- COURSE NAME :BIOMECHANICS AND APPILED KINESOLOGY
- SUBJECT CODE: 6277
- ACADEIMIC YEAR :2
- TOPIC NAME: MUSCLE FUNCTIONS &BIOMECHANICS

Muscle Function & Biomechanics

UNDERSTANDING MOBILITY, STRUCTURE, AND INSUFFICIENCY THROUGH DESIGN THINKING.

“MUSCLES DON’T JUST MOVE US, THEY STABILIZE US.”

Roadmap (Design Thinking)

- Flow chart: Empathize → Define → Ideate → Prototype → Test

- We will follow this structured approach to learn:
- - Mobility & stability
- - Muscle structure
- - Active vs Passive insufficiency

Empathize: Why Study Muscle Functions?

- • Patients struggle with weakness & instability.
- • Therapists must know how muscles:
- - Move joints (mobility).
- - Protect joints (stability).
- • Clinical relevance: injury prevention, rehab planning.

Define: Mobility Function of Muscle

- • Movement around joint axis.
- • Muscles act as levers → Fulcrum (joint), Effort (muscle), Load (weight).
- • Fusiform muscles = greater ROM.
- Example: Biceps brachii → elbow flexion.

Define: Stability Function of Muscle

- • Joint stabilization during movement.
- • Dynamic stabilization: muscles contract reflexively to protect ligaments.
- • Co-contraction of agonist & antagonist → joint stability.
- Example: Rotator cuff muscles → stabilize shoulder.

Mobility vs Stability (Comparison)

- Mobility → produces motion, long fibers, fusiform, high ROM.
- Stability → resists unwanted motion, short fibers, pennate, high joint compression.

Ideate: Elements of Muscle Structure (Overview)

- 1. Muscle fiber composition
- 2. Motor unit
- 3. Types of fibers
- 4. Fiber size & arrangement
- 5. Muscle tension
- 6. Length–tension relationship

Composition of Muscle Fiber

- • Contractile proteins: Actin & Myosin.
- • Regulatory proteins: Troponin & Tropomyosin.
- • Structural proteins: Titin (elasticity & passive tension).
- Diagram: Myofibril with actin–myosin cross-bridges.

Motor Unit

- • Definition: Alpha motor neuron + all fibers it innervates.
- • Small units → fine control (eye muscles).
- • Large units → gross force (quadriceps).
- • Recruitment principle: Small → Large (size principle).

Types of Muscle Fiber

- • Type I (Slow-twitch, red, endurance).
- • Type IIa (Intermediate, fatigue-resistant, fast).
- • Type IIx (Fast-twitch, explosive, quick fatigue).
- Diagram: Fiber type → Function → Example.

Fiber Size, Arrangement & Number

- • Parallel/Fusiform → more ROM.
- • Pennate (uni, bi, multi) → more force.
- • PCSA (cross-sectional area) determines strength.
- • Fiber length determines ROM.

Muscle Tension & Length–Tension

- • Active tension: actin–myosin cross-bridges.
- • Passive tension: connective tissue & titin.
- • Length–tension curve:
- - Optimal overlap = max force.
- - Too stretched = ↓ force.
- - Too shortened = ↓ force.

Prototype: Active Insufficiency

- • Definition: Muscle can’t shorten enough across multiple joints.
- Examples:
- - Hamstrings → hip extension + knee flexion simultaneously.
- - Biceps brachii → shoulder flexion + elbow flexion.

Prototype: Passive Insufficiency

- • Definition: Muscle can’t lengthen enough across multiple joints.
- Examples:
- - Hamstrings → limited hip flexion when knee extended.
- - Finger flexors → can’t make fist if wrist flexed (tenodesis).

Test & Conclusion

- Flow chart roadmap:
- Empathize → Define → Ideate → Prototype → Test
- • Mobility = movement.
- • Stability = protection.
- • Structure = fibers, motor units, tension.
- • Active vs Passive insufficiency = clinical application.