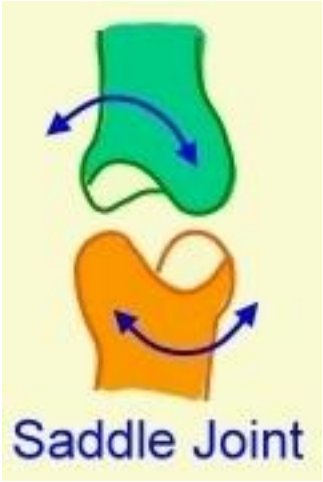
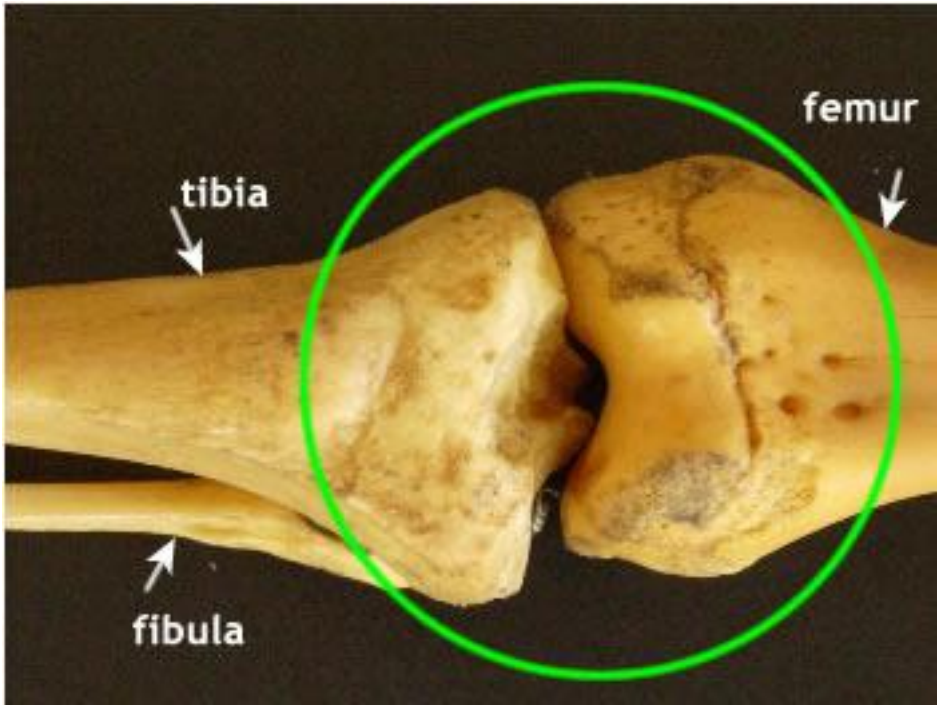
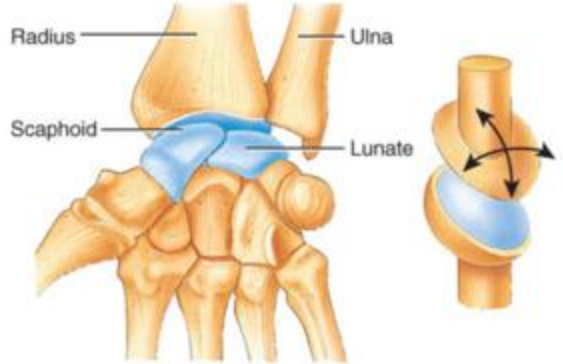
Arthrokinematics

Joint Shapes

- *ovoid or sellar*
- In **ovoid joints** one surface is convex, and the other is concave
- In **sellar (saddle) joints**, one surface is concave in one direction and convex in the other, with the opposing surface convex and concave, respectively—similar to a horseback rider being in complementary opposition to the shape of a saddle







(d) Condyloid joint between radius and scaphoid and lunate bones of the carpus (wrist)

Saddle joint

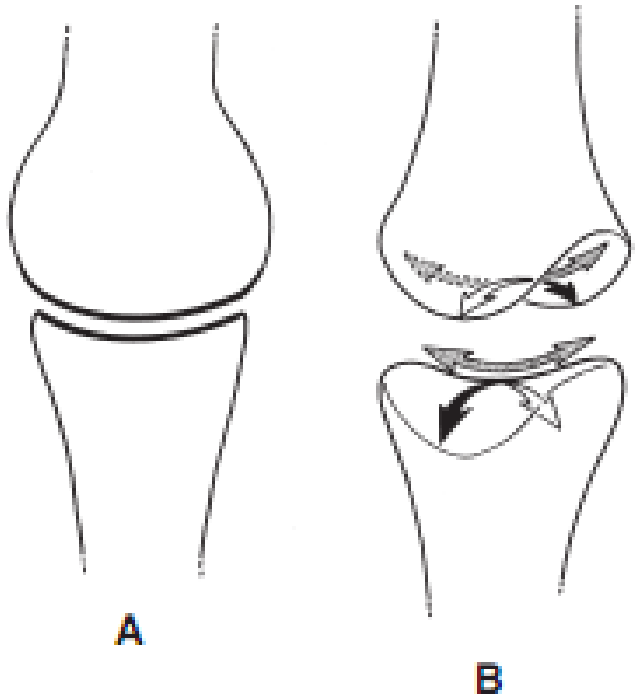


FIGURE 5.1 **(A)** With ovoid joints, one surface is convex, and the other is concave. **(B)** With saddle (sellar) joints, one surface is concave in one direction and convex in the other, with the opposing surface convex and concave, respectively.

Types of Motion

- **bony lever** moves about an axis of motion
- **bone surface**
- The movement of the bony lever is called ***swing*** *and is classically described as flexion, extension, abduction, adduction, and rotation. The amount of movement can be measured in degrees with a goniometer and is called ROM.*
- Motion of the bone surfaces in the joint is a variable combination of ***rolling and sliding, or spinning***.
- For the rolling, sliding, or spinning to occur, there must be adequate capsule laxity or joint play.

Roll

- 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

- 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.

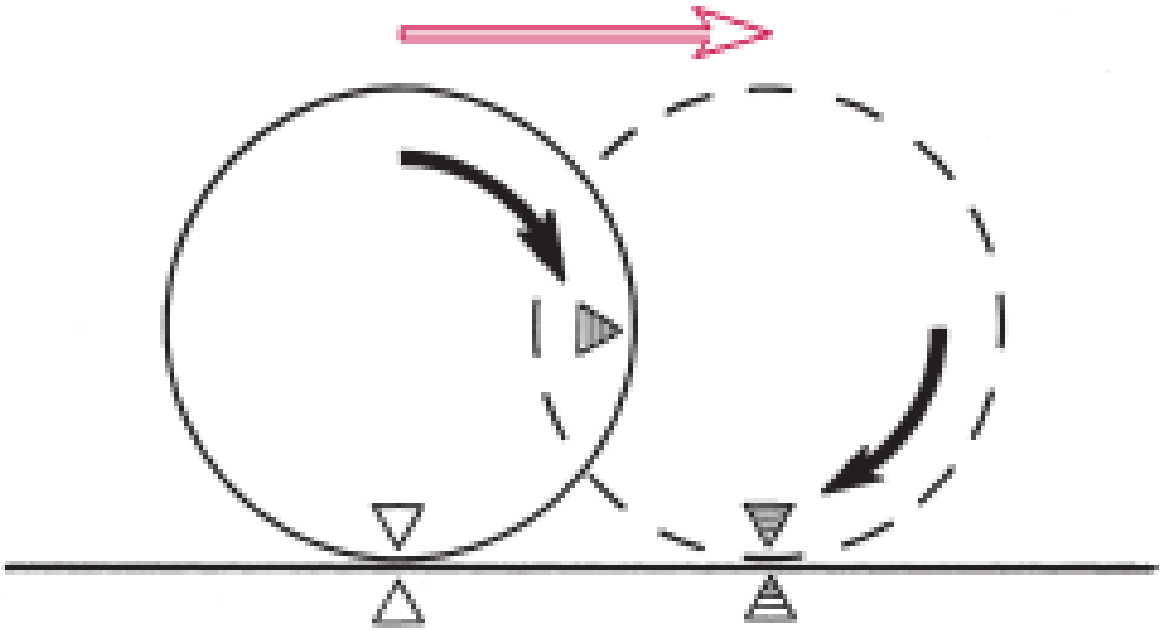


FIGURE 5.2 Representation of one surface rolling on another. New points on one surface meet new points on the opposing surface.

