Principles of Joint Mobilization

Edward P. Mulligan, MS, PT, SCS, ATC
VP, National Director of Clinical Education
HealthSouth Corporation – Grapevine, TX
Clinical Instructor
University of Texas Southwestern PT Department
Dallas, TX

The contents of this presentation are copyrighted © 2001 by continuing ED. They may not be utilized, reproduced, stored, or transmitted in any form or by any means, electronic or mechanical, or by any information storage or retrieval system, without permission in writing from Edward P. Mulligan.

Joint Mobilization

skilled passive movement of the articular surfaces performed by a physical therapist to decrease pain or increase joint mobility
Presentation Objectives

1. Define osteokinematic and arthrokinematic motion
2. Explain the arthrokinematic rules of motion
3. Detect and classify joint dysfunction
4. Define the resting and closed pack position of a joint
5. Understand the treatment application principles that govern passive joint mobilization
6. Investigate what the literature suggests regarding mobilization effectiveness and efficacy
7. Memorize the morphological and capsular characteristics of each joint
8. Demonstrate selected joint mobilization techniques

Objective 1

Define osteokinematic and arthrokinematic motion
Osteokinematics

"Motion You SEE"

observable movements of bones in space as represented by a change in the angle of adjacent articular segments "Motion You SEE"

Arthrokinematics

"Motion You FEEL"

- Unobservable articular accessory motion between adjacent joint surfaces
  - roll, glide, and spin
- These accessory motions take place with all active and passive movements and are necessary for full, pain free range of motion
- Arthrokinematic motion can not occur independently or voluntarily and if restricted, can limit physiological movement

continuing ED
Types of Arthrokinematic Motion

Joint Play
- movement not under voluntary control (passive)
- can not be achieved by active muscular contraction

versus

Component Movement
- involuntary obligatory joint motion occurring outside the joint accompanies active motion
  - i.e. - scapulohumeral rhythm

Arthrokinematic ROLL
- new points on one surface come into contact with new points on the other surface (wheel)
- rolling only occurs when the two articulating surfaces are incongruent
Arthrokinematic GLIDE

- translatory motion in which one constant point on one surface is contacting new points or a series of points on the other surface
- pure gliding can occur when two surfaces are congruent and flat or congruent and curved
- glide also referred to as translation

Arthrokinematic SPIN

- rotation around a longitudinal stationary mechanical axis (one point of contact) in a CW or CCW direction

continuing ED
Arthrokinematic Motions

**Concave on Convex**

![Diagram of concave on convex motion]

**Continuing ED**

Arthrokinematic Motions

**Convex on Concave**

![Diagram of convex on concave motion]

**Continuing ED**
ROLLING and GLIDING

- Since there is never pure congruency between joint surfaces; all motions require rolling and gliding to occur simultaneously.
- This combination of roll and glide is simultaneous but not necessarily in proportion to one another.

Arthrokinematic Motions

The more congruent - the more the gliding
The more incongruent - the more the rolling
Arthrokinematic Motions

The more congruent - the more the gliding
The more incongruent - the more the rolling

Pure Glide: A contacts point 2

Pure Roll: B contacts point 3

continuing ED
**Arthrokinematic Motions**

The more congruent - the more the gliding
The more incongruent - the more the rolling

_Glide and Roll: B contacts point 2_

**Objective 2**

Explain the arthrokinematic rules of motion
Joint Morphology

Joint surfaces are defined as:

**Convex:** male; rounded or arched
**Concave:** female; hollowed or shallow

**Ovoid:** concave and convex articular partner surface

**Sellar:** saddle shape with each articular surface having a concave and convex component in a specific direction

- Examples would include the sternoclavicular and 1st carpometacarpal joints
Concave and Convex Characteristics

- convex surfaces have more cartilage at the center
- concave surfaces have more cartilage on the periphery
- where surfaces appear flat - the larger articular surface is considered convex

Rules of Motion

**Concave Motion Rule**

- convex surface is stationary and concave surface moves
- osteo and arthrokineamic motion is in the same direction
- arthrokineamic mobilization gliding force is in the same direction as osteokinematic bony movement

GLIDE and ROLL are in the SAME DIRECTION
Rules of Motion

Convex Motion Rule

• concave surface is stationary and convex surface moves
• osteo and arthrokinematic motion is in the opposite direction
• arthrokinematic mobilization gliding force is in the opposite direction as osteokinematic bony movement

GLIDE and ROLL are in the OPPOSITE DIRECTION

continuing ED

Rules of Motion

• because their is alway incongruent surfaces, there must be some combination of glide and roll
• arthrokinematic roll always occurs in the same direction as bony movement regardless of whether the joint surface is convex or concave in shape.

continuing ED
**Functional Roll and Glide Analogy**

The more congruent
- **the more glide**

The more incongruent
- **the more roll**

Joint incongruency requires rolling and gliding in combination

---

**Obligate Translation**

- During AROM translation direction is influenced by the capsuloligamentous complex
- Passive restraints act not only to restrict movement but also to reverse articular movements at the end range of motion

**Convex-Concave Morphology vs. Capsular Obligate Translation**

- At end range, asymmetrical capsular mobility causes obligate translation away from the side of tightness
- Tight capsular structures will cause early and excessive accessory motion in the opposite direction of the tightness
Treatment Plane and Axis of Motion

The treatment plane lies in the concave articular surface and is parallel to the joint surface and perpendicular to the axis in the convex surface.

