Principles of Joint Mobilization

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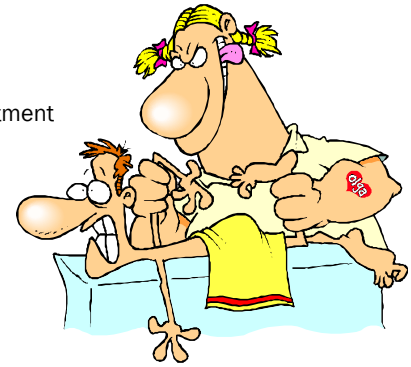
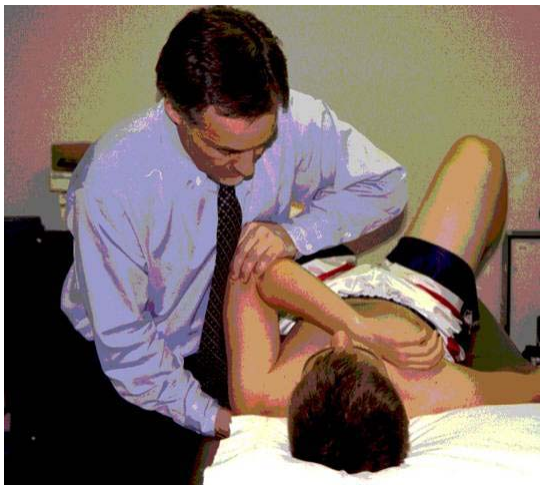


Joint Mobilization

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

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Objective 1

Define osteokinematic and arthrokinematic motion

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Osteokinematics

"Motion You **SEE**"

observable movements of bones in space as represented

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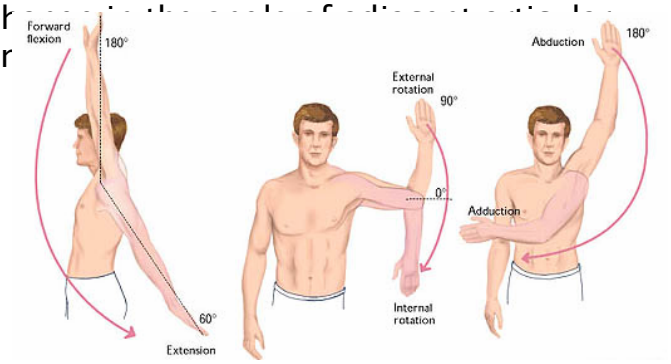

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Arthrokinematics

"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

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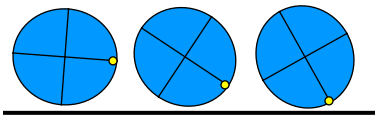
Arthrokinematic **ROLL**

- 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



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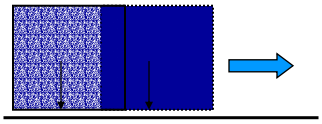
Arthrokinematic **GLIDE**

- 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



braking analogy

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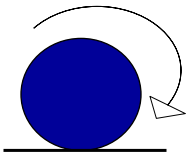
Arthrokinematic **SPIN**

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



loss of traction analogy

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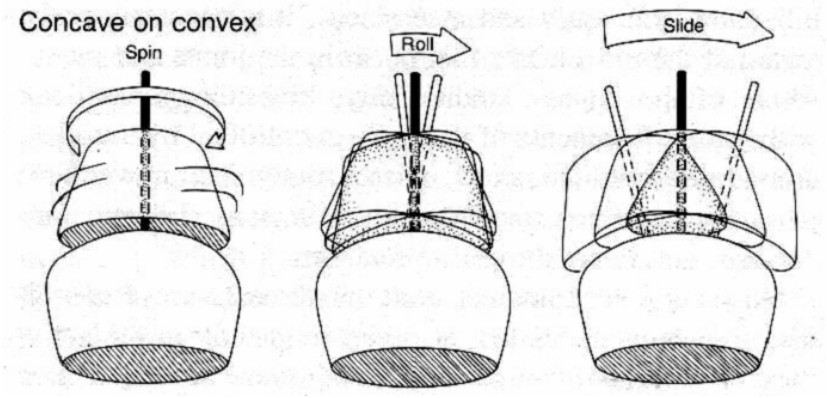
Arthrokinematic Motions