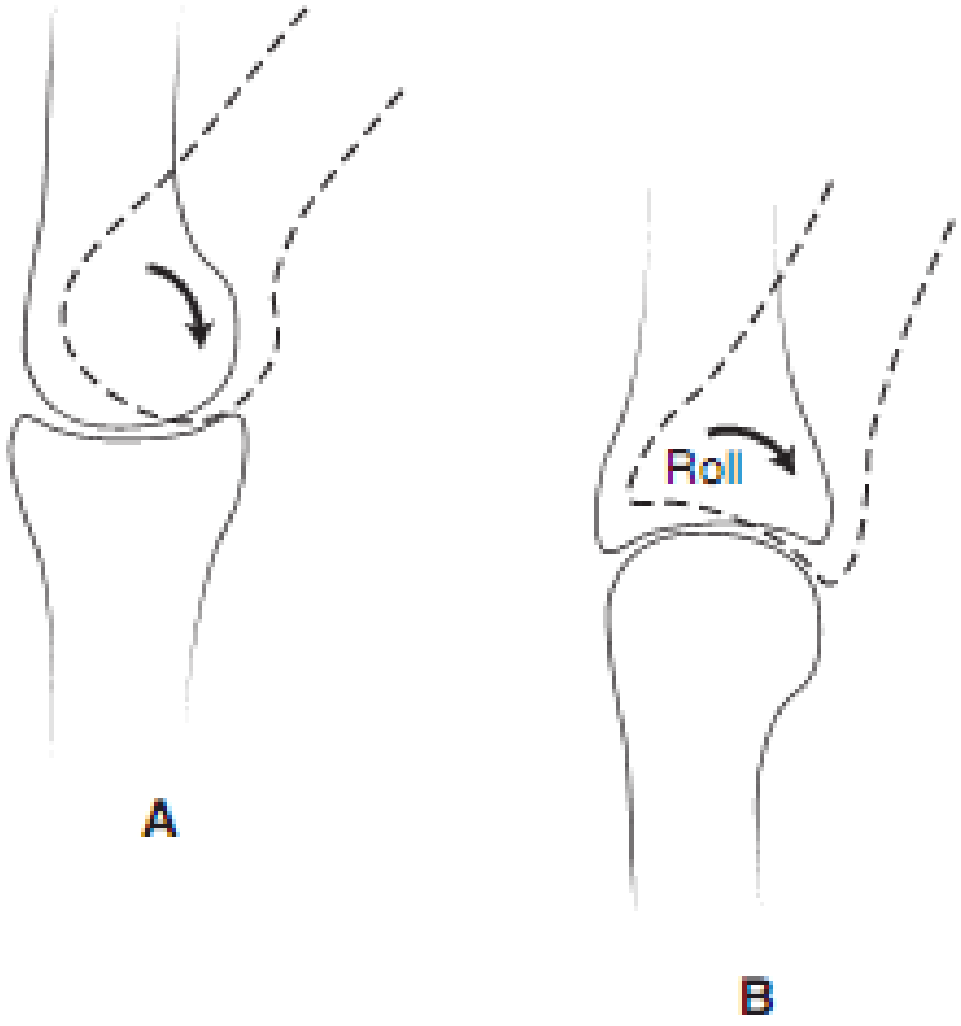


FIGURE 5.3 Rolling is always in the same direction as bone motion, whether the moving bone is **(A)** convex or **(B)** concave.

slide

- 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

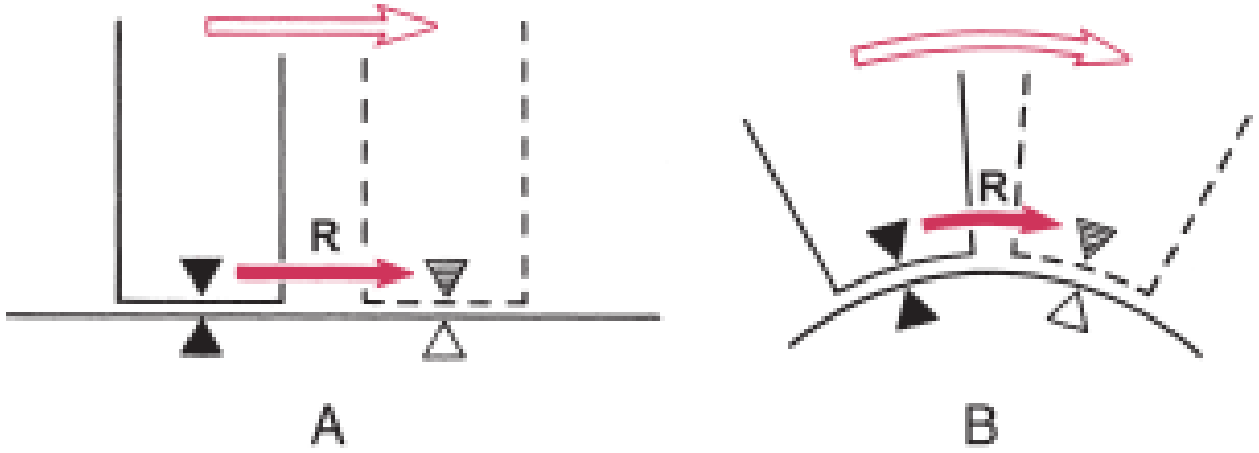


FIGURE 5.4 Representation of one surface sliding on another, whether **(A)** flat or **(B)** curved. The same point on one surface comes into contact with new points on the opposing surface.