The axis of motion always lies in the convex articular surface.

The treatment plane moves with the concave surface moves.

The treatment plane remains essentially still when the convex surface moves.
TRACTION

- the process of pulling one bony surface away from the other (joint separation)

- passive translactoric bone movement which is at a right angle to the treatment plane

GLIDING

- Translatory movement where the joint surfaces are passively displaced parallel to the treatment plane
Objective 3

Detect and classify joint dysfunction

Detect and Classification of Joint Dysfunction

<table>
<thead>
<tr>
<th>Cause of Limited Motion</th>
<th>Identification</th>
<th>Treatment Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-articular Adhesions or Pericaspsular Stiffness</td>
<td>ROM unaffected by proximal or distal joint positioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capsular End Feel</td>
<td>MOBILIZE</td>
</tr>
<tr>
<td>Shortened Extra-articular Muscle Groups</td>
<td>ROM affected by proximal or distal joint positioning</td>
<td>STRETCH</td>
</tr>
<tr>
<td>Muscle Weakness</td>
<td>ROM affected by gravity</td>
<td>STRENGTHEN</td>
</tr>
<tr>
<td>Pain</td>
<td>Empty end feel</td>
<td>MODALITIES Grade I-II Mobs</td>
</tr>
<tr>
<td>Nerve Root Adhesion</td>
<td>Neural Tension Tests</td>
<td>NEURAL MOBILIZATION</td>
</tr>
<tr>
<td>Soft Tissue Restrictions</td>
<td>Palpation</td>
<td>SOFT TISSUE MOBILIZATION</td>
</tr>
</tbody>
</table>

continuing ED
Determination of Joint Mobility

- difficult to assess
- quantity graded in millimeters
- quality graded by “end feel”
- poor intra/intertester reliability
- best gauged by comparison to uninvolved side

Direct Method
- manual assessment of decreased accessory motion in all directions

Indirect Method
- after noting decreased active and/or passive range of motion; apply the convex/concave rules to determine the direction of limited mobility
- This method is used when
  - patient has severe pain
  - joint is extremely hypomobile
  - therapist is inexperienced with direct assessment
CLASSIFICATION of JOINT MOBILITY

Ordinal Scale

<table>
<thead>
<tr>
<th>GRADE</th>
<th>DEFINITION</th>
<th>TREATMENT POSSIBILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Movement – joint ankylosed</td>
<td>No attempts should be made to mobilize</td>
</tr>
<tr>
<td>1</td>
<td>Extremely hypomobile</td>
<td>Mobilization</td>
</tr>
<tr>
<td>2</td>
<td>Slightly hypomobile</td>
<td>Mobilization-Manipulation</td>
</tr>
<tr>
<td>3</td>
<td>Normal</td>
<td>No dysfunction; no treatment needed</td>
</tr>
<tr>
<td>4</td>
<td>Slightly hypermobile</td>
<td>Look for hypomobility in adjacent joints. Exercise, taping, bracing, etc</td>
</tr>
<tr>
<td>5</td>
<td>Extremely hypermobile</td>
<td>Look for hypomobility in adjacent joints. Exercise, taping, bracing, etc</td>
</tr>
<tr>
<td>6</td>
<td>Unstable</td>
<td>Bracing, splinting, casting, surgical stabilization</td>
</tr>
</tbody>
</table>

MOTION SCHEMATIC

INSTABILITY  SLACK  LAXITY  SLACK  INSTABILITY

Disruption  Strain  Joint  Active  Resting  Active  Joint  Strain
Dislocation  Sprain  Play  Movement  Position  Movement  Play  Sprain

ACTIVE RANGE of MOTION
PHYSIOLOGICAL LIMIT of MOTION
ANATOMICAL LIMIT of MOTION
POTENTIAL DISABILITY
Objective 4

Define the resting and closed pack position of a joint

Joint Positions and Congruence

- Articular surfaces are rarely, if ever, in total congruence

- The area of contact or congruence at any particular point in the range of motion is relatively small compared to the surface area

- Allows for better lubrication and recovery time for the articular surfaces
**RESTING POSITION**

