Appendix: Supplementary information for the Methods section and the formulas used.

Calculation of rotation in sagittal and frontal planes

Determinaton of rotation in the sagittal and frontal planes from the lateral radiographs:

On the ventrodorsal (VD) and lateral (LAT) radiographs, the transverse processes are identified and the distances between the tips of these processes are determined: on the VD view this is directly measured ("A"); on the LAT view the distances are measured relative to the spinal canal orientation (parallel, "B" or perpendicular, "C"):

1. On the LAT radiograph, a line is drawn parallel to the spinal canal.
2. A second line is drawn perpendicular that intersects with the tips of the transverse processes of L7.
3. The distance between the tips of L7 is measured both parallel (A) and perpendicular (B) to the line parallel to the spinal canal.
4. On a VD radiograph, a line is drawn between the tips of the transverse processes of L7, which is parallel to the endplates of L7 (C).
5. These measurements, the craniocaudal distance between the transverse processes (degree of rotation in the sagittal plane), and the dorsoventral distance between the transverse processes (degree of rotation in the frontal plane) were then determined by the formulas \( \Theta = \sin^{-1}(B/A) \) and \( \alpha = \sin^{-1}(C/A) \), respectively, which are derived from two co-planar triangles with the same hypotenuse.

Determination of rotation in both the frontal and sagittal planes using the transverse processes of L7. (a) and (b) Schematic drawings illustrating landmarks used on the ventrodorsal and lateral radiographic views and demonstrating the method to determine rotation. (c) Co-planar right triangles with a common hypotenuse (A) illustrating the orientation in the schematic drawings. ( A = distance between the tips of the L7 transverse processes from the ventrodorsal radiographic view; B and C = craniocaudal and dorsoventral distances, respectively, between the tips of the L7 transverse processes from the lateral radiographic view. \( \Theta = \sin^{-1}(B/A) \), rotation in the sagittal plane; \( \alpha = \sin^{-1}(C/A) \), rotation in the frontal plane.)
Calculation of Reduction Index (RI)

Determination of Reduction Index (RI) on orthogonal radiographic views:

To determine the relative displacement of the affected ilial auricular surface, the intact ilium was first identified; the following steps were then performed:

1. The centre of the sacral body was identified as the midpoint on a line that bisected the sacral body in a craniocaudal direction on a LAT radiograph; this location was used purely as a reference point and is not equivalent to the described location for implant placement, which is immediately caudal to the notch in the sacral wing (9).
2. A line was drawn along the intact dorsal ilial Crest (DIC₁) and measured. A calibration marker was not required as the measurement is a ratio.
3. A perpendicular line, starting from the caudal-most point of DIC₁, was created along this length, until it intersected the centre of the sacral body.
4. The length of the perpendicular line from the center of the sacral body to DIC₁ was measured (Y₁); the corresponding arm of the perpendicular line was measured (X₁).
5. A line over the luxated dorsal ilial crest was drawn and measured (DIC₂).
6. X₂ and Y₂ were calculated, $X_2 = [(X_1/DIC_1) \times DIC_2]$ and $Y_2 = [(Y_1/DIC_1) \times DIC_2]$, these were relative ratios of $X_1$ and $Y_1$, and allowed the center of the sacrum to be identified on the affected side.
7. $X_2$ was marked along the caudal-most aspect along DIC₂.
8. $Y_2$ was drawn perpendicular to DIC₂, starting at $X_2$; the end of line $Y_2$ was thus an approximation of the centre of the sacral body position on the affected ilium.
9. The distance between the end of lines $Y_1$ (center of the sacral body) and $Y_2$ was measured. This displacement (D) was the amount of anatomical offset of the affected ilial wing.
10. Percent displacement (D%) of anatomical position offset was calculated, $D\% = D/DIC_2 \times 100$.
11. A reduction index was calculated, $RI = (D\%) \times (VD\% \text{ reduction})$.

Determination of reduction index (RI) using combined lateral (a) and ventrodorsal (b) radiographs. (a) Percent reduction is calculated on a ventrodorsal radiograph, $VD\% = A(\text{saical surface of ilium}) / B(\text{total length of sacral wing})$. (b) Displacement of the auricular surface is determined on the lateral radiograph: length of dorsal ilial crest of intact (DIC₁) and affected (DIC₂) ilia, distance to centre of sacral body on the intact (Y₁), the relative positions along the iliac crest that intersects the centre of the intact sacral body (X₁), $X_2 = [(X_1/DIC_1) \times DIC_2]$ and $Y_2 = [(Y_1/DIC_1) \times DIC_2]$, Displacement (D) of the luxated ilium. Percentage displacement (D%) = D/DIC₂. Reduction index (RI) = (VD%)*(D%). (Note that the second short screw was placed appropriately into the cranial sacral wing (see F in Figure 1 in article).}
For bilateral sacroiliac luxations, a reference ilial wing (i.e., anatomically positioned, stable) did not exist. As such, averages of DIC₁, X₁, and Y₁ were calculated from all unilateral luxations to establish an approximate norm. These averages then were used to facilitate measurements in the bilateral luxations, and determine the amount of displacement on each side from this norm. Specifically, a spreadsheet was created listing the averages of DIC₁, X₁, and Y₁; DIC₂ was measured and entered into the spreadsheet to calculate the relative ratios of X₂ and Y₂. These measurements could then be drawn on the radiograph using DIC₂, and D could be calculated as a displacement between the tip of Y₂ and the centre of the sacral body (equivalent to the tip of Y₁ in an intact ilial wing). RI could then be calculated using the formula above. This was repeated for the contralateral ilium.

Calculation of the SPI

**Determination of Screw Purchase Index (SPI) on orthogonal radiographic views:**

The percent screw length in the sacral body was calculated (screw length in sacral body/total length of screw) on postoperative LAT radiographs, the screw exiting the sacral body is identified (Z), and total screw length (S) and screw length in sacrum determined (S’ = S - Z), and percentage screw purchase calculated from the LAT radiograph [% screw purchase (lat) = S’/S]. The relative length of the screw outside the sacrum is drawn on the opposite ventrodorsal view [Z’ = (Z/S)*L]; the % screw purchase is again determined [% screw purchase (VD) = Y’/X’]. The SPI is calculated from the information on both views: SPI = (S’/S)*(Y’/X’), which took into account the amount of screw outside of the sacral body (i.e. exiting the ventral sacral body prematurely).
Screw Purchase Index (SPI). (a) and (b), lateral and ventrodorsal radiographs (ventrolateral approach); single plane assessment determined from the ventrodorsal view: screw depth in sacrum (Y) divided by total sacral width (X) [% screw purchase = Y/X]. (c) and (d), lateral and ventrodorsal radiographs (dorsolateral approach); orthogonal assessments determined from both views: e.g., lateral view, screw exiting the sacral body is identified (Z), and total screw length (S) and screw length in sacrum (S’) determines % screw purchase (lat) = S’S. The relative length of the screw outside the sacrum is inscribed on the opposite ventrodorsal view [Z’ = (Z/S)*L]; the % screw purchase is again measured [% screw purchase (VD) = Y’/X’]. The SPI is calculated from the information on both views: SPI = [% screw purchase (lat)]*[%screw purchase (VD)] = (S’S)*(Y’/X’). {Note that the second screw was misplace into the L7-S1 disc space (See Figure 1 in article.)}