Joint Roll-Gliding

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Joint roll-gliding associated with bone rotations

- **Joint roll-gliding**
- In a healthy joint, functional movement (bone rotation) produces joint roll-gliding.
- Roll-gliding is a combination of rolling and gliding movement which takes place between two joint surfaces

  (in the spine, between two adjacent vertebrae in a mobile segment).
- Relatively **more gliding** is present when joint surfaces are **more congruent** (flat or curved), and
- **more rolling** occurs when joint surfaces are **less congruent.**

Rolling

- Rolling occurs when **new equidistant points on one** joint surface come into contact with **new equidistant points on another** joint surface.
- Rolling is **possible between two incongruent** curved surfaces (i.e., surfaces of unequal radii of curvature).

Figure 1.5a
Rolling convex surface

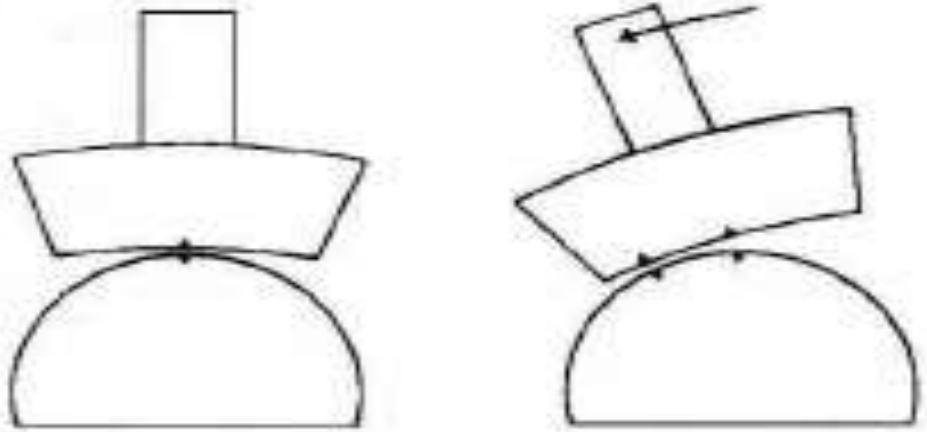


Figure 1.5b
Rolling concave surface

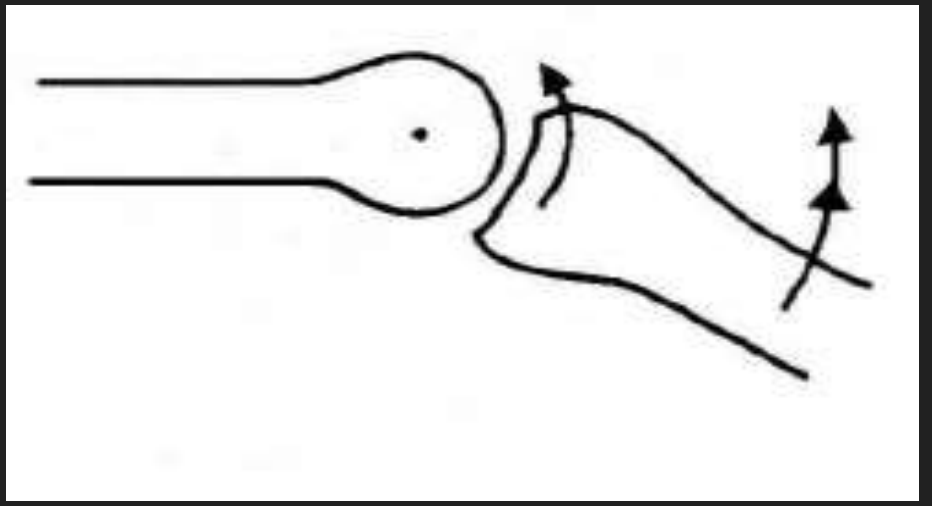
The **direction of the rolling component** of joint roll-gliding is always in the direction of the bone movement.

