Stretching

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STRETCHING

Definition

- **Stretching** is a therapeutic maneuver designed to elongate/ lengthen shortened soft tissue structures to increase ROM.
- **Flexibility:** The ability of muscle tissue to relax and yield to a stretch force
- **Tightness:** Mild decrease in the length of soft tissue

- **Contracture:** Marked shortening of a muscle or other tissue (skin, fascia, or joint capsule) crossing a joint resulting in a limitation of ROM. e.g. tightness to elbow flexors contributing to inability to fully extend elbow is an elbow flexion contracture

Muscle Contracture

- **Muscle contractures** can occur for many reasons, such as paralysis, muscular atrophy , and forms of muscular dystrophy. Fundamentally, the muscle and its tendons shorten, resulting in reduced flexibility.
- the loss of strength
- Loss of muscle control

leading to an imbalance between the various muscle groups around specific joints.

Moderate: Foot dorsiflexion is limited to 5-10 degrees less than neutral

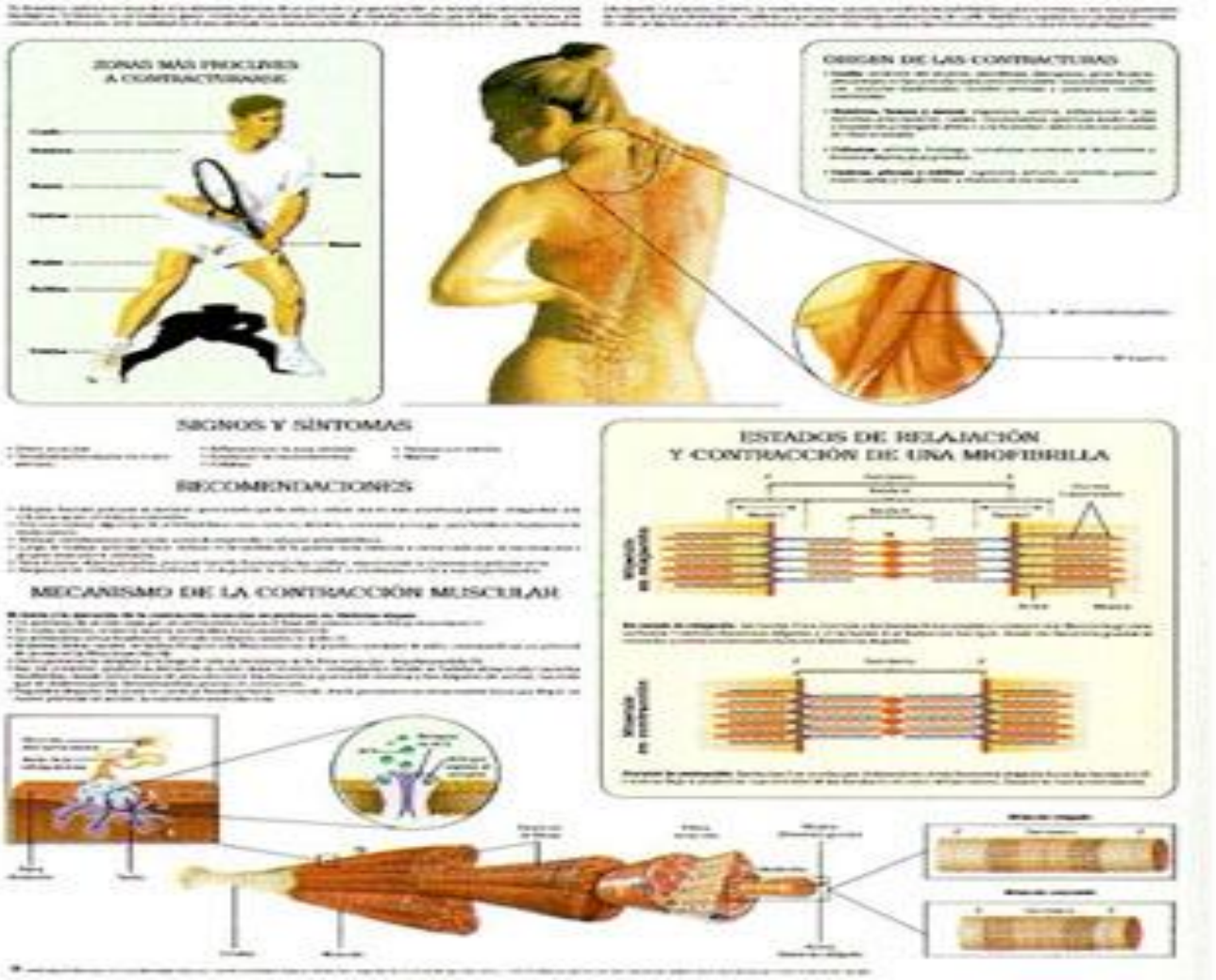
Severe: Foot cannot dorsiflex and is fixed in a "toes down" or plantarflexed position

