

# **Embryology Team – 430**

**(First Lecture)**



## **Development of Spinal Cord & Vertebral Column**

**DONE BY :**

**Salwa Al Shibani**

**Haifa Al fozan**

**Raseel Al swidan**

**Shatha al harbi**

**Reem al ahmadi**

## Development of the Spinal Cord :

The spinal cord develops from the caudal 2/3 of the neural tube

### DEVELOPMENT OF NEURAL TUBE :

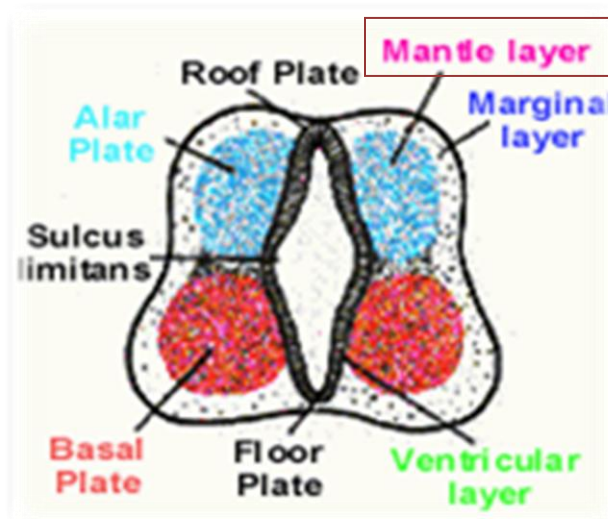
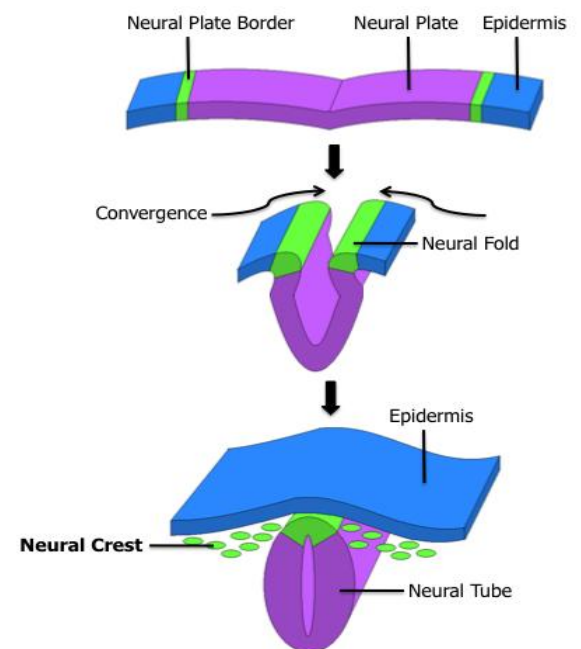
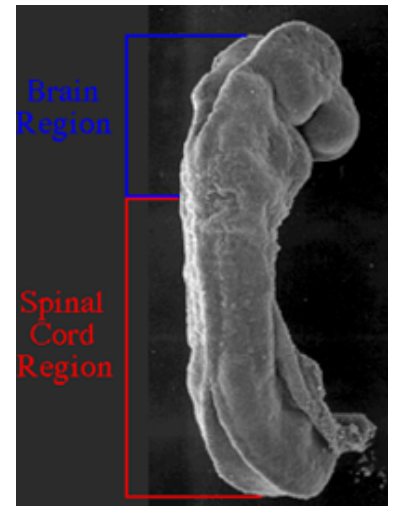
**\*\*Notochord stimulates neural tube formation**

That will stimulates vertebral column formation

- Ectodermal cells (which is dorsal to notochord) : thickens to form the neural plate
- neural groove : A longitudinal groove develops in the neural plate
- the neural folds approach to each other and fuse to form the neural tube.

