S2 Alar-Iliac Screw Insertion Safety with Augmented Reality-Assisted Surgical Navigation

Maximillian Young-Kyu Lee¹, Hania Shahzad², Nazihah S Bhatti², Alexandra Nicole Sheldon, Varun Kumar Singh, Richard Lee Price, Frank M Phillips³, Safdar Nasim Khan⁴

¹The Ohio State University College of Medicine, ²The Ohio State University, ³Rush University Medical Center, ⁴UC Davis Health

INTRODUCTION: The insertion of sacral-alar-iliac (S2AI) screws is a crucial yet technically challenging component of lumbo-pelvic fixation procedures, often complicated by the anatomy of the lumbosacral junction. Traditional navigation methods, such as 2D fluoroscopy or 3D computed tomography (CT)-based systems, while effective, are costly and time-consuming. Robotic and percutaneous techniques also offer precision but require extensive infrastructure investments. Emerging augmented reality (AR) technology provides a promising alternative, overlaying holographic navigation information directly onto the surgical field with minimal infrastructure requirements. This study aims to evaluate the safety and accuracy of S2AI screw placement using AR-assisted surgical navigation, contributing preliminary data to the growing body of evidence supporting this innovative approach.

METHODS: Following Institutional Review Board approval, data was retrieved for all patients who underwent ARnavigated surgeries with screws placed in the S2AI corridor from November 2022 through June 2023. Patient information, including age, gender, body mass index (BMI), screw length, and screw diameter, was recorded through chart review. Post-operative CT scans in the transverse plane were utilized to assess S2AI screw safety by evaluating for complete sacroiliac (SI) joint penetration and lateral and medial breaches of the pelvis. Anterior-posterior (AP) view radiographs were also analyzed for complete penetration of the SI joint and for greater sciatic notch breaches.

RESULTS: We analyzed 54 screws in 27 patients, of which 13 were female and 14 were male. The median age was 69 years old, and the median BMI was 32.3. Twenty-seven screws were placed in each side of the pelvis, right and left. All 54 screws completely penetrated the SI joint on both the transverse view on CT scan and the AP view on radiograph. The results also demonstrated exceptional safety—zero screws breached the pelvis or the greater sciatic notch.

DISCUSSION AND CONCLUSION: AR-assisted navigation in S2AI screw placement is extremely promising. The evidence suggests that integration into standard care would be very safe. Future studies should be aimed at assessing broader clinical and patient-related outcomes.