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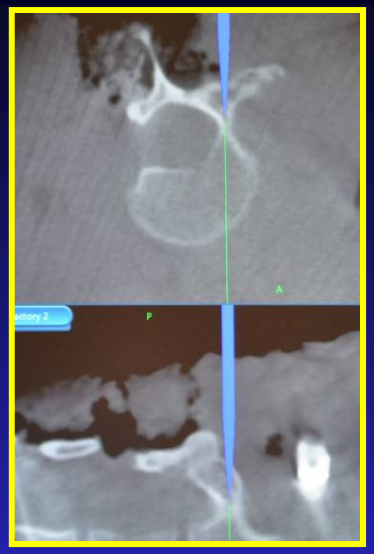
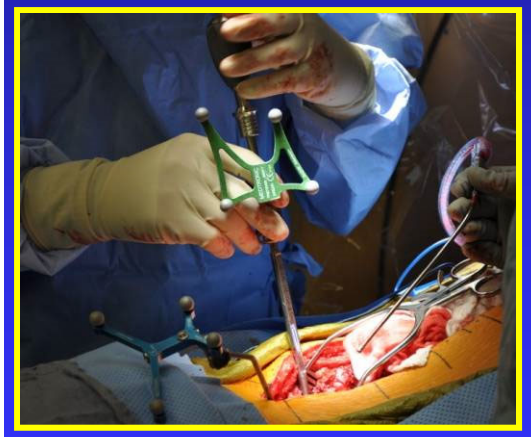


Pediatric Pedicle Screw Placement Using Intraoperative CT and 3D Image-Guided Navigation



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Disclosures

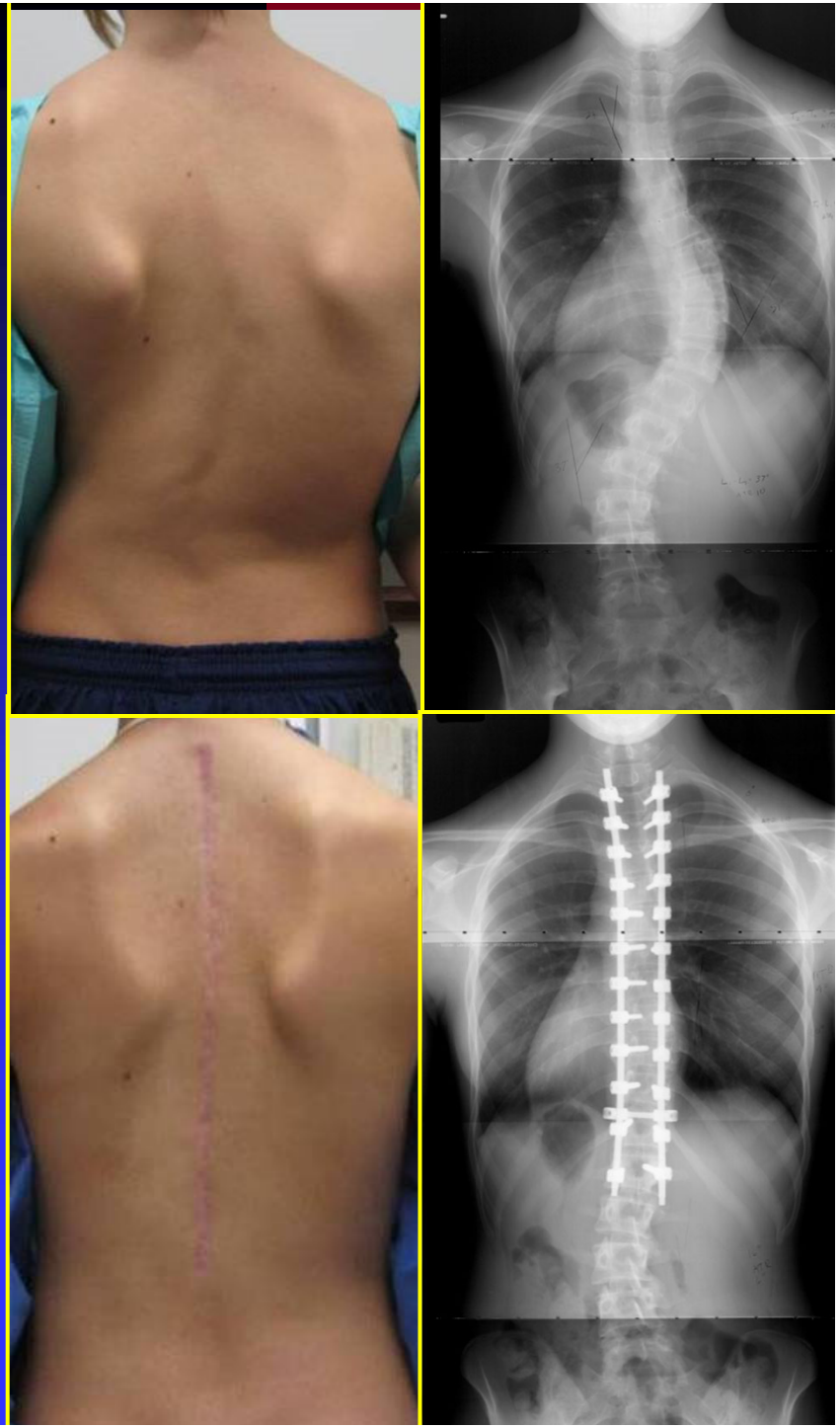
- David W. Polly, Jr., MD - Previous consulting agreements were: 1) Medtronic Spine ended 10/1/2009; 2) Medtronic Navigation ended 6/28/2010.
- Edward R. Santos, MD – Research: Medtronic, Synthes
- A. Noelle Larson, MD - none
- Charles G.T. Ledonio, MD – Research: SRS, POSNA, SRF, Medtronic, Sterilmed
- Jonathan N. Sembrano, MD – Research: Nuvasive
- Cary H. Mielke, MD - none
- Kenneth J. Guidera, MD - none