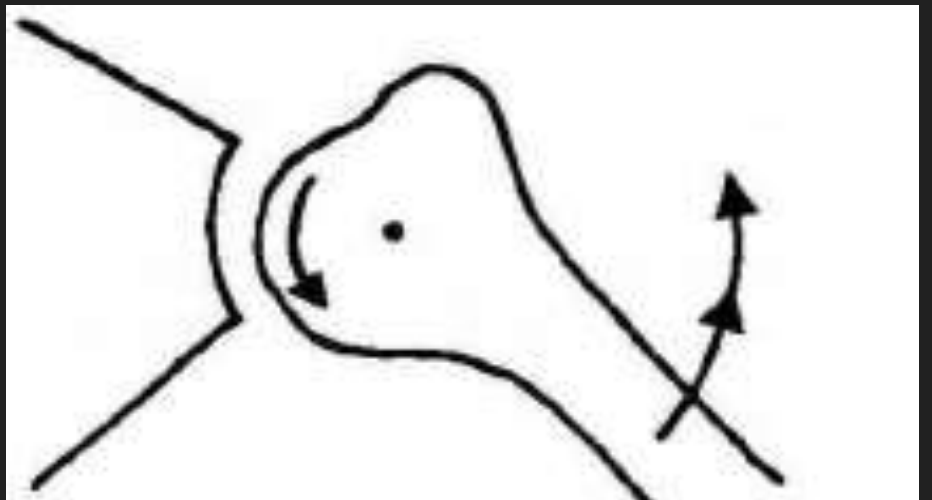
Gliding

- occurs when the **same point on one** joint surface comes into contact with **new points on another** joint surface.
- *Pure gliding is the only movement possible between flat or congruent curved surfaces.*
- Since there are no completely curved congruent or entirely flat joint surfaces, **pure gliding does not occur in the human body.**

Direction of Glide

- The direction of the gliding component of joint roll-gliding associated with a particular bone rotation movement depends on whether a concave or convex articular surface is moving.
- If a **concave** surface moves, joint gliding and bone movements are in the **same** direction.
- If a **convex** joint surface is moving, joint gliding and distal bone movement are in **opposite** directions.





- With movement restrictions (hypomobility) normal joint rollgliding is often disturbed.
- Usually the restricted movement is associated with an impaired gliding component which may allow joint rolling to occur without its associated gliding.
- Highly congruent joints, whether flat or curved, are relatively more affected by impaired gliding.
- A common *goal in our approach to OMT is to restore the gliding component of roll-gliding to normalize movement mechanics.*

Abnormal roll-gliding

- Joint rolling movements in the absence of gliding can produce a damaging concentration of forces in a joint.
- On the same side towards which the bone is moving, joint surfaces tend to compress and pinch intra articular structures, which can cause injury.
- At the same time, on the side opposite the bone movement, tissues can be overstretched.

The following examples illustrate how damaging compression forces may occur when treating hypomobile joints with long-lever rotatoric techniques , or with short-lever techniques applied parallel to a convex articular surface

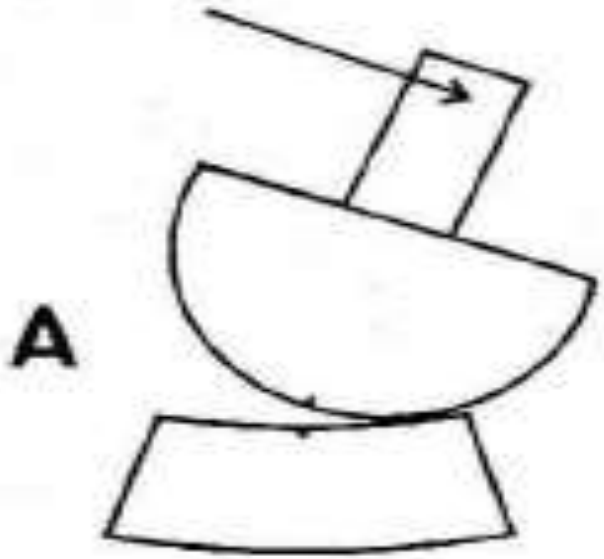


Figure 1.8a
Joint compression can result from forced passive bone rotations stretching through a long lever.