- Surrounding tissue is as lax as possible
  - Maximum incongruency
- Intracapsular space is as large as possible
- Position sought at rest or following acute trauma to accommodate maximal fluid accumulation
- Unlocked, statically inefficient for load bearing, and dynamically safe
- Treatment position
  - Max amount of joint play available

**CLOSED PACK POSITION**

- Joint positions are most congruent
- Surrounding tissue (capsules and ligaments) under maximal tension
- Intracapsular space is minimal
- Locked, statically efficient for load bearing, and dynamically dangerous
- Testing position
  - Ex: apprehension test of GH joint
Objective 5

Understand the treatment application principles that govern passive joint mobilization

Mobilization treatment

- Mobilization (movement) to a joint may:
  - fire articular mechanoreceptors
  - fire cutaneous and muscular receptors
  - abate nociceptors
  - decrease or relax muscle guarding
**mobilization treatment**

Therapeutic Effects of Mobilization include:

- stimulate synovial movement to nourish cartilage
- maintain/promote periarticular extensibility
- provide sensory input

**mobilization indications**

- pain relief
- decrease muscle guarding or spasm
- treat reversible joint hypomobility of capsular origin
mobilization treatment variables

- Joint position
- Direction of mobilization
- Type of mobilization
  - oscillation vs. sustained hold
- Grade (intensity) of mobilization
- Mobilization dosage

translatory glide mobilization grading

Grade I – small amplitude movement at the beginning of the available ROM
Grade II – large amplitude movement at within the available ROM
Grade III – large amplitude movement that reaches the end ROM
Grade IV – small amplitude movement at the very end range of motion
Grade V – high velocity thrust of small amplitude at the end of the available range and within its anatomical range (manipulation)
distraction mobilization grading

Grade I – unweighting or barely supporting the joint surfaces (piccolo)
- equalizes cohesive and atmospheric forces of the joint
- alleviates pain by unloading and decompressing
- nullifies normal compressive forces

Grade II – slack of the capsule taken up (eliminates joint pain)

Grade III – capsule and ligaments stretched

mobilization treatment considerations

- **Grades I and II**
  - “neurophysiological effect used daily to treat pain”
  - pain relief through neuromodulation on the sensory innervation of the joint mechanoreceptors and pain receptors
  - “gates pain achieved by the inhibition of transmission of nocioceptive stimuli at the spinal cord and brain stem level
  - neutralizes joint pressures
  - prevents grinding
continuing ED

mobilization treatment considerations

Grades III-V

- “mechanical effect used 3-5 times/week to treat stiffness or hypomobility”

- increase ROM through promotion of capsular mobility and plastic deformation

- mechanical distention and/or stretching of shortened tissues

mobilization treatment principles

**Oscillations**

- 60-120/min
- 1-5 sets of 5-60 sec
- generally used to treat pain

**Prolonged Hold**

- 5-30 seconds
- 1-5 reps
- typically applied at end range to treat stiffness

- Oscillations or prolonged hold at mid-range stimulates type I mechanoreceptors

- Oscillations or prolonged hold at end range stimulates type II mechanoreceptors

- Low grade sustained hold stimulates type III mechanoreceptors and inhibits guarding
### Articular Mechanoreceptors

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FUNCTION</th>
<th>LOCATION</th>
<th>FIRED BY</th>
<th>BEHAVIOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Postural</td>
<td>Superficial Capsule</td>
<td>Graded or progressive oscillations at end ROM</td>
<td>Slow Adapting Postural Kinesthetic Awareness Tonic Stabilizers</td>
</tr>
<tr>
<td></td>
<td>Active at Rest</td>
<td>Deep Capsule</td>
<td>Graded or progressive oscillations in mid ROM</td>
<td>Fast Adapting Dynamic Sensation Phasic Movers</td>
</tr>
<tr>
<td></td>
<td>Dynamic</td>
<td>Ligaments</td>
<td>Stretch or sustained hold at end ROM</td>
<td>Defensive Receptor Gives reflexive inhibition of muscle tone</td>
</tr>
<tr>
<td></td>
<td>Inhibitive</td>
<td>Most Tissues</td>
<td>Injury and Inflammation</td>
<td>Non-adapting Tonic reflexogenic effect which produces guarding</td>
</tr>
</tbody>
</table>

### Mobilization Treatment Rules

Position patient to achieve maximal relaxation

- Comfortable room temperature with patient properly draped
- Confident, firm, comfortable hand holds
- Remove watches and jewelry
- Secure ties, belt buckles, etc
mobilization treatment rules

- Articulate initially in resting position and then “chase” end range
- Use good body mechanics
- Allow gravity to assist
- Your body and the mobilizing part act as one unit
- Stabilize!!
- Short lever arms and hands as close to joint as possible
- Mobilize below the pain threshold
  - Avoid muscle guarding
  - Articulate in opposite direction if needed
  - **DO NOT CAUSE PAIN!!**

Objective 6

Recognize contraindications to mobilization treatment
Absolute Contraindications

• Malignancy in area of treatment
• Infectious Arthritis
• Metabolic Bone Disease
• Neoplastic Disease
• Fusion or Ankylosis
• Osteomyelitis
• Fracture or Ligament Rupture

Relative Contraindications

• Excessive pain or swelling
• Arthroplasty
• Pregnancy
• Hypermobility
• Spondylolisthesis
• Rheumatoid arthritis
• Vertebrobasilar insufficiency
Objective 7

Investigate what the literature suggests regarding mobilization effectiveness and efficacy

Does it Work?

