Cervicothoracic Congenital Scoliosis:
Treatment of shoulder balance and head tilt

David L. Skaggs, MD, MMM
Professor and Chief of Orthopaedic Surgery
University of Southern California
Children’s Hospital Los Angeles
Endowed Chair of Pediatric Spinal Deformity
Visible Deformity - Head Tilt

Hemi vertebrae

3 yo girl

72°

Unilateral bar
Step 1: Is it progressive???
Ask for CXRs from birth

2 mo

3 yrs
Step 2: Set Parental Expectations

- Head Tilt and Shoulder Balance likely to improve, but will never be perfect.
Step 2: Set Parental Expectations

Evaluation of shoulder balance in the normal adolescent population and its correlation with radiological parameters

Ibrahim Akel · Murat Pekmezci · Mutlu Hayran · Yasemin Genc · Ozgur Kocak · Orhan Derman · Ilkay Erdogan · Muharrem Yazici

Euro Spine J, 2008

• Mean shoulder height difference 8mm ±6mm
• 28% have ≥10mm shoulder height difference (and self report level shoulders)
• T1 tilt poorly correlated with shoulder balance
Step 3: Surgical Techniques
Congenital Cervicothoracic Scoliosis

1. Fusion
2. Resection
3. Distraction over time

No role for Bracing
Option #1 Hemi-epiphysiodesis (Fusion)

- <5yrs
- <50 deg curve
- Posterior fusion alone
- Fuse 1/3-1/2 vertebrae
- Cant get correction from cast
3 month old
Fused St. Elsewhere

1 year after in-situ fusion
Progressive deformity

In situ fusion alone questionable
- Variable results
- Crankshaft
- Progressive
- Implants help?
2 yo congenital scoliosis
Hemi Vertebrae Opposite Bar

Progression likely
Multiple growthplates convexity
2 yo congenital scoliosis
Hemi Vertebrae Opposite Bar

Upper anchor fixation sufficient for resection?
Implants allow Some compression (correction)
Pedicle screws *may* help control anterior

No Bridges Burnt
Can do wedge resection when older
Adult sized implants may be too big
Use Downsized Implants
2 year old - 4.5 mm system

Supra laminar C7

Transverse process T2
If Pedicle Screws are too Long, Cut them Shorter

2 yo - T2
Option #2 Resection and Fusion
7yo 40°
Anterior Exposure of the Cervicothoracic Spine using a Combined Cervical and Thoracic Approach

BY LYLE J. MICHELI, M.D.*, AND ROGER W. HOOD, M.D.*, BOSTON, MASSACHUSETTS

From the Department of Orthopaedic Surgery, Children’s Hospital Medical Center, Boston
Sternal Split
I Prefer All Posterior Resection
Pre-Op Hemivertebrae 40°
1.75 unilateral vertebral resection

Hooks on ribs help close wedge
Difficult if lordosis

Lamina hooks share load

40°

5°
If can fix in one surgery safely - first choice

Challenges:
Strong Enough Bone for Anchors
Protect with Halo
Halo Vest Useful
Pre-OP CT Angio

? Single Vertebral Artery
Option #3 Distraction Over Time
“Last” option
Brachial Plexus Palsy Injuries

- First rib adjacent to brachial plexus
- Avoid Solitary First Rib
- Monitor:
  - Pulse
  - SSEP, MEP
First Rib Stout – OK to distract against

Unilateral Bar
Midline Incision - Plan for final fusion

- No Dissection of Proximal Spine
- Split muscles just lateral to TP
Current Preference:
Hemiepiphsiodesis + Distraction over time

Stop Bad Growth
Encourage Good Growth

Congenital Cervicothoracic Scoliosis Treated with Hemiepiphsiodesis and Placement of Distraction-Based Instrumentation
A Case Report
Lindsay Andras, MD, Rachel Tobin, and David L. Skaggs, MD
Investigation performed at Children’s Orthopaedic Center, Children’s Hospital Los Angeles, Los Angeles, California
Hemiepiphysiodesis + Distraction over time