Introduction

Pedicle screws:

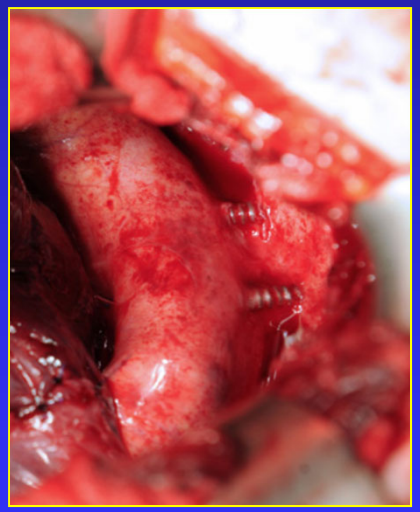
- **Biomechanical control of spinal deformity**
- **Improved correction**
- **Lower rates of reoperation**

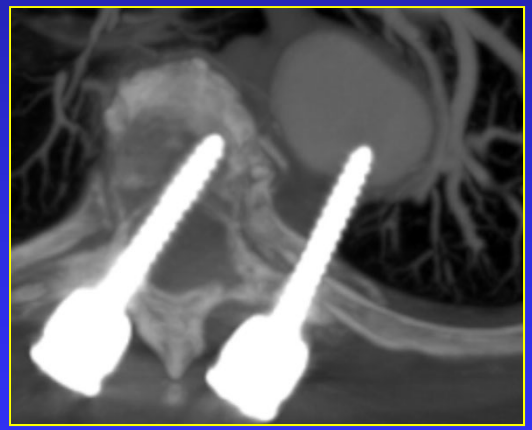
Lenke, Kuklo, Ondra, Polly, Spine 2008
Bridwell, Spine 1999
Suk et al., Spine 1995
Kuklo TR, Potter BK, et al. Spine 2007



How to avoid?

