TOPIC 6. BASIC QUESTIONS OF PHYSICAL REHABILITATION PHYSICAL MODALITIES, THERAPEUTIC EXERCISE, EXTENDED BEDREST

PHYSICAL REHABILITATION.

Physical medicine and rehabilitation (PM&R), also known as physiatry or rehabilitation medicine, aims to enhance and restore functional ability and quality of life to those with physical impairments or disabilities affecting the brain, spinal cord, nerves, bones, joints, ligaments, muscles, and tendons.

Physical therapists use therapeutic exercise, modalities and treatments to help people to restoring and regaining physical strength and function.

PHYSICAL MODALITIES. Modalities that use physical energy for their therapeutic effect includes:

– Pressure
– Thermotherapy—Heat and cold
– Hydrotherapy
– Light therapy—ultraviolet radiation, laser
– Electrotherapy
– Manipulation, mobilization, traction, massage, acupuncture

THERMOTHERAPY

The amount of energy a tissue gains or loses depends on several factors:
– Nature of the tissue, Agent used, Duration of exposure

Temperature has an effect on:

– *Viscosity*
– *Nerve conduction*—heat increases nerve conduction velocity; cold decreases it
– *Blood flow*—heat increases arterial and capillary blood flow; cold decreases blood flow
– *Collagen extensibility*—heat increases tendon extensibility, collagenase activity is increased; cold decreases enzyme activity
• *Temperatures* > 45–50°C (113–122 °F) or < 0°C (32°F) can injure tissue

HEAT.

Therapeutic uses for heat are based on:

1. Hyperemia
2. Analgesia
3. Hyperthermia
4. Decreased muscle tone
5. Increase in collagen elasticity

Indications for heat therapy

1. Generally used for chronic process:
2. Decrease muscle spasms
3. Decrease pain (myofascial, low back, neck, post herpetic neuralgia)

4. Reduction in joint stiffness, contractures
5. Arthritis, collagen vascular diseases
6. Chronic inflammation

Contraindications for heat therapy

1. Ischemia—e.g., arterial insufficiency Metabolic requirement of the limbs is increased with the use of heat. (Note: for every 10° increase in skin temperature, there is a 100% increase in metabolic demand.)
2. Bleeding disorders (e.g., hemophilia), Hemorrhage—there is an increased arterial and capillary blood flow with heat
3. Impaired sensation—e.g., spinal cord injury (SCI) may predispose to burns
4. Inability to communicate or respond to pain—e.g., dementia
5. Malignancy—May increase tumor growth
6. Acute trauma or inflammation—Diffusion across membranes is increased inflammation
7. Scar tissue—Elevation of temperature increases the metabolic demand of the tissue. Scar tissue has inadequate vascular supply, and is not able to provide an adequate vascular response when heated, which can lead to ischemic necrosis.
8. Edema—Diffusion across membranes is increased
9. Atrophic skin
10. Unstable angina or blood pressure
11. Decompensated heart failure within 6–8 weeks of a myocardial infarction

The temperature of an object can be altered by

1. ***Convection.*** Contact between two surfaces at different temperatures with resultant flow of one past the other. Conveyance of heat in liquids or gases by the movement of heated particles. The flow increases the temperature gradient between the surfaces maximizing heating and cooling. More intense than conduction. **Examples: (**Fluidotherapy, Hydrotherapy, (whirlpool), Contrast baths).

2. ***Conduction.*** Transfer of heat between two bodies at different temperatures. Movement of heat without movement of conducting body. **Examples: (**Hot water, Paraffin, Hot packs (hydrocollator packs).

3. ***Conversive heating.*** Nonthermal energy converts to heat in the tissues. **Examples:** Radiant heat (heat lamps), Shortwave diathermy, Ultrasound, Microwave.

Therapeutic Heat Can Be Superficial or Deep

1. Superficial Heat. Maximum tissue temperature is achieved in skin and subcutaneous fat. Used to heat joints with little soft tissue covering (hand, foot), or cause a deeper effect through reflex mechanisms (for relief of muscle spasms).

Convective Agents.

