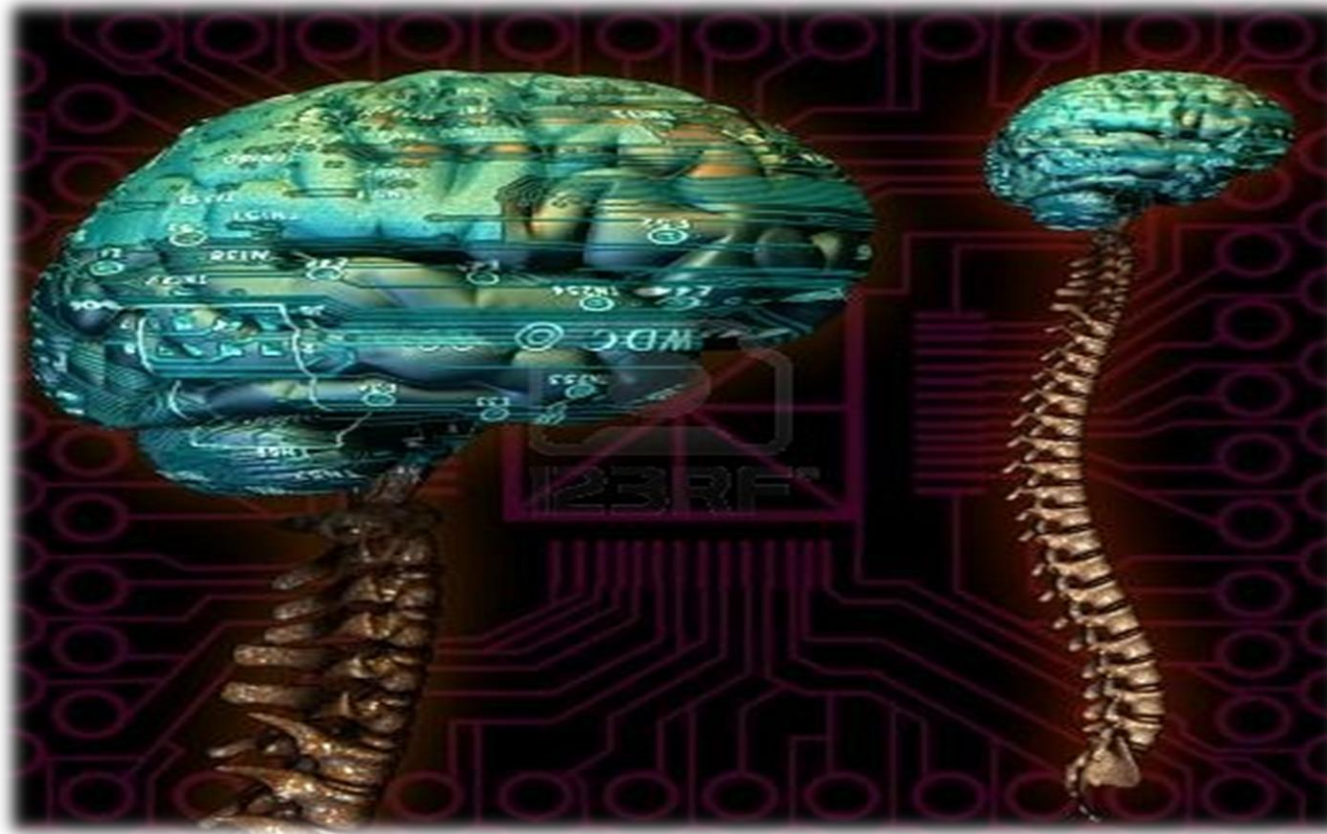


CNS Block



Development of the Spinal Cord & Vertebral Column

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Reviewed by: Fahad Alshayhan

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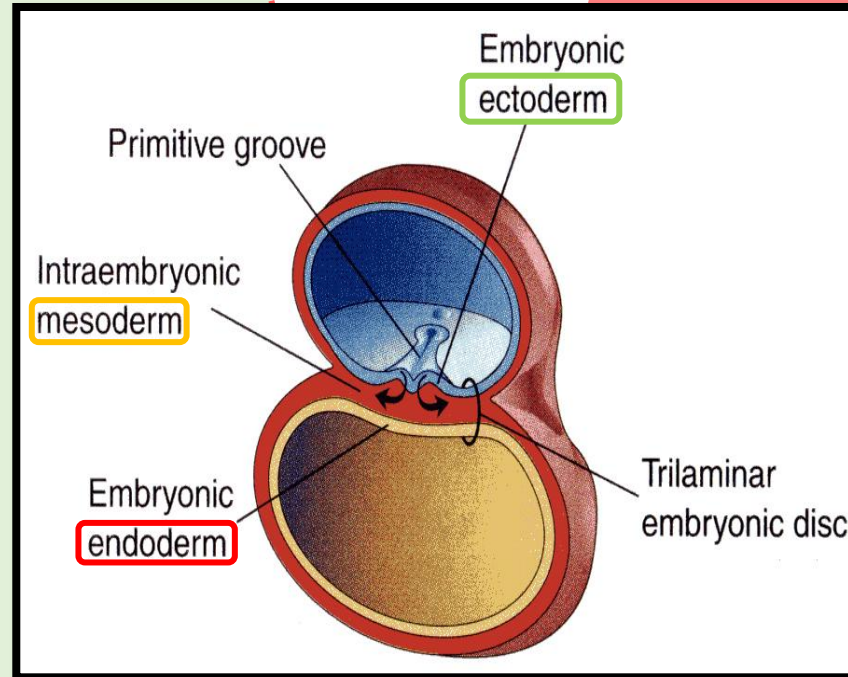
- 1) Introduction
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- 4) Fate of Notochord
- 5) After Birth Changes
- 6) Abnormalities
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To remember