- Rare catastrophic injury to pleura, heart, viscera
- Return to OR





Samdani, Ranadi et al., Neurosurgery 2010
Parker, McGirt et al., Neurosurgery 2011
Tschoeke et al., Spine 2011

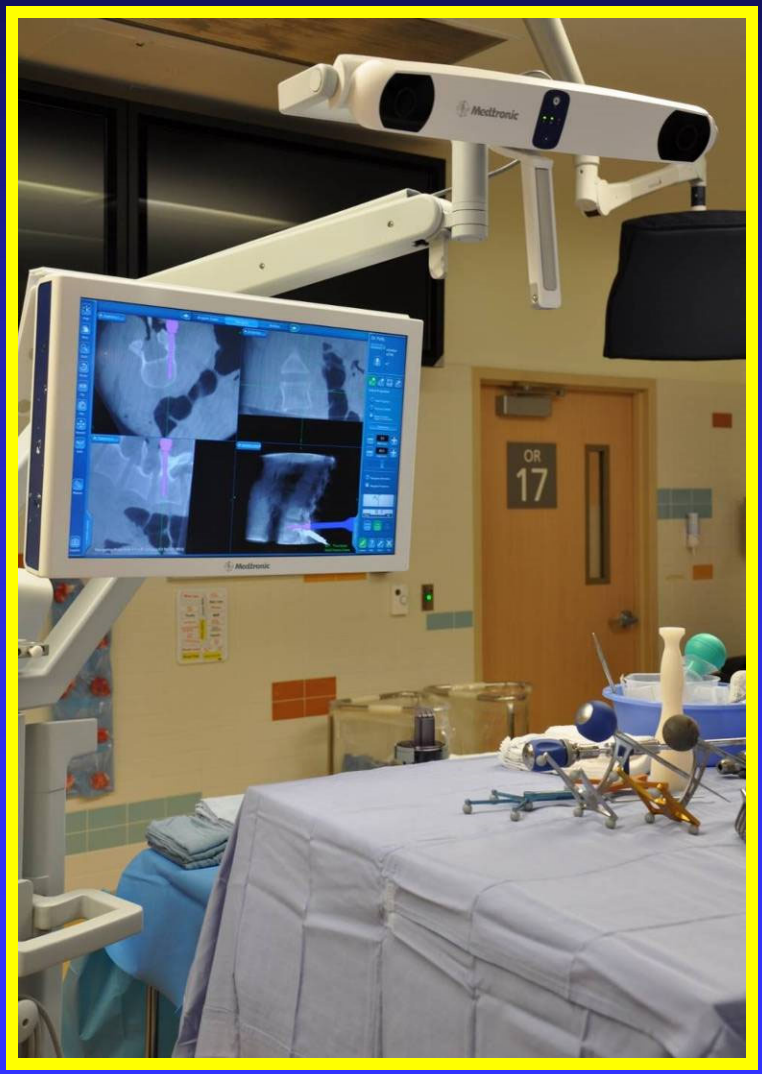
TECHNIQUES for SAFE SCREW PLACEMENT

- Anatomic landmarks
- Probing of the tract
- Fluoroscopy
- CT C-arm
- Stimulation of the screw
- **Intra-operative CT**
- **Navigation**

