Joint Mobilization and Traction Techniques in Rehabilitation

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Background

Following injury to a joint, there will almost always be some associated loss of motion.

This loss of movement may be attributed to a number of pathological factors, including contracture of inert connective tissue (for example, ligaments and joint capsule); resistance of the contractile tissue or the musculotendinous unit (for example, muscle, tendon, and fascia) to stretch; or some combination of the two.

If left untreated, the joint will become hypomobile and will eventually begin to show signs of degeneration.
Joint mobilization and traction are manual therapy techniques that involve slow, passive movements of articulating surface. They are used to collectively improve joint function, because these techniques:

- Regain normal active joint ROM
- Restore normal passive motions that occur about a joint
- Reposition or realign a joint
- Regain a normal distribution of forces and stresses about a joint
- Reduce pain

Joint mobilization and traction are two extremely effective and widely utilized techniques in the rehabilitation of sport-related injuries.
What is Joint Mobilization?

1. “Joint Mobs”

2. *Manual therapy technique*
   - Used to modulate pain
   - Used to increase ROM
   - Used to treat joint dysfunctions that limit ROM by specifically addressing altered joint mechanics

3. Factors that may alter joint mechanics:
   - Pain & Muscle guarding
   - Joint hypomobility
   - Joint effusion
   - Contractures or adhesions in the joint capsules or supporting ligaments
   - Malalignment or subluxation of bony surfaces
Terminology

- **Mobilization** – passive joint movement for increasing ROM or decreasing pain
  - Applied to joints & related soft tissues at varying speeds & amplitudes using physiologic or accessory motions
  - Force is light enough that patient’s can stop the movement

- **Manipulation** – passive joint movement for increasing joint mobility
  - Incorporates a sudden, forceful thrust that is beyond the patient’s control
**Terminology**

1. **Self-Mobilization (Auto-mobilization)** – self-stretching techniques that specifically use joint traction or glides that direct the stretch force to the joint capsule.

2. **Mobilization with Movement (MWM)** – concurrent application of a sustained accessory mobilization applied by a clinician & an active physiologic movement to end range applied by the patient
   - Applied in a pain-free direction
Terminology

- **Physiologic Movements** – movements done voluntarily
  - Osteokinematics – motions of the bones

- **Accessory Movements** – movements within the joint & surrounding tissues that are necessary for normal ROM, but can not be voluntarily performed
  - *Component motions* – motions that accompany active motion, but are not under voluntary control
    - Ex: Upward rotation of scapula & rotation of clavicle that occur with shoulder flexion
  - *Joint play* – motions that occur within the joint
    - Determined by joint capsule’s laxity
    - Can be demonstrated passively, but not performed actively
Two Type of Motions

There are basically two types of movement that govern motion about a joint:

1. **Physiological (osteokinematic) motion.** Result from either concentric or eccentric active muscle contractions that move a bone or a joint. A bone can move about an axis of rotation or a joint into flexion, extension, abduction, adduction, and rotation.

2. **Accessory (arthrokinematic) motion.** Involve the manner in which one articulating joint surface moves relative to another.
Characteristics

- Physiological movement is voluntary; accessory movements normally accompany physiological movement. The two occur simultaneously.
- Although accessory movements cannot occur independently, they can be produced by some external force.
- Normal accessory component motions must occur for full-range physiological movement to take place.
- If any of the accessory component motions are restricted, normal physiological cardinal plane movements will not occur, muscle cannot be fully rehabilitated if the joint is not free to move, and vice versa.
Traditionally in rehabilitation programs we have tended to concentrate more on passive physiological movements without paying much attention to accessory motions.

The question is always being asked, "How much flexion or extension is this patient lacking?" Rarely will anyone ask. "How much is rolling or gliding restricted?"

It is critical for the team physician to closely evaluate the injured joint to determine whether motion is limited by physiological movement constraints involving musculotendinous units or by limitation in accessory motion involving the joint capsule and ligaments.
Restriction of Physiological Movement

1. If physiological movement is restricted, the athlete should engage in stretching activities designed to improve flexibility.

2. Stretching exercises should be used whenever there is resistance of the contractile elements to stretch.

3. Stretching techniques are most effective at the end of physiological range of movement: they are limited to one direction, and they require some element of discomfort if additional range of motion is to be achieved.

4. Stretching techniques make use of long lever arms to apply stretch to a given muscle.

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Restriction of Accessory Movement

- If accessory motion is limited by some restriction of the joint capsule or the ligaments, the team physician should incorporate mobilization techniques into the treatment program.

- Mobilization techniques should be used whenever there are tight inert or noncontractile articular structures.

- They can be used effectively at any point in the range of motion, and they can be used in any direction in which movement is restricted.

- Mobilization techniques use a short lever arm to stretch ligaments and joint capsules, placing less stress on these structures, and consequently are somewhat safer to use than stretching techniques.
Joint Shapes & Arthrokinematics

- **Ovoid** – one surface is convex, other surface is concave
  - What is an example of an ovoid joint?

- **Sellar (saddle)** – one surface is concave in one direction & convex in the other, with the opposing surface convex & concave respectively
  - What is an example of a sellar joint?

- 5 types of joint arthrokinematics
  - Roll
  - Slide
  - Spin
  - Compression
  - Distraction

- 3 components of joint mobilization
  - Roll, Spin, Slide
  - Joint motion usually often involves a combination of rolling, sliding & spinning
JOINT ARTHROKINEMATICS

1. Spin occurs around some stationary longitudinal mechanical axis and can be in either a clockwise or a counterclockwise direction.

2. An example of spinning is motion of the radial head at the humeroradial joint as occurs in forearm pronation/supination.
Arthrokinematic SPIN

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

loss of traction analogy
Arthrokinematic Motions

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

Pure Spin: B contacts point 1
Spin

- Occurs when one bone rotates around a stationary longitudinal mechanical axis
  - Same point on the moving surface creates an arc of a circle as the bone spins
  - Example: Radial head at the humeroradial joint during pronation/supination; shoulder flexion/extension; hip flexion/extension
  - Spin does not occur by itself during normal joint motion
Spin

1. There is rotation of a segment about a stationary mechanical axis.
2. The same point on the moving surface creates an arc of a circle as the bone spins.
3. Spinning rarely occurs alone in joints but in combination with rolling and sliding.
4. Three examples of spin occurring in joints of the body are the shoulder with flexion/extension, the hip with flexion/extension, and the radiohumeral joint with pronation/supination.

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Diagrammatic representation of spinning. There is rotation of a segment about a stationary mechanical axis.
Examples of joint spin location in the body. (A) Humerus with flexion/extension. (B) Femur with flexion/extension. (C) Head of the radius with pronation/supination.
Rolling occurs when a series of points on one articulating surface comes into contact with a series of points on another articulating surface.