The three germ layers are :

1. Ectoderm (responsible of forming the spinal cord)
2. Mesoderm (contains notochord)
3. Endoderm



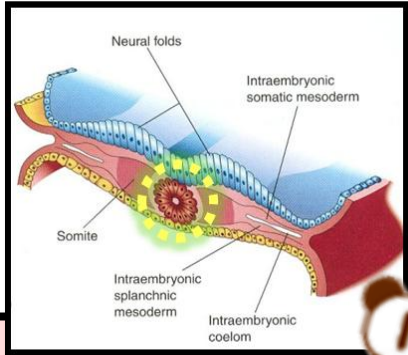
To make it clear

Those three layers are the whole embryo at these level , some of us thought that the cavities are included but they're not.

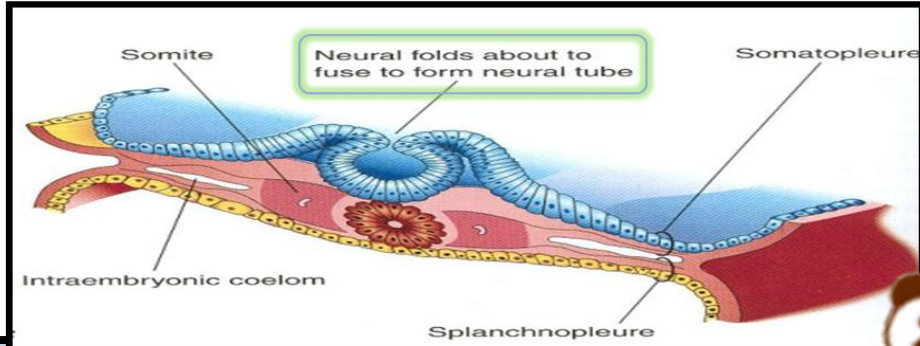


Now let's start →

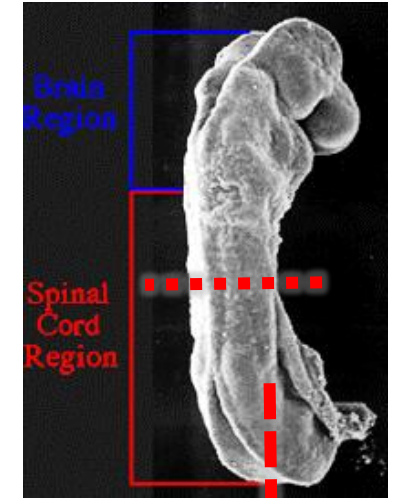
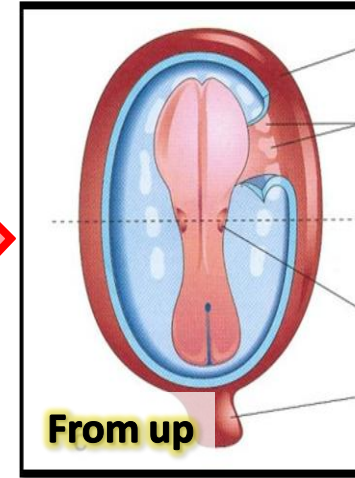
1. Spinal Cord Development



1
Notochord (in mesoderm) stimulates the ectoderm to grow



2
Continuous growing forms what's called neuronal folds which will continue on growing till they meet each other and fuse to form a tube called neuronal tube. Cells grow continuously inside the tube till it becomes **almost** close