Methods: Retrospective Cohort Study

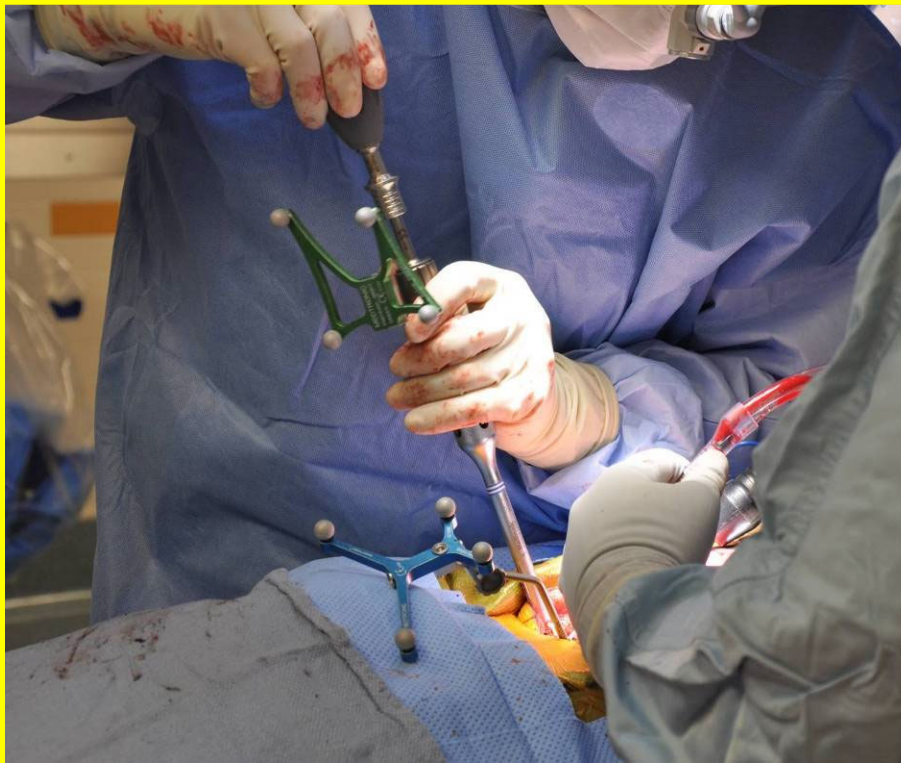
- Pediatric patients, posterior spine fusion (PSF) for deformity
  - 984 screws / 50 children
- Comparison group of Adults
  - PSF for degenerative disease and deformity
  - 1511 screws /177 adults
- Primary Outcome Measure

$$\text{Screw Accuracy} = 1 - \frac{\text{screws revised}}{\text{screws placed}}$$

