Mechanics of Muscle - Ranges of Muscle work

Exercise therapy I and Massage Manipulations

Objectives

At the end of the lecture the student will be able to:

- Describe about the ranges in which the muscle work and their usefulness

RANGE

Range of muscle work:

- The full range in which a muscle work refers to the muscle changing from a position of full stretch and contracting to a position of maximal shortening. (muscle work concentrically)

OR

- The full range in which a muscle work refers to the muscle changing from a position of full contraction to a position of maximum extension. (muscle work eccentrically)
- Muscles are rarely required to work in full range.

Uses of Active full range exercises

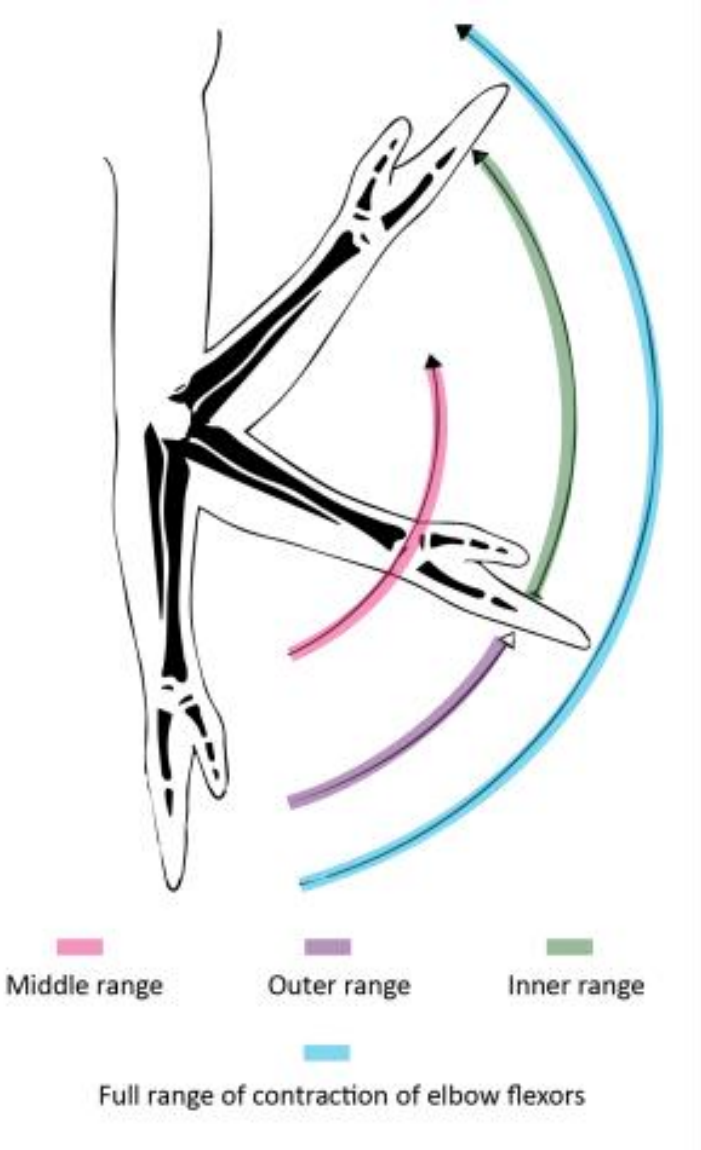
- To maintain joint mobility
- To increase the circulation
- Ensures that the emergency reserve of power and mobility is preserved

Division of Full Range

- The full range is divided into parts:

1. Outer Range
2. Inner Range
3. Middle Range

Fig1: Diagramatic Presentation of Ranges



Outer range

- Is from a position where the muscle is on full stretch to a position half way though the full range of motion, when the muscle is working concentrically .

OR

- Is from a position where the muscle is fully contracted to a position half way though the full range of motion, when the muscle is working eccentrically . (refer fig 2)

Uses of Outer Range

- Extensively used in muscle re education (as contraction is initiated more easily)

Inner range

- Is from a position halfway through the full range to a position where the muscle is fully shortened when the muscle is working concentrically .

OR

- Is from a position half way though the full range of motion to a position where the muscle is on full stretch position, when the muscle is working eccentrically . (refer fig 2)

Uses of doing Exercise in Inner Range

- To gain or maintain movement of the joint in the direction of the muscle pull, and
- To train some extensor muscles responsible for stabilising joints.

