Radiographic Outcome and Complications after Single-level Lumbar Extended Pedicle Subtraction Osteotomy for Fixed Sagittal Malalignment: A Retrospective Analysis of 55 Adult Spinal Deformity Patients with Minimum 2-Year Follow-up

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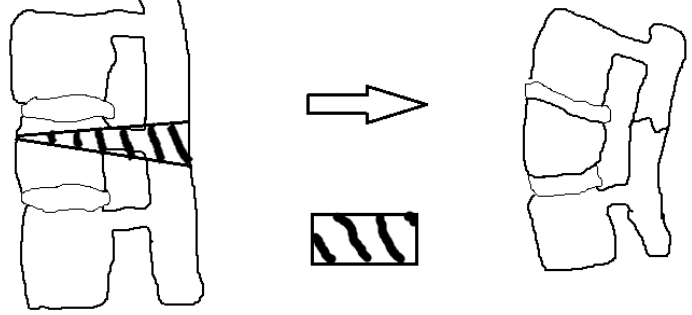
Thomas J. Buell MD

Thomas J. Buell MD, James H. Nguyen MD, Marcus D. Mazur MD, Jeffrey P. Mullin MD, Juanita Garces MD, Davis G. Taylor MD, Chun-Po Yen MD, Mark E. Shaffrey MD, Christopher I. Shaffrey MD, Justin S. Smith MD PhD (Manuscript accepted by JNS Spine)

Background

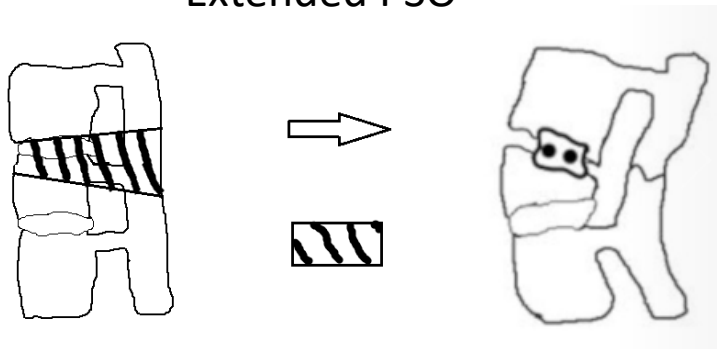
- Traditional PSO (Schwab grade III osteotomy)
  - 25° to 35° focal correction
  - Many studies have reported outcomes and complications for adult spinal deformity (ASD)

Traditional PSO



- *Extended* PSO (ePSO; Schwab grade IV osteotomy)
  - Bony wedge resection ***extends*** into the superior adjacent disc for radical discectomy
  - Cage may be placed at the osteotomy site
  - Limited literature