Mild: Foot can get to the neutral position, but cannot dorsiflex any further

Ideal: Foot should be able dorsiflex 10-20 degrees beyond neutral to allow optimal gait

Plantarflexion contactures: degrees of severity

MUSCLE CONTRACTURE



Types of Contracture

1. Myostatic
2. Scar tissue adhesions
3. Fibrotic adhesions
4. Irreversible
5. Pseudomyostatic

Myostatic

- Musculotendinous unit adaptively shortened with significant loss of ROM
- Tightness refers to mild shortening of a **healthy musculotendinous** unit, describes a mild myostatic contracture
- **Can be resolved in a relatively short period of time with gentle stretching exercises**

Scar tissue adhesions

- Scar tissue ties down motion of normal tissues in relation to one another forming adhesion
- Can develop in muscles, tendons, joint capsules and/or skin
- Most can be prevented or reduced with exercise

Fibrotic adhesions

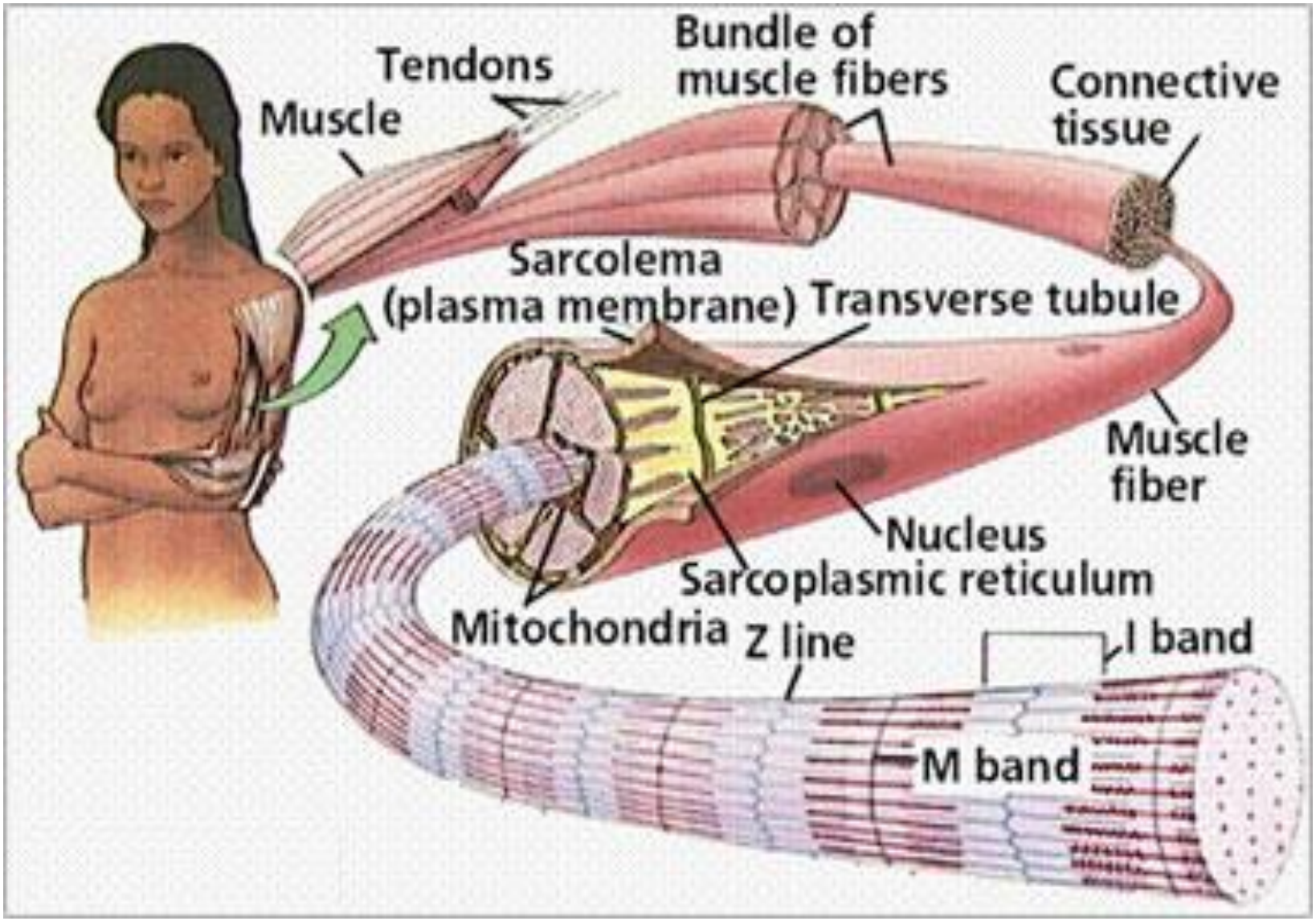
- Resultant from **chronic inflammatory conditions** and fibrotic changes of soft tissues
- Dramatically restrict ROM and very difficult to reduce

