up the maintained correction until the baby starts walking and if feasible further follow up to avoid relapse.

## Introduction

### A Brief History of the Ponseti Method

Dr. Ignacio V. Ponseti can be credited with developing a comprehensive technique for treating congenital clubfoot in the 1940s. One of the major principles of this technique is the concept that the tissues of a newborn's foot, including tendons, ligaments, joint capsules, and certain bones, will yield to gentle manipulation and casting of the feet at weekly intervals. By applying this technique to clubfeet within the first few weeks of life, most clubfeet can be successfully corrected without the need for major reconstructive surgery.

This technique is based upon Ponseti's experiences with the wide variety of treatments being applied at that time and his observations in the clinic and operating room, as well as his anatomic dissections and analysis by using a movie camera to produce radiographic images. Utilizing these principles and his understanding of clubfoot anatomy, Dr. Ponseti began employing this technique from 1948 onwards at the Iowa University and subsequently his observations have been confirmed. **The Ponseti technique** has become the most widely practiced method for

initial treatment of infants born with clubfeet. It is an easy technique to learn and, when applied accurately, it yields excellent results.

### The Ponseti Technique

The corrective process utilizing the Ponseti technique can be divided into two phases:

- The Treatment Phase - during which time the deformity is corrected completely
- The Maintenance Phase - during which time a brace is utilized to prevent recurrence

During each of these phases, attention to the details of the technique is essential to minimize the possibility of incomplete correction and recurrences.



**DB splint**

- **The Treatment Phase**

The treatment phase should begin as early as possible, optimally within the first week of life. Gentle manipulation and casting is performed on a weekly basis. Each cast holds the foot in the corrected position, allowing it to gradually re-shape. Generally, five to six casts are required to fully correct the alignment of the foot and ankle. At the time of the final cast, the majority of infants (70% or higher) will require a percutaneous surgical procedure (with a small incision through the skin) to gain adequate lengthening of their Achilles tendon.



**Club shoes**

- **The Maintenance Phase**

The final cast remains in place for three weeks, after which the infant's foot is placed into a removable orthotic device. The orthosis is worn 23 hours per day for three months and then during the night-time for several years. Failure to use the orthosis correctly may result in recurrence of the clubfoot deformity. Good results have been demonstrated at multiple centers, and long-term results indicate that foot function is comparable with that of normal feet.



Physiotherapy

### Maintenance and Recurrence Prevention

Upon removal of the final cast, the infant is placed into an *orthosis*, or brace, which maintains the foot in its corrected position. The purpose of this splinting, after the casting phase in the Ponseti method, is to maintain the foot in the proper position, with the forefeet set apart and pointed upward. This is accomplished with a brace consisting of shoes mounted to a bar.

The brace has to wear 23 hours per day for the first three months following casting and then while sleeping for several years to follow through, usually until around age three or four. Two recent studies have demonstrated the high risk for recurrence if the brace is not worn according to these guidelines. The reasons for recurrence in feet that appear to be fully corrected have not yet been clearly proven, but regardless of the cause, recurrence appears to be close to zero when the bracing regimen is followed accurately.

An Achilles tendon lengthening may be necessary if there is insufficient correction at the ankle, and a tendon transfer (tibialis anterior) may be performed in older children to help maintain the correction. Following this additional surgery, the child is then placed in a long-leg cast for four weeks with the foot in neutral position.

## Club foot scoring systems

### PIRANI SCORING

The Pirani score is a simple, easy to use tool for assessing the severity of each of the components of a clubfoot. It is extremely useful for assessing the severity of the clubfoot at presentation and for monitoring patients' progress.

The Pirani score should be recorded at each visit the patient makes. If the Pirani score increases from one visit to the next it may indicate that a relapse of deformity is occurring.

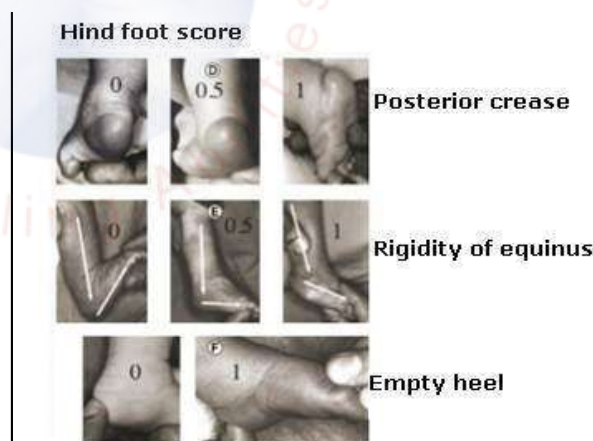
The components are scored as follows:

- 0- no abnormality;
- 0.5- moderate abnormality;
- 1- Severe abnormality.

Each component may score 0, 0.5 or 1

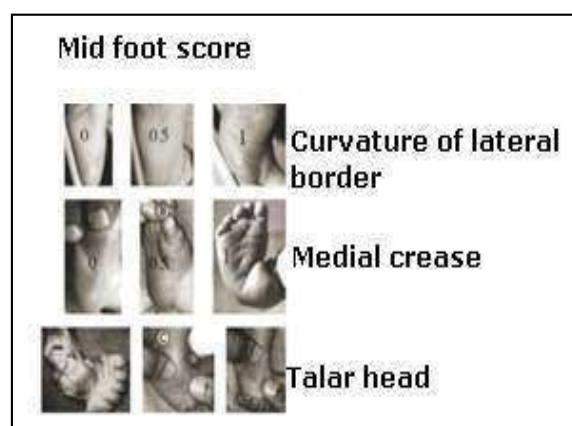
#### Hind foot contracture score (HCFS):

1. Posterior crease
2. Empty heel
3. Rigidity of equines



#### Mid foot contracture score (MFCS):

1. Medial crease
2. Curvature of lateral border
3. Position of lateral head of talus





Unlike many other clubfoot scoring systems, which are untested the Pirani scoring system has been found to be both valid and reliable. It is also useful for predicting treatment outcomes; a higher score on presentation may indicate that a higher number of casts will be required. Children with initial high HFCS may be more likely than those with lower scores to experience relapse of deformity during the bracing phase. They should therefore be monitored carefully and special emphasis put on the importance of using the SFAB when explaining to the parents.

### Risk factors

- **Gender** - males are twice as likely as females to be born with club foot.
- **Genetics** - if a parent was born with club foot, there is a higher risk of his/her baby being born with the same condition. The same applies to siblings. According to the National Health Service (NHS), UK, if one parent has club foot there is a 3% to 4% chance that the child will have the same condition; if both parents were born with the condition the risk for their child is 15%.



### Treatment

Treatment of CTEV is initiated as early as possible. A conservative method as described by Ponseti has been very effective method of correcting deformity if started early. The method consists of serial casting every 5 to 7 days sequentially correcting the deformity (CAVE in the order). The patient may need a small surgical procedure of lengthening heel cord for achieving 15-20° of dorsiflexion. The patient is then provided with Dennis brown splint at least for 3 to 5 years.

Different surgical procedure for correcting the rigid foot has been described. The basic aim of the surgery is to release all the contracted tissues on postero-medial aspect of the foot. Depending upon the age of the patient, **resection** of part of the bone may be necessary to correct the deformity. **Ilizarov** Ring fixator may also be used to correct the deformity if the size of the foot is a major concern and deformity is very severe.





## SPINA BIFIDA

Spina bifida is a congenital abnormality in which there is a developmental defect in the spinal column with incomplete closure of the vertebral canal due to a failure of fusion of the vertebral arches. This neural tube defect which occurs within the first month of fetal life, usually affects the lumbar or lumbosacral segment of spine.

### Common deformities and physical problems

- Meningocele or myelomeningocele
- May or may not be absent of Sensation
- May bowel, bladder incontinent
- Deformity of the feet/ foot
- Hip/ Hips dislocation
- Paralysis or paraesis of Muscle
- Ulcers on weight bearing area
- Tuft of hair or post midline dimple over lower back



### Etiology

Idiopathic : 50%

Folic acid deficiency : 50%

Folic acid has to be prescribed for all mothers during pregnancy.

### Types of Spina Bifida

1. Spina Bifida Occulta: Mildest form
2. Meningocele
3. Myelomeningocele: Most common & most serious

### Physiotherapy Management

#### 1) Thorough assessment:

- Sensory evaluation.
- Strength of Muscle.
- Deformities/contractures.
- Ambulation potential.
- Bed sores

#### 2) Exercise program

- Skin care, Prevent from pressure sores.
- Muscle strengthening exercises.
- Rom exercises.
- Stretching exercises if there are contractures or deformities.
- Splinting as required.
- Ambulation or gait training with or without walking aids/ braces or prosthesis.

### Complications

- Chronic ulcer
- Osteomyelitis
- Amputation may be required

## **Prevention**

1. Screening: Maternal blood test routinely at 15-18<sup>th</sup> weeks.
2. High-resolution ultrasound scan can detect 95% case of spina bifida: counseling
3. Folic acid, 400microgram/daily taken before conception & continuing through the first 12 weeks of pregnancy: It has been shown to reduce the risk of spina bifida in fetus.

## **Physiotherapy management on Spina Bifida**

### **Assessment:**

- Assess the joint range of Hip, Knee and ankle bilateral
- Evaluate the strength of bilateral lower limb
- Evaluate the proprioception of Ankle and Foot
- Check for body balance
- Assess nature of skin
- Evaluate potential of gait
- Assess sensation

### **Aim:**

The main aim of physiotherapy management is to:

- Correct the deformity
- Maintain or increase the range of movement of joints
- Maintain or increase the strength of muscles
- Reduce or prevent the skin ulcers.
- Improve the functional mobility
- Improve the body balance and coordination
- Improve the gait

### **Method:**

- Stretching exercise, Splinting measures
- Strengthening exercise (increase frequency, endurance or time)
- Care of skin( keep skin dry, do not walk on rough surface, use of soft cushion shoe)
- Gait training with orthosis
- Balancing and coordination exercise

## ARTHROGRYPOSIS

Arthrogryposis multiplex congenita (AMC), or simply arthrogryposis, describes congenital joint contractures in two or more areas of the body. Arthrogryposis (arth-ro-grip-OH-sis) means a child is born with joint contractures. It is an uncommon, but syndromic characterized by congenital immobility of multiple joints fixed in various postures. 'Arthrogryposis' a term derived from two Greek words meaning curved joints.

### Meaning of words

Arthron	: Joint
Gryposis	: Bending

**Incidence:** 1:3000 live births

### Types

- Distal Arthrogryposis
- Larsen's syndrome
- Nail-patellar syndrome
- Pterizia syndrome
- Radio- ulnar Synostosis
- Generalized Arthrogryposis



### Etiology

Exact cause is unknown but risk factors are:

- Autosomal recessive factor
- Fibrosis of muscle fibers
- Denervation of anterior horn cell of spinal cord
- Nutritional deficiency
- Reduce fetal movement at womb

### Clinical Features

- Characteristic limb position
  - Normal skin crease are lacking but deep dimples are present at knee and elbow.
  - Muscle mass is reduced so limbs looks atrophic.
  - The skin is smooth and shiny.
  - Deformities are symmetrical at birth.
  - Elbows are more extended than flexed.
  - Wrist flexed severely and ulnar deviated, fingers flexed, closed together and clutching thumb.
  - The hips are hyperflexed and often abducted and eternally rotated.
  - Knees are flexed in flexion or hyperextended.
  - The feet are in either equino varus calcaneo valgus deformity.
- A typical face: Face is round at childhood but tends to narrow with time.
- Normal intelligence and absence of visceral anomalies.
- Main problems of children affected with arthrogryposis are in ADL and Mobility.
- Secondary problems include feeding difficulties due to stiff jaw & immobile tongue.



## **Physiotherapy management**

### **Goals**

1. Increase the joint ROM
  - Active assistive and passive stretching exercise.
  - Splint in correct posture.
2. Maintain the strength of the hand Muscles
  - Active strengthening and functional exercises.
3. Maintain and increase the hand function
  - Hand functioning activities, play therapy.
4. Upgrade the ADL
  - ADL training and encouragement/improve the gait.
5. Gait training with or without orthosis.

### **Procedure**

1. Thorough assessment
2. Education to the parents regarding the conditions of problem
3. Set the goals and focus on preventive measures:
  - Splinting



- Strapping
- Proper positioning
- Stretching exercise



4. Long term goal is to make child functional independent.
5. Regular follow-up.



## CEREBRAL PALSY

Cerebral palsy (CP) is a group of permanent movement disorders that appear in early childhood. Cerebral Palsy is group of disorder resulting from non progressive brain damage during early development. It may be defined as a disorder of movement and posture due to progressive lesion in an immature brain. The injury can arise before, during or short time after child birth. At a young age C.P. can be recognized by impaired control of posture and movement.

Besides motor disturbances, there are also problems like:

- Epilepsy
- Eye problem usually squint
- Sensory disturbance (inability to feel pain)
- Hearing problem
- Cognitive problem
- Speech and communication problem
- Mental Retardation
- Behavioral problem



### Characteristics of CP

- First after birth the baby may have difficulties with breathing (Delayed Crying)
- Sucking problem with swallowing and chewing food
- Baby often cries and seems uncomfortable
- The baby may be flaccid, disinterested and passive
- The baby may have difficulty with motor coordination e.g.
- The child is able to use only one hand (instead of both) or appear to have trouble crawling.
- Has communication problem reacts less or doesn't react at all to other people.
- Problems with ADL: inability to bring food to mouth, inability to dress or care self.

In general a C.P. child's development rate is slower than that of healthy children of the same age delayed developmental milestone.

**Incidence:** 2: 1000 live births

### Causes

Cerebral palsy is caused by abnormal development or damage to the parts of the brain that control movement, balance, and posture. Most often the problems occur during pregnancy; however, they may also occur during childbirth, or shortly after birth. Often the cause is unknown.

#### 1. Prenatal causes (before birth)

Infection during pregnancy

- Rh incompatibility
- Diabetes during pregnancy
- Hydrocephalus
- Use of drug during pregnancy
- Exposure to X-ray
- Prematurity





## 2. Prenatal causes (during birth)

- Hypoxia
- Birth trauma
- Prolonged labour

## 3. Postnatal causes (after birth)

- High fever
- Meningitis
- Hypoxia
- Brain tumor
- Head injury/brain haemorrhage

### Signs

- Muscle tone can be hypo, normal or hyper
- DTR can be increased, decreased or lost
- Postural /movement pattern: in normal development an increasing variety of movement can be carried out an increasingly isolated way. However, in C.P. movement lack variety, follow a mixed pattern for e.g. flexion of extension pattern.



### Complication

- Contractures: These are caused by variation in postures and movement.
- Hip subluxation or dislocation: if there is asymmetrical sitting posture and if preferences for adduction and internal rotation of the hip exist, there is an increased risk of hip subluxation and dislocation.

### Classification of C.P

#### Manifestation

##### 1. Spastic

- Increase in muscle tone
- Exaggerated DTR
- Lack of equilibrium
- Disturbance in balancing reaction
- Associated reaction
- Slow and difficult movement
- Risk of contracture

##### 2. Athetoid

- Uncoordinated movement
- Muscle tone change from hypertonic to hypotonic
- Difficulty in head, body balance and grasping and holding
- Difficult to stop movement
- Hypersensitivity to stimuli, subside when sleeping

##### 3. Ataxic

- Uncontrolled movement, loss of sense of balance



- Shivering movement - infection tremor
- Disturbed equilibrium - nystagmus dizziness

#### 4. Flaccid

- Low muscle tone
- Decrease DTR
- Joint hyper mobile
- Drooling

#### 5. Mixed type

### Type

#### 1. Hemiplegia

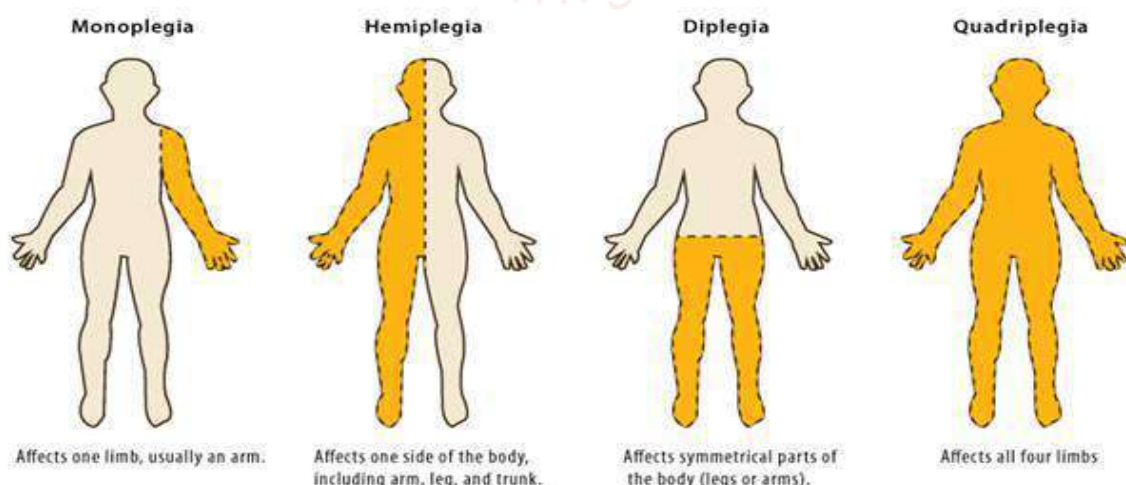
- Only one side of the body is affected
- Increased tone on hemiplegic side
- Growth disorder on affected side
- Speech, hearing and behavior disorder can be associated

#### 2. Diplegia

- Whole body affected but legs are more than the arms
- Usually these children are able to control head and speech is not impaired
- Muscle tone fluctuates from hypertonic to normal tone
- Activity of the arm is accompanied by associated reaction of the legs
- When these children walk flexion of the hips and knees
- There is also tendency to scissoring of legs
- At the same time they will tend to flex arms, hunk and head

### Total Body Involvement:

- Whole body is affected however both sides of the body can be affected to a different degree; this can lead to distinct asymmetry of posture and movement. There is sufficient control over head balance, speech and the eye, hand coordination.
- Hypertonic during physical effort fluctuating to normotone or hypotone at rest.
- Increased risk of hip dislocation or scoliosis.



## **Assessment tools**

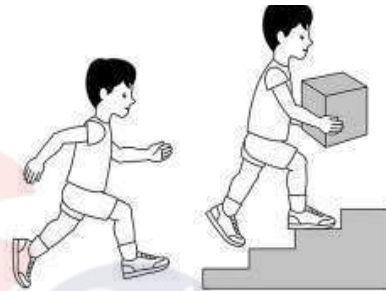
### **A. Gross Motor Function Classification System (GMFCS)**

The Gross Motor Function Classification System (GMFCS) is a five-level classification system that focuses on the voluntary movements of children with cerebral palsy (CP), with specialized focus on walking and sitting. The higher the level in GMFCS, the more severe the CP is. The GMFCS applies to all types of CP and all levels of severity. Once a child's severity level is determined, it helps healthcare providers understand which form of treatment would work best according to each individual situation. It also serves as guidelines for parents and caregivers to help them understand how their child's movement abilities may progress over time.

#### **GMFCS: Descriptors and illustrations**

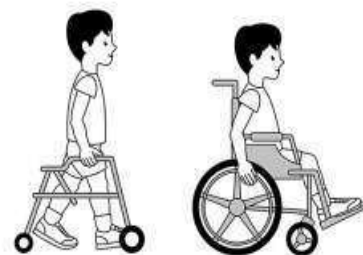
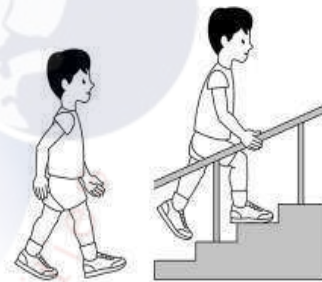
##### **GMFCS Level I**

Children walk at home, school, outdoors and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance and coordination are limited.



##### **GMFCS Level II**

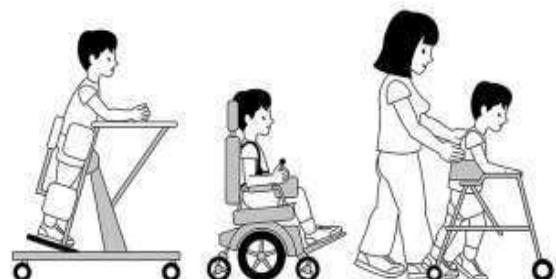
Children walk in most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a handheld mobility device or used wheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.



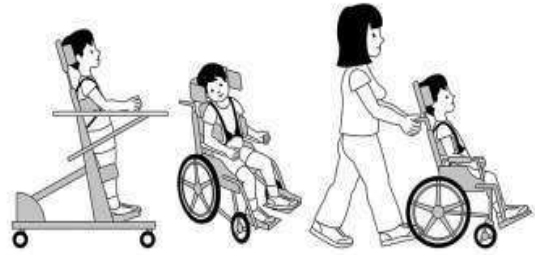
##### **GMFCS Level III**

Children walk using a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may self-propel for shorter distances.

##### **GMFCS Level IV**



Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and in the community children are transported in a manual wheelchair or use powered mobility.



### **GMFCS Level V**

Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements

## **B. MACS (MANUAL ABILITY CLASSIFICATION SYSTEM)**

The ability of children from 4 – 18 years old with cerebral palsy to handle objects in everyday activities can be categorised into 5 levels using the Manual Ability Classification System (MACS).

Knowing a child's MACS level can help parents, teachers and others to understand situations in which a child is independent and the extent to which they need support or adaptations. MACS level is determined based on knowledge about the child's actual performance in daily life. It is not done by conducting a specific assessment, but by asking someone who knows the child and how that child typically performs.

### **MACS levels**

#### **MACS Level I**

Objects are handled easily and successfully.

#### **MACS Level II**

Handles most objects but with some reduced quality and/or speed.

#### **MACS Level III**

Handles objects with difficulty – the child will need help to prepare and/or modify activities.

#### **MACS Level IV**

Handles a limited selection of easily managed objects and always requires some help from others.

#### **MACS Level V**

The child is not able to handle objects or to complete even simple actions with their hands.

### **Management**

Any serious approach to treatment demands multi disciplinary skills. The multi-disciplinary team consists of:

- Paediatrician
- Orthopaedic surgeon
- Neurologist

- Psychologist
- Speech therapist
- Physiotherapist
- Occupational therapist
- Social worker

We have to set goals based on extent and severity of neuromuscular disorders. Institutional care, wheelchair bound potential walker diplegic and adequate trunk control.



## Rehabilitation

Cerebral palsy is caused due to permanent damage and cannot be cured. We can only minimize the consequence of C.P. by therapy.

### General objectives on rehabilitation of C.P. children are:

- ADL dependency where possible.
- Some short of ambulation with or without aid where possible. Some means of communication for children with hearing or speech impaired.
- Most important education to patients and family about the condition and how to care for their child.
- For cognitively, better of children- some education where possible.
- Prevention of complications like contractures, scoliosis, hip dislocation and other psychological problem that may rise.

#### 1. Regulation of muscle tone and facilitation of active motion:

If tone is too low we try to build up, for instance by giving pressure. If tone is too high, we strive for more relaxation, fast by finding a correct starting position called Reflex inhibiting position from correct starting position we can stimulate the child to active motions.

#### 2. Stimulating development in general:

For a C.P. child development cannot take place in a normal way. it is important to give the child opportunities to gain experience, to discover the environment and to play. After a thorough observation of the development level of the child, we are able to direct the treatment to next step if the child reacts with pleasure; we know we are working at the right level.

#### 3. The most important secondary problems which can arise are:

- Contracture
- Scoliosis
- Hip subluxation or dislocation
- Psycho-social problem

A good starting position for carrying the child, eating and sleeping are of essential importance. Besides that, it may sometimes be necessary to specifically work at mobilizing the joints and stretching the muscles, all from the correct starting position.

**Besides these outlined above:**

Observation and evaluation is very important. It will help to find out the progress and further interventions. Counseling is most important part of treatment.

**Operative Intervention**

**Indications:**

- Inability to control spastic deformity by conservative methods
- Fixed deformity that interferes with function.
- Complication such as bony deformities or dislocation of hip
- Joint instability

In our situation this is not regularly recommended because it gives parents, caretakers false hopes and they are disappointed when their high expectations are not fulfilled. Sometimes preventative operations may require, for example, preventing hip dislocation. Another surgery may be needed to help in ambulation, for example, tendoachilles may be lengthened to assist ambulation. Sometime procedures like tenotomies, neurectomies, or injection with neurolytic agents like alcohol or phenol, osteomies, arthrodesis, arthroplasty, tendon transfer may be done.

**Rehabilitation** of C.P. children is long term and a lot needs to be done to see a small result. Nevertheless, it can be very meaningful to the patient and families.

**Physiotherapy Management of C.P**

**DETAIL EVALUATION**

**1. History Taking**

- Chief complaint
- Pregnancy history
- Birth History
- Trauma
- Infection
- Developmental history .e.g.
  - Head and neck control
  - Rolling
  - Sitting

**2. Observation and Examination**

**General appearance**

- a. Neurological assessment
  - Spastic / Flaccid
  - Deep tendon reflex-High or Low
  - Knee jerk
  - Achilles tendon
  - Biceps jerk
- b. Developmental level
  - Head and neck control
  - Rolling
  - Crawling
  - Standing



- Walking
- c. Active movement of upper and lower extremities
- d. Hand function grasp and release, gross and fine skills
- e. Wastage of muscles/ joint deformities and contractures
- f. Bed mobility and functional mobility
- g. Body balance and coordination
- h. Transfer (Active, needs help or passive)
- i. Gait

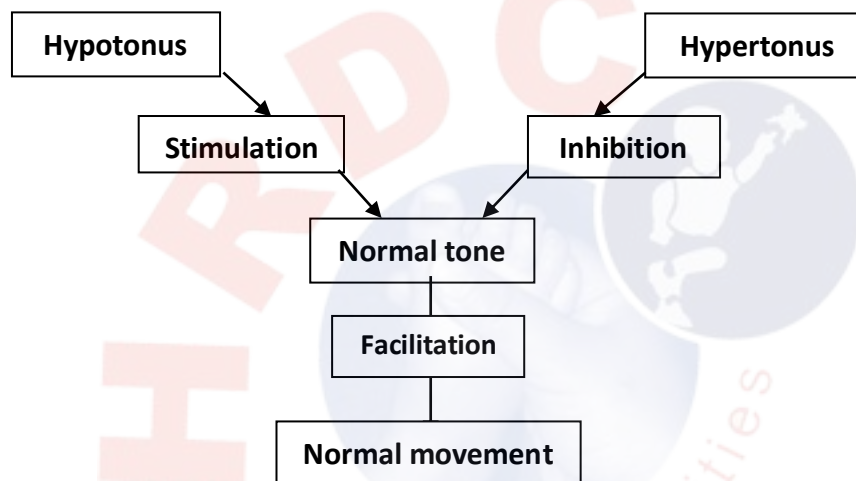
### 3. Analysis (write down with priorities)

#### 4. Plan

- a) STG
- b) LTG

#### 5. Treatment and home advises.

#### AIMS OF TREATMENT



1. To stimulate and train sensory activities like joint position and object image.
2. To gain full joint range.
3. To strengthen the muscles.
4. To promote normal development and motor growth as much as possible.

#### TREATMENT TECHNIQUES

##### 1. INHIBITION (Decrease tone)

- Proper position (reflex inhibitory Position)
- Passive trunk rotation
- Slow and rhythmical rocking
- Passive range of movement exercises
- Wt. Bearing

##### 2. STIMULATION (increase tone)

- Massage (tapping)
- Pressure (against the gravity)
- Weight bearing exercise
- Placing and holding



### **3. FACILITATION**

It is a combination of inhibition and stimulation to achieve a normal posture and movement. The aim is to let child experience a normal movement.



#### **4. INCREASE RANGE OF MOVEMENT**

- Passive ROM exercise
- Passive stretching exercise
- Ice massage
- Splint or serial casting

#### **5. TO STRENGTHEN THE WEAK MUSCLES**

- Active exercise

#### **6. PREVENTION FROM DEFORMITIES AND CONTRACTURES**

- Proper position
- Splintage
- Stretching/Range motion exercise

#### **7. TO INCREASE HAND FUNCTION**

Hand functioning example e.g. picking up the different types of objects.

#### **8. TO IMPROVE THE BODY BALANCE**

E.g. keep the baby in a prone lying and late baby to raise the head with activities. This helps to improve the head and neck control.

#### **9. TO IMPROVE THE BODY BALANCE**

Eg. Rolling, keep the baby in a supine position. Put some coloured objects close to the side. Give some movement to other side (in shoulder) following movement of whole body to roll over.

#### **10. TO IMPROVE THE COORDINATION**

- Index finger to nose
- Heel to shin
- Picking up and out different kinds of objects from one place to another (place should be defined)

#### **11. TO IMPROVE THE JOINT SENSE AND OBJECT SENSE**

- Train with joint motion closing eye.
- Training with different types and shapes of objects with eye closing

#### **12. TO IMPROVE GAIT**

- Gait training on parallel bar, walker or crutch with or without brace.

#### **SOME IMPORTANT THINGS TO KNOW**

1. The treatment should always be pleasant for child and therapist
2. Use a lot of activities.
3. Talk a lot and give simple instructions.
4. Guide these movements which child cannot do by himself properly.
5. Start with things which child is able to do well
6. Spend a lot of time with child.

