

# Accuracy of pedicle screw placement using an augmented-reality assisted navigation system

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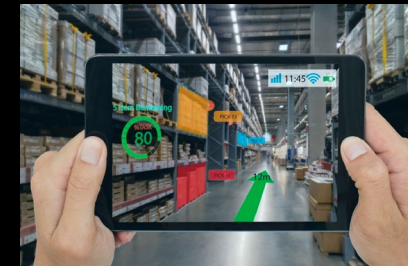
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# Virtual / Augmented Reality

- Virtual Reality (VR):
  - Complete immersion in visual and auditory inputs
- Augmented reality (AR):
  - Image overlay on the natural visual field
- Pedicle Screw Accuracy
  - Generally, improves with increasing use of technology



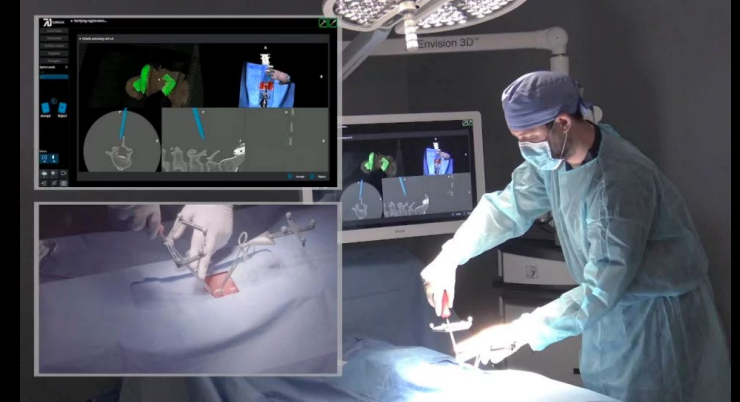
	Freehand	2D Flouro	3D Navigation
Cervical	69.4%	73.3%	90.3%
Thoracic	50.8%	78.4%	93.2%
Lumbar	75.9%	86.8%	96.7%
Overall	68.1%	84.3%	95.5%

(Kosmopoulos et al. Spine 2007, Tian et al. Int Ort 2009, Gelalis et al. ESJ 2012)

# AR in Spine Surgery

- Despite widespread use of spinal navigation, inherent difficulties persist
  - Disparate visual / spatial fields
  - Attention-shift

(Nottmeier et al. J Neurosurg Sci 2012, Rahmathulla et al. Neurosurg Focus 2014)



- AR technology builds upon current spinal navigation to reduce ergonomic and efficiency challenges

