

The Effect of Screw Fixation on Sacroiliac Joint Stiffness using Vibration Energy Color Doppler Imaging

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Purpose: The sacroiliac joints (SIJs) are highly specialized articulations in the pelvis that allow load transfer between the upper and lower body. Traumatic pelvic disruption often results in surgical fixation of one or both of the SIJs. Pain at the SIJ is associated with asymmetries in joint laxity or stiffness. This proof-of-concept study is the first to measure SIJ stiffness, using a novel technique, in patients with intact sacroiliac screw fixation. Our objectives were (1) to establish vibration energy color Doppler imaging (VECDI) SIJ intrarater reliability, (2) to measure SIJ stiffness in subjects following surgical fixation using VECDI, (3) to compare stiffness data in post-surgical subjects and healthy control subjects, and (4) to assess the relationship between stiffness and self-reported pain and disability.

Methods: 13 reliability and 19 experimental subjects between 18 and 65 years of age were tested using VECDI. Experimental subjects were grouped based on SIJ implant fixation: unilateral (n = 3), bilateral (n = 8), or controls (n = 8). Subjects were placed into a side-lying position on top of a shaker apparatus that transmits vibration energy to the pelvic ring, while three color Doppler images were taken from the SIJ. Initially, one investigator performed three unilateral SIJ measurements in reliability subjects over 2 separate testing days. Next, the investigator performed three SIJ measurements, bilaterally, of the experimental subjects at 6 weeks (T1), and 12 weeks (T2). Additionally, control subjects were measured once, bilaterally, for comparison.

Results: Intraclass correlation coefficients (ICCs) suggest good intrarater reliability (ICC = .819; 95% confidence interval [CI] = 0.405-0.945). No significant differences for Δ TU were observed between subjects ($P > 0.05$). Additionally, within the unilateral fixation group at T1, a qualitative trend was observed between the involved (mean = 3.67 ± 4.2 standard deviation [SD]) and uninvolved side (mean = 10.13 ± 2.8 SD). Pearson correlation coefficients associate current pain at T1 and T2 ($P = 0.004$, $r = 0.879$), and Oswestry Disability Index (ODI) values at T1 and T2 ($P = 0.003$, $r = 0.890$).

Conclusion: This is the first investigation to utilize VECDI in measuring SIJ stability. Presently, we offer VECDI as an objective, validated, and reliable tool in SIJ stiffness assessments. Following surgical fixation, experimental subjects demonstrated similar stiffness values 6 and 12 weeks post-operation compared to controls. Alternatively, we observed potentially meaningful differences between the involved and uninvolved sides at T1 in unilateral fixation subjects. However, direct inferences cannot be concluded due to a small sample size. Future research should investigate pre- to post-screw removal to determine the time course of healing from SIJ surgical stabilization and removal.