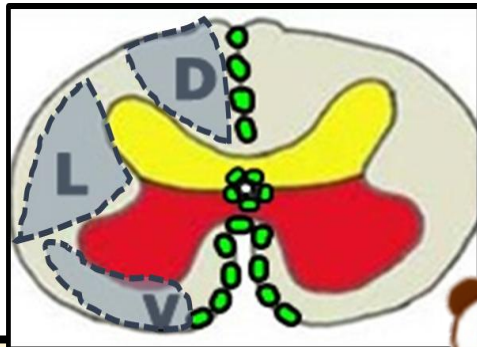


6
Formation of meninges :

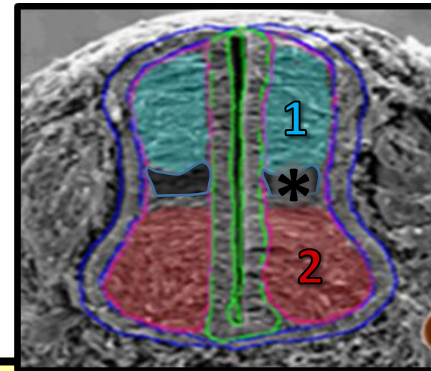
Dura: MESODERMAL

Arachnoid & Pia: ECTODERMAL

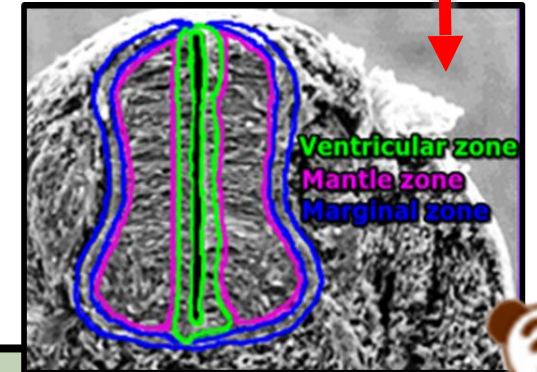
A cavity appears between arachnoid & pia (**subarachnoid space**) becomes filled with **cerebrospinal fluid**.



5
mantle zone growing leads to :
White matter differentiate into Dorsal, Lateral and Ventricle funiculi .
Formation of : 1. dorsal median septum. 2. ventral median fissure. 3. Narrowing of the neural tube → form a small central canal.



4
mantle zone itself will differentiate into:
1. **alar plate** (future dorsal horn - sensory neurons)
2. **basal plate** (future ventral horn - motor neurons)
*The 2 areas are separated by a longitudinal groove (sulcus limitans).



3
Cells differentiate at this level into three margins :
1. Ventricular (undifferentiated – forms other zones)
2. Mantle (forms gray matter in the future)
3. Marginal (forms white matter in future)

2. Vertebral Column Development

Introduction

Intraembryonic mesoderm

_ located between Ectoderm & Endoderm EXCEPT in where Notochord is found.

_ Differentiates into 3 parts:

Paraxial mesoderm

Intermediate mesoderm

Lateral mesoderm

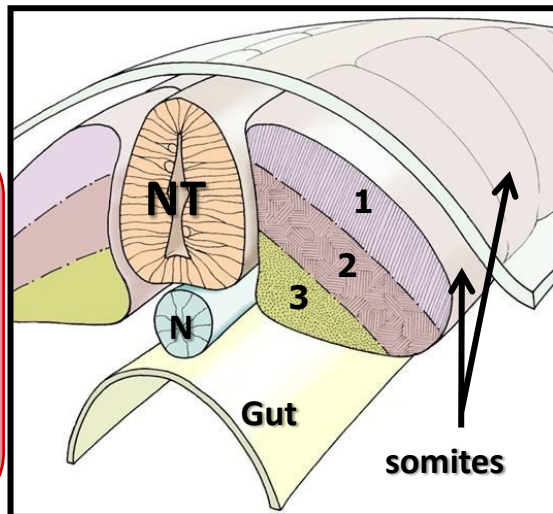
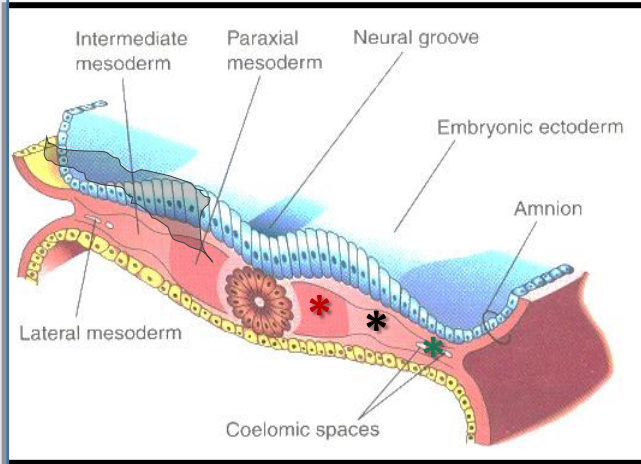
divides into segments called **'somites'**

Each somite divides into 3 parts:

1. Dermatome

2. Myotome

3. Sclerotome (vertebral column develops from this part)



Formation of body vertebrae

Each sclerotome divides into 2 parts:

Cranial →

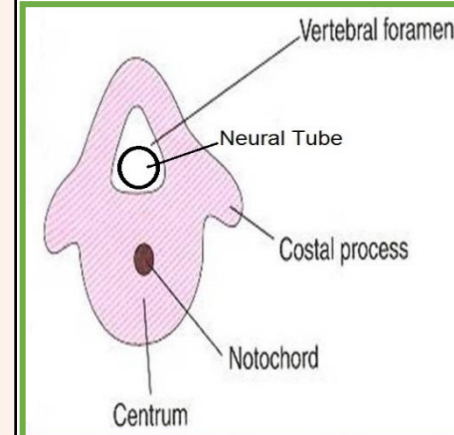
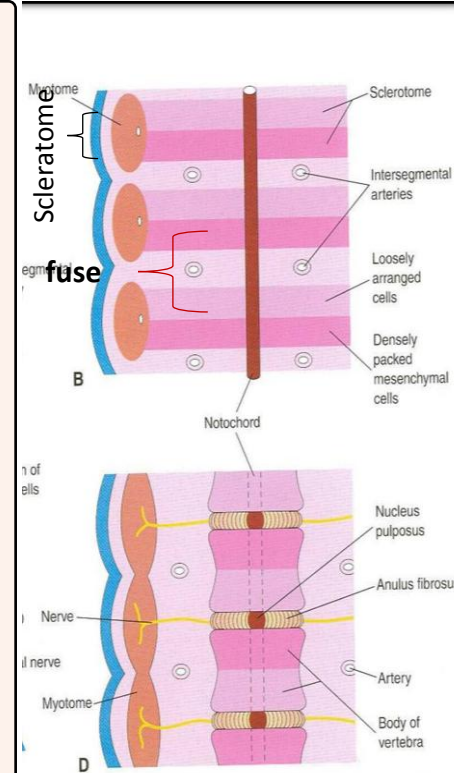
Caudal →

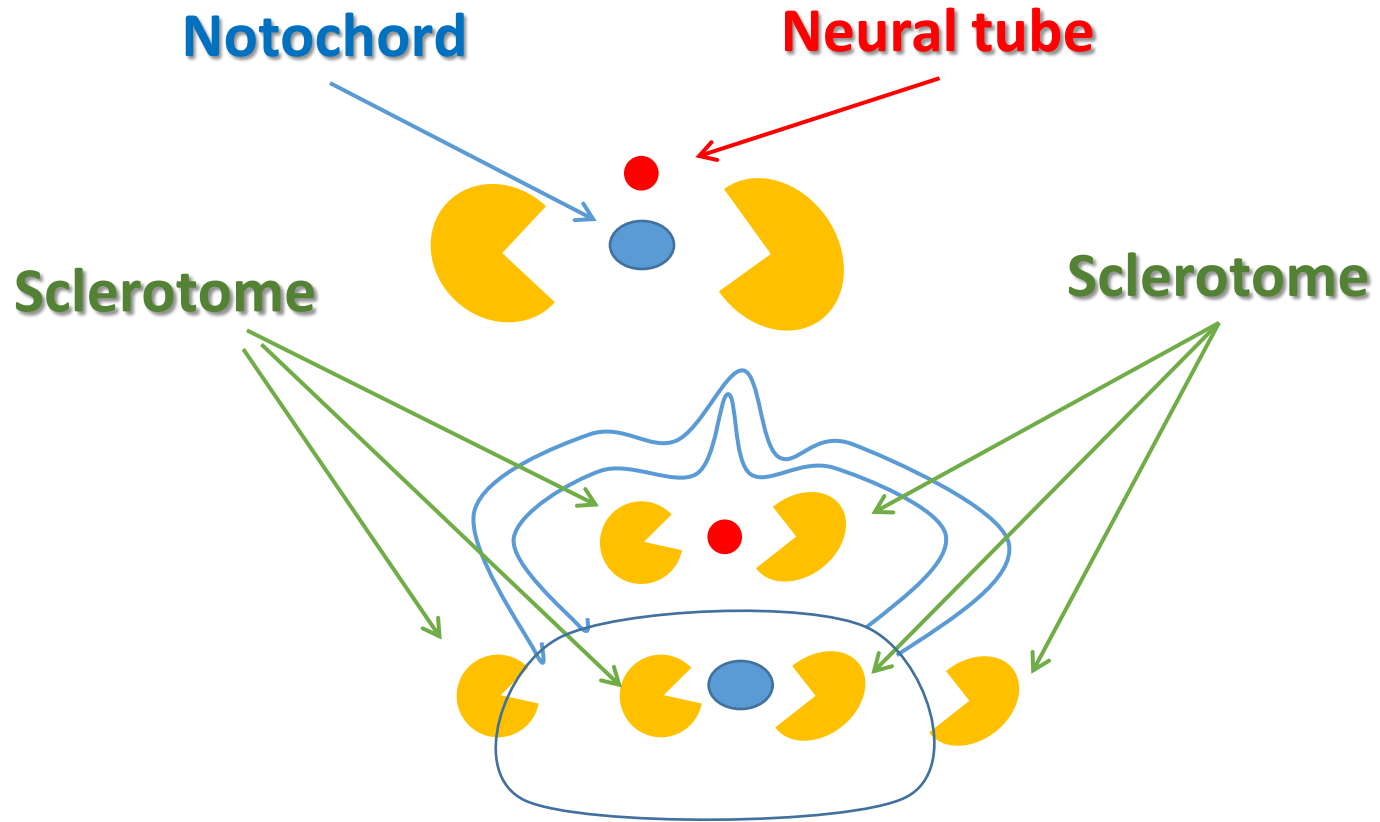
The caudal part will fuse with the cranial one from the next sclerotome at each side..