Concave on Convex



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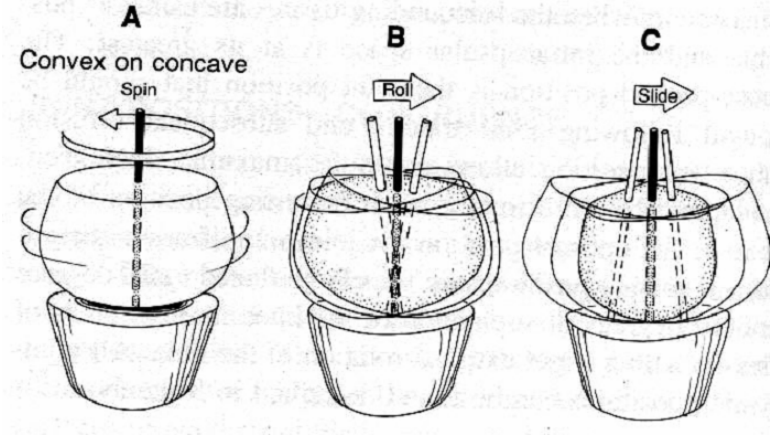
Arthrokinematic Motions

Convex on Concave



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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

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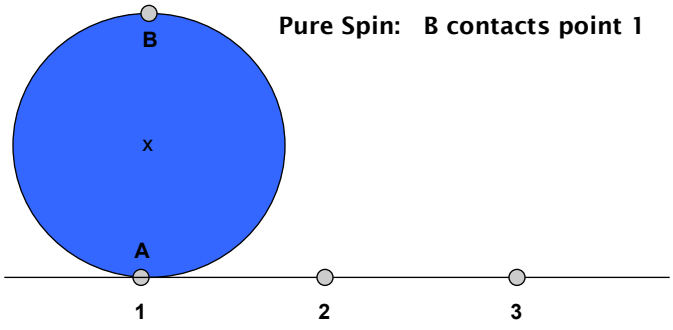
Arthrokinematic Motions

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



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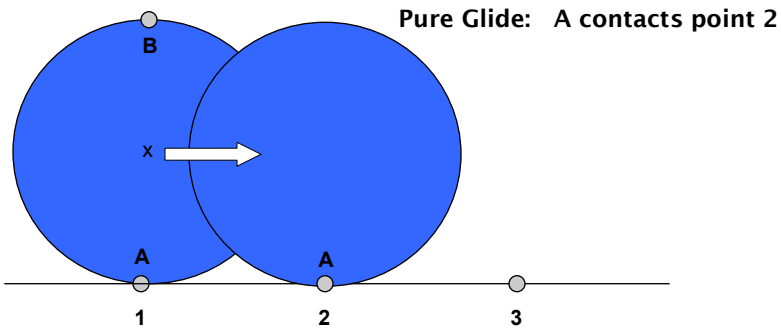

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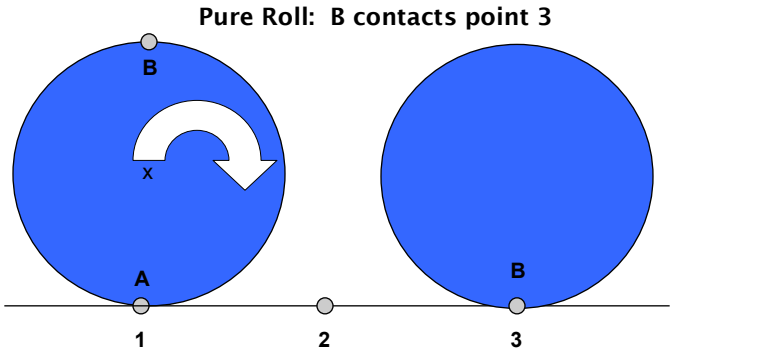