Fluidotherapy. Hot air is blown through a container holding fine cellulose particles (bed of beads or corn husks), which produces a warm air-fluid mixture with properties similar to liquid. Fluidotherapy should be avoided in infected wounds, and burn precautions should be maintained.

Hydrotherapy. External use of water to treat a physical condition. Water can be used to produce convective heating or cooling, massage, and gentle debridement.
Whirlpool baths—for partial body immersion
Hubbard tanks—used for total body immersion. The water temperature can be selected depending on the amount of body submerged, patient's health and goals of treatment: Whirlpool temperature for Upper limbs is 37.8–40.6° C (100–105° F), Lower limbs is 37.8–38.9° C (100–102° F),
Hubbard tanks—The temperature should be less than 39° C (102.2° F) to avoid systemic problems (can change core body temperature) Mild heating: 36.7–37.2° C (98–98.9° F), vigorous heating: 37.8–38.3° F (100–100.9° F)
Give treatment for approximately 10 to 20 minutes, depending on the patient's cardiopulmonary tolerance.

– In general, temperatures from 33–36° C are considered neutral for wounds and burns
and are well tolerated

Contraindications for Hubbard tanks:

1. Patients incontinent of bowel and bladder
2. Skin infections
3. Unstable blood pressure
4. Uncontrolled epilepsy
5. Acute febrile episodes
6. Upper respiratory infections
7. Tuberculosis
8. Multiple sclerosis

Contrast baths: Distal limbs receive alternating heat and cold in a whirlpool tank to produce reflex hyperemia. Temperatures range from hot 38–44° C or 100.4 to 111° F, and cold 10–18° C or 50–64.4° F. Technique: begin with warm soaks to the extremity, then follow with four cycles of alternating 1–4 minute cold soaks and 4–6 minutes warm soaks.
Indications: Rheumatoid arthritis, reflex sympathetic dystrophy, to toughen residual limbs; muscular strains and joint sprains.
Contraindications: small vessel disease caused by diabetes, arteriosclerotic endarteritis or Burger's disease.

Hot packs
Hydrocollator: canvas bags filled with silicon dioxide immersed in tanks of heated water (74.5° C/166° F). – Applied over several layers of insulating towels. Heat treatment lasts 30 minutes.
Kenny packs—Wool cloths soaked in 60° C water, then spun dried. These cool rapidly, and require repeated applications.
Heating pads. Available as electric pads and pads with circulating heated fluid such as water. – Peak temperature is 52° C (125° F), the temperature is maintained at a constant level, no spontaneous cooling. If used with moist towels there is a potential risk for electrical shock. If the patient lies on the pad there is a potential for burns. This

is common in patients with decreased adipose tissue. Generally used for periods of 20 minutes

Paraffin bath. Paraffin wax and mineral oil in a 7:1 or 6:1 ratio heated to 52.2–54.4° C (126–130° F). Commonly used in irregular surfaces such as distal extremities.

Conversive Agents

Radiant heat (Infrared lamps)

Energy is absorbed through the skin and converted to superficial heat. Distance from the lamp to skin is usually 45–60 cm (18–24 inches), and is applied for 20 minutes. Most lamps act as point sources and their heating effectiveness decreases with the square of their distance from the body (1/*r*2 law). Used in patients who cannot tolerate the weight of hot packs. Precautions: general heat precautions, light sensitivity (dermal photo-aging) and skin drying, photosensitizing medications

Deep heat (Diathermy). Diathermy—Deeper local elevation of temperature within the tissues, produced without overheating subcutaneous tissue or skin. Classified as:

1. Ultrasound
2. Shortwave diathermy
3. Microwave diathermy

All are forms of heating by conversion

Tissue temperature can be increased to a depth of 3–5 cm or more without overheating subcutaneous tissue or skin. Produced by conversion of energy into heat, and may penetrate to deep structures such as ligaments, bones, muscles, and joint capsules.

Ultrasound (US). Acoustic vibration with frequencies above the audible range (>20,000 Hz) can produce thermal (heating) and nonthermal (cavitation, acoustic streaming, and standing waves) effects:

Thermal effects:

• Ultrasound interacts with skin, fat, and muscle during treatment. Heating occurs at all of these tissue as a result of beam attenuation and absorption. Its effect is more pronounced at tissue interfaces where sound transmission discontinuities occur.

