Paediatric Spinal Ultrasound

Mikaelah Farmer
MONASH CHILDREN'S HOSPITAL

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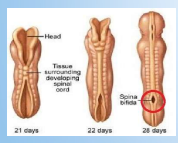
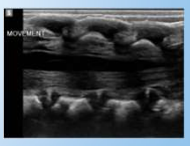
The Plan

01 Why 02 When (and how) 03 What





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01

Why

Embryology, Spectrum of Spinal Dysraphism

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Why spinal ultrasound?

- **Neural Tube Defects (NTD)**
  - Genetics
  - Maternal nutrition[1]
- **NTD prevalence**
  - 4.6 babies per 10000 births[2]
- **Ultrasound advantages**
  - Radiation free
  - Relatively quick
  - Complements MRI
  - Real-time imaging
  - No sedation

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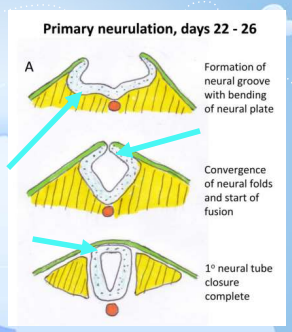
Embryology overview

Two Key Stages:

1. **Primary Neurulation**

=closure of the neural tube



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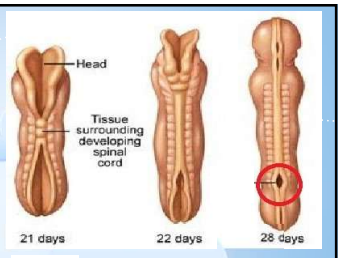
Embryology overview

Two Key Stages:

1. **Primary Neurulation**

=closure of the neural tube



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Embryology Overview

Two Key Stages:

1. **Primary Neurulation**

   Failure=OPEN neural tube defect

Myelomeningocele : Virtual Library (wfsahq.org)

Myelomeningocele

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Quiz

1/ Should we ultrasound OPEN neural tube defects??
2/Why/Why not??

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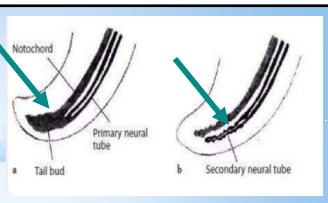
Embryology Overview

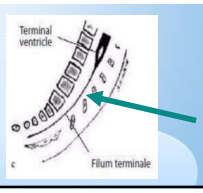
Two Key Stages:

1. Primary Neurulation
2. **Secondary Neurulation**

   =canalization

   =retrogressive differentiation





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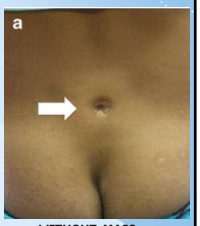
Embryology Overview

Two Key Stages:

1. Primary Neurulation
2. **Secondary Neurulation**

   FAILURE=CLOSED SPINAL DYSRAPHISM

WITH MASS
Eg. Lipomyelomeningocele



WITHOUT MASS
Eg. Dorsal Dermal Sinus

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Quiz

1/ Can we ultrasound CLOSED neural tube defects??
2/Why/Why not??

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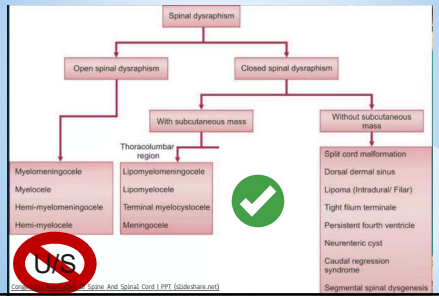
Putting it together: Open vs. Closed SD



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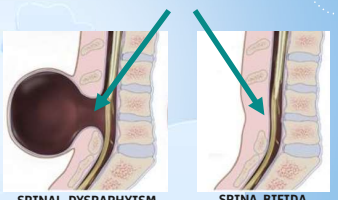
TWO KEY DEFINITIONS TO KNOW

