

**Deformity Angular Ratio is Associated with  
Neuromonitoring Changes without a  
Vertebral Column Resection:  
Spinal Deformity is More Influential than  
Type of Surgery**



Ali A. Siddiqui, BS; Kenneth D. Illingworth, MD;  
David L. Skaggs, MD, MMM; Lindsay M. Andras, MD

# Disclosures:

Ali Siddiqui MD: No relationships

Kenneth Illingworth MD: No relationships

David Skaggs MD MMM: Biomet spine (g); Grand Rounds (a Healthcare Navigation Company) (b); Green Sun Medical ( c ); NuVasive (a, b); Orthobullets (b,c,e); Orthopaedics Today ( e ); Wolters Kluwer Health-Lippincott, Williams & Wilkins (g); Zimmer Biomet (b,d,g); Zipline Medical( c )

Lindsay Andras MD: Eli Lilly ( c ); Medtronic (b, d); Orthobullets (g); Zimmer Biomet (b, d)

# Background

Increased DAR was predictive of IONM signal loss and neurological deficit during vertebral column resection (VCR) and 3-column osteotomies (3-CO)

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DEFORMITY

## The Deformity Angular Ratio

*Does It Correlate With High-Risk Cases for Potential Spinal Cord Monitoring Alerts in Pediatric 3-Column Thoracic Spinal Deformity Corrective Surgery?*

Noah D. H. Lewis,\* Sam G. N. Keshen, BSc,\* Lawrence G. Lenke, MD,† Michael G. Zywielski, MD,‡ David L. Skaggs, MD,§ Taylor E. Dear, BSc,\* Samuel Strantzas, MSc, D ABNM,\* and Stephen J. Lewis, MD, MSc, FRCSC\*‡

## Deformity Angular Ratio Describes the Severity of Spinal Deformity and Predicts the Risk of Neurologic Deficit in Posterior Vertebral Column Resection Surgery

Wang, Xiao-bin MD\*; Lenke, Lawrence G. MD†; Thuet, Earl BS, CNIM‡; Blanke, Kathy RN†; Koester, Linda A. BS§; Roth, Michael BS, CNIM¶

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DEFORMITY

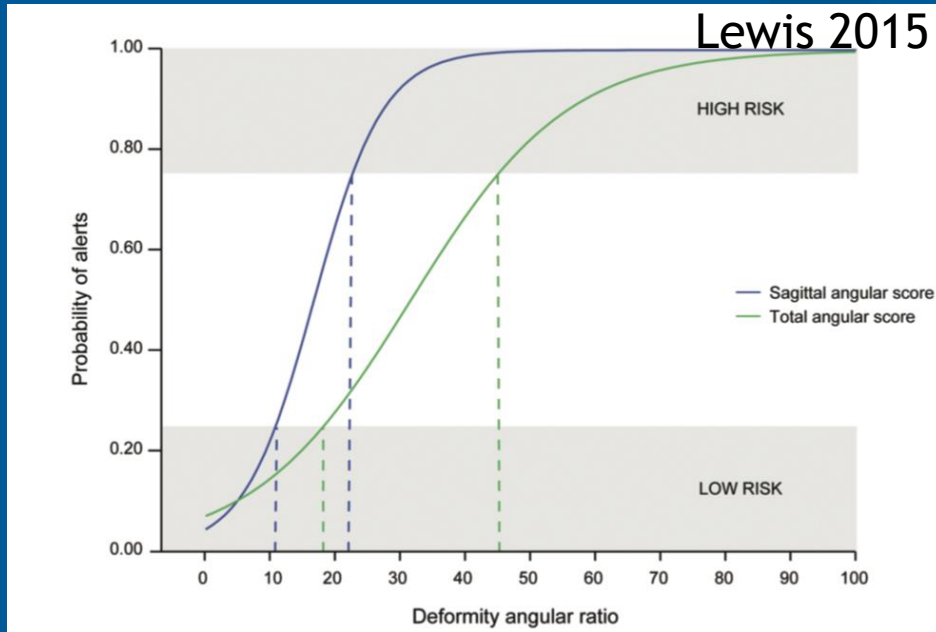
# Background

## Deformity Angular Ratio(DAR)

$$\text{DAR} = \frac{\text{Curve Magnitude}}{\text{levels of spinal deformity}}$$

# Background

Increased DAR was predictive of IONM signal loss and neurological deficit during vertebral column resection (VCR) and 3-column osteotomies (3-CO)



- Wang et al:  
T-DAR  $\geq 25$  => 41% MEP change

# Purpose

The purpose of this study is to investigate the effect of the DAR on IONM signal changes during PSF without VCR or 3-CO