An analogy would be the rocker of a rocking chair rolling on the flat surface of the floor.

An anatomical example would be the rounded femoral condyles rolling over a stationary flat tibial plateau.
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 Motions

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

Pure Roll: B contacts point 3
Roll

A series of points on one articulating surface come into contact with a series of points on another surface

- Rocking chair analogy; ball rolling on ground
- Example: Femoral condyles rolling on tibial plateau
- Roll occurs in direction of movement
- Occurs on incongruent (unequal) surfaces
- Usually occurs in combination with sliding or spinning
The surfaces are incongruent.

New points on one surface meet new points on the opposing surface.

Rolling results in angular motion of the bone (swing).

Rolling is always in the same direction as the swinging bone motion, whether the surface is Convex or concave.

Rolling, if it occurs alone, causes compression of the surfaces on the side to which the bone is swinging and separation on the other side. Passive stretching using bone angulation alone may cause stressful compressive forces to portions of the joint surface, potentially leading to joint damage.

In normally functioning joints, pure rolling does not occur alone but in combination with joint sliding and spinning.
Diagrammatic representation of one surface rolling on another. New points on one surface meet new points on the opposing surface.
Rolling is always in the same direction as bone motion, whether the moving bone is (A) convex or (B) concave.
Gliding (translation) occurs when a specific point on one articulating surface comes into contact with a series of points on another surface.

Returning to the rocking chair analogy. The rocker slides across the flat surface of the floor without any rocking at all.

Anatomically, gliding would occur during an anterior drawer test at the knee when the flat tibial plateau slides anteriorly relative to the fixed rounded femoral condyles.
Arthrokineamatic 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

braking analogy

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Arthrokinematic Motions

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

Pure Glide: A contacts point 2
Slide

- Specific point on one surface comes into contact with a series of points on another surface

- Surfaces are congruent

- When a passive mobilization technique is applied to produce a slide in the joint – referred to as a GLIDE.

- Combined rolling-sliding in a joint
  - The more congruent the surfaces are, the more sliding there is
  - The more incongruent the joint surfaces are, the more rolling there is

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Slide or Glide

- For a pure slide, the surfaces must be congruent, either flat or curved.
- The same point on one surface comes into contact with the new points on the opposing surface.
- Pure sliding does not occur in joints, because the surfaces are not completely congruent.
- The direction in which sliding occurs depends on whether the moving surface is concave or convex. Sliding is in the opposite direction of the angular movement of the bone if the moving joint surface is convex. Sliding is in the same direction as the angular movement of the bone if the moving surface is concave.
Diagrammatic representation of one surface sliding on another, whether (A) flat or (B) curved. The same point on one surface comes into contact with new points on the opposing surface.
Arthrokinematic Motions

Concave on Convex

Spin

Roll

Slide

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Arthrokinematic Motions

Convex on Concave

A
Convex on concave
Spin

B
Roll

C
Slide

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Pure gliding can occur only if the two articulating surfaces are congruent where either both are flat or both are curved.

Virtually all articulating joint surfaces are incongruent, meaning that one is usually flat while the other is more curved, so it is more likely that gliding will occur simultaneously with a rolling motion.

Rolling does not occur alone, because this would result in compression or perhaps dislocation of the joint.
Arthrokinematic Motions

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

Glide and Roll: B contacts point 2

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Combined Roll-Sliding in a Joint

1. The more congruent the joint surfaces are, the more sliding there is of one bony partner on the other with movement.

2. The more incongruent the joint surfaces are, the more rolling there is of one bony partner on the other with movement.

3. When muscles actively contract to move a bone, some of the muscles may cause or control the sliding movement of the joint surfaces. For example, the caudal sliding motion of the humeral head during shoulder abduction is caused by the rotator cuff muscles, and the posterior sliding of the tibia during knee flexion is caused by the hamstring muscles. If this function is lost, the resulting abnormal joint mechanics may cause microtrauma and joint dysfunction.

4. The joint mobilization techniques described in this chapter use the sliding component of joint motion to restore joint play and reverse joint hypomobility.

5. Rolling (passive angular stretching) is not used to stretch tight joint capsules because it causes joint compression.
1 Compression –
   - Decrease in space between two joint surfaces
   - Adds stability to a joint
   - Normal reaction of a joint to muscle contraction

1 Distraction -
   - Two surfaces are pulled apart
   - Often used in combination with joint mobilizations to increase stretch of capsule.
Other Accessory Motions that Affect the Joint

Compression

- Compression is the decrease in the joint space between bony partners.
- Compression normally occurs in the extremity and spinal joints when weight-bearing.
- Some compression occurs as muscles contract, which provides stability to the joints.
- As one bone rolls on the other, some compression also occurs on the side to which the bone is angulating.
- Normal intermittent compressive loads help move synovial fluid and thus help maintain cartilage health.
- Abnormally high compression loads may lead to articular cartilage changes and deterioration.
Traction

Traction or distraction is the separation of the joint surfaces.

For distraction to occur within the joint, the surfaces must be pulled apart. The movement is not always the same as pulling on the long axis of one of the bony partners. For example, if traction is applied to the shaft of the humerus, it will result in a glide of the joint surface. Distraction of the glenohumeral joint requires a pull at right angles to the glenoid fossa.

For clarity, whenever there is pulling on the long axis of a bone, the term long-axis traction will be used. Whenever the surfaces are to be pulled apart at right angles, the terms distraction, joint traction, or joint separation will be used.
Direction of Accessory Movements

- Although rolling and gliding usually occur together, they are not necessarily in similar proportion, nor are they always in the same direction.
- If the articulating surfaces are more congruent, more gliding will occur, whereas if they are less congruent, more rolling will occur.
- Rolling will always occur in the same direction as the movement. For example; in the knee joint when the foot is fixed on the ground, the femur will always roll in an anterior direction when moving into knee extension and conversely will roll posteriorly when moving into flexion.
Direction of Accessory Movements

The direction of the gliding component of motion is determined by the shape of the articulating surface that is moving.

If you consider the shape of two articulating surfaces, one joint surface can be determined to be convex in shape while the other may be considered to be concave in shape. In the knee, the femoral condyles would be considered the convex joint surface, while the tibial plateau would be the concave joint surface.

In the glenohumeral joint, the humeral head would be the convex surface, while the glenoid fossa would be the concave surface.
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
Convex – Concave Rule

1. It is the relationship between the shape of articulating joint surfaces and the direction of gliding.

2. If the concave joint surface is moving on a stationary convex surface, gliding will occur in the same direction as the rolling motion.

