

LUMBAR SPINE

Arthrokinematics

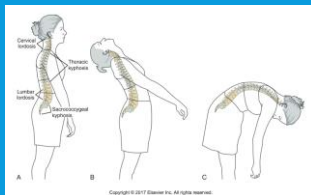
Dr Kate L Williams

SESSION AIMS...

- By the end of this session you should be comfortable...
 - Comparing the lumbar vertebrae to cervical and thoracic spine
 - Explaining how movement occurs in the motion segments of the lumbar spine
 - Applying normative ranges of movement to your own clinical assessment & MT treatment

LUMBAR POSTURE

- Lordosis
 - 30-70° (typical 40-50°)
 - Peak angle at L3-L4
 - Lumbar spine is already in EXTN



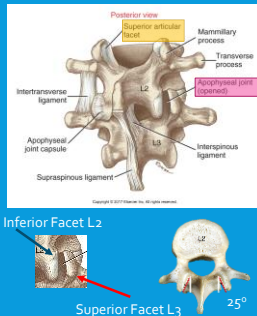
TYPICAL LUMBAR VERTEBRAE

- Massive wide bodies
 - Mass twice that of ALL cervical spine vertebrae
 - Support weight of head, trunk and arms
- Generally similar characteristics
 - Lamina & pedicles are short and thick
 - Vertebral canal is therefore triangular
- Transverse processes project laterally
 - L1-L4 thin and tapered
 - L5 short, thick and strong
- Spinous processes
 - Broad, rectangular
 - Project horizontally from each lamina



APOPHYSEAL/ FACET JOINTS

- L1-L4
- Facets orientated near vertical with sagittal plane bias
- Favour sagittal plane motion at expense of rotation and SF
- Superior articular facets are slightly concave
 - Face medial to postero-medial
- Inferior articular facets are slightly convex
 - Face lateral to antero-lateral
- Inferior facet sits INSIDE the Superior facet
- Superior facet 'hooks' inferior facet



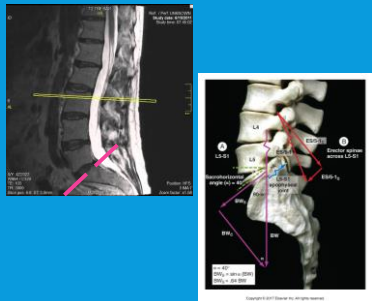
APOPHYSEAL/FACET JOINTS

- L5 – sacrum
- Facets of L5-S1 are orientated more in the frontal plane
- Widens and moves in to frontal plane
- Top (base) of the sacrum naturally inclined anteriorly and inferiorly
- ~ 40° sacrohorizontal angle in standing



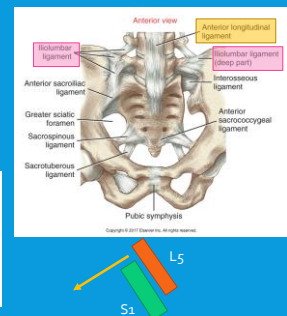
L5-S1 ARTICULATION

- ~ 40° sacrohorizontal angle in standing
- Resultant force of BW (BW) creates an anterior shear force (BW_s) and compressive force (BW_c) acting perpendicular to sacrum
 - Anterior shear ~ 64% BW
- Increasing lumbar lordosis increases sacrohorizontal angle
 - Increases shear



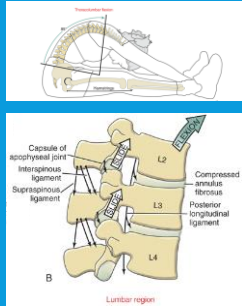
L5-S1 ARTICULATION

- Shear resisted by
 - Anterior longitudinal ligament
 - Iliolumbar ligament
- Bony stabilisation
 - Sturdy facets of L5-S1 apophyseal joints

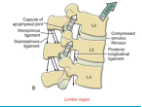


LUMBAR KINEMATICS

- FLXN
 - 85° total incl. Txsp
 - 40-50° Lxsp
 - Sagittal plane orientation of facets
 - Movement upwards and forwards
- Resistance
 - Posterior longitudinal lig
 - Facet joint capsule
 - Interspinous lig
 - Supraspinous lig

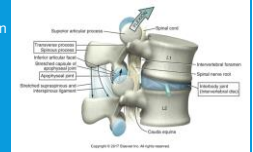


LUMBAR KINEMATICS

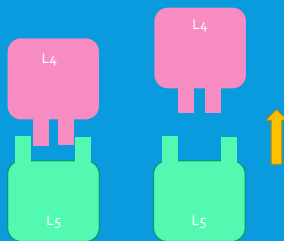
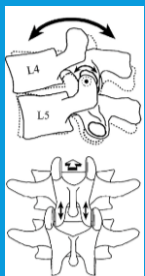


During FLXN

- Disc compression
 - During FLXN compressive forces are transmitted away from facet joints
 - Normally accept 20% of total spine load in standing
 - Shifts to the anterior aspect of the discs
- Spinal Nerve Root Decompressed
 - Diameter of each intervertebral foramen increases by 19% reducing pressure on exiting spinal nerves
- Facet Joint Capsule
 - Stretches
- Facet Joint Surfaces
 - SEPARATE – no Approximation