## POLIOMYELITIS

Poliomyelitis is essentially a viral disease affecting anterior horn cell with resulting paralysis of a lower motor neuron type with asymmetrical flaccid paralysis and normal sensation.

### It is divided into three stages

- |                                  |                                |
|----------------------------------|--------------------------------|
| 1. Acute                         | : from one week to four weeks. |
| 2. Sub acute                     | : from 0 month to 2 years.     |
| 3. Post polio residual paralysis | : after two years.             |

### Causes

Poliomyelitis is viral infection disease, which affects on the anterior horn cells of spinal cord.

### Pathology

Polio virus is infected via intestine. It reaches to the blood. It is tropic to the anterior horn cells of the spinal cord. Which is destroyed or made, thereby losing the motor function, but sensation remain intact.

### Signs and symptoms

#### Acute

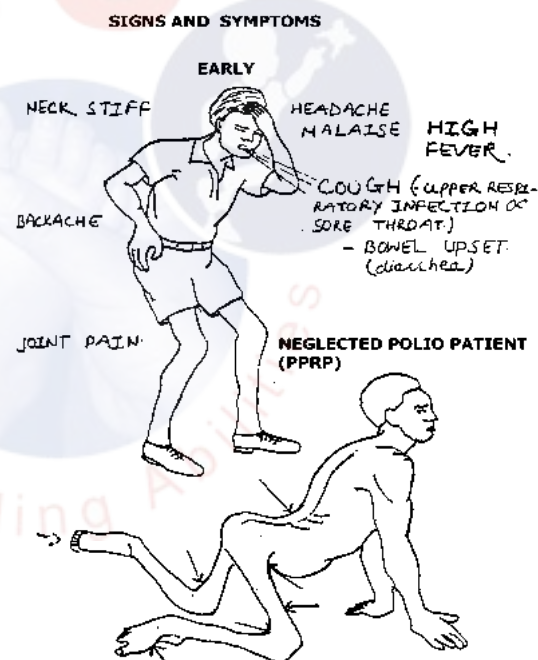
- Fever
- Malaise
- Headache
- Sore throat
- Diarrhea and vomiting
- Deep muscle pain

#### Sub - acute

- Pain
- Mild muscles atrophy
- Decrease mobility

#### Post polio residual paralysis (PPRP)

- Severely muscles atrophied
- Deformities or contractures
- Shortening of leg (affected)
- Sub-luxation or dislocation of affected joints
- Scoliosis, kyphosis or kyphoscoliosis of spine



### Less than 1% of patients affected with polio develop PPRP

- I. Brunhilde
- II. Lansing
- III. Leon

Around 10% - Patient will exhibit any symptoms at all  
< 1% - Involvement of C.N.S. (Central Nervous System)

**Preventive measures:**

Vaccination

Oral : Sabin

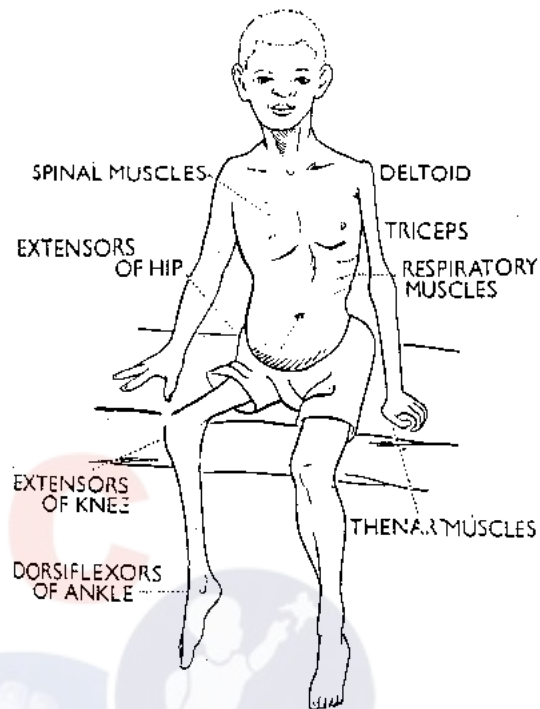
I/M : Salk

**MUSCLES COMMONLY AFFECTED IN POLIOMYELITIS****Muscles commonly affected on upper and lower extremities:****Upper Extremity:**

Shoulder : deltoid  
 Elbow : triceps  
 Wrist : wrist extensors  
 Hand : intrinsic muscles

**Lower Extremity**

Hip : gluteus maximus, gluteus medius and internal rotators  
 Knee : Quadriceps  
 Ankle : tibialis anterior and tibialis posterior

**Non operation Management****Post polio residual paralysis:**

- Range of motion exercises
- Stretching exercises
- Muscle strengthening exercises
- Splinting
- Positioning
- Gait training (progressive if necessary)
- Education, Pre stretching & stretching exercise.

**Operation Management**

- I. Soft tissue procedures
  - releases/lengthening
  - transfers
- II. Bony procedures

**Post operative Physiotherapy management**

1. Patient has single hip-spica. we give following exercises.
  - a) Isometric quadriceps muscle strengthening exercise (if possible)
  - b) Gluteal pinching
  - c) Active or passive movement
  - d) Active ROM exercise for unaffected hip, knee and ankle.
  - e) Care of hip spica.
  - f) Gait training with the help of crutches (if possible)
2. Patient has double hip-spica:
  - a) Isometric quadriceps exercise for both legs.
  - b) Active or passive toes movement.

- c) Gluteal pinching.
  - d) Cast care.
3. If the patient has released both hip, knee and ankle but has only long leg cast, we give the following exercise:
- A) Prone lying position (head turn on opposite side) with adducting both hips and straight knees (from post-operative second day)
  - b) Exercises as above.
4. If the patient has released one side of hip, knee and ankle then we give
- a) Prone lying position
  - b) Isometric quadriceps and glutei pinching exercise.
  - c) Ambulation on a pair of crutch without weight bearing on affected leg.

Usually cast removed after 6 weeks (for soft tissues release). Meanwhile the orthosis is measured. Exercises should be continued as following:

- Gentle passive ROM of joints.
- Active muscle strengthening exercises.
- Splinting.
- Gait training with a pair of crutch without weight bearing on affected leg.
- Prone lying position.

In case of muscle transfer has been done the cast is removed after 4-6 weeks.

Meanwhile the orthosis is measured and we give following exercises:

- Isolated muscle strengthening exercise for transformed muscles for 2weeks.
- Gentle passive stretching exercise for 1 week.
- Then progression from active to light resisted exercises.
- Splint is provided for maintaining the correction of foot.
- Ambulation practice given
- After delivery of orthosis, we give ambulation train using orthosis with or without crutches.

### **Deformity pattern:**

#### **Upper extremity:**

- Shoulder : Subluxation or dislocation
- : Adduction
- Elbow : Flexion
- Forearm : Pronation
- Wrist : Flexion
- Thumb : Adduction
- Spine : Kyphosis, scoliosis or hypo-scoliosis.

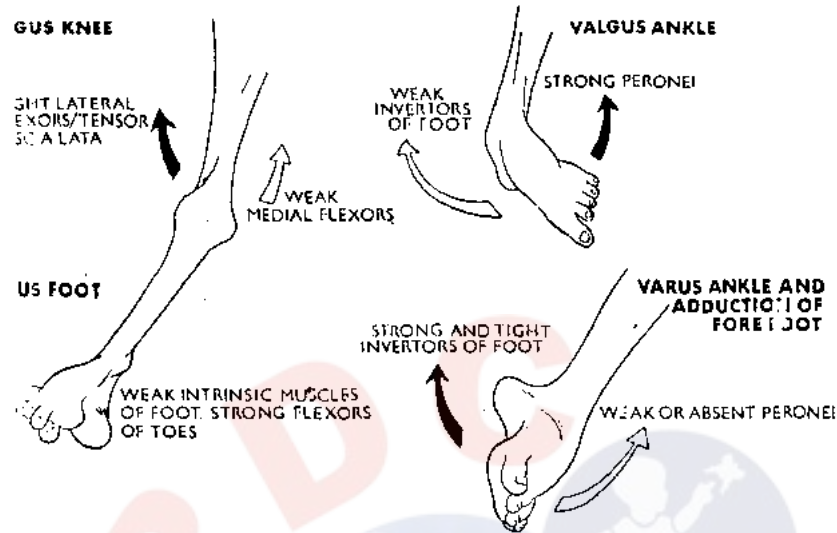
#### **Lower extremity**

- Hip : Subluxation
- : or dislocation
- : Flexion, abduction
- Knee : Flexion
- : Genu valgum
- : Genu recurvatum

Ankle and foot : Equinus  
 : Calcaneus  
 : Cavus  
 : Valgus

## CAUSATION OF DEFORMITIES

### IMBALANCE OF MUSCLES



## Physiotherapy management

### Aims:

- Prevention from joint deformities and contractures
- Maintain and increase joint range of movement
- Prevention from muscle weakness
- Increase muscle weakness
- Increase muscle strength
- Improve mobility and gait
- Improve hand function and activities of daily living.

### 1. Acute stage:

- Rest
- Corrective position
- Avoid forceful exercises
- Splints
- Avoid injection

### 2. Sub - acute stage (recovery stage):

- Corrective position
- Splint
- Range of motion exercises
- Progressive muscle strengthening exercise
- Mobility
- Activities of daily living
- Gait training



## OSTEOMYELITIS

Osteomyelitis (O.M.) is an inflammation of bone and bone marrow. Infection is caused by pyogenic bacteria.

### Factors predisposing to Bone Infection

1. Malnutrition
2. Diabetes Mellitus
3. Steroids administration
4. Immune deficiency
5. Immunosuppressive drugs
6. Venous stasis in limb
7. Peripheral vascular disease
8. Trauma
9. Iatrogenic invasive measures



### Types

1. Acute osteomyelitis
2. Sub acute osteomyelitis
3. Chronic osteomyelitis

#### 1. Acute osteomyelitis

Acute osteomyelitis is a rapidly destructive pyogenic infection. It is most common in infants and children. It starts in metaphysis of a long bone.

#### Causes

- a. Age - infancy and children
- b. Sex - Males are more 4/1
- c. Trauma - direct blow.
- d. Location - metaphysis of a long bone. Mostly growing end of the bone (e.g.- upper end of tibia. lower end of femur),
- e. Poor nutrition, unhygienic surroundings.

#### Bacteria-*Staphylococcus aureus* (most common)

Osteomyelitis can be etiologically

Pyogenic : Producing pus e.g. *Staphylococcus aureus*

Non-pyogenic : Not producing pus. e.g. Myco tuberculosis

Fungal

Viral

#### According to duration of infection

Acute : Surgical emergency

Sub acute

Chronic

## Pathology

Acute osteomyelitis is caused by bacteria through wound or soft tissue infection. An infected embolus enters nutrients artery and vessels, Most of the small arteries and vessels are located in the metaphysis. The metaphysis become infected and cannot supply the nutrients to the long bones and necrosis of bone. Finally infection spread into soft tissues and gradually develops sinus.

## Clinical picture

- The child is irritable and restless
- High grade fever : ↑ESR, CRP
- Swelling: ↑WBC
- Pain
- Surrounding muscles are painful
- Active or passive movements are painful

## Treatment

- Antibiotics
- Drainage of pus
- Daily dressing

## 2. Chronic osteomyelitis : - 3 months

Chronic osteomyelitis is always a sequel to acute osteomyelitis. Infection through an external wound usually causes a chronic osteomyelitis.

## Causes

The staphylococcus is the most common causative organism, but streptococcus, Pneumonococcus, typhoid bacilli or other bacteria may also be responsible.

It is most common in long bones. Infection starts at one end of the bone, but it may affect whole length. The bone is gradually thickened and denser than normal bone. There is formation of pus. Bones become necroses and change into sequestrum. The sinus develops. The sinus tends to heal and break down recurrently, but if a sequestrum is present, it never heals permanently.

## Clinical pictures

- Pain
- Pyrexia
- Tenderness
- Discharging Sinus
- Muscles atrophied
- Restriction of joint movement
- Limb length discrepancy



## Complications

- Bone infection
- Growth retardation
- Pathological fractures
- Bone lengthening or shortening
- Muscles or joint stiffness
- Deformity

## Treatment

- Pain killer (analgesic)
- Antibiotics
- Daily dressing

## Principles of Treatment of Osteomyelitis are:

- To provide analgesic & general supportive measures
- To rest the affected part
- To identify the infecting organism & administer effective antibiotic treatment or chemotherapy
- To release pus as soon as it is detected
- To stabilize the bone if it has fractured
- To eradicate vascular & necrotic tissue
- To restore continuity if there is a gap in the bone
- To maintain soft tissue & skin cover.

## Surgical

a. Incision and drainage

b. Sequestrectomy

3S : S- Sinus curettage

The wall of the cavity, lined by infected granulation tissue is curetted until the underlying normal-looking bone is seen.

: S- Sequestrectomy

Remove of sequestrum. A window is made in the overlying involucrum and the sequestrum is removed.

: S- Saucerization

Bone cavity is converted into a "saucer" by removing its wall. Allow free drainage of the infected material.

c. Amputation

Very rarely done. Preferred in case of long standing discharge sinus (especially when the sinus undergoes a malignant change).

## **Physiotherapy**

### **Aims:**

- Rest to decrease pain.
- Immobilization of affected limb by splinting and casting to prevent pathological fracture.
- Decrease swelling by elevating the affecting limb, use of cool compresses.
- Exercising the affected joint helps the recovery process and maintains the strength.

If treated surgically for osteomyelitis, physical therapy may be indicated post-operatively to address any impairment in:

- Strength of muscle
- Range of motion
- Proprioception
- Treatment for any functional limitations or disabilities secondary to the infection.
- Maintain function and enhance mobility
- Active range of motion physical therapy initially helps maintain flexibility

### **Acute osteomyelitis**

- Rest
- Positioning by splint
- Non weight bearing
- Nutrition



## JUVENILE RHEUMATOID ARTHRITIS

**Juvenile rheumatoid arthritis (JRA)**, also known as juvenile idiopathic arthritis, is the most common type of arthritis in children. Arthritis is a long-term condition characterized by stiffness, swelling, and pain in the joints. It is a common non bacterial inflammatory joint disease. It is also called Still's disease. It could affect several joints at the same time. Some children have arthritis for just a few months, while others have arthritis for several years. In rare cases, the condition can last a lifetime.

### Cause

The exact cause of JRA isn't known. However, researchers believe it might be an autoimmune disease. In people with autoimmune diseases, the immune system can't differentiate between the healthy cells in the body and harmful substances, such as viruses and bacteria. This causes the immune system to mistakenly attack harmless cells as though they are dangerous invaders. In children with JRA, the immune system releases chemicals that damage healthy tissues in the body, causing inflammation and pain in the joints.

### Types of JRA

Three major types of Juvenile Rheumatoid Arthritis.

- Systemic JRA(20%) : Still's disease
- Polyarticular JRA (50%) : > 5 joint involved
- Oligoarticular JRA (30%) : <4 joint involved

### Clinical features

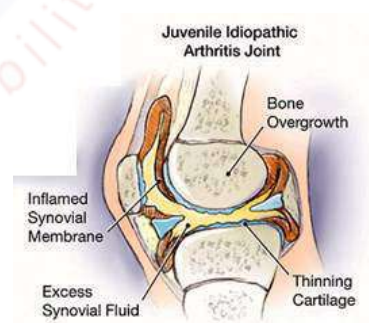
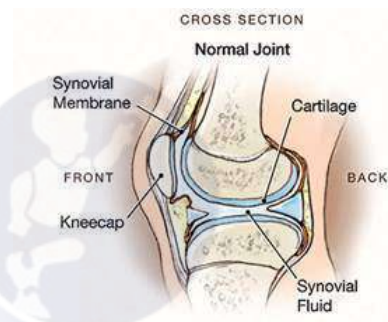
The most common symptoms of JRA include:

- joint pain
- stiffness
- reduced range of motion
- warm and swollen joints
- limping
- redness in the affected area
- swollen lymph nodes
- recurrent fevers

### Deformities and problems

#### Upper extremity

- a) Neck : Stiff in flexion position
- b) Shoulder : Flexion and adduction
- c) Elbow : Flexion
- d) Forearm : Pronation
- e) Wrist : Flexion and ulnar deviation
- f) Fingers
  - Swan neck deformity
  - Boutennier deformity



## Lower extremity

- a) Hip : Flexion, adduction and internal rotation
- b) Knee : Flexion, genu valgum, subluxation
- c) Ankle : Dorsiflexion  
: Pes Cavus
- d) Toes : Clawing

## Treatment aims

- Prevention of deformities and contractures
- Maintain and increase the joint ROM
- Maintenance of functional activities
- Improve the hand function and upgrade the ADL.
- Improve the gait and normalize the ambulation, as much as possible.
- Education for joint protection and prevention of deformity

## Methods

- Active assistive and gentle passive ROM or stretching exercises
  - Appropriate splinting or functional splints
  - Good positioning of the limb
- An active and resisted strengthening exercise depends on the muscle power. Sometimes need to give functional or play therapies when patients not well motivated and cooperated.
- Bed and mat activities such as rolling, sitting from supine, transfer and activities.
- Intensive hand functioning activities with games and play therapy.
  - May need dynamic splint.
- Activities of daily living training should be given.
  - ADL-May required assistive device to make easy activities.
- Progressive gait training.

## A. Medical Management

- Symptom modifying anti-rheumatic agents (SMARAs)  
Aspirin : commonly used
- Disease modifying anti-rheumatic agents (DMARAs)
  - Methotrexate
  - Salazopysin / Sulfasalazine
  - Gold
  - Pencillamine
  - Steroids
  - Anti-TNF therapies





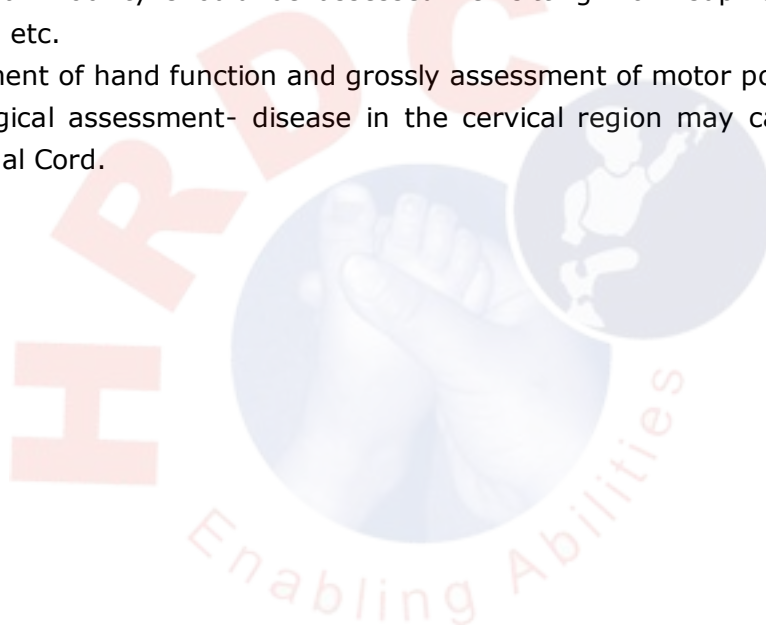
## **B. Surgical Management**

- Synovectomy
- Contracture release

## **Physiotherapy Management**

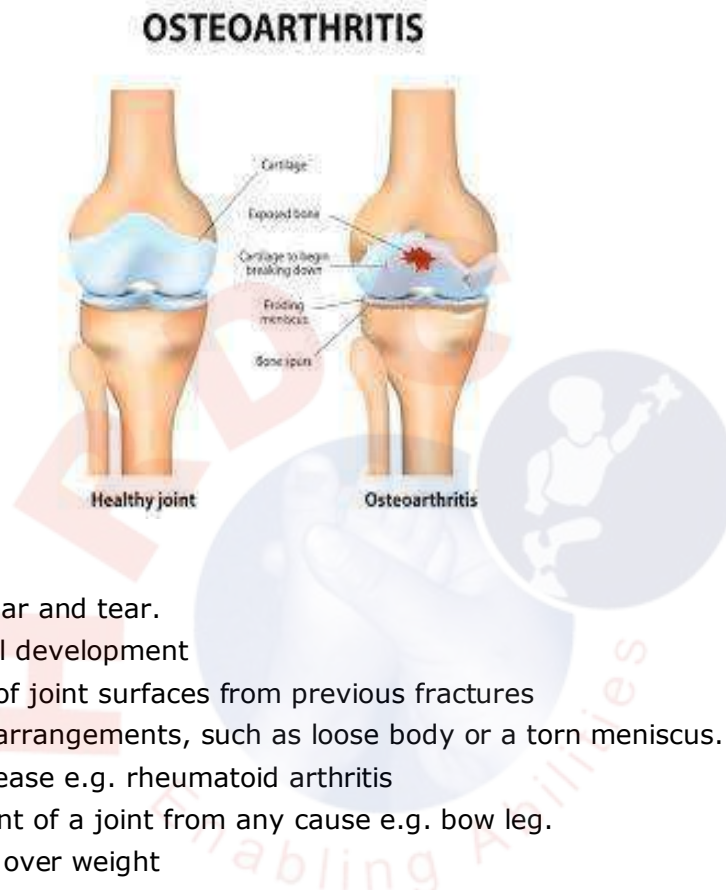
A thorough assessment of patient is carried out. Some assessment and guidelines are mentioned below:

- Measurement of pain, swelling on the joint
- Edema - lack of pumping action of muscles cause swelling of the joint.
- Measurement of joint deformities and contractures ROM should be taken active as well as passive too.
- Activities of daily living.
- Tightness of soft tissues should be recorded.
- Functional mobility should be assessed i.e. sitting from supine position, rolling crawling etc.
- Assessment of hand function and grossly assessment of motor power.
- Neurological assessment- disease in the cervical region may cause pressure on the Spinal Cord.



## OSTEOARTHRITIS

Osteoarthritis (O.A.) is a joint disease that mostly affects cartilage. Cartilage is the slippery tissue that covers the ends of bones in a joint. Healthy cartilage allows bones to glide over each other. It also helps absorb shock of movement. In osteoarthritis, the top layer of cartilage breaks down and wears away. This allows bones under the cartilage to rub together. The rubbing causes pain, swelling, and loss of motion of the joint. It is a degenerative wear and tear process occurring in joints that are impaired by congenital defect, age, vascular insufficiency, or previous disease or injury.



### Causes

It is caused by wear and tear.

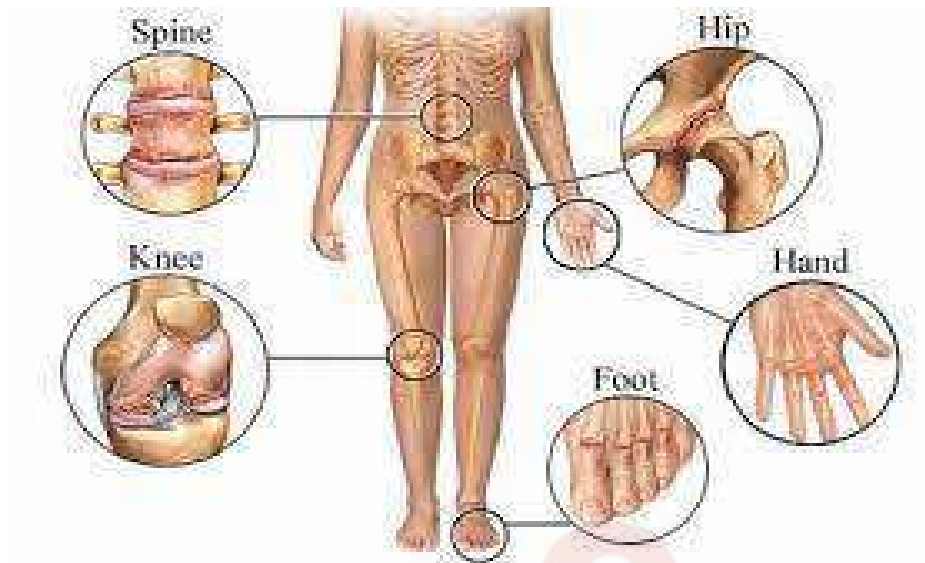
- Congenital ill development
- Irregularity of joint surfaces from previous fractures
- Internal de-arrangements, such as loose body or a torn meniscus.
- Previous disease e.g. rheumatoid arthritis
- Mal-alignment of a joint from any cause e.g. bow leg.
- Obesity and over weight

### Pathology

Any joint may be affected; lower limbs are more often affected than the upper ones. The articular cartilage is slowly worn away until underlying bone is exposed. This bone becomes hard. Meanwhile bones at the margins of the joint hypertrophies to form a projection called osteophytes. Recurrent strains develop; joints become thickened and fibrosed.



### Mostly Affected site



### Clinical features

- Thickening of the bone on palpation due to marginal osteophytes.
- Pain
- Limited joint motions
- Audible crepitations of joint
- Fixed deformity of hip and sometimes in other joints
- Swelling or tenderness in one or more joints

### Management

The primary goals of treating osteoarthritis of knee are to relieve the pain and return mobility. The treatment plan will typically include a combination of the following:

#### Counseling

1. **Weight loss:** Losing even a small amount of weight, if needed, can significantly decrease knee pain from osteoarthritis.
2. **Exercise:** Strengthening of the muscles around the knee makes the joint more stable and decreases pain. Stretching exercises help keep the knee joint mobile and flexible.

#### Medical management

1. Pain relievers and anti-inflammatory drugs.
2. Injections of corticosteroids or hyaluronic acid into the knee. Steroids are powerful anti-inflammatory drugs. Hyaluronic acid is normally present in joints as a type a lubricating fluid.

## **Conservative management**

1. Using devices such as braces.
2. Physical and occupational therapy.

If you are having trouble with daily activities, physical or occupational therapy can help. Physical therapists teach you ways to strengthen muscles and increase flexibility in your joint. Occupational therapists teach you ways to perform regular, daily activities, such as housework, with less pain.

## **Physiotherapy procedures**

- Isometric strengthening exercise for Quadriceps and Hamstring muscles
- Active/ resisted strengthening exercise for gluteus maximus and Gluteus medius.
- Resisted strengthening exercise for quadriceps if required.
- Knee care advices and counsel about life style ie: reduce the weight.

## **Surgical management**

When other treatments don't work, surgery is a good option.

1. Arthroscopy
2. Osteotomy
3. Jointreplacement surgery

## **Physiotherapy management after surgery:**

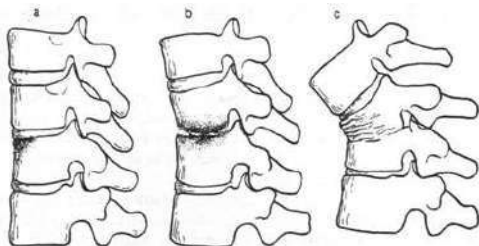
### **Aim:**

- Reduce pain.
- Improve / increase range of motion of knee joint.
- Strengthen the muscles of Hip, Knee and Ankle.
- Improve the gait.
- Improve the proprioception.
- Improve the body balance.

Counseling is very important about care of knee, weight loose and take precaution during up and down the stairs.

## TUBERCULOSIS OF THE SPINE

Tuberculosis is chronic granulomatous infection caused by the bacteria called *Mycobacterium tuberculosis*. It can affect any part of the body but commonly involves the lungs, intestine, lymph nodes, bones, uterus and meninges etc. In the musculoskeletal system it commonly involves in the spine. Then in the hip, knee, ankle, wrist, shoulder and the smaller bones like metacarpals and tarsal. Spine is the most common site of skeletal TB & accounts for 50% of all musculoskeletal TB.



### Pathology

The organism reaches the spine through the blood stream from a pre-existing factor. It affects primarily in the lungs or the intestine. The infection localizes in the para vertebral disc, anterior, central or rarely in the vertebral arch of the vertebra. Destruction of the vertebra and the inter-vertebral disc leads to anterior collapse and a kyphotic deformity leading to gibbous formation. Formation of pus and caseous material leads to pressure on the spinal cord resulting in complete or incomplete paralysis known as "Pott's paraplegia".



### Clinical feature

- Evening rise of temperature, loss of appetite, night sweating and loss of weight
- Pain on the back
- Gradual kyphotic deformity of spine and gibbous formation
- Weakness of the extremities leading to paraplegia or paraparesis.
- Increased muscle tone, increased tendon reflexes, patellar and ankle clonus.
- Extensor plantar response.

### Treatment

The treatment of Tuberculosis of the spine can be either conservative or surgical. Conservative treatment consists of anti-tuberculosis therapy with drugs like Rifampicin, Isoniazid (INH), Pyrazinamide, and Ethambutol. Vitamin B6 must be given with INH to control its side effect. Use of Thoraco - lumbar - sacral orthosis (TLSO) to contain and prevent further deformity of the spine.

## Physiotherapy

Patients with Pott's disease often undergo spinal fusion or spinal decompression surgeries to correct their structural deformity and prevent further neurological complication. Treatment regimens should address each patient individually, focusing on any impairments, functional limitations and/or disabilities with which they present. When compared with other physical therapy treatments and self-management, spinal stabilization exercises were found to produce significantly more positive ratings in global outcomes.