3. Conversely, if the convex surface is moving on a stationary concave surface, gliding will occur in an opposite direction to rolling.

4. Hypomobile joints are treated by using a gliding technique. Thus it is critical to know the appropriate direction to use for gliding.
A. Convex moving on concave.
B. Concave moving on Convex.
Rules of Motion

Concave Motion Rule

- convex surface is stationary and concave surface moves
- osteo and arthrokinematic motion is in same direction
- arthrokinematic mobilization gliding in 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**
Diagrammatic representation of the concave-convex rule. (A) If the surface of the moving bone is convex, sliding is in the opposite direction of the angular movement of the bone. (B) If the surface of the moving bone is concave, sliding is in the same direction as the angular movement of the bone.
**Convex-Concave & Concave-Convex Rule**

- Basic application of correct mobilization techniques - **need to understand this!**
  - Relationship of articulating surfaces associated with sliding/gliding

- One joint surface is MOBILE & one is STABLE

- Concave-convex rule: concave joint surfaces slide in the SAME direction as the bone movement (convex is STABLE)
  - If concave joint is moving on stationary convex surface – glide occurs in same direction as roll

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Convex-concave rule: convex joint surfaces slide in the **OPPOSITE** direction of the bone movement (concave is **STABLE**)

If convex surface in moving on stationary concave surface – gliding occurs in opposite direction to roll
Joint Positions

1. Each joint in the body has a position in which the joint capsule and the ligaments are most relaxed, allowing for a maximum amount of joint play. This position is called the resting position.

2. It is essential to know specifically where the resting position is, because testing for joint play during an evaluation, and treatment of the hypomobile joint using either mobilization or traction, are both usually performed in this position.
Placing the joint capsule in the resting position allows the joint to assume a *loose-packed position* in which the articulating joint surfaces are maximally separated.

A *close-packed position* is one in which there is maximal contact of the articulating surfaces of bones with the capsule and ligaments tight or tense.

In a *loose-packed position* the joint will exhibit the greatest amount of joint play, whereas the close-packed position allows for no joint play. Thus the loose-packed position is most appropriate for mobilization and traction.
Joint Positions

1. Resting position
   - Maximum joint play - position in which joint capsule and ligaments are most relaxed
   - Evaluation and treatment position utilized with hypomobile joints

2. Loose-packed position
   - Articulating surfaces are maximally separated
   - Joint will exhibit greatest amount of joint play
   - Position used for both traction and joint mobilization

3. Close-packed position
   - Joint surfaces are in maximal contact to each other

4. General rule: Extremes of joint motion are close-packed, & midrange positions are loose-packed.
Both mobilization and traction techniques use a translational movement of one joint surface relative to the other.

This translation can be in one of two directions: either perpendicular or parallel to the treatment plane.

The treatment plane falls perpendicular to or at a right angle to a line running from the axis of rotation in the convex surface to the center of the concave articular surface. Thus the treatment plane lies within the concave surface.
If the convex segment moves, the treatment plane remains fixed. However, the treatment plane will move along with the concave segment.

Mobilization techniques use glides that translate one articulating surface along a line parallel with the treatment plane.

Traction techniques translate one of the articulating surfaces in a perpendicular direction to the treatment plane.

Both techniques use a loose-packed joint position.
The treatment plane is perpendicular to a line drawn from the axis of rotation to the center of the articulating surface of the concave segment.
Joint Mobilization Techniques

The techniques of joint mobilization are used to improve joint mobility or to decrease joint pain by restoring accessory movements to the joint and thus allowing full, nonrestricted, pain-free ROM.

Mobilization techniques may be used to attain a variety of either mechanical or neurophysiological treatment goals:

- Reducing pain
- Decreasing muscle guarding
- Stretching or lengthening tissue surrounding a joint, in particular capsular and ligamentous tissue
- Reflexogenic effects that either inhibit or facilitate muscle tone or stretch reflex
- Proprioceptive effects to improve postural and kinesthetic awareness.

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Effects of Joint Mobilization

1 Neurophysiological effects –
   - Stimulates mechanoreceptors to pain
   - Affect muscle spasm & muscle guarding – nociceptive stimulation
   - Increase in awareness of position & motion because of afferent nerve impulses

1 Nutritional effects –
   - Distraction or small gliding movements – cause synovial fluid movement
   - Movement can improve nutrient exchange due to joint swelling & immobilization

1 Mechanical effects –
   - Improve mobility of hypomobile joints (adhesions & thickened CT from immobilization – loosens)
   - Maintains extensibility & tensile strength of articular tissues

1 Cracking noise may sometimes occur
Effects of Joint Motion

1. Joint motion stimulates biological activity by moving synovial fluid, which brings nutrients to the avascular articular cartilage of the joint surfaces and intra-articular fibrocartilage of the menisci. Atrophy of the articular cartilage begins soon after immobilization is imposed on joints.

2. Joint motion maintains extensibility and tensile strength of the articular and periarticular tissues. With immobilization there is fibrofatty proliferation, which causes intra-articular adhesions, as well as biochemical changes in tendon, ligament, and joint capsule tissue, which causes joint contractures and ligamentous weakening.
Afferent nerve impulses from joint receptors transmit information to the central nervous system and, therefore, provide for awareness of position and motion. With injury or joint degeneration, there is a potential decrease in an important source of proprioceptive feedback that may affect an individual's balance response. Joint motion provides sensory input relative to:

- Static position and sense of speed of movement (type I receptors found in the superficial joint capsule)
- Change of speed of movement (type II receptors found in deep layers of the joint capsule and articular fat pads)
- Sense of direction of movement (type I and III receptors; type III found in joint ligaments)
- Regulation of muscle tone (type I, II, and III receptors)
- Nociceptive stimuli (type IV receptors found in the fibrous capsule, ligaments, articular fat pads, periosteum, and walls of blood vessels)
Limitations of Joint Mobilization Techniques

Mobilization techniques cannot change the disease process of disorders such as rheumatoid arthritis or the inflammatory process of injury. In these cases, treatment is directed toward minimizing pain, maintaining available joint play, and reducing the effects of any mechanical limitations.

The skill of the therapist will affect the outcome. The techniques described in this text are relatively safe if directions are followed and precautions are heeded, but if these techniques are used indiscriminately on patients not properly evaluated and screened for such maneuvers or if they are applied too vigorously for the condition, joint trauma or hypermobility may result.
Measurements

1. Movement throughout a ROM can be quantified with various measurement techniques.

2. Physiological movement is measured with a goniometer and composes the major portion of the range.

3. Accessory motion is thought of in millimeters, although precise measurement is difficult.
Accessory movements can be hypomobile, normal, or hypermobile.