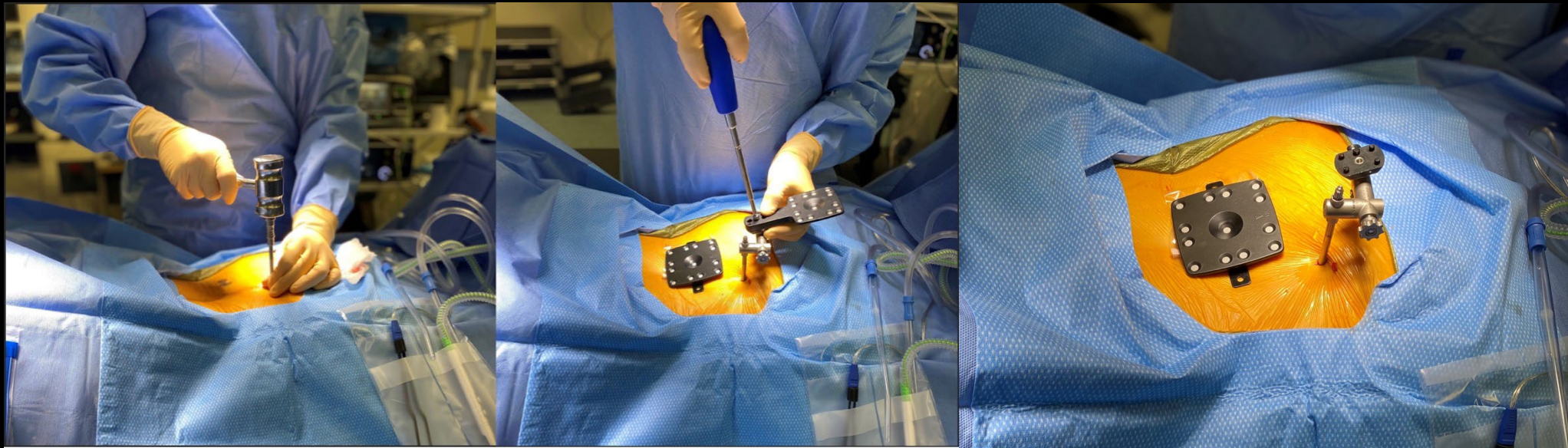


# AR in Spine Surgery

- Our study aims:
  - To radiographically analyze pedicle screws placed using AR technology
  - To report safety, accuracy, and potential for optimized workflow
- Methods:
  - Single surgeon at a single institutions (Dec 2020 – Dec 2021)
  - All patients underwent post-operative CT scan

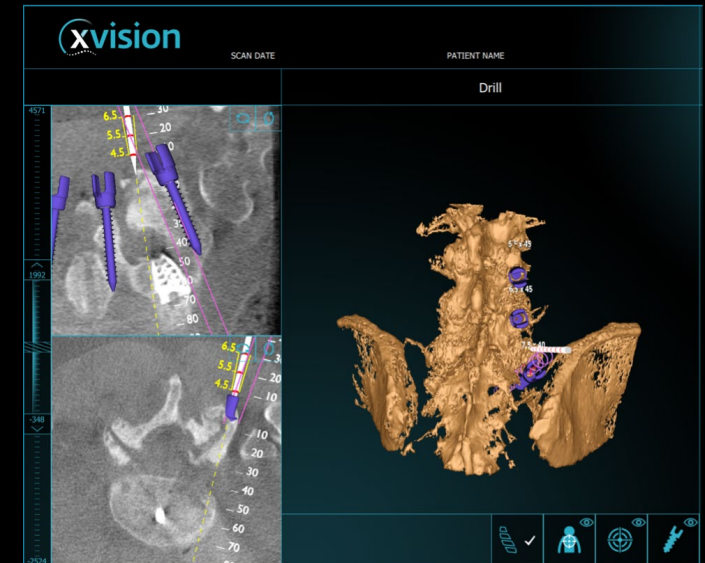
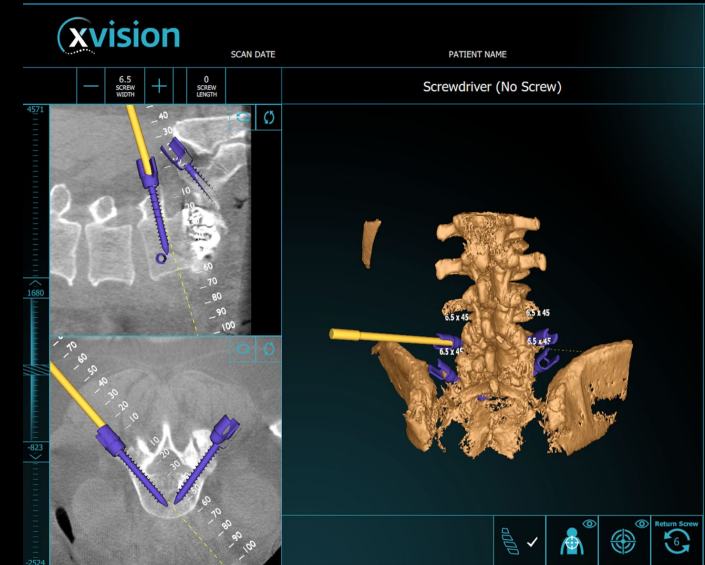
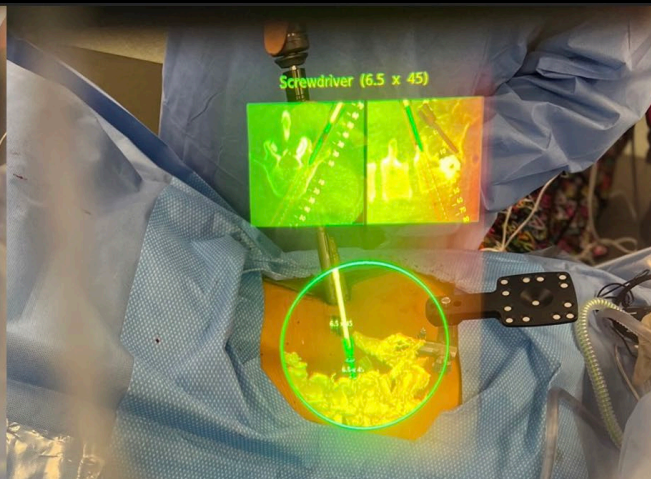
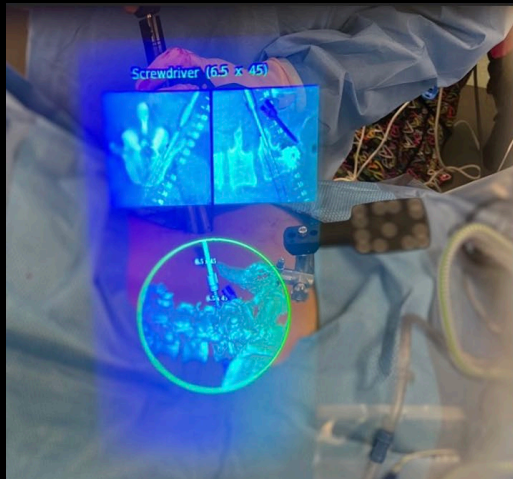
# Surgical Workflow

