Lecture: …….. Therapeutic Exercise……... Dr. Mahdi

Range of motion is a basic technique used for the **examination** of movement and for **initiating movement** into a program of therapeutic intervention.

Types of ROM Exercises

- **Passive ROM.** Passive ROM (PROM) is movement of a segment within the unrestricted ROM that is produced entirely by an *external force*; there is little to no voluntary muscle contraction. The external force may be from gravity, a machine, another individual, or another part of the individual's own body. PROM and passive stretching are not synonymous.
- **Active ROM.** Active ROM (AROM) is movement of a segment within the unrestricted ROM that is produced by active contraction of the *muscles* crossing that joint.
- **Active-Assistive ROM.** Active-assistive ROM (A-AROM) is a type of AROM in which assistance is provided manually or mechanically by an outside force because the prime mover muscles need assistance to complete the motion.

Indications for PROM

- In the region where there is acute, inflamed tissue, passive motion is beneficial. Inflammation after injury or surgery usually lasts 2 to 6 days.
- When a patient is not able to or not supposed to actively move a segment(s) of the body, as when comatose, paralyzed, or on complete bed rest.
- When a therapist is examining inert structures, PROM is used to determine limitations of motion, joint stability, muscle flexibility and other soft tissue elasticity.
- When a therapist is teaching an active exercise program, PROM is used to demonstrate the desired motion.
- When a therapist is preparing a patient for stretching, PROM is often used preceding the passive stretching techniques.

Goals for PROM

The primary goal for PROM is to decrease the complications that would occur with immobilization, such as cartilage degeneration, adhesion and contracture formation, and sluggish circulation.

Specifically, the goals are to:

- Maintain joint and connective tissue mobility.
- Minimize the effects of the formation of contractures.
- Maintain mechanical elasticity of muscle.
- Assist circulation and vascular dynamics.

- Enhance synovial movement for cartilage nutrition and diffusion of materials in the joint.
- Decrease or inhibit pain.
- Assist with the healing process after injury or surgery.
- Help maintain the patient's awareness of movement.

Limitations of Passive Motion

True passive, relaxed ROM may be difficult to obtain when muscle is innervated and the patient is conscious. **Passive motion *does not***:

- Prevent muscle atrophy.
- Increase strength or endurance.
- Assist circulation to the extent that active, voluntary muscle contraction does.

Active and Active-Assistive ROM

Indications for AROM

- When a patient is able to contract the muscles actively and move a segment with or without assistance.
- When a patient has weak musculature and is unable to move a joint through the desired range (usually against gravity).
- When a segment of the body is immobilized for a period of time, AROM is used on the regions above and below the immobilized segment to maintain the areas in as normal a condition as possible and to prepare for new activities, such as walking with crutches.
- AROM can be used for aerobic conditioning programs and is used to relieve stress from sustained postures.

Goals for AROM

If there is no inflammation or contraindication to active motion, the same goals of PROM can be met with AROM. In addition, there are physiological benefits that result from active muscle contraction and motor learning from voluntary muscle control. **Specific goals** are to:

- Maintain physiological elasticity and contractility of the participating muscles.
- Provide sensory feedback from the contracting muscles.
- Provide a stimulus for bone and joint tissue integrity.
- Increase circulation and prevent thrombus formation.
- Develop coordination and motor skills for functional activities.

Limitations of Active ROM

For strong muscles, active ROM *does not* maintain or increase strength. It also *does not* develop skill or coordination except in the movement patterns used.

Precautions and Contraindications to ROM Exercises

- ROM should **not be** done when motion is disruptive to the healing process.
- Carefully controlled motion within the limits of pain-free motion during early phases of healing has been shown to benefit healing and early recovery.
- Signs of too much or the wrong motion include increased pain and inflammation.
- ROM should not be done when the condition is life-threatening.
- PROM may be carefully initiated to major joints and AROM to ankles and feet to minimize venous stasis and thrombus formation.
- After myocardial infarction, coronary artery bypass surgery.. etc., AROM of upper extremities and limited walking are usually tolerated under careful monitoring of symptoms.