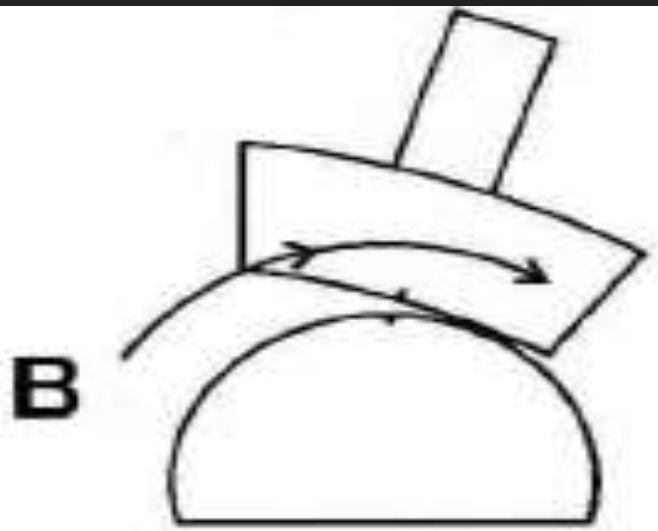


Figure 1.8b
Joint compression can result from forced passive bone rotations stretching through a short lever, or from improperly applied techniques intended to avoid compression.

Translation of a vertebral bone

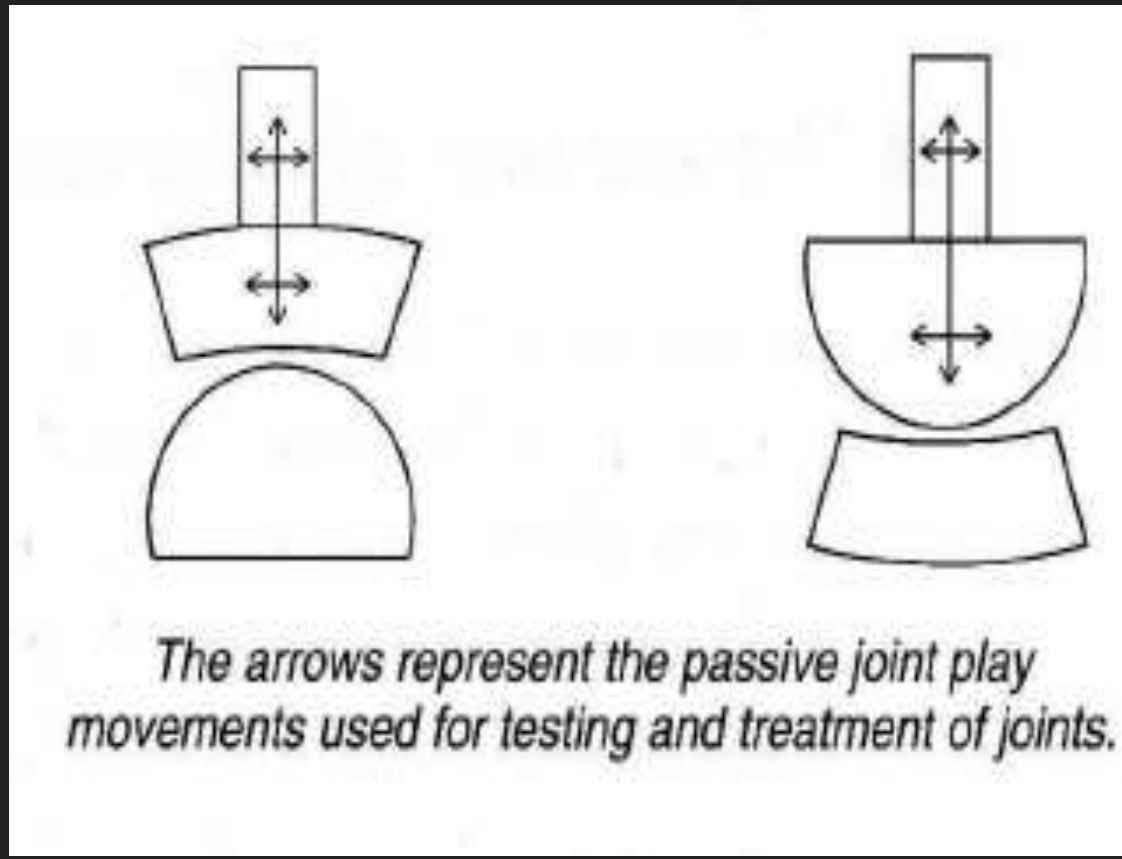
- Bone translation is a linear movement of a bone along a defined axis in its respective plane.

- During translation of a bone, **all parts of the bone** move in a straight line, equal distances, in the same direction, and at the same speed.

