

SPINAL BIOMECHANICS

CRANIOVERTEBRAL REGION

Movement	Osteokinematics	Arthrokinematics
OA flexion	Anterior Sagittal rotation Axis through mastoid	Posterior glide of condyles on lateral masses of C1
OA Extension	Posterior Sagittal rotation Axis through mastoid	Anterior glide of condyles on lateral masses of C1
OA Side Flexion / Rotation	SF produces contralateral translation of C0 on C1 Rotation is contralateral to SF due to banked lateral masses	Ipsilateral condyle glides anteromedial Contralateral condyle glides posterolateral
AA Axial Rotation	Axis is through dens Conjunct SF occurs	Ipsilateral posteroinferior Contralateral anteroinferior
AA Flexion & Extension	Sagittal motion with Axis through osteoligamentous ring	Central part glides superior & inferior on the dens Lateral joints glide posterior with flexion and anterior with extension
AA Side Flexion	Conjunct Rotation with debate if contra or ipsilateral	Slight translation ipsilateral

CERVICAL SPINE

Movement	Osteokinematics	Arthrokinematics
Flexion	Anterior sagittal rotation with anterior sagittal translation Axis posteroinferior in upper cervical moving more anterosuperior in lower cervical	Anterosuperior glide at Z-Jt Anterior glide at U-Jt
Extension	Posterior sagittal rotation and translation	Posteroinferior glide at Z-Jt Posterior glide at U-Jt
Rotation – Side Flexion	Rot coupled with ipsilateral SF Contralateral translation	Ipsilateral Z-jt Post-Inf-Med Contralateral Z-Jt Ant-Sup-Lat Ipsilateral U-Jt Inf-Post Contralateral U-jt Sup-Ant

THORACIC SPINE

Movement	Osteokinematics	Arthrokinematics
Flexion	Anterior sagittal rotation with anterior sagittal translation Rib rotates anteriorly	Z-Jt Superior-anterior glide Rib 1-6 CT-Jt superior glide Rib 7-10 CT-Jt PMS All ribs CV-Jt anterior spin
Extension	Posterior sagittal rotation with posterior sagittal translation Rib rotates posteriorly	Z-Jt Inferior-posterior glide Rib 1-6 CT-Jt inferior glide Rib 7-10 CT-Jt ALI All ribs CV-Jt posterior spin
Side Flexion	Ipsilateral translation and contralateral rotation Ipsilateral rib rotates anterior Contralateral rib posterior	Ipsilateral Z-Jt glides inferior and contralateral superior glide Ipsilateral rib superior-anterior and drives the vertebra Contralateral inferior-posterior
Rotation	Ipsilateral side flexion and contralateral translation Ipsilateral rib rotates posterior Contralateral rib anterior	Ipsilateral Z-Jt glides inferior and contralateral superior Ipsilateral rib inferior and contralateral superior glide
Inspiration	Posterior Sagittal Rotation Rib 1-6 Pump Handle Rib 7-10 Bucket Handle Rib 11-12 Caliper	Rib 1-6 Inferior glide Rib 7-10 ALI glide
Expiration	Anterior Sagittal Rotation	Rib 1-6 Superior glide Rib 7-10 PMS glide

LUMBAR SPINE

Flexion	Anterior sagittal rotation with anterior sagittal translation	Z-Jt Superior-anterior glide
Extension	Posterior sagittal rotation with anterior sagittal translation	Z-Jt Inferior-posterior glide
Side Flexion	Coupled movements variable	Ipsilateral Z-Jt glides inferior & contralateral superior glide
Rotation	Coupled movements variable	Coupled movements variable

LUMBOPELVIC REGION

Movement	Innominate	Sacrum	L5
Trunk Flexion	Posterior Rotation relative to sacrum	Nutation or flexion relative to innominate	Flexion and anterior translation on sacrum
Trunk Extension	Anterior rotation relative to sacrum	Counternutation or extension relative innominate	Extension and posterior translation
Side Flexion (right)	Left translation Right rotates anterior Left rotates posterior	Sacral base rotates to left	Variable – tends to follow sacrum
Rotation (right)	Right innominate posterior and left anterior	Sacral base rotates left	Rotates right with conjunct side flexion variable
Hip Flexion (right)	Right posterior rotation	Right sacral rotation Bilateral sacrum nutated	Rotates right