Spinal Dysraphism
=broader/umbrella term
=congenital/incomplete fusion of 1+ of:
- neural
- bony
- connective tissues

Spina Bifida
=incomplete closure of the bony elements only



SPINAL DYSRAPHYISM
Eg. Meningocele

SPINA BIFIDA
Eg. Spina Bifida occulta

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CLINICAL SIGNS/REASONS

CLOSED SPINAL DYSRAPHISM
- Sacral dimple
- Hairy tuft
- Haemangioma
- Mid-line lump on back with skin covering

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02

WHEN (AND HOW)

Patient preparation, optimal timing, ultrasound techniques

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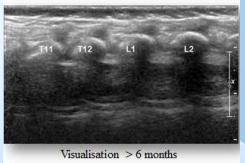
WHEN

IDEAL AGE:
- <3months
- Unossified posterior cartilage

OFTEN CONTRAINDICATED:
- >6 months

Visualisation < 3 months



Visualisation > 6 months

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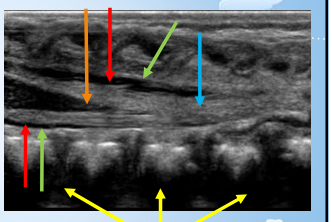
- 5 lumbar vertebrae
- Conus medullaris
  - Term: Lower Border L2
  - Pre-Term: Upper Border of L3
- Dura (Anterior/ Posterior)
- Subarachnoid space
- Cauda Equina



http://easypediatrics.blogspot.com.au/2010/05/spina-bifida-occulta.html

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PREPARATION

- ✓ Read referral/previous imaging
- ✓ Clear explanation to parents
- ✓ Determine if infant is term or pre-term
- ✓ Ask parents to show you any ROI
- ✓ Linear high resolution transducer

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PREPARATION: POSITIONING IS KEY



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HELPFUL HINTS

- Be Flexible;
- Key:
  - Warm gel, towel, blankets
  - Nappy on
  - Movement is OK for some of the examination ☺

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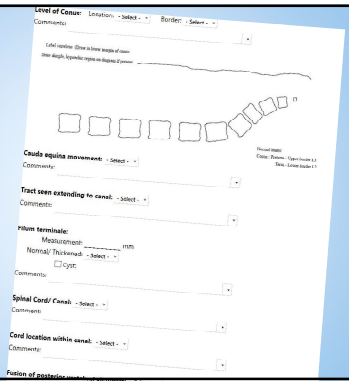
WORKSHEET



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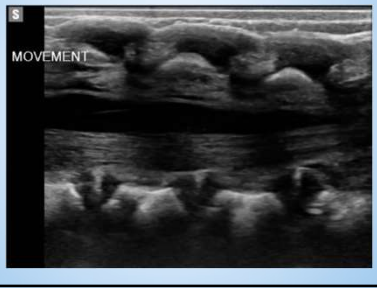
CAUDA EQUINA MOVEMENT



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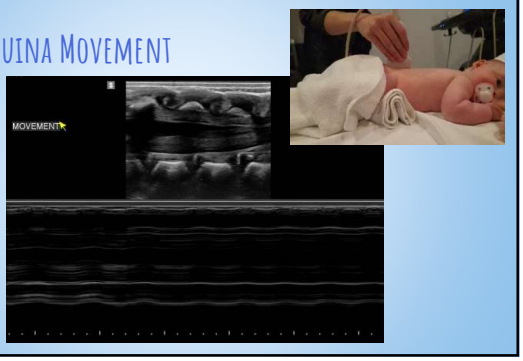
CAUDA EQUINA MOVEMENT



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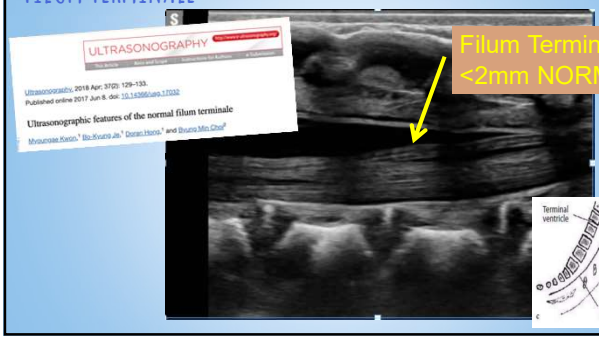
FILUM TERMINALE



