# TESTS AND MEASUREMENTS

## Lecture 1:

## Principles and methods

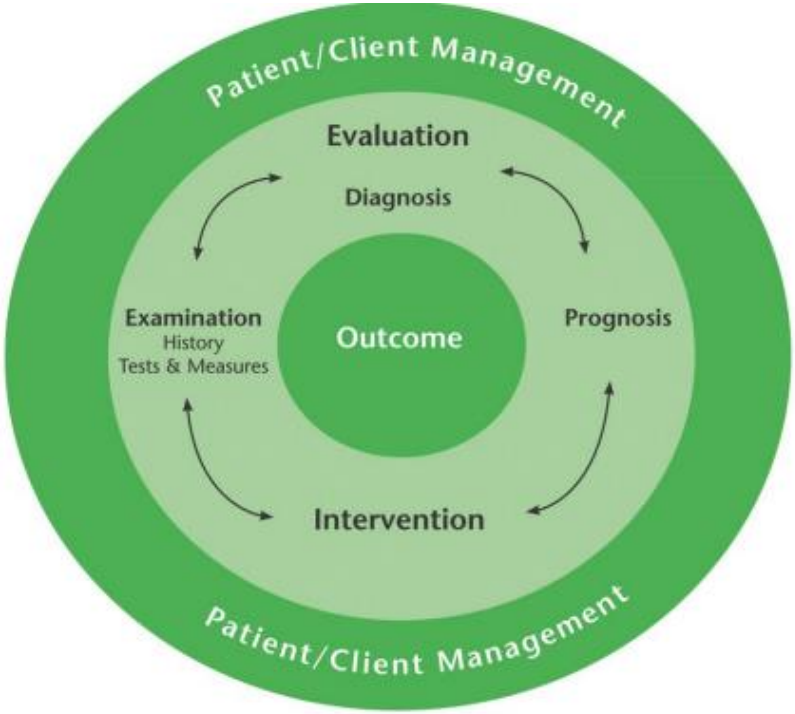
Rehab S. Mamoon
Lecturer of Physical Therapy, SVU

# Fundamentals of ROM and Muscle Strength Evaluation

- Requires understanding of principles and methods
- Essential knowledge for subsequent specific techniques

# Evaluation

- A dynamic process in which the physical therapist makes clinical judgments based on data gathered during the examination.
- The evaluation portion of the management model consists of the following:
- • Examination
- • Diagnosis
- • Prognosis



# Diagnosis

- Diagnosis is an essential element of patient management because it directs the physical therapy prognosis (including the plan of care) and interventions.
- Diagnostic Process:-

Sequence of actions and decisions :

(1) the collection of data (examination);

(2) the analysis and interpretation of all relevant data collected, leading to the generation of working hypotheses (evaluation); and

(3) organization of data.

# Examination

- History taking
- Inspection
- Palpation
- Measurements ( length & girth measurement, ROM & Manual Muscle Test)
- Special tests

# Effective Communication During Assessment

1. Explain rationale and process clearly
2. Use lay terms, slow speech, and concise explanations
3. Encourage patient questions
4. Ensure patient understands:

- Need for body exposure and positioning
- Reporting changes in symptoms during and after assessment

# Inspection

- Visual observation is an integral part of assessment of joint ROM and muscle strength.
- The body part being assessed should be adequately exposed for visual inspection.
- Information gained from visual observation includes such factors as facial expression, symmetrical or compensatory motion in functional activities, body posture, muscle contours, body proportions, and color, condition, and creases of the skin.

# Palpation

- Essential for assessing bony and soft tissue structures
- Assesses landmarks, muscle contraction, tissue irregularities, and treatment areas
- Proficiency gained through practice

# Palpation Technique

- Ensure patient comfort and muscle relaxation
- Use fingertips, direct contact with skin, and a gentle but firm touch
- Observe area before palpating, instruct patient for muscle contraction
- Roll fingers across tendons for better assessment

# Therapist Posture During Assessment

- Maintain neutral spine posture, feet shoulder-width apart
- Stance varies based on movement direction (parallel, perpendicular, diagonal)
- Protect spine by staying close to the patient and using leg muscles for lifting

Therapist’s stance when performing movements parallel to the side of the plinth.

