

Rehabilitation Medicine:

Rehabilitation is the development of the patient to the preinjury level of function or to the maximum level of function consistent with his impairments or disabilities after injury or illness.

Each patient should have proper assessment to set rehabilitation goals that should be realistic and achievable at the end of the program.

Rehabilitation is a combination of physical, occupational, speech therapy; psychological counseling; and social work.

Rehabilitation team includes physician specialized in physical medicine and rehabilitation (physiatrist), physical therapist, occupational therapist, speech therapist, orthoptist and prosthetist, psychiatrist, psychologist, social worker, vocational rehabilitation and recreational therapists, the patient and his family.

All members should work in an interdisciplinary team work to achieve the goals of rehabilitation program, all members have the same importance to achieve the goals, but the most important member is the patient and his family.

The physician role is to diagnose, assess people's level of function after injury or chronic illness and put management plan to maximize their function and to improve their quality of life. The physical therapist does his physical therapy assessment and focus on improving muscle performance mainly by strengthening large muscle groups responsible for dynamic activities, while occupational therapists work to make the patient independent in doing activities of daily living (ADL), they work more on fine motor skills and hand and upper limb motor function. Speech therapist work to assess, treat speech, language, social and cognitive communication and swallowing disorders in children and adults. Orthotists and prosthetists design and fit orthoses and prostheses for patients with physical limitations that need their intervention.

What are orthoses and prosthesis and when they are indicated?

Prosthesis is an artificial device that replace a missing body part, which may be lost through trauma, disease, or congenital condition.

Orthosis: an external appliance that is used to modify the neuro musculoskeletal function of a specific part of the body. external part that correct (straighten, align) a part of the body. orthotic (to "straighten" or "align"). They are named according to body part.

Indications for orthoses:

- correction of deformities
- immobilization
- Nerve injuries
- Inflammation
- Muscle weakness

Orthopedic rehabilitation aims to restore or maximize function after injuries of the musculoskeletal system including rehabilitation after orthopedic surgery , acute trauma such as sprains , strains, injury of the insidious onset such as tendinopathy , bursitis , and deformities like scoliosis .

Sport rehabilitation aims to improve care and wellbeing of athletes. This area of practice encompasses athletic injury management under 5 main categories :

1. acute care - assessment and diagnosis of an initial injury ;
2. treatment
3. rehabilitation-progressive management for full return to activity and sport.
4. prevention -identification and address of deficiencies known to directly result in, or act as precursors to injury , such as movement assessment
5. education - sharing specialist knowledge to individual athletes , teams or clubs to assist in prevention or management of injury

ICIDH: definitions

1. **Impairment:** any loss or abnormality of psychological, physiological, or anatomical structure or function. e.g. weakness, fracture, amputation, etc.
2. **Disability:** any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the rang considered normal for a human being. E.g inability to walk due to muscle weakness, inability to perform activities of daily living (ADL).
3. **Handicap:** a social disadvantage that result from either impairment or disability for a given individual that limits or prevents the fulfillment of a role that is normal, depends on social or environmental factors, in regard with constitutional factors (environment, living site, stairs, personal background, education, etc)
4. **As traditionally used:**
 - * impairment ----at the level of the organ
 - * Disability-----at the level of the person
 - * Handicap-----at the level of society.
5. **Example:** David , 4-yr.- old , has cerebral palsy (CP) called spastic diplegia, David's CP causes his leg to be stiff, tight ,and difficult to move . he cannot stand or walk.
 - *impairment : -----weakness.
 - *Disability :-----inability to walk.
 - *Handicap:-----prevent him from fulfilling a normal role at home , in preschool , and in community.

International classification of function, disability and health (ICF) has been developed in 2001 and is a classification of health and health related domains.it is composed of body structures and functions, activities and participation. contextual factors include environmental factors and personal background.

General Objectives of rehabilitation :

1. Restoration of function to the greatest possible degree in the shortest possible time.
2. Restoration of full or near full range of motion .
3. Increase strength & power .
4. Increase joint mobility .
5. Increase endurance.
6. Encourage relaxation .
7. Decrease pain .
8. Improve function.
9. Minimize atrophy and deconditioning .
10. Decrease inflammation and swelling.
11. Enhance coordination and skill.
12. Improve joint stability.
13. Prevent re-injury.