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LEVEL OF THE CONUS MEDULLARIS: WATCH THE T12 RIB

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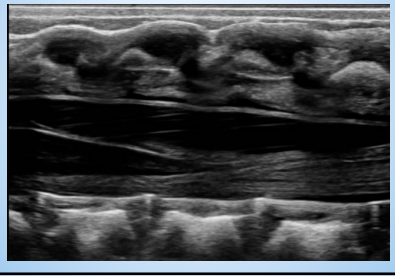
PROVIDE A ZOOMED IMAGE OF THE CONUS MEDULLARIS



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IMPORTANT VIEW FOR VARIANTS: FILAR CYST

- Filar cysts
  - Inferior to tip of the conus
  - Relatively common ~12%
- Strict Criteria:
  - Midline
  - Within Filum
  - Just below conus
  - fusiform shape
  - well-defined

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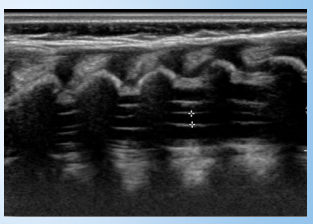
OTHER VARIANTS: HYDROMYELIA

- Mild central canal dilatation
- CSF within the ependymal lined central canal
- Variant only if an isolated finding
- ->associated with spinal dysraphism



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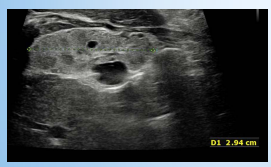
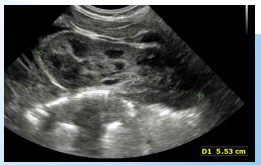
STILL MOVING? IMAGE THE KIDNEYS

- Horseshoe kidney
- Cystic Kidneys
- Hydronephrosis


Association of congenital anomalies of the spine and kidneys





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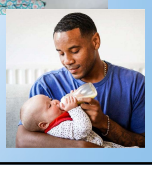
STILL MOVING? MORE HELPFUL HINTS

- Feeding
- Dummy or gloved finger
- Pause if distressed
- Sucrose (if available)
- Nappy change/burp



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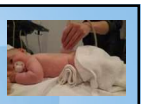
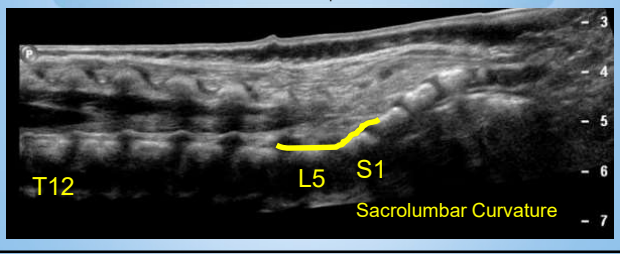
IDEALLY IF BABY SETTLES: PANORAMA



STEP 1: Count down from T12

STEP 2: Count up from L5/S1



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QUIZ

1/Why is it important to count the vertebrae from top-down and bottom-up?

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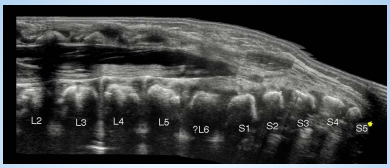
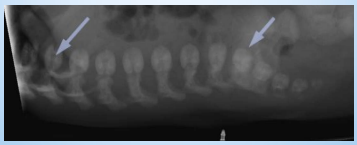
ANSWER: COULD BE AN EXTRA LUMBAR VERTEBRA