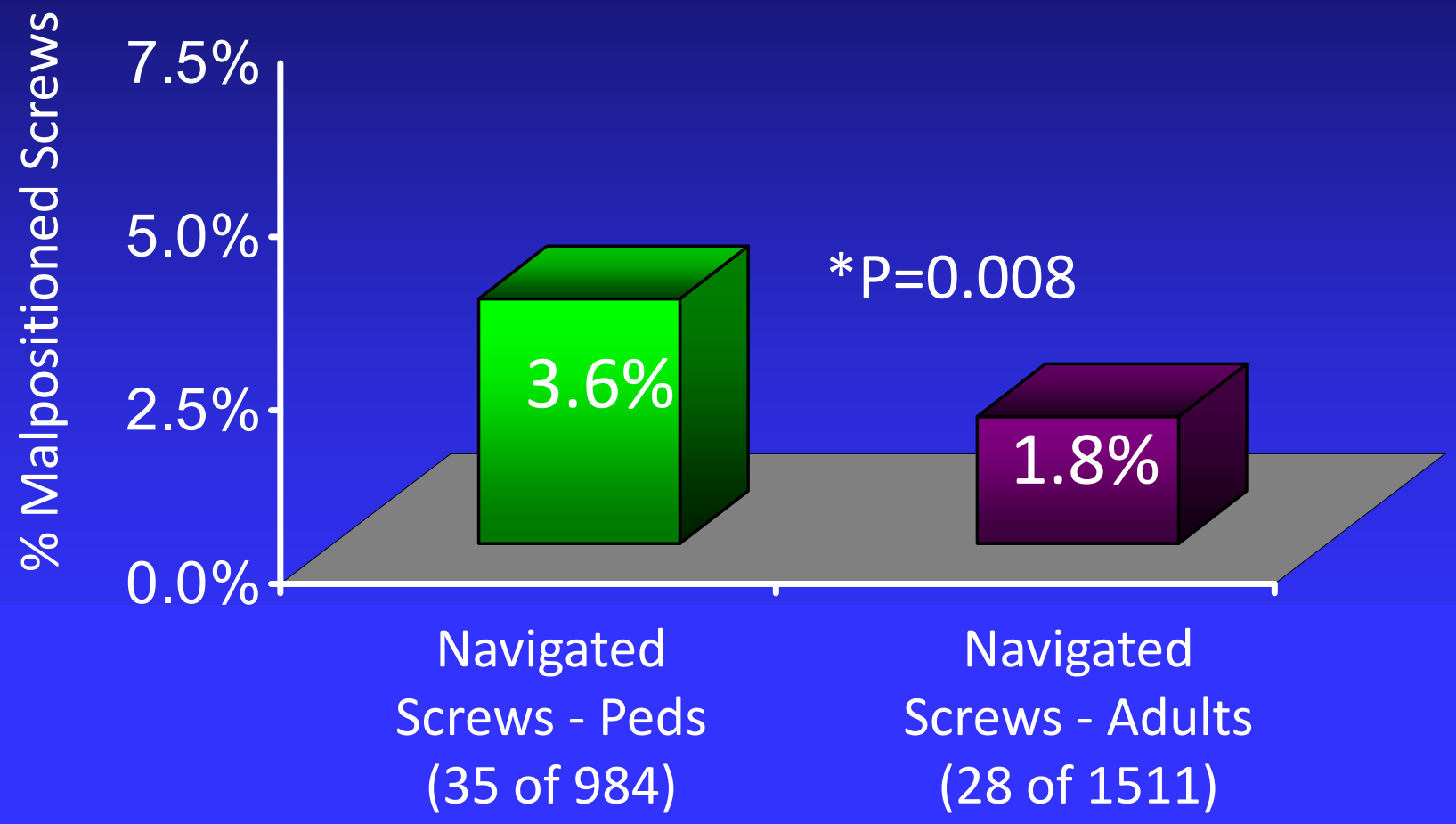


Results:
Pediatric Patients

- 35 of 984 screws (3.6%) were
  8 removed)
- 96.4% accuracy rate
- No patients returned to the O



Screw Revision Peds vs. Adults



Reported Screw Accuracy in the Literature

- Kosmopoulos V, Schizas C, Spine 2007 (adults, 10,250 screws)
  - 92.0% with navigation vs. 86.6% without navigation
- Ledonio CG, Polly DW, Vitale MG, Wang Q, Richards BS. JBJS 2011 (pediatric, 13,536 screws)
  - 94.9% without navigation vs. 96.4% in current study

On AVERAGE (20 screws/patient)