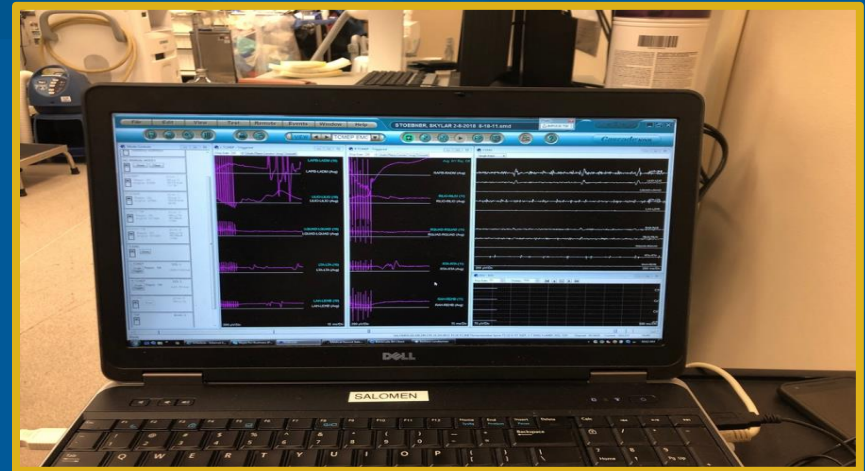
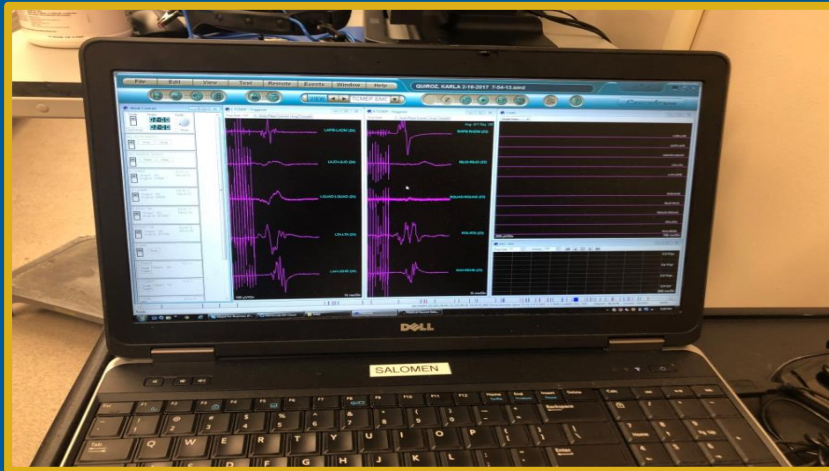


# Methods

- Retrospective review of severe pediatric spinal deformity (major curve angle  $>70$  degrees) patients treated between 2008-2018 at a tertiary care pediatric hospital
- **Inclusion criteria:**
  - Treatment with PSF without VCR or 3-CO
- **Exclusion criteria:**
  - Prior spinal instrumentation
  - Lack of baseline IONM

# Methods

- IONM signal loss was defined as decrease of greater than 50% in somatosensory evoked potentials (SSEPs) or trans-cranial motor evoked potentials (tcMEPs)





# Methods

- Patients with IONM signal loss were compared to those without IONM signal loss in regards to:
  - Demographics
  - Levels fused
  - Preoperative DAR:
    - coronal DAR (C-DAR)
    - sagittal DAR (S-DAR)
    - total DAR (C-DAR + S-DAR = T-DAR)

# Results

- **253 patients**
- Mean age: 13.7 years
- Diagnoses:
  - 89% Scoliosis
  - 11% Kyphosis



# Results

- Average number of vertebral levels fused:  
 $13 \pm 2$  levels
- Mean preop deformity magnitude:
  - Mean preop Cobb angle:  $82 \pm 26$  degrees
  - Mean preop kyphosis:  $55 \pm 27$  degrees

# Results

Loss of IONM signals occurred in  
19%(47/253) of patients

- 87% (41/47) ->return of IONM signals to baseline
- 13% (6/47) -> without IONM signal return to baseline

# Results

- Stagnara Wake-up test was performed in 7 cases
  - 3 of these patients had a new neurological deficit on wake-up test
  - All deficits resolved by mean of 41 days postop

# Predictors of IONM signal loss during PSF

Risk factor	IONM signal loss (n = 47)	No IONM signal loss (n=206)	p-value
Sagittal kyphosis	64 ± 30	51 ± 30	<b>0.003</b>
Coronal Cobb angle	86 ± 33	80 ± 24	0.16
Sagittal DAR	8 ± 4	6 ± 4	<b>0.03</b>
Coronal DAR	12 ± 11	11 ± 4	0.06
Total DAR	20 ± 6	17 ± 5	<b>0.005</b>

# Predictors of IONM signal loss during PSF

Risk factor	Incidence of IONM signal loss	p-value
Sagittal DAR > 7	<b>26%</b> (24/92)	<b>0.02</b>
Sagittal DAR ≤ 7	14% (23/161)	
Total DAR > 27	<b>44%</b> (7/16)	<b>0.02</b>
Total DAR ≤ 27	17% (40/237)	

Less

Neurologic Risk

More

Ponte/  
SPO

PSO

Vertebral  
Column  
Resection

- This is a tool to help one identify patients at higher risk of neuromonitoring signal changes
- Interestingly, even though we generally consider the neurologic risk of a VCR to be higher than that with a Ponte, we found a similar rate of losing signals
- Nevertheless, responding to this change in the face of a more destabilized spine can be more challenging in the setting of a 3-column osteotomy



# Conclusion

- S-DAR > 7(26%) or T-DAR > 27(44%) were predictive of IONM loss during PSF without VCR
  - *Similar to Wang et al: T-DAR > 25 associated with a 41% risk of IONM loss*
- The severity of the deformity, rather than specific surgery, may be the more influential contributor to the risk of IONM changes