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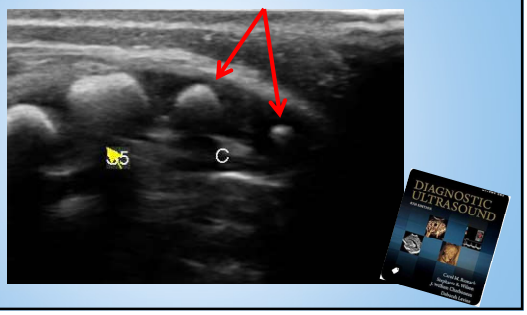
WATCH OUT FOR: MULTIPLE OSSIFICATION CENTERS OF THE COCCYX



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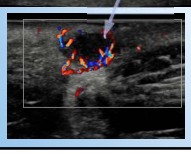
COCCYX VARIATIONS: DYNAMIC SCANNING AND COLOUR

Report: Dysmorphic coccyx with associated phlegmon



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QUIZ

IS THIS CONUS MEDULLARIS IN THE CORRECT POSITION?

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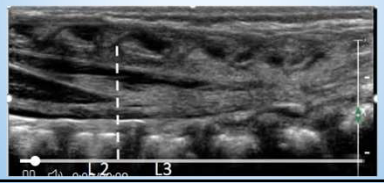
?CONUS NORMAL (THIS IS A TERM INFANT)

CRITERIA FOR NORMAL
- Term (>37wk) Infant: Lower border L2
- Pre-Term: Upper border L3



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03

WHAT

Closed Spinal Dysraphysm Pathologies You May See

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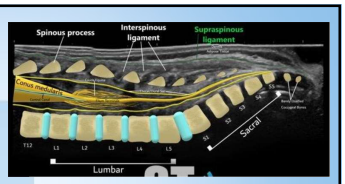
TETHERED CORD SIGNS

- Low lying conus medullaris
- Reduced movements of the cauda equina
- Posterior displacement within the canal



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QUIZ

1/ Is this cord low lying in this term infant?
2/Can you see signs of cord tethering?

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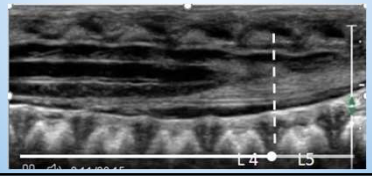
?CONUS NORMAL +/-TETHERED

CRITERIA FOR NORMAL
- Term (>37wk) Infant: Lower border L2
- Pre-Term: Upper border L3



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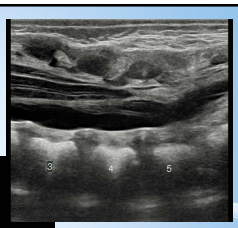
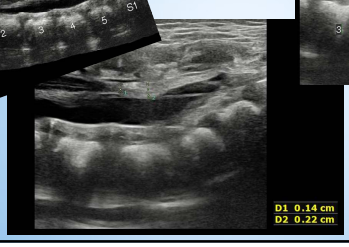
Case Study:
- Preterm infant





DDx Tethered Cord
- Low lying conus
- Thickened filum (>2mm) with lipomatous change
- Reduced cauda equina movement

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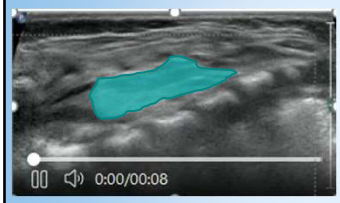
LIPOMA EXAMPLES



Intradural Lipoma

Associated tethered Cord

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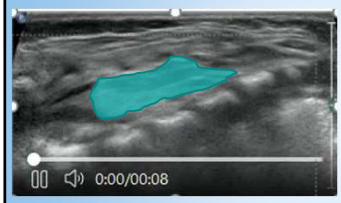
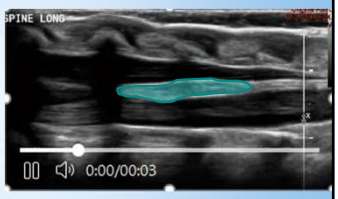
LIPOMA EXAMPLES