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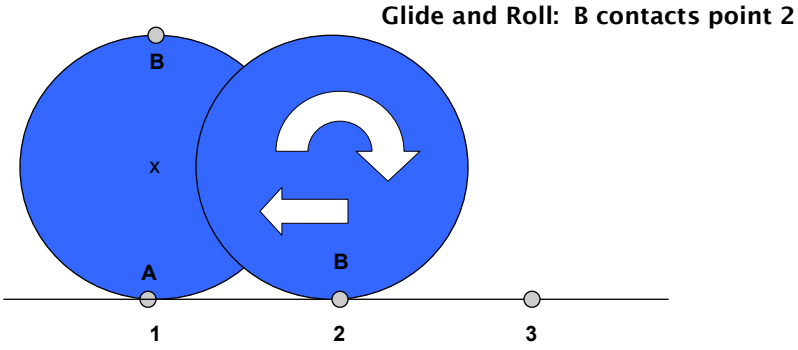

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Objective 2

Explain the arthrokinematic rules of motion

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Joint Morphology

Joint surfaces are defined as:

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

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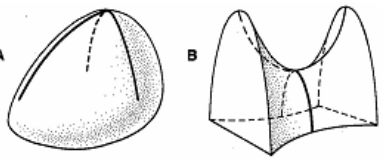
Joint Morphology

Joint surfaces are defined as:



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*

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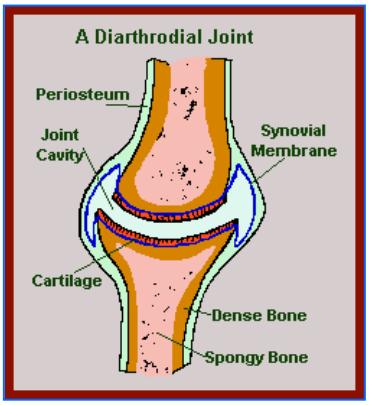
Concave and Convex Characteristics

- 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



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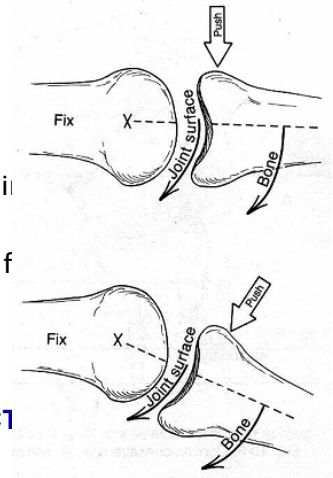
Rules of Motion

Concave Motion Rule

- convex surface is stationary and concave surface moves
- osteo and arthrokinematic motion is i ***same direction***
- arthrokinematic mobilization gliding f ***same direction*** as osteokinematic bony movement



GLIDE and ROLL are in the SAME DIRECT

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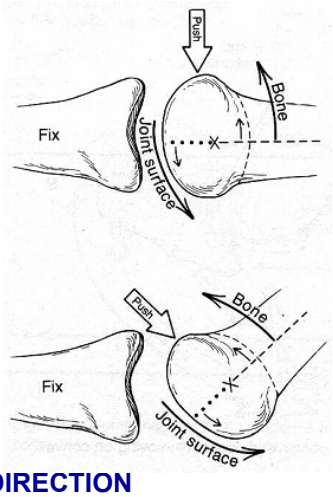
Rules of Motion

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

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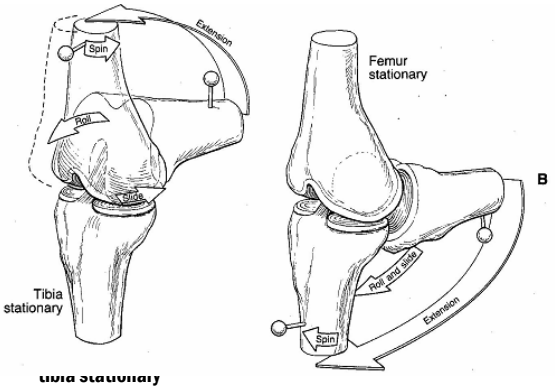
Rules of Motion

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



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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

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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