Extended PSO



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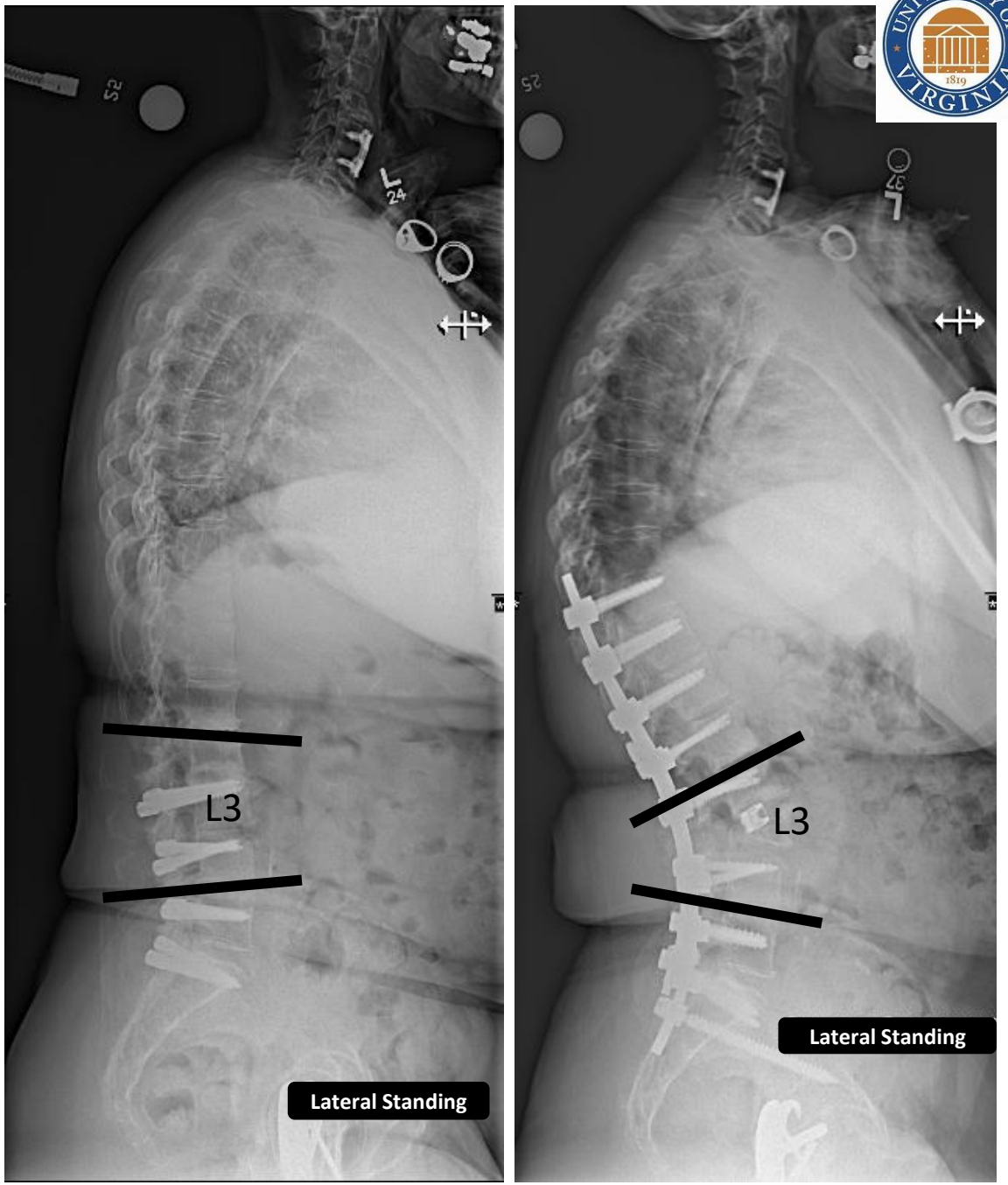
Study Objective & Methods

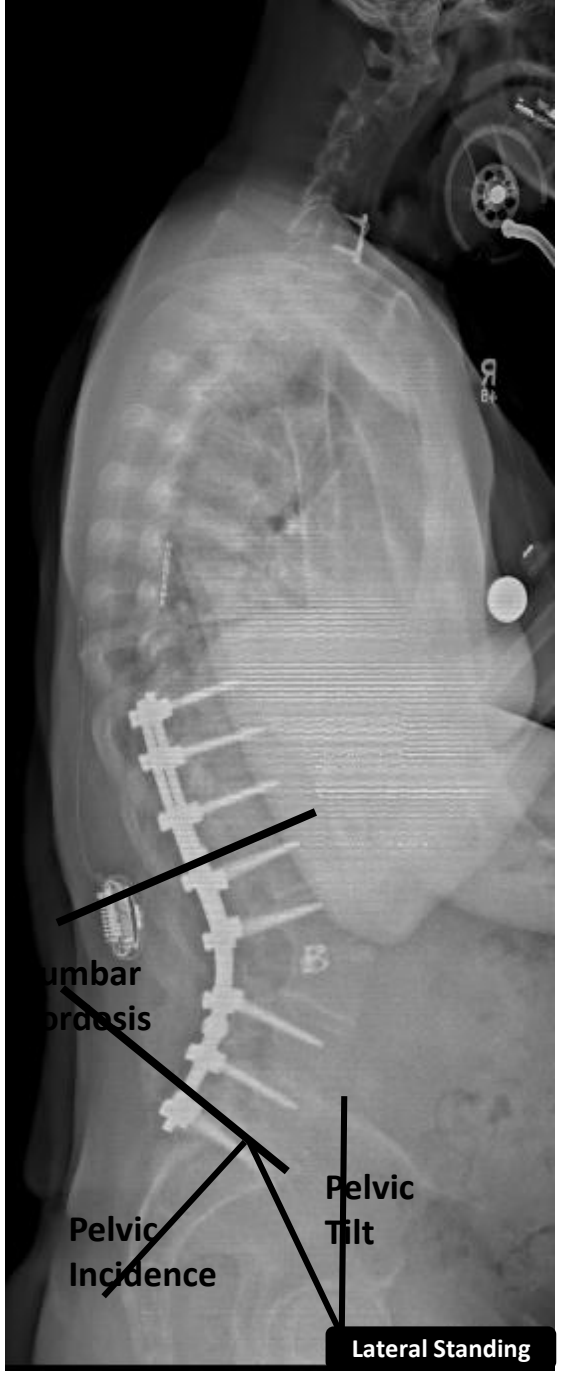
- Objective
  - Investigate radiographic outcome and complications after single-level lumbar ePSO for adult spinal deformity