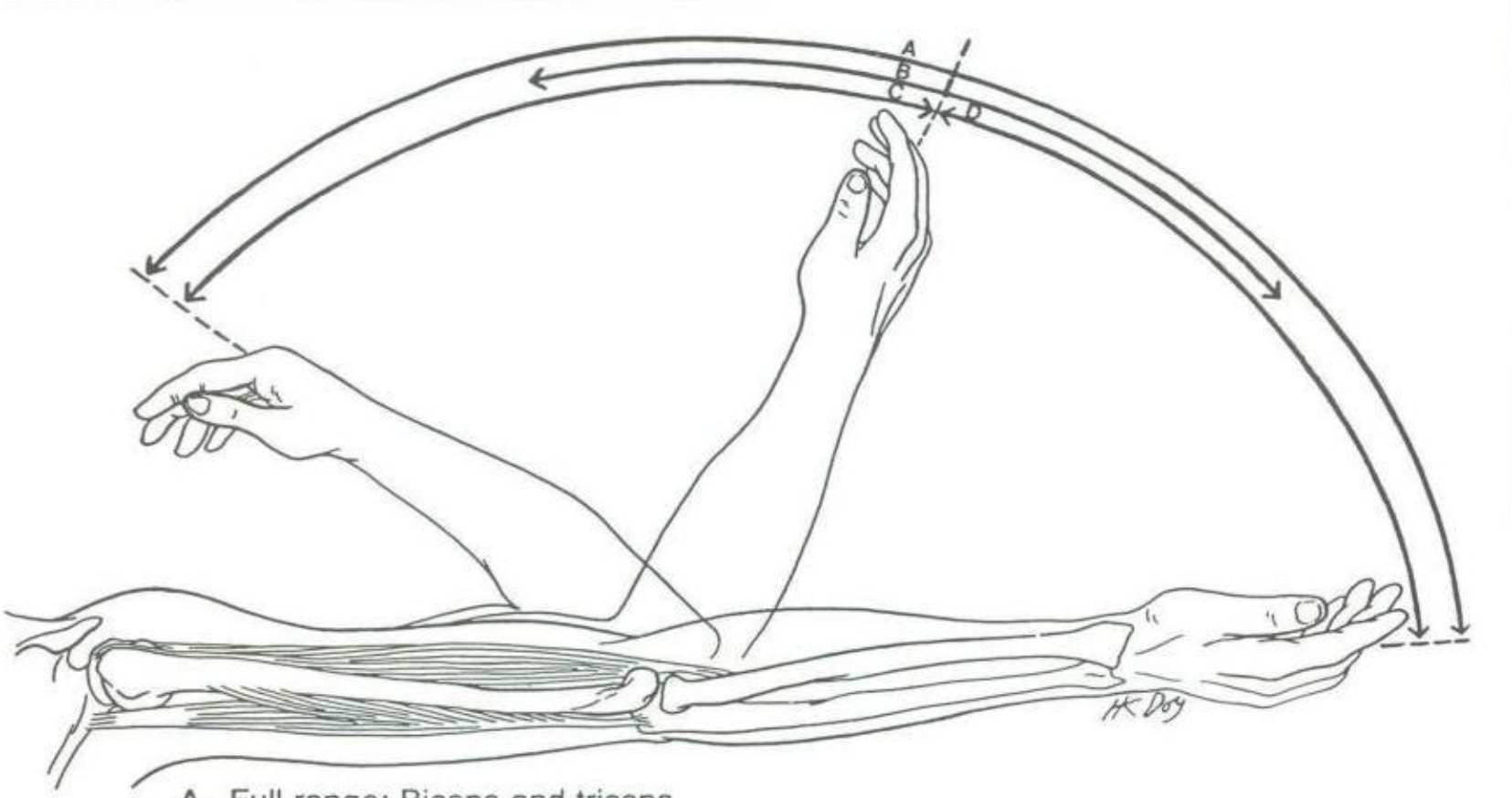
Middle range

- Is the portion of the full range between the mid-point of the outer range and the midpoint of the inner range whether the muscle is working concentrically or eccentrically. (refer fig 2)

Uses of Middle range

- Its the range in which muscles are often used in everyday life.
- Muscles are most efficient in this range.
- Exercises in this range maintain tone & normal power.

Fig 2: Better understanding of Ranges for Biceps and Triceps muscle



A. Full range: Biceps and triceps
B. Middle range: Biceps and triceps
C. Inner range: Biceps
   Outer range: Triceps
D. Inner range: Triceps
   Outer range: Biceps

Mechanics of Muscle - Group Action of Muscles

Exercise Therapy I & Massage Manipulation

Objectives

- At the end of the lecture, students will be able to:
- Explain in short about group actions of the muscles

Introduction

- Muscles don’t work singly, but work in groups.
- Co ordinated movement is the result of several muscle groups working harmoniously.

