Exercise Therapy

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ANGLE OF PULL WITH ANATOMICAL EXAMPLE

Definition: The angle of pull is the angle formed between the line of pull of a muscle (the direction of the muscle fibres) and the bone (or body part) on which it acts.

A force is most effective when it is applied at right angles (90^0) to a lever.

Angle of pull is important when muscle acting on joints.

Mechanical Efficiency: Mechanically, the pull is most efficient when the muscle is inserted at right angles to the bone. This efficiency decreases as the angle of pull becomes smaller, since part of the force is then used in pulling the bone of insertion toward the joint (fulcrum) instead of producing movement. This approximation of the articular surfaces has a stabilizing effect upon the joint. When the angle of insertion increases beyond the right angle, the joint becomes less stable as the angle increases.

Efficiency of a Resistance: A force resisting movement of one of the body levers may be applied by means of a rope or through the physiotherapist's hand. The effect of this resisting force is maximal when it is applied at right angles to the moving bone.

Key points:

1. Maximum efficiency occurs when the force acts at a right angle to the lever.
2. When the angle of pull decreases, part of the force is used for joint stabilization rather than movement.
3. When the angle increases, the joint becomes less stable.
4. Resistance applied at a right angle provides maximum opposing force during movement.

Anatomical Example: Muscle: Biceps brachii, Joint: Elbow joint

Elbow at 90^0: When the elbow is flexed at 90°, the line of pull of the biceps brachii forms a 90° with the forearm. At this position: The muscle force is maximum, producing the greatest torque for elbow flexion.
When the elbow is extended (less than 90°): The line of pull becomes more parallel to the bone. The stabilizing component increases (pulls the joint surfaces together), and the rotary component decreases.
When the elbow is flexed beyond 90°: The line of pull shifts, and a dislocating component appears (tending to pull the radius away from the humerus).

Reference: Kisner, Carolyn Therapeutic exercise : foundations and techniques / Carolyn Kisner, Lynn Allen Colby. — 5th ed.