

Growth Patterns of the Neurocentral Synchondrosis in Immature and Growing Vertebra

Richard M. Schwend, MD; Laurel C.
Blakemore, MD; John A. Schmidt, PhD;
Behrooz Akbarnia, MD



Disclosures

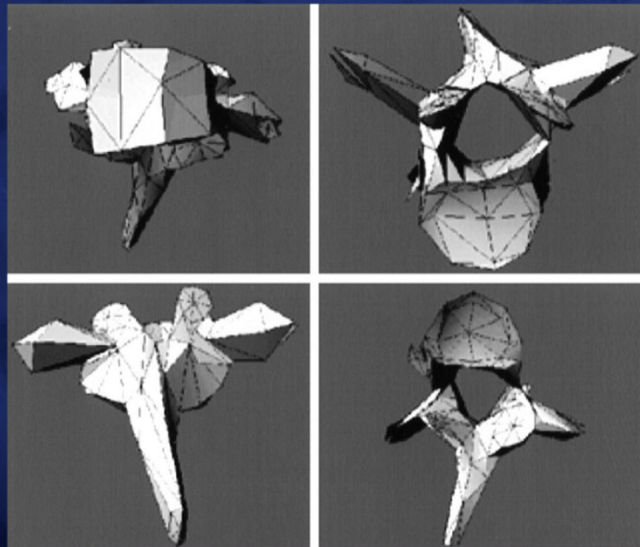
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Neurocentral Synchondrosis (NCS)

- Previous authors have described growth patterns and postulated on effects of early closure



Parent Spine 2004

Goal

- To evaluate the NCS in all three regions of the spine in children aged 1-18 YO.



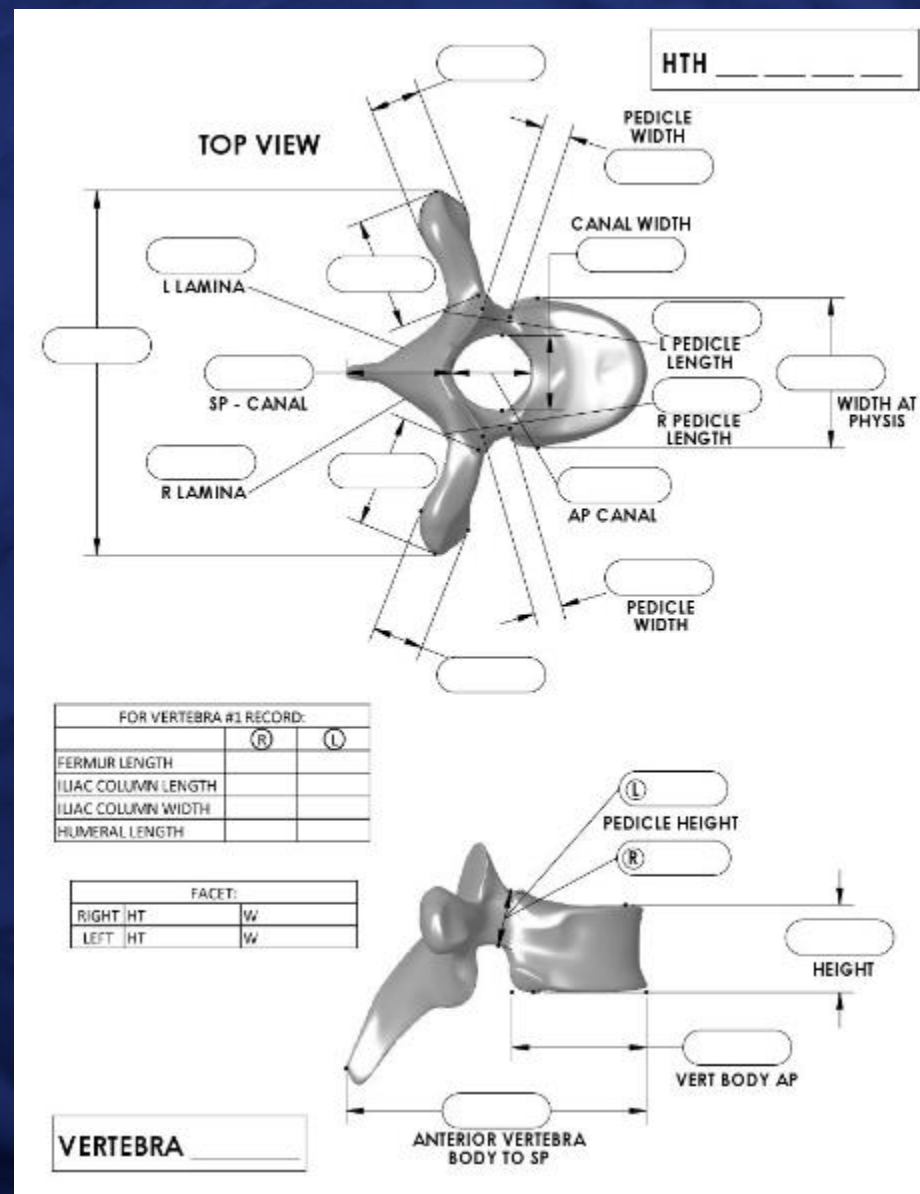
- Hamann-Todd Osteological Collection provided the bones of 32 complete pediatric cadaveric osteologic specimens aged 1-18 years (ages 2 and 9 missing from series)
- 733 vertebral body specimens