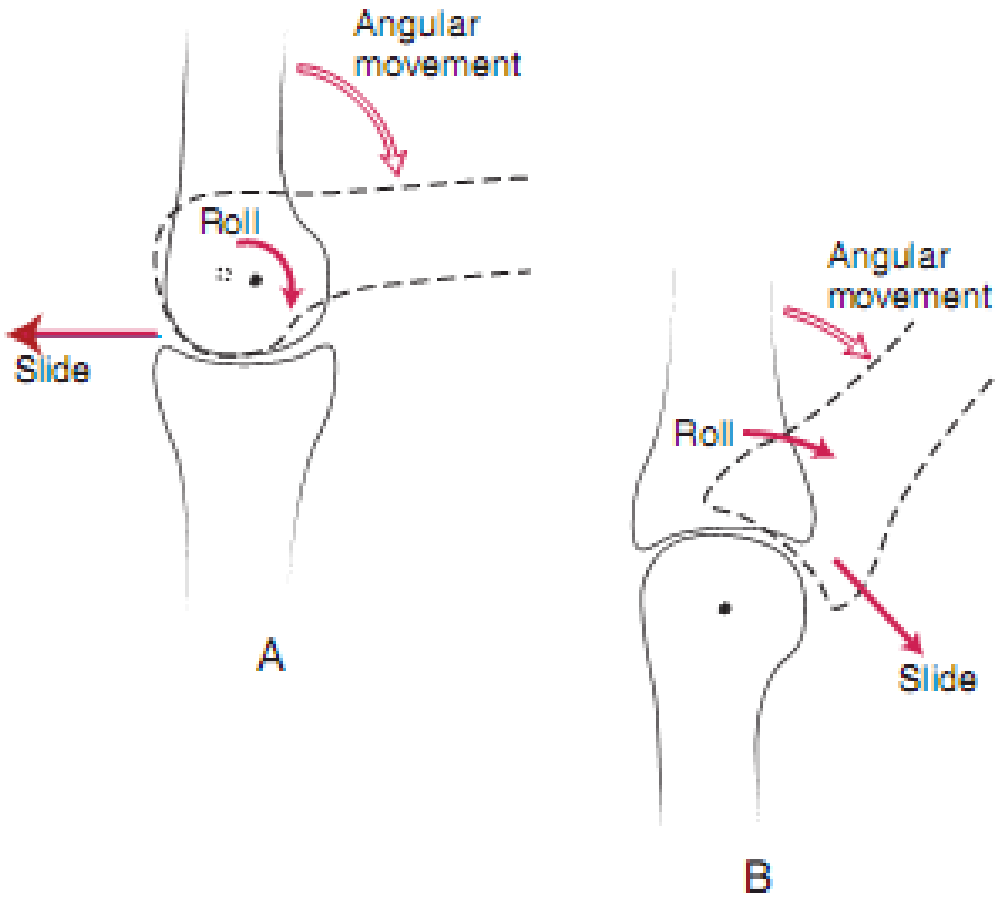


FIGURE 5.5 Representation of the concave-convex rule. **(A)** If the surface of the moving bone is convex, sliding is in the direction opposite to that of the angular movement of the bone. **(B)** If the surface of the moving bone is concave, sliding is in the same direction as the angular movement of the bone.

Combined Roll-Sliding in a Joint

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

- The joint mobilization techniques described in this chapter use the **sliding component** of joint motion to restore joint play and reverse joint hypomobility.
- **Rolling (passive angular stretching) is not used to stretch tight joint capsules**, because it causes joint compression.