Therapist’s stance when performing movements perpendicular to the side of the plinth.

# Supporting the Patient's Limb

- Support limbs at the center of gravity
- Use a relaxed grasp and contour your hand to the limb
- Provide additional support with the forearm
- Ensure joints are adequately supported during movement

The limb supported at the center of gravity using a relaxed hand grasp

# Joint Range of Motion (ROM)

- **Osteokinematics**: Study of bone movement in space
- Joint ROM represents movement at a joint to produce bone movement

## Active vs Passive Range of Motion

- **AROM**: Patient voluntarily contracts muscles to move through ROM
- **PROM**: Therapist or external force moves body part through ROM

# Assessment of Joint ROM

- **ROM** is the arc of motion available at a single joint or series of joints.
- It is the angle through which the joint moves from the anatomical position to the extreme limit of its motion in a particular direction.

# Assessment of Joint ROM

- ROM is essential for functional mobility.
- Dysfunction of the neural or musculoskeletal systems may lead to joint hypomobility or hypermobility.
- Range of motion assessments help us to identify if there are limitations of the bony structure or connective tissues, such as tendons, ligaments and the joint capsule, that surround the joint.
- It, therefore, forms an integral part of patient assessment.

# Contraindications for AROM & PROM

Avoid if movement disrupts healing or causes injury:

1. After injury or surgery
2. Suspected subluxation, dislocation, or fracture
3. Myositis ossificans or ectopic ossification

# Precautions for AROM & PROM

Use with caution in:

1. Painful conditions or inflammation
2. Patients on pain medication or muscle relaxants
3. Osteoporosis or bone fragility
4. Hemophilia or hematoma presence
5. Hypermobile joints, recent fractures, or soft tissue injuries

# Precautions for AROM & PROM

**6. AROM Precautions After Surgery**

- Be cautious post-neurosurgery, abdominal, intervertebral, or eye surgery

**7. Avoid Valsalva Maneuver**: Instruct patients to breathe during testing

**8. Fatigue and Overwork Considerations**

- Avoid strenuous testing if fatigue could worsen the condition (e.g., COPD, MS, cardiovascular disease)
- **Signs of Fatigue**: Tiredness, pain, tremor, and decreased movement ability

# **AROM Assessment:** Key Insights

AROM provides information on:

- Willingness to move
  - Level of consciousness
  - Ability to follow instructions
  - Attention span
  - Coordination
  - Joint ROM
  - Movements that cause or increase pain
  - Muscle strength
  - Ability to perform functional activities

# Factors Affecting AROM

- **AROM may be decreased due to patient factors:**
  - Unwillingness to move
  - Inability to follow instructions
  - Restricted joint mobility
  - Muscle weakness
  - Pain

# Scan of Upper and Lower Limb AROM

- Instruct the patient to perform activities that include movement at several joints simultaneously.
- Example: Instruct patient to touch fingertips behind the back
  - Observe scapular, shoulder, elbow, forearm, wrist, and finger movements
  - Results guide further assessment needs

