

# PLANET OF THE ROBOTS?

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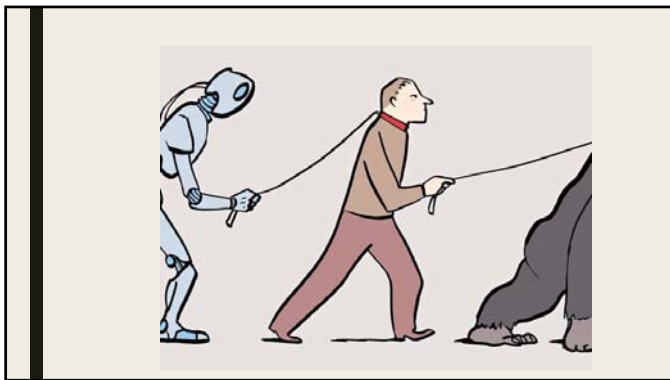
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## Questions we need to ask

- What problem are we trying to solve?
- How will this improve our efficiency?
- Can we improve our outcomes?
- What can robotics do that we can't?
- At what cost

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### What do robotics provide that we can't?

- Multiple studies to show no significant advantage over freehand pedicle screw placement
- At the expense of added cost burden to the patient and hospital



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### Cost of Admission

- Mazor X average cost - \$789,000 including the robot, workstation, instrument tray and one year tech support with \$1,200 worth of disposables per case
- Cannulated Screws
  - Cost on average 250 dollars more than non-cannulated screws
  - One level case can add 1000 dollars by this means alone

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### Cost of Admission

- OR time
  - Average cost per minute ~65 dollars
- Pre-operative CT scan
  - Added cost for routine degenerative cases that would not be part of the protocol otherwise
- No good data on cost effectiveness of robotic pedicle screw instrumentation

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### Lack of evidence

- Lack of evidence of improved clinical outcomes or decreased costs

**Robot-assisted and fluoroscopy-guided pedicle screw placement: a systematic review**

Hani J. Marcus · Thomas P. Cundy · Dipankar Nandi · Guang-Zhong Yang · Ara Darzi

**METHODS:** The Cochrane Central Register of Controlled Trials, PubMed, and EMBASE databases were searched between January 2006 and January 2013 to identify relevant publications that (1) featured placement of pedicle screws, (2) compared robot-assisted and fluoroscopy-guided surgery, (3) assessed outcome in terms of pedicle screw position, and (4) present sufficient data in each arm to enable meaningful comparison (>10 pedicle screws in each study group).

**RESULTS:** A total of 246 articles were retrieved, of which 5 articles met inclusion criteria, collectively reporting placement of 1,308 pedicle screws (729 robot-assisted, 579 fluoroscopy-guided). The findings of these studies are mixed, with limited higher level of evidence data favoring fluoroscopy-guided procedures, and remaining comparative studies supporting robot-assisted pedicle screw placement.

**CONCLUSIONS:** There is insufficient evidence to unequivocally recommend one surgical technique over the other. Given the high cost of robotic systems, and the high risk of spinal surgery, further high quality studies are required to address unresolved clinical equipoise in this field.

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### What are we improving on?

Spine (Phila Pa 1976). 2018 Apr 18. doi: 10.1097/BRS.0000000000002696. [Epub ahead of print]

**The Arrival of Robotics in Spine Surgery: A Review of the Literature.**

Ghasem A<sup>1</sup>, Sharma A<sup>2</sup>, Graf DN<sup>3</sup>, Alam M<sup>1,2</sup>, Maish MA<sup>2</sup>.

- **Radiation Exposure**
  - Onen et al. looked at robotic assistance in the case of 27 surgeries, both open and percutaneous, and found a mean RET of 1.3 seconds/screw with no significant differences between open and percutaneous robotic surgery

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### Operative Time

Neurosurgery. 2013 Jan;72 Suppl 1:12-6. doi: 10.1227/NEU.0b013e318270402c.

**Spinal robotics: current applications and future perspectives.**

Rosset F<sup>1</sup>, Tataroglu M, Maier G.

- 3-arm approach and recorded
  - **111.2 minutes per freehand operation**
  - **160.8 minutes per navigation-assisted surgery**
  - **140.8 minutes per robot-assisted surgery**

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## Operative Time

Eur Spine J. 2016 Mar;25(3):947-55. doi: 10.1007/s00586-015-3759-8. Epub 2015 Jan 10.