- **Longitudinal Axis Bone Translation**
- » **Separation of adjacent vertebrae, pulling them away** from each other
- » **Approximation of adjacent vertebrae, pushing them** toward each other
- **Sagittal Axis Bone Translation**
- » **Ventral-Dorsal Gliding: parallel movement of vertebrae** in relation to each other in a ventral or dorsal direction
- **Frontal Axis Bone Translation**
- » **Lateral Gliding: parallel movement of vertebrae in** relation to each other to the right or left

Joint play associated with bone translation

- Bone translations produce isolated traction, compression, or gliding joint play movements in relation to the treatment plane.
- These translatoric joint play movements are essential to the easy, painless performance of active movement.



The arrows represent the passive joint play movements used for testing and treatment of joints.

The Vertebral Motion/Mobile Segment

- the superior and the inferior vertebra and all related anatomic structures, including the
- intervertebral disc,
- 2 apophyseal joints,
- and various soft tissues.
- An example of a vertebral motion segment is the third cervical vertebra (C3) situated above the fourth cervical vertebra (C4).
- The **nomenclature** used to describe this union is the
- **C3,4 motion segment**.

Junction or Transitional segment

- A junction or transitional segment is an area where one region of the spine is joined to a different region. Example are the
- craniocervical,
- cervicothoracic,
- thoracolumbar,
- and lumbosacral junctions.

➢ The craniocervical junction is also known as the occipitoatlantal segment or O-A;

➢ the cervicothoracic junction is synonymous with C7,T1;

➢ the thoracolumbar junction with T12,L1;

➢ and the lumbosacral junction with L5,SI.

Physiologic Motion

- Each of the 24 vertebrae (7 cervical, 12 thoracic, and
- 5 lumbar) have the ability to move in 3 planes of reference.
- The sagittal plane motions include forward bending or flexion and backward bending or extension,
- the frontal plane motions include side bending or lateral flexion to the right and left,
- and the horizontal plane motions include axial rotation to the right and left.

Motion Axes

- Each of these 6 spinal motions can be considered rotations
- Forward and backward bending are rotations about the
  - **X or horizontal axis**,
- side bending is a rotation about the
  - **Z or anteroposterior axis**,
- and axial rotation occurs about the
  - **Y or vertical axis.**

- The thumb, index, and middle fingers one hand can be used to assist in recalling these 3 axes of spinal motion.
- The thumb pointing to the ceiling represents the
- **Y or vertical axis**,
- the middle finger flexed to 90 degrees at the metacarpophalangeal joint represents the
- **X axis**,
- and the index finger at a right angle to the middle finger, directed anteriorly, represents the
- **Z axis (Figure 1-2).**