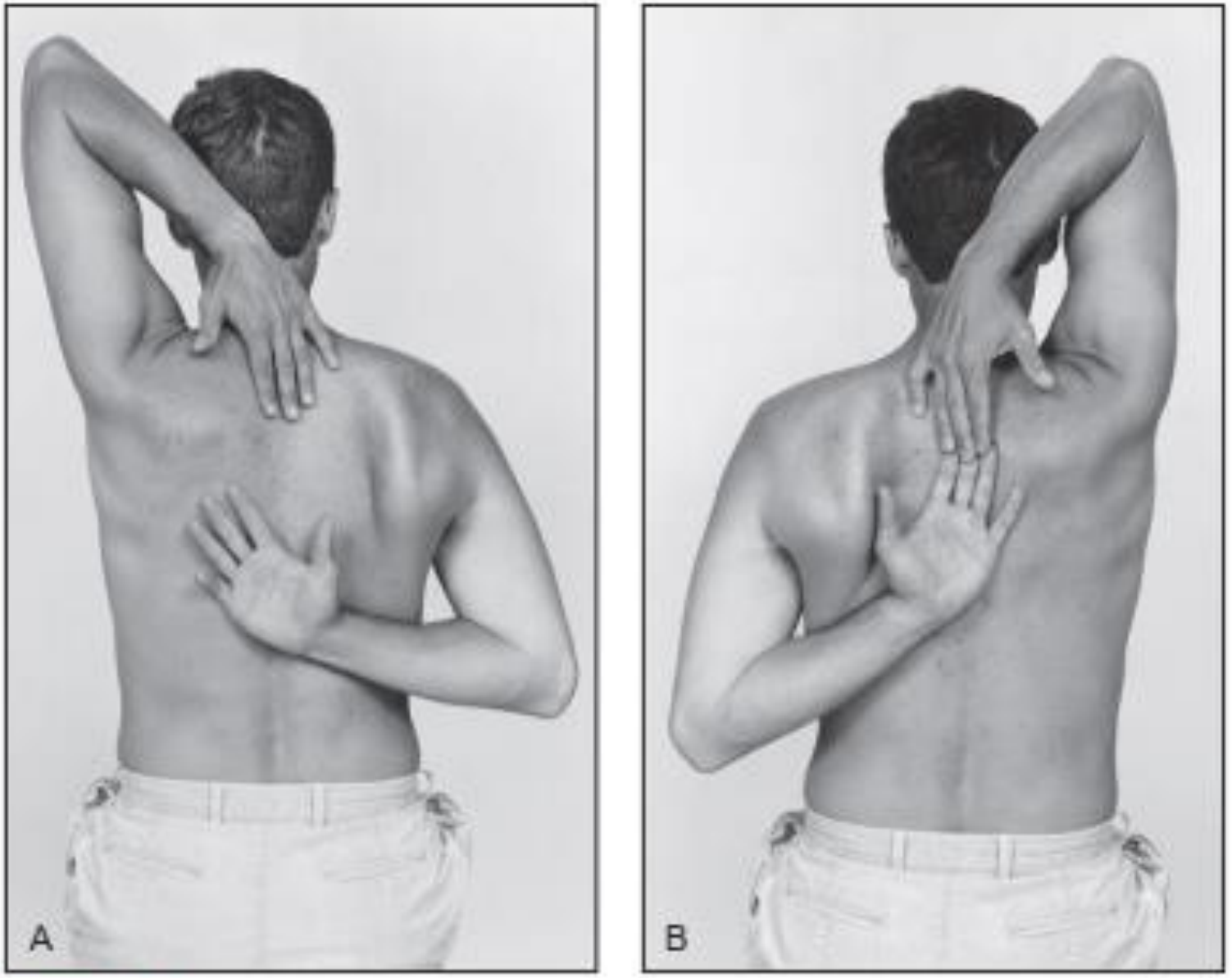



**Figure 1-23** **A and B.** End positions: scan of active range of motion (AROM) of the upper extremities.

# Detailed AROM Assessment

- Perform all movements at the affected joint(s), and joint just proximal and distal.
- Compare AROM bilaterally and simultaneously for accuracy
- Measure AROM using a goniometer to provide an objective measure
- Consider the effect of gravity on AROM (vertical vs horizontal planes)
- Muscle strength grade provides insight into functional capability