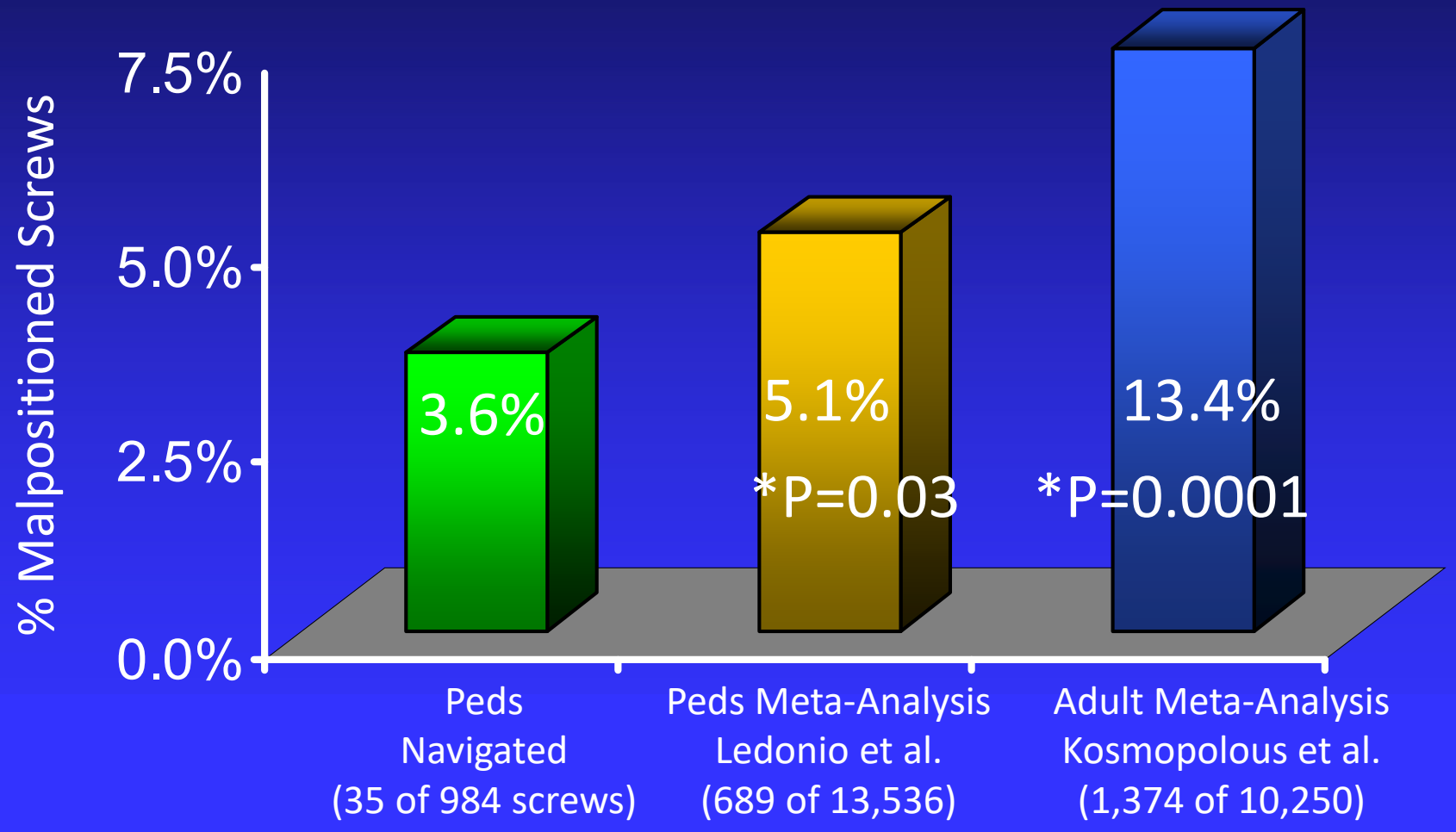
- Ledonio et al.: Every patient has 1 malpositioned screw!
- With navigation and intra-operative CT: 2 out of 3 patients with malpositioned screw . . . detected prior to leaving the OR