Classification of muscles on the basis of their Action

- Prime Movers or Agonists
- Antagonists
- Synergists
- Fixators

Prime Movers or Agonists

- They bring about the movement by their contraction.
- An agonist actively contracts to produce a concentric, eccentric, or isometric contraction.

Antagonists

- Opposing group of muscles to Agonists
- Progressive relaxation & lengthening of this muscles leads to controlled movement.

Synergists

- These are the muscles which work or relax to modify the action of the prime movers/ Agonists.
- They may alter direction of pull.
- In case of two joint muscle, they fix or move the joint in which the main action is not required into the position which is most advantageous. (refer two joint muscles)

Fixators

- They work to steady the origin of the prime movers or the synergists.

Examples

1. In flexion of the fingers, for making a fist:

   Prime movers/ Agonists: flexors of the fingers

   Antagonists: Extensors of the fingers

   Synergists: Extensors of the Wrist

Examples Contd.

2. During forearm flexion for example lifting a cup

Agonist/Prime movers: Biceps brachii

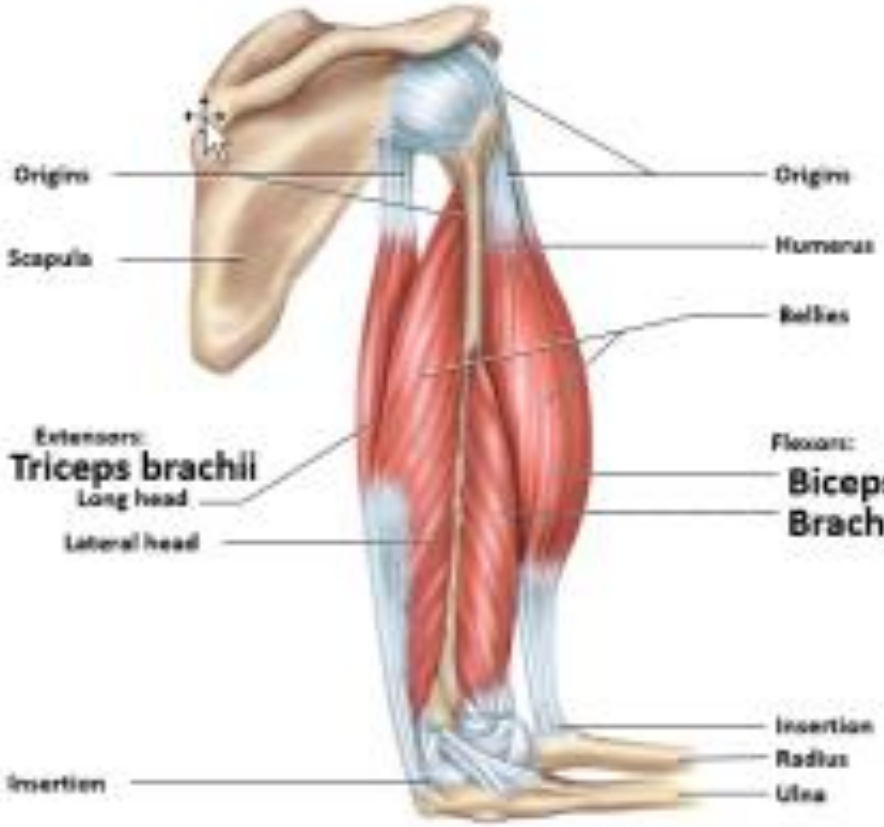
Antagonist: Triceps

Synergist: Brachialis

Fixators: Deltoid, rhomboids and pectorals

(refer figure I)

Fig I: action of different muscles during Elbow flexion



- **prime mover** - brachialis
- **synergist** - biceps brachii
- **antagonist** - triceps brachii
- **fixator** - muscle that holds scapula firmly in place
  - *rhomboids*

Examples Contd.