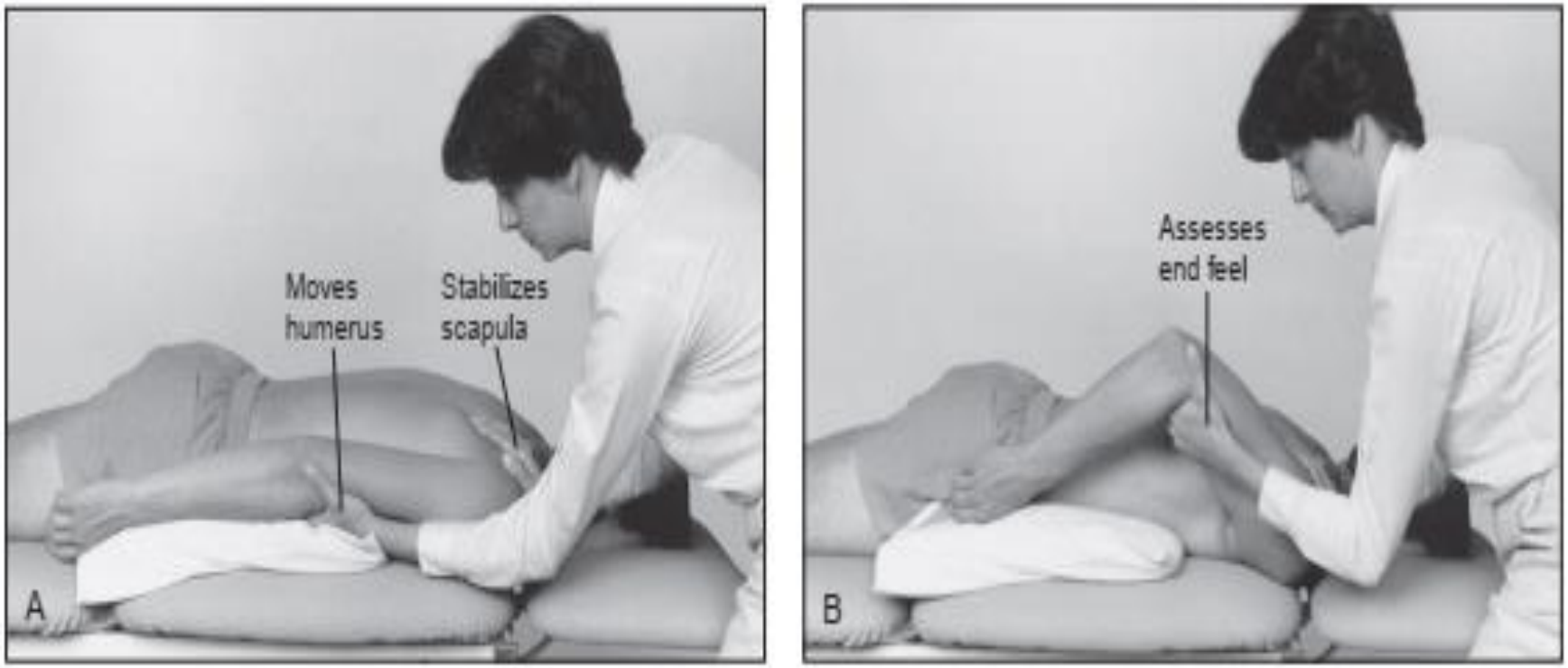
# Assessment of PROM

- Assessment of the PROM provides information about the following:
  - Amount of movement possible at the joint
  - Factors responsible for limiting movement
  - Movements that cause or increase pain

- PROM is usually slightly greater than AROM, owing to the slight elastic stretch of tissues and in some instances due to the decreased bulk of relaxed muscles.
- However, the PROM can also be greater than the AROM in the presence of muscle weakness.

## To assess the PROM at a joint:

- Stabilize the proximal joint segment(s) and move the distal joint segment(s) through the full PROM
- Visually estimate the PROM
- Determine the quality of the movement throughout the PROM
- Determine the end feel and factors that limit the PROM
- Note the presence of pain
- Determine whether a capsular or non-capsular pattern of movement is present




Assessment of passive range of motion (PROM) using glenohumeral joint extension as an example.

A. The patient is comfortable, well supported, and relaxed with the joint in the anatomical position. The therapist manually stabilizes the proximal joint segment (e.g., scapula) and moves the distal joint segment (e.g., humerus).

**B.** The distal joint segment is moved to the end of PROM and gentle overpressure is applied to determine the end feel.

# Assessing PROM

- **Observe PROM**: Determine if the range is full, restricted, or excessive.
- **End Feel**: Sensation at the extreme end of PROM indicating limiting structures.
- **Normal End Feel**: Full PROM, normal anatomy limits movement.
- **Abnormal End Feel**:
  - Decreased or increased PROM
  - Structures other than normal anatomy limit movement
- **Types of End Feels**:

Normal (physiological) & Abnormal (pathological)

# Normal Limiting Factors and End Feels

The factors that normally limit movement and determine the PROM at a joint include:

- The stretching of soft tissues (i.e., muscles, fascia, and skin)
- The stretching of ligaments or the joint capsule
- The apposition of soft tissues
- Bone contacting bone

