JOINTS OF THE VERTEBRAL COLUMN

Spine by Sara Young

Kaan Yücel M.D., Ph.D.

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1) Craniocervical (atlanto-axial and atlanto-occipital) joints
2) Costovertebral joints
3) Sacroiliac joints

**JOINTS OF THE VERTEBRAL COLUMN**

**Symphyses between vertebral bodies** \( n=2 \) 1 above, 1 below

**Synovial joins between articular processes** \( n=4 \) 2 above, 2 below

A total of 6 joints between two vertebrae
Joint type: symphyses (secondary cartilaginous joints) designed for weight-bearing and strength

A layer of **hyaline cartilage** on each vertebral body

An **intervertebral disc** between these layers

an outer **anulus fibrosus** surrounds

a central **nucleus pulposus**.
Anulus fibrosus

- an outer ring of collagen *surrounding*
- a wider zone of fibrocartilage arranged in a lamellar configuration.
Nucleus pulposus

- core of the intervertebral disc
- fills the center of the intervertebral disc
- gelatinous
- absorbs compression forces between vertebrae.

**semifluid nature** responsible for much of the flexibility & resilience of the intervertebral disc and of the vertebral column as a whole.
INTERVERTEBRAL DISCS

Provide strong attachments between the vertebral bodies and unite vertebral bodies into a continuous semirigid column. Form the inferior half of the anterior border of the intervertebral foramen. 20-25% of the length (height) of the vertebral column.
Diagram of sagittal section of vertebral body and disc showing relationship of endplate and longitudinal ligament to the disc and the vertebrae.
1, vertebral body; 2, annulus fibrosus; 3, nucleus pulposus; 4, endplate; 5, spinal nerve root
No intervertebral disc between C1 and C2 vertebrae

Most inferior functional disc between L5 and S1 vertebrae
Thickness of the discs of the vertebral column descends

The range (amount) of movement is relative to the thickness of the body. The greatest range is in the cervical and lumbar regions, while movements of the vertebral column are greatest. The thickness of the discs is most uniform in the thoracic region.
Thanks to the semifluid nature

One vertebra rock forward or backward on another during flexion & extension
Intervertebral discs by aging

- Fibrocartilage of the nucleus pulposus

- Collagen fibers of the anulus degenerate.

  Thin & less elastic discs

  Nucleus & anulus not distinguishable
JOINTS OF THE VERTEBRAL ARCHES

ZYGAPOPHYSIAL JOINTS, FACET JOINTS

**plane synovial joints**

between superior & inferior articular processes of adjacent vertebrae.

@ cervical region articular capsule especially thin

wide range of movement
JOINTS OF THE VERTEBRAL ARCHES

ZYGAPOPHYSIAL JOINTS, FACET JOINTS

- permit gliding movements between articular processes
- **shape & disposition of the articular surfaces** determine the types of movement possible.

Accessibility ligaments unite the laminae, transverse processes, and spinous processes and help stabilize the joints.
UNCOVERTEBRAL (LUSCHKA’S) JOINTS

Uncinate process elevations@ lateral margins of the upper surface

Articulation with the body of the vertebra above commonly between unci of the bodies of C3 or 4-C6 or 7 vertebrae @ the lateral & posterolateral margins of the intervertebral discs

synovial joints or degenerative spaces (clefts) in the discs occupied by extracellular
LIGAMENTS OF THE VERTEBRAL COLUMN

Joints between vertebrae reinforced & supported by numerous ligaments 

**pass between vertebral bodies**

**interconnect components of vertebral arches.**
LIGAMENTS OF THE VERTEBRAL COLUMN

Anterior & posterior longitudinal ligaments
Ligamenta flava
Supraspinous ligament & ligamentum nuchae
Interspinous ligaments

between two laminae
Anterior longitudinal ligament

- From base of the skull to anterior surface of sacrum
- Along its length attached to vertebral bodies and intervertebral discs

Tectorial membrane
Posterior longitudinal ligament connecting axis to base of the skull
Ligamenta flava/Ligamentum flavum

Between
posterior surface of the lamina on the vertebra below
anterior surface of the lamina of the vertebra above
- resist separation of the laminae in flexion.
- assist in extension back to the anatomical position.
Supraspinous ligament

connects tips of the spinous processes from vertebra C7 to the sacrum

From vertebra C7 to the skull becomes structurally distinct ligamentum nuchae
Ligamentum nuchae

triangular, sheet-like structure in the median sagittal plane
External occipital protuberance to magnum
tip of spinous process of C7
deep side attached to
posterior tubercle of vertebra C1 & spinous processes of other cervical vertebrae.
supports the head.
resists flexion.
facilitates returning the head to the anatomical position.
provide attachment for adjacent muscles broad lateral surfaces & posterior edge
Interspinous ligaments

between adjacent vertebral spinous processes

from base to apex of each spinous process

*blend with*

**supraspinous ligament** posteriorly

**ligamenta flava** anteriorly

on each side
CRANIOVERTEBRAL JOINTS

**atlanto-occipital joints**
between atlas (C1) & occipital (condyle) bone

**atlanto-axial joints**
between atlas (C1) & axis (C2)

**Synovial joints with no intervertebral discs**
a wider range of movement than in the rest of the vertebral column.
nodding of the head, “yes” movement also sideways tilting of the head. **Main movement** flexion, with a little lateral flexion and rotation.
**LIGAMENTS OF ATLANTO-OCCIPITAL JOINTS**