Nonthermal effects:

• Cavitation—produces gas bubbles in a sound field due to turbulence, which, by their forced oscillation and bursting, are capable of disrupting tissue

• Acoustic streaming—unidirectional movement of compressible material or medium due to pressure asymmetries caused by US waves

• Acoustic streaming and cavitation are associated with wound contraction and protein synthesis

• Standing waves—In a stationary US field standing waves produce fixed areas of elevated pressure and rarefaction. They have not been found to have physiological benefits

Ultrasound indications:

1. Bursitis
2. Tendinitis (calcific tendinitis)
3. Musculoskeletal pain

4. Degenerative arthritis and contracture (adhesive capsulitis, shoulder periarthritis and hip contracture).
5. Subacute trauma
6. Less established:
7. Scar tissue (keloids)
8. Postherpetic neuralgic pain
9. Plantar warts

Ultrasound Contraindications

1. General heat contraindications
2. Near brain, cervical ganglia, spine, laminectomy sites (can cause spinal-cord heating)
3. Near the heart, reproductive organs
4. Near pacemakers—may cause thermal or mechanical injury to the pacemaker
5. Near tumors
6. Gravid or menstruating uterus
7. At infection sites
8. On contact lenses, eyes (fluid filled cavity with risk of cavitation and heat damage).
9. Skeletal immaturity—open epiphysis can be affected with decreased growth due to thermal injury
10. Arthroplasties—the effect on bony ingrowth arthroplasties is not well defined, for this reason the most prudent course is avoiding US over these areas

Shortwave diathermy (SWD). Produces deep heating through the conversion of electromagnetic energy (radio waves) to thermal energy. The most commonly used frequency is 27.12 MHz. Provides deep heat to 4–5 cm depth, therefore is good for deep muscle. The heating pattern produced depends on the type of shortwave unit and water content and electrical properties of the tissue.

Shortwave indications

1. Chronic prostatitis
2. Refractory pelvic inflammatory disease
3. Myalgia
4. Back spasms

Shortwave contraindications

1. General heat precautions
2. Metal (jewelry, pacemakers, metallic intrauterine devices, surgical implants) are excellent electrical conductors and can potentially cause burns.

Microwave diathermy. Conversion of electromagnetic energy (microwaves) to thermal energy.

Microwave indications

1. Used to heat superficial muscles and joints, to speed the resolution of hematomas, and for local hyperthermia in cancer patients
2. The lower frequency has a higher depth of penetration, and is better for muscle heating

Microwave contraindications

1. General heat precautions
2. Skeletal immaturity

Microwave diathermy selectively heats fluid-filled cavities:
Its use should be avoided in edematous tissue, moist skin, eyes, blisters, and fluid-filled cavities. Eye protection should be worn by patient and therapist due to risk of cataract formation

COLD

Therapeutic effects of cold are based on the following

1. Immediate local vasoconstriction
2. Reduction of local and systemic metabolic activity
3. Decreased acute inflammatory response
4. Slows nerve conduction velocity—decreased motor and sensory nerve conduction.
5. Decreased muscle spindle activity—decreased firing rates of Ia and II afferent fibers
6. Decreased pain/muscle spasm—increases nerve pain threshold
7. Decreased spasticity
8. Increased tissue viscosity with decreased tissue elasticity
9. Transient increase in systolic and diastolic blood pressure
10. Release of vasoactive agents (histamine)

Indications for cold therapy

1. Generally used for acute process
2. Acute traumatic conditions—reduction of inflammation and edema in the 24–48 hour period.
3. Musculoskeletal conditions—arthritis, bursitis
4. Acute and chronic pain