**The wall of the neural tube shows three layers:**

Position of the layer	Name of the layer	Type of cells
inner	ventricular zone	undifferentiated cells
middle	mantle zone	cell bodies of neurons (future grey matter)
outer	marginal zone	nerve fibers or axons (future white matter)



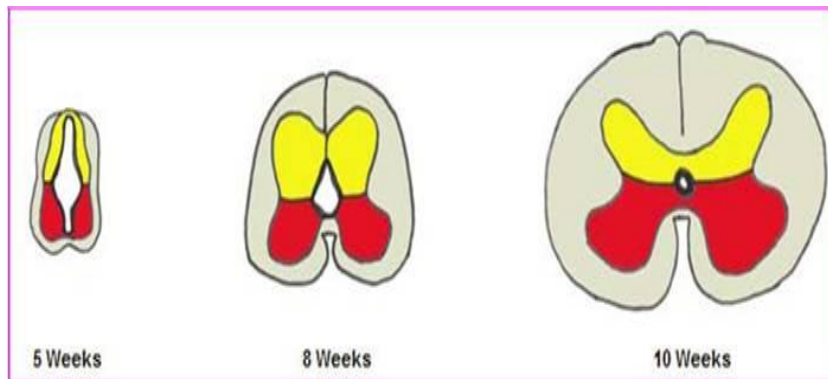
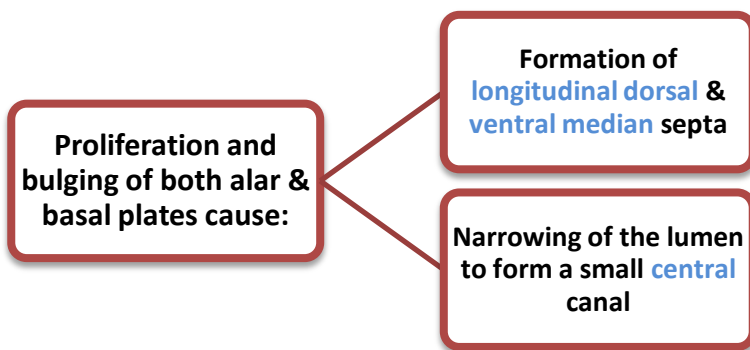
## MANTLE LAYER OF SPINAL CORD

- ❑ Neurons of mantle layer (future grey matter) differentiate into:

1-A dorsal alar plate  
(future dorsal horn):  
containing sensory  
neurons

2-A ventral basal plate (future ventral horn): containing motor neurons

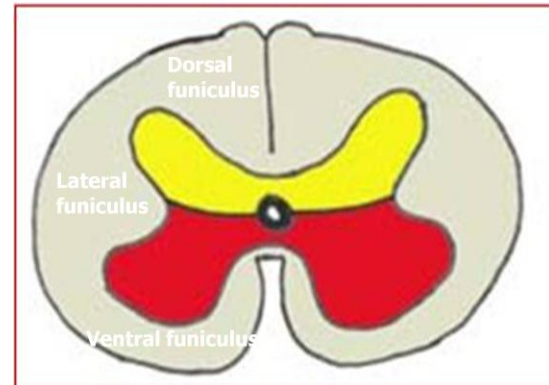
- ❑ The 2 areas are separated by a longitudinal groove (sulcus limitans).