### Pre-operative

1. Detail Evaluation
  - i. Range of Motion of joint
  - ii. Contracture and Deformity measurement
  - iii. Muscle charting
  - iv. Sensory mapping
2. Bed Mobility/Functional mobility
3. Activities of Daily Living (ADL)
4. Ambulation potential

### Treatment

1. Active or passive ROM exercises
2. Reflex inhibitory position
3. Splinting
4. ADL activities
5. Gait Training

### Post operative

- Spinal Stabilization Exercises
- Spinal Stabilization Exercises
- Back School
- Strengthening Exercise
- Pain and disability management
- TENS (Transcutaneous Electrical Neuromuscular Stimulation)
- Over ground Training (Walking Program)
- Aerobic Exercise
- Trunk Strengthening
- Psychosocial counseling

### Supportive treatment

1. Rest
2. Braces
3. High Protein diet
4. Multivitamins
5. Hygiene
6. Bed sore care
7. Chest/Urinary tract care
8. Improve Immune Status





## SEPTIC ARTHRITIS

Septic arthritis is an infective arthritis caused by bacteria. It's infects in a joint. Many different types of germs (bacteria) can cause septic arthritis. Infection with a bacterium called *Staphylococcus aureus* is the most.

### Common organisms

Any age : Staphylococcus, streptococcus or pneumococcus usually responsible.  
Neonates : E. Coli  
Infants : H. Influenza

### Pathology

- a. **Haematogenous:** If some germs (bacteria) settle on a small section of a joint, they can multiply and cause infection. Bacteria can get to a joint **via the bloodstream**. This is the most common cause, particularly in children. Bacteria may get into the blood from an infection in another part of the body and travel to a bone. Even if you are healthy, bacteria sometimes get into the blood from the nose or gut.
- b. **From an injury.** Bacteria can get into a joint if you have a wound that cuts into a joint.
- c. **During surgery.** Infection is an uncommon complication if you have joint surgery or joint investigations (such as arthroscopy).

### Risk factors

Anyone at any age can develop septic arthritis. However, you have an increased risk if you:

- Rheumatoid arthritis
- An injury to a joint.
- Joint prosthesis (such as an artificial hip or knee).
- Surgery to a joint.
- Poor immune system. For example, AIDS, taking chemotherapy etc.
- Inject street drugs which can be contaminated with germs (bacteria).
- Gonorrhoea (sexually transmitted disease).
- Infection of bone (osteomyelitis) near to a joint.

### Clinical pictures

- Pain
- Joint swelling, redness and warmth
- Fever
- Restricted or painful range of movement

### **On examination**

- Affected joint is swelling of the joint
- Effusion
- Increase temperature and redness
- Joint movements restricted
- Muscles atrophied

### **Treatment**

#### **Primary treatment**

- Rest
- Antibiotics (Causative organisms must be identified and its sensitivity to antibiotics determined)
- Draining the joint fluid

#### **Physiotherapy Management**

Once the infection has been treated and when symptoms begin to settle it is important to get the affected joint moving again. This may help to prevent long-term stiffness in the affected joint.

- Splint to affected limb to decrease pain
- Traction to decrease pain
- ROM exercises
- Muscle strengthening exercise (Isometric or Isotonic) to maintain muscle strength
- ADL encouragement
- Progressive ambulation with or without assistive devices

#### **Surgical Treatment**

- Fluid aspiration- sent for C/S
- Arthrotomy and Joint debridement

#### **Late cases**

- Arthrodesis
- Arthroplasty : Once the infection has burnt out (in selective cases).

## BURN

Burns are among the most common household injuries, especially in children. The term "burn" means more than the burning sensation associated with this injury. Burns are characterized by severe skin damage in which many of the affected cells die. Depending on the cause and degree of injury, most people can recover from burns without serious health consequences. More serious burns require immediate emergency medical care to prevent complications and death.

### Burns Types

- |                            |  |
|----------------------------|--|
| 1. Scald                   | : contact with hot liquid                              |
| 2. Flame burn              | : contact with fire                                    |
| 3. Contact burn            | : hot surface / object                                 |
| 4 Chemical burn            | : certain chemicals e.g. acid                          |
| 5. Friction burn           | : due to friction between the skin and another surface |
| 6. Frostbite / Cold injury | : exposure to cold temperatures                        |
| 7. Sunburn                 | : ultraviolet sun rays                                 |
| 8. Electrical burn         | : electric current                                     |
| 9. Radiation burn          | : X-Rays or a radioactive substance                    |

### Assessing Severity

#### 1. Depth

##### First Degree Burn

Involves only the epidermis, appears as erythema and blisters e.g. sunburn.



##### Second Degree Burn

Involve the entire epidermis and part of the dermis. Skin can still grow back over the burn site painful because nerve endings are exposed. Appears moist and red e.g. scald, flame burn.



First and second degree burns are also known as partial thickness burns.

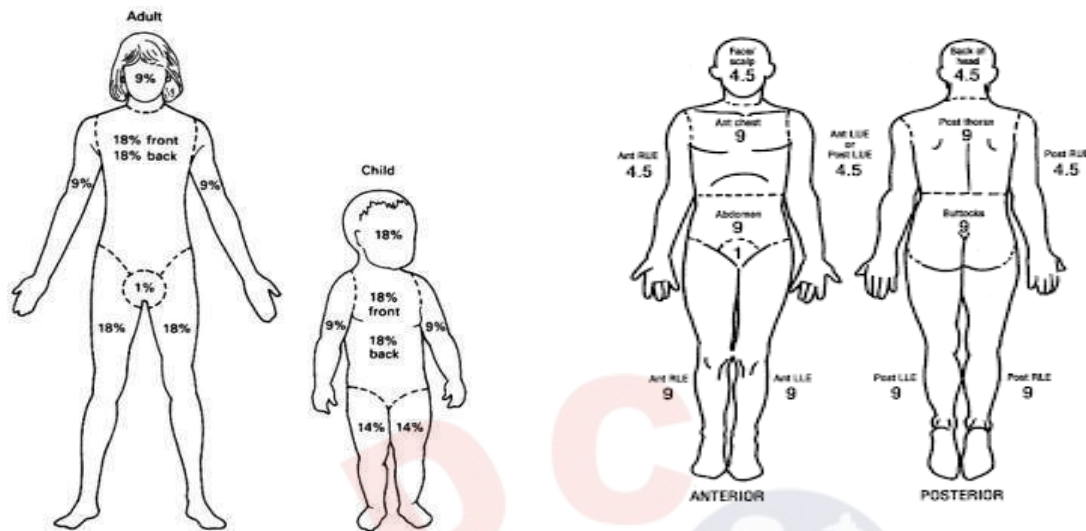
##### Third Degree Burn

Involve the entire thickness of the dermis and epidermis. Skin cannot re grow over the burn site, and it is painless due to the destruction of nerve endings. Appear dry and brown e.g. electrical burn. Third Degree burns are also known as Full Thickness or Deep Burns.



## 2. Surface Area

The 'Rule of Nines' can be used to assess the percentage of the surface area affected by burns. In children this rule is not used as the head is bigger in comparison to the body than in an adult. Another way to approximate the percentage surface area burned is to remember that the area of the patient's palm is equal to 1% of the surface area.



## 3. Other Factors

- Site of burn
- Burn type
- Length of contact
- Patient age (young and elderly have thin skin)
- Other injuries / illness

## Management

### 1. First Aid

- Remove from danger
- Airway
- Breathing
- Circulation
- Cold water running or icepacks to burn site transport to hospital.

### 2. Fluid Therapy

#### Indications

- Children >10% burn
- Adults > 15 % burn

Ideally give colloids (e.g. Dextran, Human Albumin), but crystalloids (Normal Saline, Ringers Lactate, Hartman's Solution) can be used.

## How much

Clinical condition and urine output guide fluid management after first 24 hours. Normal fluid requirements must be added to fluid given for burns. Timing is taken from the time of burn, not the time of admission.

- IV cannulas must be put in unburned skin.
- 1 - 1.5 litres for every 10% burned. Half of this is given in first 8 hours. the rest is given in the following 16 hours.  
OR
- $\text{Wt. in kg} \times \% \text{ burned} / 2 = 1 \text{ ration}$ :
  - 3 rations in 1st 8 hrs.
  - 2 rations in 2nd 8 hrs.
  - 1 ration in 3rd 8 hrs.OR
- Young child - 4 ml / kg/% burned  
Adult / older child - 2 ml /kg/%burned

**Blood:** Given in all full thickness burns on the 2nd day.

## 3.Wound Care

- Clean and debride but do not puncture blisters
- Elevate to prevent edema
- Dressings:
  - i. Occlusive with antibacterial agents in water based cream or tulle (e.g. nitrofurazone.).
  - ii. Silver sulphadiazine used as antibacterial for old burns prevents organism resistance.) These are used in 1st / 2nd degree burns on the limbs.
  - iii. Left open with mesh cloths over bed / cradle used in burns to trunk or face.

## Deep Burns

- May need escharotomy (incision- through eschar to prevent gangrene or chest wall movement).
- Daily / alternate day dressing changes under IV betamine.
- Skin graft as soon as healthy granulation tissue appears.

## Prevention of Infection - Major causes of Morbidity and Mortality

- Swabs from wound site to monitor growth.
- May use penicillin/erythromycin for a week to prevent streptococcal growth (graft will not take if streptococcal infection present).
- Tetanus immunization.

## 4. Nutrition

Need for a high protein, high calorie diet as protein is lost through the burn site and needed for healing, and the metabolic rate increases with burn healing.

## 5. Scar Prevention

- Nurse in functional position.
- Early physiotherapy is ideal if patient is reliable and co-operative.
- Uncooperative patients need strict immobilization in functional position.
- Early skin grafting in full thickness burns.
- Prevent infection - can make the burn deeper.
- Compression dressings.

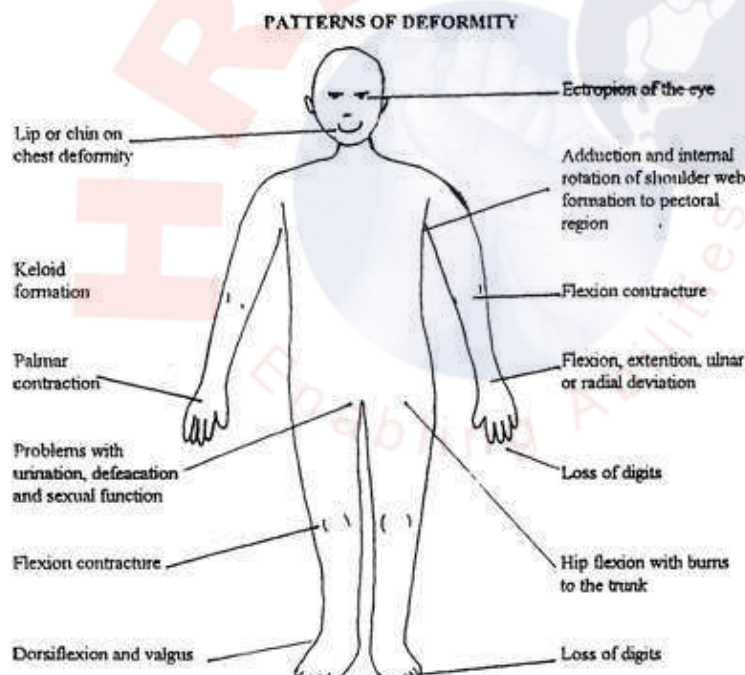
## 6. Common Complications

### Acute

- Renal failure
- Paralytic ileus
- Stress (Curling's) ulcers
- Infection

### Chronic

- Burn contractures
- Malnutrition
- Keloid / hypertrophic scars,
- Protein losing enteropathy



## Burn Rehabilitation

Late sequel of burns, in our patient population, is the third most common cause of disability after infection and congenital diseases. Patient with late post burn complications like severe contractures, loss of limbs and multiple deformities present to us rather late. From a study done a few years ago of our burn patients, we found that most of them sustained burns under the age of six, and wait on an average 7 years before seeking any treatment at HRDC or elsewhere. Thus patients and their care-takers



are bound by their own constraints like ignorance, finances, distance etc. and tend to seek treatment late.

Our aims in burn rehabilitation are again obtaining maximum function, making them independent in ADL and social rehabilitation when possible. The parameters that guide us and make burn rehabilitation successful are proper patient selection, team approach, pre and post operative management, patient / care- taker counseling and motivation, age of the child, staged planning of procedures and evaluating results. And so far our efforts are towards making the rehabilitation acceptable to patients and their care-takers.

1. First of all proper assessment of the problem is done by the team. All necessary investigations are ordered to assess the status of involved bones and joint, contractures, scars, ulcers etc.
2. Preoperative counseling is done. Patient and care-taker are involved in the discussion of plan of action and aimed level of achievement by the intervention. Pre - operation physiotherapy is also instituted.
3. Antibiotics are routinely used both pre and post operatively in those cases where extensive areas are grafted, where operative procedures are long and when otherwise indicated.
4. Adequate time is given post operatively for grafts to take and wounds to heal before instituting aggressive physiotherapy, but early measures are taken to reduce swelling, to promote circulation, healing etc.
5. Post operatively aggressive physiotherapy is given at times with orthosis to maintain correction or strengthen power for quite a long time. And patients are followed up for at least 2 - 3 years post operatively, before we call them rehabilitated and close their files.
6. Some patients who require staged procedures at various intervals need much longer follow - up.

## **Physiotherapy Management of Burn**

### **Principles**

#### **1. Scar and skin care**

- Warm water soaking 15—20 minutes.
- Sterile soaking if the wound is infected
- Massage with ghee or oil
- ROM exercises for stretching of skin

#### **2. To prevent the deformity and contractures by ROM/Stretching**

- Active exercise: after 1 week of the post operation, start active movement by the patient.
- Active assistive: post operation 10 days to 2 weeks start active and gentle active assistive exercises to stretch new skin. New plastic or plaster splint is applied day and/or night.
- Passive exercise: after post operation 3-4 weeks when skin graft is closed or less painful we do stronger passive stretching to gain maximum mobility of the joints.
- During this time, splint is very important to maintain the position of joints.

### **There are two types of splints:**

- Static : one piece and no movements of the joints
- Dynamic : many parts and movements of the joints

A static or dynamic splint helps to maintain the position, helps weak muscles to prompt from the deformity. A patient must wear splint all the day except when the exercise is being done. The operated part is soaked with warm water for 15 - 20 minutes twice day and massage after soaking. Start from the light activities of daily living such as hand functions and weight bearing on foot.

### **3. To strengthen the muscles** by strengthening exercises -to increase the strength of muscles, we can do active and resistance exercises.

We can use many things to strengthen muscles such as:

- Foam, cloth.
- Rubber bands or tube, clay or mud.
- Sands etc.

### **4. Sensory Stimulation**

Child may have hypersensitive skin or decreased sensation.

#### **Hypersensitive Skin**

Child has difficult to tolerate being touched. At first, give forms + smooth touch and gradually increase with rough things, cold or hot

#### **Decreased sensation**

The skin cannot feel touch and pain. At first teach child to be aware of the fact that cannot feel normally.

#### **Sensory stimulation includes**

- Alternating cold and warm water:
- Massage:
- Giving different objects - give different objects - smooth, rough, soft; hard to identify activities of daily living/self care.

### **5. Coordination (Speed of Movement)**

If the child has decreased strength, sensation and coordination, he may have a problem. So he has to learn how to use his other hand/leg to compensate good coordination.

### **6. Activities of Daily Living**

Different kinds of activities help child to make easy daily work. We have to help them find ways to do activities that work for them:

- Feeding
- Dressing
- Bathing/Washing
- Toileting
- Bowels/Bladder
- Mobility etc.

## **7. Home Program**

Patient is discharged to home. Patient and family should be independent in whole home program. Night splint is used. Sometimes a day splint is also needed. A brace or orthopaedic shoes may be continually used, use regular soaking massage, stretching. Watch carefully for recurrent deformity. Continue strengthening and activities of daily living.

## **8. At home**

Community Based Rehabilitation (CBR) facilitators monitor recurrence of deformities during their home visits and in the centers. Home based rehabilitation program includes:

- Soaking with warm water by massaging and stretching, frequency as required
- Progress after stretching and strengthening
- Use of night splint and day splint
- Repair of splint
- Check the use of brace/shoes.
- Progress of activities of daily living
- Progress of walking ability/mobility

## **Up to 1 Year at Home**

CBR facilitator continues to monitor operated part for return of deformity or contracture:

- Massage and stretching may be continued.
- Strength of daily living or walking ability is progressed.
- Child is integrated into normal activities of home and community.

## FRACTURE

Fracture is a medical condition in which there is damage in the continuity of the bone. A bone fracture can be the result of high force impact or stress, or a minimal trauma injury as a result of certain medical conditions that weaken the bones, such as osteoporosis, bone cancer, or osteogenesis imperfecta, where the fracture is then properly termed a pathologic fracture.

### Cause

The most common causes of fractures are:

- **Trauma:** A fall, a motor vehicle accident, or a tackle during a game can all result in fractures.
- **Osteoporosis:** This disorder weakens bones and makes them more likely to break. (Most Common - Vertebral bodies)
- **Overuse:** Repetitive motion can tire muscles and place more force on bone. This can result in stress fractures. Stress fractures are more common in athletes.

### Etiology

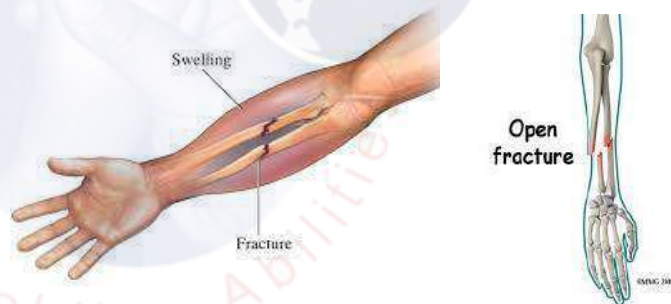
1. Traumatic Fracture / Pathological Fracture
2. Undisplaced Fracture / Displaced Fracture

### Sign and Symptoms

Many fractures are very painful and may prevent you from moving the injured area.

Other common symptoms include:

- Swelling
- Tenderness around the injury
- Bruising
- Deformity
- Loss of function



### Types of fracture

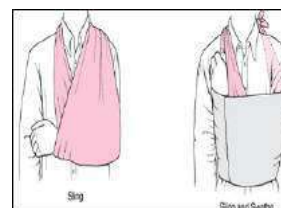
1. Close fracture  
In a closed fracture, the broken bone does not break the skin. This type of fracture is also called a simple fracture. But these fractures can be just as dangerous as open fractures.
2. Open fracture  
In an open fracture, the ends of the broken bone tear the skin. When the bone and skin are exposed, they are at risk of infection. This type of fracture is also called a compound fracture.

### Treatment

1. Early treatment
  - Wound care
  - Anti tetanus vaccination
  - Antibiotics
  - Immobilization
  - Splinting

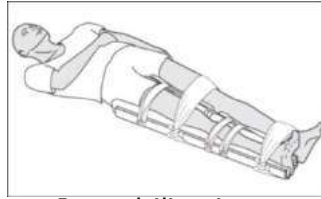


Wound care



Splinting

- Plastering



Immobilization



Plastering

2. Medical teams use a variety of treatments to treat fractures:

- Surgery  
Surgery is sometimes required to treat a fracture. The type of treatment required depends on the severity of the break, whether it is "open" or "closed," and the specific bone involved. For example, a broken bone in the spine (vertebra) is treated differently from a broken leg bone or a broken hip.
- Pain Management
- Cast
- Immobilization
- Traction
- External Fixation
- Open Reduction and Internal Fixation
- Nutrition diet

### Stage of Fracture Healing

- |  |                |
|--|----------------|
| 1. Stage of hematoma formation           | < 7days        |
| 2. Stage of granulation tissue           | upto 2-3 weeks |
| 3. Stage of callus (Soft bone) formation | 4-12 weeks     |
| 4. Stage of remodeling                   | 1-2 year       |
| 5. Stage of modeling                     | many years     |

### Complication

Some fractures can lead to serious complications including a condition known as compartment syndrome. If not treated, compartment syndrome can eventually require amputation of the affected limb. Other complications may include non-union, where the fractured bone fails to heal or mal-union, where the fractured bone heals in a deformed manner. Complications of fractures can be classified into three broad groups depending upon their time of occurrence. These are as follows:

1. Immediate Complications
  - Haemorrhage (blood loss)
  - Hypovolaemic shock
  - Structures around bones
2. Early Complications
  - Hypovolaemic shock
  - Infection
  - DVT (Deep Vein Thrombosis)
  - Compartment syndrome
  - ARDS (Adult Respiratory Distress Syndrome)
  - Fat embolism Syndrome
  - Pulmonary Syndrome

### 3. Late Complications

- Malunion
- Non union
- Delayed union
- Shortening
- Deformity
- Fracture diseases

## **Rehabilitation**

### **Aims:**

Most fractured (broken) bones will heal in usually six weeks. But that is only **half of the problem**.

### **Joint stiffness and muscle weakness**

This may even affect joints that don't seem related to the break. For example, a fractured shoulder may result in a very stiff elbow or wrist just because keeping shoulder in a sling for a few weeks.

Typically, your physiotherapist will attempt to prevent post-fracture stiffness and weakness in the adjacent joints and muscles during the first six weeks while your fracture is healing. After six weeks or later if X-rays show poor healing, physiotherapist can work on regaining full joint range of motion and muscle strength that operate near or over the fracture site.

After a fracture, physical therapy may be ordered to help ensure return to optimum function as quickly as possible. It may encounter a physical therapist at different times after suffering a fracture.

### **In the Hospital**

Gait training: a physical therapist may visit you in the hospital.

Instruct properly with non weight bear using an assistive device, like a cane or crutches.

If fracture arm, it may be required to keep the arm in a sling to help with healing. In the hospital, physical therapist may teach how to apply and remove the sling.

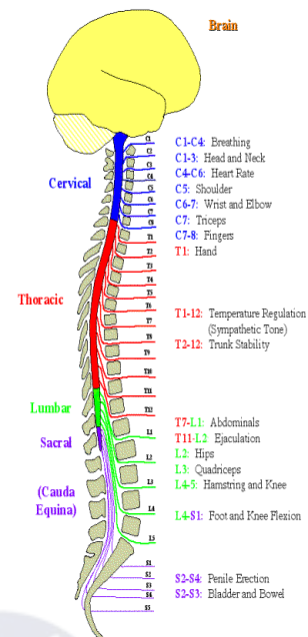
### **At Home**

After discharge from the hospital, continue to work on range of motion exercise and strengthening exercise. Gait training with or without assistive device to continued as advice by doctor and physiotherapist.



## SPINAL CORD INJURY (SCI)

Spinal cord injury (SCI) is damage to the spinal cord that causes changes in its function, either temporary or permanent. These changes translate into loss of muscle function, sensation, or autonomic function in parts of the body served by the spinal cord below the level of the lesion. It begins with a sudden, traumatic blow to the spine that fractures or dislocates vertebrae. Most injuries to the spinal cord don't completely sever it. Instead, an injury is more likely to cause fractures and compression of the vertebrae, which then crush and destroy axons extensions of nerve cells that carry signals up and down the spinal cord between the brain and the rest of the body. An injury to the spinal cord can damage a few, many, or almost all of these axons. Some injuries will allow almost complete recovery. Others will result in complete paralysis.



### Evidence

Twenty five years ago, SCI was labeled as "a condition not to be treated". Up till 20th century beginning mortality rate in SCI patients was 90%. Only 1% survived 20 years.

### Causes of SCI

1. Traumatic
2. Atraumatic

#### 1. Traumatic

- Road traffic accident
- Domestic/industrial accident
- Sports
- Criminal assault



In 55% the site of SCI is in the cervical spine and in 35% it is in the thoracic spine.

#### 2. Atraumatic

The atraumatic or non- traumatic causes of SCI are myelodysplasia, tuberculosis, tumours, vascular malformation etc. Injury to spinal cord may lead to Paraplegia or paraparesis in which the lower extremities are paralyzed or weakened and the upper extremities are spared. It may lead to Quadriplegia or quadriparesis in which all four limbs are paralyzed or weakened. This depends on the level of lesion or injury.

## Classification

In a complete lesion, below the level of injury or lesion there is complete loss of all neurological functions. If the thoracic or lumbar or sacral spine is involved there is paraplegia. If the cervical spine is involved there is quadriplegia.

In incomplete lesion, there is partial preservation of neurological function, e.g. anterior cord syndrome, posterior cord syndrome, central cord syndrome and Brown - Sequard syndrome.



## Signs and Symptoms

Some symptoms of a spinal cord injury include:

- problems walking
- loss of control of the bladder or bowels
- inability to move the arms or legs
- feelings of spreading numbness or tingling in the extremities
- unconsciousness
- headache
- pain, pressure, stiffness in the back or neck area
- signs of shock
- unnatural positioning of the head

## Management of Acute SCI patients

1. Look for trauma to other parts of the body.
2. Investigations:
  - X-rays
  - CT scan
  - MRI
  - MYELOGRAM
3. In case of dislocation - reduction e.g. cervical traction
4. Thoraco-lumbar fracture - Bed rest 8-12 weeks.

Care of other concurrent problems e.g. internal injury to organs, flail chest, extremity fractures.

## **Emergency Management**

1. Airway
2. Breathing
3. Circulation
4. Drugs and others

Take care in moving or lifting patients where you suspect SCI, Stable fracture can be made into unstable fracture or can cause more injury to spinal cord. Before moving, make sure there is horizontal stability and longitudinal traction.

## **Bladder Management**

The main goals of bladder management are to:

1. Maintain good kidney and bladder function and prevent any kidney or bladder damage
2. Achieve and maintain socially acceptable continence.

### **What problems can occur with the bladder?**

The role of a healthy bladder is to store urine and to empty at appropriate times. People living with Spinal Cord Injury can have what is known as a neurogenic bladder. This means that the brain and the bladder are not working together as well as they should. The two main problems that occur with the bladder are:

- It doesn't empty properly (retention) or
- It allows urine to leak either some or all the time (incontinence).

### **Bladders that do not empty completely**

A bladder will not empty if the muscle that controls the opening (the sphincter) remains closed all the time. The urine is then unable to pass through the urethra. If too much urine builds up in the bladder, it will cause a rise in pressure. This will then force the urine back up via the ureters into the kidneys. Over time, this will cause pressure on the kidneys, and if left untreated will damage the kidneys. Urinary tract infections (UTI's) can also be a problem if the bladder is not emptied of urine. Urine may appear cloudy, discoloured, may have a strong smell and can lead to pain when passing urine. Repeated UTI's can lead to kidney infections and kidney damage which must be avoided.

The usual way to manage this type of bladder is with clean intermittent catheterisation (CIC). Intermittent catheterisation is used to improve urinary control for people with abnormal bladder function. It reduces the rate of urinary infection, and helps relieve pressure on the kidneys thus helping the kidneys to remain healthy. A disposable catheter (plastic tube) is inserted into the bladder via the urethra to empty it. It is not a sterile procedure but hygiene is essential. Once the catheter has drained as much urine from the bladder as possible, it is slowly removed. Timing of this can vary but the same technique is usually repeated up to six times a day, at regular intervals. This is done during the daytime, but usually not at night while asleep. It is important to drink plenty of fluids. This will help to avoid urinary tract infections and keep good bladder health.

### **Bladders that leak urine**

Bladders will leak urine if the muscle that controls emptying (sphincter) is relaxed most of the time. These types of bladders can still have risks of infection and kidney health and will need to be monitored. It is most important with this type of incontinence to remain clean and dry, and prevent odour and wet clothing. Some medications can be useful to improve urine storage in the bladder and reduced leakage which will be advised by your treating doctor and nurse on their use. Special attention needs to be given to the skin to prevent rashes and skin injuries.

### **Management of Urinary Tract Infections (UTI's)**

#### **Urinary Tract Infections (UTI's) can be caused by:**

- Not emptying the bladder properly and urine stays behind for a long time. This allows bacteria to grow in the urine.
- Unclean catheter techniques
- Chronic constipation causing difficulties with bladder drainage.

#### **Symptom of UTI's**

- Blood staining of the urine
- Abdominal pain
- Fever
- Headache
- Back pain
- Decreased appetite
- Vomiting and a general feeling of being unwell
- Increased spasms
- Shivering
- Sweating
- Autonomic dysreflexia
- Urinary incontinence or unusual wetting between CIC.

#### **Urinary Tract Infection can usually be treated by:**

- Drinking more (dilution of the urine) and
- Performing an extra catheter (emptying the bladder more frequently) or
- Occasionally using medications that prevent bacteria to stick to the bladder wall.

#### **Things to remember**

- Drinking water regularly is important for good bladder and kidney health.
- Empty the bladder regularly.
- The Spinal Cord Injury nurse at hospital is available for advice, support and education with catheterizing techniques.
- Doctors will only treat symptomatic UTI's with antibiotics.
- Check the skin for pressure injuries more frequently when ill with a UTI as the skin is more vulnerable during this time.
- Intermittent catheterization can be taught to children after 6 years of age.
- Important for bladder training is that the fluid intake must be monitored. The nurse should help patient and care-taker to maintain fluid chart, whereby patient takes adequate fluid during the day and to keep dry through the night fluid must be restricted after dinner.

## **Bowel management**

When spinal shock has resolved, one of two types of neurogenic bowel may develop.

### **1. Reflex bowel**

Injuries to the twelfth thoracic vertebra (T12) and above result in what is known as a 'reflex bowel'. Injuries at this level result in damage to upper motor neurons (lying within the spinal cord) leaving the reflex arc from the cord to the colon and ano-rectum intact.

### **2. Flaccid bowel**

Injuries to the first lumbar vertebra (L1) and below result in a flaccid bowel with a lax anal sphincter and pelvic floor. Injuries at this level damage the reflex arcs between the spinal cord and the colon and ano-rectum and the reflex activity of the bowel is lost. This results in slow stool propulsion through the descending and sigmoid colon and a high risk of faecal incontinence through the lax anal sphincter.