Contraindications for cold therapy

1. Cold intolerance, hypersensitivity to cold (Raynaud's disease/phenomenon)
2. Arterial insufficiency—areas with circulatory compromise such as ischemic areas in patients with peripheral vascular disease affecting the arterial system
3. Impaired sensation—insensate skin is at risk for burns
4. Cognitive and communication deficits that preclude the patient from reporting pain
5. Cardiac, respiratory involvement—if severe hypertention present, the patient's BP must be monitored closely
6. Cryotherapy induced neuropraxia/axonotmesis, regenerating peripheral nerves
7. Cryopathies: Cryoglobulinemia, Paroxysmal cold hemoglobinuria
8. Open wounds after 48 hours

Note: Reflex vasodilation with hyperemia can occur after removal of ice

Mechanisms of cold transfer

1. Conduction: Cold packs, ice massage
2. Convection: Cold baths (whirlpool)
3. Evaporation: Vapo-coolant spray

The treatment modality depends on the size of the area to be treated and how accessible it is for cold application.

Conduction

1. Cold packs. Include ice packs, wraps and sluices, endothermic chemical gel packs and hydrocollator packs. The pack is wrapped in moist towels and treatment time is generally 20–30 minutes. Surface skin temperature can decrease by 15° C after 10 minutes, subcutaneous temperatures decrease by 3°–5° C.

2. Ice massage. For cooling of small areas (muscle belly, tendon, trigger point) before applying deep pressure massage. Combines the therapeutic effect of ice with the mechanical effects of massage. Direct application of ice to a painful area using gentle stroking motion.

Convection

1. Cold baths. An example of hydrotherapy; uses water-filled containers for distal limb immersion. Best suited for circumferential cooling of the limbs. Water temperature: 4°–10° C. Can be uncomfortable and poorly tolerated. Effective for treatment of localized burns due to rapid skin temperature reduction.

2. Evaporation. Vapo-coolant sprays. Volatile liquids such as Fluori-methane spray are commonly used. • Used for spray-and-stretch techniques to treat myofascial pain ; also used for local anesthesia. Produce an abrupt temperature change over a small surface area. **Precautions**: risk for skin site irritation and local cutaneous freezing

3. Other techniques

Cryotherapy Compression units. Combines the benefits of cold with the advantages of pneumatic compression. Uses sleeves with circulating cold water, attached to an intermittent pump unit. Edematous extremities are placed inside the sleeves.

• Used primarily to treat acute musculoskeletal injury with soft tissue swelling. Also used after some surgical procedures. Temperatures used are 45°F (7.2° C) and pressures up to 60 mmHg

LIGHT THERAPY

Ultraviolet Radiation

• It can be produced by a small, hand-held mercury or “cold quartz” lamp. Produces a nonthermal photochemical reaction with resultant alteration of DNA and cell proteins

• Physiologic effects

1. Bactericidal on motile bacteria
2. Increased vascularization of wound margins
3. Hyperplasia and exfoliation
4. Increased Vitamin D production
5. Excitation of calcium metabolism
6. Tanning

Indications

1. For treatment of aseptic and septic wounds
2. Psoriasis treatment—utilizes Goeckerman’s technique, where a coal-tar ointment is
3. applied to the skin prior to UV treatment.
4. Acne treatment
5. Treatment of folliculitis

• **Precautions**

1. Fair skin
2. Scars, atrophic skin
3. Acute renal and hepatic failure
4. Severe diabetes
5. Hyperthyroidism
6. Generalized dermatitis
7. Advanced arteriosclerosis
8. Active, progressive pulmonary tuberculosis
9. Protect eyes from conjunctivitis, photokeratitis—shield from UV rays using goggles

• **Contraindications**

1. Pellagra
2. Porphyria
3. Sarcoidosis
4. Acute psoriasis
5. Lupus
6. Eczema
7. Herpes simplex
8. Xeroderma pigmentosum

ELECTROTHERAPY

Refers to the use of electricity to transcutaneously stimulate nerve or muscle, using electrodes

• **Physiologic effects**

1. Increases joint range of motion (ROM)
2. Muscle group contraction
3. Retards muscle atrophy
4. Increases muscle strength
5. Increases circulation
6. Decreases muscle spasm
7. Releases polypeptides and neurotransmitters (b-endorphins, Dopamine, enkephalins,
8. Vasoactive Intestinal Peptide, Serotonin)
9. Decreases spasticity
10. Promotes wound healing
11. Induces osteogenesis—tissue regeneration, remodeling
12. Inhibits pain fibers—stimulates large myelinated Type A nerve fibers (gate control
13. theory, please refer to next section on TENS)
14. Drives medicated ions across the skin