## MARGINAL LAYER OF SPINAL CORD

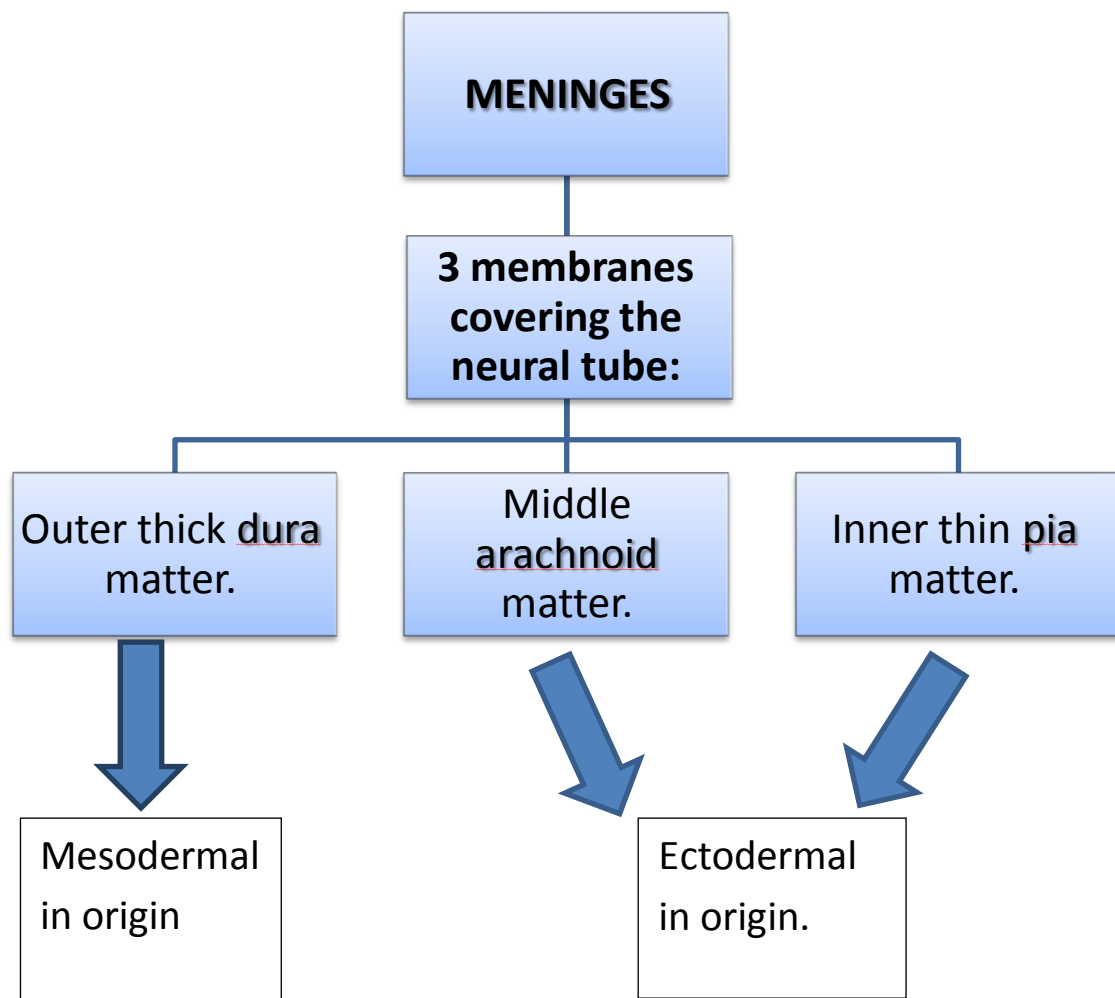
- ❑ Marginal layer (**future white matter**)

increases in size due to addition of ascending, descending & intersegmental nerve fibers.



- ❑ Myelination of nerve fibers starts at **4<sup>th</sup> month** & continues during the **postnatal** period. **Motor fibers myelinate before sensory fibers.**

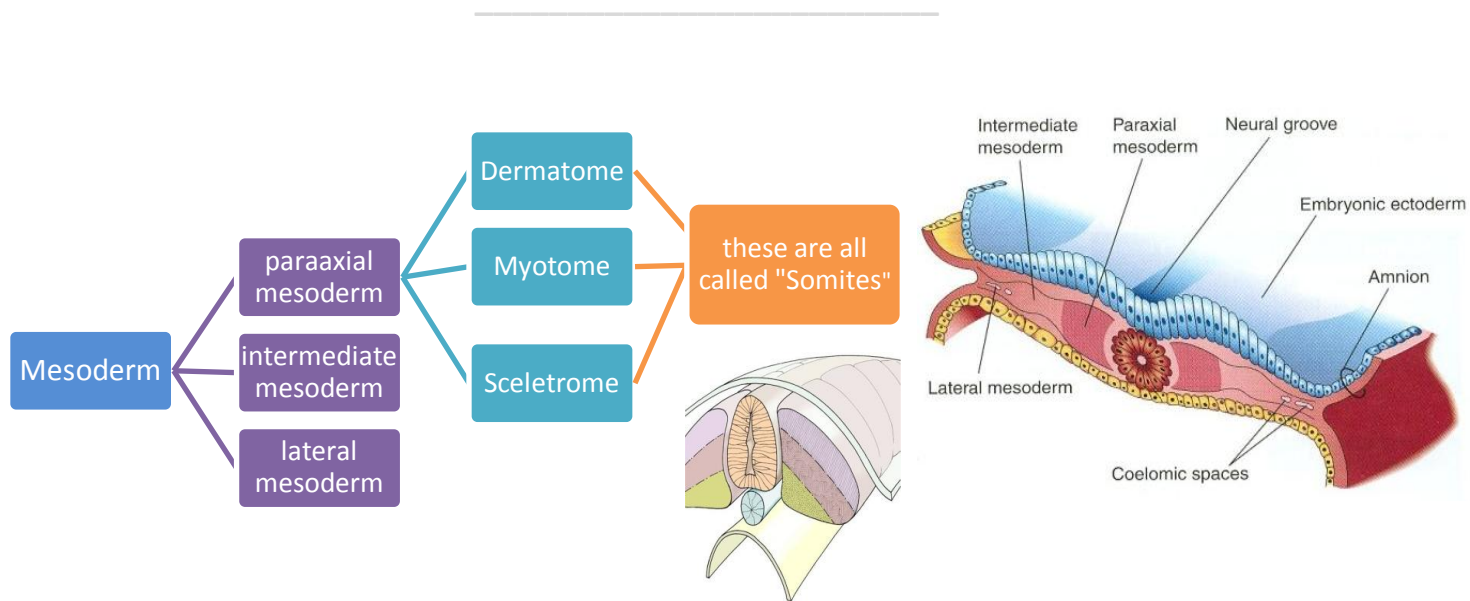
Marginal layer is divided into: dorsal, lateral and ventral funiculus (**white column**)