- When the therapist passively moves the articulating surface using the **slide component** of joint motion, the technique is called **translatoric glide**, translation, or simply glide.
- It is used to control pain when applied **gently** or to stretch the capsule when applied with a **stretch** force.

Spin

- There is rotation of a segment about a stationary mechanical axis
- The same point on the moving surface creates an arc of a circle as the bone spins.
- Spinning rarely occurs alone in joints but in combination with rolling and sliding.
- 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

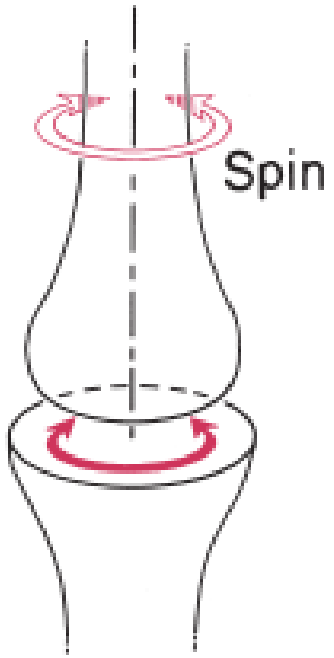


FIGURE 5.6 Representation of spinning. There is rotation of a segment about a stationary mechanical axis.

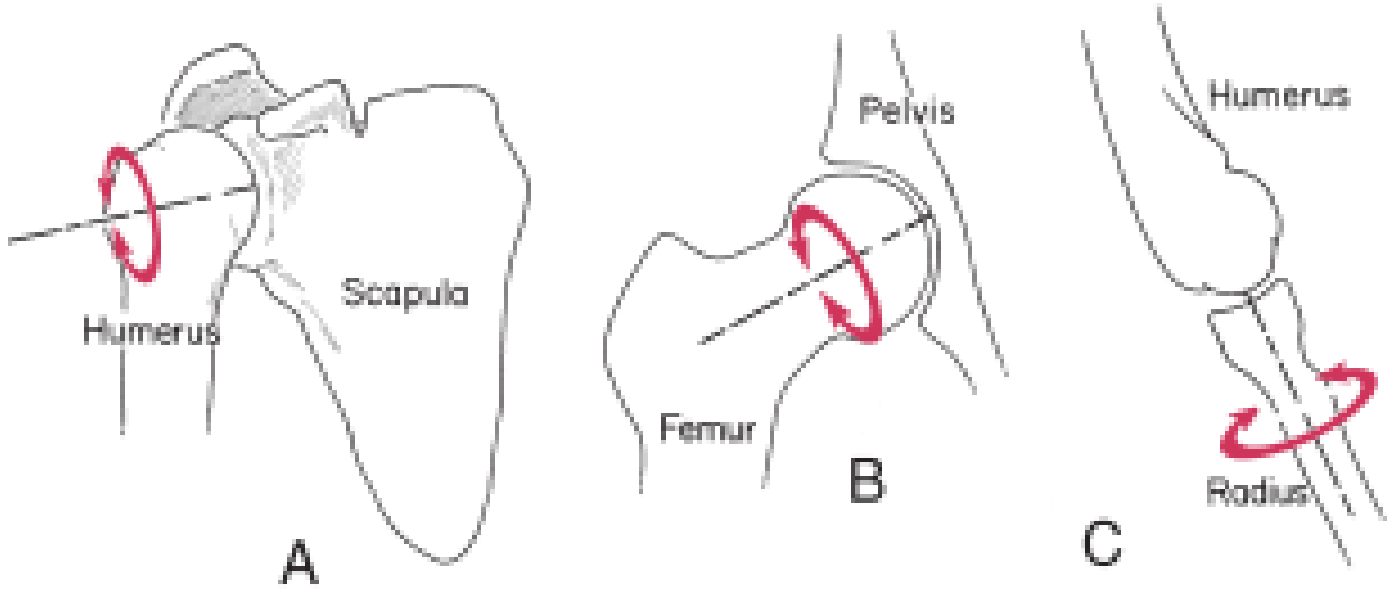
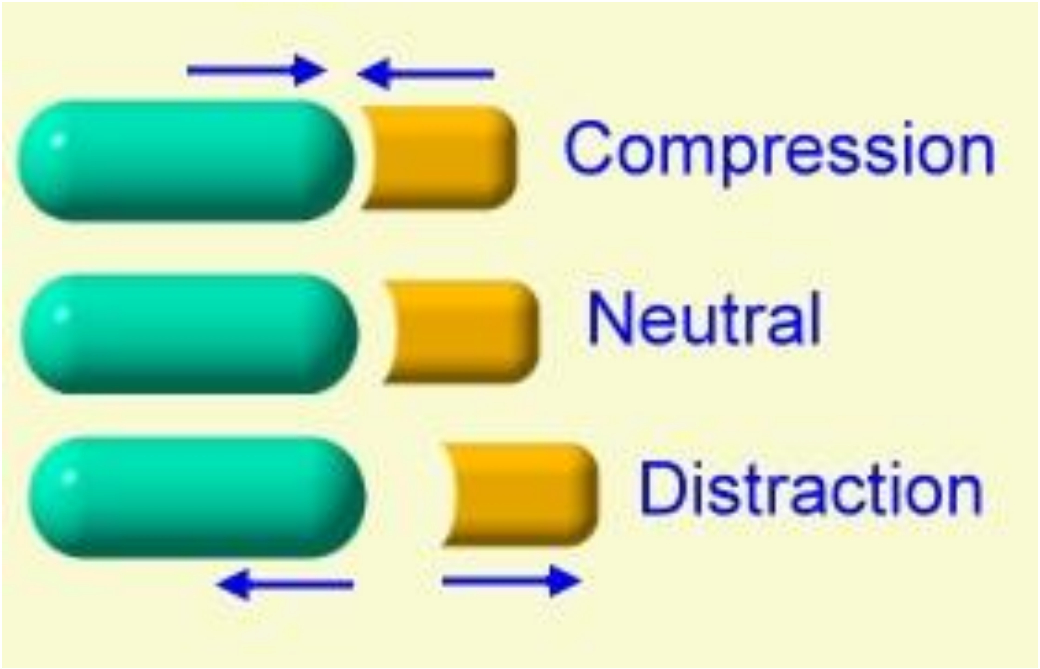
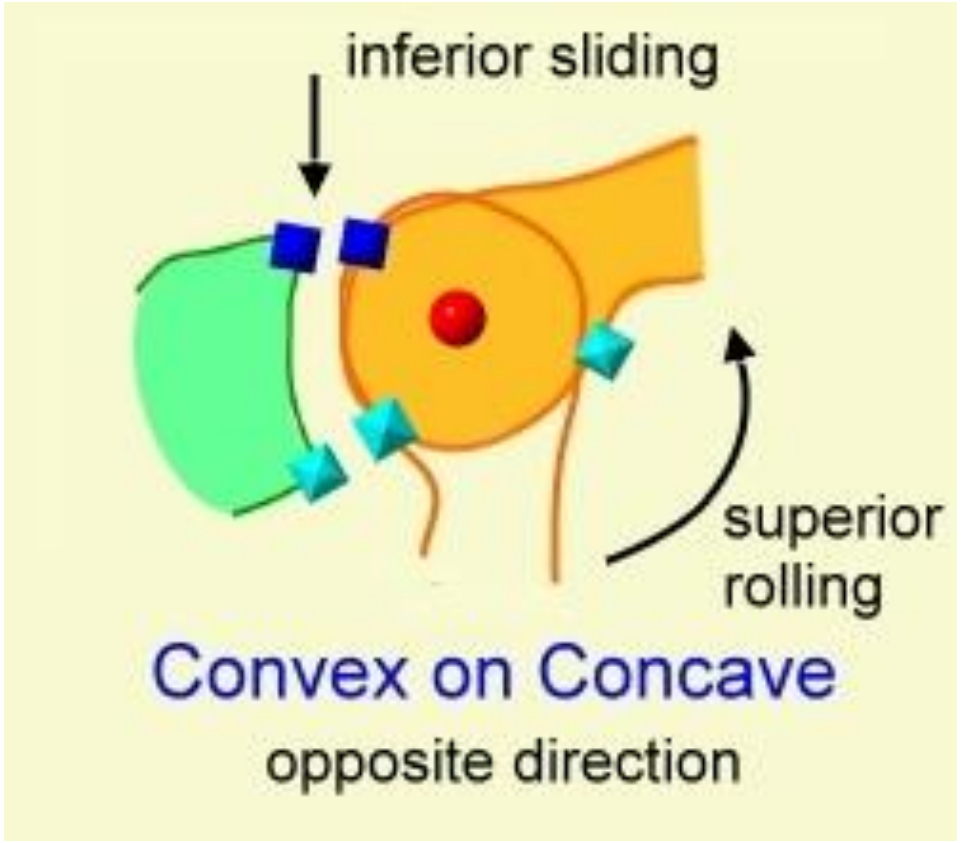