Each joint has a range of motion continuum with an anatomical limit (AL) to motion that is determined by both bony arrangement and surrounding soft tissue.
### 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>

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MOTION SCHEMATIC

INSTABILITY    SLACK    LAXITY    SLACK    INSTABILITY

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

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

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In a hypomobile joint, motion stops at some point referred to as a pathological point of limitation (PL), short of the anatomical limit caused by pain, spasm, or tissue resistance.

A hypermobile joint moves beyond its anatomical limit because of laxity of the surrounding structures.

A hypomobile joint should respond well to techniques of mobilization and traction.

A hypermobile joint should be treated with strengthening exercises, stability exercises, and, if indicated, taping, splinting, or bracing.
In a hypomobile joint, as mobilization techniques are used into the ROM restriction, some deformation of soft tissue capsular or ligamentous structures occurs.

If a tissue is stretched only into its elastic range, no permanent structural changes will occur.

However, if that tissue is stretched into its plastic range, permanent structural changes will occur.

Thus, mobilization and traction can be used to stretch tissue and break adhesions.

If used inappropriately, they can also damage tissue and cause sprains of the joint.
Treatment techniques designed to improve accessory movement are generally slow, small-amplitude movements, amplitude being the distance that the joint is move passively within its total range.

Mobilization techniques use these small-amplitude oscillating motions that glide or slide one of the articulating joint surfaces in an appropriate direction within a specific part of the range.
Maitland has described various grades of oscillation for joint mobilization. The amplitude of each oscillation grade falls within the ROM continuum between some beginning point (BP) and the AL.

There are various grades of oscillation that are used in a joint with some limitation of motion. As the severity of the movement restriction increases, the PL will move to the left, away from the AL. However, the relationships that exist among the five grades in terms of their positions within the ROM remain the same.
Maitland’s five grades of motion
The five mobilization grades

1. *Grade I*. A small-amplitude movement at the beginning of the ROM. Used when pain and spasm limit movement early in the ROM.

2. *Grade II*. A large-amplitude movement within the midrange of movement. Used when spasm limits movement sooner with a quick oscillation than with a slow one or when slowly increasing pain restricts movement halfway into the range.
Grade III. A large-amplitude movement up to the PL, in the range of movement. Used when pain and resistance from spasm, inert tissue tension, or tissue compression limit movement near the end of the range.

Grade IV. A small-amplitude movement at the very end of the range of movement. Used when resistance limits movement in the absence of pain and spasm.

Grade V. A small-amplitude, quick thrust delivered at the end of the range of movement, usually accompanied by a popping sound, which is called a manipulation. Used when minimal resistance limits the end of the range. Manipulation is most effectively accomplished by the velocity of the thrust rather than by the force of the thrust.
Most authorities agree that manipulation should be used only by individuals trained specifically in these techniques, because a great deal of skill and judgment is necessary for safe and effective treatment.
Maitland Joint Mobilization Grading Scale

- Grading based on amplitude of movement & where within available ROM the force is applied.

- Grade I
  - Small amplitude rhythmic oscillating movement at the **beginning** of range of movement
  - Manage pain and spasm

- Grade II
  - Large amplitude rhythmic oscillating movement within **midrange** of movement
  - Manage pain and spasm

- Grades I & II – often used before & after treatment with grades III & IV
Grade III
- Large amplitude rhythmic oscillating movement up to point of limitation (PL) in range of movement
- Used to gain motion within the joint
- Stretches capsule & CT structures

Grade IV
- Small amplitude rhythmic oscillating movement at very end range of movement
- Used to gain motion within the joint
  - Used when resistance limits movement in absence of pain

Grade V – (thrust technique) - Manipulation
- Small amplitude, quick thrust at end of range
- Accompanied by popping sound (manipulation)
- Velocity vs. force
- Requires training
Joint mobilization uses these oscillating gliding motions of one articulating joint surface in whatever direction is appropriate for the existing restriction.

The appropriate direction for these oscillating glides is determined by the **convex-concave rule**.

When the concave surface is stationary and the convex surface is mobilized, a glide of the convex segment should be in the direction opposite to the restriction of joint movement.

If the convex articular surface is stationary and the concave surface is mobilized, gliding of the *concave* segment should be in the same direction as the restriction of joint movement.
A. Glides of the convex segment should be in the direction opposite to the restriction.

B. Glides of the concave segment should be in the direction of the restriction.
Examples

1. The glenohumeral joint would be considered to be a convex joint with the convex humeral head moving on the concave glenoid. If shoulder abduction is restricted, the humerus should be glided in an inferior direction relative to the glenoid to alleviate the motion restriction.

2. When mobilizing the knee joint, the concave tibia should be glided anteriorly in cases where knee extension is restricted.

3. If mobilization in the appropriate direction exacerbates complaints of pain or stiffness, the athletic trainer should apply the technique in the opposite direction until the patient can tolerate the appropriate direction.
Indications for Joint Mobilization

- Pain, Muscle Guarding, and Spasm
- Reversible Joint Hypomobility
- Positional Faults/Subluxations
- Progressive Limitation
- Functional Immobility
Pain, Muscle Guarding, and Spasm

- Painful joints, reflex muscle guarding, and muscle spasm can be treated with gentle joint-play techniques to stimulate neurophysiologic and mechanical effects.

Neurophysiological Effects

- Small-amplitude oscillatory and distraction movements are used to stimulate the mechanoreceptors that may inhibit the transmission of nociceptive stimuli at the spinal cord or brain stem levels.

Mechanical Effects

- Small-amplitude distraction or gliding movements of the joint are used to cause synovial fluid motion, which is the vehicle for bringing nutrients to the avascular portions of the articular cartilage (and intra-articular fibrocartilage when present). Gentle joint-play techniques help maintain nutrient exchange and thus prevent the painful and degenerating effects of stasis when a joint is swollen or painful and cannot move through a ROM.
Reversible Joint Hypomobility

1. Reversible joint hypomobility can be treated with *progressively vigorous joint-play stretching* techniques to elongate hypomobile capsular and ligamentous connective tissue.

2. Sustained or oscillatory stretch forces are used to mechanically distend the shortened tissue.
Positional Faults/Subluxations

- A malposition of one bony partner with respect to its opposing surface may result in limited motion or pain. This can occur with a traumatic injury, after periods of immobility, or with muscle imbalances.

