CNS 2018 ANNUAL MEETING
HOUSTON, TEXAS
OCTOBER 6–10, 2018

Robotics Workflow with New Robotic Guidance System for Percutaneous Screws: Review of Institutional Experience

Jakub Godzik MD MSc; Corey Tyler Walker MD; Clinton David Morgan MD; Steve W. Chang MD; Randall W. Porter MD; Juan S. Uribe MD; Nicholas Theodore MD, FACS; Laura A. Snyder MD

BARROW Neurological Institute

Introduction

Minimally-invasive (MIS) approaches to the anterior column such as lateral (LLIF) frequently require percutaneous screw fixation to achieve circumferential instrumentation. Robotic guidance represents a new technology for augmenting the surgical workflow to improve screw placement accuracy and decreasing the ionizing radiation exposure to the surgical team. Here we report our initial experience with robotically assisted percutaneous screw placement and review our surgical workflow.

Methods

Consecutive patients undergoing single level LLIF with robotically assisted percutaneous pedicle screw fixation (PSF) in prone or lateral decubitus position (Fig 1) were identified. A novel CT-guided robotic guidance arm was used for screw placement (ExcelsiusGPS) in combination with the O-Arm (Medtronic). Demographic data, surgical timing, and perioperative complications were collected. Screw accuracy was determined with routine post-operative CT; breach was defined as violation of lateral or medial pedicle wall.

Results

We identified 11 patients who underwent robotically assisted PSF; robotic placement of screws was aborted in one surgery due to challenging anatomy. Mean age was 63.1±12.5, 50% were female, with mean BMI 31.4±5.5. Most common pathology was L4-5 spondylolisthesis (8/10, 80%). Mean surgical time for PSF was 183±51 minutes, with a decrease over six months (r=-0.49, p=0.15). A total of 40 screws were successfully placed (40/44, 90.1%), primarily in the prone position (9/10, 90%). One pedicle breach was observed on postoperative CT (1/40, 2.5%), with no associated CSF leak or neurological deficit. Mean length of stay following surgery was 51.1±34.2 hours. Two complications occurred (2/10, 20%) in the perioperative period.

Conclusions

Robotic guidance provides for accurate percutaneous PSF in the majority of cases. Nonetheless, the technology still represents an early phase of development, with a steep learning curve that trends towards improved surgical times with subsequent use. Future studies are needed to demonstrate the utility of this novel guidance system and continued improvement in workflow.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) identify the two different positioning options for robotically assisted percutaneous screw placement; 2) describe the surgical workflow of a robotic system; 3) list the limitations of robotic screw placement and key aspects of surgical anatomy that dictate feasibility

References

T. Fujishiro et al., Accuracy of Pedicle Screw Placement with Robotic Guidance System: A Cadaveric Study. Spine 40, 1882 (Dec, 2015).

2.P. A. Laudato, K. Pierzchala, C. Schizas, Pedicle Screw Insertion Accuracy Using O-Arm, Robotic Guidance, or Freehand Technique: A Comparative Study. Spine 43, E373 (Mar 15, 2018).

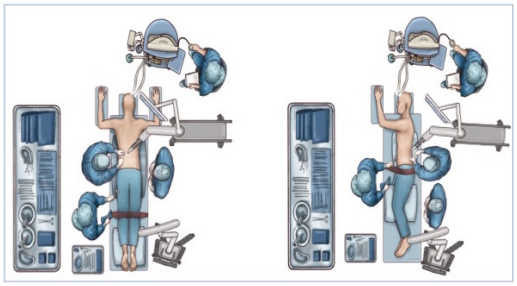
3.S. C. Overley, S. K. Cho, A. I. Mehta, P. M. Arnold, Navigation and Robotics in Spinal Surgery: Where Are We Now? Neurosurgery 80, S86 (Mar 1, 2017).

4.T. M. Urakov, K. H. Chang, S. S. Burks, M. Y. Wang, Initial academic experience and learning curve with robotic spine instrumentation. Neurosurgical focus 42, E4 (May, 2017).

5.I. H. Lieberman, M. A. Hardenbrook, J. C. Wang, R. D. Guyer, Assessment of pedicle screw placement accuracy, procedure time, and radiation exposure using a miniature robotic guidance system. Journal of spinal disorders & techniques 25, 241 (Jul, 2012).

6.N. Keric et al., Evaluation of robot-guided minimally invasive implantation of 2067 pedicle screws. Neurosurgical focus 42, E11 (May, 2017).

Patient Positioning and Operating Room Set-up



Standard prone positioning (Left) and alternate single position lateral (Right) for percutaneous screw placement.

Improvement in Surgical Time Across Subsequent Cases