Irreversible

- **Permanent loss** of extensibility of soft tissues where that tissue is replaced by non-extensible tissue like bone or fibrotic tissue

Pseudomyostatic

- **Hypertonicity** of musculotendinous unit caused by CNS lesion limiting ROM

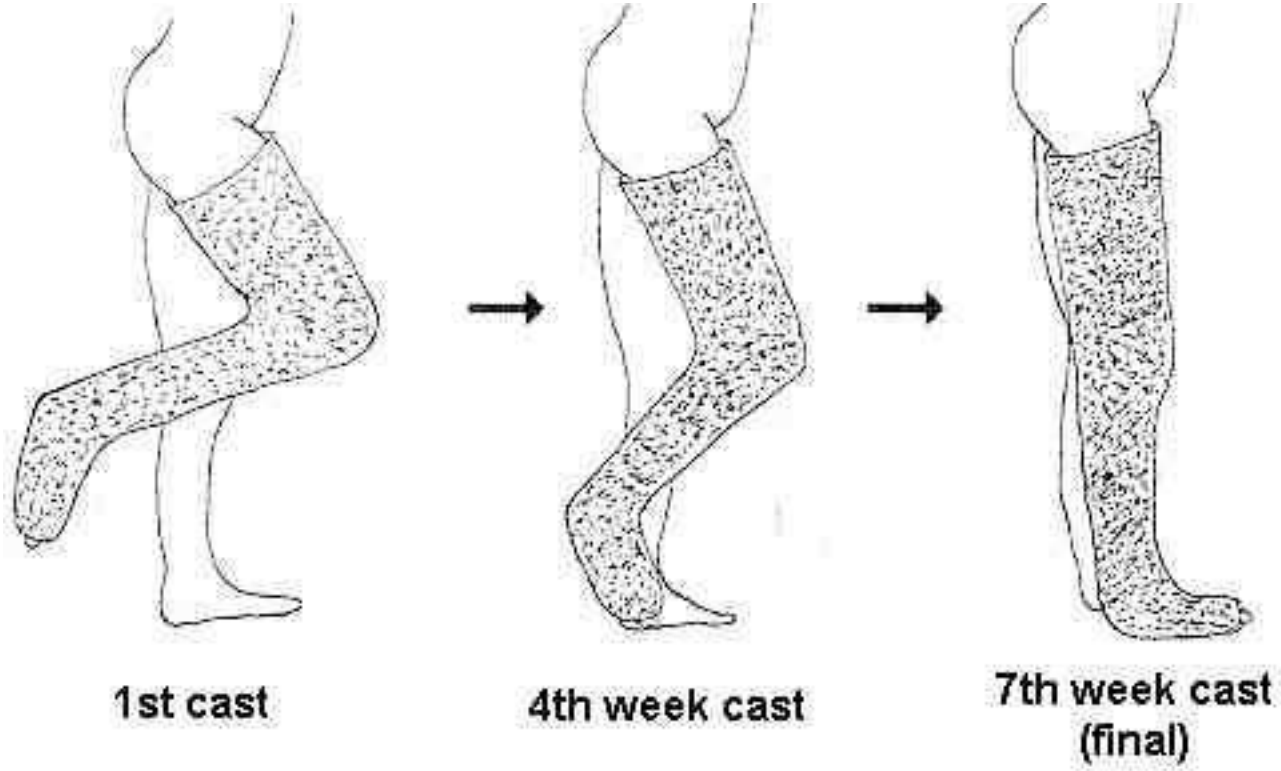

Tendons
Muscle
Bundle of muscle fibers
Connective tissue
Sarcolema (plasma membrane)
Transverse tubule
Muscle fiber
Nucleus
Sarcoplasmic reticulum
Mitochondria
Z line
I band
M band

