A Systematic Review of the Cadaveric Studies Utilizing Augmented Reality in Pedicle Screw Placement (#84)

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Disclosures

Adam Strigenz: Nothing to disclose

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Introduction

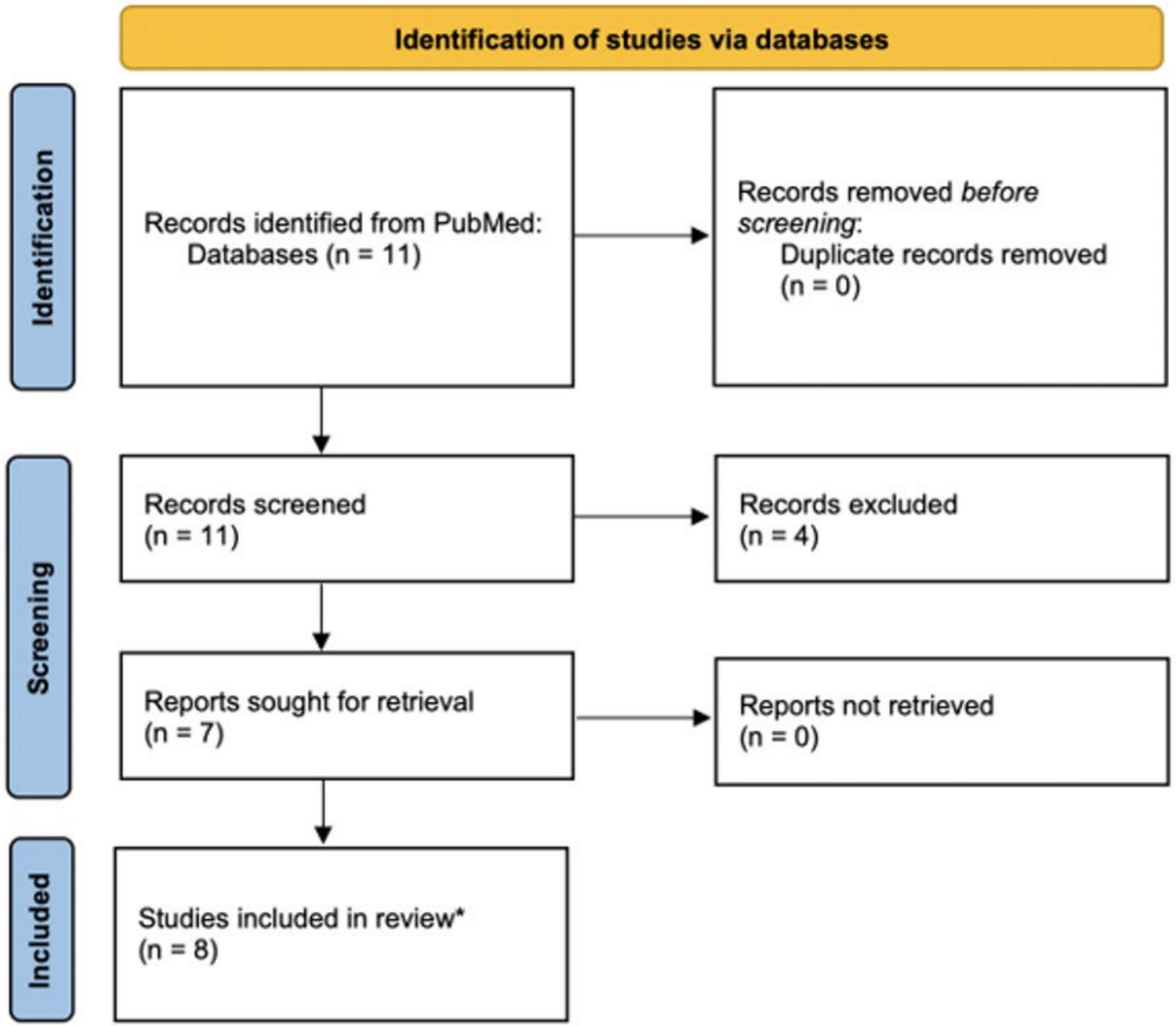
- Spinal procedures often employ **real time imaging techniques** to ensure accurate implant placement.
- **Augmented Reality (AR)** is a burgeoning technology with a wide range of applications.
- In surgery, AR is a novel system that allows for **superimposed visual information** directly onto the body
- The efficacy of AR in pedicle screw placement has been examined in **cadaveric studies**.
- Our objective is to **review current literature** that assesses the accuracy, utility, and limitations of AR in cadaveric spinal procedures.

Methods

- This systematic review was performed using **PRISMA** (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines
- The search terms consisted of “**augmented reality**” “**pedicle screw**” “**cadaver**”
- Studies that utilized AR in **pedicle screw placement** using a **human cadaveric study** design were included.
- Studies that utilized AR for other purposes or in non-human cadaveric studies were **excluded**.
- The **technical accuracy** of pedicle screw placement using AR as compared to the current standards was examined.

Results

- **11 results** were returned from the initial search.
- **7** of these fitting **inclusion criteria**. An additional **landmark article** was added for review.
- **3** of the articles were **excluded** as they failed to meet inclusion criteria.



Results

- When compared to current **image-guided** techniques (n=3), AR's accuracy **yielded mixed results.**
- When compared to **freehand techniques** (n=2), there was **greater accuracy** in the AR screw placements compared to freehand placements.
- When compared to **preplanned trajectories** (n = 3), AR screw placements were deemed clinically accurate when deviation from preoperative paths was assessed.

Table 1. Studies describing the use of augmented reality in orthopedic spinal procedures

Study	Study Type	Instrumented Spine	Outcomes	GRADE quality of evidence
Müller et al. (2020) (17)	Cadaveric Laboratory Study	Lumbar	No significant difference in accuracy between pedicle screw placement with AR and Pose Tracking system.	Low
Urakov et al. (2019) (18)	Cadaveric Laboratory Study	Thoracic, lumbosacral	7/19 AR screws were completely out of the pedicle.	Low
Peh et al. (2020) (10)	Cadaveric Laboratory Study	Thoracic, lumbar	AR demonstrated to be as accurate as intraoperative fluoroscopy.	Moderate
Elmi-Terander et al. (2018) (21)	Cadaveric Laboratory Study	Thoracic, lumbar	Screw placement directed by AR is accurate and efficient without fluoroscopy or X-ray imaging.	Low
Spirig et al. (2021) (22)	Cadaveric Laboratory Study	Lumbar	Improved angular precision in AR as opposed to freehand technique.	Low
Burström et al. (2020) (23)	Cadaveric Laboratory Study	Thoracic, lumbosacral	Robotic guidance system integrated with AR has 100% clinical accuracy in pedicle screw placement.	Moderate
Elmi-Terander et al. (2016) (24)	Cadaveric Laboratory Study	Thoracic	AR demonstrated higher accuracy than free-hand technique for thoracic pedicle screw placement.	Moderate
Molina et al. (2019) (25)	Cadaveric Laboratory Study	Thoracic, Lumbar	AR pedicle screw insertion accuracy was non-inferior to computer-navigation insertion and superior to freehand insertion.	Moderate

Discussion / Conclusions:

- The technical accuracy of pedicle screw placement using AR is *significantly more accurate* compared to placement using **freehand technique** and *“clinically accurate”* when compared against **preplanned screw trajectories**
- Accuracy compared to the screws guided with **current image-guided modalities** yielded ***mixed results***.
- Potential benefits of AR include the reduced need for radiation. Technical limitations exist in registration concerns and imperfect headset ergonomics. More research should further assess clinical accuracy and to address limitations noted.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Thank you!