Analysis of literature identified 14 studies that were judged to be valid demonstrations of the efficacy of manual therapy in the treatment of spine related dysfunction

Does it Work in the UE?

• Manual therapy combined with supervised clinical exercise resulted in superior outcomes to exercise alone in patients with shoulder impingement syndrome

• Mobilization decreased 24-hour pain and pain associated with subacromial compression test in patients with shoulder impingement syndrome

• The only effective treatment modality for adhesive capsulitis is mobilization and exercise therapy

• End-range mobilization techniques increased mobility in patients with adhesive capsulitis

Does it Work in the LE?

• Addition of talocrural mobilizations to the RICE protocol in the management of inversion ankle injuries necessitated fewer treatments to achieve pain-free dorsiflexion and to improve stride speed more than RICE alone.

• Joint mobilization and physical therapy resulted in a significant, although temporary, improvement in the mobility of the ankle and foot in diabetic patients with limited joint mobility and neuropathy
Objective 8

Memorize the morphological and capsular characteristics of each joint

Glenohumeral Joint

Concave Surface: glenoid fossa
Convex Surface: humeral head
Closed Pack Position: 90° Abduction and ER
Resting Position: 50-70° scaption with mild external rotation
Capsular Pattern: ER > Abd > IR
**HUMEROULNAR JOINT**

- Concave Surface: ulna
- Convex Surface: humeral trochlea

- Closed Pack Position: full extension
- Resting Position: 70° flexion; 10° supination
- Capsular Pattern: flexion > extension

**HUMERORADIAL JOINT**

- Concave Surface: radial head
- Convex Surface: humeral capitellum

- Closed Pack Position: 90° flexion; 5° supination
- Resting Position: Full extension-supination
- Capsular Pattern: flexion = extension
RADIOULNAR JOINT

Concave Surface: ulnar notch
Convex Surface: radial capitellum
Closed Pack Position: 5° supination
Resting Position: 70° flexion; 35° supination
Capsular Pattern: Equal limitation of pro-supination

WRIST JOINT

Concave Surface: distal radius-ulna
Convex Surface: proximal carpal row
Closed Pack Position: full extension and radial deviation
Resting Position: neutral with slight ulnar deviation
Capsular Pattern: flexion=extension
MCP and IP JOINTS

- Concave Surface: distal
- Convex Surface: proximal
- Closed Pack Position: Full flexion
- Resting Position: Slight flexion
- Capsular Pattern: Flexion > extension

SPINAL JOINTS

- Concave Surface: variable
- Convex Surface: variable
- Closed Pack Position: Full extension
- Resting Position: midway between flexion and extension
- Capsular Pattern: Lateral flexion and rotation equally limited, mild loss of extension
HIP JOINT

Concave Surface: acetabulum
Convex Surface: femoral head
Closed Pack Position: full extension and IR
Resting Position: 30° flexion, abduction, ER
Capsular Pattern: flexion, abduction, IR
(order varies)

KNEE JOINT

Concave Surface: tibial plateau
Convex Surface: femoral condyles
Closed Pack Position: full extension
Resting Position: 25-30° flexion
Capsular Pattern: flexion > extension
TIBIOFIBULAR JOINT

Concave Surface: tibia
Convex Surface: fibula
Closed Pack Position: maximum dorsiflexion
Resting Position: slight plantarflexion
Capsular Pattern: pain with stress

TALOCRURAL JOINT

Concave Surface: tib-fib talar dome
Convex Surface: talus
Closed Pack Position: maximum dorsiflexion
Resting Position: 10° plantarflexion
Capsular Pattern: plantarflexion > dorsiflexion
SUBTALAR JOINT

Concave Surface: talus  
Convex Surface: calcaneus  
Closed Pack Position: full supination 
Resting Position: STJ neutral  
Capsular Pattern: increasing loss of varus until stuck in valgus

MTJ, TMTJ, and First Ray have same resting and closed pack positions
MTP and IP JOINTS

Concave Surface: distal
Convex Surface: proximal articulation
Closed Pack Position: full hyperextension
Resting Position: slight plantarflexion
Capsular Pattern: Flexion = extension

Recommended Readings

thank you

continuing ED