

**Safe Zone Quantification of the Third Sacral Segment in Normal and Dysmorphic Sacra***John S. Hwang; Mohamad Kareem Shaath; Mark Cameron Reilly; Stuart Changoor;**Michael S. Sirkin; Jonathan G. Eastman; Milton L. Routt, MD<sup>1</sup>; Mark R. Adams**<sup>1</sup>University of Texas, Houston, Texas, USA*

**Purpose:** The purpose of this study was to radiographically quantify the osseous limits of the third sacral segment in patients with sacral dysmorphism and assess the potential for placement of an iliosacral screw in this segment.

**Methods:** A retrospective evaluation of a trauma database was performed. Inclusion criteria consisted of patients above the age of 18 years and had both pelvic radiographs and CT scans. A single investigator evaluated each patient's imaging, classifying them as having a normal or dysmorphic sacrum based on the criteria described by Routt. A second orthopaedic trauma fellowship-trained investigator, blinded to the classification of the sacra, analyzed each CT scan included in the study. The first measurement taken was the cross-sectional area of each safe zone. On both the true coronal and axial views, the angle of a screw that was parallel to the safe zone axis was measured relative to the horizontal. A safe zone diameter of 10 mm and 9 mm were used as the critical threshold as this would be a limit considered difficult by most surgeons using a 6.5-mm to 8.0-mm cannulated iliosacral screw.

**Results:** 30 patients (51%) were classified into the dysmorphic group. In the normal group, the average S3 coronal transverse width, replicating the outlet view, was measured to be 7.71 mm compared to 9.49 in the dysmorphic group ( $P < 0.05$ ). The mean S3 axial transverse width in the normal group was 7.11 mm, as compared to 9.14 mm in the dysmorphic group ( $P < 0.05$ ). 23 patients in the dysmorphic group could have a screw passing through the ilium, while only 12 patients could have the same in the normal group ( $P < 0.05$ ). The mean S3 cross-sectional area of the normal group was 55.8 mm, as compared to 77.9 mm in the dysmorphic group ( $P < 0.05$ ). Based on the aforementioned measurements, it was found that when using a safe zone threshold of 10 mm and available ilium, an S3 iliosacral screw could be placed in 7% of normal sacra and 14% of dysmorphic sacra. Using a safe zone threshold of 9 mm, an S3 iliosacral screw could be placed in 10% of normal sacra and 43% of dysmorphic sacra.

**Conclusion:** Our study demonstrated that the third sacral segment of dysmorphic sacra have a larger osseous pathway available to safely accommodate a sacroiliac screw when compared to those of normal sacra. Although there is sufficient area for an S3 screw to be placed in about half of dysmorphic sacra, surgeons should use their discretion and closely examine radiographs and CT scans prior to insertion of an S3 screw, since the diameter of the corridor is significantly smaller than those of S1 and S2 segments.