Indications

1. Pain management—acute and chronic musculoskeletal pain; chronic neurogenic pain; general systemic pain
2. Joint effusion, interstitial edema (acute and chronic)
3. Muscle disuse atrophy
4. Dermal ulcers, wounds

5. Circulatory disorders—neurovascular disorders, venous insufficiency
6. Postherpetic neuralgia
7. Arthritis—osteoarthritis, rheumatoid arthritis
8. ROM and stretching exercises

Contraindications:

1. Circulatory impairment—arterial or venous thrombosis, thrombophlebitis
2. Stimulation over the carotid sinus
3. Stimulation across the heart—especially if patient has pacemaker
4. Pregnancy
5. Seizure disorder
6. Fresh fracture
7. Active hemorrhage
8. Malignancy
9. Decreased sensation—direct current can cause burns (electrochemical)
10. Atrophic skin
11. Patients inability to report stimulation-induced pain
12. Known allergies to gel or pads

Balneotherapy. Treatments involve a combination of physical therapy, water baths, mud treatments, mineral water consumption, water containing dissolved gases (such as nitrogen and carbon dioxide), elements (e.g., calcium, magnesium, zinc, and cobalt), and compounds (e.g., hydrogen sulfide) has therapeutic effects. Use of balneotherapy for the inflammatory and degenerative arthritides.

The physical agents are typically prescribed as part of a program that may also include massage, exercise, and education. Written prescription involves the same elements that are common to all good writing: **who** (the patient), **what** (the agent), **why** (the diagnosis), **where** (the treatment area), **when** (the frequency and duration), and **how** (intensity, device settings). Modality choice depends on balancing of the diagnosis, the characteristics of the agents, evidence of effectiveness, concurrent issues (e.g., level of cooperation, anticoagulation, preference), and treatment goals. General rules introduce some order into the situation. For example, acute (<24 to 48 hours) musculoskeletal conditions are usually treated with cooling. Hot packs, cool packs, hydrotherapy, shortwave diathermy, and some of the electrical therapies are commonly used to treat broader areas. More intense agents such as ice massage and ultrasound are more common if smaller regions are to be treated. The diathermies are frequently favored for deeper tissues, but the comfort-inducing effects of superficial agents may be as beneficial. In the end, choice involves blending a physiologic understanding of the agents, experience, preference, and equipment availability.

MASSAGE

Massage is the therapeutic manipulation of the soft tissues of the body, with a goal of normalization of those tissues. Pressure and stretching are provided in a rhythmic fashion to the soft tissues which are usually done with the hands, such as friction, kneading, rolling, and percussion of the external tissues of them body in a variety of ways, either with a curative, palliative, or hygienic object in view.

Massage can have mechanical, reflexive, neurologic, and psychological effects and can be used to reduce pain or adhesions, promote sedation, mobilize fluids, increase muscular relaxation, and cause vasodilatation.

Reflexive effects

1. Reflex vasodilation with improvement in circulation
2. Decrease in pain by means of the gate control or release of endogenous opiates or – neurotransmitters
3. General relaxation
4. Increased perspiration

Mechanical effects

1. Assists in venous blood return from the periphery to the CNS
2. Increase lymphatic drainage
3. Decrease muscle tightness
4. Prevents or breaks adhesions in muscles, tendons, and ligaments
5. Softens scars
6. Loosening of secretions—example COPD

Psychological effect

1. "Laying of hands" promotes a sense of general well-being
2. There is no effect on the metabolism. Massage will not affect muscle strength, mass, or rate of atrophy of denervated muscle

Contraindications

1. Do not use over malignancies
2. Avoid open wounds, infected tissues, burns
3. Nerve entrapments. Severe pressure over trigger points has produced hematoma formation with subsequent nerve entrapment, in severe cases.
4. Acute inflammatory conditions: gout, rheumatoid arthritis, cellulitis, thrombophlebitis.
5. Severe varicose veins
6. Severe clotting disorders or patients on anticoagulation