FIGURE 5.7 Examples of joint spin locations in the body. **(A)** Humerus with flexion/extension. **(B)** Femur with flexion/extension. **(C)** Head of the radius with pronation/supination.


Compression
Neutral
Distraction

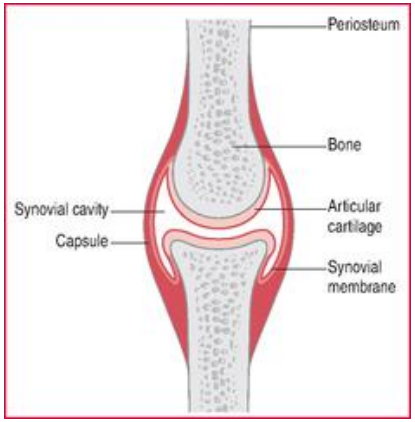

inferior sliding
superior
rolling
Convex on Concave
opposite direction

Effects of Joint Motion/mobilizations

Farjad afzal

Nutrition of articular cartilage

- 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



Immobilizations

↓

Decreased flow of nutrition to joints cartilage

↓

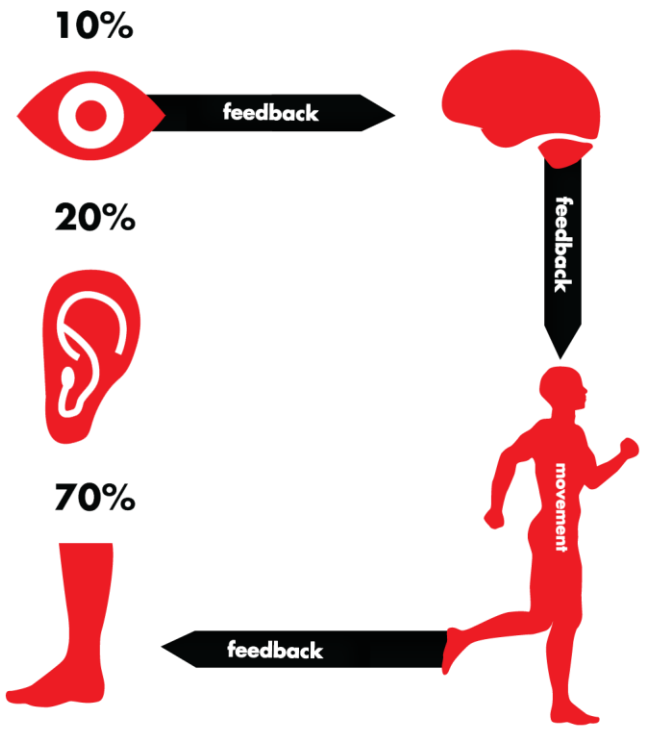
Atrophy of articular cartilage

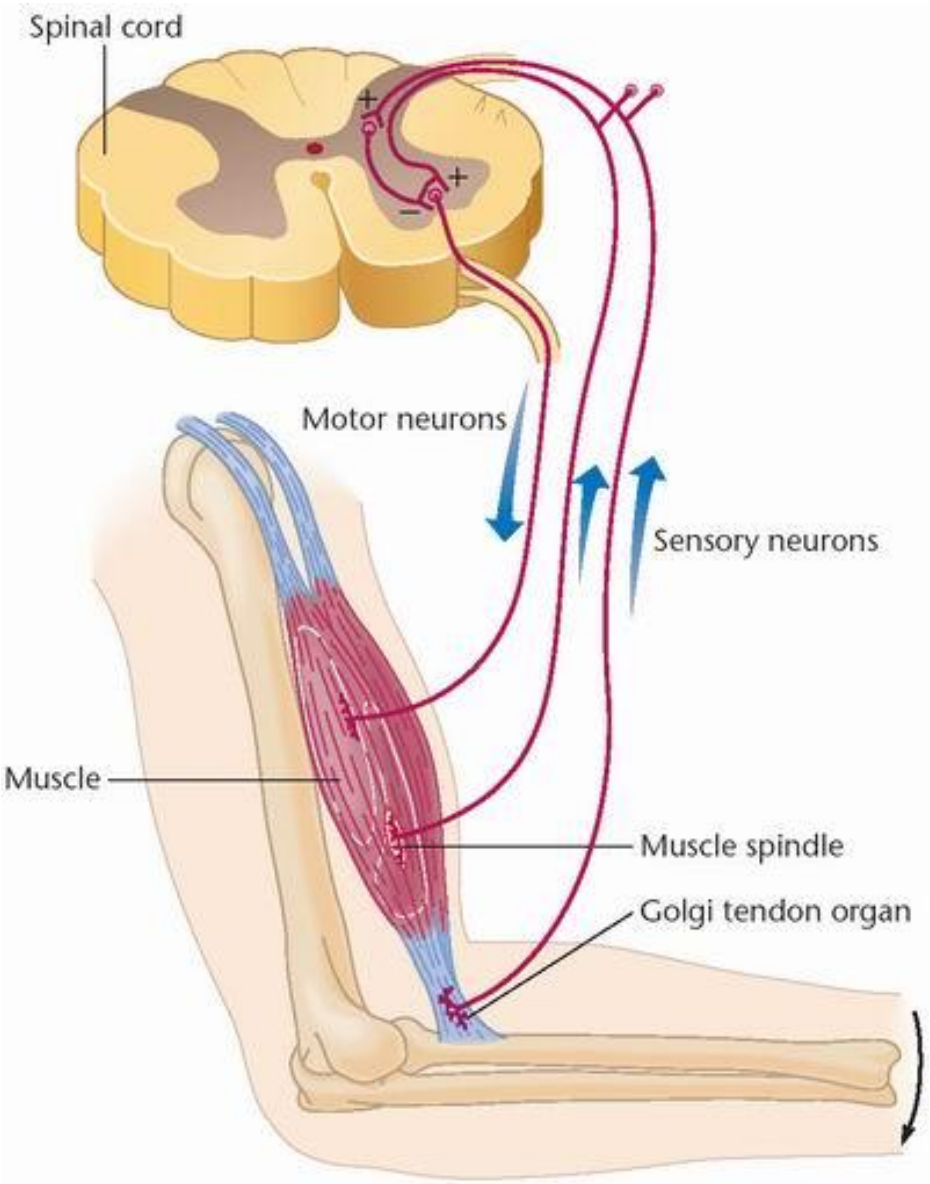
Joint extensibility

- Extensibility and tensile strength of the articular and periarticular tissues are maintained with joint motion
- With immobilization there is fibrofatty proliferation, which causes intra-articular adhesions as well as biochemical changes in tendon, ligament, and joint capsule tissue, which in turn causes joint contractures and ligamentous weakening

Properioception

= Proprioception




Spinal cord
+
+
–
Motor neurons
Sensory neurons
Muscle
Muscle spindle
Golgi tendon organ

Properioception and awarness

- Afferent nerve impulses from joint receptors transmit information to the central nervous system and, therefore, provide 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

- 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)**

Indications of joint mobilization

- **Gentle mobilizations** may be used to treat pain and muscle guarding,
- whereas **stretching techniques** are used to treat restricted movement.

Pain, Muscle Guarding, and Spasm

- Painful joints, reflex muscle guarding, and muscle spasm can be treated with *gentle joint-play techniques to stimulate* ***neurophysiological 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

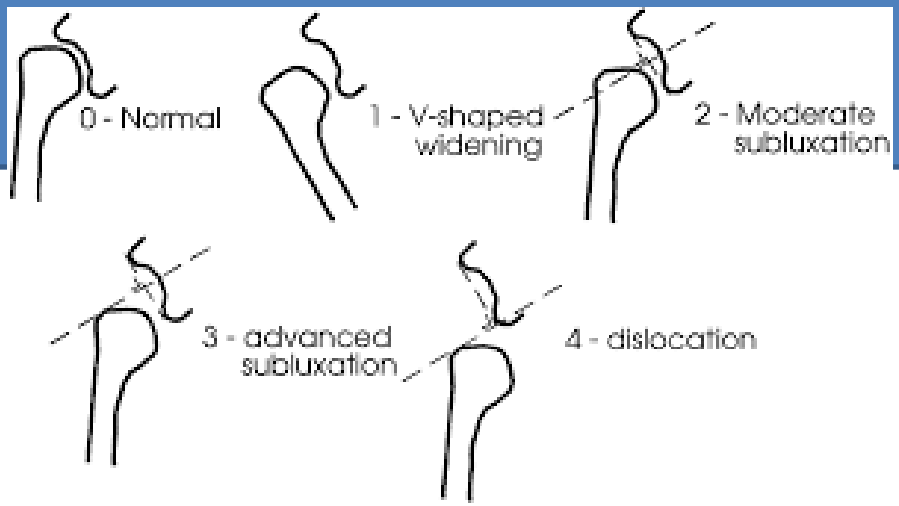
- Small-amplitude distraction or gliding movements of the joint are used to cause synovial fluid motion, which is the vehicle for bringing nutrients to the avascular portions of the articular cartilage (and intra-articular fibrocartilage when present).
- Gentle joint-play techniques help maintain nutrient exchange and, thus, prevent the painful and degenerating effects of stasis when a joint is swollen or painful and cannot move through the ROM.
- When applied to treat pain, muscle guarding, or muscle spasm, these techniques should not place stretch on the reactive tissues

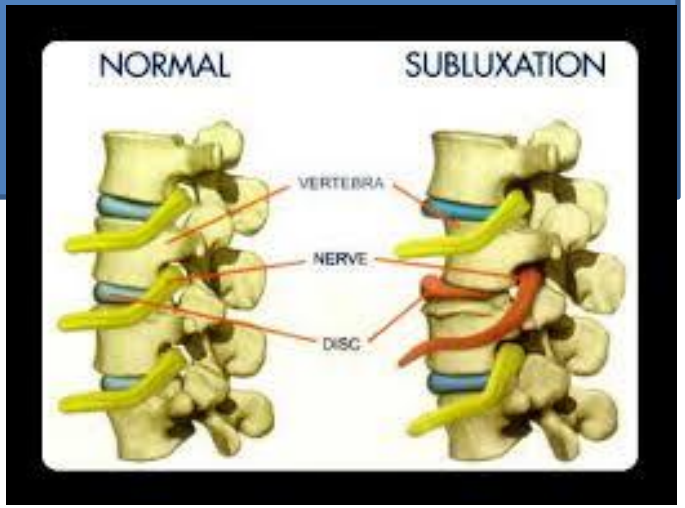
Reversible Joint Hypomobility

- Reversible joint hypomobility can be treated with *progressively vigorous joint-play stretching techniques to elongate hypomobile capsular and ligamentous connective tissue. Sustained or oscillatory stretch forces are used to distend the shortened tissue mechanically.*

Positional Faults/Subluxations

- A faulty position 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





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.

Functional Immobility

- 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.

Limitations of Joint Mobilization/ Manipulation Techniques

- Joint 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 affects the outcome.
- if these techniques are used indiscriminately on patients not properly examined and screened for such maneuvers or if they are applied too vigorously for the condition, joint trauma or hypermobility may result

Contraindications and Precautions

Hypermobility

- The joints of patients with potential necrosis of the ligaments or capsule should not be mobilized with stretching techniques.
- 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

- There may be joint swelling (effusion) due to trauma or disease.
- Rapid swelling of a joint usually indicates bleeding in the joint and may occur with trauma or diseases such as hemophilia.
- Medical intervention is required for aspiration of the blood to minimize its necrotizing effect on the articular cartilage.
- Slow swelling (more than 4 hours) usually indicates serous effusion (a buildup of excess synovial fluid) or edema in the joint due to mild trauma, irritation, or a disease such as arthritis

Inflammation

- Whenever inflammation is present, stretching increases pain and muscle guarding and results in greater tissue damage.
- Gentle oscillating or distraction motions may temporarily inhibit the pain response.

Conditions Requiring Special Precautions for Stretching

mobilizations may be used with *extreme care in the following conditions if the signs and the patient's response are favorable*

- Malignancy.
- Bone disease detectable on radiographs.
- Unhealed fracture. (The site of the fracture and the stabilization provided will dictate whether or not manipulative techniques can be safely applied.)
- 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 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.

Grades and dosages

- Two systems of grading dosages (or rate of application) and their application in the range of available motion have been popularized.