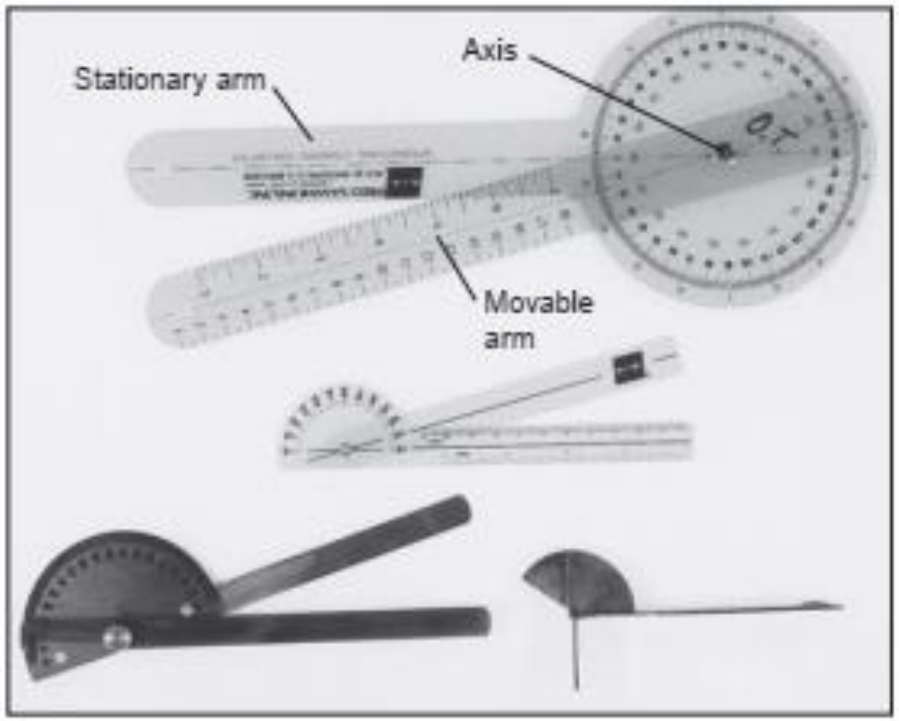
# Normal (Physiological) End Feels

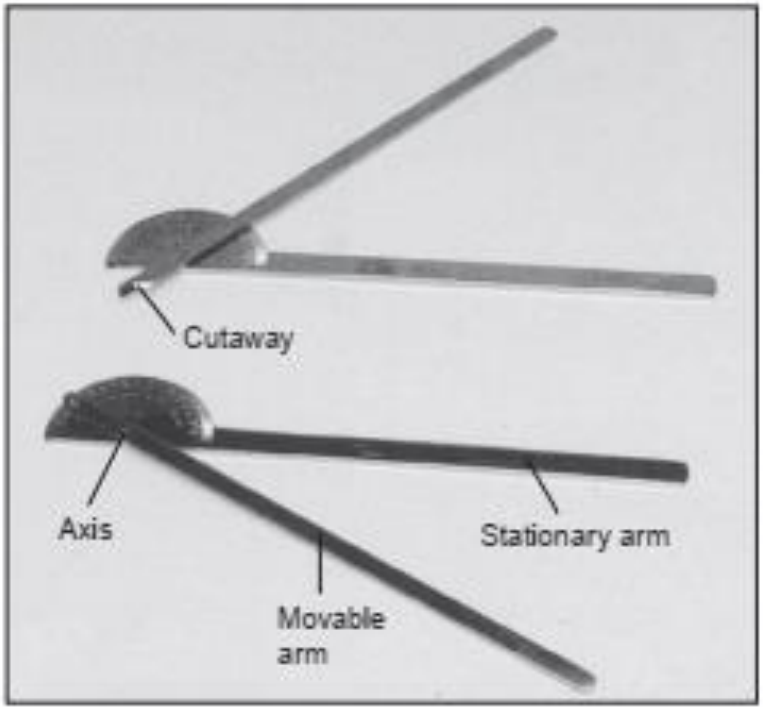
| End Feel<br>General Terminology<br>(Specific Terminology) | Description |
|---|---|
| Hard<br>(Bony) | A painless, abrupt, hard stop to movement when bone contacts bone; for example, passive elbow extension, the olecranon process contacts the olecranon fossa. |
| Soft<br>(Soft tissue opposition) | When two body surfaces come together a soft compression of tissue is felt; for example, in passive knee flexion, the soft tissue on the posterior aspects of the calf and thigh come together. |
| Firm<br>(Soft tissue stretch) | A firm or springy sensation that has some give when muscle is stretched; for example, passive ankle dorsiflexion performed with the knee in extension is stopped due to tension in the gastrocnemius muscle. |
| (Capsular stretch) | A hard arrest to movement with some give when the joint capsule or ligaments are stretched. The feel is similar to stretching a piece of leather; for example, passive shoulder external rotation. |