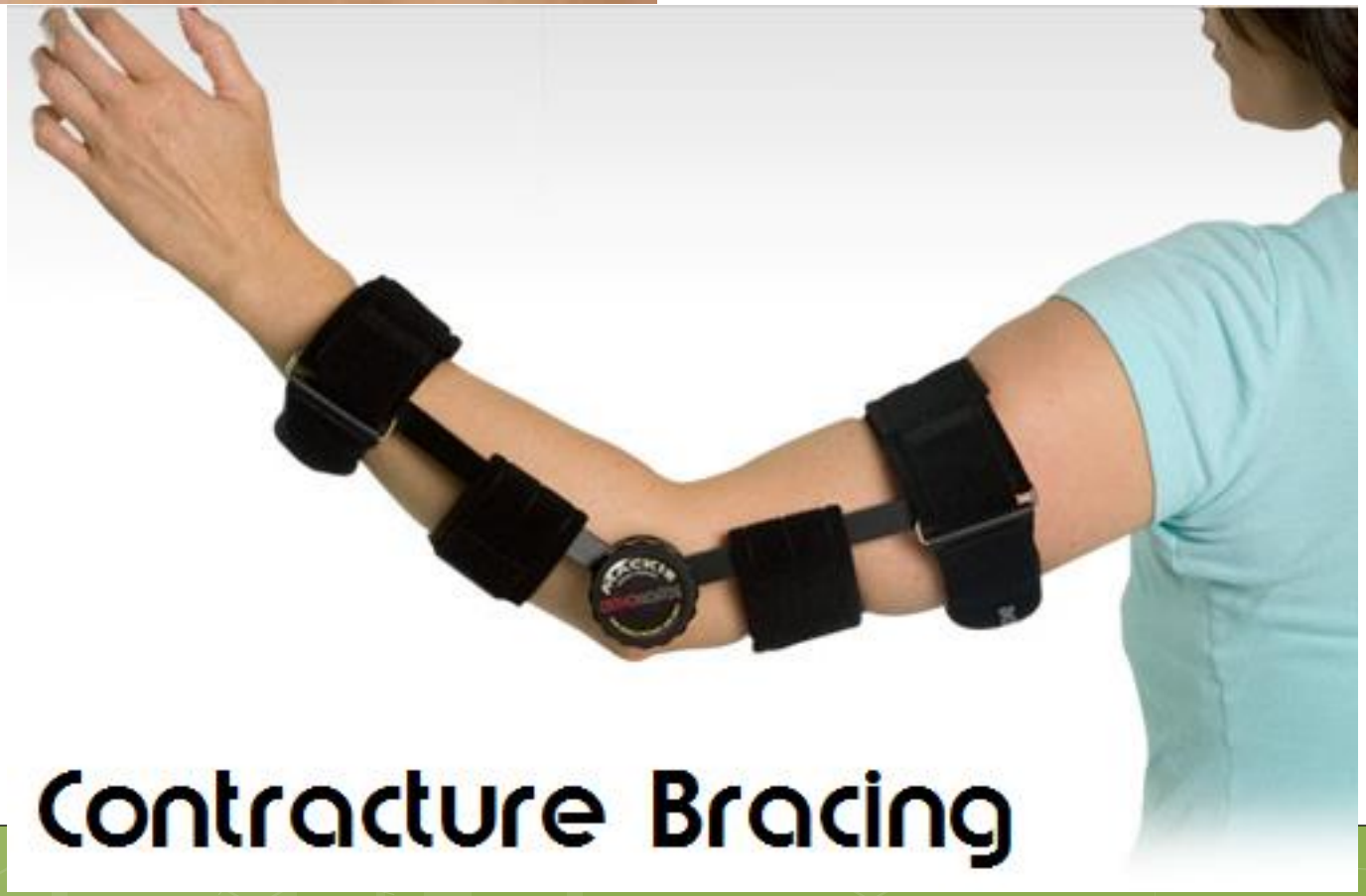
Treatment

- Positioning: Optimal maximal positions vary based on the body parts that are affected.
- Splints: Custom designed splints help to keep the soft tissues (muscles and tendons) stretched properly. Using a splint to place a muscle under tension for as many hours as possible helps prevent contractures by obtaining plastic response in the connective tissue

AEROPLANE SPLINT

static cast to correct contracture





Contracture Bracing

therapy

- **Dynamic splinting:** In certain situations, we use special dynamic splints. These are different from static splints because they include a spring-like or elastic mechanism to produce elongation of the tissues through a low load prolonged duration stretch.

Dynamic splinting:

therapy

- **Electrical stimulation:** Electrical stimulation can be used as an adjunct to a strengthening program and to augment voluntary muscle contraction.

therapy

- **Hydrotherapy (water therapy):** Hydrotherapy helps patients avoid significant muscle weakness, especially when both legs are being lengthened. It promotes active range of motion.
- The natural buoyancy allows simulated weight bearing. The higher the level of the water (chest deep versus waist deep, for example), the more "weightless" one feels.