- **Non-Thrust Oscillation Techniques**
- The oscillations may be performed using physiological (osteokinematic) motions or joint-play (arthrokinematic) techniques.

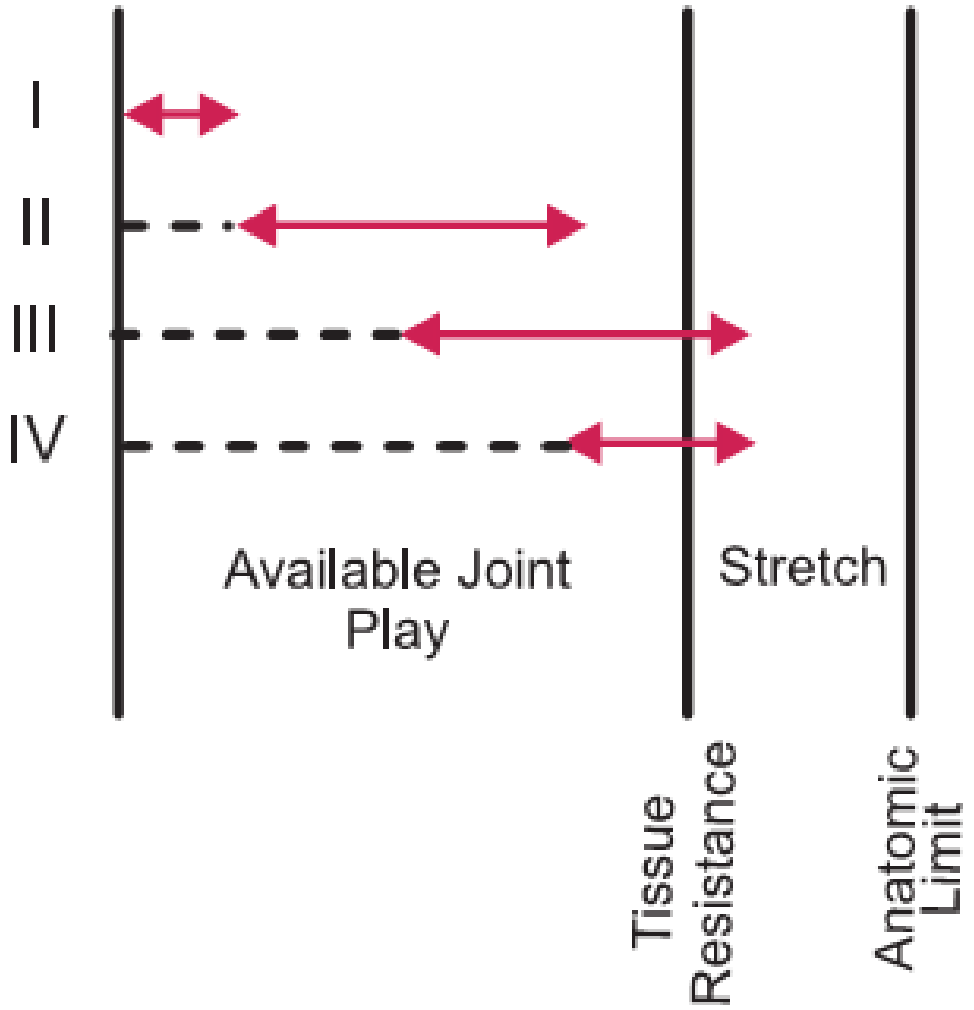


FIGURE 5.9 Representation of oscillation techniques. *(Adapted from Maitland.[11])*

Dosage and Rate of Application

- ***Grade I.*** *Small-amplitude rhythmic oscillations are performed at the beginning of the range. They are usually rapid oscillations, like manual vibrations.*
- ***Grade II.*** *Large-amplitude rhythmic oscillations are performed within the range, not reaching the limit. They are usually performed* ***at 2 or 3 per second for 1 to 2 minutes.***
- ***Grade III.*** *Large-amplitude rhythmic oscillations are performed up to the limit of the available motion and are stressed into the tissue resistance. They are usually performed* ***at 2 or 3 per second for 1 to 2 minutes.***
- ***Grade IV.*** *Small-amplitude rhythmic oscillations are performed at the limit of the available motion and stressed into* the tissue resistance. They are usually rapid oscillations, like manual vibrations.

- **Indications**
- **Grades I and II** are primarily used for treating joints limited by **pain or muscle guarding**. The oscillations may have an inhibitory effect on the 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.
- **Grades III and IV** are primarily used as stretching maneuvers.
- 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.

Non-Thrust Sustained Joint-Play Techniques

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

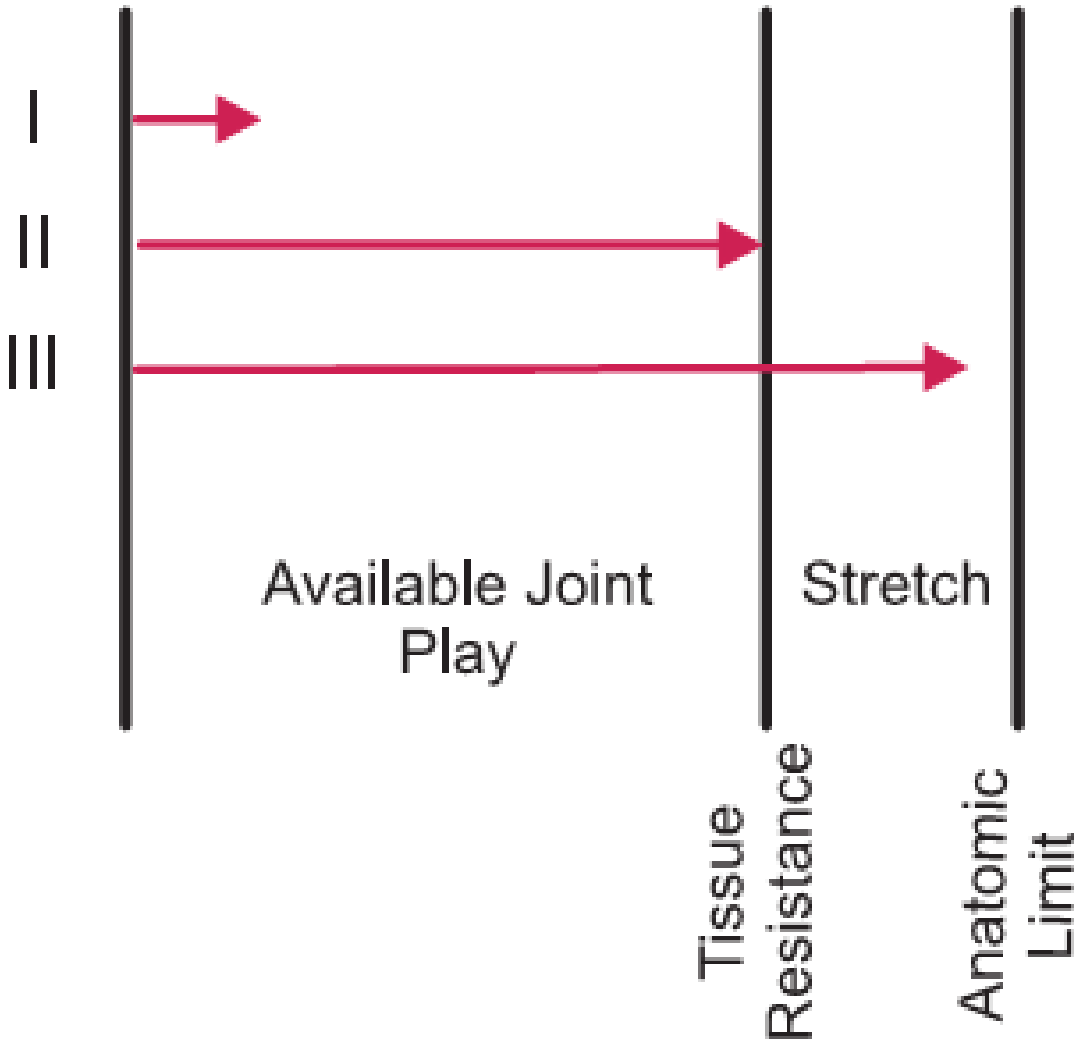


FIGURE 5.10 Representation of sustained joint-play techniques. *(Adapted from Kaltenborn.[15])*