# Abnormal (Pathological) End Feels

| End Feel | Description |
|---|---|
| Hard | An abrupt hard stop to movement, when bone contacts bone, or a bony grating sensation, when rough articular surfaces move past one another, for example, in a joint that contains loose bodies, degenerative joint disease, dislocation, or a fracture. |
| Soft | A boggy sensation that indicates the presence of synovitis or soft tissue edema. |
| Firm | A springy sensation or a hard arrest to movement with some give, indicating muscular, capsular, or ligamentous shortening. |
| Springy block | A rebound is seen or felt and indicates the presence of an internal derangement; for example, the knee with a torn meniscus. |
| Empty | Empty If considerable pain is present, there is no sensation felt before the extreme of passive ROM as the patient requests the movement be stopped, this indicates pathology such as an extra-articular abscess, a neoplasm, acute bursitis, joint inflammation, or a fracture. |
| Spasm | A hard sudden stop to passive movement that is often accompanied by pain, is indicative of an acute or subacute arthritis, the presence of a severe active lesion, or fracture. If pain is absent a spasm end feel may indicate a lesion of the central nervous system with resultant increased muscular tonus. |

# Measurement of ROM



- A *goniometer* is an apparatus used to measure joint angles.
- The goniometer chosen to assess joint ROM depends on the degree of accuracy required in the measurement, the time, and resources available to the clinician, and the patient's comfort and well-being.
- In the clinical setting, the universal goniometer is the goniometer most frequently used to measure ROM for the extremity joints.

# Validity and Reliability

- ***Validity:*** is "the degree to which an instrument measures what it is supposed to measure".
- Validity indicates the accuracy of a measurement.
- A goniometer, inclinometer, or tape measure is used to provide measurements of the number of degrees or distance in centimeters, of movement or the position of a joint.

# Validity and Reliability

- ***Reliability:*** is "the extent to which the instrument yields the same measurement on repeated uses either by the same operator (intraobserver reliability) or by different operators (interobserver reliability)".
- Reliability indicates the consistency or repeatability of a measurement.

# Joint ROM Assessment Procedure

- ***Expose the Area***
  Explain to the patient the need to expose the area to be assessed.

- ***Explanation and Instruction***
  Briefly explain the ROM assessment and measurement procedure to the patient. Explain and demonstrate the movement to be performed and/or passively move the patient's uninvolved limb through the ROM.

# Joint ROM Assessment Procedure

**Assessing Normal ROM**:

- Assess and record ROM of the uninvolved limb to determine the patient's normal ROM.
- Use clinical judgment for bilateral limb involvement.
- Keep in mind PROM is usually slightly greater than AROM.
- Refer to normal AROM tables.
- Consider individual factors like gender, age, occupation, and health status.
- Determine essential functional ROM for daily activities.

# Joint ROM Assessment Procedure

- **Assessment and Measurement Procedure**:
- Ensure the patient is comfortable and well-supported.
- Position the patient so that:
  - The joint is in the anatomical position.
  - Proximal joint segment is stabilized.
  - Movement is unrestricted.
  - Goniometer placement is proper.
- Note if the patient's position varies from the standard position.

# Substitute Movements

- An additional movements at the joint being assessed or at other joints, thus giving the appearance of having a greater joint ROM than is actually present.
- So, Ensure only the desired movement occurs at the joint.
- Prevent additional movements that may falsely appear as increased ROM.


