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 gucose 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) 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. Convention : 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 time then wrap with platic 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 denevated 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: UMNL 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 againist 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, squad

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 after1- 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.