### Robot-assisted spine surgery: feasibility study through a prospective case-matched analysis.

Lonjon N<sup>1,2</sup>, Chan-Seng E<sup>2</sup>, Costalat V<sup>2</sup>, Bonnatoux B<sup>2</sup>, Vassal M<sup>2</sup>, Bissetto J<sup>2</sup>.

- 20 Patients were operated on successively by the same surgeon using robotic assistance (ROSA™, Medtech) (Rosa group 10 patients, n = 40 screws) or by the freehand conventional technique (Freehand group 10 patients, n = 50 screws)
- looked at using both open techniques and ROSA-guided robotic assistance; robot-guided procedures took **nearly 2 hours longer than freehand ones**
- 336 minutes compared to 209 minutes of total operative time.

## Length of Stay

Int J Med Robot. 2017 Sep;13(3). doi: 10.1002/roa.1779. Epub 2016 Sep 27.

### A prospective, randomized, controlled trial of robot-assisted vs freehand pedicle screw fixation in spine surgery.

Kim HJ<sup>1</sup>, Jung WJ<sup>1</sup>, Chang BS<sup>2</sup>, Lee CK<sup>2</sup>, Kang KT<sup>3</sup>, Yeom JS<sup>1</sup>.

- reported an average time to return to ambulation to be **39.7 hours for freehand procedures and 36.2 hours for Renaissance-assisted surgery**,  $p = 0.363$ . (Not Statistically Significant)

## Screw Malposition

Spine (Phila Pa 1976). 2012 Apr 15;37(8):E496-501. doi: 10.1097/BRS.0b013e3182467787.

### Accuracy of robot-assisted placement of lumbar and sacral pedicle screws: a prospective randomized comparison to conventional freehand screw implantation.

Ringel F<sup>1</sup>, Stuer G, Reinken A, Preuss A, Behr M, Auer F, Stoffel M, Meyer B.

**RESULTS:** A total of 298 pedicle screws were implanted in 90 patients (FH, 152; RO, 146). Ninety-three percent had good positions (A or B) in FH, and 85% in RO. Preparation time in the operating room (OR), overall OR time, and intraoperative radiation time were not different for both groups. Surgical time for screw placement was significantly shorter for FH (84 minutes) than for RO (95 minutes). Ten RO screws required an intraoperative conversion to the FH. One FH screw needed a secondary revision.

- The primary end point screw position was assessed by a postoperative computed tomography, and screw position was classified
  - (A: no cortical violation; B: cortical breach <2 mm; C: ≥2 mm to <4 mm; D: ≥4 mm to <6 mm; E: ≥6 mm)
  - Good position determined to be A or B
- 10 Robotic Screws were converted to Freehand
- Surgical time for screw placement was significantly shorter for FH (84 minutes) than for RO (95 minutes)

## Complications and Revisions

Spine (Phila Pa 1976). 2010 Nov 15;35(24):2109-15. doi: 10.1097/BRS.0b013e3181e323ab.

### Clinical acceptance and accuracy assessment of spinal implants guided with SpineAssist surgical robot: retrospective study.

Devito DE<sup>1</sup>, Kaplan L, Dieff B, Pfeiffer M, Horne D, Silberstein B, Harderbrook M, Kiriyanthan G, Barzilay Y, Bruekin A, Sackner D, Alexandrovsky V, Silber C, Burger R, Meurer J, Donald GD, Schoenmayer R, Friedlander A, Knoller N, Schmieder K, Pochilvanis J, Kim IS, Meyer B, Shoham M.

- reversible neurological complications in 4 of 593 (0.7%) cases using SpineAssist for pedicle screw instrumentation
- Freehand procedures had higher rates of dural tears (four compared to one) when compared to robot groups ( $p = 0.142$ )
  - Not statistically significant

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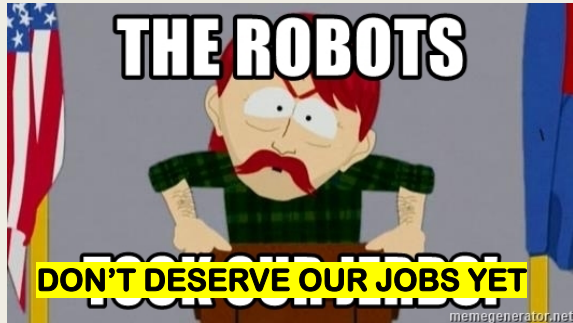
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