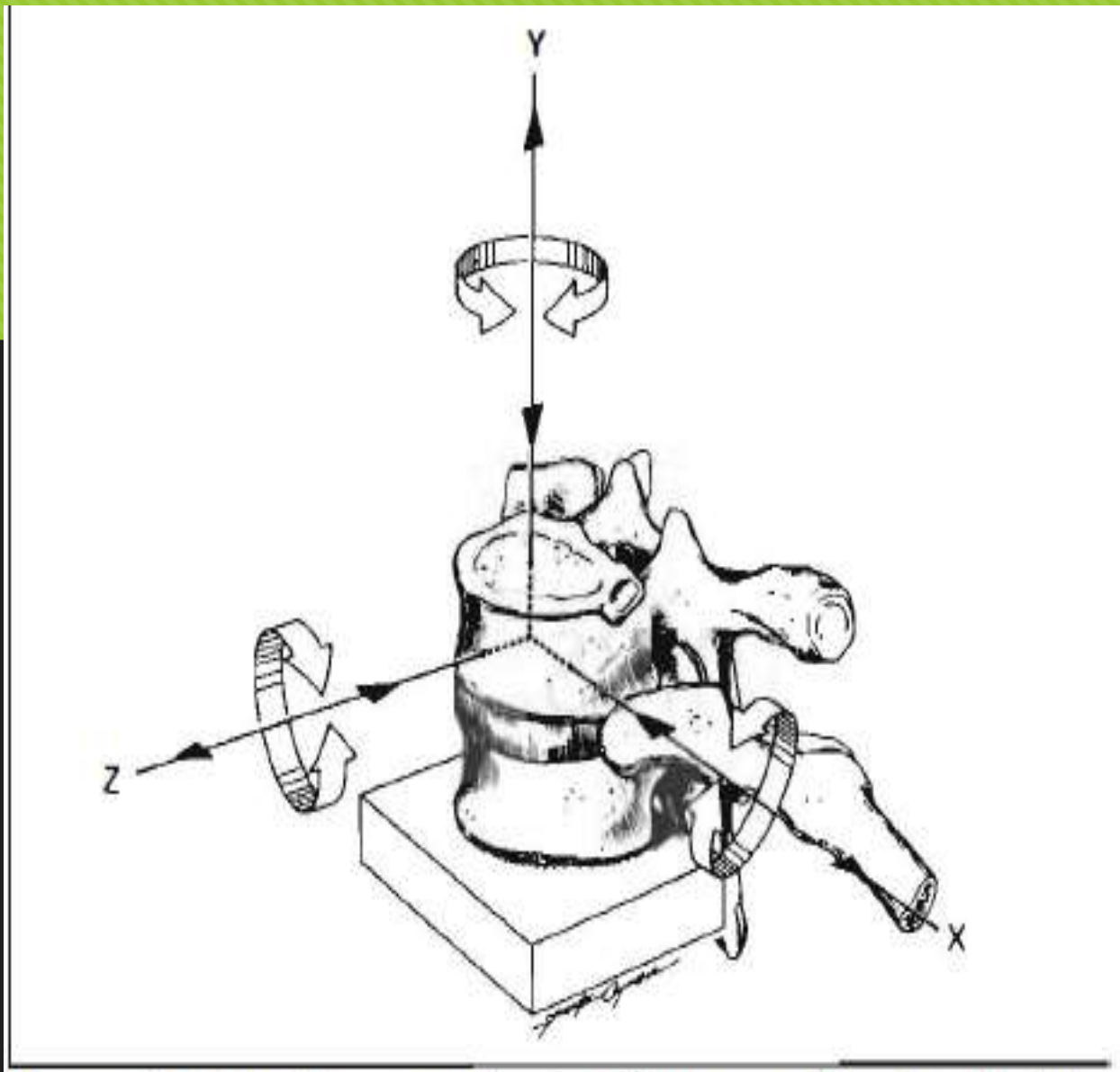


Figure 1-1. The three vertebral motion axes. (Reprinted with permission from Lee D. Biomechanics of the thorax: a clinical model of in vitro function. *J Man Manip Ther.* 1993;1(1):14.)