* then those in the both sides will grow ventrally under notochord to fuse and form what's called centrum (body of vertebrae)

*They'll grow dorsally to go around the neuronal tube (spinal cord later) to form vertebral arch.

*Those on the wall of body of vertebrae near to neural tube will form costal ribs (gives ribs in thoracic region). See next slide..





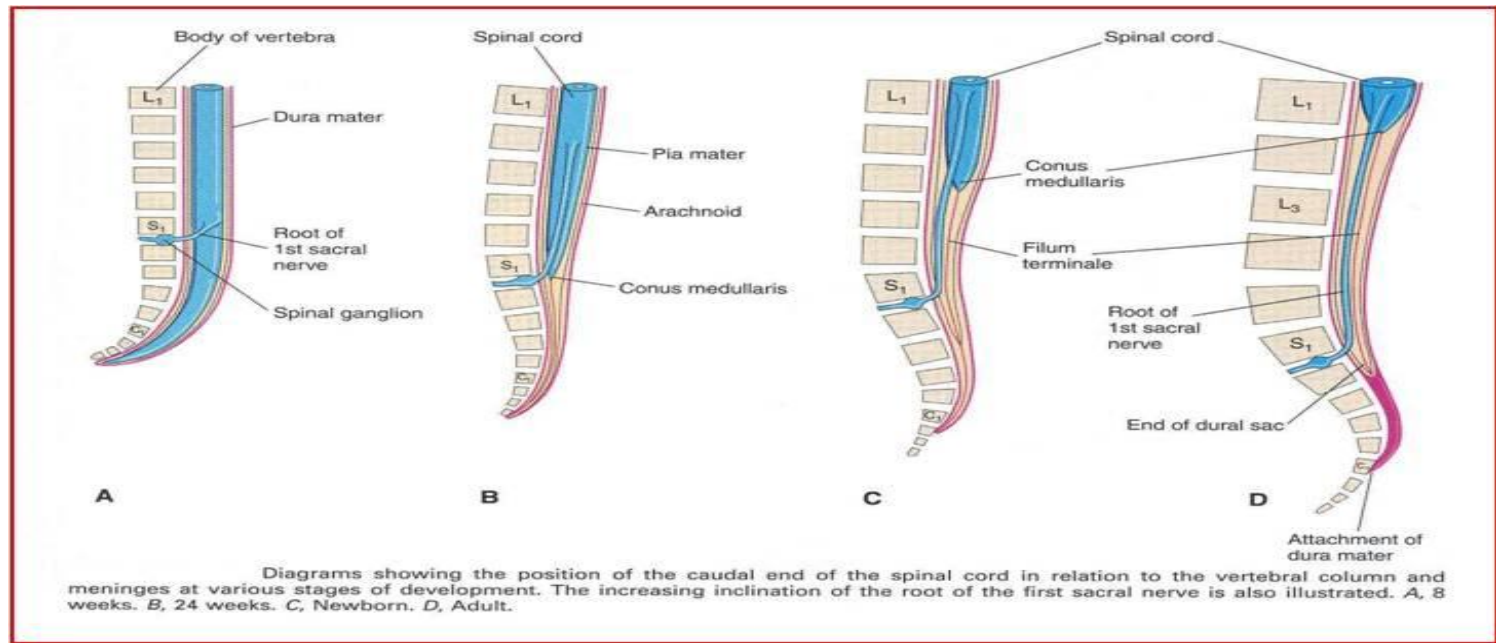
* Without notocord no neural tube

A: spinal cord occupies the whole length of the vertebral canal. (week 8)

B: Because of faster growth of vertebral column, spinal cord being at level S1. (week 24)

C: Spinal cord at level L3. (Birth)

D: Spinal cord at level L1 – L2. (Adult)