Return to OR

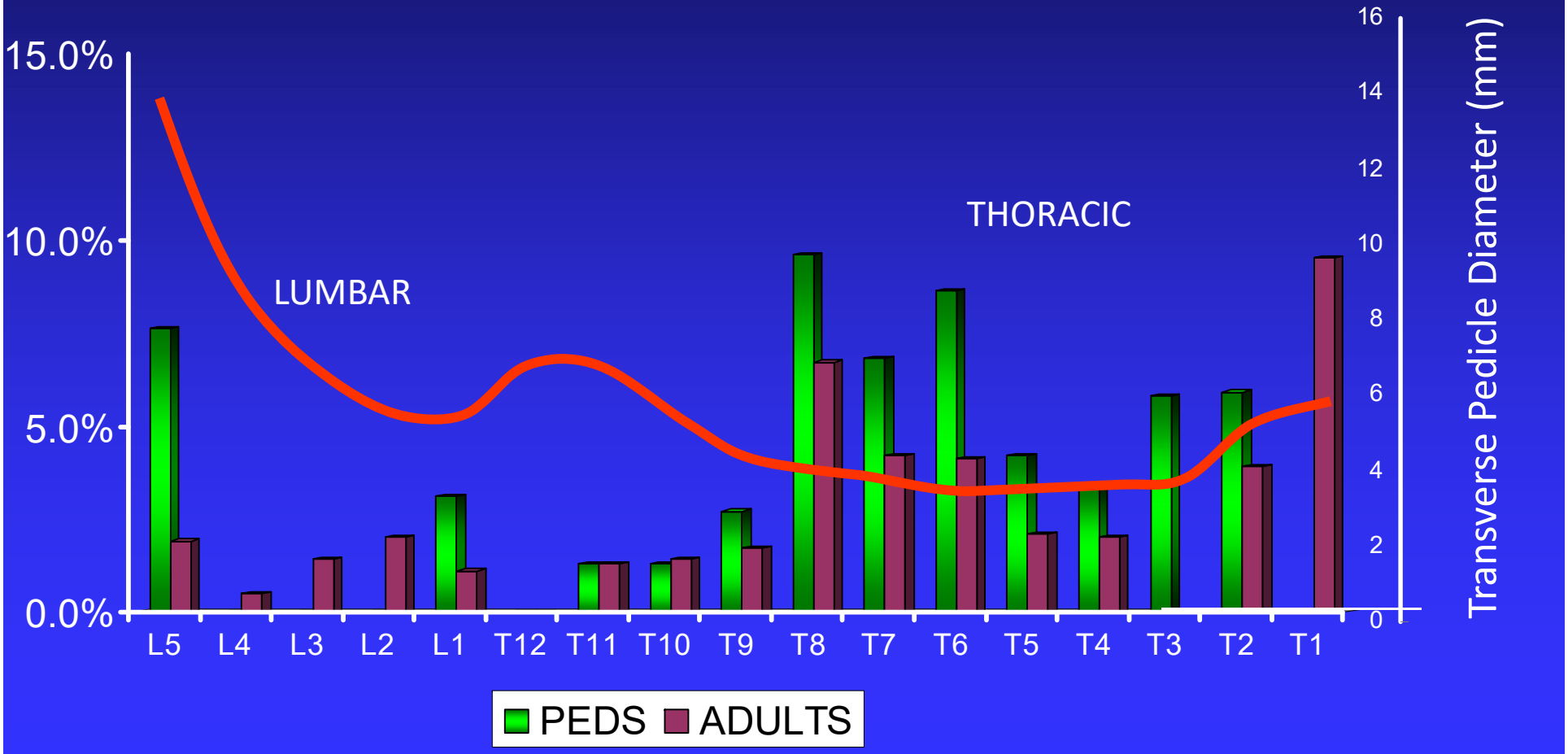
- 0% return to OR with image-guidance
- Literature: 0.8% - 4.3% return to OR without guidance

(Parker, McGirt et al., Neurosurgery 2011, Hicks et al, Spine 2010, Di Silvestre et al., Spine 2007)

Screw Revision: This Study vs. Literature



Pediatric and Adult Screw Revision Rate



Radiation Concerns
O-Arm vs. Fluoroscopy

- Radiation to OR team: O-arm <<< fluoro
- Radiation to patient: O-arm ≈ fluoro
  - 1 intraop O-Arm CT = 9 mGy / 35 second of fluoro
  - 7-20 seconds of fluoro/screw (Ul Haque 2006; Jones 2000)
- For a 20 screw construct 140 – 400 seconds of fluoro, equivalent to 4 - 11 intra-operative scans
- 2 to 6 scans/patient in this study

Conclusions

- Higher rates of screw malposition in pediatric (3.6%) vs. adult pedicle screws (1.8%) using CT/Navigation
- Improved screw accuracy in pediatric patients (96.4%) compared to literature meta-analyses (94.9%)
- Eliminates return to OR for screw malposition
- Helpful for congenital deformity, revision cases
- Commensurate radiation exposure to fluoro guided screw placement