3. While flexing the leg at the knee during walking or running

   Prime movers/ Agonists: Hamstring muscles

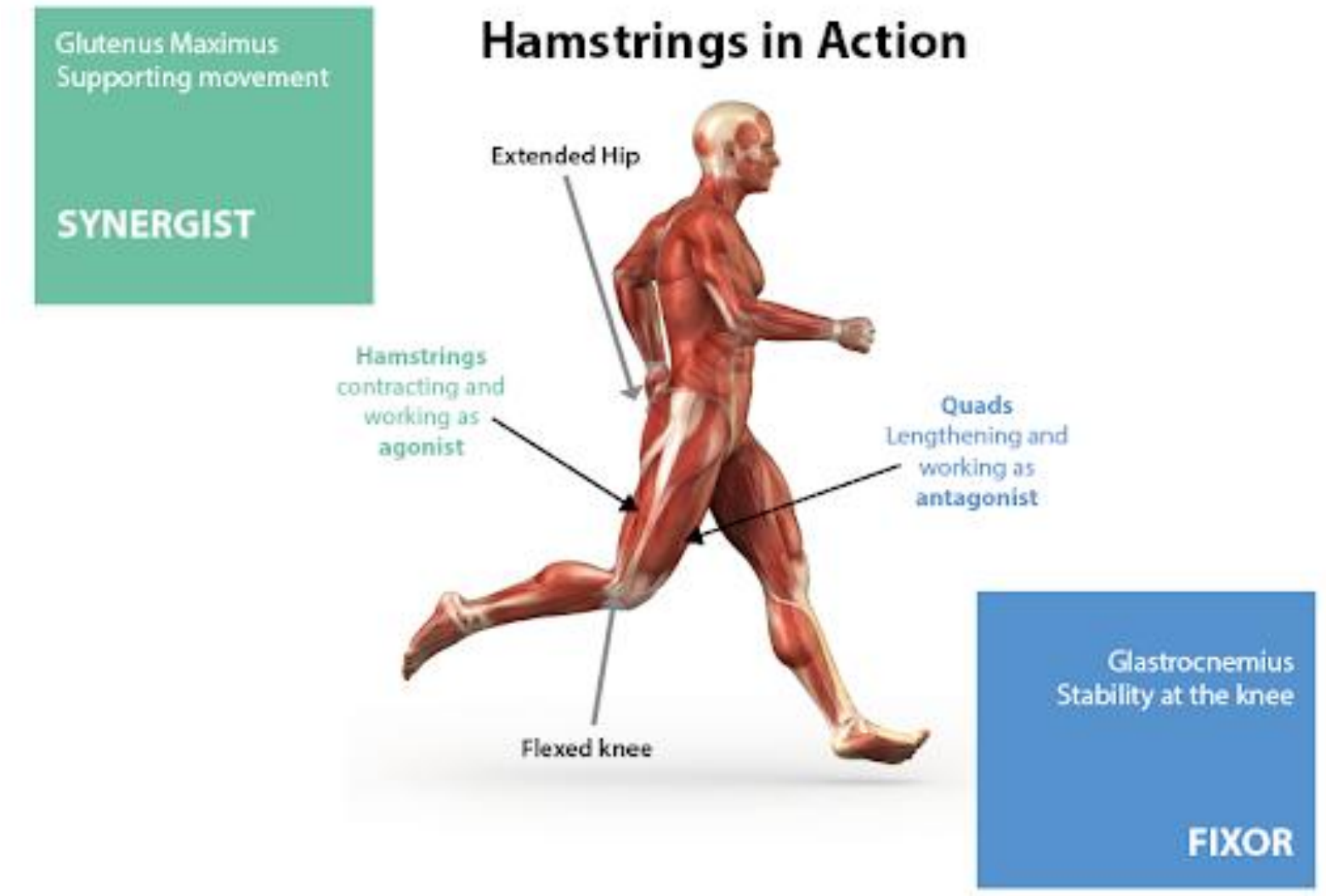
   Antagonists: Quardriceps

   Synergist: Gluteus Maximus

   Fixator: Gastrocnemius muscle

(refer figure II)

Fig II: action of different muscles in the lower limb



Control of Muscular contraction by CNS

- Impulses for contraction or relaxation of the muscles is received from the CNS.
- Movements and not individual muscle or group of muscles are represented in the Cerebral cortex .
- Thus during re education emphasis is focussed on the movement
- Patient is well accustomed to this natural movements.

Two Joint Muscles

- These groups of muscles include those muscles which extends across more than one joint .

Examples

- Rectus Femoris
- Hamstring group of muscles
- Gastrocnemius muscles
- Biceps and triceps etc.

Legs

1.Rectus Femoris

✓ crosses hip and knee

✓ performs hip flexion and knee extension

2.Hamstrings

✓ cross hip and knee

✓ perform hip extension and knee flexion

3.Gastrocnemius

✓ crosses knee and ankle

✓ performs knee flexion and plantar flexion

.

Arms:

4.Biceps Brachii

✓ crosses shoulder and elbow

✓ performs elbow and shoulder flexion

✓ also pronates

5.Triceps Brachii

✓ crosses shoulder and elbow

✓ performs elbow and shoulder extension

Effectiveness

- Most effective in moving one joint when they are stretched over the other.
- This is because the latter joint is used as fulcrum and
- Stretching of muscle acts as an additional stimulus to the contraction.

Reference

- The Principles of Exercise Therapy by M. Dena Gardiner, 4th Edition, Chapter 15, page: 169 to 173

THANK YOU