Vertebra and Rib Analysis

- 6226 individual photographs of all vertebral bodies and ribs were obtained from these specimens. Quantitative measurements were taken with image analysis software and were analyzed.
- 32,000 separate measurements were analyzed.

NCS Measurement

- left and right sides of each NCS along with the actual width of the pedicle at same location were measured.
- Dividing NCS by the pedicle width and multiplying by 100 gives the percentage open of the growth plate



NCS Measurement



The % NCS is
Open =
 NCS/Width

1441, 10YO Male, 68.71%

Different Spine Regions Behaved Differently

- Cervical:
 - By 5y the cervical spine has virtually closed with only 10% of the NCS remaining.
- Lumbar:
 - is still nearly 50% open at 5y and closed by 10y.

Different Spine Regions Behaved Differently

- Thoracic
 - only 25 % closed at 5y and remains open through 17y.
- t-testing showed that there was no difference between the left and right NCS data.

Thoracic spine NCS

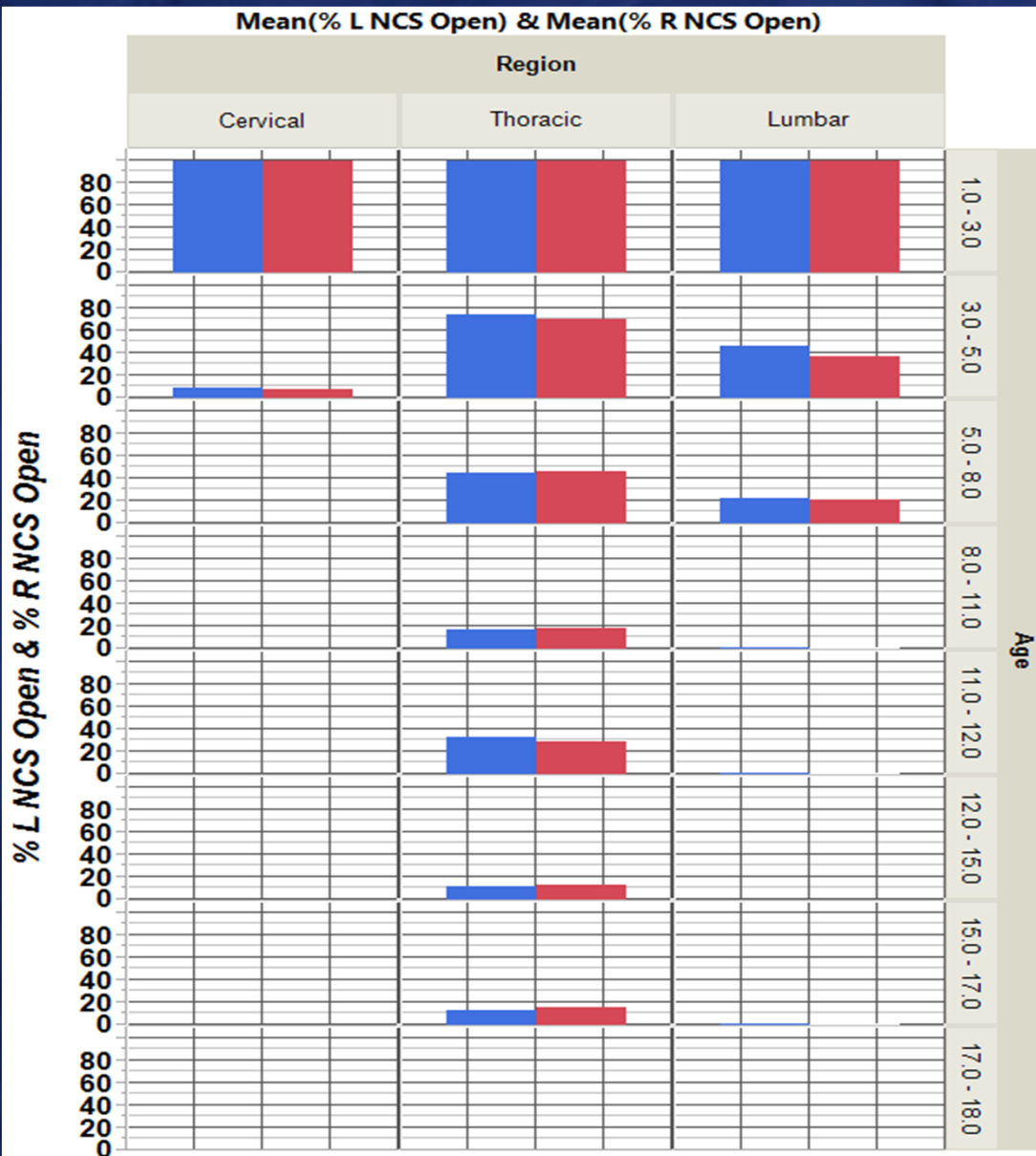
1557 - T6, 3YO, Male
100% Open



526 – T9, 11YO, Female
35% L, 47% R



Findings to Date



Cervical & Lumbar –
NCS fully closed by
10y

Thoracic open to 18y

Mean(% L NCS Open)
Mean(% R NCS Open)

Spinal Canal Size

- (data presented previously at Zorab)
- by 5y Canal ~71% of final size
- by 10y Canal is ~95% of final size