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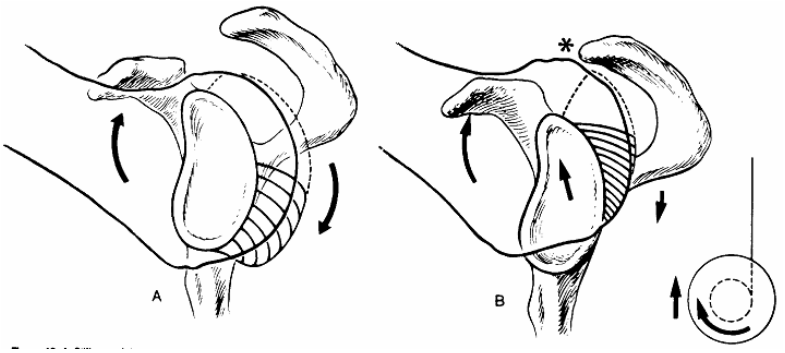
obligate translation

secondary to capsular tightness asymmetry



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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

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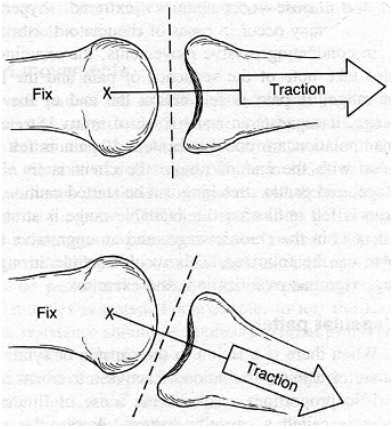
TRACTION

- the process of pulling one bony surface away from the other (joint separation)
- passive translatoric bone movement which is at a right angle to the treatment plane



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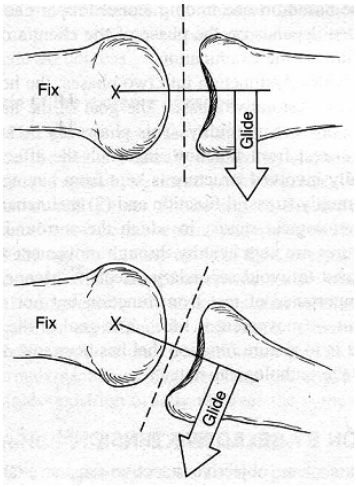
GLIDING

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



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Objective 3

Detect and classify joint dysfunction

continuing ED

Detect and Classification of Joint Dysfunction

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

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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

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Determination of Joint Mobility

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

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CLASSIFICATION of JOINT MOBILITY
Ordinal Scale

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

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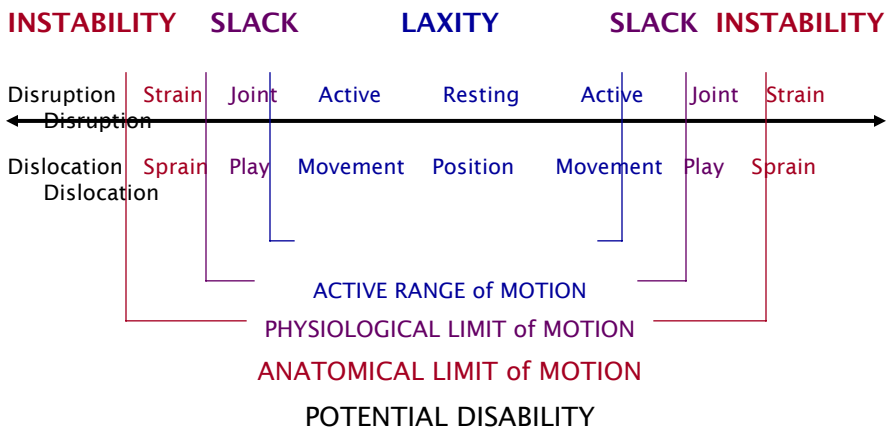
MOTION SCHEMATIC



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Objective 4

Define the resting and closed pack position of a joint

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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

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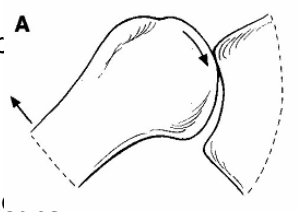
RESTING POSITION



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

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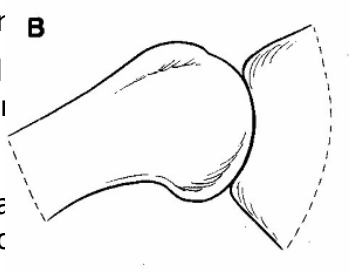
CLOSED PACK POSITION