## **Aims of Bowel Management**

The overall aim of bowel training is to enable the SCI individual to be in control of his bowel function, independently or through a career, and to promote his reintegration into society. The individual requiring assistance must give his consent for any intervention, usually verbally. This supports the individual's right to self-determination and autonomy.

## **Factors Affecting Bowel Management**

Bowel management will be affected by various factors including:

- Previous medical history, particularly any pre-existing bowel condition
- Pre injury bowel habit
- Current medication, which may affect bowel activity
- The level of injury i.e. whether the patient has a reflex or flaccid bowel
- Psychological and emotional factors
- Lifestyle

## **Management**

- Exercise and activity
- Diet and fluid intake
- Stimulation of the gastro-colic reflex
- Abdominal massage
- Oral laxatives
- Remove of stool from the lower bowel and rectum
- Developing a bowel management routine

Most SCI patients will have problems because of constipation. Order a high fiber diet. After breakfast encourage patient to sit on the toilet for 15-20 minutes every day. This way a pattern will be set. In case of constipation laxatives can be used and at times enema may be required.

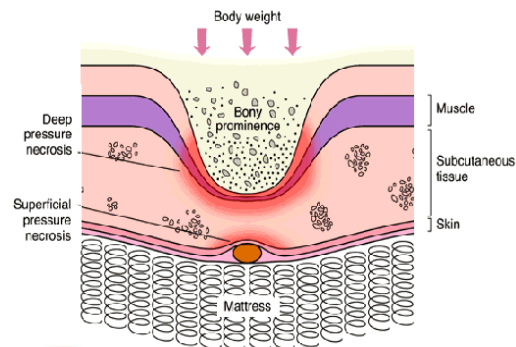


## Pressure sores

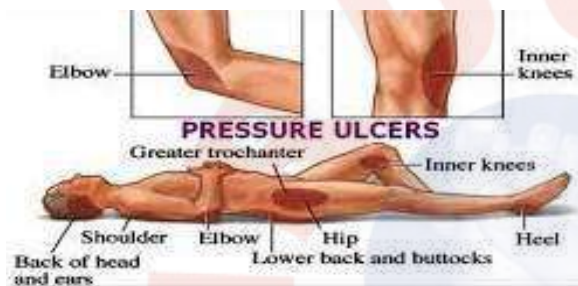
A pressure sore (or bed sore) is an injury to the skin and tissue under it. Sitting or lying in the same position will begin to cut off the flow of blood to that area, blocking oxygen and vital nutrients from maintaining healthy tissue. When the tissue becomes starved to too long a period of time it begins to die and a pressure sore starts to form. A pressure sore is serious. It must not be ignored. With proper treatment, most pressure sores will heal.

### Cause

- Immobility
- Inactivity
- Fecal or urinary incontinence
- Poor nutrition
- Decreased level of consciousness
- Low body weight
- Smoking



### Site of Pressure sore



### Stage of pressure sore

**Stage I:** Skin is not broken but is red or discolored. The redness or change in color does not fade within 30 minutes after pressure is removed.

**Stage II:** The epidermis or topmost layer of the skin is broken, creating a shallow open sore. Drainage may or may not be present.

**Stage III:** The break in the skin extends through the dermis (second skin layer) into the subcutaneous and fat tissue. The wound is deeper than in Stage Two.

**Stage IV:** The breakdown extends into the muscle and can extend as far down as the bone. Usually lots of dead tissue and drainage are present.

### Symptoms and Complications

A pressure sore usually begins as a reddened, sensitive patch of skin and then goes on to develop into a sore or ulcer that can extend deep into the muscle and even bone. If left untreated, a pressure sore may lead to cellulitis or a chronic infection.

### Prevention

It requires knowledge of correct techniques of management, identification of risk factors and continuous application of those techniques as well as application of preventive maintenance.

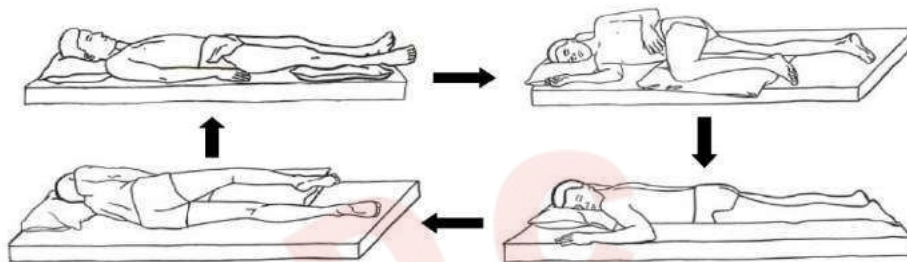


### General preventive measures

- Education,
- Identification of risk patients,
- Recognition of impending skin breakdown.
- Nutrition food

### Specific preventive measures

- Elimination or reduction of pressure by intermittent pressure relief. Change of position 2 hourly, lifting in wheel- chair every 15 minutes, proper mattress 11 seating.
- Wound care
- Good body position.



### Intervention

- |                          |  |
|--------------------------|--|
| <b>General measures</b>  | : Good state of nutrition  |
| <b>Specific measures</b> | : Pressure relief, debridement, infection control.   |
| <b>Surgical measures</b> | : of wound excision, direct closure, skin grafting, and reconstruction with flap rotation. |

### Important

Establish both sensory and motor level of injury and other associated injuries. Quick motor and dermatome assessment. SCI patient are poikilothermic (thermo-regulatory mechanism doesn't work, patient's body adapts to the temperature of the environment) so keep the patient warm. Patient's can develop hypertension because of autonomic dysfunction and paralytic vasodilatation.

### SPINAL SHOCK

It is a state of diminished excitability of the isolated spinal cord immediately after transaction of cord - state of altered reflex activity. It usually remains from 3/4 days to 6/8 weeks. After the spinal shock period, reflexes appear; hyper reflexia / spasticity results.

Recovery if to occur comes pretty early. If some functions appear in 24 hours - prognosis is good. If none return and where there is complete paralysis - prognosis is not so good. Incomplete lesions take longer 3-6 months for recovery to occur.

### Complication

#### Early complications

1. Gastro-intestinal complication
  - Paralytic ileus

- Gastric dilatation
  - Acute peptic ulceration
  - Bowel ulceration
2. Respiratory problems
- Especially in high SCI injury results from either associated injuries or from paralysis of breathing muscles.
3. Venous drainage complication
- Deep vein thrombosis
  - Pulmonary embolism

### **Late and long term complication**

- Neurogenic bladder
- Neurogenic Bowel
- Pressure sores
- Spasticity
- Chronic pain
- Para-articular heterotrophic calcification
- Osteoporosis and pathological fracture
- Sexual dysfunction and reproduction problem

### **Neurogenic Bladder**

Before World War II, most SCI patients died from renal causes within few years. Now with improved SCI care most have almost normal life spans, less than half die from renal pathology.

During spinal shock to avoid overflow incontinence, indwelling catheter is used. Two hourly clamps twice during day time so that the detrusor muscle contraction can be maintained. After spinal shock before bladder training, bladder profile must be obtained.

### **Complication**

- Decubitus Ulcer
- Deformities/Contractor
- Chest Infection
- Osteoporosis/pathological fracture
- Bowel/bladder incontinent
- Spasticity
- Depression

### **Physiotherapy Management**

**Through Assessment** - Identify motor and sensory levels,

#### **Decubitus Ulcer**

- " Prevention is better than cure"
- Position changing : 2 hourly
- Personal hygiene maintain : Back care /use of clean cotton cloth
- Check for pressure (points) areas
- Weight relief : Push up every 20- 30 minutes



## **Wound Care**

- Dressing
- Surgical closure of the wound

## **Deformities/ Contractures**

- ROM -Stretching exercise
- Strengthening exercise for non involved parts and balancing exercise
- Brace/ Splint as necessary
- Positioning

## **Chest Infection due to Respiratory dysfunction**

Breathing exercise (chest physiotherapy)

## **Osteoporosis/Pathological Fracture:**

Physiological Standing- Tilt table, Parapodium and Passive weight bearing

## **Spasticity:**

- Antispastic Exercise- Trunk rotation/ Breathing/Approximation/ Gentle PROM
- Positioning
- Drug Therapy

## **Bowel/Bladder training**

Depression: Counseling - involve in recreational and hand work activities/keep busy

## **Rehabilitation**

The overall goals in the rehabilitation of patient with SCI are to teach the patient to perform at the maximum level, of functional independence, prevent contractor/deformity and prevent pressure sores.

- Self care: ADL
- Mobility depends on level of injury
- Ambulation with braces- HKFO, KAFO
- Wheel chair training
- Home visit
- Case conference (By Rehabilitation Team)

## RICKETS

Rickets is defective mineralization or calcification of bones before epiphyseal closure in immature mammals due to deficiency or impaired metabolism of vitamin D, phosphorus or calcium, potentially leading to fractures and deformity. Rickets is among the most frequent childhood.

The main cause of rickets is a lack of vitamin D. Not having enough calcium in one's diet may also be a cause of rickets, as may vomit and diarrhea. Some childhood kidney and liver diseases can cause rickets, as may a digestive disorder complication that affects calcium and phosphorous absorption.

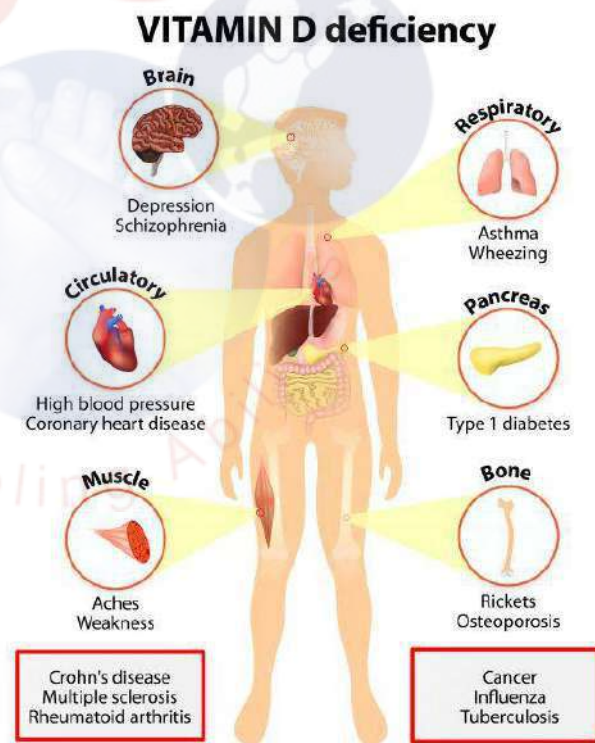
Rickets affects mainly children, although the disorder may also affect adults (osteomalacia). In most cases, the child suffers from severe and long-term malnutrition, usually during early childhood. The common age of Rickets is 6 months to 3 years.

### Causes of rickets

- a. **Lack of vitamin D** - the main cause of rickets. Our bodies need vitamin D in order to absorb calcium from the intestines. Ultraviolet light (from sunlight) helps our skin cells convert vitamin D from an inactive into an active state.

If we do not have enough vitamin D, calcium that we get from the food we eat is not absorbed properly, causing hypocalcemia (lower-than-normal blood calcium) to develop. Hypocalcemia results in deformities of bones and teeth, as well as neuromuscular problems.

The following foods are known to be rich on vitamin D: eggs, fish oils, margarine, some fortified milks and juices, some oily fishes, and some soymilk products that have vitamin D added.



- b. **Genetic defect** - Hypophosphatemic rickets is a rare genetic fault that undermines the way the kidneys process phosphates. Phosphate blood levels are too low, leading to weak and soft bones.
- c. **Some diseases** - Some renal (kidney), hepatic (liver) and intestinal diseases can interfere with the way the body absorbs and metabolizes minerals and vitamins, resulting in rickets.

### Risk factors for rickets

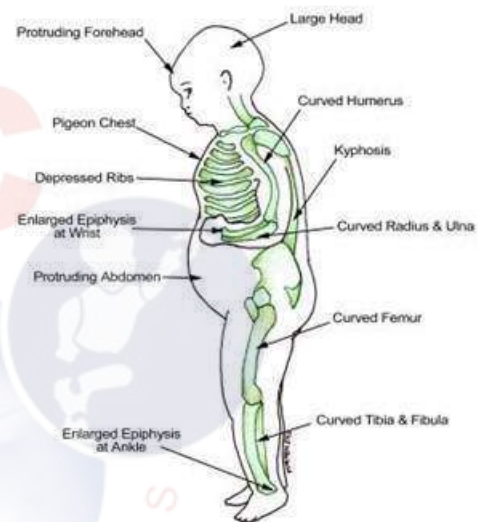
- **Poverty** - Rickets is more likely to occur among children who are poor.
- **Sunlight** - Children who do not get enough sunlight are more dependent on excellent nutrition to make sure they are getting enough vitamin D.
- **Malnutrition** - Rickets is more common in areas of the world where severe droughts and starvation occur.

### Sign and Symptoms

A symptom is something the patient feels and reports, while a sign is something other people, such as the doctor detect. For example, pain may be a symptom while a rash may be a sign.

### Symptoms of rickets may include:

- Baby is floppy (Muscular hypotonia)
- Bone pain during rest
- Excessive perspiration in upper half of the body
- History of recurrent diarrhea, constipations, bronchitis
- Bone tenderness
- Bones break easily
- Costochondral swelling (pigeon chest) - prominent knobs of the bone at the costochondral joints are prominent; large beads show up under the skin of the rib cage
- Harrison's groove - a horizontal line is visible at the lower margin of the thorax, where the diaphragm attaches to the ribs.
- Low calcium blood levels (hypocalcemia)
- Older children may have knock knees (genu valgum)
- Soft skull (craniotubes)
- The child's physical growth (height, weight) may be affected
- There may be spinal, pelvic or cranial deformities
- Growth retardation
- Toddlers may have bowed legs (genu varum)
- Uncontrolled muscle spasms, which may affect the entire body (tetany)
- Widening of the ends of the long bones



### Common deformities in infantile Rickets

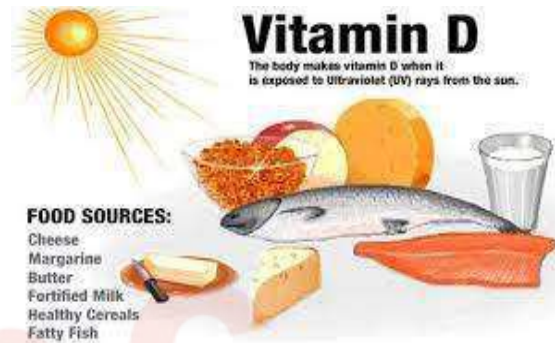
- a) Skull : Broadened forehead  
: Squared skull (Craniotubes)  
: Frontal bossing
- b) Chest : Pigeon chest  
: Ricketic rosary  
: Harrison's sulcus



- c) Widening of the distal end (Metaphysical Segments) of long bones like radius, tibia and cupping of the distal ends in both sides.
- d) Deformity of joint : e.g. Hip coxa vara, Knee genu varum or genu valgum,
- e) Spine : Kyphosis or Scoliosis and lumber lordosis as the child starts to walk.

### Treatment and Prevention

1. Diet and sunlight
2. Supplementary



### Physiotherapy Management

There are no direct physical therapy interventions for vitamin D deficiency. Patient will be referred to physical therapy for treatment of impairments that may be a cause of vitamin D deficiency such as decline in muscle strength, decline in physical functioning, or falls prevention. Physical therapists can take a team approach with medical management through patient education on:

- Foods high in vitamin D
  - Importance of following medical recommendations for vitamin D intake
  - Importance of proper sun exposure with risks of overexposure
1. Ultra- violet irradiation
  2. Chest physiotherapy to maintain the inter costal muscles power of the lungs and prevention from the thoracic deformity.
  3. Improve the circulation and maintain the joint ROM: Active exercise progress to resisted exercises.
  4. Prevention of deformities: Wrong postures and weight bearing situations should be avoided to the bones prone to develop deformity.
  5. Corrective splints can also be provided to decrease and prevent the deformity of long bones.
  6. Corrective orthosis are given to prevent further deterioration in the deformity.
  7. Surgery may be done for the correction of deformities and fracture. After surgery, progressive mobilization and strengthening program should be given for the return of function.



## MUSCULAR DYSTROPHY

Muscular dystrophy is a group of diseases that cause progressive weakness and loss of muscle mass. In muscular dystrophy, abnormal genes (mutations) interfere with the production of proteins needed to form healthy muscle.

There are many different kinds of muscular dystrophy. Symptoms of the most common variety begin in childhood, primarily in boys. Other types don't surface until adulthood.

Some people who have muscular dystrophy will eventually lose the ability to walk. Some may have trouble breathing or swallowing.

There is no cure for muscular dystrophy. But medications and therapy can help manage symptoms and slow the course of the disease.

### Signs and symptoms

#### Early stages

- Frequent falls
- Difficulty getting up from a lying or sitting position (Gowers' sign positive)
- Trouble running and jumping
- Waddling gait
- Walking on the toes
- Large calf muscles
- Muscle pain and stiffness



#### Late stages

- Poor balance
- Drooping eyelids
- Atrophy
- Scoliosis of spine
- Unability to walk
- Waddling gait
- Respiratory problem
- Joint contractures
- Cardiomyopathy
- Arrhythmias
- 



Gower's Sign

#### Types

1. Duchenne Muscular Dystrophy
2. Becker Muscular Dystrophy
3. Emery-Dreifuss Muscular Dystrophy
4. Limb-Girdle Muscular Dystrophy
5. Facioscapulohumeral Muscular Dystrophy
6. Myotonic Muscular Dystrophy
7. Oculopharyngeal Muscular Dystrophy
8. Distal Muscular Dystrophy
9. Congenital Muscular Dystrophy

## 1. Duchenne Muscular Dystrophy

The most common form of muscular dystrophy in children, Duchenne muscular dystrophy affects only males. It appears between the ages of 2 and 6. The muscles decrease in size and grow weaker over time yet may appear larger. Disease progression varies, but many people with Duchenne (1 in 3,500 boys) need a wheelchair by the age of 12. In most cases, the arms, legs, and spine become progressively deformed, and there may be some cognitive impairment. Severe breathing and heart problems mark the later stages of the disease. Those with Duchenne MD usually die in their late teens or early 20s.

### Early History and symptoms

- Gower's sign positive.
- Delay walking.
- Child is less active than normal child.
- Walks more slowly and falls more frequently.
- Child will be lethargy.
- Child starts to walk with lordosis and limping at around the age of 4 years.
- Difficult to climb stairs.
- Hypertrophy of calf, deltoid and glutei muscles.
- Atrophy of thigh muscles, trunk muscles, hip and knee flexor muscles.
- Life span: 18 to 20 years - die because of respiratory muscle paralysis.

### General treatment

- No any effective drugs have been found.
- No any special treatment.  
(Role of steroid is under investigation. It is said to prolong development of muscle weakness of the body.)

### Physiotherapy Treatment

- Breathing exercises are very important to prevent from chest complication.
- Active and passive range of movement exercise and splinting to prevent contracture.
- Positioning
- Muscle strengthening exercises (Active Only) to maintain the muscles strength of whole body.
- Postural and gait training exercises if possible.
- Home adaptations in sitting, standing and other ADL activities.

## 2. Becker Muscular Dystrophy

Becker muscular dystrophy (BMD) is a less severe variant of Duchenne muscular dystrophy and is caused by the production of a truncated, but partially functional form of dystrophin. Survival is usually into old age. Affect only in boys. Muscles of facial expression are not affected & neither are the muscles controlling bowel & bladder.

Signs and symptoms are similar to those of Duchenne muscular dystrophy, but typically are milder and progress more slowly. Symptoms generally begin in the teens but may not occur until the mid-20s or even later.

### **3. Emery-Dreifuss Muscular Dystrophy**

Emery-Dreifuss Muscular Dystrophy patients normally present in childhood and the early teenage years with contractures. Clinical signs include muscle weakness and wasting, starting in the distal limb muscles and progressing to involve the limb-girdle muscles. Most patients also suffer from cardiac conduction defects and arrhythmias which, if left untreated, increase the risk of stroke and sudden death.

### **4. Limb -Girdle Muscular Dystrophy**

Hip and shoulder muscles are usually the first affected. People with this type of muscular dystrophy may have difficulty lifting the front part of the foot and so may trip frequently. Onset usually begins in childhood at the age of 12 to 16 years or the teenage years. It appears more slowly (progressive) than others. It affects both the sexes (male and female).

#### **Symptoms**

- The muscles of the shoulder girdle are affected first and those of pelvic girdle and spine later. Waddling gait.
- All the muscles become atrophy.

### **5. Facio-Scapulo Humeral dystrophy (FSHD)**

Muscle weakness typically begins in the face and shoulders. The shoulder blades might stick out like wings when a person with FSHD raises his or her arms. Onset usually occurs in the teenage years but may begin in childhood ages of 16 to 18 years or as late as age 40.

#### **Symptoms**

- Facial muscles are affected first.
- The eyelids cannot be closed, lips become thickened, weak and flaccid.
- Mouth cannot be closed which interferes in speech.
- Weakness of scapular muscles causing winging of scapula & difficulty with shoulder abduction.

### **6. Myotonic Muscular Dystrophy**

Myotonic muscular dystrophy is an autosomal dominant condition that presents with myotonia (delayed relaxation of muscles) as well as muscle wasting and weakness. Myotonic dystrophy varies in severity and manifestations and affects many body systems in addition to skeletal muscles, including the heart, endocrine organs, eyes, and gastrointestinal tract.

Also known as Steinert's disease, this form is characterized by an inability to relax muscles at will following contractions. Myotonic muscular dystrophy is the most common form of adult-onset muscular dystrophy. Facial and neck muscles are usually the first to be affected.

## **7. Oculopharyngeal Muscular Dystrophy**

Oculopharyngeal MD's age at onset: 40 to 70 years, symptoms affect muscles of eyelids, face, and throat followed by pelvic and shoulder muscle weakness, has been attributed to a short repeat expansion in the genome which regulates the translation of some genes into functional proteins.

## **8. Distal Muscular Dystrophy**

Distal Muscular Dystrophy is a group of disorders characterized by onset in the hands or feet. Many types involve dysferlin, but it has been suggested that not all cases do.

## **9. Congenital Muscular Dystrophy**

This type affects boys and girls and is apparent at birth or before age 2. Some forms progress slowly and cause only mild disability, while others progress rapidly and cause severe impairment.

### **Management**

#### **1. Surgical management:**

Muscular Dystrophy is a progressive disease. The main aim of the management is to prevent from respiratory illness and to prevent deformities and contractures. The role of surgical management is very minimal. If there is any joint deformities and contractures in the joint, release can be done to make easy in functional movement, but it again depends on the severity of contractures.

#### **2. Conservative management:**

It includes Physiotherapy and Orthotic management. Orthosis will help to maintain the joint in proper position and prevention from deformities and contractures.

The main goal of Physiotherapy is to prevent respiratory illness and reduce the contractures and deformities. Due to progressive weakness of muscles, there is gradually weakening of respiratory and cardiac muscles. So that person with Muscular Dystrophy has very difficult to breathe. To maintain the strength of respiratory muscles breathing exercises should be provided to prevent the respiratory illness. Postural advices and instructions be given. Active exercise and functional exercise should be prescribed to maintain the mobility of the limbs. Nutritional education is very important to parents or care giver. Parents or care giver should be counseled about the problem and importance of exercise.

### **Physiotherapy Management**

#### **Assessment**

Assessment is very important for M.D. to find out the ability and disability of child but it should not be done in such a way that might cause more fatigue and depression of child.

#### **A. Functional assessment**

- Able to walk and climb the stairs without assistance.
- Walks and climbs with minimum help.
- Walks and climbs with maximum help.

**B. Functional mobility**

- Sitting with or without support.
- Crawling.
- Buttock sitting.
- Squatting.

**C. Functional muscle charting:**

It is very difficult to test MMT. We can do only functional muscle grading but we must remember that the patient has no fatigue and overload.

**D. Deformity and contracture measurement****E. Respiratory function test:**

A Spiro meter or peak-flow meter may be used to assess the strength of respiratory muscles.

**Principle of Physiotherapy treatment**

1. Prevention from respiratory illness- Deep breathing exercise.
2. Prevention form deformity and soft tissue contracture
  - Full active ROM exercise as much as possible.
  - Gentle stretching exercise.
  - Positioning.
  - Splinting.
  - Functional activities play therapy and ADL.
3. Prevention of immobilization and inactivity both mental and physical
  - Encouragement and active exercise with play therapy.
4. Supportive treatment (for patients)
  - Establish good relationship with parents. Parents need guidance about diet and this guidance should begin early

**For the child**

The child himself required encouragement. He may be negative and un-communicative will become depressed due to seeing little achievement The physiotherapist must grade assistance and resistant is such a way that the child feels he is doing his best and sees that he is accomplishing something.

**Management**

- Evaluation
- Exercise / Activities
- Regular follow up at physiotherapy as advised by physiotherapist
- Periodic progress evaluation of joint mobility, strength and hand function
- Home program and advice's to patient and parents
- Consultation with Doctors for possible surgical intervention

## **A. Evaluation**

- a) Observation
  - Skin Colour
  - Wound
  - Deformities/contractures
- b) Active and passive movement of joint (Elbow, forearm, wrist, fingers and thumb.)
- c) Muscle power of elbow, forearm- wrist, all fingers and thumb.
- d) Hand function 

	<u>Note</u>
• pulp to pulp pinch	able
• Key pinch	not able
• Grip	
- e) Sensation
  - Light touch
  - Hot and cold
  - Ball pen prick
- f) Hand coordination
  - 9 hole peg test
  - Moberg 10 test
- g) Activities of daily living

## **B. Exercise / Hand activities**

- a. Warm water soaking
- b. Massaging with ghee or oil
- c. ROM exercise.
- d. Stretching exercise.
- e. Strengthening exercise
- f. Splinting measures.
  - i) Static
  - ii) Dynamic
- g. Serial Casting
- h. Functional hand activities
- i. Sensory exercises
- j. Coordination exercises
- k. ADL Training



## AMPUTATION

Removal of limb partially or fully from the body is called Amputation. Generally amputation of lower extremity is more common than the upper extremity.

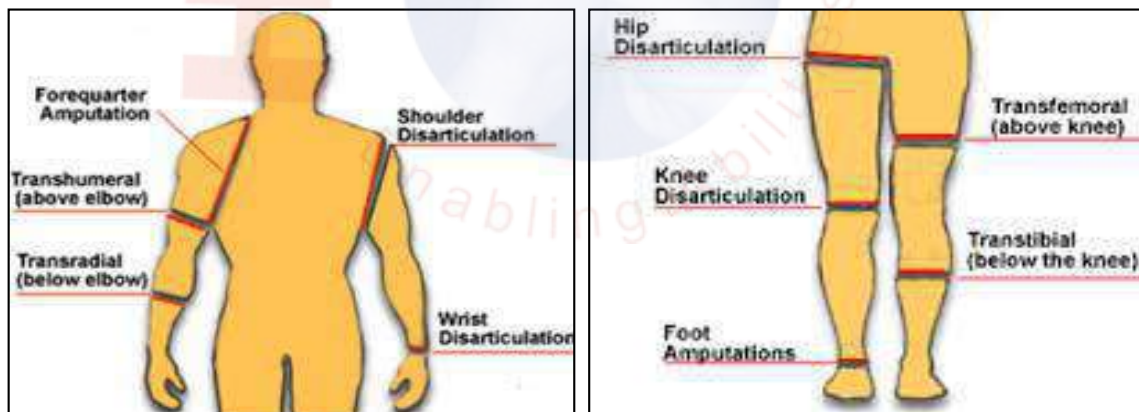
### Indication for the amputation

- Trauma
- Malignant tumor
- Never injuries
- Peripheral vascular insufficiency
- Congenital absence of limbs or malformations
- Uncontrolled infection



### Level of amputation

Upper extremity	Lower extremity
Forequarter amputation	Hemi-pelvectomy
Shoulder disarticulation	Hip disarticulation
Above elbow amputation	Above knee articulation
Below elbow amputation	Below knee amputation
Wrist disarticulation	Syme's amputation
Finger amputation	Boyd's amputation
	Chopart amputation
	Lisfranc amputation



### Complications after amputation

- Bleeding
- Phantom pain
- Hypothermia of stump
- Circulatory/deformities
- Bony projection
- Ulcers
- Breakdown of stump wound

## **Physiotherapy Management**

Physiotherapy management can be divided into three stages:

1. Pre-operation stage
2. The early post operative stage
3. The mobility stage

### **Pre-operation Stage**

- Assessment
- Training
- Re-assurance

### **Assessment**

Through assessment of ROM, muscular power, condition of skin, status of circulation and sensory need to be evaluated critically. The status of vision and hearing also play an important role in training. Assessment of psychological status is also very important. The idea of losing limb itself is great psychological trauma leading to depression.