- Two reference arrays
  - Temporary array (sticker): overlying the planned surgical field
  - Permanent array (PSIS pin): direct palpation vs. fluoroscopy
- Intra-op 3D imaging
  - 3D/CT vs. 2D/flouro-based device
  - Integrated to surgeon's wireless headset





# Surgical Workflow

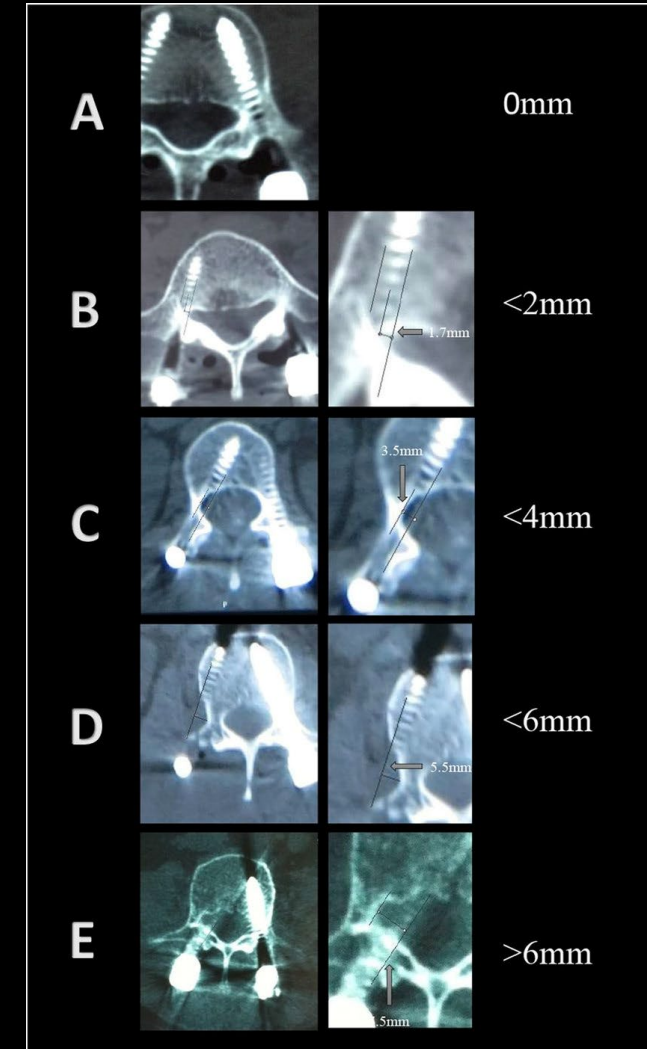


# Results

- 10 cases : 67 pedicle screws
- No intra-op revision or post-op hardware complication
- Gertzbein-Robbins Grade
  - A: 89.5%
  - B: 9.0%
  - C: 1.5%
  - D: 0.0%
- Complete intrapedicular screw placement: (GR A+B) = **98.5%**

Degenerative	6 (60.0%)
Deformity	2 (20.0%)
Tumor	2 (20.0%)

Thoracic	16 (23.9%)
Lumbar	51 (76.1%)



# Future Direction

- Applications of AR for progressing surgical technique and efficiency are rapidly developing.
- The radiographic characteristics of initial pedicle screws placed using a novel AR system indicate promising potential for a high standard of accuracy and efficiency.