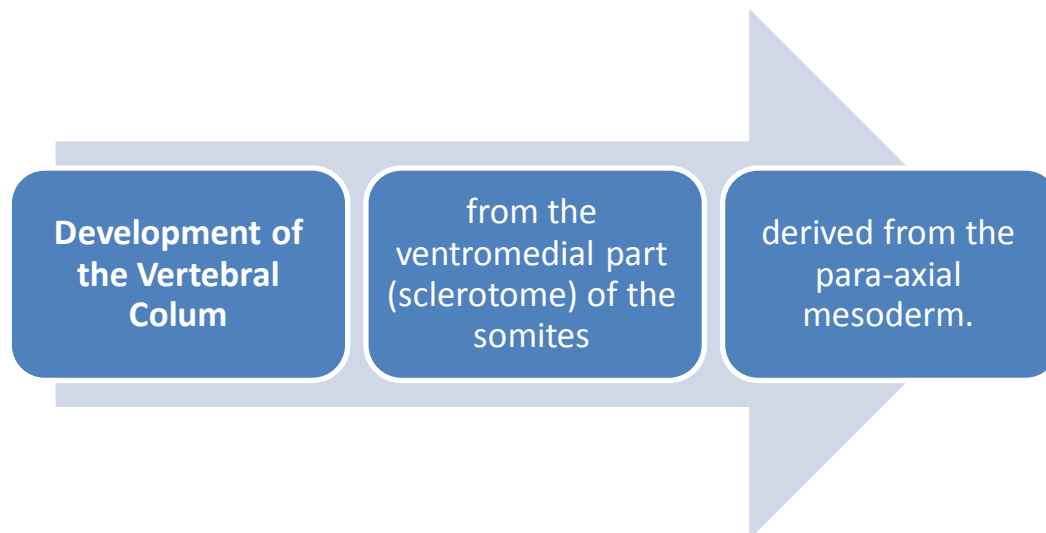
- A cavity appears between **arachnoid & pia (subarachnoid space)** & becomes filled with **cerebrospinal fluid**.

**\*POSITIONAL CHANGES OF SPINAL CORD:**

- ❑ Initially, the spinal cord occupies **the whole length** of the vertebral canal.
- ❑ As a result a faster growth of vertebral column, the **caudal** end of spinal cord (**conus medullaris**) shifts gradually to a higher level.



**Development of the Vertebral Colum:**



- **Intraembryonic mesoderm**

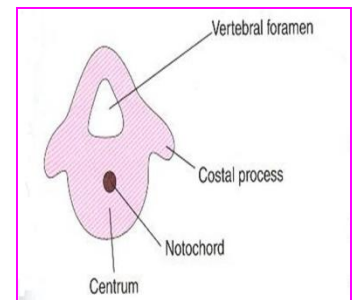
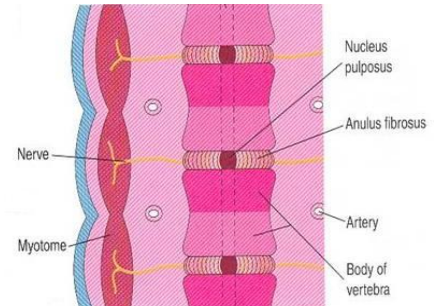
**Site:** between ectoderm and endoderm in the central axis of embryo where **notochord** is found.