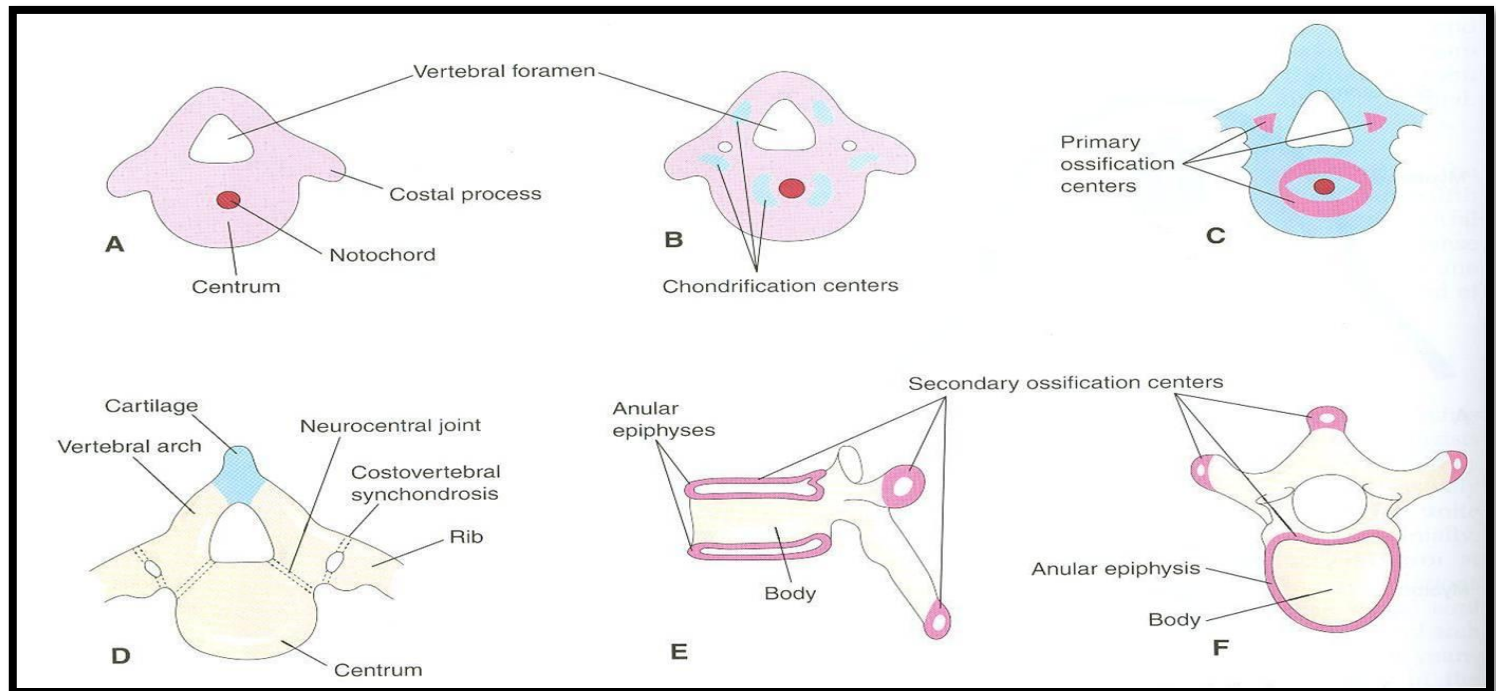
B: appear at 6 week.

C: appear at 8 week.

D: fusion of the cartilage at 3-5 years, and fusion of neurocentral joint at 4-6 years.

E & F : 5 secondary ossification centers appear at puberty

*all centers are disappear at 25 years

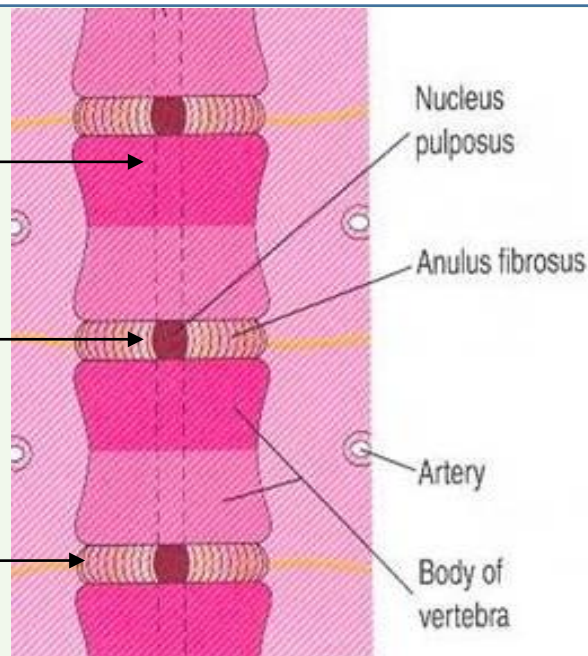


1) Fate of notochord

It degenerates
In the region of the bodies of vertebrae

Between bodies of vertebrae It forms the what's called '**nucleus pulposus**' of the intervertebral discs

