CONCLUSIONS: This study found that stand-alone L5-S1 ALIF without posterior fixation or decompression led to both radiographic and clinical improvement in patients with symptomatic L5-S1 retrolisthesis.

FDA DEVICE/DRUG STATUS: This abstract does not discuss or include any applicable devices or drugs.

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Biomechanics

109. Improving stabilization across osteotomy level following a sacral PSO: A finite element investigation

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BACKGROUND CONTEXT: S1-PSO is known to address and reduce pelvic incidence in patients with positive sagittal imbalance; however, it is associated with a high rate of surgical and neurological complications. Determining the optimum fixation technique is essential to minimize the occurrence of postoperative complications, decrease the revision rate, and ultimately improve clinical outcomes.

PURPOSE: As sacral PSOs raise unique challenges for stabilization, given relatively limited fixation caudal to the PSO, this study's purpose is to compare biomechanics of different instrumentation configurations used to stabilize an S1-PSO.

STUDY DESIGN/SETTING: Finite element analysis.

OUTCOME MEASURES: Spinopelvic parameters (L1-S1 and L4-S1 lordosis, pelvic incidence, sacral slope, and pelvic tilt), the L5-S1 range of motion (PSO-ROM), PSO-force and maximum von Mises stresses on 1˚R, LR, and HR.

METHODS: A validated spinopelvic finite element model was used to create a 30˚ PSO at sacrum. Fixation cranial to the PSO was T11-L5 pedicle screws and distal to the PSO was dual iliac screws. The PSO was stabilized with a combination of the following rods to create different multi-rod (4-,5-,6-) constructs: (1) main midline rods (1˚R) engaging the T11-L5 pedicle screws; (2) a horizontal rod (HR) connecting the two distal iliac screws; (3) lateral accessory rods (LR) connected to the cranial iliac screws and 1˚R proximally; (4) medial accessory rods (MR) connected to the HR and 1˚R proximally. Five different instrumentation strategies were evaluated: (A) 4-Rod(LR): 1˚R + bilateral LR; (B) 4-Rod(MR+HR): 1˚R combined with a MR connected to a HR; (C) 4-Rod(LR+HR): 1˚R connected to a HR combined with bilateral LR; (D) 5-Rod: 1˚R connected to a HR combined with bilateral LR and one MR; 6-Rod: 1˚R connected to a HR combined with bilateral LR and two MR. In the first step, follower loads of 300N, 400N, and 400N were applied to the thoracic, lumbar, and sacrum, respectively. Afterwards, pure moments (7.5Nm) were applied to the top endplate (T10) in all anatomic directions. Acetabular surfaces were fixed in all degrees of freedom.

RESULTS: Compared to intact, S1-PSO increased L1-S1 and L4-S1 lordosis by 65.8% and 59.7%, while decreasing sacral slope, pelvic incidence, and pelvic tilt by 60.3%, 40.4%, and 8.9%, respectively. 4-Rod (MR+HR) construct showed maximum L5-S1 ROM. Compared to this model, the 4-Rod (LR), 4-Rod (LR+HR), 5-Rod, and 6-Rod models showed up to 49%, 41%, 35%, and 36% lower PSO ROMs, respectively. Among all the models, 6-Rod configuration showed the least stress on 1˚R. Compared to this model, 4-Rod (LR), 4-Rod (MR+HR), 4-Rod (LR+HR), and 5-Rod showed up to 127%, 91%, 24%, and 23% higher von Mises stresses on 1˚R, respectively. The 4-Rod (MR+HR) model showed the least stress on AR and HR. The 4-Rod (LR), 4-Rod (LR+HR), 4-Rod (MR+HR), 5-Rod, and 6-Rod configuration showed 265.2N, 280.7N, 302.6N, 265.5N, and 261.9N PSO-forces in flexion, respectively.

CONCLUSIONS: Previous FEAs were focused on lumbar PSOs, and this is the first biomechanical investigation of sacral-PSO with various multirod configurations. Our FE predictions showed that the construct consisting of primary midline rods connected to cranial iliac bolts supplemented with medial accessory rods connected vertically to a horizontal rod connecting distal iliac screws (4-Rod [MR+HR]) demonstrated highest PSO-ROMs and greatest PSO forces. Hence, FE predictions suggest using this configuration might lead to fewer postoperative complications; however, further clinical investigations are necessary to confirm these findings.

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110. The effect of the shape of the fixation implant on the biomechanics of sacroiliac segment: comparison of triangular vs threaded screw fixation implants: a finite element study

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BACKGROUND CONTEXT: Sacroiliac joint (SIJ) pain has been recognized as a main source of pain in 15% to 30% of patients with low back pain. The common surgical treatment involves using SIJ implants for stabilization of the joint through minimally invasive surgeries. While clinical studies have investigated the effect of such procedures, there is no data on the effect of the shape of implant on the SIJ biomechanics. This study utilizes finite element analysis to compare biomechanical responses of two different unilaterally instrumented SIJ implant designs, triangular vs rounded screw-based, under physiological loadings.

PURPOSE: The objective of this study was to investigate the difference in biomechanics of the]kSIJ instrumented with two common types of fixation implant design including triangular vs round threaded screw designs.

STUDY DESIGN/SETTING: Cadaver validated finite element modeling.

OUTCOME MEASURES: Range of motion (ROM) at SIJ and load sharing on bone around the fixation areas.

METHODS: The ligamentous L1-pelvis finite element (FE) model of lumbo-pelvic was used. The was developed from the CT scans of a 55-year-old female. The model included all critical tissue components and was validated against internal cadaver test data under physiological loads in the three planes of motion. To simulate the surgical procedures for trans-articular placement of SIJ implants, three implants were simulated across the left SI joint, using two different implants design made of titanium: a fully threaded screw (SI-Restore, Bio Fusion Medical, TX) with 9.5mm diameter and a triangular implant design (iFuse, Si-Bone Inc., CA) with a size of 7mm. The implants lengths were as follows: superior, 60 mm; middle, 45; inferior, 55 mm. To simulate placement of each implant into SIJ, voids were created inside the left ilium and sacral components of the intact pelvic and the implants were affixed to the surrounding bone in each void. The model was fixed at the hip joint and subjected to 10 Nm moment followed by a 400 N compressive follower load to simulate flexion-extension, lateral bending (LB) and axial rotation (AR). The range of motion across intact and instrumented SIJ along with the peak stress around each were calculated and compared among the instrumented models in each loading condition.

RESULTS: The motion at contralateral SIJ decreased by 71% (Flex-Ext), 48% (LB) & 22% (AR) in Triangular implant construct vs intact; the corresponding numbers in screw implant constructs were 76%, 58% and 31% respectively. On the instrumented side the threaded implant construct resulted in slightly more constrain in motion vs the triangular construct (98% vs 90% reduction). The peak stress on bone was 90 MPa (Flex-Ext), 57 MPa (LB) and 70 MPa (AR) in the triangular implant construct vs 89 MPa, 57 MPa, and 54 Mpa, respectively in the screw construct.