Deconditioning: functional impairments affecting different body systems due to long period of immobility.it affects almost all systems of the body.

Musculoskeletal system:

- 1- muscle loss and weakness, due to immobility may lead to loss of muscle strength that can start even after a single day of immobility and increases with time. Studies showed that the muscle can lose 1-1.5% daily, 5-12% weekly and up to 50% after 1-2 months of immobility. This will be followed by muscle wasting and loss of sarcomeres.
- 2- Contracture formation due to loss of passive range of motion at a specific joint. Contractures can be caused by intrinsic factors affecting skin, muscle, joint, bone tendon or ligaments including injury, trauma, fracture or chronic diseases, or extrinsic factors which may be mechanical ,positional or due to spasticity or flaccidity affecting the mechanical properties of the muscles.
- 3- Decreased bone density: immobility leads to progressive loss of bone density mainly affecting weight bearing bones, so to maintain bone density , mechanical loading is necessary and weight bearing exercises and resistance exercises in upright position are essential.
- 4- Immobilization hypercalcemia.
- 5- Heterotopic ossification "HO
 - a) Extraarticular extracapsular bone formation in areas where we should not have bone. tis
 - b) Most frequently is seen with either musculoskeletal trauma, spinal cord injury, burns or traumatic brain injury injury.
 - c) Most common presentation with pain around the site of HO associated with decreased range of motion.
6. Joint stiffness: Lack of movement →lack of blood supply from synovial to cartilage → ischemic changes.

Respiratory system →atelectasis, chest infections and PE.

Cardiovascular system

- a) DVT
- b) Orthostatic hypotension
- c) Cardiac muscle atrophy →increased resting HR , increased submaximal HR, constant maximal HR (as it depends on age) , decreased CO with exercise. And increased possibility to myocardial ischemia.

Gastrointestinal system: loss of appetite, Gastroesophageal reflux and constipation

Genitourinary system: stasis and increased possibility of stone formation, increased risk of UTI.

Neurological system : compression mononeuropathies and critical illness polyneuropathy and myopathy.

Skin: bed sores.

Psychological wellbeing is affected and the risk of posttraumatic stress disorder, anxiety and depression increases.

Endocrine system: changes in hormonal balance, increased fat stores and glucose intolerance and disturbed electrolyte balance.

MUSCLE STRENGTH VS .MUSCLE ENDURANCE

- Muscle strength is the force output that results from maximal voluntary contraction. Activities that involve high loads for short period of time increase muscle strength.
- Muscle endurance is the ability of the muscle to have repetitive submaximal contractions. Low loads over for an extended period of time increase muscle endurance.
- No good correlation between Muscle strength & Muscle endurance
- slow twitch "red " fiber muscle to fast twitch " white" fiber muscle ratio is 50% to 50% in most people.
- Some have Slow twitch predominance and some have fast twitch predominance
- Slow twitch muscle fibers : Contract slowly , but keep going for long time →endurance activities
- Fast twitch muscle fibers :Contract quickly , but rapidly get tired →rapid movement like jumping or sprinting
- One repetition max :(1RM): maximum amount of force that can be generated in one maximal contraction that can be done for one time and only one time.
- 10 repetitions max (: maximum amount of force that can be generated and repeated for 10 times. each one is nearly 75% of 1 RM
- Progressive resistive exercise, such as Delorme or Oxford techniques, improve strength by adding weights starting from 50% of 10 RM at the beginning to 75% mid-session to 100% 10 RM at the end of session (Delorme) or by starting at 100% 10RM and removing weight (oxford) to 75% mid session and 50% at the end of the session.
- Both the Delorme and Oxford protocols improve strength , no regimen is considered superior to other.

Therapeutic modalities

1. Criteria

- a) Injury site , type and severity.
- b) Modality indication and contraindication .
- c) Physician prescription.
- d) Patient willingness to accept treatment.