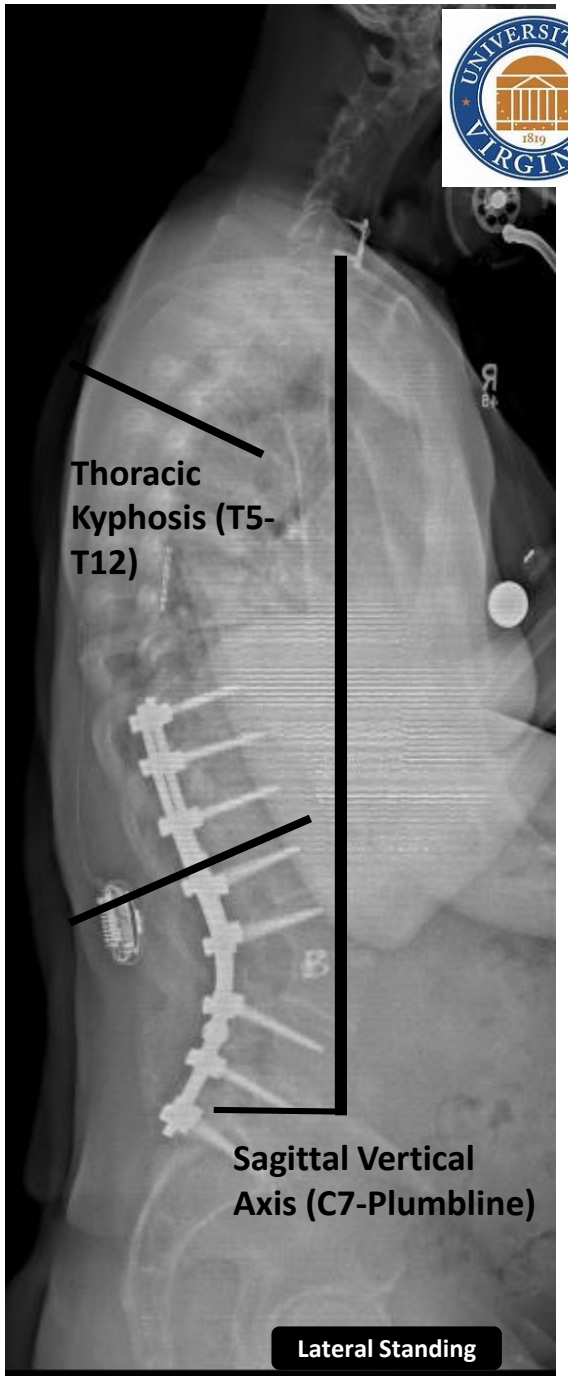
- Methods
  - Single-center retrospective analysis of consecutive ASD patients between 2010 and 2015
  - ePSO segmental lordosis was measured pre- and post-operatively (Cobb angle demonstrated in the figure)



Methods

- Other measurements included:
  - Lumbar lordosis
  - Pelvic tilt
  - Pelvic incidence
  - PI-LL mismatch
  - Thoracic kyphosis
  - Sagittal vertical axis
- Complications
  - Rod fracture
  - Pseudarthrosis
  - Neurological deficits





Results

- Results
  - 55 (77%) of 71 consecutive patients achieved minimum 2-yr follow-up (mean=52 months [range:26-92 months])
  - Mean age=64.0 years; 65.5% female; Mean BMI 30.2 kg/m^2; ASA 2.6
  - 96.4% prior lumbar fusion

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Results

- Results
  - 58% of ePSO were performed at L3
  - 56% of ePSO included cage placement at the osteotomy site
  - 6% asymmetric PSO
  - 71% had uppermost instrumented vertebrae between T9 to T11
  - Mean fusion length was 12 segmental levels with 89% iliac fixation