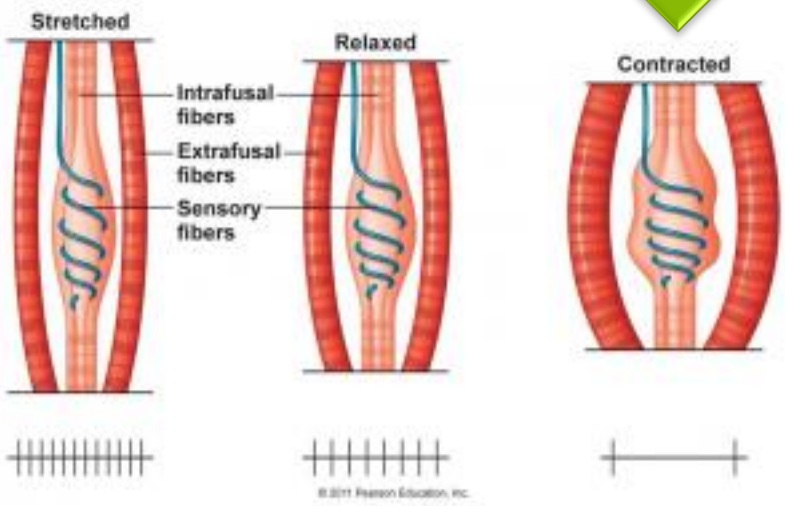
Properties of Soft Tissues Affecting Elongation and stretching

- 1- Mechanical properties of contractile tissue
- 2- Mechanical characteristics of non-contractile soft tissue

Mechanical properties of contractile tissue

- ***Response of muscle to stretch***

Slow(GTO) fast (muscle spindle)



Mechanical Characteristics of Non-Contractile Soft Tissue

- **Composition of connective tissue:** network of collagen and Elastin fibers.
- Connective tissue will adaptively shortened with immobilization and elongate slowly with a maintained stretch.

Non-Contractile Soft Tissue

Collagen fibers

- Resist tensile deformation and responsible for strength and stiffness of tissue
- Elongate quickly under light loads
- As tension increases, fibers stiffen to resist deformation
- With tension beyond deformation, fibers fail

Elastin fibers

- Elongate significantly with light loads and fail abruptly at higher loads

Mechanical behavior of connective tissue

- **Determined by proportion of collagen and elastin fibers and by structural orientation**
  - In tendons, collagen fibers are parallel and can resist the greatest tension load
  - In skin, collagen fibers are random and weakest at resisting tension.
  - In ligaments, joint capsules and fascia, collagen fibers vary. Ligaments resist major joint stresses and have mostly parallel fiber orientation

Goals of Stretching

- Regain or re-establish normal ROM of joints and mobility of soft tissues surrounding joints
- Prevent irreversible contractures
- Increase flexibility prior to strengthening exercises
- Prevent or minimize the risk of musculotendinous injury

