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# Commentary: Sacroiliac Joint Fusion Using Robotic Navigation: Technical Note and Case Series

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The authors of this article[1] present a retrospective series of 10 patients undergoing lateral minimally invasive sacroiliac (SI) joint fusion with robotic assistance for SI joint disease.[1] This article is the first of its kind to describe a percutaneous robotic-assisted approach to a lateral SI joint fusion surgery. As robotic-assisted approaches to the lumbar spine have proven to increase the accuracy of pedicle screw placement, the increase in safety can certainly be applied to SI joint fusion surgery. Although extensive research has demonstrated that these techniques can reduce operative times, blood loss, and complication rate,[2,3] it is still uncertain whether this concept applies to the lateral approach to the SI joint. In a technical report by Piche et al[4] describing the technique for percutaneous SI joint fusion under robotic guidance, there is mention of improved operative times, blood loss, and even patient outcomes; however, this was not supported by statistical data because this was not the purpose of this article. Under standard fluoroscopy, an experienced surgeon can perform a successful surgery with minimal blood loss and exceptionally short operating room (OR) times. We have seen OR efficiency improve with robotic assistance, particularly in large deformity cases; however, this relatively short surgery can anecdotally be performed with minimal OR time or blood loss barring any intraoperative complications. As the authors have shown, successful SI joint fusions with robotic assistance can be performed efficiently in <1 hour.

One pitfall that can be encountered during fluoroscopy-guided lateral SI joint screw placement is the misalignment of screws that may collide or cause injury to traversing vessels and sacral neural foramen.[5] The authors of this study note mitigating this risk by taking advantage of the proprietary software on the robotic navigation system. Preplanning screw soft-tissue paths and bony trajectories does help to reduce the risk of complications limited by fluoroscopy such as a patient's sacral dysmorphism, anatomy, or body habitus.[6] To register the navigation system, the authors merge true A/P and lateral hip x-rays with a preoperative computed tomography (CT) scan loaded onto the robotic navigation system to begin planning the approach. This in turn prevents initial screw misplacement as well as reduces long-term need for revision surgery.[7,8] A cadaveric study by Vaccaro et al[3] reveals that robotic-assisted minimally invasive surgery allows for larger pedicle screws with a reduced rate of spinous process breach, which supports the authors' requirement of a larger bore drill bit for the insertion of pedicle screws over the traditional rounded drill bit.

Although the article discussed does minimize the surgical staff to radiation exposure, it is noted that the radiation from preoperative CT scans can pose some risk to patients. A study by Slomczykowski et al[9] evaluating the effect of pedicle screw placement with fluoroscopy vs CT-assisted techniques noted safer radiation doses to patients when using spiral/helical CT protocols.

Considering operative time and radiation exposure, the use of intraoperative fluoroscopy may still obviate the use of robotic assistance in SI joint fusion surgery. A recent systematic review and meta-analysis evaluating the accuracy of pedicle screw placement with 3 image-guided systems by Du et al[10] demonstrated improved accuracy with three-dimensional (3D) FluoroNav systems compared with CT-guided and two-dimensional fluoroscopic-navigated systems, which coincides with previous literature that also reports lower radiation exposure with 3D-assisted navigation systems.[11]

Furthermore, even after the patient obtains a preoperative CT scan, confirmation with true anterior-posterior, lateral x-rays and perhaps pelvic inlet/outlet images would still need to be obtained intraoperatively to assess the screw placement. The additional advantage of reproducible and reliable accuracy certainly improves confidence intraoperatively. However, as the authors mention, there are no comparison groups to advocate for or against traditional fluoroscopy which could decrease operative time with improved patient outcomes. Moreover, required preplanning and realignment during surgery may theoretically prolong operative time and diminish overall OR efficiency, as mentioned by the authors of this study. This is compounded by the often bulky and cumbersome design of contemporary robotic systems that may limit operative maneuvering, again highlighting the need for comprehensive studies comparing the 2 surgical approaches to provide objective data on total operative times. Similarly, cost considerations of robotic navigation systems are also of paramount concern for healthcare institutions, especially given the wide range of prices and high annual maintenance fees for current generation systems, not including the necessary recruitment of skilled operators and fluoroscopic technologists.[12,13] However, studies have shown long-term cost-effectiveness compared with traditional spinal surgery without robotic assistance, with the study by Menger et al[14] reporting cost savings of $608 546, in part due to reduced operative times and length of stay, and fewer postoperative complications over a 1-year period. It should be noted that robotic-assisted visualization systems have inherent differences in design, such as the use of K-wires or variable frame fixation to either the bed mount or directly onto the spinous processes, among other aspects.[3] A degree of standardization or comparative analysis would aid in differentiating robotic systems by utility.

Ultimately, robotic-assisted approaches to treatment of SI joint disease may pair well with cost-reductive strategies and deliver high-quality care with minimal surgical failure rates, but further research is needed to establish superior clinical benefit over conventional methods. We congratulate the authors on their contribution to the literature.

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