- Joint positions are most congruer
- Surrounding tissue (capsules and ligaments) under maximal tensio
- Intracapsular space is minimal
- Locked, statically efficient for loa bearing, and dynamically dangerc
- Testing position
  - ex: apprehension test of GH joint

continuing ED

Objective 5

Understand the treatment application principles that govern passive joint mobilization

continuing ED

mobilization treatment

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

continuing ED

mobilization treatment

Therapeutic Effects of Mobilization include:

- stimulate synov
  movement to n
- maintain/prom
  extensibility
- provide sensor

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mobilization indications

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

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mobilization treatment variables

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

continuing ED

translatory glide mobilization grading

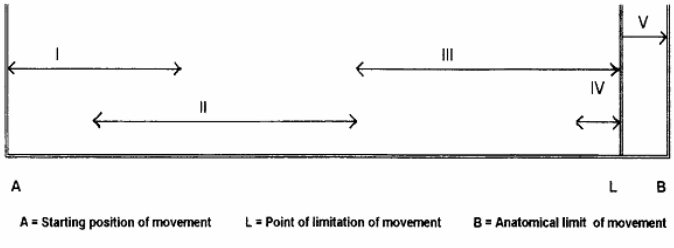
Grade I – small amplitude movement at the beginning of the available ROM

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)



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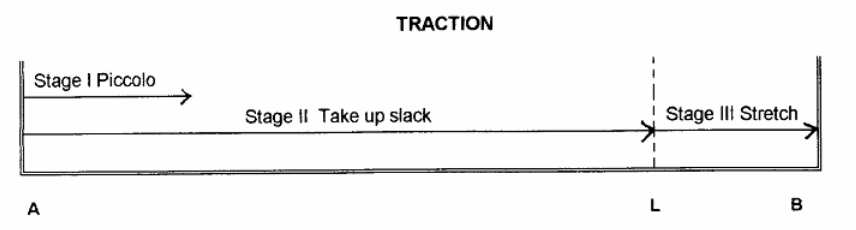
distraction mobilization grading

Grade I – unweighting or barely supporting the joint surfaces (picolo)
- 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



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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

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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

continuing ED

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 hod at end range stimulates type II mechanoreceptors

- Low grade sustained hold stimulates type III mechanorceptors and inhibits guarding

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articular mechanoreceptors

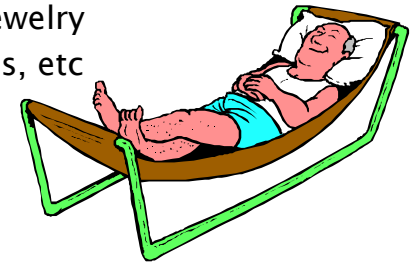
TYPE	FUNCTION	LOCATION	FIRED BY	BEHAVIOR
I	**Postural** Active at Rest	Superficial Capsule	Graded or progressive oscillations at end ROM	Slow Adapting Postural Kinesthetic Awareness Tonic Stabilizers
II	**Dynamic** Silent at rest; fires as movement begins	Deep Capsule	Graded or progressive oscillations in mid ROM	Fast Adapting Dynamic Sensation Phasic Movers
III	**Inhibitive** Very similar in function and structure to GTO	Ligaments	Stretch or sustained hold at end ROM	Defensive Receptor Gives reflexive inhibition of muscle tone
IV	**Nocioceptive**	Most Tissues	Injury and Inflammation	Non-adapting Tonic reflexogenic effect which produces guarding

continuing ED

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



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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!!**

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Objective 6

Recognize contraindications to mobilization treatment

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Absolute Contraindications

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

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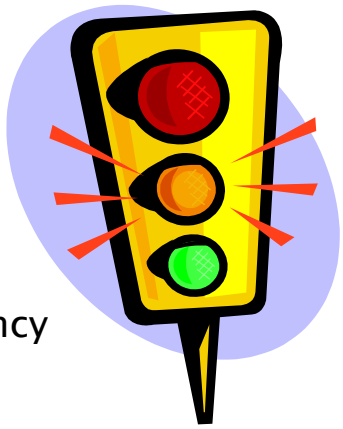
Relative Contraindications

- Excessive pain or swelling
- Arthroplasty
- Pregnancy
- Hypermobility
- Spondylolisthesis
- Rheumatoid arthritis
- Vertebrobasilar insufficiency