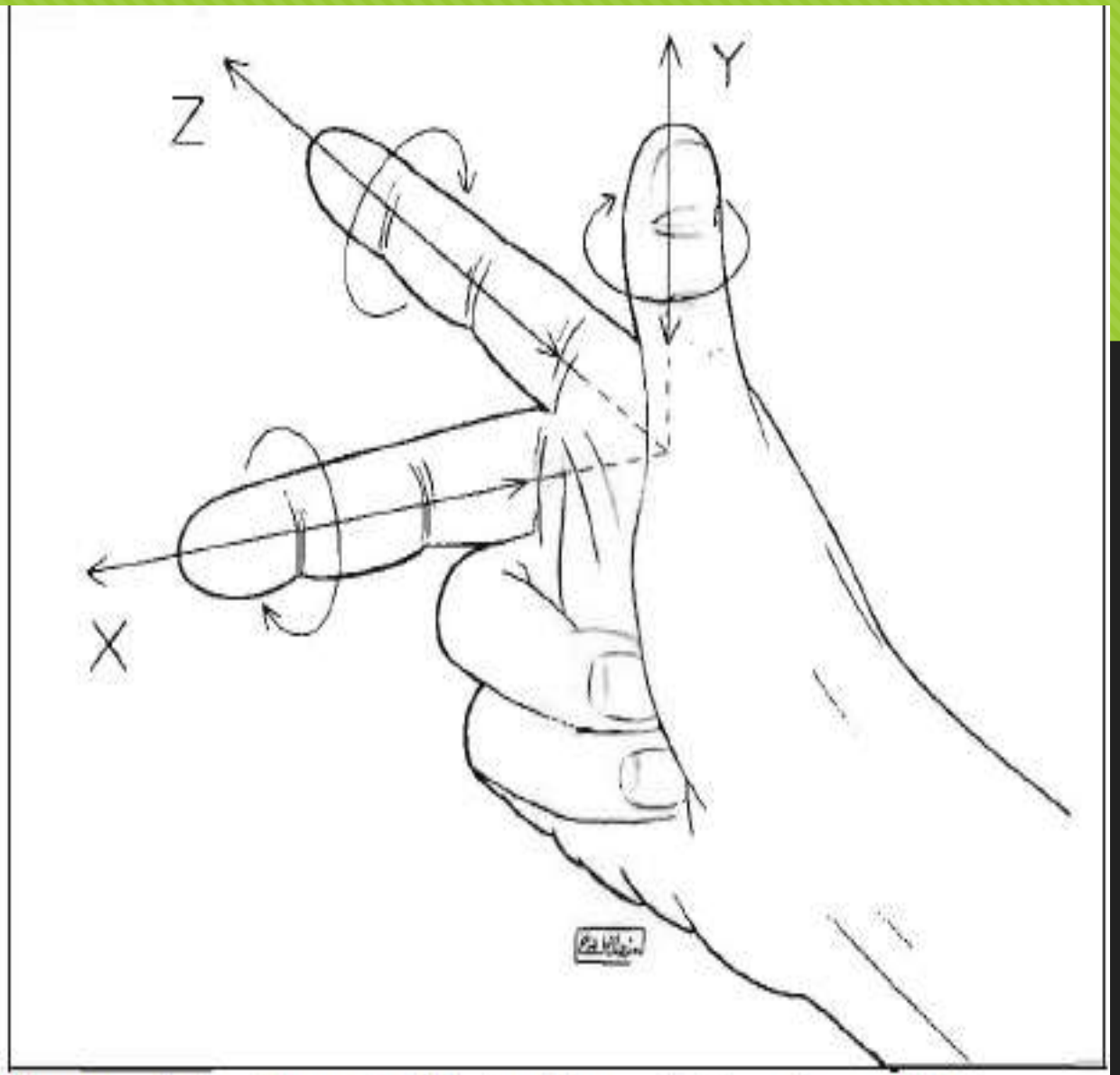


Figure 1-2. Manual illustration of the 3 cardinal axes. (Illustration by Ed Klein.)

Rule of Superior Motion

- When manual therapists describe segmental motion, it is understood that the superior vertebra is mentioned first.
- For example, side bending right at the T5,6 motion segment suggests that the fifth thoracic vertebra (T5) is side bending right on T6.
- Most often this will be documented as T5,6 side bending right.
- However, some clinicians may describe this in short form as T5 side bending right.
- When only one vertebral level is noted, it denotes that segment's motion not under the level above but rather over the level below.
- Consequently, T5 side bending right refers to its motion relative to T6;
- L4 rotation left is motion relative to L5.

- This is the case whether spinal motion is initiated from above down or from below up.
- For example, trunk rotation that is initiated by rotating the lower extremities and pelvis to the right and proceeding up to and including T8
- is still described as T7,8 rotation left by virtue of the fact that T7 is left rotated relative to T8.

Rule of Vertebral Body Motion

- A vertebra's motion is always described by the direction of vertebral body motion and not spinous process (SP) movement.
- Consequently, a passive movement of the T11
- SP to the left, which induces vertebral rotation to the right, is described as T11,12 rotation right because of the direction of vertebral body motion.

Type 1 and 2 Impairment

Type 1 or neutral Impairment

- Restricted spinal motion involving 3 or more segments in a neutral position of the trunk is referred to as type 1 or neutral impairment (ie, dysfunction).
- For example, in a neutral trunk position a restriction in left side bending from T9 through T12 is associated with a restriction at the same levels in right rotation.
  its position can often be identified on an anteroposterior spinal radiograph.

➢ **eg Scoliosis**

Type 2 or Non Neutral Impairment

- Restricted spinal motion of one segment in a non-neutral position is referred to as type 2 or non-neutral impairment.
- For example, T3,4 is said to be FRS (flexed, rotated, and side bent) right when it is limited in the opposite directions (ie, extension, rotation, and side bending to the left).
- Conversely, L4,5 is said to be ERS (extended, rotated, and side bent) left when it is limited in flexion, rotation, and side bending to the right.
- These one-segment motion impairments may not be easily seen on a spinal radiograph but can be readily diagnosed through segmental motion analysis.