 - transverse growth
 - cervical spine and L5 greatest increase
- Growth of canal area for all VBs and ages is $6.2\text{mm}^2/\text{year}$

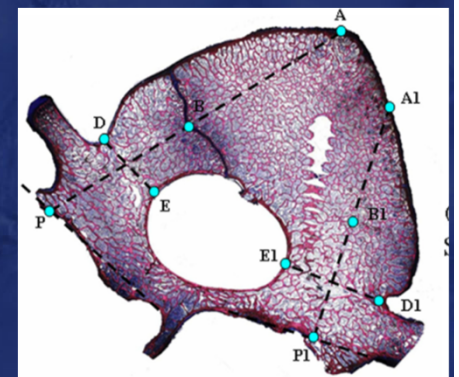


Other studies

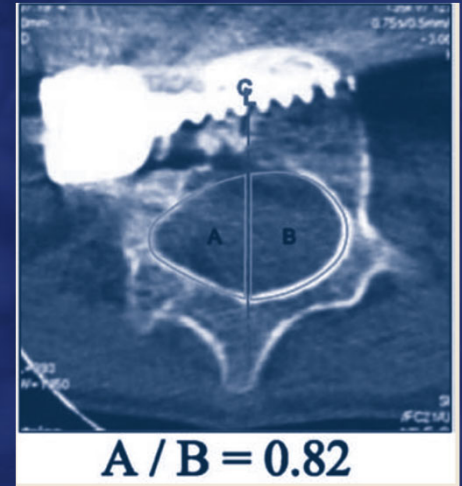
- Maat *Spine* 1996
 - 2 pediatric cadaveric specimens- considered NCS fused by age 6
- Yamakazi *JPO* 1998
 - MRI 91 pts –thoracic NCS closed at 11-16 yrs
- Cannadell *Rev Med Univ Navarra* 1974
 - cadaveric- fused 11-14 yrs

Instrumenting NCS can affect spinal growth (in pigs anyway)

- *Cil Spine 2005*
 - lumbar PS in newborn pigs resulted in shortened PS and 20-26% canal narrowing
- *Zhang JBJS 2008*
 - unilateral TPS in pigs can produce scoliosis
- *Pekmezci Spine 2009*
 - ant. lumbar fusion caused canal narrowing
- *Zhou JBJS 2014*
 - TPS in pigs caused 20% loss canal area



But not in kids?



- *Ruf Spine 2002*
 - 16 1-2 yo pts, T and L PS, 3 pts 6+ yr f/u
 - no stenosis by MRI in those 3 (? all lumbar)
- *Olgun Spine 2012*
 - 15 pts <5 yo, no effect on canal dimensions at 2 yr f/u
- *Elsebaie (IMAST 2010)-reported 7 1-2 y o's w/anterior screws combined with anterior fusion → 10-20% canal size decrease

Conclusions

- NCS closes later in the thoracic spine than in other regions
- the implications for treatment of spinal deformity in children are still not understood

Thank You