- **Dosages and Rate of Application**
- As indicated by the name, rate of application is slow and sustained for several seconds followed by partial relaxation and then repeated depending on the indications.
- ***Grade I (loosen).*** *Small-amplitude distraction is applied when no stress is placed on the capsule. It equalizes cohesive forces, muscle tension, and atmospheric pressure acting on the joint.*
- ***Grade II (tighten).*** *Enough distraction or glide is applied to tighten the tissues around the joint. Kaltenborn* called this "taking up the slack."
- ***Grade III (stretch).*** *A distraction or glide is applied with an amplitude large enough to place stretch on the joint capsule and surrounding periarticular structures.*

- **Indications**
- Grade I distraction is used with all gliding motions and may be used for relief of pain. Apply intermittent distraction **for 7 to 10 seconds** with a few seconds of rest in between for several cycles. Note the response and either repeat or discontinue.
- Grade II distraction is used for the initial treatment to determine the sensitivity of the joint. Once the joint reaction is known, the treatment dosage is 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 distractions or glides are used to stretch the joint structures and thus increase joint play. 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.

Tractions vs. Distraction

Tractions vs. Distraction

Traction

- pulling something along a surface

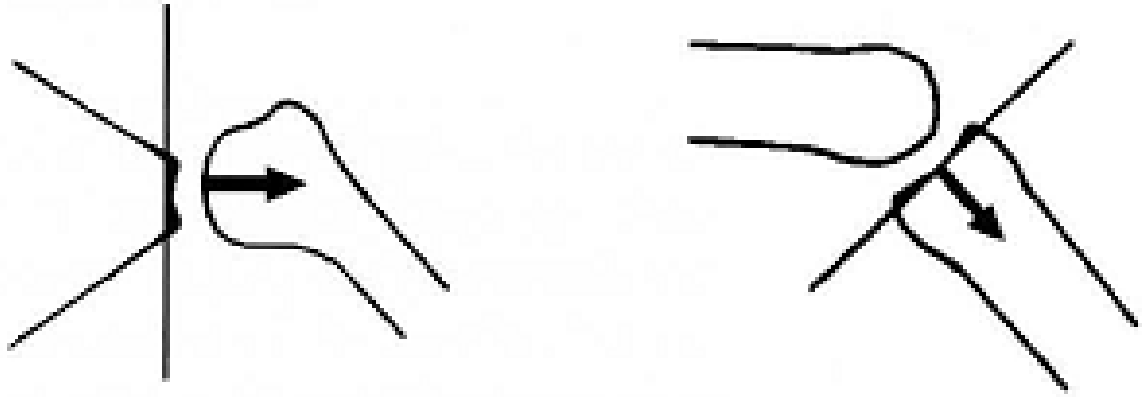
Distarction

- separation of 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 glenohumeraljoint requires a pull at right angles to the glenoidfossa.***
- 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.***

- words **Traction and distraction** are used synonym in many books
- **Traction and distraction** both are used for joint separations (one of joint play movements)
- **Distraction** is a separating force at right angle to treatment plane in keltenborn, he also used the term traction for same force
- **Traction** is applied at long axis to bone and there is some degree of glide also present.

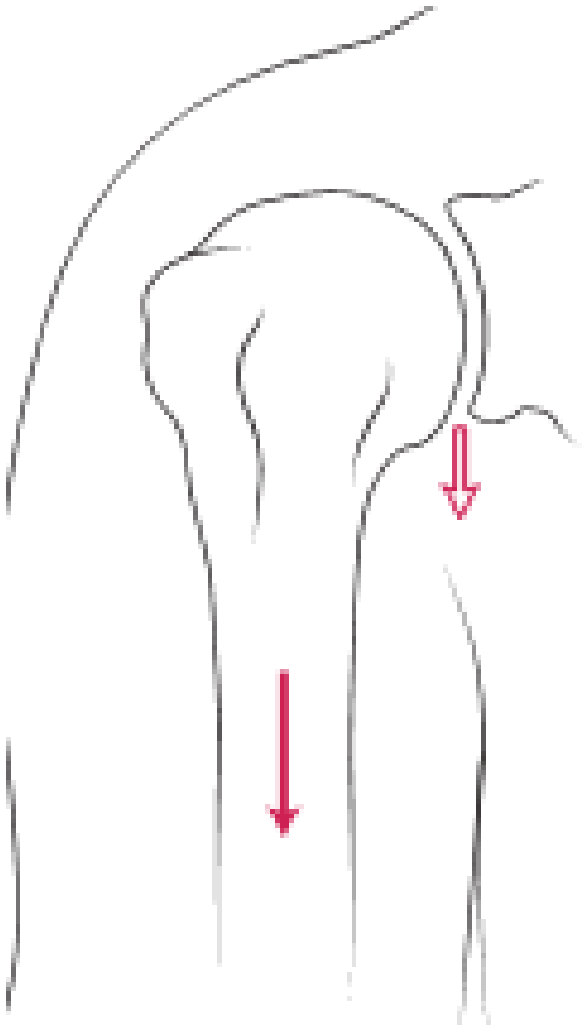
Distraction



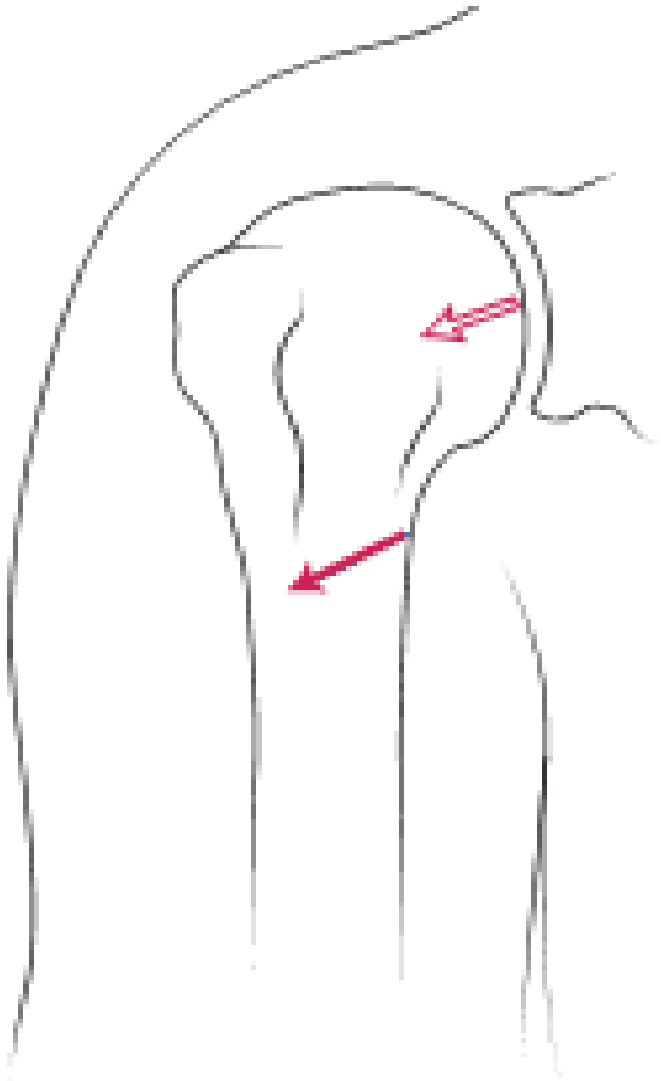
Bone movement at a right angle to and away from the