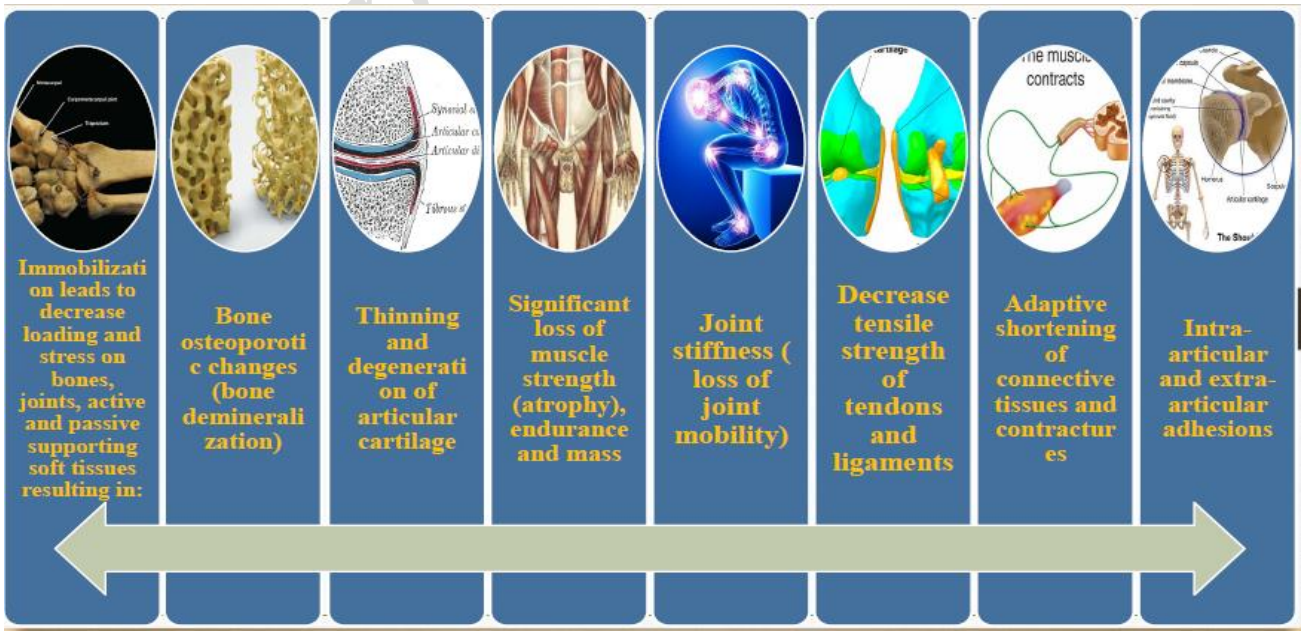
Self-assisted ROM → S-AROM

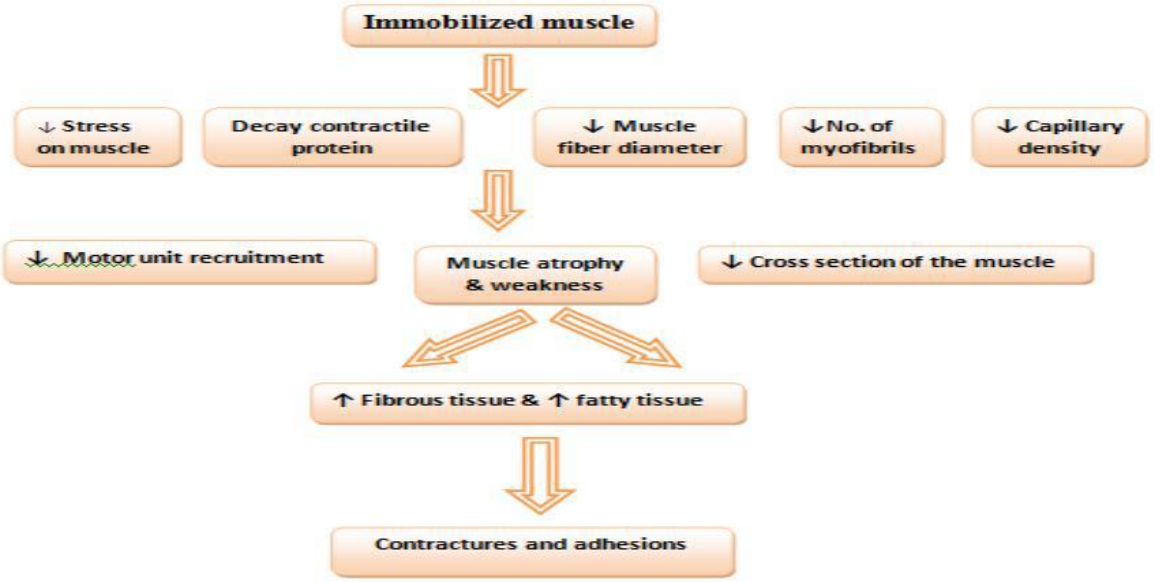
Used to protect healing tissue when more intensive muscle contraction is contraindicated i.e. Post-surgical or Post-trauma