Each sclerotome becomes subdivided into two portions:

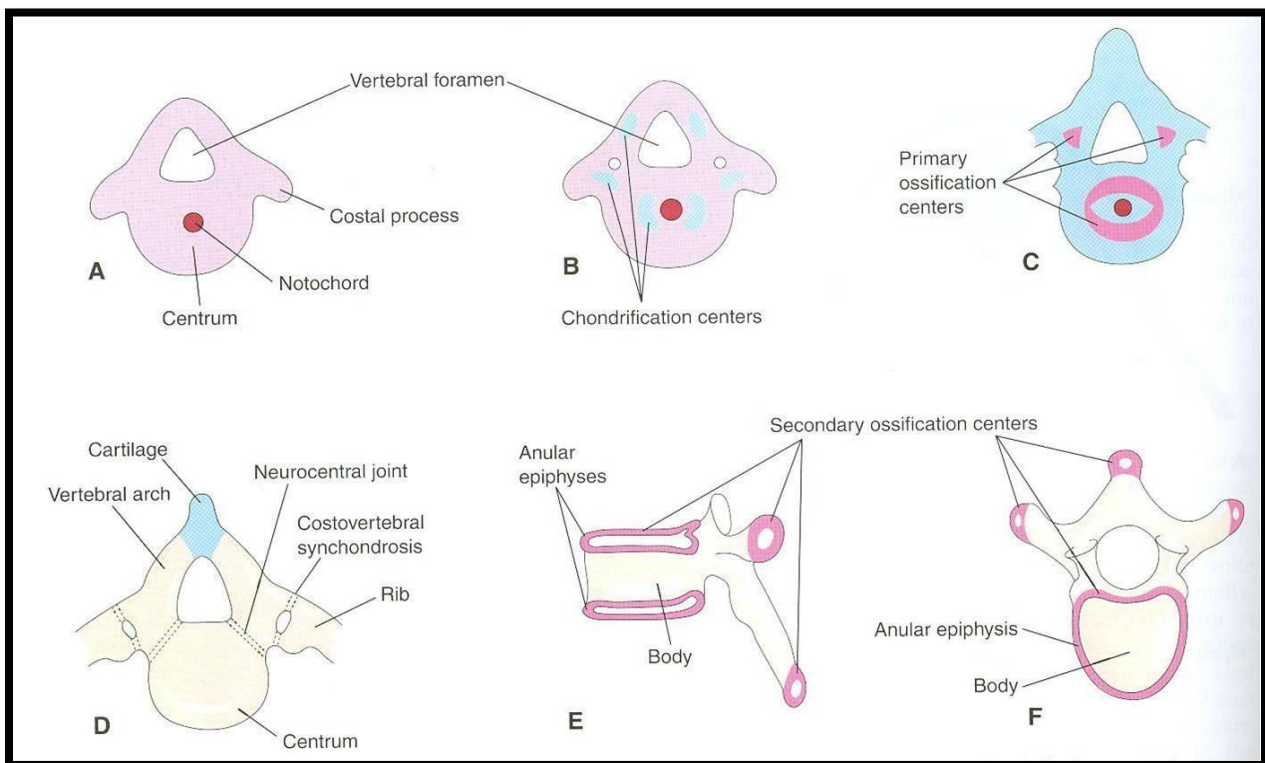
**Anterior :** loosely arranged cells .

**Posterior:** condensed tissue , one of its somite fuses to the anterior part of the **consecutive** somite , around the **notochord** to form the **body** of vertebra called the **Centrum**.

- The vertebral neural arch develops around the neural tube, ventrally the costal process give rise to ribs only in the thoracic region.