2.Types

- a) Cryotherapy: ice packs , ice massage , whirlpool, immersion, sprays.
- b) thermotherapy (heat therapy): moist heat packs ,whirlpool, paraffin , ultrasound, phonophoresis.
- c) Electrotherapy
- d) Massage
- e) Exercise

3. Acute vs. chronic pain

- a) Acute , \leq 3 days→cold therapy
- b) Subacute or chronic→ heat therapy

4. Cryotherapy, Ice therapy

- a) Effects
 - i. Reduce inflammatory phase
 - ii. Depth of cold penetration can reach up to 5 cm→superficial
 - iii. Decrease in blood flow , hemorrhage < i.e. Vasoconstriction.
 - iv. Reduce swelling & or edema
 - v. Decrease in muscle spasm , muscle fatigue .
 - vi. Decrease in pain perception
 - vii. Produce reactive hyperemia
- b) Contraindications
 - i. simple cold intolerance →cause muscle spasm
 - ii. hypertension (due to secondary vasoconstriction).
 - iii. Raynaud disease.
 - iv. local limb ischemia
 - v. History of vascular impairment , such as frostbite or arteriosclerosis.
 - vi. Cold allergy(cold urticaria).
 - vii. Hypersensitivity
- c) Principles
 - i. Ice should never be applied for longer than 20-30 minutes
 - ii. Ice packs administration : for 15-20 min .Every 1-1.5 hour
 - iii. Ice massage :7-10 min each time
 - iv. Cold water used in temp. of (4-8C)
 - v. Ice therapy used in the first 48-72 hour (acute phase)
 - vi. Used for distal injuries,soft tissue injuries in hand and feet
 - vii. Cold spray used for rapid relief of pain but you have to r/o significant trauma
- d) Rice : Rest, I: ice , C:compression, E :elevation

Cryotherapy types: used usually from 15 -20 minutes.

- a) Cold packs
- b) Ice message.
- c) Cold water immersion:(around 10 C)
 - i. Whirlpool, bucket or container filled with mixture of water and ice
 - ii. Good for hand ,feet and ankles.
- d) Vapocoolant spray :Flouri -Methane
 - i. cold spray of chemicals sprayed over the surface of skin to freeze it . used to treat myofascial pain and trigger point , usually combined with stretching
- e) Contrast baths : alternation between hot and cold. Five 1 minute cold water(10-15 C) immersion and five 3 minutes hot water (40-42 C)immersion for a total of 20 minutes.

5. Heat therapy

- a) Effects
 - i. increase blood flow
 - ii. Decrease muscle spasm
 - iii. Decrease pain perception
 - iv. increase metabolic rate
 - v. Decrease joint stiffness
 - vi. increase range of motion : by increasing the extensibility of collagen tissue & increase collagen fiber length
- b) Used in chronic and subacute phase (3 days - 1 week), or when signs of acute inflammation disappear.
- c) Contraindications:
 - i. immediately after an injury →acute phase
 - ii. an area where there is decreased arterial circulation →if the pt has an atherosclerosis , the arteries lose it is response to heat by vasodilation . so if we apply heat , there will be no vasodilation and there willbe increased rate of metabolism which will cause relative hypoxia and nutrient hypoxia
 - iii. Eyes and genitalia
 - iv. Abdomen during pregnancy
 - v. over tumer or mets
- d) Superficial vs. deep (5-7 em)
- e) Duration of (20-30 min)
 - i. Therapeutic effect: achieved in first 2-3 min in a temp range 40-45C
 - ii. Different tissue response depend on:
 - 1.tissue type
 - 2.Rate in temp . increase depend on the modality used
 - 3. Size of the area exposed to heat .(large →more effect)
 - iii. Fibrosis and contractures need rapid rate of temp increase.
- f) Thermotherapy Methods
 - i. Conduction→direct applying
 - ii. Convection : in a medium (hydrotherapy →hot water + gas)
 - iii. Radiation : infra-red radiation
 - iv. moist heat packs
 - 1. superficial , fat works as insulator
 - 2. used for proximal parts of the body , inside the packs temp(70-80)
 - 3. duration of 20-30 min.
 - 4. never lay on it . risk rupture
 - v. Hydrotherapy : hot water →whirlpool bath
 - 1.tank with turbine motor which regulate the movement of water and air.
 - 2. Mechanism : both Convection and conduction occur
 - 3.Bouyancy effect : improve ROM and muscle strength, and include either water resistive or water assistive exercises.
 - 4.used in un-weight bearing (unloading the joints)when its contraindicated to walk (Knee, hip ankle surgery)
 - 5. hydrostatic pressure effect against edema
 - 6.Turbulence effect : massage effect
 - vi. Paraffin Bath →
 - 1.kept at 52-55C →cause no burn as the energy conducted through paraffin is low
 - 2.useful for contractures in burns , RA & Scleroderma
 - 3.paraffin : Mineral oil + wax in ratio of(5:1), (50-55C)of low heat conductivity
(on risk of burn)