### **Pre prosthetic management:**

- Good shape and size of stump
- No bony projection.
- Normal sensation around the stump
- No deformities and contractures
- Good muscle strength
- Good body balance

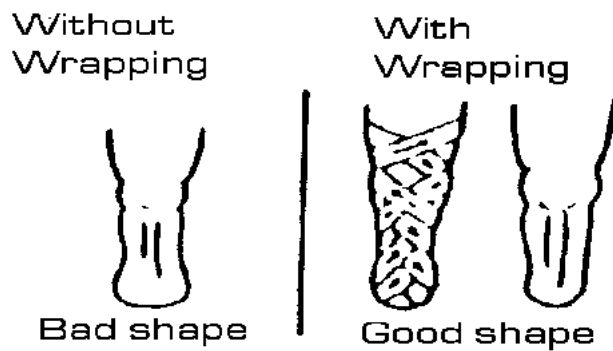
### **Gait training with Prosthesis**

- Instruction for proper use of prosthesis
- Proper weight bearing
- Stepping practice
- Progressive walking

### **Care of stump and prosthesis:**

- Clean the stump thoroughly everyday.
  - Check for blisters, redness and edema.
  - Wash the stump daily with clean water or antiseptic soap.
  - Keep the skin dry.
- Clean the socket of prosthesis
  - Wash inner surface of socket with clean water and soap.
  - Allow it to dry before use.
- Clean the stump, socks and elastic bandage.
  - Wash with clean water and soap.
  - Dry before use.

### Rules for stump care for the amputee:



### Elevating the stump

The amputated limb should be lifted high up. Avoid spending a lot of time with the arm or leg hanging down.



### Training

The basic aim of the pre-operative training is to prevent the complications of the post operative stage.

The pre-operative training includes:

- Prevention of thrombosis by maintaining circulation through active movements.
- Prevention of chest complication by deep breathing, coughing exercise and postural drainage.
- Pressure mobility of all joints by active ROM exercise.
- Improve the mobility of other parts of body; trunk, pelvis shoulder girdle to compensate for restriction due to prosthesis.
- Limb positioning in the bed and elevate transfer in wheelchair, single limb standing and balancing.

### Re-assurance

Psychological re-assurance plays an important role in the recovering following amputation. It can be done by practical demonstration by a patient who has undergone similar surgery and is physically independent.

## 2. Early post operative management

- Prevention from chest complication
  - Deep breathing and coughing exercise
  - Postural drainage

- Prevention for thrombosis
  - Active ROM exercise for remaining limb.
- Prevention for swelling
  - Elevation of limb
  - Proper stump bandaging
- Maintain the muscle strength
  - Active and isometric muscle strengthening exercise.
- Prevention from deformities and contractures
  - Positioning
  - Splinting
  - ROM Exercises
  - Stretching Exercise
- Maintain the body balance- balancing -exercise

### **Management of the stump**

Improper management of the stump is one of the major causes of delayed rehabilitation. The following measures should be taken to control the edema of the stump.

- Stimulation with limb in elevation.
- Elastic bandaging.
- Resistance strengthening exercise
- Stump bandaging.

### **Principle of stump bandaging**

- The pressure of the bandage should be firm and evenly distributed.
- Diagonal, oblique or spiral turns should be used while bandaging.
- Wrap distal to proximal.
- Special turns should difference  $\frac{1}{2}$ " in each fold.
- Should be covered proximal front.
- Wrap distal to proximal.
- Spiral turns should be difference  $\frac{1}{2}$ " in each fold.
- Should be covered proximal joint.

## **3. Mobility stage**

This is a stage of mobilization and restoration of functional independence.

- Mobilization and stretching exercises.
- ROM Exercises

### **Treatment**

- Fluid therapy
- Daily dressing
- Active and passive range of motion exercises, splinting measures
- Nutrition therapy

**Sometimes skin graft is needed.**

## Complications

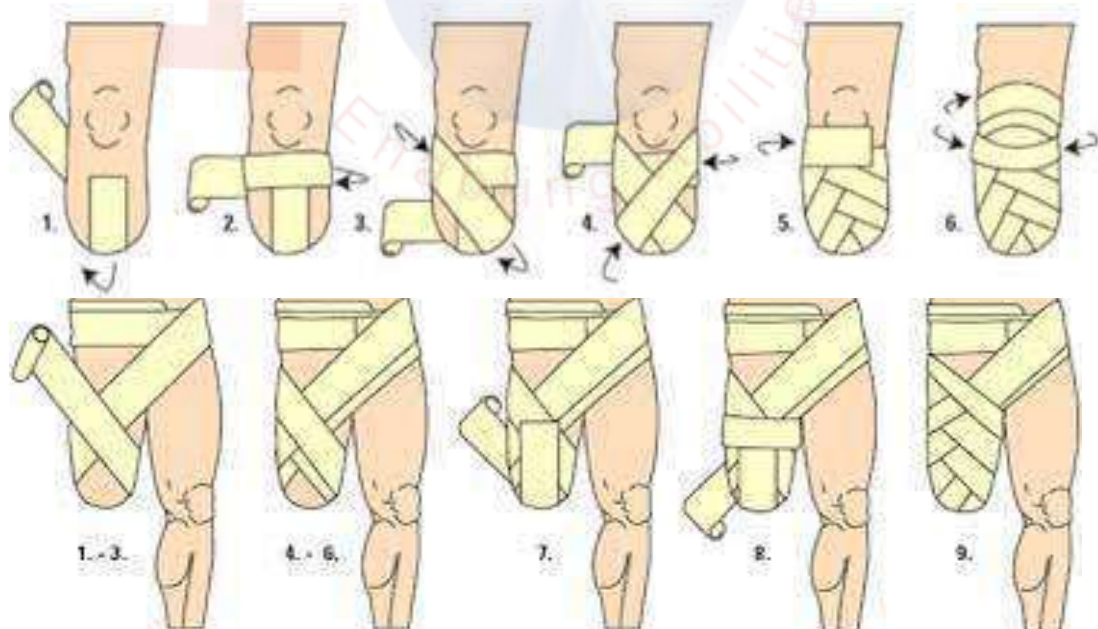
- Wound infection
- Ulcer
- Renal failure
- Shock
- Contractures
- Keloids
- Wound breakdown

## Common deformity pattern in upper and lower extremity

Eye	Ectropion
Lip	Eversion
Neck	Flexion
Chest	Scapular protraction
Shoulder	Adduction
Elbow	Flexion
Forearm	Pronation
Wrist	Flexion and extension
Flip	Flexion
Knee	Flexion
Ankle	Dorsiflexion and eversion

## Prevention of deformity and Rehabilitation

- Stump care
- Skin care
- Stump bandaging



- Positioning

Encourage positions that keep the joints stretched and avoid these keep the joint bent.



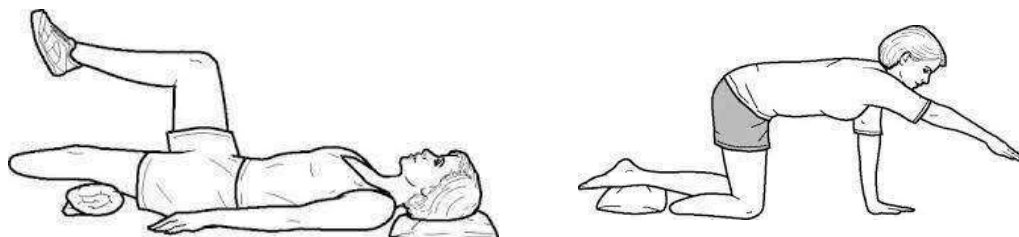
- Prevention of contractures

A person with an amputated leg does not use his leg normally. He usually keeps the leg in binding and tends to develop contracture of hip or knee or both. Therefore, special positioning and exercise are needed to prevent contractures and maintain the full range of movement of the joints.

- Stretching Exercise



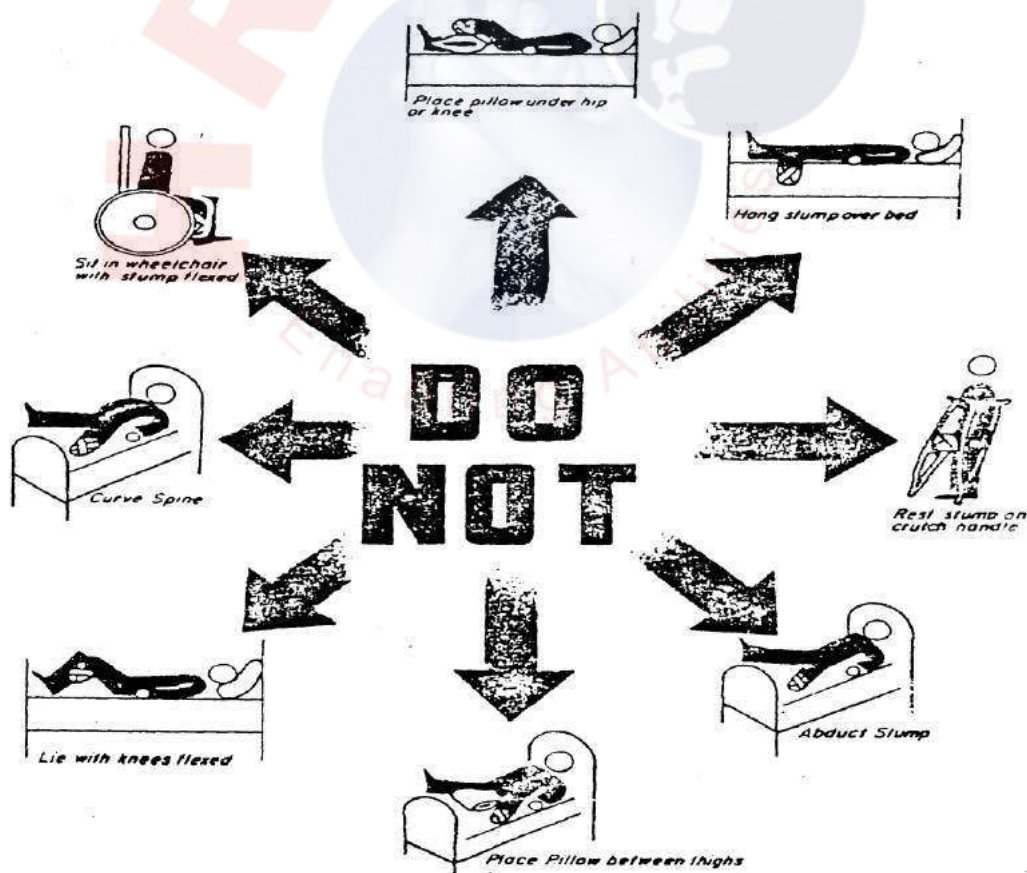
- Strengthening Exercise





## GENERAL GUIDE FOR POSITIONING THE POST-OP AMPUTEE

S.N.	Above-Knee	Below Knee
<b>1</b>	<b>Common contractures which must be avoided</b>	
	Hip flexion	Hip flexion
	Hip abduction	Hip abduction
	Hip external rotation	Hip external rotation
<b>2</b>	<b>Recommended procedures and positions</b>	
	Back-lying with pelvis level and hip joint in extension	Same as above-knee, in extension
	Neutral rotation and neutral Abduction-adduction	Lying prone with lower limb Limb positioned as above
	Lying prone with lower limb Positioned as above	
<b>3</b>	<b>The following are to be avoided as much as possible</b>	
	Pillows under residual limb	Pillows under residual limb
	Prolonged sitting	Prolonged sitting
	Lying with residual limb in flexion, abduction and external rotation	Lying with hip in flexion abduction and external rotation and knee in flexion



Give a reason for each of the above contradictions.

## OSTEOGENESIS IMPERFECTA

Osteogenesis imperfect (OI) is a rare connective tissue disorder in which bones bend and break easily. It is known as brittle bone disease. Sometimes the bones break for no known reason. OI can also cause many other problems such as weak muscles, brittle teeth, and hearing loss. It is two types:

1. Congenita (recessive)
2. Tarda (dominant)

### 1. Osteogenesis imperfecta congenita

Multiple fractures occur before, during or soon after birth. The limbs are short and deformed.



### 2. Osteogenesis imperfecta tarda

This is less severe delayed walking may be the chief complaint. The patient is likely to survive into adult life. Fracture of limbs may be in early or late childhood. The tendency of fracture diminishes after puberty.

### Pathology

This is the collagen disease, so that bone remodeling is not adequate, which makes the bone brittle and fragile, making prone to fractures even from a minor trauma. Congenital absence of Type I collagen. The strength of the bone reduces and fractures easily with minor trauma.

### Signs and symptoms

All people with osteogenesis imperfecta have brittle bones. OI can range from mild to severe and symptoms vary from person to person. Some of the symptoms that people with OI may have are:

- Malformed bones
- Short, small body
- Loose joints
- Muscle weakness
- Sclera (whites of the eyes) that look blue, purple, or gray
- Triangular face
- Barrel-shaped rib cage
- Curved spine
- Brittle teeth
- Hearing loss (often starting in 20s or 30s)
- Breathing problems
- Type 1 collagen that does not work well
- Not enough collagen.
- Short stature and limb deformities.
- Blue sclera
- Laxity of joints
- Broad skull
- Fractures
- Poor development of teeth.



**Brittle teeth**



**Blue sclera**

## **Treatment**

### **1. Medical treatment**

- Pain medication

### **2. Surgical treatment**

- to correct the deformity for mobility

### **3. Conservative treatment**

#### **• Physiotherapy**

- Education for careful handling to prevent the fracture.
- Gentle passive ROM and stretching exercises to maintain the joint mobility.
- Splinting to prevent the bone & joint deformity and contracture.
- Gait training with or without assistive device if possible.
- Encouragement for daily activities.
- Care for fracture bone - splinting/casting
- Use of wheelchairs, braces, and other aids

A healthy lifestyle also helps people with OI

- Exercise (swimming, water therapy, walking)
- Keep a healthy weight
- Eat a balanced diet
- Do not smoke
- Do not drink a lot of alcohol and caffeine
- Do not take steroid medicines.

### **Proper care helps children who have OI to**

- Stay active
- Make bones more dense
- Keep muscles strong.

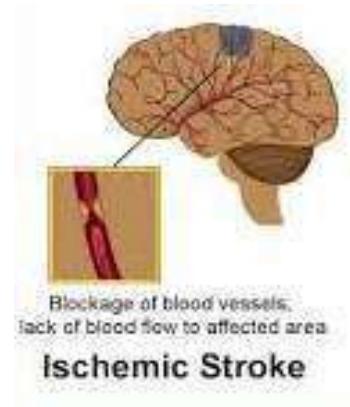
## STROKE

The term "stroke" is synonymous with cerebral vascular accident or CVA. According to WHO, it can be defined rapidly developed clinical sign of a focal disturbance of cerebral function of vascular origin and of more than 24 hour's duration.

### Types

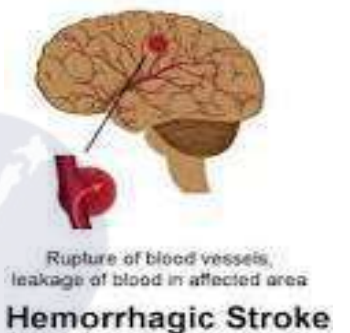
#### 1. Ischaemic:

The most common cause of stroke is due to obstruction of one of the major cerebral arteries. They complain headache, symptoms of hemiparesis, dysphasia, visual disturbance, initially flaccid, but within a few days this changes in to spastic.



#### 2. Haemorrhage

About 5 to 10 % of strokes are caused by haemorrhage into the brain. The patient has hypertension and a condition called lipohyalinosis in small arteries in the brain. The arterial walls weaken and cause haematoma, headache, vomiting, loss of consciousness (50%).



#### 3. Subarachnoid haemorrhage

Between 5 and 10% of strokes are due to subarachnoid haemorrhage. The patient complains of: - headache - vomiting - neck stiff.

### Risk factors for stroke

- Hypertension
- Cigarette smoking
- Diabetes mellitus
- Oestrogen contraceptive
- Family History
- Previous stroke
- Heart disease
- Inactivity
- Age
- Binge Drinking



## **Physiotherapy Management**

### **Evaluation**

#### **a. Vital function**

- i. Respiratory - breathing patterns may change due to impaired motor function.
- ii. Chewing and swallowing
- iii. Bowel and bladder control.

#### **b. Communication ability**

- i. Verbal
- ii. Non verbal
- iii. Mental- aware of time, place and person.

### **Clinical pictures of stroke**

- Changes in muscle tone.
- Sensory disturbance
- Loss of reflective movement
- Loss of balancing reaction
- Communication problem

### **Management**

#### **a. Surgery**

#### **b. Conservative**

1. Medical
2. Physiotherapy

Patient with Subarachnoid haemorrhage are treated surgically. If they are not, conservative treatment will be started. Some patients with haematomas are also treated surgically.

Most part of the treatment of patients suffering stroke is conservative. In some cases 2 or 3 days after stroke usually developed oedema. Dexamethasone or intravenous mannitol drugs can be used, but these drugs.

#### **c. Sensory**

- Touch, heat and cold, pressure.
- Proprioception - joint position sense
- Body awareness
- Visual

#### **d. Motor ability and tone**

- Reflexes and reactions
- Muscle tone
- Coordination
- Movement ability- trunk and extremities.
  - Head and neck control
  - Movement patterns



- e. Motor in developmental postures.
  - Mobility
  - Stability
  - Controlled mobility
  - Skilled movement
- f. Functional abilities
  - Dressing
  - Feeding
  - Personal hygiene
  - Locomotion
- g. Range of motion
- h. Social, family and occupational status - helps to encourage maximum functioning when the patient's status is recognized.

### **Principle of treatment**

#### **Treatment must be**

- Early
- Symmetrical approach
- Positioning
- Exercises must move in to recovery patterns.

#### **Treatments**

- Reflex inhibitory position
- Breathing exercise
- Anti- spastic exercises
  - trunk rotation
  - passive ROM
  - Shaking
- Balancing and coordination exercises
- Sensory exercises
- Functional exercises for upper and lower extremity
- Gait training
- ADL training
- Strengthening exercise



## Low Back pain

Pain in the lower back area that can relate to problems with the lumbar spine, the discs between the vertebrae, the ligaments around the spine and discs, the spinal cord and nerves, muscles of the low back, internal organs of the pelvis and abdomen, or the skin covering the lumbar area.



About 80 percent of adults experience low back pain at some point in their lifetimes. It is the most common cause of job-related disability and a leading contributor to missed work days. Men and women are equally affected by low back pain.

Most low back pain is acute, or short term, and lasts a few days to a few weeks. It tends to resolve on its own with self-care and there is no residual loss of function.

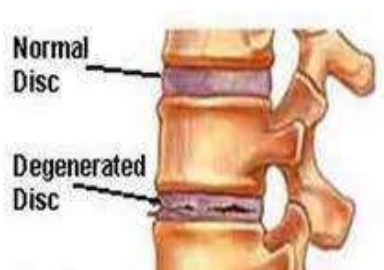
### Stages

**Subacute low back pain** is defined as pain that lasts between 4 and 12 weeks.

**Chronic back pain** is defined as pain that persists for 12 weeks or longer. .

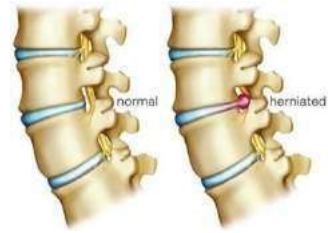
### Causes

- **Sprains and strains:** Sprains are caused by overstretching or tearing ligaments, and strains are tears in tendon or muscle. Both can occur from twisting or lifting something improperly, lifting something too heavy, or overstretching. Such movements may also trigger spasms in back muscles, which can also be painful.



- **Intervertebral disc degeneration** is one of the most common mechanical causes of low back pain,.
- **Herniated or ruptured discs** can occur when the intervertebral discs become compressed and bulge outward (herniation) or rupture, causing low back pain.

- **Nerve irritation:** It is a condition caused by compression, inflammation and/or injury to a spinal nerve root. Pressure on the nerve root results in pain, numbness, or a tingling sensation that travels or radiates to other areas of the body that are served by that nerve



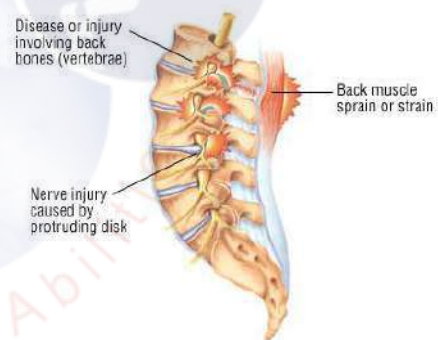
- **Sciatica** is a form of radiculopathy caused by compression of the sciatic nerve, the large nerve that travels through the buttocks and extends down the back of the leg. presses on the sciatic nerve or its roots.



- **Spondylolisthesis** is a condition in which a vertebra of the lower spine slips out of place, pinching the nerves exiting the spinal column.



- **A traumatic injury**, such as from playing sports, car accidents, or a fall can injure tendons, ligaments or muscle resulting in low back pain.



- **Spinal stenosis** is a narrowing of the spinal column that puts pressure on the spinal cord and nerves that can cause pain or numbness with walking and over time leads to leg weakness and sensory loss.



- **Skeletal irregularities** include scoliosis, a curvature of the spine that does not usually cause pain until middle age; lordosis, an abnormally accentuated arch in the lower back; and other congenital anomalies of spines..



Low back pain is rarely related to serious underlying conditions, but when these conditions do occur, they require immediate medical attention. Serious underlying conditions include:

- **Infections** are not a common cause of back pain. However, infections can cause pain when they involve the vertebrae, a condition called osteomyelitis; the intervertebral discs, called discitis; or the sacroiliac joints connecting the lower spine to the pelvis, called sacroiliitis.
- **Tumors** are a relatively rare cause of back pain. Occasionally, tumors begin in the back, but more often they appear in the back as a result of cancer that has spread from elsewhere in the body.
- **Kidney stones** can cause sharp pain in the lower back, usually on one side.

### Risk factors

Beyond underlying diseases, certain other risk factors may elevate one's risk for low back pain, including:

**Age:** The first attack of low back pain typically occurs between the ages of 30 and 50, and back pain becomes more common with advancing age. As people grow older, loss of bone strength from osteoporosis can lead to fractures, and at the same time, muscle elasticity and tone decrease. The intervertebral discs begin to lose fluid and flexibility with age, which decreases their ability to cushion the vertebrae. The risk of spinal stenosis also increases with age.

**Fitness level:** Back pain is more common among people who are not physically fit. Weak back and abdominal muscles may not properly support the spine. "Weekend warriors"—people who go out and exercise a lot after being inactive all week—are more likely to suffer painful back injuries than people who make moderate physical activity a daily habit. Studies show that low-impact aerobic exercise is beneficial for the maintaining the integrity of intervertebral discs.

**Pregnancy** is commonly accompanied by low back pain, which results from pelvic changes and alterations in weight loading. Back symptoms almost always resolve postpartum.



**Weight gain:** Being overweight, obese, or quickly gaining significant amounts of weight can put stress on the back and lead to low back pain.

**Genetics:** Some causes of back pain, such as ankylosing spondylitis, a form of arthritis that involves fusion of the spinal joints leading to some immobility of the spine, have a genetic component.



**Occupational risk factors:** Having a job that requires heavy lifting, pushing, or pulling, particularly when it involves twisting or vibrating the spine, can lead to injury and back pain. An inactive job or a desk job may also lead to or contribute to pain, especially if you have poor posture or sit all day in a chair with inadequate back support.



**Mental health factors:** Pre-existing mental health issues such as anxiety and depression can influence how closely one focuses on their pain as well as their perception of its severity. Pain that becomes chronic also can contribute to the development of such psychological factors. Stress can affect the body in numerous ways, including causing muscle tension.

**Backpack overload in children:** Low back pain unrelated to injury or other known cause is unusual in pre-teen children. However, a backpack overloaded with schoolbooks and supplies can strain the back and cause muscle fatigue.



## Symptoms

Symptoms range from a dull ache to a stabbing or shooting sensation. The pain may make it hard to move or stand up straight. Acute back pain comes on suddenly, often after an injury from sports or heavy lifting. Pain that lasts more than three months is considered chronic. If pain is not better within 72 hours, should consult a doctor.

## Management

A complete medical history and physical exam can usually identify any serious conditions that may be causing the pain. Examination includes:

onset of problem, site, and severity of the pain; duration of symptoms and any limitations in movement; and history of previous episodes or any health conditions that might be related to the pain.

## Investigation

X-ray is often the first imaging technique used to look for broken bones or an injured vertebra. X-rays show the bony structures and any vertebral misalignment or fractures. Soft tissues such as muscles, ligaments, or bulging discs are not visible on conventional x-rays.



**Computerized tomography (CT)** is used to see spinal structures that cannot be seen on conventional x-rays, such as disc rupture, spinal stenosis, or tumors. Using a computer, the CT scan creates a three-dimensional image from a series of two dimensional pictures.

**Magnetic resonance imaging (MRI)** uses a magnetic force instead of radiation to create a computer-generated image.

**Bone scans** are used to detect and monitor infection, fracture, or disorders in the bone

**Blood tests** are not routinely used to diagnose the cause of back pain; however in some cases they may be ordered to look for indications of inflammation, infection, and/or the presence of arthritis.

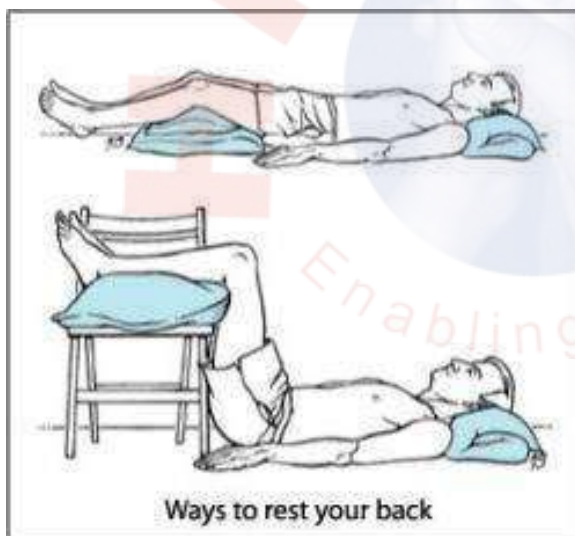
### **Physiotherapy management**

#### **Aim of treatment**

- To strengthen muscles
- To improve the mobility and flexibility
- To promote proper position and posture

#### **Procedures**

- **Hot or cold packs** to promote relaxation and decrease pain.
- **Proper position**



**Activity:** Bed rest should be limited. Individuals should begin stretching exercises and resume normal daily activities as soon as possible.

**Strengthening exercises** exercise should be initiated.

## Low Back Pain Exercises



Standing hamstring stretch



Cat and camel



Pelvic tilt



Quadruped arm/leg raise



Partial curl



Extension exercise



Gluteal stretch



Side plank

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## Medical management

- **Analgesic medications** are those specifically designed to relieve pain.
- **Nonsteroidal anti-inflammatory drugs (NSAIDs)** relieve pain and inflammation and include OTC formulations (Ibuprofen, ketoprofen, and naproxen sodium).
- **Anticonvulsants**—drugs primarily used to treat seizures may be useful in treating people with radiculopathy and radicular pain.
- **Antidepressants** such as tricyclics and serotonin and norepinephrine.
- **Counter-irritants** such as creams or sprays applied topically stimulate the nerves in the skin to provide feelings of warmth or cold in order to dull the sensation of pain. Topical analgesics reduce inflammation and stimulate blood flow.
- **Epidural steroid injections** are a commonly used short-term option for treating low back pain and sciatica associated with inflammation.
- **Transcutaneous electrical nerve stimulation (TENS)**

## Surgery

When other therapies fail, surgery may be considered an option to relieve pain caused by serious musculoskeletal injuries or nerve compression. It may be months following surgery before the patient is fully healed, and he or she may suffer permanent loss of flexibility.

- Vertebroplasty and kyphoplasty
- Spinal laminectomy (also known as spinal decompression)
- Discectomy or microdiscectomy
- Spinal Artificial disc replacement

## Lateral Epicondylitis

It is a lesion that affects the tendinous origin of the common extensor tendon of wrist joint. It is also known as the classical tennis elbow and pain and tenderness on the lateral aspect of the elbow.

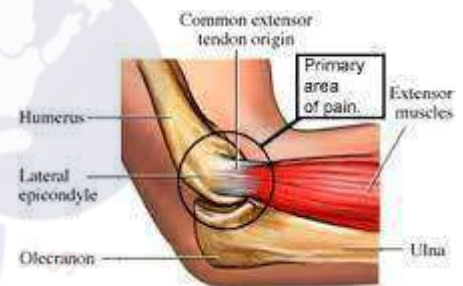


### Causes

- Tears in the common extensor origin due to trauma.
- Inflammation of bursa between common extensor tendon and radio-humeral joint.
- Calcification within the common extensor tendon.
- Hypertrophy of the synovial membrane between the radial head and the capitulum.
- Neurological origin: infection of cervical spine, compression of radial nerve.

### Contributing factors

- Little playing experience.
- Poor stroke technique: use of arm instead of body.
- Poor strength of musculature.
- Repetitive movement of wrist joint.



### Pathophysiology and related symptoms

Stage 1 : Acute inflammation but no angioblastic invasion. Patient complains of pain during activity.

Stage 2 : Stage of chronic inflammation. There is some angioblastic invasion. Patient complains of pain both during activity and rest.

Stage 3 : Chronic inflammation with extensive angioblastic invasion. Patient complains of pain at rest, night pains, and pain during activity.

### Clinical test

- Local tenderness on lateral aspect of the elbow.
- Cozen test: Painful resisted extension of wrist with elbow in full extension demonstrates pain at lateral aspect of elbow.



TENNIS ELBOW (LATERAL EPICONDYLITIS)

## Treatment

### Conservative treatment

1. Rest, Icing, Compression if needed, Elevation (RICE).
2. Physiotherapy

- Strengthening of wrist extensors



- Stretching of wrist extensors



- Cold therapy



- Ultra- sound massage



- TENS
- Functional exercises



- Tennis elbow band



### Surgical management

- Percutaneous release of extensor muscles.
- Excision of proximal portion of annular ligament.