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Objective 7

Investigate what the literature suggests regarding mobilization effectiveness and efficacy

continuing ED

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

DiFabio R, *Phys Ther* 72:853-864, 1992

continuing ED

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
  - Bang, et al *J Ortho Sports Phys Ther* 30:126-138, 2000
- Mobilization decreased 24-hour pain and pain associated with subacromial compression test in patients with shoulder impingement syndrome
  - Conroy, et al *J Ortho Sports Phys Ther* 28:3-14, 1998
- The only effective treatment modality for adhesive capsulitis is mobilization and exercise therapy
  - Nicholson J Ortho Sports Phys Ther 6:238-246, 1985
- End-range mobilization techniques increased mobility in patients with adhesive capsulitis
  - Vermeulen, et al *Phys Ther* 80:1204-1211, 2000

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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.

  Green, et al. Phys Ther, 2001

- 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

  Dijis, et al. Am J Podait Med Assoc, 2000

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Objective 8

Memorize the morphological and capsular characteristics of each joint

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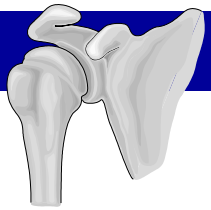

GLENOHUMERAL JOINT

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

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HUMEROULNAR JOINT

Concave Surface: ulna
Convex Surface: humeral trochlea

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

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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

continuing ED

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

continuing ED

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

continuing ED

MCP and IP JOINTS

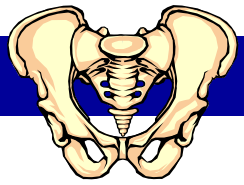
Concave Surface: distal
Convex Surface: proximal
Closed Pack Position: Full flexion
Resting Position: Slight flexion
Capsular Pattern: Flexion > extension

continuing ED

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

continuing ED



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)

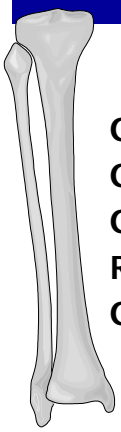
continuing ED

KNEE JOINT

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

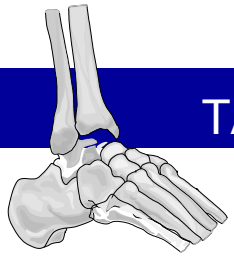
continuing ED

TIBIOFIBULAR JOINT



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

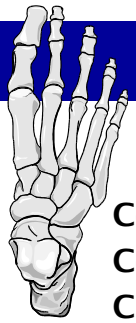
continuing ED



TALOCRURAL JOINT

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

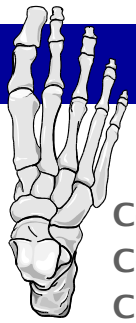
continuing ED



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

continuing ED



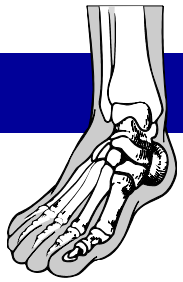
SUBTALAR JOINT

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

continuing ED

MTP and IP JOINTS

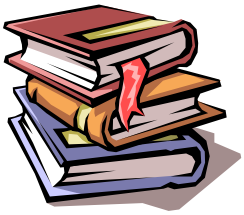


Concave Surface:	distal
Convex Surface:	proximal articulation
Closed Pack Position:	full hyperextension
Resting Position:	slight plantarflexion
Capsular Pattern:	Flexion = extension

continuing ED

Recommended Readings

- Kaltenborn FMM, et al. Manual Mobilization of the Joints: The Kaltenborn Method of Joint Examination and Treatment: The Extremities, Vol. 1. OTPT, 1999.
- Kaltenborn FMM, et al. Spine: Basic Evaluation and Mobilization Techniques. OTPT, 1993
- Cookson J. Orthopedic Manual Therapy: An Overview, Parts I/II. *Phys Ther* 59:136-259, 1979
- Maitland GD. Peripheral Manipulation. Reed Elsevier Plc Group, 1991.
- Barak T, et al. Mobility: Passive Orthopedic Manual Therapy in Orthopedic and Sports Physical Therapy. CV Mosby, 1985.



continuing ED

thank you

continuing ED