While **Annulus fibrosus** is formed by the mesoderm surrounding the notochord



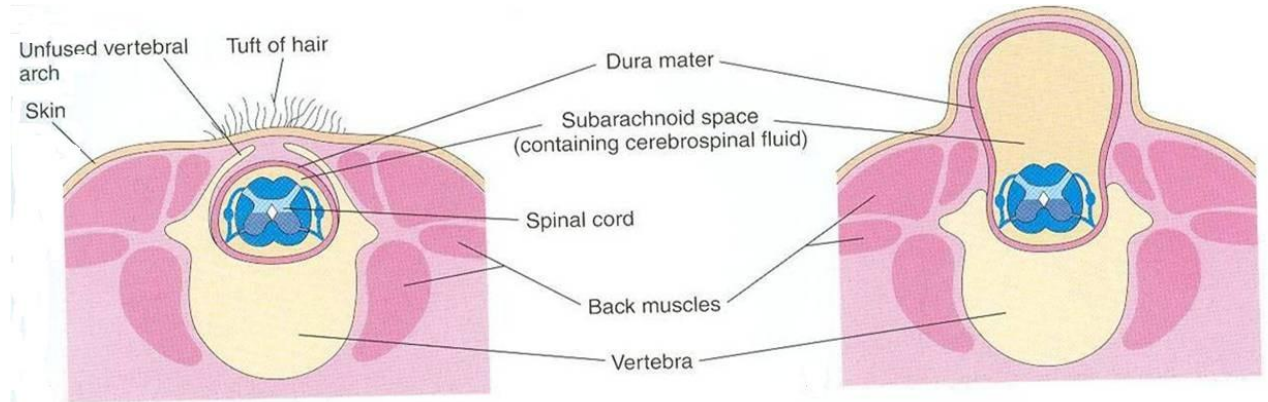
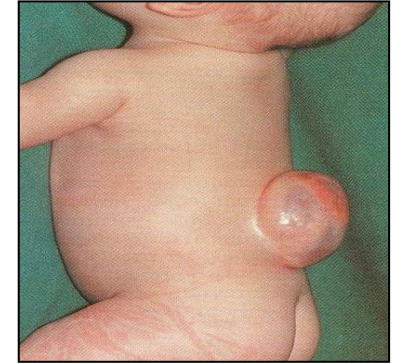
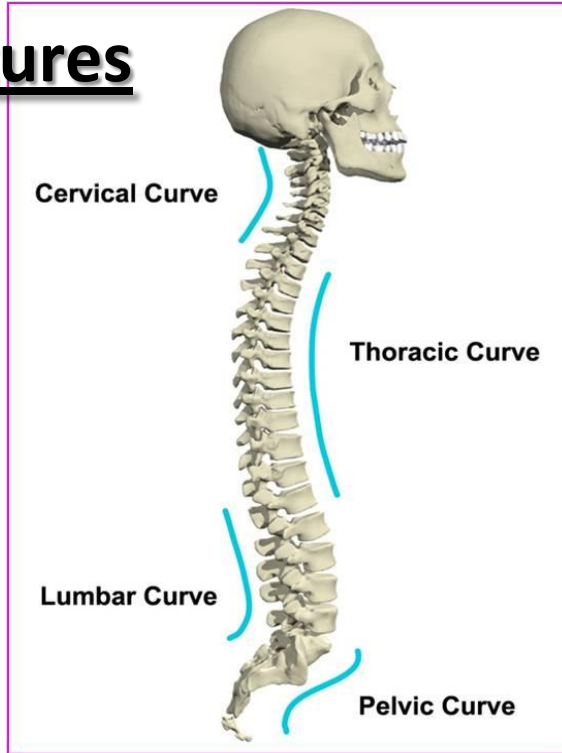
3) abnormalities : Spina Bifida (vertebral arch not formed)

Cause	Failure of fusion of the halves of vertebral arches	
	Sex: more frequent in females	
Types	Spina bifida occulta (discreased) 20%	<ul style="list-style-type: none"> *The closed type *Only one vertebra is affected *No clinical symptoms *Skin overlying it is intact *Sometimes covered by a tuft of hair
	Spin bifida cystica (forming a cyst) 80%	<ul style="list-style-type: none"> *The open type *Neurological symptoms are present *Subdivided into: <ol style="list-style-type: none"> 1. Spina bifida with meningocele: protrusion of sac containing meninges & cerebrospinal fluid 2. Spina bifida with meningomyelocele: protrusion of sac containing meninges with spinal cord and/or nerve roots 3. Spina bifida with myeloschisis: spinal cord is open due to failure of neural folds

