Navigated Robotic Spine Surgery: A One-Year Prospective Multicenter Analysis of Complications and Revision Rates in 787 Thoracolumbar Fusions

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[1]Research

INTRODUCTION:
The merging of computerized preoperative planning, robotic guidance, and real-time 3-dimensional navigation into one advanced enabling technology has the potential to optimize screw placement and improve surgical outcomes in thoracolumbar fusions. In the Prospective Robotic-Guided Registry of Spine Surgery (PRoGRSS), real-world outcomes were tracked for cases using an integrated robotic-assisted navigation system for spine surgery. The purpose of this study is to determine surgical complication and revision surgery rates at 12 months following thoracolumbar surgery using an advanced robotic-assisted navigation platform.
METHODS:
In this prospective multicenter cohort study**,** PRoGRSS includes adults undergoing navigated robotic thoracolumbar surgery from 2020-2024. Cases were prospectively enrolled by 7 surgeons at 4 distinct centers spanning 3 US regions. Each surgeon's prior experience using navigation and robotics was advanced. Surgical complications and revision surgeries were collected to 12 months and reported as proportions.
RESULTS:
Of 787 distinct surgeries, the average age was 60 years, 52.2% were female, the mean BMI was 29.8 kg/m^2, 86.7% had CCI<2, and the most common primary diagnosis was spondylolisthesis (40%). There were 2,758 instrumented levels and 5,166 executed screws. Cases were 50.9% staged and 49.1% single day, with 16.1% revision cases. Screw placement was 50.2% percutaneous and 49.8% midline open approach, with 19.1% having pelvic fixation, 52.3% having decompression, 68.9% pedicle screws, and 30.9% cortical screws. Intraoperatively, 96.8% had no adverse events. None of the 3.2% intraoperative adverse events (2.3% durotomy, 0.5% vascular injury, 0.3% loss of motor signals, and 0.1% small pneumothorax) were robot related. Cumulatively, 8.8% had surgical complications (0.2% were robot related) and 2.8% underwent a revision surgery up to 12 months.
DISCUSSION AND CONCLUSION:
This study demonstrates that experienced users of an integrated navigation and robotic spine platform achieve low complication and revision surgery rates for thoracolumbar spine surgery. Our real-world data found 3.2% intraoperative adverse events (0% robot related), 8.8% postoperative surgical complications (0.2% robot related), and 2.8% revision surgeries up to 12 months. By improving implant accuracy and spinal alignment with computerized planning and navigated robotic guidance, thoracolumbar fusion patients have the potential to achieve successful outcomes.