- The malpositioning may be perpetuated with maladapted neuromuscular control across the joint so that whenever attempting active ROM there is faulty tracking of the joint surfaces resulting in pain or limited motion. Mobilization with movement (MWM) techniques attempt to realign the bony partners while the person actively moves the joint through its ROM. Manipulations are used to reposition an obvious subluxation such as a pulled elbow or capitate-lunate subluxation.
Progressive Limitation

- Diseases that progressively limit movement can be treated with joint-play techniques to maintain available motion or retard progressive mechanical restrictions.
- The dosage of distraction or glide is dictated by the patient's response to treatment and the state of the disease.
When a patient cannot functionally move a joint for a period of time, the joint can be treated with nonstretch gliding or distraction techniques to maintain available joint play and prevent the degenerating and restricting effects of immobility.
Indications for Mobilization

1. In Maitland’s system, grades I and II are used primarily for treatment of pain, and grades III and IV are used for treating stiffness. Pain must be treated first and stiffness second.

1. Painful conditions should be treated on a daily basis. The purpose of the small amplitude oscillations is to stimulate mechanoreceptors within the joint that can limit the transmission of pain perception at the spinal cord or brain stem levels.

1. Joints that are stiff or hypomobile and have restricted movement should be treated 3 to 4 times per week on alternating days with active motion exercise. The athletic trainer must continuously reevaluate the joint to determine appropriate progression from one oscillation grade to another.
Indications for Specific Mobilization Grades

1. If the athlete complains of pain before the athletic trainer can apply any resistance to movement, it is too early and all mobilization techniques should be avoided.

2. If pain is elicited when resistance to motion is applied, mobilization using grades I and II is appropriate.

3. If resistance can be applied before pain is elicited, mobilization can be progressed to grades III and IV.

By Farzin Halabchi
Indications for Mobilization

1. Grades I and II - primarily used for pain
   - Pain must be treated prior to stiffness
   - Painful conditions can be treated daily
   - Small amplitude oscillations stimulate mechanoreceptors - limit pain perception

2. Grades III and IV - primarily used to increase motion
   - Stiff or hypomobile joints should be treated 3-4 times per week – alternate with active motion exercises
Contraindications for Mobilization

Techniques of mobilization and manipulation should not be used haphazardly.

These techniques should generally not be used in cases of inflammatory arthritis, malignancy, bone disease, neurological involvement, bone fracture, congenital bone deformities, and vascular disorders of the vertebral artery.

Again, manipulation should be performed only by those athletic trainers specifically trained in the procedure, because some special knowledge and judgment are required for effective treatment.

By Farzin Halabchi
Contraindications for Mobilization

1. Should not be used haphazardly

2. Avoid the following:
   - Inflammatory arthritis
   - Malignancy
   - Tuberculosis
   - Osteoporosis
   - Ligamentous rupture
   - Herniated disks with nerve compression
   - Bone disease

3. May use I & II mobilizations to relieve pain
   - Neurological involvement
   - Bone fracture
   - Congenital bone deformities
   - Vascular disorders
   - Joint effusion

By Farzin Halabchi
Contraindications and Precautions

1. The only true contraindications to stretching techniques are hypermobility, joint effusion, and inflammation.
The joints of patients with potential necrosis of the ligaments or capsule should not be stretched.

Patients with painful hypermobile joints may benefit from gentle joint-play techniques if kept within the limits of motion; stretching is not done.
Joint Effusion

1. There may be joint swelling (effusion) from trauma or disease.

2. Rapid swelling of a joint usually indicates bleeding within the joint and may occur with trauma or in diseases such as hemophilia. Medical intervention is required for aspiration of the blood to minimize its necrotizing effect on the articular cartilage.

3. Slow swelling (greater than 4 hours) usually indicates serous effusion (a buildup of excess synovial fluid) or edema within the joint from mild trauma, irritation, or a disease, such as arthritis.
Joint Effusion

1. Never stretch a swollen joint with mobilization or passive stretching techniques. The capsule is already on a stretch by being distended to accommodate the extra fluid. The limited motion is from the extra fluid and muscle response to pain, not from shortened fibers.

2. Gentle oscillating motions that do not stress or stretch the capsule may help block the transmission of a pain stimulus so that it is not perceived and may also help improve fluid flow while maintaining available joint play.

3. If the patient's response to gentle techniques results in increased pain or joint irritability, the techniques were applied too vigorously or should not be done with the current state of pathology.

By Farzin Halabchi
Inflammation

- Whenever inflammation is present, stretching will increase pain and muscle guarding and will result in greater tissue damage.
- Gentle oscillating or distraction motions may temporarily inhibit the pain response.
Conditions Requiring Special Precautions for Stretching

1. In most cases, joint mobilization techniques are safer than passive angular stretching, in which the bony lever is used to stretch tight tissue and joint compression results.

2. Mobilization may be used with extreme care in the following conditions if signs and the patient's response are favorable:
- Malignancy.
- Bone disease detectable on x-ray.
- Unhealed fracture (depends on the site of the fracture and stabilization provided).
- Excessive pain (determine the cause of pain and modify treatment accordingly).
- Hypermobility in associated joints (associated joints must be properly stabilized so the mobilization force is not transmitted to them).
- Total joint replacements (the mechanism of the replacement is self-limiting, and therefore, the mobilization gliding techniques may be inappropriate).
- Newly formed or weakened connective tissue such as immediately after injury, surgery, or disuse or when the patient is taking certain medications such as corticosteroids (gentle progressive techniques within the tolerance of the tissue help align the developing fibrils, but forceful techniques are destructive).
- Systemic connective tissue diseases such as rheumatoid arthritis, in which the disease weakens the connective tissue (gentle techniques may benefit restricted tissue, but forceful techniques may rupture tissue and result in instabilities).
- Elderly individuals with weakened connective tissue and diminished circulation (gentle techniques within the tolerance of the tissue may be beneficial to increase mobility).
Precautions

- Osteoarthritis
- Pregnancy
- Flu
- Total joint replacement
- Severe scoliosis
- Poor general health
- Patient’s inability to relax
JOINT TRACTION TECHNIQUES

1. Traction is a technique involving pulling on one articulating segment to produce some separation of the two joint surfaces.

2. Although mobilization glides are done parallel to the treatment plane, traction is performed perpendicular to the treatment plane.

3. Like mobilization techniques, traction can be used either to decrease pain or to reduce joint hypomobility.
Traction should be **perpendicular** to the treatment plane, while glides are parallel to the treatment plane.
JOINT TRACTION TECHNIQUES

1. Kaltenborn has proposed a system using traction combined with mobilization as a means of reducing pain or mobilizing hypomobile joints.