ขอขอบคุณ

คุรุสภา

คณะกรรมการคุรุสภา

คณะกรรมการมาตรฐานวิชาชีพ

สำนักงานเลขาธิการคุรุสภา

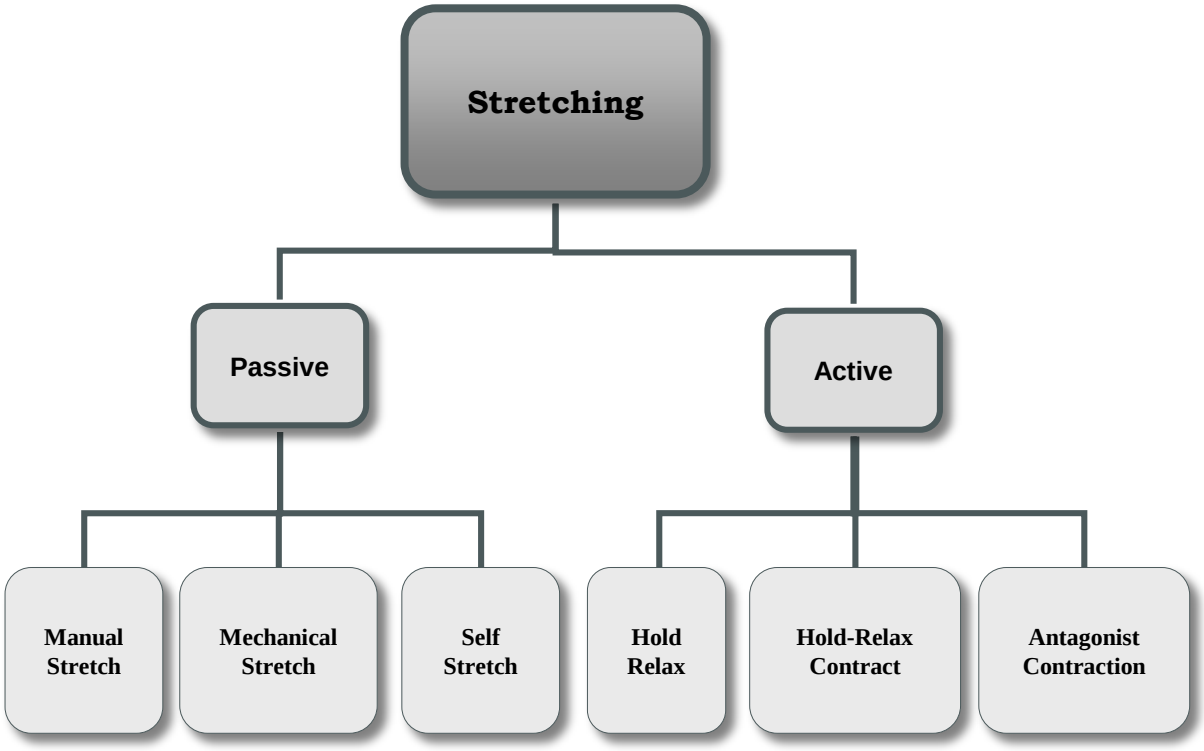
สำนักพัฒนาและส่งเสริมวิชาชีพ

เอื้อเฟื้อสถานที่ถ่ายทำ

ดร.สุกาวดี วงษ์สกุล

ผู้อำนวยการโรงเรียนสวนกุหลาบวิทยาลัย รังสิต

Types of stretching



Passive stretching (Self, manual and mechanical)

- **self stretching :** The patients perform stretch himself using his body weight or by actively inhibiting tight muscle and then lengthened it.

Manual stretching

- The therapist applies external force and controls speed, direction, intensity and duration of stretch
- Move the part behind the free available range
- Stretch force applied for minimum of 15 seconds and repeated several times during the treatment session according to the tolerance of patient
- Intensity dependent upon patient's tolerance and clinician's strength and endurance
- The stretch force is applied in a steady way with low intensity.

Manual stretching

Mechanical

- Low intensity external force applied to shortened tissues over prolonged period of time with mechanical equipment (e.g. pulleys)
- The force is applied for period of time be at least 20 minutes as it effectively increase ROM on permanent basis
- Permanent lengthening (plastic changes) occur to contractile and non-contractile tissues

Mechanical

Active stretching

patient participates in stretching to inhibit tight muscle

Principle:

- The basic principle of active stretch is to induce reflexive relaxation of muscle to be stretched resulting in less resistance to stretch
- Used to elongate contractile tissue (muscle) not non-contractile soft tissue (connective tissue)
- This type of stretch only possible if the muscle to be stretched is normally innervated (not with weak, paralyzed or spastic).
- The stretch is performed under voluntary control of the patient.

Types of active stretching

1. Contract-relax
2. Hold-relax-contract
3. Antagonist contraction

What is the difference between Autogenic and reciprocal inhibition?

- **both occur when certain muscles are inhibited from contracting due to the activation of the Golgi tendon organ (GTO) and the muscle spindles.**
- **These two musculotendinous proprioceptors located in and around the joints and muscles respond to changes in muscle tension and length, which helps manage muscular control and coordination.**

Mechanism of contract relax

- **CR Stretching:** The basis of CR stretching is the **Golgi tendon organ (GTO) reflex.** GTOs are proprioceptive receptors that are located in the tendons of a muscle and are sensitive to **tension result from stretching muscle**. If a muscle belly contracts forcefully,
- it pulls on and stretches its tendon; this stretching force is detected by the GTO. If the muscle belly contracts too forcefully, the tendon might be torn; therefore the role of the GTO is to protect the tendon and relax the muscle

autogenic inhibition.

- The GTO, located between the muscle belly and its tendon, senses increased tension when the muscle contracts or stretches.
- When the muscle contracts, the GTO is activated and responds by inhibiting this contraction ***(reflex inhibition)*** and contracting  the opposing *(antagonist)* muscle group. This process is known as **autogenic inhibition**.

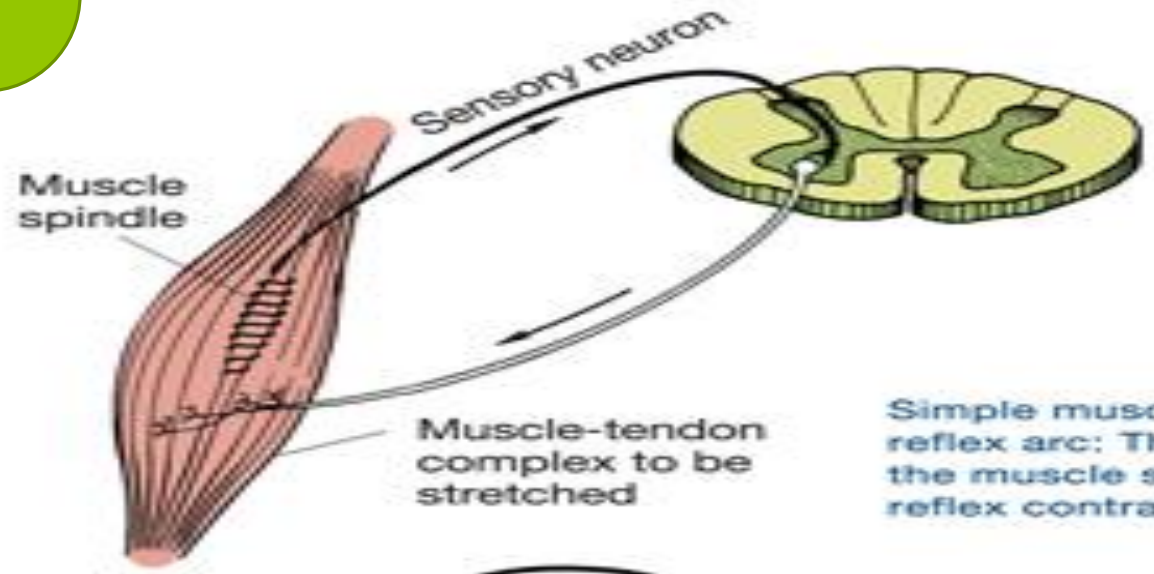
- The GTO response plays an important role in flexibility. When the GTO inhibits the *(agonist)* muscle's contraction and allows the antagonist muscle to contract more readily, the muscle can be stretched further and easier.