Forms of S-AROM

- Manual
- Equipment
- Wand or T-bar
- Finger ladder,Wall climbing, Ball rolling
- Pulleys
- Skate or Powder board
- Reciprocal Exercise devices → Bicycle, Upper/Lower body ergometer etc

Effects of Immobilization MSK





Stretching and Flexibility

Factors that influence flexibility

1- Joint structure: The type of joint determine the degree of ROM. For example; a ball-and-socket joint, like shoulder has greater ROM than a hinge joint like wrist.
2- Age: With age, muscles go through a shortening process due to lack of physical activities and a loss of elasticity in the connective tissues surrounding the muscles.
3- The Elasticity: The elasticity of the skin, tendons and ligaments.
4-Gender: Females tend to be more flexible than males of similar age throughout life.
5-Exercise: Participation in regular exercise involving full ROM generally enhances flexibility, while a sedentary lifestyle often results in diminished flexibility.
6-Muscle mass: Muscle mass can be a factor (for example, large hamstrings limits the ability to fully bend the knees). Excess fatty tissue imposes a similar restriction.

Causes of soft tissue shortening

1- Prolonged immobilization: As patient in splint or plaster cast after fracture or surgery.
2- Restricted mobility: Patient rest in bed or wheel chair for long time leading to long term static and faulty position of the joints and soft tissues.
3- Neuromuscular diseases: like paralysis, spasticity, weakness, muscle imbalance.
4- Connective tissue diseases: like dermatomyositis, polymyositis, joint disease as rheumatoid arthritis which cause pain, inflammation and alter the structure of soft tissues.
5- Trauma and tissue pathology: like oedema, hemorrhage, surgical incision and burn.
6- Congenital and acquired bony deformities.

Types of Stretching

1- Ballistic stretching.

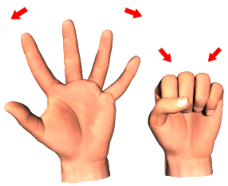
Is a form of passive stretching or dynamic stretching in a bouncing motion. It involves fast, "jerky" movements where a double bounce is performed at the end range of movement.

2- Dynamic stretching.

Is controlled, swings, and moving gently part of your body to the limits of your range of motion. Dynamic stretching exercises should be performed in sets of 8-12 repetitions.

3- Active stretching.

Is a technique used to increase joint mobility by inhibiting and lengthening elastic muscle tissues or skin. This type of stretching is only done with normally innervated muscle and under voluntary control. It can not be used in patient with severe muscle weakness, spasticity, or paralysis from neuromuscular dysfunction.



There are 3 variations of active inhibition technique:

- Hold- relax
- Hold- relax –contract
- Agonist contraction

4- Passive stretching.

An external force applied either manually or mechanically while the patient is relaxed. This type can be classified into:

a- Manual Passive Stretch

- The patient must be relaxed as possible during passive stretching.
- The stretch force is usually applied for at least 30 seconds and repeated 3 times in an exercise session.
- The therapist applies an external force and controls the direction, speed, intensity and duration of stretch to shorten soft tissues. The tissues are elongated beyond their resting length.
- This technique should not be confused with passive range of motion exercises. Passive stretching takes the structures beyond the free range of motion. Passive range of motion is applied only within the unrestricted available range.

b- Prolonged Mechanical Passive Stretch

- A low intensity external force (5-15 lb) is applied over a prolonged period of time with mechanical equipment.
- The stretch force is applied with the patient as relaxed as possible.
- The stretch may be maintained for 15-30 minutes or as long as several days or weeks, depending on the type of apparatus used.
- The stretch can be applied through positioning of the patient, with weighted traction and pulley systems, or with serial splints or casts.