**Anterior atlanto-occipital membrane** ( continuation of anterior long.lig.) connects anterior arch of the atlas to anterior margin of the foramen magnum.

**Posterior atlanto-occipital membrane** (similar to the ligamentum flavum) connects the posterior arch of the atlas to the posterior margin of the foramen magnum. Help prevent excessive movement of the atlanto-occipital joints.
Right & left lateral atlantoaxial joints
between inf. facets of lateral masses of C1 & superior facets of C2

Median atlantoaxial joint
between dens of axis & anterior arch of atlas

ATLANTO-AXIAL JOINTS

Atlas (C1)

Dens

Axis (C2)

Median plane pivot

[Diagram showing anatomical structures and X-ray images]
MOVEMENTS OF ATLANTO-AXIAL JOINTS

Cranium & atlas rotate on axis as a unit.

During rotation of the head

Dens/pivot held in a collar
- anteriorly anterior arch of atlas
- posteriorly transverse ligament of atlas

between tubercles on medial sides of lateral masses of atlas

HEAD TURNS FROM SIDE TO SIDE, DISAPPROVAL (“NO” MOVEMENT).
LIGAMENTS OF ATLANTO-AXIAL JOINTS

- Superior and inferior longitudinal bands
- Apical ligament
- Alar ligaments
- Cruciate ligament of the atlas
- Tectorial membrane (Membrana tectoria)
A typical rib articulates with:

- **bodies** of adjacent vertebrae joint with the head of the rib
- **transverse process** of its related vertebra costotransverse joint

- Necks rotate around their longitudinal axis **mainly in upper ribs**
- Ribs ascend descend relative to the spine **mainly in lower ribs**

**essential for altering the volume of the thoracic cavity during breathing**
Joint with head of rib

Head of the rib
Two facets face of articulation
1- with superior facet of its own vertebra
2- with inferior facet of the vertebra above

divided into two synovial compartments

by an intra-articular ligament
Costotransverse joints

**Costotransverse ligament** medial to the joint

**Lateral costotransverse ligament** lateral to the joint

Attaches the tip of the transverse process to the nonarticular part of the tubercle of the rib.

**Superior costotransverse ligament**

Attaches the superior surface of the neck of the rib to the transverse process of the vertebra above.

**Slight gliding movements**
Range of movement according to the region and the individual

Mobility primarily from compressibility & elasticity of the intervertebral discs

Normal range of movement reduced by 50% or more as a result of aging

Movements by the vertebral column

- Flexion
- Extension
- Lateral flexion
- Rotation
- Circumduction
Movements in a specific region (cervical, thoracic, and lumbar) determined by **shape & orientation of joint surfaces** on the articular processes & on the vertebral bodies.
MOVEMENTS OF THE VERTEBRAL COLUMN

Range of movement limited by

1) Thickness, elasticity, and compressibility of the IV discs

2) Shape & orientation of the zygapophysial joints

3) Tension of the joint capsules of the zygapophysial joints

4) Resistance of the back muscles and ligaments

5) Attachment to the thoracic (rib) cage

6) Bulk of surrounding tissue
A tear within the anulus fibrosus

Material of the nucleus pulposus can track

This material tracks into the vertebral canal or into the intervertebral foramen

Pressure on neural structures

*common cause of back pain*


A prolapsed intervertebral disc may impinge upon the meningeal sac, spinal cord, and most commonly the nerve root, producing symptoms attributable to that level.

**PHYSIOTHERAPY OR INTERVENTION BY A NEUROSURGEON**

**DISCECTOMY/LAMINECTOMY**

**Sensory nerve root**
Impulses about bodily sensations are carried by sensory nerve fibres. These converge to form sensory roots at the back of the spinal cord. Impulses are then conveyed to the brain via nerve fibre tracts.

**Sensory root ganglion**
Each spinal nerve has a dorsal (posterior) sensory root ganglion, which is a cluster of nerve cell bodies.

**Motor nerve root**
Bundles of fibres called motor nerve roots leave the front of the spinal cord. The fibres conduct impulses from the central nervous system to control voluntary movement and involuntary processes such as digestion.
Level of the disc protrusion identified before surgery.

MRI scanning and on-table fluoroscopy to prevent operating on the wrong level.

In some instances removal of the lamina will increase the potential space and may relieve symptoms.