Iliosacral Screw Pathways in the Pediatric Population: Are There Safe Bony Corridors?

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Purpose: Bony corridors for safe iliosacral screw placement in the first (S1) and second (S2) sacral segments are commonly used to place screws with diameters of 6.5 mm and greater in the adult pelvic ring. Data regarding the size of these corridors in pediatric patients are limited to case reports. We hypothesize that bony corridors for 6.5 mm diameter screws in the S1 and S2 segments will be less common in patients aged 2 to 10 years when compared to patients aged 10 to 16.

Methods: After obtaining IRB approval, our digital imaging archive was retrospectively searched for all patients between ages 2 and 16 years who underwent a CT scan including the pelvis from January 1, 2013 to February 12, 2013. The only exclusion criterion was incomplete imaging of the pelvic ring. A total of 175 patients were identified, with 91 males and 84 females. Average age was 10.7 years (SD = 3.9). CT images were transferred to TeraRecon (Foster City, CA) thin client 3D platform. Corrected axial images were created that were perpendicular to the plane of the sacrum centered at S1 and S2 corridors. Two representative images were transferred back to Centricity picture archiving and communication system (PACS) (GE Healthcare, Waukesha, WI): one of the S1 corridor and one of the S2 corridor. Three distances were defined in each hemipelvis. S1 reduction was defined as the shortest distance from anterior sacral cortex to the anterior border of the S1 nerve root tunnel that was perpendicular to the pathway of a sacroiliac or "reduction-type" screw. The S1 sacral corridor was defined as the shortest distance from the anterior border of the S1 foramen between a line connecting the anterior borders of the left and right S1 foramina and a line connecting the most posterior limits of the left and right anterior ilium or sacrum. The S2 corridor was defined as the shortest distance from the anterior border of the S2 foramen between a line connecting the anterior borders of the left and right S2 foramina and a line connecting the posterior borders of the S1 foramina. All measurements were independently made using PACS on a diagnostic quality monitor by three orthopaedic surgeons: a resident, a trauma fellow, and a trauma attending. Two means were compared using a paired Student *t*-test and proportions were compared using Fisher's exact test. Interobserver reliability was measured using the inter-rater reliability coefficient.

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Results:

Average Bony Corridor (in mm)				
	Ages 2-10 (n = 70)		Ages 10-16 (n = 105)	
Measurement	R	L	R	L
S1 Reduction	14.2	14.1	17.9	17.7
S1 Sacral	5.8	5.8	8.1	8.0
S2	8.6	8.6	9.8	9.7

The interrater reliability coefficient between the three surgeons was greater than 0.93 for all six measurements. Measurements for bilateral S1 reduction, bilateral S1 sacral, and bilateral S2 were significantly less for ages 2-10 than ages 10-16 (all $P < 0.003$). All 175 patients had bilateral S1 reduction measurements >6.5 mm. S1 sacral measurements >6.5 mm were significantly higher in the older group and present in 48% of patients ages 2-10 and 68% of patients ages 10-16 ($P = 0.04$). S2 measurements >6.5 mm were present in 92% of patients ages 2-10 and 94% of patients ages 10-16 with no significant difference ($P = 0.77$).

Conclusion: Contrary to our hypothesis, 100% of pediatric patients aged 2-16 had a screw pathway to accommodate a 6.5 mm diameter screw in the S1 corridor in a "reduction-type" vector, and more than 93% of all patients had pathways for a 6.5 mm diameter screw in the S2 corridor. S1 corridors in a "sacral" vector are much less predictable and are more likely to accommodate a 6.5-mm screw with older age.

See pages 99 - 147 for financial disclosure information.