Intradural Lipoma

Associated tethered Cord

Within Filum Terminale

Variant if no tethered cord

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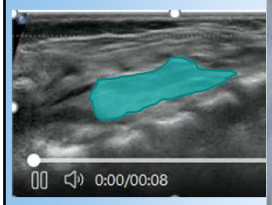
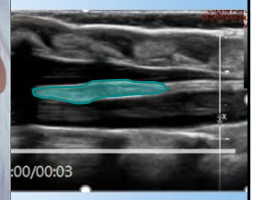
LIPOMA EXAMPLES





Intradural Lipoma

Associated tethered Cord

ithin Filum Terminale

ariant if no tethered cord

Extradural

Eg. Lipomyelomeningocele

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ASSESSMENT OF THE SACRAL DIMPLE/SACRAL PIT

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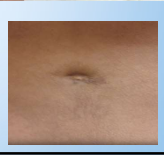
TWO MAIN PATHOLOGIES: SACRAL PIT VS SACRAL SINUS

- **Low-risk: Sacral Pit**
  - Simple
  - < 5 mm diameter
  - < 2.5 cm above anus
  - Below coccyx

- **High-risk lesions: Dermal Sinus**
  - Atypical dimples (eg lateral)
  - > 5 mm in diameter,
  - > 2.5 cm above the anus (Lowe 2005)
  - Meningitis risk... (sterile gel)



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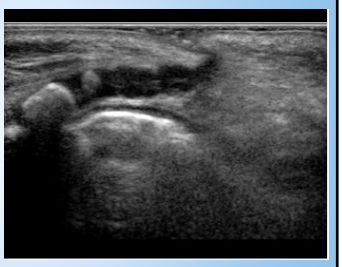
PSEUDO SINUS TRACT

- At the level of the coccyx or below
- Fibrous cord
- Look for any fluid or mass along the fibrous tract



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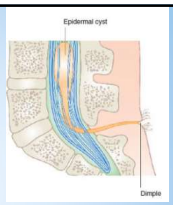
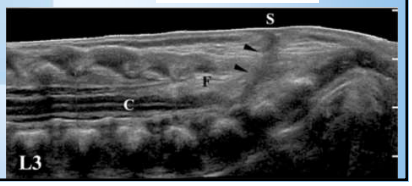
DORSAL DERMAL SINUS

- Epithelial lined tract
- Located higher than the coccyx
- Extends from the skin surface to the spinal cord, cauda equina or subarachnoic space





Lowe et al AJR:2007

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DORSAL DERMAL SINUS: DYNAMIC ASSESSMENT

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QUIZ

Is this a pseudotract or a dorsal dermal sinus?

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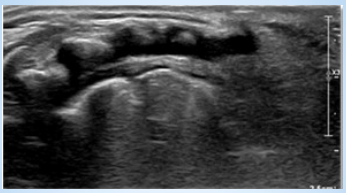
IS THIS A PSEUDO-TRACT OR A DORSAL DERMAL SINUS?



PSEUDO-TRACT

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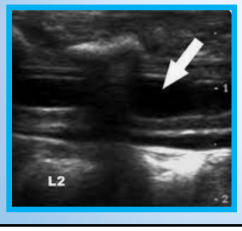
CLOSED SPINAL DYSRAPHISM: OTHER EXAMPLES

- Syrinx
- Diastematomyelia



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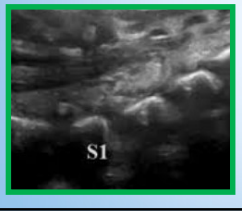
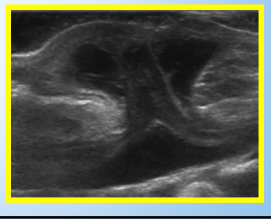
CLOSED SPINAL DYSRAPHISM: OTHER EXAMPLES

- Anterior sacral meningocele
- Meningocele





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TAKE HOME SUMMARY

1/ WHY:

- Embryology
- OPEN VS CLOSED

2/ HOW AND WHEN:

- Clinical Signs
- <6 months
- Count top-down & bottom-up

3/ WHAT:

- Closed spinal dysraphism pathologies

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