Clinical: Navigation, Image Guided Surgery and Robotic Assistance

Percutaneous Pedicle Screw Placement Using Intra-operative CT Navigation Is Safe and Accurate

E.R.G. Santos¹, J.N. Sembrano¹, A.N. Larson¹, C.G. Ledonio¹, D.W. Polly¹

¹University of Minnesota, Orthopaedics, Minneapolis, MN, United States

Purpose: Pedicle screws are widely used in the treatment of various spine disorders. Intra-operative CT-guided navigation systems are available which facilitate percutaneous pedicle screw placement. This study reports the accuracy of percutaneous pedicle screw insertion using an intra-operative CT-guided navigation system, and compares accuracy rates to previous reports.

Methods: Between August 2008 and September 2010, 33 patients underwent percutaneous pedicle screw fixation for the treatment of various spinal disorders. Intraoperative CT was performed to generate images that were used for navigation. A navigated Jamshidi needle was used to cannulate the pedicles. Intra-operative CT scans were performed after placement of the K-wires. Cannulated screws were then placed after demonstration of good position of the K-wire within the pedicle on CT images. K-wire revision and screw revision rates were determined as the primary measures in this study.

Results: Mean patient age was 53.5 years (range 13 to 87 years). There were 10 male and 23 female patients. Underlying diagnoses included degenerative disc disease (24), spinal stenosis (8), spondylolisthesis (7), degenerative scoliosis (2) and pseudoarthrosis (2). A total of 166 pedicle screws were placed using real-time navigation, with a mean of 5 screws per patient (range 2 to 12). Following K-wire placement, a CT was obtained intraoperatively. 9 K-wires (5.4 %) were revised intraoperatively due to suboptimal position. In 8 cases, the K-wire was successfully redirected, and in 1 case, the K-wire was removed. None of the screws were revised after insertion for a 0% screw revision rate. At latest follow-up, no patients had returned to the OR due to screw malposition. There were no major neurovascular complications.

Conclusion: We found a 95 % accuracy for navigated K-wire placement, and 100% accuracy in percutaneous pedicle screw placement using an image-based navigation system. This is more accurate than the 95% accuracy rate for image-guided insertion from a previous meta-analysis (Kosmopoulos, 2007). Using CT-imaging, malpositioned K-wires were identified prior to screw insertion, and were either removed or redirected. Percutaneous pedicle screw placement in using CT navigation resulted in no identified complications and is a promising technique for improving the safety of pedicle screw placement. Screw accuracy was comparable to other techniques.