Distract every 1-2 years

No thorocotomy!
Complications of Distracting on Ribs
Lengthening complication

• Monitoring normal intra-op
Arm pain post op when arm at side

- Monitoring normal intra-op
Return to OR in Few Days

MEPs Normal

MEPs 50% Diminished
Lesson:
Position arms at side when distracting on top rib
Complication: Rib Mass Avulsion
Rib Avulsion: Treatment

• Step 1
  – Remove Devices
  – Fuse Avulsed ribs to spine
Rib Avulsion: Treatment

• Step 1
  – Remove Devices
  – Fuse Avulsed ribs to spine

• Step 2 (4-6 months)
  – Replace Device
  – Modest Distraction
Pre-OP

Post-op
Complications: Implants Migrate Through Ribs
Treatment: Put them back!

Migrations inherent in non-constrained, growing systems
Conclusions

• Simple fusion
  – Deformity acceptable
  – \(< 4?\) vertebrae - with implants
  – Risk averse

• Excision
  – Deformity concerning
  – Well defined hemi-vertebrae
  – \(< 2?\) vertebrae

• Fusion + Distraction
  – Multiple levels involved
  – Risk of Thoracic Insufficiency Syndrome
  – Multiple operations acceptable
  – Solid upper anchors
Conclusions

- **Simple fusion**
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- **Excision**
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Conclusions

• Simple fusion
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• Excision
  – Deformity concerning
  – Well defined hemi-vertebrae
  – $\leq 2$ vertebrae

• Fusion + Distraction
  – Deformity Not Acceptable
  – Multiple levels involved
  – Multiple operations acceptable
  – Solid upper anchors

No thorocotomy!

[Image of an X-ray with annotations]
Thank You
Adjacent to TP

Extra-Periosteal
Want ribs to hypertrophy
NOT in chest
No chest tube
No Advantage to “Claw” (my opinion)
Congenital Scoliosis with Right Side T2 Hemivertebrae

40° Rt C-T curve
By age 4 the Cervical curve progressed to 45°

Intra op Halo was placed to slowly bring her head tilt to neutral 2 weeks prior to instrumentation and fusion
Concave Distraction over time

Convex Fusion C7-T4
Option #1 Hemiepiphysiodesesis (Fusion in situ)
Option #2 Resection and Fusion

18 mo after in-situ fusion
Option #3 Distraction Over Time
3 yo - progressive deformity
Step 1 - concave distraction
Step 1 - concave distraction

Create cleft 2 hooks
Step 2 - convex hemi-epiphysiodesis
Step 3- Intra-operative Distraction Over Time
The Effect of Early Thoracic Fusion on Pulmonary Function

Lori Karol, M.D., Charles Johnston, M.D.,
Kiril Mladenov, M.D., Peter Schochet, M.D.,
and Patricia Walters, RRT-NPS.
Texas Scottish Rite Hospital for Children
Dallas Texas
RESULTS

- 28 patients spinal fusions
- Age at surgery = 3 yrs (4 mos - 8 yrs)
- Ave f/u 11 years (6 - 20 yrs)
- 27/28 had anterior surgery
FVC VS. PROXIMAL LEVEL OF FUSION

Ave FVC

T1, T2, T3, T4, T5, T6, T7, T8, T9
Cephalad Extent of Fusion More Important than # segments Fused

- FVC < 50%
  - 67% (8/12) top of fusion T1 or T2
  - 25% (4/16) top of fusion T3-T9
  - P=0.0004
• Posterior spine fusion in rabbits
• T1-T6 fusion decreases thoracic volume > T7-T12 fusion

• hypothesis
  – T1-T6 ribs articulate with the sternum
  – T7-T12 ribs do not
Current Technique:

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Lengthenings opportunity for complications
MCGRs may change complication rate
3 yo girl

72°

Hemi vertebrae

Unilaterial bar