4. Used for distal parts (feet, hands, and ankles) contractures

5. Types:

Dipping : 5-10 times then wrap with plastic towel for 30min

immersion : 3-5 dips then leave in paraffin for 30min

brushing: used in pediatrics age group

vii. Ultrasound therapy → 5-10min

1. Deep joint as hip joint need deep heat: U/S (5-7cm) under surface

2. high frequency sound waves

3. sound energy causes molecules in the tissue to vibrate, thus producing heat and mechanical energy

4. Thermal and mechanical effects of US increase circulation and promote healing

5. Also provides a micro massaging action on cells

6. US raises tissue temp 7-8 degree F up to 2 inches below the skin surface

7. little or no change in skin's surface

8. so it is a deep thermal modality

9. CI

a) pediatric (affect growth plate)

b) Genital area

c) Laminectomy, arthroplasty with plastic component.

viii. Phonophoresis

1. Phonophoresis is the use of US to enhance the delivery of topically applied drugs. it enhances the absorption of topically applied analgesics and anti-inflammatory agents through the therapeutic application of US.

2. Massage medication into the skin over area, then spread the coupling agent, then US.

3. Used for tendonitis, bursitis, and painful trigger points

ix. short wave and microwave are other forms of deep heat therapy, they work by conversion and should be avoided in cases where the patient have any type of metal implant.

6. Electrotherapy:

a) Electricity is a form of energy that displays the following factors on tissue:

i. Magnetic, chemical, mechanical, thermal effect.

b) Indications:

i. control pain → gate control theory

1. close pain receptors

2. increase endogenous endorphins

ii. Exercise muscle tissue to decrease atrophy. direct stimulation for denervated muscles against atrophy.

iii. Promote circulation. increase tissue temp.

iv. Relieve spasms

v. stimulate already innervated muscles such as calf muscles to prevent DVT post op.

c) Contraindication

i. pacemakers

ii. pregnancy

iii. when muscle contractions are not wanted

d) Mechanism

i. The small pad is the active pad which brings the current to the body

- ii. The large pad is where the electrons leave the body
- iii. The closer the pad are , the shallower and more isolated the muscle contraction
- iv. Active exercise can be used at the same time
- e) Exercise and electrotherapy can be used together but they are not summative
- f) Functional electrical stimulation: UMN injuries when peripheral nerves are intact .(stroke and spinal cord injuries) :is a technique that uses low energy electrical pulse to artificially generate body movements in individuals who have been paralyzed due to injury to the central nervous system . to restore or improve their function. FES is commonly used for the exercise, but also to assist with breathing , grasping , transferring , standing , and walking.

7. Massage:

The systematic therapeutical friction , stroking , and kneading of the body .

- a) increasing venous flow and lymphatic drainage
- b) increase circulation and nutrition

8. Exercise:

- a) maintaining or increasing mobility and preserving ROM at joint by preventing fibrosis which is caused by immobility
- b) decrease edema by elevation
- c) indications:
 - painful conditions (e.g. fractures, joint trauma, dislocation, sprains)
 - inflammatory conditions
- d) Type of exercise used in rehabilitation:
 - i. isometric :
 1. no movement (up to 10% of range of motion) no work of muscles
 2. like holding a weight in a fixed position , or pushing a against a door frame
 3. The first Exercise to start with
 4. CI in HTN as it increase BP
 5. Angle specific.
 - ii. Isotonic: constant tension
 1. Concentric: shortening contraction, less energy produced , decreased with velocity
 2. Eccentric: Lengthening contraction, more energy produced , increased with velocity
 3. energy production: Eccentric > Isometric >Concentric
 4. **strength velocity relationship**: there is a correlation between the type of contraction and the force output that result from contraction. In eccentric contraction, as the velocity of lengthening increases, the force output increases until it plateaus, while in concentric contraction, as the velocity of shortening increases the force output decreases until it plateaus.
 - iii. Isokinetic : fixed velocity using a specialized apparatus that provides variable resistance to movement i.e. no matter how much effort is exerted, the movement takes place at a constant speed. Usually reserved to late stages of rehabilitation or for athletic rehabilitation. Range of motion should be full and the muscle strength should be at least 80% of the predicted.
 - iv. plyometrics : a form of exercise that involves rapid and repeated stretching