Treatments can be provided to the extremities—5–15 minutes, or given to the trunk (neck, back, abdomen) which ranges from 15–30 minutes

Common techniques of therapeutic massage

Classical massage

1. **Effleurage or Stroking Massage**—Gliding movement of the skin without deep muscle movement; used for muscle relaxation
2. **Pétrissage or Kneading Massage -** to increase circulation and reduce edema
3. **Tapotement or Percussion Massage**. Helps with desensitization, allows clearing of secretions, and improves circulation. Used for chest therapy in conjunction with postural drainage
4. **Friction massage**—Prevents adhesions in acute muscle injuries and breaks adhesions in subacute and chronic injuries. Also reduces local muscle spasm, and decreases edema. Can be applied transverse or perpendicular to the muscle, tendon, or ligament fibers

5. **Soft tissue mobilization**—Forceful massage of the fascia-muscle system. Massage is done with the fascia-muscle in a stretched position, rather than relaxed or shortened. Used for reduction of contractures
6. **Myofascial release**—Prolonged light pressure is applied in specific directions of the fascia system to stretch focal areas of muscle or fascial tightness
7. **Accupressure**—Finger pressure is applied over trigger points or acupuncture points to decrease pain

TRACTION

Traction is the act of drawing or pulling, or a pulling force. In medicine, forces are applied to the body generally to stretch a given part or separate two or more parts. Traction continues to be effectively used in the treatment of fractures of the extremities and the spine. In physiatry, traction is usually limited to the cervical or lumbar spine, with the hope of relieving pain in, or originating from, those areas, and this section addresses only spine traction.

THERAPEUTIC EXERCISE

Therapeutic exercises are prescribed to improve flexibility, increase endurance, aerobic capacity, and strengthening, among other purposes.
Exercises that may be included in a therapeutic program include:

1. Strengthening exercises, usually performed with heavy resistance and fewer repetitions.
2. Endurance exercises that engage large muscle groups over a longer period of time.
3. Flexibility exercises achieved through stretching and movement.
4. Balance and coordination exercises that focus on maintaining an individual's center of gravity.

Range of motion exercises:

1. **Passive Range of Motion** (PROM): With PROM, the client applies no effort to move the joint, which is moved through a variety of stretching exercises by a physical therapist or with the help of equipment.
2. **Active Assisted Range of Motion** (AAROM): With AAROM, the client uses the muscles around a weak joint to complete stretching exercises with the help of a physical therapist or equipment.
3. **Active Range of Motion** (AROM): With AROM, the client performs stretching exercises, moving the muscles around a weak joint without any aid.

STRENGTHENING EXERCISES

Are designed to increase the maximal force that a muscle or muscle group can generate. Strength is affected by several factors, such as: the type of muscle contraction, speed of contraction, cross-sectional size of the muscle, length–tension relationship, and the recruitment of motor units.

Strengthening exercises can be divided into three categories
Isotonic Isometric Isokinetic

Conditioning, Total Body Endurance Exercises, or Cardiopulmonary Endurance Exercises

These exercises use large muscle groups, and are continuous and rhythmic, providing low intensity and high repetition, to improve overall cardiopulmonary fitness. They can be divided into aerobic and anaerobic endurance exercises.

Cardiovascular effects of conditioning exercises

1. Decreased resting heart rate and submaximal effort
2. Increased peak BP during maximal exercise, decreased BP at rest and submaximal effort.
3. Increase in stroke volume during maximal exercise
4. Reduced myocardial oxygen consumption at rest and submaximal activities
5. Muscle lengthening—resists a stretching force
6. Fast eccentric contractions—generate greatest force
7. Cause more tissue destruction
8. Muscle soreness increases up to 48 hours after initial muscle contraction. It can be minimized by beginning with low-intensity exercise and encouraging the patient to continue to exercise on a regular basis
9. Muscle soreness decreases with muscle conditioning. It is best relieved by mild exercise of the affected muscle groups rather than rest • Low metabolic cost: less VO2 required, therefore, more energy efficient • Muscle shortening. Tension develops to overcome resistance.
10. High metabolic cost
11. Generates little force

