THE EFFECTS OF ZONE II SACRAL FRACTURE MALREDUCTION ON THE SAFE PLACEMENT OF ILIOSACRAL SCREWS

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Introduction: Cranially displaced zone II (vertical transforaminal) sacral fractures frequently occur after high-energy trauma. Two iliosacral screws have become the standard means of internal fixation for these injuries. Screws enter the pelvis postero-laterally, crossing the ilium, to traverse the first sacral segment. Among other factors, the amount of residual fracture displacement influences the safety of screw insertion. The present study’s purpose was to quantify the effects of cranial displacement on the dimensional constraints of iliosacral screw insertion for zone II sacral fractures.

Methods: Six human cadaveric pelves were fixed prone in a specially designed jig. A simulated zone II sacral fracture was created with a microsagittal saw, allowing controlled cranial displacements of 5, 10, 15, and 20 mm. Sagittal images at 1 mm intervals were obtained for each specimen at each displacement using helical computed tomography. Images were then imported into a computer-aided design program (AutoCAD®) and the space available in the first sacral segment was graphically delineated. The cross sectional area at the narrowest portion of the screw path was recorded and geometrically represented by the maximum number of 7.0 mm screws which could be simultaneously inserted within bone. Subsequently, images were imported into IDEAS® to reconstruct a three dimensional solid object for volumetric analysis enabling determination of the volumetric maximum of available screw space for each specimen at each displacement.

Results: The area at the foramen was decreased by 30%, 56%, 81% and 90% at 5, 10, 15 and 20 mm of displacement, respectively. The volume available for screw insertion was decreased by 21%, 25%, 26% and 34% for 5, 10, 15 and 20 mm of displacement, respectively. In 50% of the specimens at 15mm displacement and 66% of the specimens with 20mm displacement, two screws inserted simultaneously could not be contained within bone at the foramen. In 17% of the specimens displaced 15 mm and 50% of the specimens displaced 20 mm, the cross sectional area at the foramen was smaller than the diameter of one screw.

Discussion: With increasing amounts of cranial displacement, the available bone for iliosacral screw insertion is decreased. Although previous authors have accepted up to 15 mm, the data indicates that two screws may not be safely inserted in some pelves with residual cranial displacement greater than 10 mm. As containment within bone offers the best assurance to avoid damage to nearby neurovascular structures, anatomic fracture reduction is optimal.

Figure 1. Three dimensional reconstruction of intact pelvis.

Figure 2. Three dimensional reconstruction of fracture displaced 15 mm.