

A Novel Spinopelvic Sensor Correctly Categorizes Patients' Spinopelvic Stiffness

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INTRODUCTION:

Spinopelvic stiffness increases the risk of total hip arthroplasty (THA) dislocation. Preoperative spinopelvic assessment is performed with lateral sit-to-stand radiographs; however, these do not consider patients' dynamic patterns of motion and require additional radiation. This study evaluates the relationship between a novel spinopelvic motion sensor and spinopelvic radiographic parameters.

METHODS:

We prospectively enrolled 40 participants; 80% had osteoarthritis, 59% were female, mean age was 62.6, and mean BMI was 31 kg/m². Patients with contralateral hip arthritis, THA, or spine instrumentation were excluded. Each participant underwent lateral sit-to-stand lumbar radiographs with sensors placed on the sacrum, upper back, and thigh. Sensor data was excluded in seven patients with inappropriate sensor placement, excessive movement, or incomplete data. (SS) pelvis to femur angle (PFA), pubic symphysis to sacrococcygeal junction distance (PSCD) and sacrofemoral angle (SFA). Spinopelvic motion was categorized as "stiff" if the change in SS (ΔSS) was $\leq 10^\circ$, "normal" if $10^\circ < \Delta SS < 30^\circ$ or hypermobile if $\Delta SS \geq 30^\circ$. Measurement correlation was evaluated with Pearson's correlation coefficient.

RESULTS:

The mean sitting and standing radiographic PT was 40° and 20° , respectively. The mean sitting and standing PFA was 57° and 175° , respectively. The mean sitting and standing SS was 16.2° and 33.2° , respectively. Mean PI was 52° . Radiographic measurements did not differ significantly based on gender or osteoarthritis diagnosis. Older age correlated with more posterior pelvic tilt ($r=0.52$, $p<0.01$) and decreased hip flexion on sitting radiographs ($r=-0.39$, $p=0.01$). Posterior PT on the lateral radiographs correlated with a shorter pubic symphysis to sacrococcygeal junction distance and smaller sacrofemoral angle measured on AP radiographs ($r=-0.39$, $p=0.02$, and $r=-0.63$, $p<0.01$, respectively). Nine patients were radiographically "stiff", 19 were "normal," and two were "hypermobile." The sensor measurements correctly categorized spinopelvic motion in 80% of patients. The radiographic change in SS correlated with the sensor-measured change in SS ($r=0.31$, $p=0.04$) and sensor-measured standing SS ($r=0.39$, $p=0.01$). Increased BMI correlated with higher sensor-measured standing sacral pitch ($r=0.46$, $p=0.03$) and spine yaw ($r=0.43$, $p=0.04$).

DISCUSSION AND CONCLUSION:

Novel external sensors were able to quantify SS in a manner that correlated with measurements from sit-to-stand radiographs. Radiographic pelvic tilt on lateral imaging correlated with the PSCD and SFA on supine radiographs, suggesting that an AP radiograph combined with this novel sensor technology may serve as an adjunct to future preoperative spinopelvic evaluation.



Radiographic Measurements