Keltenborn also used term the traction for same movements

Traction



Distraction



Tractions vs. Distraction

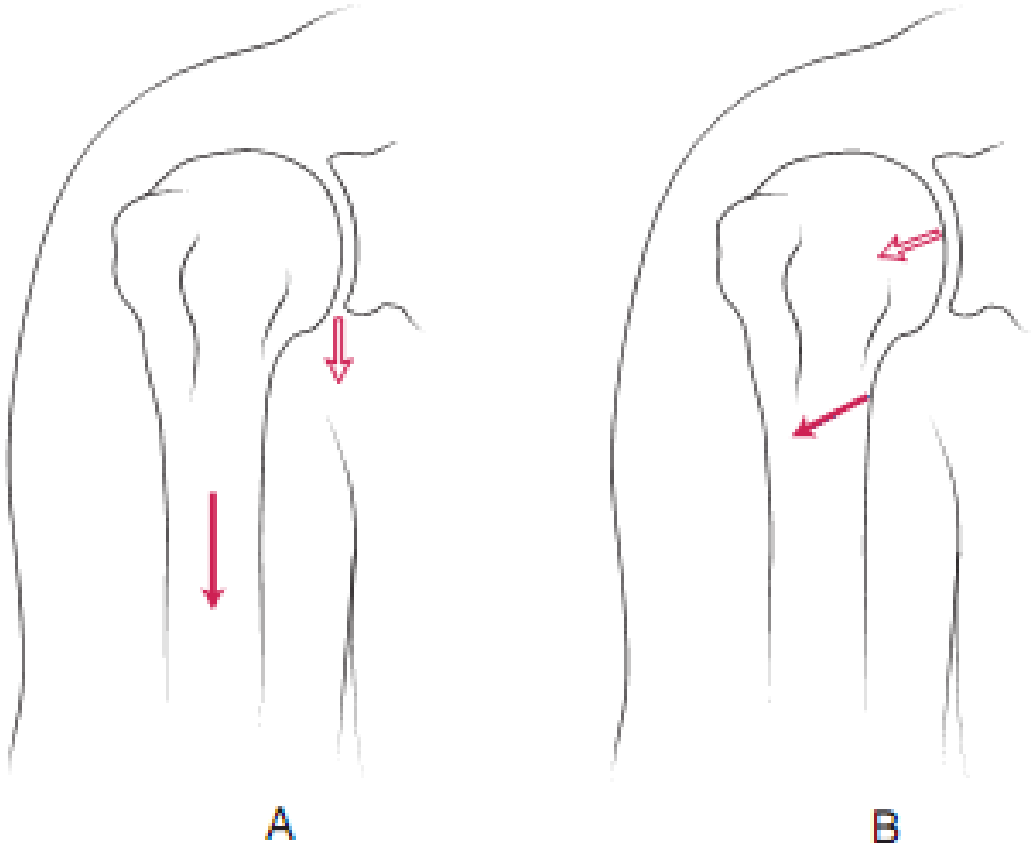


FIGURE 5.8 **(A)** Traction applied to the shaft of the humerus results in caudal gliding of the joint surface. **(B)** Distraction of the gleno-humeral joint requires separation at right angles to the glenoid fossa.

Separation of joints → distraction

Separation with glide(inferior) → traction

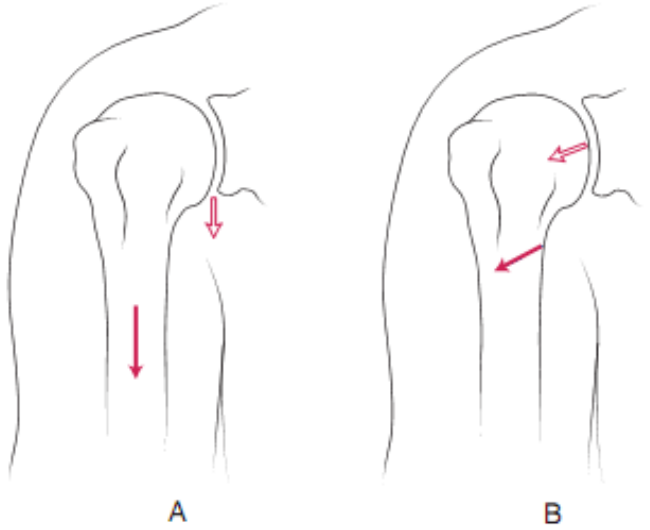


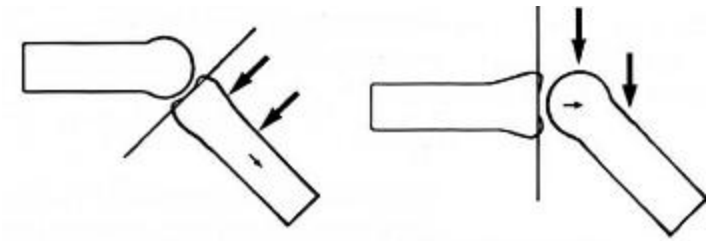
FIGURE 5.8 (A) Traction applied to the shaft of the humerus results in caudal gliding of the joint surface. (B) Distraction of the gleno-humeral joint requires separation at right angles to the glenoid fossa.

GLIDE VS DISTRACTION

Both are joint play

Glide

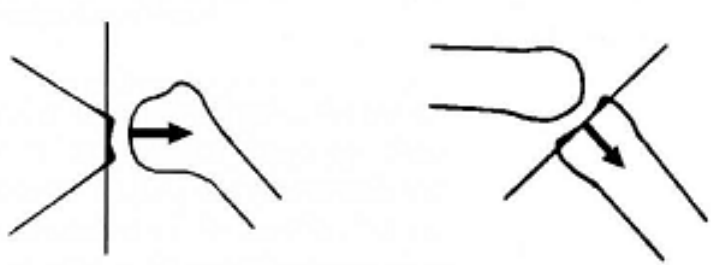
- a joint play movement parallel to the treatment plane.



Translatoric bone movement parallel to the treatment plane

Distraction

- a joint play movement right angle/vertical/perpendicul-ar to the treatment plane

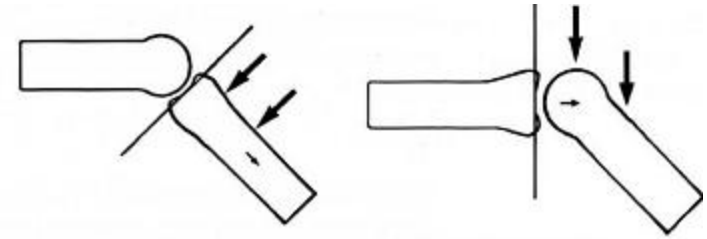


Bone movement at a right angle to and away from the

GLIDE VS TRACTION

Glide

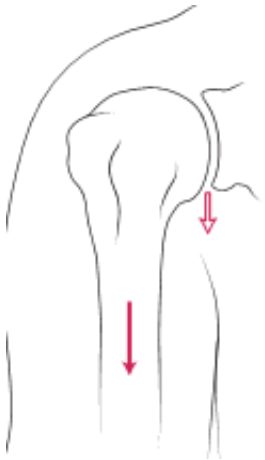
- a joint play movement parallel to the treatment plane.



Translatoric bone movement parallel to the treatment plane

Traction

Separation with glide(inferior) → **traction**



STILL CONFUSED?

YES……


LET ME DIE!
CW

THANK YOU

BEST OF LUCK

Thanks

Thanks