## Volkman's Ischemic Contracture (VIC)

### Introduction

Volkman contracture is a permanent shortening of forearm muscles, usually resulting from injury that gives rise to a claw like deformity of the hand, fingers, and wrist. It is more common in children. Volkman's Ischemic Contracture, also known as Compartment syndrome is a claw-like deformity of the hand, includes wrist and fingers. It is the permanent shortening of the forearm that is usually caused by restricted blood flow in the forearm and can result from an injury. Volkman's Ischemic Contracture is a condition that could lead to severe damage, if not treated quickly and correctly.



### Signs and symptoms

#### Early

The clinical presentation includes the five Ps:

- Severe pain on passive stretch of forearm flexors.
- Pallor
- Pulselessness
- Paresthesias
- Paralysis

#### Signs & Symptoms

##### Later

- Arm appearance is characterized by a fixed position of elbow flexion, forearm pronation, wrist flexion, MP extension, IP flexion, thumb adduction.
- Weak muscles of the elbow, forearm, wrist and finger muscles.
- Sensory deficit.
- Hand function and ADL problem.



### Pathophysiology

Volkman contracture is usually seen in children with displaced supracondylar fractures of the humerus or forearm fractures. It results from severe injury to the deep tissues and muscles of the volar compartment secondary to increased compartmental pressures.

### Types

- Mild (involving the wrist flexors)
- Moderate (involving injury to the flexor digitorum profundus, flexor digitorum superficialis, flexor pollicis longus, flexor carpi radialis, and flexor carpi ulnaris)
- Severe (involving both the flexors and the extensors)

## **Management**

Initial treatment for Volkmann contracture consists of removal of tight dressings or splitting or removal of casts. Analgesics are the mainstay for symptomatic relief in chronic cases.

Emergency fasciotomy is required to prevent progression to Volkmann contracture. There is some disagreement regarding which compartment pressure readings are indications for fasciotomy; however, most agree that patients with compartment pressures exceeding 30 mm Hg should be taken to the operating room for emergency fasciotomy. There are no absolute contraindications to immediate decompression for Volkmann contracture in the acute setting.

Both physical therapy and occupational therapy are vital to the improvement of range of motion and the return of function in patients with Volkmann contracture.

### **Physiotherapy management**

Both physical therapy and occupational therapy are vital to the improvement of range of motion and the return of function in patients with Volkmann contracture. Pre operative assessment and exercise is a key to improve the hand function.

#### **Pre operative management**

- Detail evaluation of sensory and motor function
- Evaluation of joint range of movement
- Assessment of ADL

**Aim:** is to stretching of tight structures of long flexors of forearm and hand.

#### **Treatment method**

- Stretching of tight muscles by splinting, casting and stretching exercise.
- Hand functioning activities.

#### **Post operative management**

- Detail complete evaluation of sensory and motor function.
- Re-evaluation of range of motion of joint.
- Re- evaluation of hand function and ADL.

**Aim:** is to regain the hand function.

#### **Treatment method**

- Aggressive stretching exercise
- Hand functioning activities
- Strengthening exercise
- Splinting measures

After the surgery, it is important to ensure that the mobility is recovered. we can increase the mobility by passive stretching techniques. We force the normal range of motion and by that; we can enhance the range of motion. This range is limited by loss of soft tissue elasticity. An other part in the therapy is activating and strengthening the weak agonist. By that, we can ensure that the agonist pulls the antagonist in balance.



## Cervical Spondylosis

### Introduction

Cervical spondylosis, also known as cervical osteoarthritis or neck arthritis, is a common, age-related condition that affects the joints and discs in neck. It develops from wear and tear of the cartilage and bones found cervical spine, which is in neck. While it's largely due to age, it can be caused by other factors as well. The condition is present in more than 85 percent of people over the age of 60, although some people who have it never experience symptoms. For some, it can cause chronic, severe pain and stiffness. However, many people who have it are able to conduct normal daily activities.

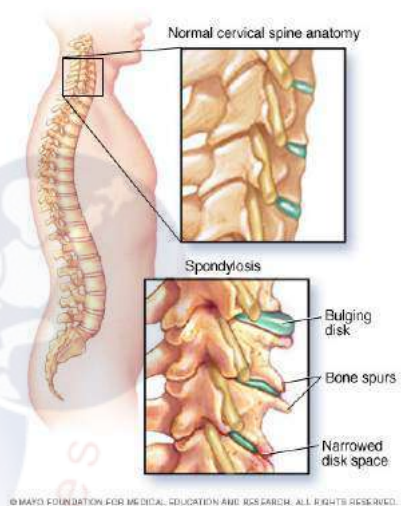


### Causes

Unfortunately, the bones and protective cartilage in your neck are prone to wear and tear that can lead to cervical spondylosis. Possible causes of the condition include:

#### Bone Spurs

These overgrowths of bone are the result of the body trying to grow extra bone to make the spine stronger. However, the extra bone can press on delicate areas of the spine, such as the spinal cord and nerves, resulting in pain.

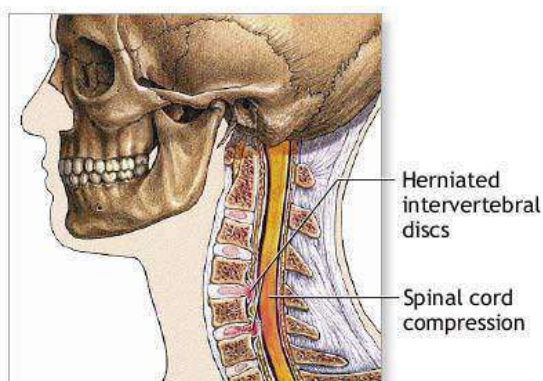


#### Dehydrated Spinal Disks

Your spinal bones have discs between them, which are thick, pad-like cushions that absorb the shock of lifting, twisting, and other activities. The gel-like material inside these discs can dry out over time. This causes your bones (spinal vertebrae) to rub together more, which can be painful. This process can begin around age 40.

#### Herniated Disks

The spinal disks can develop cracks, which allow leakage of the internal cushioning material. This material can press on the spinal cord and nerves, resulting in symptoms such as arm numbness and sciatica.





## **Injury**

Injury to neck, such as during a fall or an accident, this can accelerate the aging process.

## **Ligament tear**

The tough cords that connect spinal bones to each other can become even stiffer over time, which affects neck movement and makes the neck feel tight.

## **Overuse**

Some occupations or hobbies involve repetitive movements or heavy lifting, such as construction work. This can put extra pressure on the spine, resulting in early wear and tear.

## **Risk Factors**

The greatest risk factor for cervical spondylosis is aging. Cervical spondylosis often develops as a result of changes in neck joints as age. Disk herniation, dehydration, and bone spurs are all results of aging.

Factors other than aging can increase your risk of cervical spondylosis. These include:

- neck injuries
- work-related activities that put extra strain on neck from heavy lifting
- holding your neck in an uncomfortable position for prolonged periods of time or repeating the same neck movements throughout the day (repetitive stress)
- genetic factors (family history of cervical spondylosis)
- smoking
- being overweight and inactive

## **Symptoms**

Most people with cervical spondylosis don't have significant symptoms. If symptoms do occur, they can range from mild to severe and may develop gradually or occur suddenly.

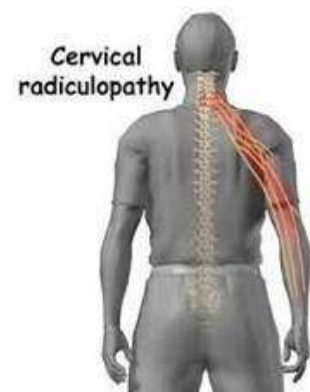
One common symptom is pain around the shoulder blade. Patients will complain of pain along the arm and in the fingers. The pain might increase when:

- standing
- sitting
- sneezing
- coughing
- tilting your neck backward

Another common symptom is muscle weakness. Muscle weakness makes it hard to lift the arms or grasp objects firmly.

## **Other common signs include**

- a stiff neck that becomes worse.
- headaches that mostly occur in the back of the head.
- tingling or numbness that mainly affects shoulders and arms, although it can also occur in the legs.



Symptoms that occur less frequently often include a loss of balance and a loss of bladder or bowel control. These symptoms warrant immediate medical attention.

## **Treatment Options**

Treatments for cervical spondylosis focus on providing pain relief, lowering the risk of permanent damage, and helping you lead a normal life. Nonsurgical methods are usually very effective.

### **Physical Therapy**

Physical therapy helps to stretch the neck and shoulder muscles. This makes them stronger and ultimately helps to relieve pain. Traction, which involves using weights to reduce and relieve the pressure on cervical discs nerve roots and increase the space between the cervical joints.



### **Medications**

- muscle relaxants, such as cyclobenzaprine, to treat muscle spasms.
- narcotics, such as hydrocodone, for pain relief.
- anti-epileptic drugs, such as gabapentin, to relieve pain caused by nerve damage.
- steroid injections, such as prednisone, to reduce tissue inflammation and subsequently lessen pain.

### **Surgery**

If condition is severe and doesn't respond to other forms of treatment, might need surgery. This can involve removal of bone spurs, parts of neck bones, or herniated disks. Surgery is rarely necessary for cervical spondylosis. However, a doctor may recommend it if the pain is severe and it's affecting the ability to move arms.

### **Home Treatment**

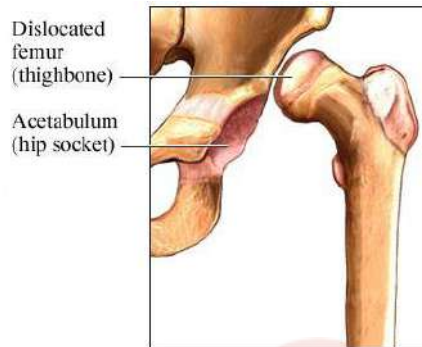
If the condition is mild, can try a few things at home to treat it:

- Take an over-the-counter pain reliever, such as an anti-inflammatory drug can be taken.
- Use a heating pad or a cold pack on neck to provide pain relief for sore muscles.
- Exercise regularly to help recover faster. The exercise includes strengthening of deep neck flexors.

## Developmental dysplasia of Hip (DDH)

### Introduction

Developmental dysplasia of hip is defined as partial or complete displacement of the femoral head from acetabular cavity since birth.



### Etiology

- Genetic theory: Dysplastic trait is found in the family.
- Hormonal theory: Hormone induced joint laxity.
- Mechanical theory: Faulty intrauterine positions particularly in the first born.
- Primary acetabular dysplasia.

### Risk factors: (4 F's)

- Females
- First born
- Familial
- Faulty intrauterine position (Breech)

### Incidence

- 1:1000 in live births
- Left hip affected in 60% , right 20%, both 20% of cases
- Family history present in 20%
- Incidence of breech 30% to 40%
- Female preponderance (80%)
- Breech delivery ( hamstring force)

### Pathophysiology

- Acetabulum: There could be a primary a dysplasia of acetabulum and acetabulum is shallow.
- Head of femur: The dislocated head of femur at first appears normal, ossification is delayed, later head is flat on its posterior and medial aspect.
- Neck of femur: There could be shortening and anteversion of neck of femur.
- Capsules: The capsule may be thickened and produce stress.
- Muscles: Shortening of adductors of hip and hamstring muscles may cause dislocation of hip.

## Clinical features

The clinical features may be varying in infant, children and adolescence.

### 1. Infants:

Detailed clinical evaluation is needed to carry out to detect the presence of any other congenital anomalies. If the hip is dislocated, all the features of dislocations are present.

- Asymmetry of thigh and gluteal creases.
- The hip is abducted and externally rotated.
- Internal rotation of hip is reduced.

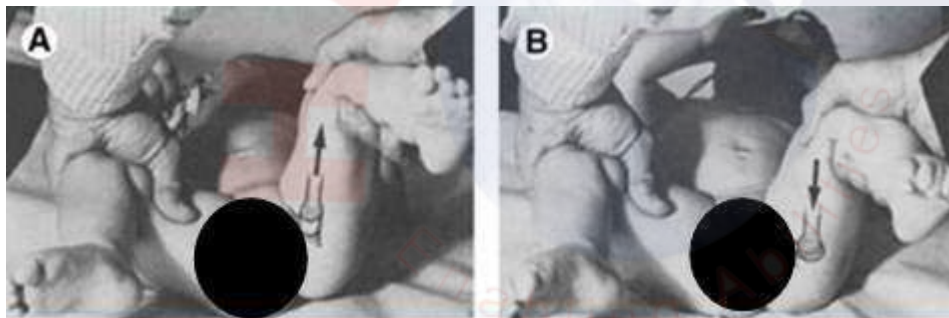
### 2. Children and adolescence:

- Waddling gait, if bilateral dislocation of hip.
- Increased lumbar lordosis
- Limb length discrepancy, if one hip is dislocated.
- Perineum is wide, buttocks are broad and flat.
- Decreased abduction and external rotation of hip.

## Clinical test

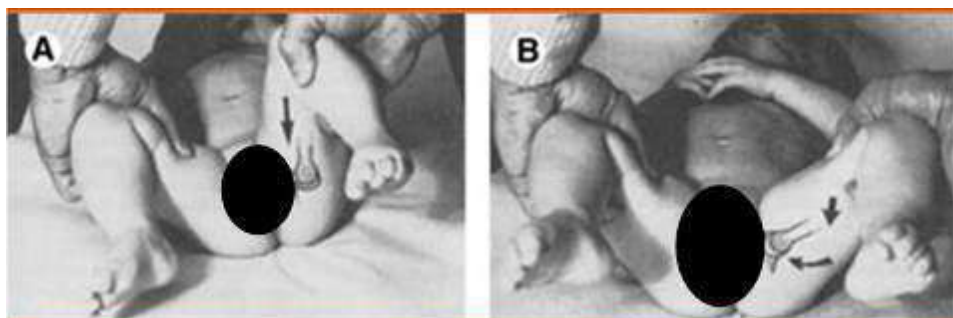
### Barlow's test

This test is done within 2 to 3 days of birth. The infant is kept on supine position with the knees fully flexed and hip at 90 degree of flexion. The hip is slowly abducted to 45 degree and the head is slowly pushed towards the acetabulum by the fingers.



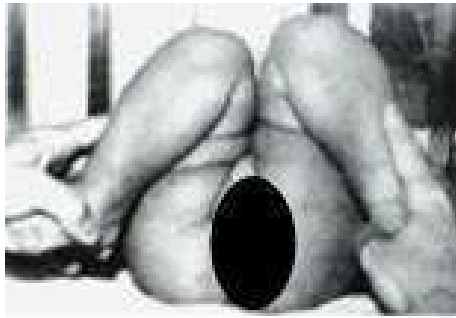
### Ortolani's test

This test is done between 3 to 9 months. Infant is kept in supine position with the hip and knee flexed. The hip is slowly adducted and abducted to detect the reduction of femoral head into the acetabulum.



### **Galleazzi or Allen's sign**

The child is in supine position with both the hip and the knee in flexion position. The level of the both the knee joints are uneven.



### **Treatment**

The aim of treatment in DDH is to achieve and maintain an early concentric reduction to prevent future degenerative joint disease.

#### **Birth to six months**

- Triple-diaper technique
  - Prevent hip adduction
- Pavilk harness
  - Allows free movement within confines of restrains

#### **Physiotherapy Management**

Physical therapy is important in pre and postoperatively. It is often a vital part of the rehab process. Preoperatively following things should be focused:

- Strengthening the lower extremity and trunk muscle.
- Instructing the parents or caregivers on positioning techniques and handling skills before and after surgery.
- Educating the family about the surgical procedure, the reason, the estimated length of hospitalization, casting, traction or braces, and expectation of pain.
- Explaining to parents that the child may need frequent therapy after surgery.
- Teaching the parents how to care for the child with a cast, traction or braces.
- Focusing on evaluating the areas of muscle weakness and decreased range of motion, and working with the patient to gain functional strength and mobility.

Part - 3

**Nursing Care**





# INFECTION

## Introduction

Microorganisms are the causative agents of infection. They include bacteria, viruses, fungi and parasites. For infection prevention purposes, bacteria can be further divided into three categories: vegetative (staphylococcus); mycobacterium (tuberculosis); and endospores (tetanus), which are most difficult to kill.

The term asepsis, antisepsis, decontamination, cleaning, disinfections and sterilization often are confusing.

## Purpose of Infection Prevention

1. To minimize infection due to microorganisms that cause serious wound infections, abdominal or scrotal abscesses, pelvic inflammatory disease, gangrene and tetanus.
2. To prevent the transmission of serious diseases such as Hepatitis B and HIV/AIDS.

## Methods of preventing infection

### Asepsis or aseptic technique

Asepsis or aseptic techniques are general terms used in health care settings to describe the combination of efforts made to prevent the entry of microorganisms into any area of the body where they are likely to cause infection.

1. Antisepsis:

Antisepsis is the prevention of infection by killing or inhibiting microorganisms on skin and other body tissue, by using a chemical agent (antiseptic).

2. Decontamination:

Decontamination is the process that makes objects safer to be handled by the staff, especially cleaning personnel, before cleaning. Such objects include large surface (e.g. pelvic examination or operating table), surgical instruments & gloves contaminated with blood or body fluids during or following surgical procedures.

3. Cleaning:

Cleaning is the process that physically removes all visible blood, body fluids or any other foreign material, such as dust or dirt, from skin or inanimate objects.

4. Disinfection:

Disinfection is the process that eliminates most but not all, disease causing microorganisms. High level disinfection (HLD) by boiling or the use of chemicals, eliminates all microorganisms, except bacterial endospores.

5. Sterilization:

Sterilization is the process that eliminates all microorganisms (bacteria, viruses, fungi and parasites), including bacterial endospores from inanimate objects.

## Principles of infection prevention

- Consider every person (clients or staff) infectious.
- Wash hands the most practical procedure for preventing cross-contamination (person to person).

- Wear gloves before touching anything wet, broken skin, mucous membranes, blood or other body fluids (secretions or excretions) Or soiled instruments and items.
- Use physical barriers (protective goggles, face masks & aprons) if splashes & spills of any body fluids (secretions or excretions) are anticipated.
- Use safe work practices such as not recapping or bending needles, safely passing sharp instruments & properly disposing of medical waste.
- Isolate patients only if secretions (airborne) or excretions (urine or feces) cannot be contained.

### **Tools & Protocols for Infection Prevention**

1. Universal Hand washing technique
2. Gloves
3. Skin Preparation Prior to injections
4. Skin Preparation Prior to Surgical Procedures
5. Processing Used Instruments & Disposal of Sharp Objects
  - Waste Disposal
  - Sharps Disposal
  - Shorting
  - Transportation of waste
  - Decontamination
  - Cleaning
  - High Level Disinfection (HLD) -
    - i. Boiling
    - ii. Steaming
    - iii Chemical
  - Sterilization -
    - i. Steam sterilization
    - ii. Dry heat
    - iii. Chemical

### **1. Universal hand washing techniques**

Hand washing is the most practical procedure for preventing cross-contamination (person to person). Hand washing may be the single most important procedure for preventing infection.

Experience has shown that the most effective way to increase hand washing is to have health providers or other respected individuals (role models) consistently wash their hands and encourage others to do same.



### **When to wash hands?**

- Wash hands before and after examining any client (direct contact).
- Wash hands after removing gloves because the gloves may have holes in them.
- Wash hands after exposure to blood or any body fluids (secretions and excretions) even if gloves were worn.

### **Necessary Supply**

- Soap (plain) or antiseptic, which is preferred, as provided by the facility.
- A continuous supply of clean water, either from the tap or a bucket
- Stick or brush for cleaning the fingernails.
- Soft brush or sponge for cleaning the skin.
- Single use towels (do not use shared towels to dry hands).

### **Instruction for Hand washing**

- STEP 1 : Remove all jewelry.
- STEP 2 : Adjust water to a comfortable temperature.
- STEP 3 : Holding hands above the level of the elbows, wet hands thoroughly. Apply soap and clean under each fingernail using a brush.
- STEP 4 : Beginning at the fingertips, lather & wash with a soft brush or sponge, using a circular motion. Wash between all fingers, Move from fingertips to the elbow of one arm & repeat for 2<sup>nd</sup> arm.
- STEP 5 : Wash using a soft brush or sponge for 3–5 minutes (when using alcohol, pour or rub for 2 minutes.)
- STEP 6 : Rinse each arm separately, fingertips first, holding hands above the level of elbows.
- STEP 7 : Using a separate towel for each hand, wipe from the fingertips to the elbow, and then discard the towel.
- STEP 8 : Before putting on sterile gloves (and gown), hold hands above the level of the waist and do not touch anything.
- STEP 9 : If scrubbed hands touch any “dirty” (non sterile or non high – level disinfected) object during the procedure, steps 3 through 8 must be repeated.

## **2. Wear gloves**

- When performing a procedure.
- When handling soiled instruments, gloves & other items.
- When
- Disposing of contaminated waste items (cotton, gauze or dressings).

A separate pair of gloves must be used for each client to avoid cross-contamination. Using disposable gloves is preferable, but where resources are limited, surgical gloves can be reused if they are:

- Decontaminated by soaking in 0.5% chlorine solution for 10 minutes.
- Washed and rinsed
- Sterilized (by autoclaving) or high - Level Disinfected (by steaming or boiling).

### **3. Skin Preparation Prior to Injections**

Skin preparation must be completed prior to injections to remove as many microorganisms as possible from the client's skin in order to prevent superficial infection at the injection site or possibly an abscess.

### **4. Skin preparation prior to surgical procedures**

Skin preparation with antiseptic solutions minimizes the number of microorganisms that may contaminate the surgical wound and cause infection. Antiseptics should be used for antiseptic preparation prior to injections, surgical procedures.

### **5. Processing Used Instruments and Disposal of Sharp Objects**

#### **a. Waste disposal**

Safely disposes of contaminated item.

Waste from family planning and health care facilities may be non – contaminated or contaminated. Non – contaminated wastes pose no infectious risk to persons who handle them. Examples of non – contaminated waste include paper, trash, boxes, bottles and plastic containers, which house products delivered to the clinic. Much waste from health care facilities, however is contaminated. Contaminated wastes may carry high loads of microorganisms, which are potentially infectious to any persons who contact or handle the waste and to the community at large, if not disposed of properly. Contaminated wastes include blood, pus, urine, stool and other body fluids; and items, which contact them such as used dressings.

#### **The purpose of proper disposal of clinic wastes is to:**

The purpose of waste disposal is:

- To prevent the spread of infection to clinic personnel who handle the waste.
- To prevent the spread of infection to the local community.
- To protect those who handle wastes from accidental injury.

Proper handling of contaminated waste (blood or body fluid – contaminated items) is required to minimize the spread of infection to clinic personnel and to the local community.

#### **Proper handling means**

- Wearing utility gloves
- Transporting solid contaminated waste to the disposal site in covered containers
- Disposing of all sharp items in puncture – resistant containers
- Carefully pouring liquid waste down a utility drain or flushable toilet
- Burning or burying contaminated solid waste
- Washing hands, gloves and containers after disposal of infectious waste.

## **Sorting**

Proper management of waste items minimizes the spread of infection and harm to clinic personnel and to the local community. Proper management includes sorting, transportation and disposal.

Separate container should be used for disposing of general and medical waste. The person who generates it should put in the appropriate containers.

- Sharp disposed in puncture proof container
- Burnable contaminated and non – contaminated wastes collected in covered plastic or metal buckets.
- Human tissues collected in leak – proof container
- Glass collected in separate container with lead

## **b. Sharps Disposal**

Guidelines:

- Wear thick, household gloves.
- Dispose of all sharp items in sharp bin
- When the sharp container is  $\frac{3}{4}$  full; cap, plug or tape it tightly closed send for incineration.
- Dispose container when  $\frac{3}{4}$  full by burying. Needles and other sharp objects may not be destroyed by burning, and may later cause injuries, which can lead to a serious infection.

## **c. Destroying Medical Waste**

Transport contaminated waste covered, leak – proof waste containers to the disposal site. Persons handling wastes should wear heavy gloves.

Burning is the preferable method to destroy medical waste, because high temperature destroys microorganisms and reduces the amount of waste.

Burning in an incinerator or oil drum is recommended.

If medical waste cannot be burned, onsite burial is the next best option. However, burial is feasible only when there is sufficient space to dig a pit the size needed to accommodate the amount of medical waste generated at the facility. Choose a site that is at least 50 meters away from water source to avoid contamination the water source.

## **d. Decontamination**

Decontamination is important for pre – treating instruments and objects that may have come in contact with body fluids, to make them safer to handle by personnel who clean them. Proper decontamination will inactivate HIV & HBV, making instruments safer to staff to handle.

Using 0.5% chlorine solution (virex) in an inexpensive and effective way to do decontamination

### **Items required**

- Bucket
- Mug
- Gloves
- Brush
- Soap

## **Process**

- Before preparation of 0.5% Chlorine solution, gather the above equipment.
- Cut at the end of Virex packet.
- Pour the powder slowly at the bottom of the bucket.
- Pour on one liter of water and mix it well.
- After mixing with water, pour an additional 9 liters of water and mix it well.
- Place instruments into the water for 10 minutes.
- Take out the instrument from the solution and wash it properly with soap and water.
- After cleaning the instrument with the clean water make it dry and instruments should be sterilize in a HLD or autoclave for reuse.

## **Process of decontamination:**

- Keeps a fresh plastic bucket containing 0.5% chlorine solution near the procedure site.
- Immediately after each procedure, place the used items in 0.5% chlorine solution for 10 minutes.
- After 10 minutes, rinse with water and remove gross organic material before being cleaned. Soaking instruments for excessive periods of time in the chlorine solution damages them.
- Decontaminate large surfaces (e.g., pelvic examination table top) by wiping them with 0.5% chlorine solution.

## **Precautions:**

- Use only Plastic containers for chlorine solution. Chlorine damages metal containers.
- Use utility gloves while working with chlorine solution.
- Submerge all the instruments in 0.5% chlorine solution so that the chlorine solution level is above the instruments. Open jointed items such as clamps and scissors.
- To prevent the damage to the instruments do not keep them in chlorine solution for more than 20 minutes.
- Chlorine solutions should be replaced daily or more often if necessary, because they lose potency rapidly over time or after exposure to light.
- Rinse the instruments with cold water immediately after decontamination.
- Store the chlorine powder where there is good ventilation. Do not keep it in a general storage area where there are other metal instruments and equipment.

## **e. Cleaning**

Cleaning is a crucial step in instrument processing. Cleaning greatly reduces the number of organisms and endospores on instruments and other equipment.

### **Items required**

- Soap or detergent.
- Clean water (warm water if available).



- Brush, such as toothbrush.
- Utility gloves and other protective attire.

#### **Process**

- Hold items under soapy water and vigorously scrub with a brush to completely remove all blood, tissue and other residue. Use a liquid or powdered detergent, which can easily dissolve in water.
- Remove all materials caught in the small spaces and around the joints.
- Rinse thoroughly with water, as soap may interfere with chemical disinfection or sterilization.
- Dry by air or with a clean towel.

### **f. High Level Disinfection**

#### **i. Boiling**

##### **Items required**

- Pot with a lid
- Fuel source: electric stove or Kerosene stove

##### **Process**

- Always boil for a full 20 minutes in a pot with a lid.
- Items must be completely covered with water during the 20 minutes.
- Do not add anything to the pot after boiling begins, including water.
- After 20, minutes, remove items from water using high – level disinfected forceps/pickups.
- Air dries before use or storage.

##### **Boiling Tips**

- Always boil for 20 minutes in a pot with a lid.
- Start timing when the water begins to boil.
- Items should be completely covered with water during boiling.
- Do not add anything to the pot after boiling begins.
- Air dries in a high – level disinfected container before use or storage.

#### **ii. Steaming**

Place only clean, dry items (e.g., surgical gloves) in the steamer pans. Start timing when steam begins to come out from between the pans and lid.

Air dry high – level disinfected items in a clean area of the room. Use instruments and other items immediately or place them in a covered, dry, high – level disinfected container. Store for up to 1 week.

##### **Steaming Tips**

- Always steam for 20 minutes in a steamer with a lid.
- Reduce heat so that water continues to boil at a rolling boil.
- Start timing when the steam begins to come out from between the pans and lid.

- Do not use more than 3 steamer pans.
- Air dries in the covered steamer pans or a high – level disinfected container before use or storage.

### **iii. Chemical (HLD)**

Key Steps in Chemical HLD:

- Following decontamination, thoroughly clean and dry all equipment and instruments.
- Cover all items completely with correct dilution of properly stored disinfectant.
- Soak for 20 minutes.
- Rinse well with boiled water and air dry.
- Store for up to 1 week in a high – level disinfected, covered container or use promptly.

A variety of chemical high – level disinfectants are available worldwide:

- 0.1% chlorine (Sodium Hypochlorite)
- 2% Glutaraldehyde (Cidex)

Although alcohols (60 – 90%), iodine & iodophors are inexpensive and readily available, they are no longer classified as high - level disinfectants. They should be used for disinfection only when high – level disinfectants are not available or appropriate.

To prepare a high – level disinfected container, boil (if small) or fill it with 0.1% chlorine solution and soak for 20 minutes. (The chlorine solution can then be transferred to a plastic container and reused.)

Rinse the inside thoroughly with boiled water. Air dries before use.

### **Sterilization**

- i. Steam sterilization (Autoclave)
- ii. Dry heat (Hot air Oven)
- iii. Chemical sterilization

### **By soaking**

#### **Storage:**

Unwrapped instruments must be used immediately or stored in dry sterile containers (1 week).