2. All joints have a certain amount of joint play or looseness. Kaltenborn referred to this looseness as *slack*.

3. Some degree of slack is necessary for normal joint motion.
Joint Traction Techniques

- Technique involving pulling one articulating surface away from another – creating separation
- Performed perpendicular to treatment plane
- Used to decrease pain or reduce joint hypomobility
- Kaltenborn classification system
  - Combines traction and mobilization
  - Joint looseness = slack
Kaltenborn's 3 Traction Grades

1. *Grade I traction (loosen).* *Traction* that neutralizes pressure in the joint without actual separation of the joint surfaces.

2. The purpose is to produce pain relief by reducing the compressive forces of articular surfaces during mobilization and is used with all mobilization grades.
Grade II traction (tighten or "take up the slack"). Traction that effectively separates the articulating surfaces and takes up the slack or eliminates play in the joint capsule. Grade II is used in initial treatment to determine joint sensitivity.

Grade III traction (stretch). Traction that involves actual stretching of the soft tissue surrounding the joint to increase mobility in a hypomobile joint.
Kaltenborn’s grades of traction
Indications

Grade I traction should be used in the initial treatment to reduce the chance of a painful reaction. It is recommended that 10-second intermittent grades I and II traction be used, distracting the joint surfaces up to a grade III traction and then releasing distraction until the joint returns to its resting position.

Kaltenborn emphasizes that grade III traction should be used in conjunction with mobilization glides to treat joint hypomobility. Grade III traction stretches the joint capsule and increases the space between the articulating surfaces, placing the joint in a loose-packed position. Applying grade III and grade IV oscillations within the athlete's pain limitations should maximally improve joint mobility.
Kaltenborn Traction Grading

1 Grade I (loosen)
   - Neutralizes pressure in joint without actual surface separation
   - Produce pain relief by reducing compressive forces

1 Grade II (tighten or take up slack)
   - Separates articulating surfaces, taking up slack or eliminating play within joint capsule
   - Used initially to determine joint sensitivity

1 Grade III (stretch)
   - Involves stretching of soft tissue surrounding joint
   - Increase mobility in hypomobile joint
Grade I traction should be used initially to reduce chance of painful reaction

10 second intermittent grade I & II traction can be used

Distracting joint surface up to a grade III & releasing allows for return to resting position

Grade III traction should be used in conjunction with mobilization glides for hypomobile joints
- Application of grade III traction (loose-pack position)
- Grade III and IV oscillations within pain limitation to decrease hypomobility
Grades or Dosages of Movement

Two systems of grading dosages for mobilization are used:

- Graded Oscillation Techniques
- Sustained Translatory Joint-Play Techniques
Graded Oscillation Techniques

**Dosages**

- **Grade I.** Small-amplitude rhythmic oscillations are performed at the beginning of the range.
- **Grade II.** Large-amplitude rhythmic oscillations are performed within the range, not reaching the limit.
- **Grade III.** Large-amplitude rhythmic oscillations are performed up to the limit of the available motion and are stressed into the tissue resistance.
- **Grade IV.** Small-amplitude rhythmic oscillations are performed at the limit of the available motion and stressed into the tissue resistance.
- **Grade V.** A small-amplitude, high-velocity thrust technique is performed to snap adhesions at the limit of the available motion. Thrust techniques used for this purpose require advanced training and are beyond the scope of this book.
Diagrammatic representation of graded oscillation techniques.
(Adapted from Maitland)
Uses

1. Grades I and II are primarily used for treating joints limited by pain. The oscillations may have an inhibitory effect on perception of painful stimuli by repetitively stimulating mechanoreceptors that block nociceptive pathways at the spinal cord or brain stem levels. These nonstretch motions help move synovial fluid to improve nutrition to the cartilage.

1. Grades III and IV are primarily used as stretching maneuvers.
Techniques

The oscillations may be performed using physiologic (osteokinematic) motions or joint-play (arthrokinematic) techniques.
Sustained Translatory Joint-Play Techniques
Diagrammatic representation of sustained translatory joint-play techniques. (Adapted from Kaltenborn)
Dosages

1. Grade I (loosen). Small-amplitude distraction is applied where no stress is placed on the capsule. It equalizes cohesive forces, muscle tension, and atmospheric pressure acting on the joint.

2. Grade II (tighten). Enough distraction or glide is applied to tighten the tissues around the joint. Kaltenborn calls this "taking up the slack."

3. Grade III (stretch). A distraction or glide is applied with an amplitude large enough to place a stretch on the joint capsule and on surrounding periarticular structures.

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Uses

- Grade I distraction is used with all gliding motions and may be used for relief of pain.
- Grade II distraction is used for the initial treatment to determine how sensitive the joint is. Once joint reaction is known, the dosage of treatment is either increased or decreased accordingly.
- Gentle grade II distraction applied intermittently may be used to inhibit pain. Grade II glides may be used to maintain joint play when ROM is not allowed.
- Grade III joint distraction or glides are used to stretch the joint structures and, thus, increase joint play.
Techniques

This grading system describes only joint-play techniques that separate (distract) or glide (slide) the joint surfaces.
Comparison

1. When using either grading system, dosages I and II are low intensity and so do not cause a stretch force on the joint capsule or surrounding tissue, although, by definition, sustained grade II techniques take up the slack of the tissues whereas grade II oscillation techniques stay within the slack.

2. Grades III and IV oscillations and grade III sustained stretch techniques are similar in intensity in that they all are applied with a stretch force at the limit of motion.

3. The differences are related to the rhythm or speed of repetition of the stretch force.
The choice of using oscillating or sustained techniques depends on the patient's response.

- When dealing with managing pain, either grade I or II oscillation techniques or slow intermittent grade I or II sustained joint distraction techniques are recommended; the patient's response dictates the intensity and frequency of the joint play technique.

- When dealing with loss of joint play and thus decreased functional range, sustained techniques applied in a cyclic manner are recommended; the longer the stretch force can be maintained, the greater the creep and plastic deformation of the connective tissue.

- When attempting to maintain available range by using joint-play techniques, either grade II oscillating or sustained grade II techniques can be used.
Procedures for Applying Passive Joint Mobilization Techniques
ALWAYS Examine PRIOR to Treatment

1. If limited or painful ROM, examine & decide which tissues are limiting function

2. Determine whether treatment will be directed primarily toward **relieving pain** or **stretching a joint or soft tissue limitation**
   - Quality of pain when testing ROM helps determine stage of recovery & dosage of techniques

1) If pain is experienced **BEFORE** tissue limitation, gentle pain-inhibiting joint techniques may be used
   - Stretching under these circumstances is contraindicated

2) If pain is experienced **CONCURRENTLY** with tissue limitation (e.g. pain & limitation that occur when damaged tissue begins to heal) the limitation is treated cautiously – gentle stretching techniques used

3) If pain is experienced **AFTER** tissue limitation is met because of stretching of tight capsular tissue, the joint can be stretched aggressively

By Farzin Halabchi
Examination and Evaluation

1. If the patient has limited or painful motion, examine and decide which tissues are limiting function and the state of pathology. Determine whether treatment will be directed primarily toward relieving pain or stretching a joint or soft tissue limitation.