- Results (continued)
  - Accessory rods (98% CoCr)
    - 47% - None
    - 20% - One
    - 33% - Two
  - EBL 3.1L
  - Operative duration 6.7 hrs
  - ICU stay 2.7 days
  - Hospital stay 9.4 days
  - 74.5% discharged to rehab

Results

Table 2. Pre-op, early postoperative, and final sagittal plane radiographic parameters[1]

	Preop	Early postop	Initial postop change	P^2	Last follow-up	Change from early postop	P^3
ePSO segmental lordosis (°)	7.0 ± 16.8 (-40.0–+43.0)	-33.5 ± 8.6 (-56.0—14.0)	-40.5 ± 13.7 (-69.0—7.0)	**<0.001**	-32.9 ± 8.9 (-63.0—15.0)	0.5 ± 3.6 (-8.0–+8.0)	0.270
Lumbar lordosis (°)	-9.3 ± 15.4 (-40–+20)	-47.3 ± 9.9 (-70.0—28.0)	-38.0 ± 10.6 (-58.0—9.0)	**<0.001**	-46.7 ± 9.8 (-70.0—26.0)	0.6 ± 4.6 (-7.0–+11.0)	0.339
Pelvic tilt (°)	33.2 ± 9.2 (6.0–55.0)	27.1 ± 8.3 (7.0–56.0)	-6.0 ± 8.7 (-29.0–+11.0)	**<0.001**	--	--	--
PI-LL mismatch (°)	52.6 ± 12.1 (33.0–80.0)	11.9 ± 10.2 (-11.0–+41.0)	-40.7 ± 13.3 (-68.0—4.0)	**<0.001**	--	--	--
Thoracic kyphosis (°)	23.9 ± 14.5 (0–56.0)	38.9 ± 11.8 (12.0–60.0)	15.1 ± 13.0 (-9.0–+50.0)	**<0.001**	--	--	--
Sagittal vertical axis (cm)	16.8 ± 7.8 (0–40.0)	4.4 ± 3.4 (-3.4–+14.0)	-12.5 ± 6.9 (-33.6–+3.4)	**<0.001**	4.8 ± 3.8 (-5.7–+12.0)	0.4 ± 3.2 (-13.7–+7.4)	0.330

- Overall, the average postoperative increase in ePSO segmental lordosis was 40.5 ± 13.7° ($p<0.001$).
- This was maintained when comparing early postoperative measurement to last follow-up.

