Robotic Guidance for the Insertion of Posterior Pedicle Screws: 2-Dimensional Operative Video

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Recent years have shown an increase in implementing robotics in surgical procedures. Utilizing robotic technology in spine surgery remains limited in comparison to other surgical fields. We present a surgical video of minimally invasive robotic-assisted insertion of posterior pedicle screws using the newest generation robotic technology (Mazor X, Mazor Robotics Ltd, Caesarea, Israel), in a 29-yr-old man who suffers from Grade I degenerative spondylolisthesis at L5-S1 levels and severe, right-sided foraminal stenosis. The plan was to perform anterior fusion at L5-S1 using robotic guidance with posterior pedicle screw supplementation due to his extensive smoking history. This technology has two distinct registration methods: (1) using a preoperative thin-cut computed tomography (CT) scan to create a surgical plan for screw placement; and (2) scan-and-plan using intraoperative 3-dimensional (3D) imaging to create a plan in real-time intraoperatively. We present the scan-and-plan technique.

The widely used freehand technique allows the surgeon to manually direct tools and implants relying on the 6-degrees-of-freedom of the human arm. When Mazor X robotic technology is utilized, a pilot hole is drilled through a cannula docked to the bone above the entry point, which provides the surgeon with a planned trajectory and eliminates 4 of 6-degrees-of-freedom (up/down and yaw remain). This provides increased multidimensional control and reduces reliance on hand-eye coordination with simultaneous concentration on the imaging, potentially leading to increased rates of accuracy and reduction in severe complications of misplaced screws. Further prospective clinical studies are needed to determine the long-term effectiveness of this technology.

Patient consent was obtained prior to performing the procedure. Institutional board review approval is not required for the report of a single case at the University at Buffalo.

KEYWORDS: Lumbar spine, Mazor X, Percutaneous pedicle screws, Robotic-guidance, Spinal stabilization

Operative Neurosurgery 0:1–2, 2018
DOI:10.1093/ons/opy246
Received, March 31, 2018. Accepted, July 27, 2018.

Disclosures
Dr Pollina is involved in surgical training with Medtronic/Nuvasive. The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

COMMENT
In this case, the authors present a surgical video illustrating minimally invasive robotic posterior pedicle screw placement using the Mazor X system in a 29-year-old, male smoker, with Grade I L5-S1 spondylolisthesis and right-sided foraminal stenosis. The patient underwent anterior lumbar fusion and additional posterior fixation. No intraoperative complications were observed. The Mazor X robot uses 2 methods for registration: either using a preoperative thin-cut CT scan or a scan-and-plan method using intraoperative 3-dimensional (3D) imaging to create a real-time surgical plan intraoperatively, with the latter technique utilized for this case and screw planning taking approximately 5 minutes. Although there have been a number of publications on the legacy technology, there is have
been fewer on the Mazor X. The video provides a clear illustration of registration, screw planning, and placement using this robot. Postoperative radiographs demonstrate the screws in good position. With robotic surgery being increasingly utilized in surgical centers across the world, this makes a notable contribution especially for providers considering acquiring a robotic system for their respective practices.

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