The future of standing 3D spine imaging in Spine Surgery: how we can use this new tool to better treat our patients?

Stefan Parent, MD, PhD
Atlantic Canada Spine Meeting
October 20th, 2018
Disclosures

- Depuy Synthes spine (a, b),
- Canadian Institutes of Health Research (a),
- Scoliosis Research Society (a),
- POSNA Biomet Spine Research Grant (a),
- Natural Sciences and Engineering Research Council of Canada (a),
- Orthopedic Research and Education Foundation (a), Setting Scoliosis Straight Foundation (a),
- Medtronic (b),
- EOS-Imaging (a, b, c, d, e) including Royalties
- Spinologics (c)

(a) Grants/Research Support
(b) Consultant
(c) Stock/Shareholder
(d) Speakers’ Bureau
(e) Other Financial Support
MUSCULOSKELETAL DISEASES AND REHABILITATION

Academic Chair in Pediatric Spinal Deformities of CHU Ste-Justine
Debating Dr Muharrem Yazici

- Difficult task
- Articulate
- Good looks
- Mesmerizing
- Perfect!
But then I found something…

- Wait…
And then...

Nominating Committee Update

Kenneth MC Cheung, MD
Nominating Committee Chair

The nominating committee met on two occasions via conference calls in March and April.

The following have been nominated by the committee:

Vice President:
Muharrem Yazici

I guess I will try to behave...
Growth Modulation

A new approach in the treatment of Idiopathic Scoliosis
For patients with significant growth remaining
**AIS Treatment algorithm**

11 - 25°

- Skeletal maturity?
  - Yes
    - Follow-Up as needed
  - No
    - Follow-Up until skeletal maturity reached (every 6-12 months)

25 - 45°

- Skeletal maturity?
  - Yes
    - Follow-Up every 5 years to evaluate progression
  - No
    - Treatment with brace to consider

> 40-50°

- Consider surgery

Adapted from Parent et al. ICL 2005
PSF in the immature patient

Open TRC

- More likely to progress distally (crankshaft)
- Anterior/posterior fusion recommended
  - Sponseller et al. JPO, 2016

Closed TRC

- PSF alone seems reasonable
- but fusing short of the stable vertebra was also a risk for adding-on
  - Sponseller JPO, 2016
Traditional approach
What Muharrem thinks about Growth Modulation:

- « Although recent animal studies using anterolateral spinal tethering have been encouraging, very limited clinical experience is present »
  - Sounds like we should be doing this procedure more often to find out

- « The most attractive feature of this technique is the possibility of a definitive correction without final fusion surgery. However, unless the indications could be extended to more severe curve patterns, we find it unlikely that this technique would be adopted by most. »
  - This sounds like a challenge to do bigger curves...
**Scoliosis pathomechanism**

**Hueter-Volkmann principle:**
- Compressive loads on GP = growth inhibition
- Reduced loading on GP = accelerated growth

Mathematical algorithm (in vivo experiments)
Growth rate linear response to loadings at GP
(Stokes 2006, 2007, Villemure 2009)

\[
G = G_m [1 - \beta (\sigma - \sigma_m)]
\]

- \(\sigma_m\) = normal stress
- \(\sigma\) = stress in pathologic spine / AVBT
- \(\beta\) = bone sensitive factor (0.4 – 2.3 MPa\(^{-1}\))
- \(G_m\) = growth rate (0.8-1.1 mm/year)

**Asymmetric pressures** on epiphyseal growth plates
**Asymmetric growth** (Hueter-Volkmann)

**Vicious cycle**
**Progression** of vertebral wedging and spinal curves

Adapted from I.A. Stokes
Growth modulation – Fusionless treatments

Symmetric growth (Hueter-Volkmann)

Correction of vertebral wedging and spinal curves

Vertuous cycle

Symmetric pressures on epiphyseal growth plates

Fusionless treatments

Adapted from I.A. Stokes
What are the current challenges for Growth Modulation

- Overcorrection is a risk
  - Too much growth
- Undercorrection is a concern
  - Not enough growth
- What levels to instrument (or tether)?
- How much tension to apply?
Does this work even in large curves??
Current indications

- AIS, Lenke 1A, 1B preferred (1C possible)
- 40° - 70°
- Pre-menarchal
- Risser 0 or 1
- Open TRC and Risser 0 preferred
- Older than 8-9 years or > 30 kg
- Patients and families are told this is EXPERIMENTAL
Benefits

- Less blood loss
- Shorter hospitalization
- Retaining spine flexibility
- Potential to correct spine without fusion
Limitations

- **Over-correction**
  - Risk greater for smaller curves that are younger
- **Patients are told that there will be at least one other surgery to remove material**
- **No long-term outcomes**
  - Don’t know what the impact on the disk will be
- **Is it really better than bracing/traditional surgery**
Is growth modulation for everyone?

- Probably not…
- But if significant growth remaining AND
- Flexible curve AND
- Curve can be expected to correct with amount of growth remaining

- This option may be explored with the family.
Natural history

Maturity

Potential benefit of early treatment

Natural history

Maturity

Potential benefit of early treatment

26°

39°

41°

45°

47°

50°

2y

3y

2°

1y

1.5y

0

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