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Complications

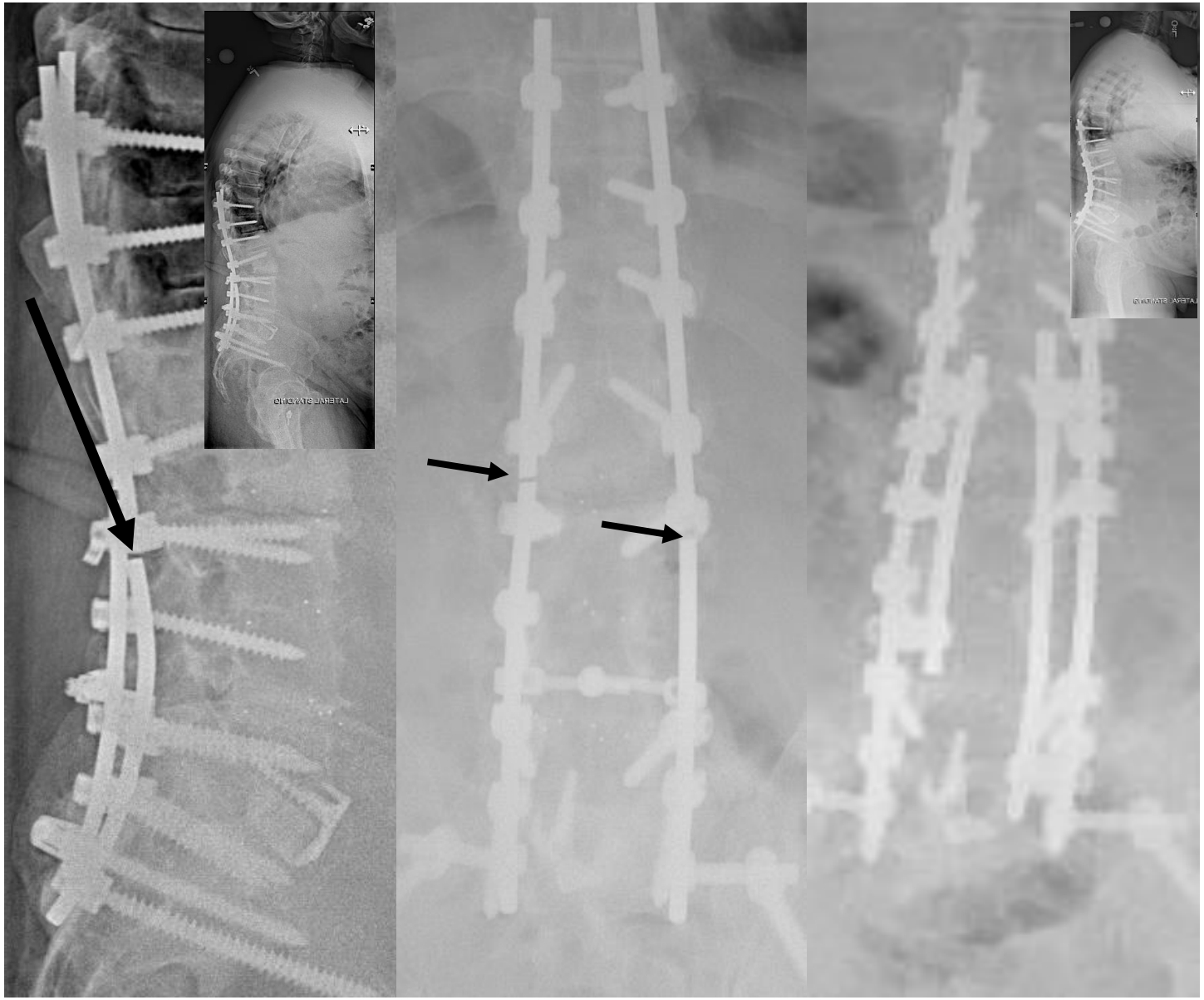
- Transient neurologic deficits
  - Radicular pain – 16.4%
  - Motor deficit – 14.5%
  - Sensory deficit – 1.8%

- Persistent deficits
  - Radicular pain – 5.5%
  - Motor deficit – 1.8%
  - Sensory deficit - 0

- Rod fracture
  - 18.2% - ePSO
  - 5.5% - L4-5
  - 5.5% - L5-S1

- Pseudarthrosis
  - 14.5% - ePSO
  - 1.8% - L4-5
  - 3.6% - L5-S1

- The figure demonstrates bilateral rod fractures (arrows) revised with bilateral accessory supplemental rods



- Accessory rods
  - 62% intact vs. 10% RF/PA (p=0.004)
- Logistic regression for predictors of RF/PA
  - Accessory supplemental rods had significant protective effect

Table 4. Predictors of rod fracture or pseudarthrosis at the extended PSO site[1]

				Binary Logistic Regression[3]		
	Intact rods without pseudarthrosis at the ePSO site (n=45)	Rod fracture or pseudarthrosis at the ePSO site (n=10)	*P*[2]	Odds Ratio	95% CI	*P*
Age at surgery (years)	63.7 ± 11.6	65.5 ± 7.4	0.636	—	—	—
Body Mass Index (kg/m^2)	30.3 ± 6.9	29.8 ± 10.8	0.900	—	—	—
Number of instrumented vertebrae	12.0 ± 3.2	11.2 ± 2.9	0.468	—	—	—
Postoperative SVA (°)	4.2 ± 3.5	5.2 ± 3.0	0.397	—	—	—
Postoperative PI-LL mismatch (°)	10.9 ± 9.5	16.3 ± 12.4	0.134	1.059	0.982–1.143	0.137
Postoperative lumbar lordosis (°)	47.8 ± 9.9	45.3 ± 9.9	0.474	—	—	—
Postoperative ePSO segmental lordosis (°)	34.0 ± 8.8	31.4 ± 7.6	0.401	—	—	—
Accessory supplemental rods (3- or 4-rod constructs spanning the ePSO site)	28 (62.2)	1 (10.0)	**0.004**	0.062	0.007–0.553	**0.013**
Rod diameter (mm)	5.6 ± 0.2	5.6 ± 0.2	0.267	—	—	—
CoCr rods*	42* (97.7)	10 (100.0)	1.000	—	—	—