Wrapped instruments, gloves and drapes can be stored for up to 1 week if the package remains dry and intact and up to 1 month if sealed in a plastic bag.

## Nutrition

Nutrition is a science of food and its relationship to health and concerned with the growth, development and maintenance of the body.

"Nutrition is the intake of food considered in relation to the body's dietary needs. Good nutrition - inadequate, well balanced diet combined with regular physical activity - is a corner stone of good health. Poor nutrition can lead to reduced immunity. Increased susceptibility to disease, Impaired physical and mental development, and reduced productivity." - WHO

### Nutrient

Nutrients are chemical substances obtained from food and used in body to provide energy, structural materials, regulating agent to support growth, maintenance and repair of body's tissues.

### Types of Nutrients

#### 1. Macro nutrient

Macronutrients are defined as a class of chemical compounds which humans consume in the largest quantities (must be above a threshold amount) and which provide humans with the bulk of energy. While water does make up a large proportion of the total mass ingested as part of a normal diet, it does not provide any nutritional value. They are: Carbohydrate, protein, fats.

#### Carbohydrate

Carbohydrates are compound which contain carbon, hydrogen and oxygen. They are main source of energy. Carbohydrate provides 4 calories/gm.

##### Functions

- Each gram provides 4 Kcal of energy
- Primary source of energy for the nervous system and lungs.
- Adds flavor and variety to diet

##### Sources

- Main sources of carbohydrates are potatoes, honey, sweet potatoes, dairy products, tree, fruits, milk etc.



#### Proteins

Proteins are principles component of all living cells and are important in cells structure and functions. It provides 4 calories/gm energy.

##### Functions

- Building block
- Formation of enzyme, hormone and other substances eg. Trysin, pepsin, insulin, thyroxin, antibodies.
- Protein as defensive antibodies
- Source of energy

## Sources

- Plant sources: cereals grains, pulses, nuts, soybean
- Animal sources: meat, fish, poultry eggs, milk and milk products.
- Deficiency of proteins and energy leads to inadequate intake of protein leads to kwashiorkor usually appears at the age of about 12 month when breast feeding is discontinued but it can develop at any time during child's formative years.
- Inadequate intake of energy leads to marasmus usually develop between age of 6 month and 1 yrs in children who have been weaned from breast milk or who suffer from weakening condition like chronic diarrheas.

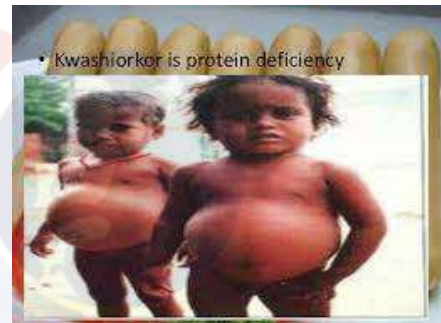


## Deficiency

1. Kwashiorkor
2. Marasmus

## Clinical features of Kwashiorkor

- Edema
- Retarded growth rate
- Moon shaped, putty face
- Impaired appetite
- Hepatomegally (Enlargement of livers)
- Dry, brittle and thin hair
- Dry and inelastic skin



## Marasmus

- Growth retardation
- Monkey face
- No edema
- Prominent body part
- Irritable
- Distended abdomen
- Flattened buttocks eg. Wrinkling



## Preventive Measures

- Health promotion of pregnant and lactating mother.
- Promotion of breast feeding: Breast feeding a baby for at least 6 months is considered the best way to prevent early childhood malnutrition
- Development of low cost weaning foods
- Nutritional education
- Family planning and birth spacing
- Family environment
- Immunization
- Deworming
- Early diagnosis of growth lags.
- Early diagnosis and treatment of diarrhea and other infections

- Measures to improve family diet
- Hospital treatment
- Follow up care

## Fats

Fats are most concentrated source of energy. Fats provide 9 calories/gm energy. They differ in CHO in respect that it contains much less O<sub>2</sub> and much greater proportions of carbon.

### Functions

- Supplies energy
- Provide taste to food
- Vehicles for fat soluble vitamin as A, D, E, K and needed for absorption of vitamin A

### Sources

- Plant source: ground nut oil, coconut, mustard oil
- Animal source: butter, ghee, cream



## 2. Micro nutrient

Micronutrients are nutrients required by organisms throughout life in small quantities to orchestrate a range of physiological functions. They are vitamins and minerals

### Vitamins

Vitamins are chemical compound that are requires for normal growth and metabolism. They are required by body in very small amount. So they fall in category of micro nutrients. Vitamins are divided into 2 groups:

- Fat soluble vitamin: A, D, E, K
- Water soluble vitamin: Vitamins of B-group and C

### Vitamin A

Vitamin A in its pure form is a pale yellow substance fat soluble vitamin. It is found highest quantity in liver.

### Function

- It is essential for normal vision. It contributes to the production of retinal pigments.
- It support growth especially skeletal growth
- It is necessary for maintaining integrity and normal functioning of skin and eyes.
- In cosmetic, vitamin A is used as anti-aging chemical and Rx of acne.



### Sources

Animal Sources: liver, egg yolk, butter, cheese, fish liver oil.



Plant: cheapest source of vitamin A is green leafy vegetable such as spinach, dark green leaves, yellow fruits, vegetable (papaya, mango, pumpkin)

### Deficiency of vitamin A

- Night blindness
- Bitot's spots



- Conjunctival xerosis
- Corneal xerosis



### Vitamin D

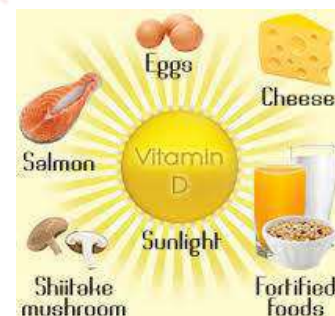
Vitamin D regulates calcium and phosphorus level in blood by promoting their absorption from food in intestines and by promoting re-absorption of calcium in kidney. Vitamin D is also known as sunlight vitamins.

#### Function

- Vitamin D is required for formation of healthy bone and teeth.
- It promotes intestinal absorption and utilization of phosphorus and calcium.
- It maintains concentration of calcium and phosphorus in blood.

#### Sources

Sunlight is the important natural sources of vitamin D. Other food includes liver, egg yolk, butter, cheese.



### Deficiency of Vitamin D

- Rickets, (childhood) characterize by impeded growth and deformity of long bone.
- Osteomalacia in adult.
- Osteoporosis.



## Vitamin E (Tocopherals)

### Function

- Act as antioxidant.
- Help in maintaining the stability and integrity of cell membrane.
- Prevent destruction of lipid by oxidation.

### Deficiency

- Not common
- Seen in premature bodies

### Source

- Vegetable oils, green leafy vegetable, nuts.
- Food of animal are low in Vitamin E



## Vitamin K

### Function

- Vitamin K is very essential for formation of prothrombin and other clotting factor.
- Vitamin K required for synthesis of other protein.

### Deficiency

- Heavy menstrual bleeding
- Gum bleeding
- Nose bleeds



### Sources

- Green leafy vegetable like cauliflower, pork liver, cabbage.



## Vitamin C

It is water soluble and most sensitive of all vitamins. It is destroyed by high temperature. So it must be stored in dark, cold and not metal container.

### Function

- An important anti-oxidant.
- Prevent from common cold and protection against infection.
- Enhance iron absorption.
- Helps in wound healing.

### Sources

- All fresh fruits contain vitamin C.
- Amala is one of the richest sources.
- Guava, lime, orange, tomato



### Deficiency:

- Scurvy



- Delay wound healing
- Anaemia and weakness
- Increased susceptibility to infection

### Vitamin B or B-complex

This represent a group of vitamins.

#### Vitamin B1 (Thiamine)

It is soluble in water and insoluble in alcohol.

#### Functions

- Important role in helping body metabolize carbohydrates and fat to produce energy.
- It is essential for normal growth and development and help to maintain proper functioning of heart, nervous and digestive systems.



#### Sources

- Thiamine occurs in all natural food, although in small amount such as wheat, rice, gram, nuts especially ground nut, almonds, cow's milk, egg, liver.

#### Deficiency

Beri -Beri

Dry beriberi: – nerve involvement

Wet beriberi: – heart involvement

Infantile beriberi: – 2-4 month baby

#### Vitamin B2 (Riboflavin)

It is yellow colored pigment widely distributed in plant food and in small amount in animal food.

#### Function

- Plays a key role in energy metabolism and is required for the metabolism of fats, CHO, proteins.

#### Sources

Richest sources milk, egg, liver, kidney, green leafy vegetables.

- Meat and fish contains small amt.

**Deficiency**

- Most common; angular stomatitis



Angular stomatitis

**Vitamin B3 (Niacin or Nicotinic Acid)**

It is white crystalline compound soluble in water, stable to heat, light, acid and alkalis.

**Function**

- Essential for normal functioning of skin, GI and nervous system.
- Necessary for tissue oxidation.

**Sources**

- Liver, kidney meat, poultry, ground nuts, fish rich sources
- Milk, egg and vegetables are fair sources,

**Deficiency**

- Mild deficiency: fatigue, wt loss, loss of appetite.
- Severe deficiency: Pellagra (4DS-dermatitis, diarrhoea, dementia and death)



Dermatitis

**Vitamin B6 (Pyridoxine)****Function**

- Role in metabolism of amino acid, fats and CHO.

**Sources**

- Milk, liver, egg yolk, fish.

**Deficiency**

- Peripheral neuritis

**Vit B7 (Biotin)**

Simple compound and stable in heat, light and acids.

**Function**

- Essential for CHO in formation of purines.

**Sources**

- Organ meat, rice, soybean.

**Vit B9 (Folic acid or Folate)**

Bright yellow crystalline compound and slightly soluble in H<sub>2</sub>O, easily oxidized to acid and is sensitive to light.

### **Function**

- It is needed together with Vit B12 for formation of normal RBC in bone marrow.
- Promotes the protein synthesis.

### **Sources**

- Liver, kidney, green leafy vegetable which are excellent sources
- Egg, whole grain cereals and fruit are good source.

### **Deficiency**

- Change in RBC production (leads to macrocytic megaloblastic anemia)
- Infertility and sterility.
- Glossitis.



Glossitis

## **Vit B12 (Cyanocobalamin)**

### **Function**

- Formation of mature RBC.
- Synthesis of DNA in bone marrow.

### **Sources**

- Good sources; liver, kidney, fish, egg, milk and cheese.
- Not found in vegetable origin.

### **Deficiency**

- Demyelinating neurological vision in spinal cords.

## **Minerals**

Dietary minerals are chemical elements required by living organism for the growth, repair and regulation of vital body function.

### **Calcium**

#### **Function**

- Formation of bone
- Coagulation of blood
- Cardiac action
- Contraction of muscles

#### **Sources**

- Milk and milk products
- Egg and fish



#### **Deficiency**

- It may occur in pregnant, lactating mother and infant
- Poor development and maintenance of bone and teeth

## **Phosphorus**

- Essential for formation of bone and teeth

**Source**

- Maize, rice, wheat, carrot, ground nuts

**Deficiency is rare****Sodium**

Found in all body fluid. It is lost through urine, sweat. Its depletion causes muscular cramps. This requirement depends upon climate, occupation, physical activity. Food of animal origin contains more sodium than plant origin.

Plant sources are maize, wheat flour, gram and so on.

**Magnesium**

Essential for normal metabolism of calcium and potassium.

**Source**

whole wheat, black gram, soybean, almond

**Iron**

Iron is an essential component of protein involved in O<sub>2</sub> transport, regulation of cell growth. A deficiency of iron, limits O<sub>2</sub> delivery to cells, resulting in fatigue, poor work performance, and decreased immunity. On the other hand, excess amount of iron can result in toxicity and even death.

**Source**

- Liver, meat, poultry and fish
- Green leafy vegetables, nuts, oil seeds, dry fruits.

**Zinc****Copper****Water etc.**

## **Wound**

Wound is defined as any break in the integrity of skin or tissue which may be associated with disruption of structure or function.

### **Etiology**

- Trauma
- Radiation
- Infection
- Electrical
- Iatrogenic etc.

### **Types of Wounds**

#### **1. Close wound**

##### **a) Contusion**

Swollen bruises due to accumulation of blood and dead cells under skin.

##### **b) Abrasion**

An abrasion occurs when the skin rubs or scrapes against a rough or hard surface. Road rash is an example of an abrasion. There's usually not a lot of bleeding, but the wound needs to be scrubbed and cleaned to avoid infection.

#### **2. Open wound**

##### **a) Lacerated wound**

A laceration is a deep cut or tearing of the skin. Accidents with knives, tools, and machinery are frequent causes of lacerations. The bleeding is rapid and extensive.

##### **b) Punctured wound**

A puncture is a small hole caused by a long, pointy object, such as a nail, needle, or ice pick. Sometimes, a bullet can cause a puncture wound. Punctures may not bleed much, but these wounds can be deep enough to damage internal organs. If you have a puncture wound (even just a small one), visit your doctor to get a tetanus booster shot and prevent infection.

##### **c) Incised wound**

A sharp object, such as a knife, shard of glass, or razor blade, causes an incision. Incisions bleed a lot and quickly. A deep incision can damage tendons, ligaments, and muscles.

##### **d) Penetrated wound**

These result from trauma that breaks through the full thickness of the skin, reaching down to the underlying tissue and organs.

##### **e) Crush Injured wound**

Crush injury wound occurs pressure from a heavy object onto a body part. A crush injury wound may also arise from squeezing of a body part between two objects.



f) Avulsion wound

An avulsion is a partial or complete tearing away of skin and tissue. Avulsions usually occur during violent accidents, such as body-crushing accidents, explosions, and gunshots. They bleed heavily and rapidly.

### Goal of Wound care

- Facilitate hemostasis
- Decrease tissue loss
- Promote wound healing
- Minimize scar formation
- Prevent infection

### Causes of wound infection

Most cases of infected wounds are caused by bacteria, originating either from the skin, other parts of the body or the outside environment. The skin contains bacteria (normal flora) which are normally harmless if the skin is intact. However, the protective barrier formed by the skin is disrupted when there is a wound, and these normal floras are able to colonize the injured area. This results in further tissue damage and may prolong wound healing by promoting more inflammation, which prolongs the process of wound healing.



The most common bacteria causing wound infection is *Staphylococcus aureus* and other groups of staphylococci. Contamination from other parts of the body may also cause wound infection. Poor wound dressing techniques and unhygienic conditions may increase the risk for wound infection.

### Signs and Symptoms

#### 1. Feelings of Malaise

Malaise is a common non-specific sign of a localized systemic infection. It is a feeling of tiredness and a lack of energy. It may not feel up to completing normal activities or begin sleeping more than usual.

#### 2. Running a Fever

Running a fever can cause headaches and decrease appetite. Running a low-grade fever of 100 degrees Fahrenheit or less is typical. If temperature reaches 101 degrees or more, it may be indicative of a wound infection. If this happens, consult physician immediately. Keep in mind that if fever is due to an open or chronic wound.

#### 3. Fluid Drainage

It is quite normal to have some fluid drainage from the incision area, Expect clear or slightly yellow-colored fluid to drain from wound. If the drainage fluid is cloudy, green, or foul smelling, this could be a sign that the wound is infected. Contact health care provider to find out what types of wound care supplies need to treat the infection.

#### 4. Increased Pain

While pain is common, it should gradually subside as body heals. Pain medication can help, but should be able to stop taking them comfortably over time. To prevent unwarranted pain, follow doctor's wound care directions and avoid strenuous activities. If continue to experience pain or suddenly have increased pain, it may be a sign of infection. If this happens, consult with physician.

#### 5. Redness and Swelling

Some redness is normal at the wound site, but it should diminish over time. However, if wound continues to be red or exhibit radiating streaks known as lymphangitis, this is a warning sign of a wound infection. Like redness, some swelling is to be expected at the wound site and should decrease over time. If the swelling does not go down during the initial phases of the wound healing process, could have an infection.

#### 6. Extreme temperature over wound Site

When an infection develops in a wound, the body sends infection-fighting blood cells to the location. This may make wound feel warm to the touch. If the hot temperatures continue, the infection may cause to develop other infection symptoms.

#### Wound Examination

- Location
- Size
- Shape
- Margins
- Depth
- Alignment with skin lines
- Neuro function
- Vascular function
- Tendon function
- Wound contamination
- Foreign bodies
- Location



#### Treatment

The primary factor that needs to be addressed in wound infections is proper wound care. A wound requires a moist (not wet) environment for proper functioning of the cells responsible for wound healing. It is recommended that dressings should be changed daily (or more often), and that proper precautions (washing hands prior to dressing the wound, sterilized equipment, etc.) during wound dressing be taken in order to minimize the risk of further infection. A number of advanced dressings, which are currently available, require less frequent dressing changes and may provide the added benefit of faster wound healing.



The use of antibiotics, whether applied directly to the wound (topical) or taken orally (systemic), should only be given under the direction of a physician. In some cases of severe infection, intravenous antibiotics may be given to combat severe blood infection (sepsis).

### **Complications**

- Infected wounds can have serious local and systemic complications. The most serious local complication of infected wounds is a non-healing wound, which results in significant pain and discomfort for the patient. The infection can also affect the surrounding tissues and may cause a bacterial skin infection (cellulitis) or an acute or chronic bacterial bone infection (osteomyelitis).
- Scarring: Regenerated calls have different characteristics and fibrous tissue that can heal the wound, but may leave a scar behind.
- Deformity and contracture
- Loss of function: Many wounds can be disabling and life threatening if a major organ, blood vessel or nerve was damaged. E.g. Compartment syndrome



### **Factors affecting healing of wound**

- Nutrition deficiency
- Cold
- Poor blood circulation
- Infection

Part - 4

## **Pathology**

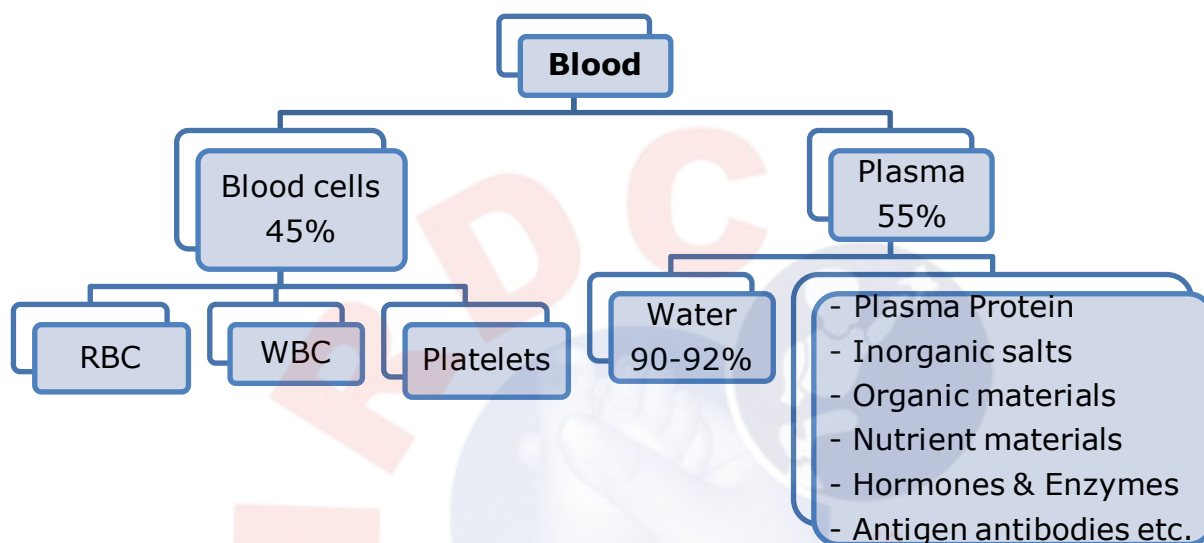


## Blood

Blood is defined as specialized connective tissue which is fluid in nature and circulates in a closed system of blood vessels. It is bright red color in arteries while pink bluish color in veins due to oxy-haemoglobin and carboxy-haemoglobin.

### Composition of blood

Blood is composed of cellular as well as liquid portion. The cellular portion is called blood cells (i.e. RBC, WBC & Platelets) and liquid portion is called plasma. Cellular portion consists of 45% of total blood volume while liquid portion consists of 55% of total blood volume.



### Function of blood

- Transport of respiratory gases ( $O_2$  &  $CO_2$ ).
- Transport of nutrients (e.g. Glucose, amino acid, fatty acid, Vitamins etc).
- Defense mechanism.

### Blood cells

Blood cells are 3 types

1. Red Blood Cells (RBC) / Erythrocyte  
Normal range:  $4.0 - 6.5 \times 10^6$  cells/ $\mu\text{mm}$
2. White Blood Cell (WBC) / Leucocytes  
Normal range: 4000 - 11000 cells/ $\mu\text{mm}$
3. Platelets / Thrombocytes  
Normal range: 1, 50,000 - 4, 00,000 cells/ $\mu\text{mm}$

### 1. RBC / Erythrocyte

- It is circular biconcave disc like structure.
- Nucleus absent
- Size 7.2  $\mu\text{m}$  in Diameter
- Life span 120 days
- Haemoglobin is present in side RBC

Normal Hb level

Male : 13 - 18 gm%  
Female : 12 - 16 gm%  
New born : 20 -22 gm%

Function of RBC (Haemoglobin -Hb)

- Haemoglobin gives red colour to the blood.
- Haemoglobin is the respiratory pigment so helps in transport of  $\text{O}_2$  &  $\text{CO}_2$ .

### 2. WBC / Leucocytes

- These are nucleated, colorless & largest blood cells.
- 2 types of WBC.

#### I. Granulocytes

They have granules in their cytoplasm & multi-lobed nucleus.

- Size 12 - 16  $\mu\text{m}$
- Type: Neutrophil  
Eosinophil  
Basophil

#### II. Agranulocytes

They have no cytoplasmic granules

Type: Lymphocyte (20 - 45 %)  
Monocyte (2 - 8 %)

#### Functions of WBC

They are mainly concerned with:

- Protect from infection & provide immunity.
- Phagocytosis & destruction of bacteria by lysozyme.
- Involved in allergic reaction.
- Kills parasitic larva
- Involved in inflammatory reaction.
- Production of antibody.
- Macrophages formation.

### 3. Platelets / Thrombocytes

- These are smallest blood cells without nucleus.
- Life span 8 - 10 days.

**Function:** It helps in clotting of blood.



## **Differential leucocytes count (DLC)**

It is the method where by the number of different type of white cells presenting in the blood is counted by examining a well stained thin blood smear. The number of each type of WBCs is then expressed as a percentage of the total number of cell counted, usually 100 cells.

### **Normal range of DLC (DC)**

Neutrophil	: 40 - 75%
Lymphocyte	: 20 - 45%
Monocyte	: 2- 10%
Eosinophil	: 1 - 6%
Basophil	: 0 -1%

### **Clinical significance of DLC**

DLC is useful to identify changes in the distribution of white cells which may be related to specific types of disorder. It also gives in idea regarding the severity of the disease and the degree of the response of the body.

## **Neutrophilia**

Increase the number of neutrophils is called neutrophilia.

### **Causes**

- Main cause is pyogenic bacterial infections.
- All the physiological condition that produce leukocytosis, e.g. at birth, pregnancy, muscular exercise, severe pain etc.

## **Neutropenia**

Decrease in the number of neutrophils is called neutropenia.

### **Causes**

- A. Infection
  - i. Bacterial - Typhoid, Paratyphoid
  - ii. Viral - Measles, Influenza
- B. Anaemia
  - i. Aplastic anaemia
  - ii. Megaloblastic anaemia
  - iii. Iron Deficiency anaemia (IDA)
- C. Radiation
  - i. Gamma radiation

## **Lymphocytosis**

Increase the count of lymphocytes is called lymphocytosis.

### **Causes**

- In children, lymphocyte count is high.
- Certain infections like whooping cough, mumps, measles, syphilis, tuberculosis and typhoid.
- CLL (Chronic Lymphocytic leukemia)

## **Lymphopenia**

Decrease count of lymphocytes is called lymphopenia. It is less important but seen in acute stages of excessive irradiation.

## **Monocytosis**

Increase count of monocyte is called monocytosis.

### **Causes**

- Kala-azar, typhoid, tuberculosis.
- Sub acute bacterial endocarditis (Inflammation of endocardia caused by staphylococcus)
- Malaria

## **Eosinophilia**

Increase count of eosinophils is called eosinophilia.

### **Cause**

- Parasitic infection especially helminthes parasites. e.g. Hook worm, Filaria.
- Allergic condition e.g. asthma
- CML: Chronic Myeloid Leukemia

## **Basophilia**

Increase the count of basophils is known as basophilia.

### **Cause**

- Allergic Condition
- CML (Chronic Myeloid Leukemia)

Total White Cell Count / Total Leukocyte count (TLC)

A white blood cell (WBC) count is used to investigate infections and unexplained fever and to monitor treatments which can cause leucopenia. In most situations when a total WBC count is requested it is usual to perform also a differential WBC count.

## **Leukocytosis**

Increase count of total WBC count is called Leukocytosis.

The main causes of a raised WBC count are

- Acute infection e.g. Pneumonia, Meningitis, Abscess, Whooping Cough, Tonsillitis, Acute Rheumatic Fever, Septicemia, Gonorrhea, Cholera, Septic Abortion.
- Inflammation and tissue necrosis e.g. Burns, Gangrene, Fractures and Trauma, Arthritis, Tumor, Acute Myocardial Infection.
- Metabolic disorders e.g. Eclampsia, Uremia, Diabetic Coma and Acidosis.
- Poisoning e.g. Chemicals, Drugs, and Snake Venoms.
- Acute Haemorrhage
- Leukemia and myeloproliferative disorders.
- Stress, Menstruation, Strenuous exercise.

## **Leukopenia**

Decrease count of total WBC count is called Leukopenia.

### **Cause**

- Viral, Bacterial, Parasitic infections e.g. HIV/AIDS, Viral hepatitis, Measles, Rubella, Influenza, Rickettsia infections, Overwhelming, Bacterial infections such as military tuberculosis, relapsing fever, typhoid, paratyphoid, brucellosis, parasitic infections, including leishmaniasis and malaria.
- Drugs & reactions to chemicals.
- Hypersplenism
- Aplastic anaemia
- Folate & Vitamin B<sub>12</sub> deficiencies (Megaloblastic anaemia)
- Bone marrow infiltration (e.g. Lymphomas, Myelofibrosis, Myeloma)
- Anaphylactic shock
- Ionizing radiation
- Anaphylactic shock

## **Platelet Count**

A platelet count may be requested to investigate abnormal skin and mucosal bleeding which can occur when the platelet counts are also performed when patients are being treated with cytotoxic drug or other drugs which may cause thrombocytopenia.

## **Thrombocytopenia**

Decrease count of platelets is called Thrombocytopenia.

The main causes for a reduction in platelet numbers are:

### **A. Reduced production of platelets**

- Infection e.g. typhoid and other septicemia
- Deficiency of folate or Vitamin B<sub>12</sub>
- Aplastic anaemia
- Drugs (e.g. cytotoxic, quinine, aspirin) Chemicals (e.g. benzene), some herbal remedies.
- Leukemia, Lymphoma, Myeloma, Myelofibrosis, Carcinoma.
- Hereditary thrombocytopenia (rare condition)

B. Increased destruction or consumption of platelets.

- Infections e.g. acute malaria, dengue, trypanosomiasis, visceral leishmaniasis.
- Disseminated intravascular coagulation (DIC)
- Hypersplenism
- Immune destruction of platelets etc.

## **Thrombocytosis**

Increase count of platelets is called thrombocytosis.

### **Causes**

- Chronic myeloproliferative diseases (e.g. polycythemia Vera, chronic myeloid leukemia etc)
- Carcinoma
- Chronic inflammatory disease e.g. Tuberculosis
- Haemorrhage
- After splenectomy
- Iron deficiency anaemia etc.

## **Complete Blood Count (CBC)**

Complete blood count means estimation of normal blood cells counts which include total RBC count, total WBC counts and total platelets count. It also includes estimation of haemoglobin level, haematocrit value and study of blood pictures e.g. MCH, MCHC etc. CBC is normally a part routine haematological test of disease or infection. The high or low CBC value helps in many ways for proper diagnosis.

## **ESR (Erythrocyte Sedimentation Rate)**

When anticoagulated blood is placed in a vertical glass tube and allows standing undisturbed for a period of time the erythrocytes or RBCs will tend to fall towards the bottom, forming two layers the lower layer is red cells and upper plasma. This process is called sedimentation. The length (mm) of fall of the top of the column of RBC in a given interval of time (1<sup>st</sup> hour) is the ESR.