A. Patient reaches into a back pocket using normal right upper extremity.
B. **B.** Substitute motions at the left shoulder girdle and trunk compensate for restricted left shoulder joint range of motion (ROM) as the patient attempts to reach into a back pocket.

# Measurement Procedure Universal Goniometer

- *Goniometer placement:*

The preferred placement of the goniometer is lateral to the joint, just off the surface of the limb, but it may also be placed over the joint using only light contact between the goniometer and the skin.

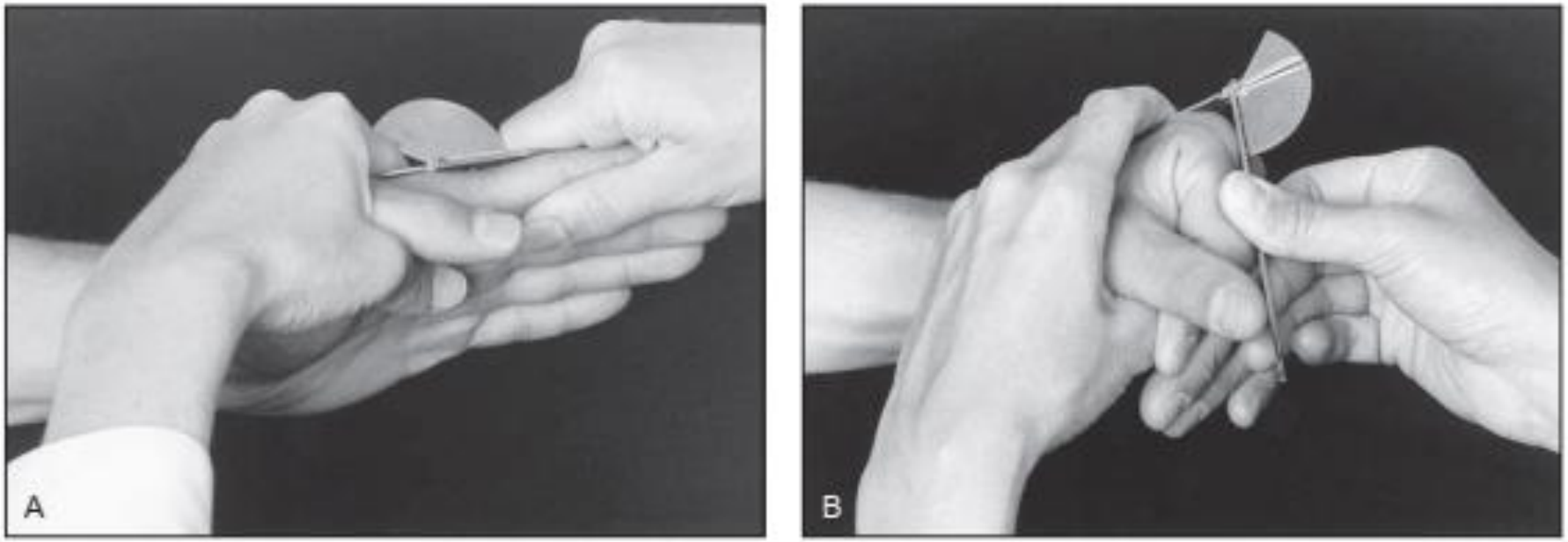
# Measurement Procedure Universal Goniometer

## *Axis:*

- The axis of the goniometer is placed over the axis of movement of the joint.
- A specific bony prominence or anatomical landmark can be used to represent the axis of motion.

# Measurement Procedure Universal Goniometer

- ***Stationary arm:*** The stationary arm of the goniometer normally lies parallel to the longitudinal axis of the fixed proximal joint segment and/or points toward a distant bony prominence on the proximal segment.
- ***Movable arm:*** The movable arm of the goniometer normally lies parallel to the longitudinal axis of the moving distal joint segment and/or points toward a distant bony prominence on the distal segment.




A. Start position (0°) for metacarpophalangeal (MCP) joint flexion with the universal goniometer placed over the dorsum of the MCP joint.

**B.** End position: MCP flexion PROM (90°) with the goniometer aligned over the joint.


Any
questions

سبحانك اللهم وبحمدك

أشهد أن لا إله إلا أنت أستغفرك وأتوب إليك

*Thank you*