Spinal motion

The spine, or vertebral column, serves as a dynamic structure allowing for movement, stability, and protection of the spinal cord. Spinal motion is facilitated by the intervertebral joints, intervertebral discs, and supporting ligaments and muscles, while the facet joints and ligaments help guide and limit specific motions.

Types of Spinal Motion Spinal motion occurs in three primary planes, with each segment of the spine contributing differently:

Flexion and Extension (Sagittal Plane):

Flexion: Forward bending of the spine. Occurs mainly in the cervical and lumbar regions. Limited in the thoracic spine due to rib attachments. Extension: Backward bending of the spine. Greatest in the cervical and lumbar regions. Lateral Flexion (Coronal Plane):

Side bending of the spine. Most pronounced in the cervical and lumbar regions. Restricted in the thoracic spine due to rib attachments. Axial Rotation (Transverse Plane):

Twisting motion around the longitudinal axis. Most significant in the cervical spine (due to the atlantoaxial joint) and the thoracic spine. Limited in the lumbar spine due to the orientation of the facet joints. Regional Contributions to Spinal Motion Each segment of the spine has unique mechanical properties that influence motion:

Cervical Spine:

High degree of mobility for flexion, extension, lateral flexion, and rotation. Specialized joints (e.g., atlanto-occipital and atlanto-axial) allow for head nodding and rotation. Thoracic Spine:

Least mobile due to the rib cage and the orientation of the facet joints. Flexion, extension, and lateral flexion are restricted. Rotation is moderate. Lumbar Spine:

Primarily facilitates flexion and extension. Lateral flexion is moderate. Rotation is minimal due to the sagittal orientation of the facet joints. Sacrum and Coccyx:

These segments are fused and contribute minimally to motion. Structures Supporting Spinal Motion Intervertebral Discs:

Act as shock absorbers and allow motion between vertebral bodies. The nucleus pulposus facilitates multidirectional movement. Facet Joints:

Synovial joints that guide and limit spinal motion based on their orientation: Cervical: Horizontal, favoring rotation. Thoracic: Coronal, favoring rotation and lateral flexion. Lumbar: Sagittal, favoring flexion and extension. Ligaments:

Limit excessive motion and provide stability. Anterior and posterior longitudinal ligaments: Restrict excessive flexion and extension. Ligamentum flavum, interspinous, and supraspinous ligaments: Maintain tension and limit over-flexion. Muscles:

Intrinsic muscles (e.g., erector spinae, multifidus): Provide local control of motion. Extrinsic muscles (e.g., latissimus dorsi, trapezius): Assist with broader movements. Pathological Considerations

Affecting Spinal Motion Spinal Instability: Excessive or abnormal motion between vertebrae due to ligamentous injury, fractures, or degenerative changes. Degenerative Disc Disease: Loss of disc height and elasticity reduces mobility. Ankylosing Spondylitis: Fusion of spinal segments restricts motion. Scoliosis: Alters the normal range of motion due to abnormal spinal curvature. Clinical Relevance Understanding spinal motion is critical for diagnosing and managing:

Injuries: Fractures, dislocations, and ligament tears. Degenerative conditions: Herniated discs, spinal stenosis. Rehabilitation: Designing therapies to restore or protect spinal mobility while minimizing strain. Summary Spinal motion is a complex interplay of anatomical structures and biomechanics. Each region of the spine contributes distinctively to overall mobility while maintaining the stability needed to protect the spinal cord and neural elements.

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