

# Self-harvesting porous sacral-alar-iliac screws: a biomechanical study comparing combined S1ai and S3ai trajectories to other pelvic fixation techniques.

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## INTRODUCTION:

Pelvic fixation is a corner stone of multi-level spinal fusion constructs. Different fixation techniques have been established, including conventional iliac, S1-alar-iliac (S1ai), S2-alar-iliac (S2ai), and S3-alar-iliac (S3ai) fixation. The use of novel self-harvesting porous sacral-alar-iliac (SAI) screws with an integrated tulip in long spinal fusion constructs requiring bilateral SAI screw placement is becoming more popular. Less is known about the biomechanical profile of such rigid pelvic fixation.

## Objective:

We present a finite element analysis (FEA) evaluating the biomechanical impact of combined S1ai and S3ai pelvic fixation in comparison to other fixation methods. The results of this study have potential utility in clinical guidance and decision making, by matching the biomechanical properties of a fixation technique to the specific needs of a patient's pathology.

## METHODS:

Six L1-pelvis FEA spinal models were created comparing one noninstrumented control to 5 instrumented variants with pelvic fixation via: iliac bolt, S1ai, S2ai, S1ai + S3ai (8.5mm), and S1ai + S3ai (10.5mm). Interbody fusion was also modeled at L5-S1 in all instrumented variants. Loading conditions included flexion, axial-loading, and lateral bending at 100N, 200N, and 300N. Bony, discal and hardware related von Mises Stress (VMS) was calculated and analyzed for each variant and loading condition. Range of motion (ROM) was calculated for all motion segments.

## RESULTS:

The S1ai+S3ai large caliber screws (V6) demonstrated the lowest L5/S1 and L1/2 segmental mean ROM and provided the best pelvic stress shielding. Variant 3 (S1ai 8.5mmx80mm screws) did not provide sufficient stability of a long fusion construct.

## DISCUSSION AND CONCLUSION:

This FEA reveals biomechanically significant differences with pelvis fixation in long spinal fusion constructs. Combined S1ai+S3ai large caliber pelvic screws outperformed all other fixation variants under investigation. In clinical practice we would expect lower hardware failure rates, superior stress shielding of the pelvis and possible improved kinematics at the cranial adjacent level.