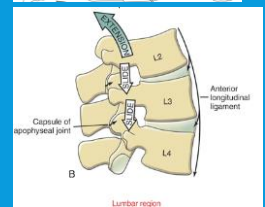


LUMBAR KINEMATICS



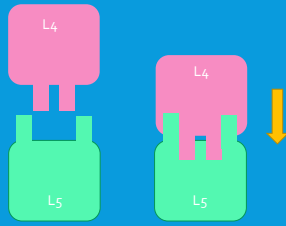
LUMBAR KINEMATICS

- EXTN
 - 35° EXTN total across Txsp and Lxsp
 - Txsp 20-25°
 - Lxsp 15-20°
- Increase in natural lordosis
- Inferior facet slide inferiorly and posteriorly relative to the superior facets
 - Increase in contact area between the facet joints
 - Accept a greater % of BW
- Extreme/hyperextension
 - Sharp tips of inferior facet slide inferiorly beyond the joint surface of the superior articular facet
 - Continue downwards til they reach the adjacent lamina
 - Increase in contact pressures



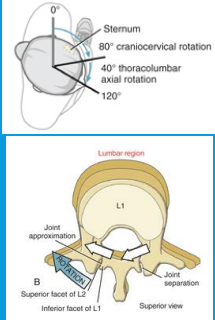
LUMBAR KINEMATICS

- In EXTN:
 - Disc is decompressed
 - Facet joint surface load increases
 - Facet joint capsule is stretched (extreme ROM)
 - Intervertebral foramen is reduced, potentially compressing the exiting spinal nerve



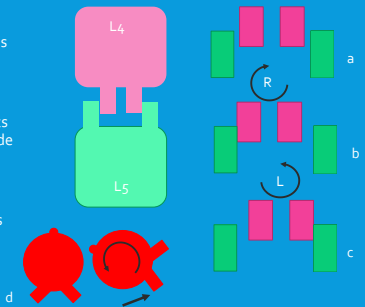
LUMBAR KINEMATICS

- Rotation
 - Only 5-7° rotation to each side
 - Often measure more than this
 - Rotation to R at L1 + L2
 - Left inferior facet of L1 approximates/ compresses against the Left superior facet of L2
 - Right inferior facet of L1 separates or distracts from the right superior facet of L2
 - Left - closes
 - Right - opens



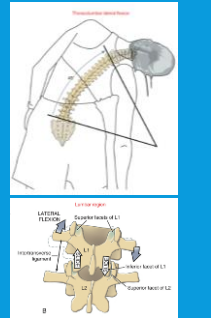
LUMBAR KINEMATICS

- TRADE OFF
 - Sagittal plane orientation is great for FLXN/EXTN
 - At the expense of axial rotation
 - The apophyseal/facet joints located on contralateral side of the rotation compress (approximate)
 - Blocks further movement
 - Tension in annulus fibrosus also restricts rotation

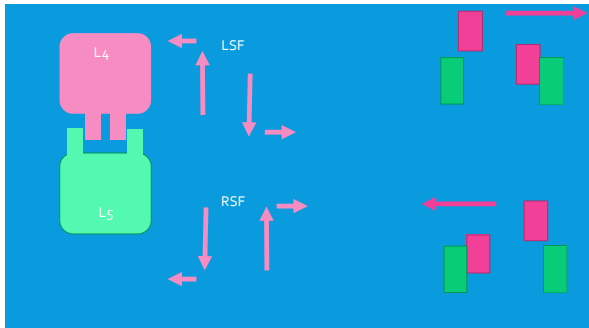


LUMBAR KINEMATICS

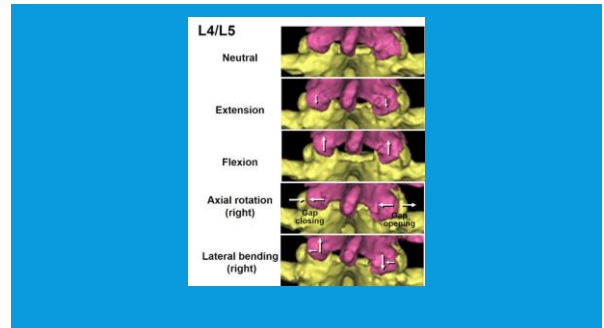
- Side Flexion
 - 20° to each side
 - Ligaments on contralateral side limit side flexion
 - More movement than rotation as the 'flexion' element provides more room



LUMBAR KINEMATICS



LUMBAR KINEMATICS



SUMMARY OF LUMBAR MOVEMENT

FLXN & EXTN	ROTATION	SIDE FLXN
FLXN = 40-50°	5-7°	20°
EXTN = 15-20°		
Total = 55-70°		
Structure	Effect of FLXN	Effect of EXTN
Nucleus Pulposus	Deformed, pushed posteriorly	Deformed, pushed anteriorly
Annulus Fibrosus	Posterior side stretched	Anterior side stretched
Facet Joint	Capsule stretched Reduced articular contact Loading decreased	Capsule slackened Maximised articular contact Loading increased
Intervertebral foramen	Widened	Narrowed
Posterior ligaments	Increase tension (lengthened)	Decrease tension (slackened)
Anterior longitudinal ligament	Decrease tension (slackened)	Increase tension (lengthened)
Spinal Cord	Increase tension (lengthened)	Decrease tension (slackened)