Reciprocal inhibition.

- The muscle spindle is located within the muscle belly and stretches along with the muscle itself.
- When this occurs, the muscle spindle is activated and causes a reflexive contraction in the agonist muscle (known as the *stretch reflex*) and relaxation in the antagonist muscle. This process is known as **reciprocal inhibition.**

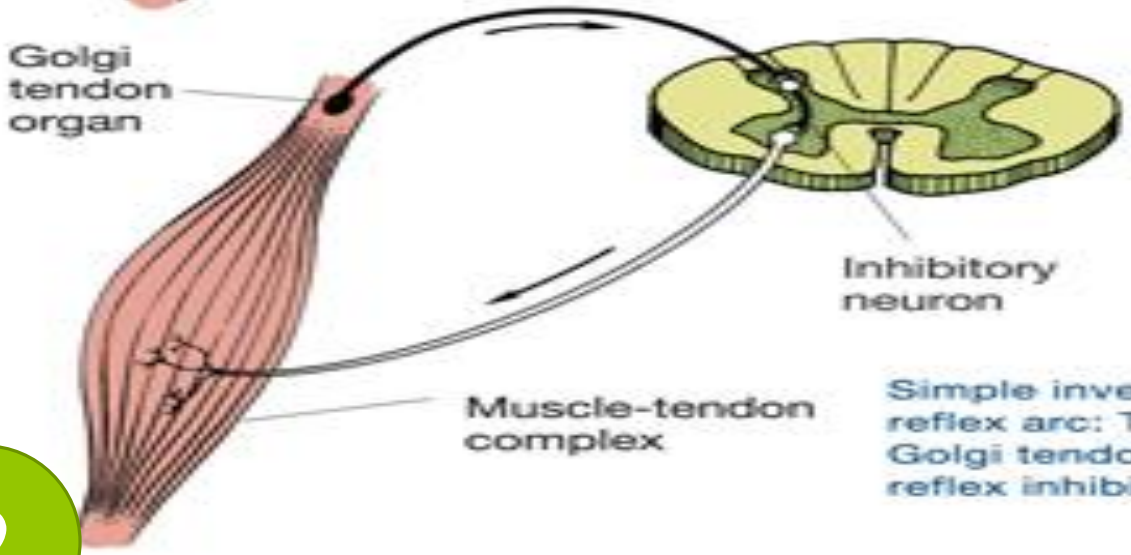
	Autogenic Inhibition (End Result)	Reciprocal Inhibition (End Result)
Agonist Muscle Group	Relaxation	Contraction
Antagonist Muscle Group	Contraction	Relaxation

1



Reciprocal inhibition

Simple muscle stretch reflex arc: The stretch of the muscle spindle causes reflex contraction.



Autogenic inhibition

Simple inverse stretch reflex arc: The stretch of Golgi tendon organ causes reflex inhibition (relaxation).

2

Contract relax

- Patient actively contracts muscle to be stretched against manual resistance from therapist **through full ROM prior to stretch** (autogenic inhibition)
- Start with the tight muscle in a comfortable position
- Ask patient to isometrically contract the tight muscle against substantial resistance for 5-10 seconds until the muscle begin to fatigue
- The patient is asked to relax the muscle voluntary
- The therapist then lengthens the muscle by passively moving the joint through the gained range