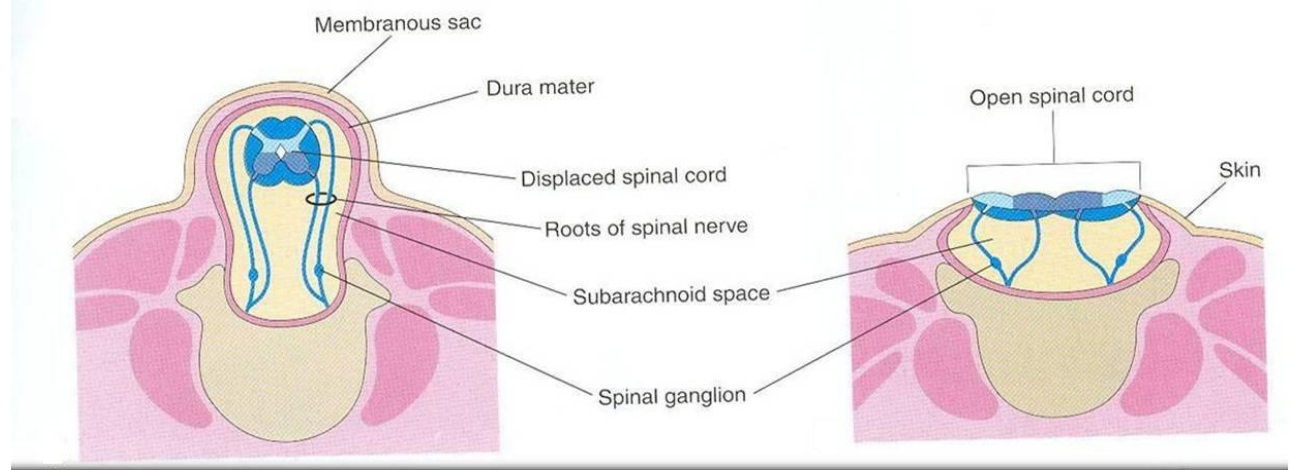
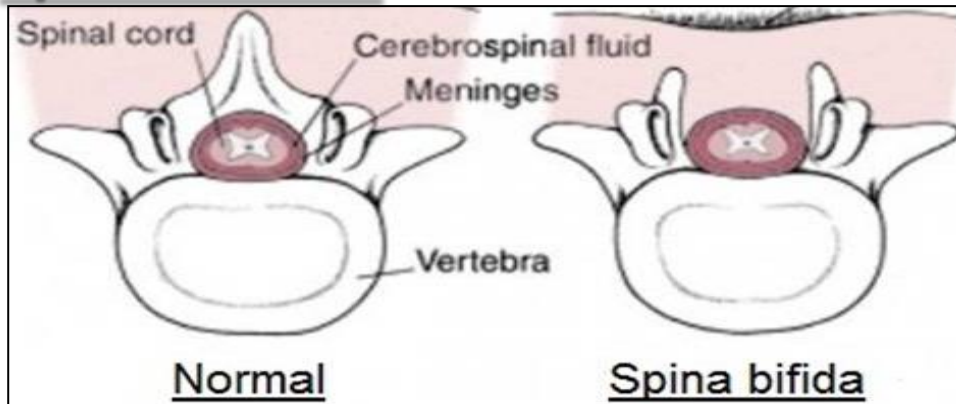
2) After birth

Curvatures	Positional Changes of Spinal Cord
<p>Primary curvatures: develop prenatally</p> <ol style="list-style-type: none"> 1. Thoracic 2. Pelvic or Sacral <p>Secondary curvatures : develop postnatally</p> <ol style="list-style-type: none"> 1. Cervical: as a result of lifting the head 2. Lumbar: as a result of walking 	<p>Initially, the spinal cord occupies the whole length of the vertebral canal. As a result of faster growth of vertebral column, the caudal end of spinal cord (conus medullaris) shifts gradually to a higher level.</p>

Curvatures



Spina Bifida



Prof. Ahmed Fathalla note and questions

Myelination start at 4 month and continue during 1st postnatal period and it formed by oligodendrocytes

A- Which one of the following regions of spinal cord contains **cell bodies of sensory neurons**?

1. Alar plate
2. Ventricular zone
3. Basal plate
4. Dorsal funiculus

B- At which one of the following periods of life fusion between vertebral arch & body of vertebra occurs?

1. 8th week
2. Puberty
3. 4-6 years
4. Around 25 years

C- Regarding spina bifida which one of the following statements is correct?

1. The closed type is more frequent than the open type.
2. The closed type presents with clinical symptoms.
3. Spina bifida is due to failure of fusion between the halves of vertebral arch.
4. In cases of spina bifida with meningocele, the spinal cord is open.