### **Normal value**

Male : 0 - 10 mm/1<sup>st</sup> hr  
Female : 0 - 20 mm/1<sup>st</sup> hr

### Some Bio-Chemical Tests & their normal range

- |                       |   |   |
|-----------------------|---|---|
| 1. Glucose            | : | F - 60 - 110 mg/dl<br>PP - 70 - 140 mg/dl<br>R - 60 - 140 mg/dl |
| 2. Urea               | : | 15 - 45 mg/dl   |
| 3. Creatinine         | : | 0.6 - 1.4 mg/dl   |
| 4. Calcium            | : | 8 - 11 mg/dl  |
| 5. Phosphorus         | : | Adult - 2.5 - 4.5 mg/dl<br>Children - 4.0 - 7.0 mg/dl           |
| 6. Bilirubin Total    | : | up to 1.0 mg/dl<br>Direct - up to 0.3 mg/dl                     |
| 7. ALT/SGPT           | : | 5-42u/l   |
| 8. AST/SGOT           | : | 5 - 37 u/l  |
| 9. Alkaline phosphase | : | 53 -128 u/l, Children <500 u/l                                  |

### Medically Important Bacteria

1. Rigid, Thick - walled cells
  - A. Free - living (extracellular bacteria)
    - a. Cocci
      - i. Streptococci
      - ii. Pneumococci
      - iii. Staphylococci
    - b. Spore - forming rods
      - i. Aerobic
        - Bacillus anthralis
        - Bacillus cereas
      - ii. Anaerobic
        - Clostridium terani
        - Clostridium botulium
        - Clostridium pertringens etc.
    - c. Non - spore forming rods
      - i. Non-filamentous
        - Corynebacterium diphtheria
        - Listeria monocytogenes
      - ii. Filamentous
        - Actinomyces
        - Nocardic
  - B. Non-Free Living (Obligate Intracellular Cells)
    - a. Rickettsia
    - b. Chlamydia
    - c. Coxiella

## 2. Gram Negative Cells

### a. Cocci

- i. *Neisseria gonorrhoeae*
- ii. *Neisseria meningitidis*

### b. Nonenteric rods

- i. Spiral form
  - *Spirillum*
- ii. Straight rods
  - *Pasteurella*, *Brucella*
  - *Yersinia*
  - *Haemophilus* etc

### c. Enteric rods

- i. Facultative anaerobes e.g.
  - *Escherichia coli*
  - *Klebsiella*
  - *Salmonella*
  - *Shigella*
  - *Vibrio cholera*
  - *Proteus*
  - *Enterobacter* etc.
- ii. Obligate anaerobes e.g.
  - *Pseudomonas*
- iii. Obligate anaerobes e.g.
  - *Bacterioides*
  - *Fusobacterium*

## 3. Acid Fast Cells

- A. *Mycobacterium tuberculosis*
- B. *Mycobacterium bovis*
- C. *Mycobacterium ulcerans*
- D. *Mycobacterium leprae*

## 4. Flexible, Thin walled cells

- A. *Spiriochetes*  
*Treponema pallidum*
- B. *Borrelia*
- C. *Leptospira*

Wall less cells : *Mycoplasma*



## Parasites

A parasite is a living organism which depends on a living host for its survival and derives nutritious from the host without giving any benefit to the host.

### Classification of parasite

#### a. Protozoal Parasite

- Amoeba
- Flagellates
  - leishmania
  - Giardia
  - Trichomonus
- Sporozoa
  - Plasmodium
  - Toxoplasma
- Ciliates
  - Blantidium

#### b. Helminthic Parasite

- Trematodes
  - leaf like eg. Fasciola, Schistosoma
- Nematodes
  - Elongated, Cylindrical, Unlegmented eg. Hook worm, round worm, thread worm
- Cestodes
  - Tape like segmented e.g. Taenia, Echinococcus

## Blood Grouping

Blood grouping & cross - matching is an essential requirement before blood transfusion in any individual. Blood grouping is also done to settle paternity disputes and other medico legal problem.

### Principle

The red blood corpuscles contain a series of antigens (agglutinogens) on their surface, while the plasma contains antibodies to react with sera containing known agglutinins. The slide is then examined under the microscope to detect the presence or absence of agglutination and clumping of red cells.

### Procedure

1. Using a glass-making pencil, divide a glass slide into two halves, and mark these areas 'A' and 'B' in the left & right corner of the slide.
2. Take another slide and mark it 'D', mark a third slide 'S' (for saline).
3. Place 6-8 drops of citrate - saline or normal saline in the middle of 'S'.
4. Get a finger-prick and add 2 drops of blood to the saline on the slide 'S'. Mix the blood and saline with a clean dropper (or use toothpick) to obtain a suspension of red cells.
5. Put 1 drop of anti- 'A' serum on the left side of area marked 'A' 1 drop of anti 'B' serum on the area marked 'B' and 1 drop of anti 'D' serum on the slide marked 'D'.
6. Put 1 drop each of red cell suspension on anti 'A', Anti 'B' & Anti 'D' sera.
7. Mix the sera & blood by tilting the slide one way and then the other a few times, taking care that the sera on the first slide do not flow into each other & get mixed.
8. Wait for 12 - 15 minutes then inspect the 3 anti sera, first with the naked eye to see whether any clumping & agglutination has occurred or not, then confirm under the microscope.  
Agglutination: Agglutination of the RBCs appears as a coarse separation of red cells into isolated clumps with a brick-red coloring of the blood-sera mixture by free hemoglobin.
9. The slide 'S' also acts as a 'Control' for differentiating between agglutination and no agglutination because agglutination does not occur in this case.

## Examination of urine

Examination of urine is a fundamental investigation in patients in whom kidney disorder or infections of the urinary tract are suspected. There are also many patients who exhibit no clinical symptoms but in whom previously unrecognized urinary tract infections can be diagnosed by urinary examination.

### 1. Appearance

Urine is normally clear straw-yellow in colour. More concentrated urine may appear dark yellow.

Appearance	Possible caused
Cloudy	Bacterial Urinary infection
Red and cloudy	Urinary Schistosomiasis, Bacterial infection
Brown and cloudy	Blackwater fever, Other conditions that cause intravascular haemolysis.
Yellow-Brown	Acute viral hepatitis
Green-Brown (due to Billirubin)	Obstructive jaundice
Yellow-Orange	Haemolysis, Hepatocellular jundice
Milky-white	Bancroftain filariasis

Other changes in the color of Urine can be caused by the ingestion of certain foods, herbs and drugs especially vitamins.

### Measuring the pH

Normal freshly passed urine is slightly acidic with a pH of around 6.0.

In certain disease the pH of the urine may increase or decrease.

### Detection of Glucose

Glucose is the most commonly found sugar substance in urine particularly in diabetic patients and patients suffering from chronic renal failure.

### Detection and estimation of protein

Elevated protein levels are observed in the urine of patients with

- Urinary schistosomiasis
- Chronic renal disease
- Pyelonephritis
- Diabetes mellitus
- Systemic disorders (lupus erythematosm)

### Multiple myeloma

However, orthostatic proteinuria, a form of functional proteinuria usually seen in young man, which occurs on standing up and disappear on lying down has no pathological significance.

### Examine the specimens microscopically

Urine is examined microscopically as a wet preparation to detect.

- Significant pyuria i.e. WBCs in excess of 10 cells/ $\mu$ l ( $10^6$ /l) of Urine.
- Red cells

- Casts
- Yeast cells
- T. vaginalis motile trophozoites
- S. haematobium eggs
- Bacteria etc.

### **Culture the specimen**

It is not necessary to culture urine which is microscopically and biochemically normal, except when screening for asymptomatic bacteriuria in pregnancy, culture is required when the urine contains bacteria, cells, casts, protein, nitrite or has a markedly alkaline or acidic reaction.

### **Anti-microbia (Sensitivity Testing)**

In the treatment and control of infectious diseases, especially when caused by pathogens that are often drug resistant, sensitivity (Susceptibility) testing is used to select effective antimicrobial drugs.

### **Possible pathogens**

Bacteria

#### **Gram positive**

- Staphylococcus Saprophyticus
- Haemolytic Streptococci

#### **Gram negative**

- Escherichia coli
- Proteus species
- Pseudomonas aeruginosa
- Klebsiella strains
- Salmonella typhi
- Salmonella paratyphi
- Neisseria gonorrhea etc.

### **Examination of Sputum specimens**

The presence of pathogenic organism is revealed by microscopic examination of sputum specimens.

#### **The organisms include:**

- Bacteria: Gram-positive & Gram - negative, acid - fast bacilli
- Fungi or yeasts: Filaments of mycelium with or without pores.
- Actinomycetes
- Parasites

### **Collection of specimens**

Sputum specimens should be collected early in the morning.

- Ask the patient to take a deep breath and then cough deeply, spitting what he/she brings up into the container
- Screw the top and label the container with the name and number of the patient
- Check that a sufficient amount of sputum has been produced.

### **Important**

Liquid forthy saline and secretions from the nose and pharynx are not suitable for bacteria logical examination. Ask the patient to produce another specimen.



Part - 5

## **Prosthesis and Orthosis**

## Prosthetic and Orthotic

### General terms

**Orthotics:** It is a science / technology of evaluation, designing and fabrication of orthosis.

**Prosthetics:** It is a science / technology of evaluation, designing and fabrication prosthesis.

**Orthopaedic Appliance:** It is an appliance used on medical treatment or rehabilitation process of a person with Musculo-skeletal problem.

**Prosthetist:** A person, who evaluates, proscribes designs and fabricates prostheses.

**Orthotist:** A person, who evaluates, prescribes designs and fabricates orthosis.

**Orthosis :** It is a device used externally in existing organ with musculo-skeletal problem on treatment process. For example: Ankle Foot Orthosis.

**Prosthesis:** It is a device used as replacement of non-existing organ on the rehabilitation process. For example: Below Knee Prosthesis.

**Ortho-prosthesis:** It is a device with combination of orthotic and prosthetic components.

### Role of orthopaedic appliances in rehabilitation process

The rehabilitation team has important role in rehabilitation of a person with physical disabilities and neuromuscular problem. For the best outcome, the teamwork and combined effort of every member of rehabilitation team is crucial. Orthopaedic appliances can help person with physical disability and neuromuscular problem by providing functional and cosmetic way in the daily living activities.

Principle of rehabilitation implies the restoration of normal physical functions by physical means in order to achieve personal, social and economic independence; prostheses and various orthopaedic appliances have played an important role in aiding the disabled.

### Rehabilitation team members

- Orthotist / Prosthetist
- Orthopaedic surgeon
- Physiotherapist
- Occupational therapist
- Nurse
- Social mobilizer
- Counselor



## Specifications for the ideal Prosthesis / Orthosis

Need	Definition
Function	Meets the user's needs, simple, easily learned, dependable
Comfort	Fits well, easy to don/doff, lightweight, adjustable
Cosmesis	Looks, smells, sounds "normal", cleans easily, stain-resistant
Fabrication	Fast, modular, readily and widely available
Economics	Affordable, worth cost of monetary investment

## Types of Orthopaedic Appliances

1. Orthosis
2. Prosthesis
3. Orthoprosthesis

### 1. Orthosis

It is a device used externally in existing organ with musculo-skeletal problem on the treatment process, for example AFO

#### Functions of Orthosis

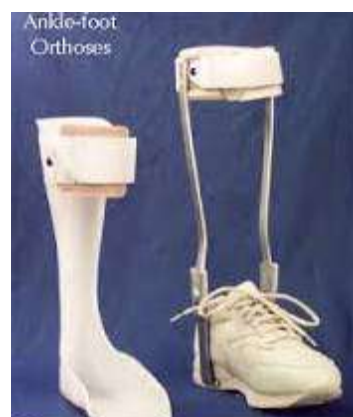
- Support weak part
- Correct deformity
- Prevent deformities
- Control ROM
- Immobilize unnecessary movement
- Protect sensitive area
- Improve function / ADL
- Reduce Pain

#### Classification of Orthosis

1. Lower extremity orthosis
2. Upper extremity orthosis
3. Spinal orthosis
4. Others

#### Lower extremity Orthosis

- FO : Foot Orthosis  
AFO : Ankle Foot Orthosis  
KAFO : Knee Ankle Foot Orthosis  
KO : Knee Orthosis  
HKAFO : Hip Knee Ankle Foot Orthosis  
HO : Hip Orthosis



### Foot Orthosis (FO)

There may be different types of disability/deformity in foot. Clubfoot deformity is more common deformity in foot. For the correction and treatment of deformed foot, orthopaedic shoe is given. Orthopaedic shoe is also given for flat foot deformity, Pes Valgus, Pes varus deformities in foot. Orthopaedic shoe, arch support, moulded shoe are foot orthosis.

### Ankle Foot Orthosis (AFO)

If there is deformity not only in foot but also in ankle, ankle foot orthosis is given, the deformities in ankle are:

- Equinus deformity
- Calcaneus deformity
- Foot drop deformity

**Metal, plastic and other fabrics may make ankle foot orthosis.**

### Knee Ankle Foot Orthosis (KAFO):

If the deformity and disability are in foot ankle and knee, the KAFO is prescribed. There may be flexion contracture of knee joint by the cause of post polio paralysis; post burn contracture or arthritis.

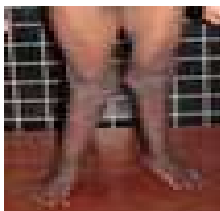
### Knee Orthosis (KO)

If deformity / disability are only in knee area, KO is given for correction and prevention of deformity. For example, KO is given in genu valgum, genu varum and unstable knee problem.



### Different types of Knee deformities

#### 1. Genu valgum



#### 3. Genu varum



#### 2. Knee Hyper extension



#### 4. Knee Flexion contracture



### **Hip Knee Ankle Foot Orthosis (HKAFO)**

If hip joint is deformed and muscles are weak in knee, ankle and foot, HKAFO to be used. Especially HKAFO is used when lower extremities are paralyzed.



### **Hip Orthosis (HO):**

If the problem is only in Hip joint, the HO is given, usually in DDH or CDH HO is given.



### **Upper extremity Orthosis**

- HO : Hand Orthosis
- WHO : Wrist Hand Orthosis
- EWHO : Elbow Wrist Hand Orthosis
- EO : Elbow Orthosis
- SO : Shoulder Orthosis.

### **Common deformities of the Spine**

- Scoliosis : Lateral deviation of the spine from straight line,
- Kyphosis : Excessive backward convexity of the spine also called gibbus, hunchback
- Lordosis : Excessive frontal convexity of the spine.
- Torticollis : Lateral deviation of spine in cervical region by weak sternocleidomastoid muscles.
- LO : Lumbar Orthosis

### **Spinal Orthosis**

- CTL SO : Cervical Thoracic Lumbo-sacral Orthosis
- TL SO : Thoracic Lumbo-sacral Orthosis
- LSO : Lumbo-sacral Orthosis
- SIO : Sacroiliac Orthosis
- CO : Cervical Orthosis

### **Functions of spinal Orthosis**

- a) To relieve pain and protect trauma with or without surgical reconstruction by immobilization in the position of optimum function and comfort.
- b) To prevent progressive deformities of the spine caused by abnormal strains from such deformity forces as muscle imbalance, tissue contractures.
- c) To correct the deformities by means of some corrective devices in the brace.
- d) To facilitate in sitting, standing and walking by supporting certain weakened or paralyzed muscles and unstable joints.

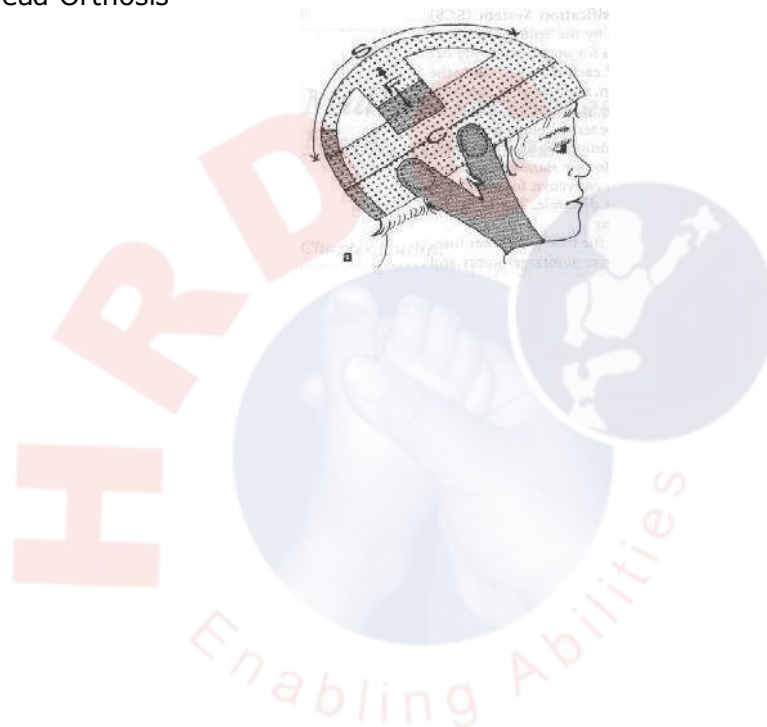
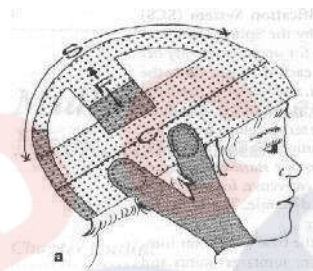
### Commonly prescribed spinal Orthosis

1. Milwaukee brace
2. OMC brace
3. Moulded jacket
4. Knight tailors brace
5. ASH brace
6. Thomas collar
7. Soft collar
8. Philadelphia collar
9. Four post
10. SOMI brace



### Other Orthosis

HO : Head Orthosis



## ORTHOPAEDIC SHOES

### Definition

Orthopaedic shoes are specially designed shoes for correction, prevention and protection from different deformity and problems in foot with neuro- musculo-skeletal problem. Club shoes are included in orthopaedic shoes. If there is one and more components of orthopaedic shoes fitted in normal shoes, it can also be said orthopaedic shoes.

### Component of Orthopaedic shoes

There are several components of orthopaedic shoe depending on pathology, deformity and problems wise.

Generally used components of orthopaedic shoes can be listed as below:

1. Wedge
2. Arch support
3. Compensation
4. High quarter shoes
5. Reverse lasted shoe
6. Closed shoe
7. Anterior opened shoe
8. T-straps
9. Soft cushion in insole
10. Flat sole

### Wedge

Wedge is given in sole or heel of orthopaedic shoe, it should be thin in medial/lateral side and thick in another side, it is made of normally rubber. If there are valgus and varus deformity in foot wedge should be fitted in shoe.

### There are two types of wedge

1. Medial wedge
2. Lateral wedge

Wedge can be given only in sole or heel or both side. Medial wedge is given in valgus foot and lateral wedge is given in varus foot. Normally wedge is given up to  $\frac{1}{4}$  inch thickness.

### Arch support

Normally there are longitudinal and transverse arches in foot. These arches help by shock absorption (spring action) and proper weight transfer of body weight to ground when walking. If there is any problem or collapse of arch in foot, it creates secondary problems like foot, ankle, and knee pain. Arch support is given when there collapse of arch of foot. Arch support may be longitudinal (lateral and medial) and transverse. It may be made of soft foams, cork or hard Polypropylene.

### Compensation

If there is limb length discrepancy problem, it may create other problems like pain in hip joints, scoliosis deformity (spinal) later. Compensation in shoe should be given according to extent of short for prevention of secondary problems. Compensation can be given up to 7-8cm normally. ASIS level should be checked when compensation is given.

Compensation may be inside/outside of shoe and parallel /inclined type.

### **High quarter boot**

High quarter boot is prescribed support of total foot and sub-talar joint of foot.

### **Reverse lasted shoe**

It is specially designed when fore foot adduction deformity to be corrected. Normally reverse lasted shoe is given for clubfoot deformity.

### **Closed shoe**

When toes of the foot are splayed, closed shoe is very effective for the prevention of deformity.

### **Anterior opened shoe**

This type of shoe is very useful when foot is flail and deformed. It allows fresh air on foot and easy to check fitting of foot in shoe properly.

### **T-straps**

Some times t-straps are attached in orthopaedic shoe with bar for the correction of varus and valgus deformity of the foot. T-straps may be attached medial or lateral side of the shoe.

### **Soft cushion in insole**

When there are scars, loss of sensation or pain in planter surface of foot, soft cushion in foot is necessary.

### **Flat sole**

Flat sole in orthopaedic shoe is given for prevention and correction of equines deformity of foot. Club shoe is designed with flat sole.

### **Measurement of orthopaedic shoe**

Measurement of orthopedic shoe can be taken in different ways, like taking a cast a foot, taking a footprint in paper using ink etc. The simple paper measurement of orthopedic shoe can be taken in this way:

1. Prepare foot for measurement
2. Prepare materials and equipments
3. Put foot on paper on flat surface
4. Put pen in 90 degree.
5. Draw line around foot; make sure that foot is stretched in corrected position
6. Measure circumference of mid foot and note.
7. Note personal data of patient.
8. Note medical data like diagnosis, deformity, history and treatment.
9. Note name of measured by, measurement date, appointment date and comments.



## PROSTHESIS

### Definition:

In general an artificial limb is known as prosthesis. If the existing limb or body part is missing by any reason such as in congenital deficiencies, amputations etc; on artificial one can replace the missing part to perform the function and this is called prosthesis. Above knee prosthesis, below knee prosthesis, Syme's prosthesis is the examples of it. It is normally make a patient with limb amputation or with the deficiencies mobile and rehabilitated. Sometimes prosthesis is given just for cosmetic reasons e.g. breast prosthesis, nose prosthesis, ear prosthesis etc

### Types of prosthesis

1. Lower limb prosthesis
2. Upper limb prosthesis
3. Others

### Amputation

Amputation : The loss of some part of the body  
                  : Cut of the some part of the body  
                  : Removal of medically undesired part of the body  
Type a) Congenital  
      b) Acquired: 1) Trauma 2) Disease  
Amputee : A person having any type of amputation  
Stump : A residual incomplete part of the body after amputation  
       : A body part left after amputation

### Lower limb amputation and prosthesis

- |                                   |  |
|-----------------------------------|--|
| 1. Partial foot amputation        | : Partial foot prosthesis (Shoes with<br>(Rays amputation, lisfrank amputation, filler, modified prosthesis, Chopart amputation) |
| 2. Boyd amputation                | : Boyd prosthesis, elephant boot   |
| 3. Syme's amputation              | : Syme's prosthesis  |
| 4. Below knee amputation          | : Below knee prosthesis  |
| 5. Through knee amputation        | : Through knee prosthesis  |
| 6. Above knee amputation          | : Above knee Prosthesis  |
| 7. Hip disarticulation amputation | : Hip disarticulation prosthesis   |

### Upper limb amputation and Prosthesis

- |  |                                       |
|--|---------------------------------------|
| 1. Partial hand amputation             | : Partial hand prosthesis             |
| 2. Wrist disarticulation amputation    | : Wrist dis. prosthesis               |
| 3. Below elbow amputation              | : Below elbow prosthesis              |
| 4. Elbow disarticulation amputation    | : Elbow disarticulation prosthesis    |
| 5. Above elbow amputation              | : Above elbow prosthesis              |
| 6. Shoulder disarticulation amputation | : Shoulder disarticulation prosthesis |

## **Other Prosthesis**

1. Nose Prosthesis
2. Ear Prosthesis
3. Eye Prosthesis
4. Breast Prosthesis

## **Principle of weight distribution inside the socket in lower limb**

### **Syme's prosthesis**

#### **Weight / Pressure**

- The end bears the weight
- Sometimes from patellar tendon too.

Some time from medial surface of proximal tibial condyle.

#### **No Weight / No Pressure**

Bony prominences

### **Below knee prosthesis**

#### **Weight / pressure**

- PTB \_Patellar Tendon Bearing
- Medio interior flare of tibial condyle
- Lateral surface of stump
- Posterior surface of stump

#### **No Weight/ No pressure**

- Head of fibula
- End of tibia
- End of fibula
- Hamstring tendon
- Bony prominence
- Tibial crest

### **Above Knee Prosthesis**

#### **Weight / pressure**

- Ischial seat
- Periphery of the stump
- Scarpa's triangle

#### **No weight /No pressure**

- End of femur
- Greater trochanter
- Abductor's tendon
- Perineum

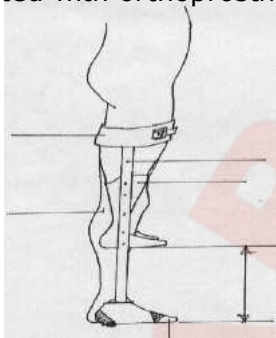
## ORTHOPROSTHESIS

### Definition

It is a kind of orthopaedic appliance, which is neither prosthesis nor an orthosis, but the appliance made with combination of both orthotic and prosthetic principle. This appliance is prescribed when patient has tremendous limb length discrepancy (lower limb) and surgical intervention for the amputation is not performed.

### Indication

Some of people with tremendous leg length discrepancy are very difficult to manage through the orthotic mean. Shoe with adequate compensation can be provided to manage the shortening of leg. But if leg length discrepancy is more than 8-10 cm, it can't be managed by using same compensation, but an ortho-prosthesis help much better without major amputations. People who have already undergone for an amputation feel they have lost a part of their body but with a short leg keep their mind higher and may be fitted with orthoprosthesis depending upon the possibility.



### Causes of short leg:

- Congenital
- Acquired

#### **Congenital shortening:**

- Fibular hemimelia
- Phocomelia
- Femoral hemimelia
- Pseudoarthrosis
- Osteogenesis Imperfecta
- Hip dislocation etc

#### **Acquired shortening:**

- Trauma
- Destruction of epiphysis
- Untreated malunited fractures
- Pseudoarthrosis
- Different surgical interventions.
- Infection

## **Basic materials used in fabrication of orthopaedic appliances**

### **Wood**

It is common material used in fabrication of orthopaedic appliances. It is used for making artificial leg, foot etc. The wood used in appliances should be light and strong one.

### **Steel**

Steel is very strong material. It is used for fabrication of calipers, braces etc. stainless steel, mild steel are common steel in orthopaedic appliances.

### **Resins**

Resins are used for making sockets of prosthesis and different orthosis. There are different types of resins. Some resin shows hard property, some shows soft property. Resins are used with combination of harder, accelerator etc. Epoxy resin and polyester resins are common resin used in fabrication of orthopaedic appliances.

### **Rubber**

It is also very common material used in orthopaedic appliances. Normally, rubber are used excessively in shoe fabrication and prosthetic foot, there are different type of rubber for example filler, micro cellular rubber etc. These rubbers are used in different appliances according to their properties and need.

### **Fabric**

Fabrics are also important material in fabrication of orthopaedic appliances. For example cotton stockinet, nylon stockinet, cotton straps, nylon straps, rexins, jeans and Teri cotton are used for various types of orthopaedic appliances.

### **Aluminum**

It is light and strong material in fabrication of orthopaedic appliances. Aluminum is used in spinal and limb braces excessively.

### **Plaster of Paris (POP)**

Plaster of Paris also used in the fabrication process of orthopaedic appliances. Plaster of Paris bandage is used at taking a cast and plaster of Paris powder is used in making mould (models) to make appliances.

### **Plastics**

Plastics are also very suitable materials in fabrication of orthopaedic appliances. Different kind of polypropylene, high-density polyethylene, polyvenyle chloride and polyvenyle acrylic are plastics used in orthopaedic appliances.

### **Adhesive**

Different kind of adhesives are also important material in fabrication of orthopaedic appliances, Rubber adhesive, Leather adhesive, wood adhesive are used for bonding materials used in orthopaedic appliances.

## Leather

Leather is also an important material in fabrication of orthopaedic appliances. There are different kinds of leather quality wise. Leather is strong and skin friendly material in orthopaedic appliances. Upper leather, living leather, sole leather and belt leather are example of leather used in orthopaedic appliances.

## Foam

Foams are also used in fabrication of orthopaedic appliances. There are different kinds of foams; such as soft, hard, thick, thin etc. Foams are used in making soft sockets of prosthesis and padding of appliances.

## Important characteristics of Prosthetic and Orthotic materials

Term	Definition
Strength	Maximum external load that can be withstood
Stiffness	Stress/strain or force - to - displacement ratio
Durability	Ability to withstand repeated loading
Density	Weight per unit volume
Corrosion resistance	Resistance to chemical degradation
Ease of fabrication	Equipment and techniques needed to shape it

## Repair and maintenance places of orthopaedic appliances

### Black smith's shop

Black smith's shop may be a local repairing center of orthopaedic appliances. Riveting of loosened rivets and tightening the loosened nut, bolts, screw of orthopaedic appliance can be done at black smith's shops.

### Tailor's shop

In tailor's shop, new straps, Velcro can be made if old straps are spoiled. New bottoms, press bottoms also can be fitted in tailor's shop. If leather straps, fabrics are worn, these can be repaired in tailors shop.

### Shoe maker's shop

Orthopaedic shoes can be repaired in shoemaker's shop. New shoes can be ordered or bought at shoemaker's shop.

### Carpenter's shop

Orthopaedic appliances relating wooden works can be repaired in carpenter's shop. Broken prosthetic foot or broken peg leg of prostheses may be repaired at that shop.

### Mechanical workshop

Mechanical workshop usually located in urban areas. Maximum repair works of orthopaedic appliances can be done at mechanical workshop, lengthening of calipers, rejoining of broken orthosis, etc. can be done in Mechanical workshops.

**Orthotic/Prosthetic centers:**

All types of repairing except advanced type of appliances may be done all local orthotic prosthetic centers. Some suggestions and advices can be obtained regarding using and repairing of orthopaedic appliances from Orthotic/ Prosthetic centers. All types of orthotic prosthetic problem can be solved in advance type of orthotic prosthetic centers

**How to repair different kind of braces?****Repairing of plastic braces:**

If plastic braces are tightened, it can be obtained in required size some extent by heating the brace and putting in water in stretched position of brace.

**Repairing steel braces:**

Steel brace can be welded and bent in required shape. It can be joined by riveting process also. Repairing of steel braces can be done at mechanical workshop easily.

**Repairing aluminum braces:**

Aluminum can't be welded. If aluminum bar is broken, it should be joined by riveting. If aluminum braces are bent at undesired position, hammering and bending can straighten it. Aluminum braces can be repaired at blacksmith's shop or mechanical workshop.

