

## Is Sacral Dysmorphism Protective Against Spinopelvic Dissociation?

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**Purpose:** Sacral dysmorphism (SD) recently has become a topic of interest in the orthopaedic literature, particularly when discussing percutaneous fixation of pelvic fractures such as in cases of spinopelvic dissociation (SPD). The prevalence of SD has been reported as high as 50% in prior studies. It is characterized by 5 radiographic signs, and defined as a sacral phenotype in which the size and orientation of the upper sacral segment do not allow for safe passage of transiliac-transsacral screws. Little is known how it may alter injury patterns in patients with sacral fractures. We hypothesized that there would be a decreased prevalence of SD in patients with SPD, potentially due to the biomechanically stronger upsloping sacral ala that may protect from this injury.

**Methods:** Pelvic radiographs and CT scans from over 1000 sacral fracture patients (OTA 61-A, B, C) who presented at 2 separate Level-I trauma centers between 2000 and 2019 were retrospectively reviewed. Patients with SPD were identified on sagittal and axial CT scans, and imaging was evaluated for signs of SD. Fractures were characterized by the Roy-Camille Classification scheme, and degree of sagittal kyphosis.

**Results:** 82 patients with SPD were identified, and 12.2% displayed features of SD, significantly less than reported in the literature. Age and gender were similar in patients with normal sacra (NS) and SD. The S2 vertebral segment was the most common location of horizontal sacral fractures in both groups (46% NS vs 50% SD). Roy-Camille Type 1 patterns were more common in NS (35%), compared to Type 2 in SD patients (40%). SD patients had lower BMIs (19.7 vs 25.2,  $P = 0.001$ ). Fracture segment kyphosis angle ( $23^\circ$  NS vs  $24^\circ$ ,  $P = 0.838$ ) and kyphosis Cobb angles ( $26^\circ$  NS vs  $31^\circ$ ,  $P = 0.605$ ) were similar between groups. Motor vehicle crashes were the most common mechanism of injury, with pelvic ring injuries and spinal fractures being the most common associated injuries. Percutaneous fixation was the most common operative technique in both groups.

**Conclusion:** In this study, we report a significantly lower prevalence of SD in patients with SPD than previously reported in the literature. This finding suggests that variations in the osseous anatomy of the sacrum changes the force transmission across the sacrum during traumatic loading, which appears to be protective against certain high-energy fracture patterns. Placement of transiliac-transsacral screws, as previously demonstrated in the literature, is technically more difficult and dangerous in dysmorphic sacra. As a popular surgical fixation technique in these injuries, it is critical to understand the importance of careful preoperative evaluation of sacral anatomy, not only for establishing the size and orientation of sacral segment safe zones for iliosacral screw placement, but also better understanding the pathomechanics involved in sacral trauma patients.