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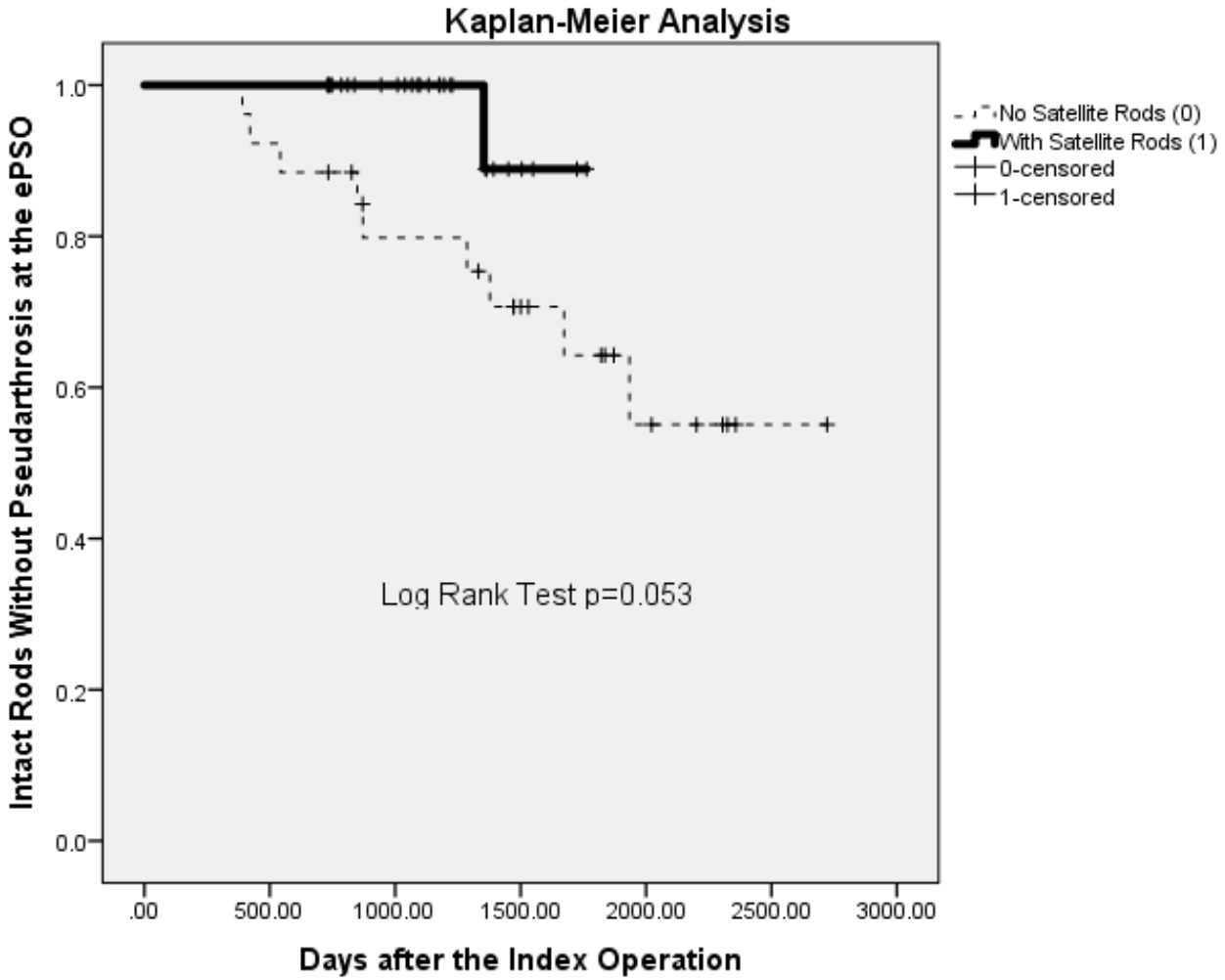

- Accessory supplemental rods across the ePSO site, a more recently employed technique, significantly reduced occurrence of RF/PA on univariate (p=0.004) and multivariable analyses (OR=0.062, 95% CI 0.007–0.553, p=0.013); this effect approached statistical significance on Kaplan-Meier analysis (log rank test, p=0.053)

Lumbar ePSO for Adult Spinal Deformity

- Conclusions
  - ePSO is an effective technique for ASD
  - May allow greater focal correction vs. traditional PSO
  - Further studies warranted

- Limitations
  - Lack of traditional PSO group for direct comparison
  - Retrospective
  - Radiographic primary outcomes

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Disclosures

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