- **Vertebral development :**



- A) The development of **Centrum** and the costal process appear.
- B) **Chondrification center** appear at **the 6<sup>th</sup> week**.
- C) **Primary ossification centers** appear at **the 8<sup>th</sup> week**.
- D) **Fusion** between **halves of neural arch** occurs at **3-5 years**.  
**fusion** between **neural arch and body** at **4-6 years**.
- E & F) **secondary ossification centers** appear at **puberty**

**All centers unite around 25 years.**

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- **CURVATURES OF VERTEBRAL COLUMN**

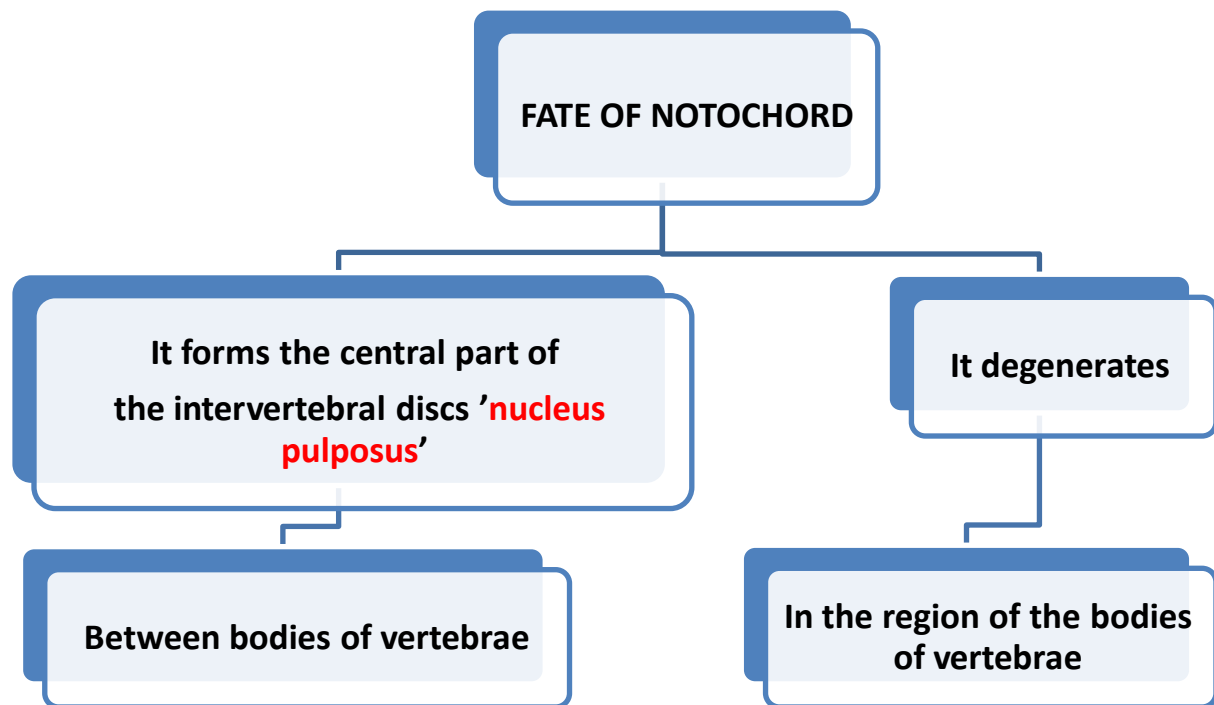
☐ **Primary curvatures: develop prenatally**

1. Thoracic
2. Pelvic or Sacral

☐ **Secondary curvatures : develop postnatally**

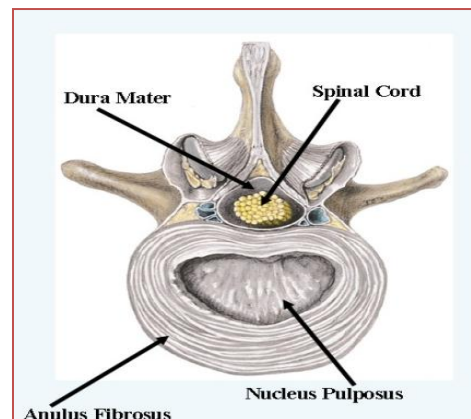
1. Cervical: as a result of lifting the head
  2. Lumbar: as a result of walking
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fate of the **mesoderm** surrounding the notocord

**Annulus fibrosus**  
( part of the intervertebral discs )



- ❑ **Causes of SPINA BIFIDA:** Failure of fusion of the halves of vertebral arches
- ❑ **Incidence:** 0.04-0.15%
- ❑ **Sex:** more frequent in females