5- Self Stretching

- Self stretching is a type of flexibility exercise that the patient carries out himself. It may involve relaxation of muscle and a passive stretch applied through the weight of the body.
- Self stretching can also be carried out actively by the patient first inhibiting and then lengthening the tight muscle.

Goals of Stretching

1- Regain normal ROM of joints and mobility of soft tissue that surrounding that joint.
2- Prevent irreversible contractures.
3- Increase the general flexibility of muscle and soft tissues before vigorous strengthening exercises.
4- Minimize and prevent the risk of musculo-tendinous injuries related to specific physical activities and sports.

Indications of Stretching

1- Limited ROM due to contractures, adhesions and scar tissue formation leading to shortening of muscles, ligaments, connective tissue and skin.
2- When there are structural (skeletal) deformities as a result of limitation.
3- Whenever contracture interfere with activities of daily living.
4- When there is muscle imbalance (muscle weakness and opposing tissue tightness). Tight muscle must be stretched first before strength of weak muscle.

Contra-indications of Stretching

1- Presence of bony block that limits joint motion.
2- Recent fracture.
3- Cases of acute inflammation or infection (presence of heat and swelling around the joint).
4- Presence of acute sharp pain with joint movement or muscle elongation.
5- When a hematoma or other tissue trauma are observed.
6- When contracture or shortening of soft tissues are providing increase joint stability or increased functional abilities as in case of paralysis or sever muscle weakness.

Precautions of Stretching

1-Don't force the joint beyond its normal ROM (remember ROM varies in normal subjects).
2-Newly united fractures should be protected by stabilization between the fracture site and the joint where the movement takes place.
3-Patient known or suspected osteoporosis as, prolonged bed rest, old age, and prolonged use of steroids.
4-Avoid vigorous stretching of muscles and connective tissues that have been immobilized for long time.
5-If there is joint pain or muscle soreness lasting for more than 24 hours, it is preferable to take rest and if you start to make stretch take care don't use too much force during stretch.
6-Avoid stretching edematous tissues because it is more susceptible to injury.
7-Avoid overstretch the weak muscles because it may lead to more pain and edema.
8-Elderly patients due to age-related change in flexibility.

Definition of terms related to shortening

- **Flexibility**: It is like stretching exercises used to increase ROM. It is the ability of a muscle to relax and yield to a stretch force.
- **Tightness**: It is a mild decrease in length of soft tissues. Tightness occurs in muscle or soft tissues before full ROM can occur. The subject is able to achieve all range but the outer range is limits.
- **Contracture:** It is a marked decrease in soft tissue length leading to significant loss of ROM. The mechanical elasticity of the muscle is greatly compromised. Contracture is described by identifying the shorten muscle; e.g., contracture of the elbow flexors will lead to reduce elbow extension range and we call it elbow flexion contracture.
  The term contracture and contraction are **not synonymous** because contraction means physiological shortening of muscle.
- **Irreversible Contracture**: is a permanent loss of flexibility of soft tissue that cannot elongate or released by non surgical methods. The elastic tissues are replaced by non elastic tissues as bone, fibrosis and scar tissues.
- **Overstretch:** Stretch beyond the normal range of motion of a joint and the surrounding soft tissues.
  Overstretch may be necessary for certain healthy individuals with normal strength and stability participating in sports such as gymnastics.
- **Selective stretch:** is the use of stretching technique selectively to limit the range motion in specific joints.
  For example: in patient with spinal cord injury, stability of the trunk is necessary for independence in sitting. With thoracic and cervical lesions, the patient will not have active control of back extensors. If moderate tightness is allowed to develop in the extensors of the low back, the patient will be able to lean into the slightly tight structures and will have some trunk stability in sitting.