Aerobic endurance exercises

Combination of cardiopulmonary endurance exercise with strengthening

• Should consist of a warm-up period, a training period and a cool-down period:

Warm-up 5 to 10 minutes

Training period—20 to 30 minutes at 40%–60% (low intensity), 60%–70% (moderate intensity), or 70%–85% (heavy intensity) of their VO2 max

Cool-down period 5 to 10 minutes

Guidelines for the quantity and quality of aerobic exercise programs for healthy adults as proposed by the American College of Sports Medicine

• Mode—any exercise that uses large muscle groups, continuous and rhythmic in nature.

Examples: running, swimming, walking, stair climbing.

• Frequency—3–5 days/week

• Duration—20–60 minutes

• Intensity—60%–90% HR max 50%–85% of VO2 max or 50%–85% of HR reserve max

Anaerobic exercises

High-resistance, short-duration exercises at 80% of maximum exertion capacity.

Deplete the glycolytic system, which functions during the first two minutes of exercise.

Mobility exercises: exercises to improve flexibility

• Flexibility is defined as the ability to move body joints through their entire range of motion (ROM)

• Each joint of the body has a specific ROM

• Flexibility exercises maintain mobility within the available ROM

• Flexibility exercises should be done at least three times a week, should consist of three to five repetitions once or twice a day.

Water-Based Exercise. Water-based exercise and therapeutic pools are a popular way to provide gentle, progressive exercise in a setting that permits limited weight bearing. Use in patients with rheumatoid and osteoarthritis juvenile inflammatory arthritis.

EFFECTS OF EXTENDED BEDREST—IMMOBILIZATION AND INACTIVITY MUSCLE

– Strength—immobilization decreases strength by 1.0%–1.5% per day. Strength can decrease as much as 20%–30 % during only a week to nine days of bedrest. Five weeks of total inactivity costs 50% of the previous muscle strength.
One contraction a day at 50% of maximal strength is enough to prevent this decrease
– Strength is lost especially in the quadriceps and extensors
and 24% decrease in soleus muscle torque was found

BONE AND JOINTS. Lack of gravitational force and muscle pull on bone cause osteopenia. As a result of osteopenia, hypercalcemia develops. Calcium is excreted in the urine and feces starting at 2–3 days after immobilization, and peaking at 3–7 weeks. After activity is resumed, calcium levels remain high for 3 weeks, reaching normal values at 5–6 weeks.
Joints show a decrease in periarticular connective tissue extensibility after inactivity. Articular cartilage begins to deteriorate due to lack of nutritional support. Ligaments undergo biochemical changes noted as early as two weeks after immobilization.

GASTROINTESTINAL (GI)—Decreased GI motility leads to constipation and loss of appetite.

GENITOURINARY—Urinary stasis, leading to an increased risk of urolithiasis and urinary tract infections.

PULMONARY—Diminished diaphragmatic movement and chest expansion, due to loss of strength of diaphragm and intercostal muscles, leading to impaired secretion clearance. Reduced cough and bronchial ciliary activity. Patients can develop hypostatic pneumonia. Reduction in pulmonary function with decreased tidal and minute volumes, decreased vital capacity. A-V shunting and regional changes in ventilation-perfusion occur.

CARDIAC

Reduction in blood and plasma volumes. Redistribution of body fluids leads to postural hypotension. Venous blood pooling occurs in the legs. In addition, _-adrenergic sympathetic activity is increased.

Heart rate increases approximately 0.5 beats/minutes/day, leading to immobilization tachycardia and abnormal HR with minimal or submaximal workloads. Stroke volume decrease may reach 15% in 2 weeks of bed rest, as a result of blood volume changes and venous pooling in the lower extremities. There is also a decrease in maximal oxygen extraction (VO2 max) that can occur as early as 3–5 days.
Thromboembolism secondary to a decrease in blood volume and increased coagulability.

INTEGUMENTARY—skin atrophy and pressure sores develop.