Contract relax

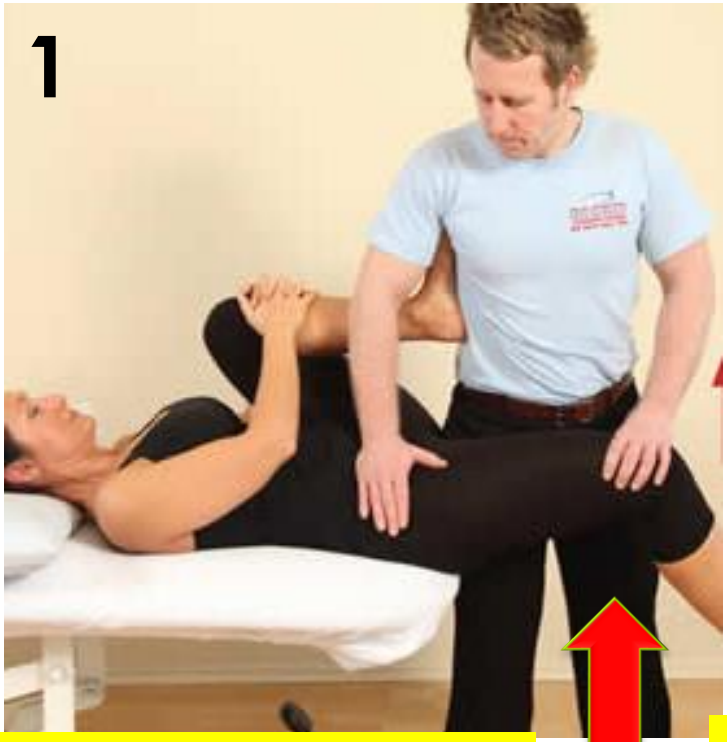
Hold-relax-contract

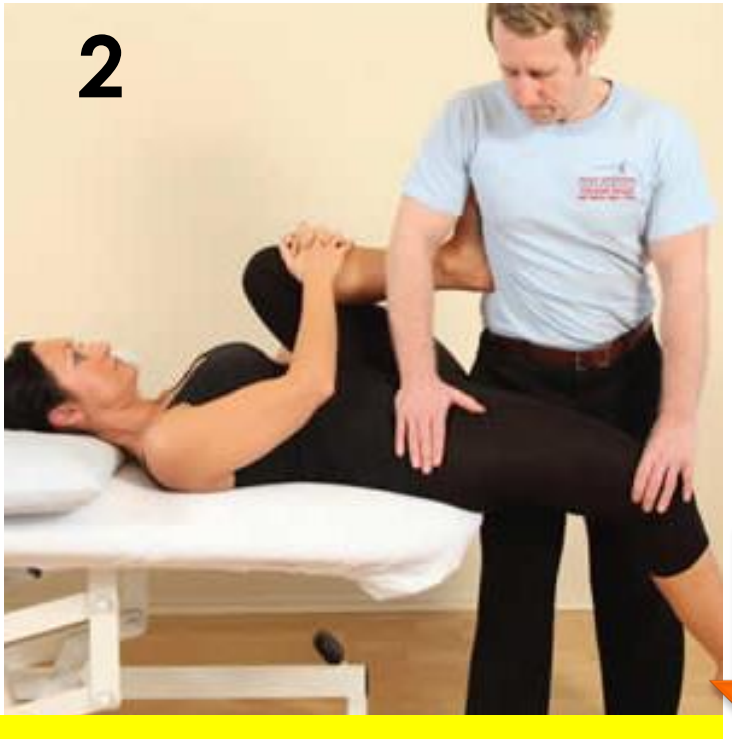
- Patient actively contracts muscle to be stretched against manual resistance from therapist near end ROM prior to stretch (autogenic inhibition)

Hold-relax-contract

- Start with the tight muscle in a comfortable position
- Ask patient to isometrically contract the tight muscle against substantial resistance for 5-10 seconds until the muscle begin to fatigue
- The patient is asked to relax the muscle voluntary
- The patient actively contracts the antagonist of the tight muscle and actively moves the joint through the gained range.

Hold – relax - contract





isometrically contract the tight muscle against resistance

The patient actively contracts the antagonist

Antagonist contraction

- Patient actively contracts muscle opposite (antagonist) muscle to be stretched while stretch is applied (reciprocal inhibition). This method is specially effective if muscle spasm is the cause of tightness.
- Start with the tight muscle in a comfortable position
- The patient actively contract the antagonist of the tight muscle against mild resistance
- As the muscle contract the tight muscle is simultaneously and reciprocally inhibited and elongated as the joint moves.

Indications

- When ROM limited due to contractures, adhesions and/or scar tissue formation leading to shortening of muscles, connective tissue and skin.
- When contractures interfere with normal functional activities.
- When muscle weakness is opposed by tissue tightness, tight tissues must be elongated before weak muscles can be effectively strengthened.

Contraindications

- When bony block limits ROM.
- After recent fracture.
- During acute inflammatory conditions in or around joints.
- If sharp, acute pain occurs with joint movement or muscle elongation.

Precautions

- Do not passively force joint beyond normal ROM
- Avoid vigorous stretching of muscles and connective tissues immobilized over long period. These tissue lose tensile strength while immobilized
- If patient experiences joint pain or muscle soreness lasting more than 24 hours, too much force has been used
- Avoid overstretching weak muscles may contributes to greater instability of joint

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