and contacting of the muscles, designed to increase strength .Plyometrics, also known as jump training or plyos , are exercises in which muscles exert maximum force in short intervals of time , with the goal of increasing power (speed- strength) . this training focuses on learning to move from a muscle extension to a contraction in a rapid or "explosive" manner , such as in specialized repeated jumping

v. Open/Closed chain .

-Open : distal part is free , isolation of movement and joint , single joint and group of muscle .

a. lifting weights

- closed : distal part is attached to ground or surface to get more stability by using weight (weight bearing)

a. different movement of different joint ---better stability

b. Ex ----push up

Phases of Rehabilitation

- Phase 1 : immediate response phase
 - Within the 1st 48-72 hours
 - Symptoms include those of inflammatory process :swelling , redness, heat , pain & loss of function
 - Short term goals : decrease pain , swelling , and inflammation . increase range of motion and control pain . maintain cardiovascular conditioning .
 - to control swelling (PRICE):
 - protect
 - rest
 - ice
 - compress
 - elevation
- Phase 2 :
 - minimize edema and restore functional ROM, within 72 hour up to 2 weeks
- Phase 3:
 - Address strength and flexibility deficits
 - Last up to 6 months
 - Tissue is repairing, changing and remodeling to restore function

General rehabilitation principles after THR & TKR

THR (Total Hip Replacement)

- Before surgery
 - Increase muscle strength → hip Abductors and extensors
- One of the complication of the surgery is hip dislocation (after surgery)
 - Caused by extreme movement (extreme flex.+ ext. or IR + ER or add), so advise the pt to avoid extreme movement
 - In posterior approach surgery
 - Avoid adduction, flexion >90, internal rotation. For the first 3 month after surgery
 - Ex:
 - Crossing legs.

- Setting → flexion >90 → use high chair
- Leaning forwards
- To avoid adduction → use wedge pillow between the thighs
- In anterior approach surgery
 - Avoid adduction, extension, external rotation. For the first 3 months after surgery
- Risk of immobilization is high → early mobilization is recommended
 - Pt should move as soon as possible
 - 1st day post op
 - On walker
 - If cemented THR → weight bearing as tolerated
 - If uncemented THR → 2 protocols
 - 1st school: same as cemented
 - 2nd school: Either non weight bearing or weight bearing but with caution for 6 weeks, then weight bearing as tolerated
- Sports → avoid in the first 3 months
 - Contact sports and high impact sports → avoid for ever
 - low impact and non-contact sports → recommended
- Driving (assuming the car is automatic the driver on the It side of the car)
 - Rt THR → drive after 6wks
 - Lt THR → drive after 1- 2 wks. with precautions
- Sexual activity
 - Can be resumed 4-6 weeks after surgery
 - Better sexual activity after surgery because of increased ROM, and decreased pain
 - Advise pt to avoid certain positions, and extreme movements
- In THR and TKR → discharged pt after 5-7 days if there os no complications
- Weight bearing "WB"
 - As tolerated → 50-100% of weigh
 - Partial WB → 20-50%
 - Low touch WB → 5-20%
 - No WB → 0%

THR (Total Knee Replacement)

- Pre op rehabilitation → Increase muscle strength
- Pain control after surgery → analgesia and ice for swelling
- Ambulation 1st post-operative day → WB as tolerated.
- Strengthening exercises and functional exercises are very important.
- Electrical stimulation if patient has severe pain.
- Continuous passive motion (CPM), has shown not to increase expected ROM at 6 months post-op compared to active and passive exercise.
- Driving, sport → like THR
- Expected ROM after surgery
 - At discharged → 0-90
 - On the long term → 0-120
- Walking at level needs 65 knee flexion, at the stairs 85-110 knee flexion
- Orthosis (braces or splints)

- Not recommended except if there is muscle weakness or post op complication
- Stairs
 - Starts at 3-5 days post op
 - Up with the the non-operated, down with the operated, always with assistive devices.