2. The quality of pain when testing the ROM helps determine the stage of recovery and the dosage of techniques used for treatment.
Pain experienced with ROM when involved tissue is in the (A) acute stage, (B) early subacute stage, and (C) late subacute or chronic stage.
If pain is experienced *before* tissue limitation such as the pain that occurs with muscle guarding after an acute injury or during the active stage of a disease, gentle pain-inhibiting joint techniques may be used. The same techniques will also help maintain joint play. Stretching under these circumstances is contraindicated.

If pain is experienced *concurrently* with tissue limitation—such as the pain and limitation that occur when damaged tissue begins to heal, the limitation is treated cautiously. Gentle stretching techniques specific to the tight structure are used to gradually improve movement yet not exacerbate the pain by reinjuring the tissue.

If pain is experienced *after* tissue limitation is met because of stretching of tight capsular or periarticular tissue, the stiff joint can be aggressively stretched with joint-play techniques and the periarticular tissue.
The joint capsule is limiting motion and should respond to mobilization techniques if the following signs are present:

1. The passive ROM for that joint is limited in a capsular pattern.
2. There is a firm capsular end-feel when overpressure is applied to the tissues limiting the range.
3. There is decreased joint-play movement when mobility tests (articulations) are performed.
<table>
<thead>
<tr>
<th>Joint</th>
<th>Capsular Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporomandibular</td>
<td>Opening</td>
</tr>
<tr>
<td>Occipitoatlanto</td>
<td>Extension &amp; side flexion equally limited</td>
</tr>
<tr>
<td>Cervical Spine</td>
<td>Side flexion &amp; rotations equally limited, extension</td>
</tr>
<tr>
<td>Glenohumeral</td>
<td>Lateral rotation, abduction, medial rotation</td>
</tr>
<tr>
<td>Sternoclavicular</td>
<td>Pain at extreme range of movement</td>
</tr>
<tr>
<td>Acromioclavicular</td>
<td>Pain at extreme range of movement</td>
</tr>
<tr>
<td>Humeroulunar</td>
<td>Flexion, extension</td>
</tr>
<tr>
<td>Radiohumeral</td>
<td>Flexion, extension, supination, pronation</td>
</tr>
<tr>
<td>Proximal Radioulnar</td>
<td>Supination, pronation</td>
</tr>
<tr>
<td>Distal Radioulnar</td>
<td>Pain at extremes of rotation</td>
</tr>
<tr>
<td>Wrist</td>
<td>Flexion &amp; extension equally limited</td>
</tr>
<tr>
<td>Trapeziometacarpal</td>
<td>Abduction, extension</td>
</tr>
<tr>
<td>MCP and IP</td>
<td>Flexion, extension</td>
</tr>
<tr>
<td>Thoracic Spine</td>
<td>Side flexion &amp; rotation equally limited, extension</td>
</tr>
<tr>
<td>Lumbar Spine</td>
<td>Side flexion &amp; rotation equally limited, extension</td>
</tr>
<tr>
<td>SI, Symphysis Pubis, &amp; Sacrococcygeal</td>
<td>Pain when joints stressed</td>
</tr>
<tr>
<td>Hip</td>
<td>Flexion, Abduction, medial rotation (order varies)</td>
</tr>
<tr>
<td>Knee</td>
<td>Flexion, extension</td>
</tr>
<tr>
<td>Tibiofibular</td>
<td>Pain when joint stressed</td>
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<tr>
<td>Talocrural</td>
<td>Plantar flexion, dorsiflexion</td>
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<td>Subtalar (Talocalcaneal)</td>
<td>Limitation of varus range of movement</td>
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<tr>
<td>Midtarsal</td>
<td>Dorsiflexion, plantar flexion, adduction, medial rotation</td>
</tr>
<tr>
<td>First MTP</td>
<td>Extension, flexion Second to Fifth MTP Variable</td>
</tr>
<tr>
<td>IP</td>
<td>Flexion, extension</td>
</tr>
</tbody>
</table>
An adhered or contracted ligament is limiting motion if there is decreased joint play and pain when the fibers of the ligament are stressed; ligaments often respond to joint mobilization techniques if applied specific to their line of stress.

Subluxation or dislocation of one bony part on another and loose intra-articular structures that block normal motion may respond to thrust techniques.
## Detect and Classification of Joint Dysfunction

<table>
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<tr>
<th>Cause of Limited Motion</th>
<th>Identification</th>
<th>Treatment Intervention</th>
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<td>Intra-articular Adhesions or Pericapsular Stiffness</td>
<td>ROM unaffected by proximal or distal joint positioning</td>
<td>MOBILIZE</td>
</tr>
<tr>
<td></td>
<td>Capsular End Feel</td>
<td></td>
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<tr>
<td>Shortened Extra-articular Muscle Groups</td>
<td>ROM affected by proximal or distal joint positioning</td>
<td>STRETCH</td>
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<tr>
<td>Muscle Weakness</td>
<td>ROM affected by gravity</td>
<td>STRENGTHEN</td>
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<tr>
<td>Pain</td>
<td>Empty end feel</td>
<td>MODALITIES</td>
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<tr>
<td></td>
<td></td>
<td>Grade I-II Mobs</td>
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<tr>
<td>Nerve Root Adhesion</td>
<td>Neural Tension Tests</td>
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<tr>
<td>Soft Tissue Restrictions</td>
<td>Palpation</td>
<td>SOFT TISSUE MOBILIZATION</td>
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</tbody>
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By Farzin Halabchi
Procedural Rules (1)

- All joint mobilizations follow the convex-concave rule
- Mobilization should be done with both the athlete and the therapist positioned in a comfortable and relaxed manner.
- Always explain purpose of treatment & sensations to expect to patient
- The therapist should mobilize one joint at a time.
- The joint should be stabilized as near one articulating surface as possible, while moving the other segment with a firm, confident grasp.
- Evaluate BEFORE & AFTER treatment

By Farzin Halabchi
Procedural Rules (2)

1. Stop the treatment if it is too painful for the patient
2. Use proper body mechanics
3. Use gravity to assist the mobilization technique if possible
4. Begin & end treatments with Grade I or II oscillations
Positioning & Stabilization

1. Initial mobilization is performed in a loose-packed position
   - In some cases, the position to use is the one in which the joint is least painful

2. Firmly & comfortably stabilize one joint segment, usually the proximal bone
   - Hand, belt, assistant
   - Prevents unwanted stress & makes the stretch force more specific & effective
Examination of joint play and the first treatment are initially performed in the resting position for that joint so that the greatest capsule laxity is possible. In some cases, the position to use is the one in which the joint is least painful. With progression of treatment, the joint is positioned at or near the end of the available range prior to application of the mobilization force. This places the restricting tissue in its most lengthened position where the stretch force can be more specific.

Firmly and comfortably stabilize one joint partner, usually the proximal bone. A belt, one of the therapist's hands, or an assistant holding the part, may provide stabilization. Appropriate stabilization prevents unwanted stress to surrounding tissues and joints and makes the stretch force more specific and effective.
Treatment Force and Direction of Movement

- The treatment force (either gentle or strong) is applied as close to the opposing joint surface as possible. The larger the contact surface is, the more comfortable the procedure will be. For example, instead of forcing with your thumb, use the flat surface of your hand.

- The direction of movement during treatment is either parallel to or perpendicular to the treatment plane. The treatment plane is described by Kaltenborn as a plane perpendicular to a line running from the axis of rotation to the middle of the concave articular surface, the plane is in the concave partner so its position is determined by the position of the concave bone.

- Joint traction techniques are applied perpendicular to the treatment plane. The entire bone is moved so that the joint surfaces are separated.
Treatment plane (T.P.) is at right angles to a line drawn from the axis of rotation to the center of the concave articulating surface and lies in the concave surface. Joint traction is applied perpendicular and glides are applied parallel to the treatment plane.
Gliding techniques are applied parallel to the treatment plane.

Glide in the direction in which the slide would normally occur for the desired motion. Direction of sliding is easily determined by using the convex-concave rule (earlier in this chapter). If the surface of the moving bony partner is convex, the treatment glide should be opposite to the direction in which the bone swings. If the surface of the moving bony partner is concave, the treatment glide should be in the same direction.

The entire bone is moved so that there is gliding of one joint surface on the other. The bone should not be used as a lever; it should have no arcing motion (swing) that would cause rolling and thus compression of the joint surfaces.
Initiation and Progression of Treatment

1. The initial treatment is the same whether treating to decrease pain or to increase joint play. The purpose is to determine joint reactivity before proceeding. Use a sustained grade II distraction of the joint surfaces with the joint held in resting position or the position of greatest relaxation. Note the immediate joint response relative to irritability and range.
2- The next day, evaluate joint response, or have the patient report the response at the next visit.

- If there is increased pain and sensitivity, reduce the amplitude of treatment to grade I oscillations.

- If the joint is the same or better, perform either of the following: (1) Repeat the same maneuver if the goal of treatment is to maintain joint play. (2) Progress the maneuver to sustained grade III traction or glides if the goal of treatment is to increase joint play.
3- To progress the stretch technique, move the bone to the end of the available ROM, then apply the sustained grade III distraction or glide techniques.

Advanced progressions include prepositioning the bone at the end of the available range and rotating it prior to applying grade III distraction or glide techniques. The direction of the rotation will be dictated by the joint mechanics. For example, laterally rotate the humerus as abduction is progressed; medially rotate the tibia as knee flexion is progressed.
4- Hints:

I Warm the tissue around the joint prior to stretching. Modalities, massage, or gentle muscle contractions will increase the circulation and warm the tissues.

I Muscle relaxation techniques and oscillation techniques may inhibit muscle guarding and should be alternated with the stretching techniques, if necessary.

I When using grade III gliding techniques, a grade I distraction should be used with it. A grade II or III distraction should not be used with a grade III glide to avoid excessive trauma to the joint.
4- Hints (Continued):

1. If gliding in the restricted direction is too painful, begin gliding mobilizations in the painless direction. Progress to gliding in the restricted direction when mobility improves a little and it is not painful.

2. When applying stretching techniques, move the bony partner through the available range of joint play first, that is, "take up the slack." When tissue resistance is felt, apply the stretch force against the restriction.

3. Incorporate MWM techniques as part of the total approach to treatment.
5- To maintain joint play by using gliding techniques when range of motion techniques are contraindicated or not possible for a period of time, use sustained grade II or grade II oscillation techniques.
Initiation and progression of treatment.

By Farzin Halabchi
Mobilization Program

- Typical mobilization of a joint might involve a series of three to six sets of oscillations lasting between 20 and 60 seconds each, with one to three oscillations per second (Prentice).
Speed, Rhythm, & Duration of Movements

- Joint mobilization sessions usually involve:
  - 3-6 sets of oscillations
  - Perform 2-3 oscillations per second
  - Lasting 20-60 seconds for tightness
  - Lasting 1-2 minutes for pain

- Apply smooth, regular oscillations

- Vary speed of oscillations for different effects

- For painful joints, apply intermittent distraction for 7-10 seconds with a few seconds of rest in between for several cycles

- For restricted joints, apply a minimum of a 6-second stretch force, followed by partial release then repeat with slow, intermittent stretches at 3-4 second intervals

By Farzin Halabchi
Speed, Rhythm, and Duration of Movements

Oscillations

- Grades I and IV are usually rapid oscillations, like manual vibrations.
- Grades II and III are smooth, regular oscillations at 2 or 3 per second for 1 to 2 minutes.
- Vary the speed of oscillations for different effects such as low amplitude and high speed to inhibit pain or slow speed to relax muscle guarding.
Sustained

1. For painful joints, apply intermittent distraction for 7 to 10 seconds with a few seconds of rest in between for several cycles. Note response and either repeat or discontinue.

2. For restricted joints, apply a minimum of a 6-second stretch force, followed by partial release (to grade I or II), then repeat with slow, intermittent stretches at 3- to 4-second intervals.
Patient Response

- May cause soreness
- Perform joint mobilizations on alternate days to allow soreness to decrease & tissue healing to occur
- Patient should perform ROM techniques
- Patient’s joint & ROM should be reassessed after treatment, & again before the next treatment
- Pain is always the guide
Stretching maneuvers usually cause soreness. Perform the maneuvers on alternate days to allow soreness to decrease and tissue healing to occur between stretching sessions. The patient should perform ROM into any newly gained range during this time. If there is increased pain after 24 hours, the dosage (amplitude) or duration of treatment was too vigorous. Decrease the dosage or duration until the pain is under control.

The patient's joint and ROM should be reassessed after treatment and again before the next treatment. Alterations in treatment are dictated by the joint response.
Convex – Concave Surfaces in Major Joints

By Farzin Halabchi
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

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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

By Farzin Halabchi
MTP and IP JOINTS

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


Good friends are hard to find, harder to leave, and impossible to forget.