Supine and Standing Pelvic Radiographs Yield Significantly Different Measurements in Femoroacetabular Impingement and Hip Dysplasia: A Systematic Review and Meta-Analysis

Jacob D. Kodra[1], BS; Sophia Marinelli[2], BS; Kevin Girardi[3], BS; Serkan Surucu[4], MD; Andrew Schab[5], BS; James MacLeod[1], MD; Jay Moran[3], MD; Rajiv Vasudevan[3], MD; Renato Locks[3], MD; Andrew E. Jimenez[3], MD

[1]Department of Orthopaedics, Medical College of Wisconsin, Milwaukee, WI; [2]University of Rhode Island, South Kingstown, RI; [3]Department of Orthopaedics and Rehabilitation, Yale University, New Haven, CT; Department of Orthopaedics, University of North Carolina, Chapel Hill, NC; [5]American Hip Institute, Des Plaines, IL

jkodra@mcw.edu

Disclosures: Jacob D. Kodra (N), Sophia Marinelli (N), Kevin Girardi (N), Serkan Surucu (N), Andrew Schab (N), James McCleod (N), Jay Moran (N), Rajiv Vasudevan (N), Renato Locks (N), Michael Leslie (N), Andrew E. Jimenez (Arthrex)

INTRODUCTION: Radiographic measurements are essential in diagnosis and operative management of femoroacetabular impingement (FAI) and developmental dysplasia of the hip (DDH), yet the impact of patient positioning on these measurements remains underexplored. The purpose of this study was to compare measurements of key hip parameters obtained from supine versus standing pelvic radiographs in patients with FAI or DDH.

METHODS: A systematic review was registered on PROSPERO and performed in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), and Scopus were queried in June 2025. Included studies compared radiographic measurements in supine versus standing positions in FAI or DDH patients. Articles were excluded if they failed to provide extractable radiographic data for both positions. Demographics, study design, and radiographic parameters including lateral center-edge angle (LCEA), pelvic tilt, Tönnis angle, femoral head translation, joint space width (JSW), femoroepiphyseal acetabular roof index (FEAR), Sharp angle, and femoral head extrusion index were analyzed. Meta-analyses with a random effects model were performed to generate forest plots comparing pooled differences in supine versus standing measurements for LCEA, Tönnis angle, and pelvic tilt (pubic symphysis to sacrococcygeal distance) across all studies. Subgroup meta-analyses were then conducted among studies limited to FAI or DDH populations to isolate pooled differences specific to each diagnosis.

RESULTS SECTION: Twelve studies comparing supine and standing radiographs were included, comprising a total of 824 hips in 675 patients. Mean patient age ranged from 14 to 66 years. LCEA and pelvic tilt were reported in ten studies, Tönnis angle in eight, and JSW in two. Statistically significant differences in supine and standing radiographic measurements were identified for pelvic tilt (10/10 studies), Tönnis angle (7/8), LCEA (6/10), and femoral head translation (1/1). In contrast, ≥50% of studies reported no significant positional differences in JSW, FEAR index, Sharp angle, and femoral head extrusion index. Meta-analyses of supine versus standing radiographic measurements are presented in Figures 1-3. Pelvic tilt was pooled across five studies (318 hips), demonstrating a mean difference of +1.74° (95% CI [0.82, 2.65]; $P = 0.0002$). This difference persisted in independent subgroup analyses specific to FAI (+1.38°, 95% CI [0.92, 1.84]; $P < 0.00001$) and DDH (+1.98°, 95% CI [0.37, 3.59]; $P = 0.02$). A pooled analysis of Tönnis angle was synthesized from six studies (440 hips), revealing a significant mean difference of –1.46° (95% CI [–2.27, –0.65]; $P = 0.0004$). Subgroup analyses confirmed this effect in both FAI (–1.14°, 95% CI [–2.19, –0.09]; $P = 0.03$) and DDH (–1.93°, 95% CI [–3.20, –0.65]; $P = 0.003$). LCEA was pooled across eight studies (548 hips), demonstrating no significant difference between supine and standing positions (+0.99°, 95% CI [–0.19, 2.16]; $P = 0.10$). Similarly, no significant positional differences were identified among subgroup analyses of FAI (+0.97°, 95% CI [–0.80, 2.74]; $P = 0.28$) and DDH (+1.03°, 95% CI [–0.70, 2.76]; $P = 0.24$).

DISCUSSION: Supine and standing pelvic radiographs often yield significantly different measurements for key hip parameters in FAI and DDH, most notably in pelvic tilt and acetabular coverage. Meta-analyses confirmed that supine positioning results in greater pelvic tilt and decreased Tönnis angle, while no significant differences were observed in LCEA. These findings highlight the impact of positioning on radiographic assessment and the importance of careful interpretation in both diagnostic and preoperative settings. Future studies are warranted to assess positional differences in additional radiographic parameters of the hip. Limitations included heterogeneity across study populations, limited data for several radiographic variables, and a lack of clinical outcome correlation.

SIGNIFICANCE/CLINICAL RELEVANCE: Supine and standing pelvic radiographs yield different measurements for key hip parameters, underscoring the importance of standardized positioning to improve diagnostic accuracy and optimize surgical planning in hip preservation surgery.

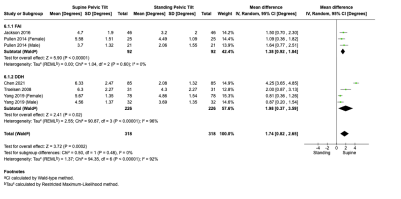

Figure 1. Meta-analysis of pelvic tilt measurements obtained from supine versus standing radiographs across five studies (318 hips). Supine radiographs demonstrated a significantly greater pelvic tilt (mean difference: +1.74°, 95% CI [0.82, 2.65]; $P = 0.0002$), with consistent increases observed in both femoroacetabular impingement (FAI) (+1.38°, $P < 0.00001$) and developmental dysplasia of the hip (DDH) (+1.98°, $P = 0.02$) isolated subgroup analyses.

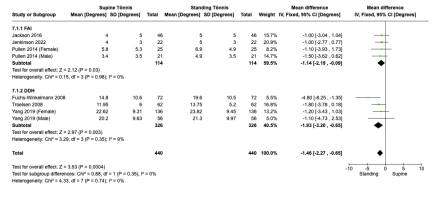

Figure 2. Meta-analysis of Tönnis angle measurements obtained from supine versus standing radiographs across six studies (440 hips). Supine radiographs demonstrated a significantly smaller Tönnis angle (mean difference: –1.46°, 95% CI [–2.27, –0.65]; $P = 0.0004$), with consistent reductions observed in both femoroacetabular impingement (FAI) (–1.14°, $P = 0.03$) and developmental dysplasia of the hip (DDH) (–1.93°, $P = 0.003$) isolated subgroup analyses.

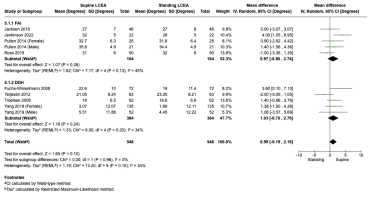

Figure 3. Meta-analysis of LCEA measurements obtained from supine versus standing radiographs across eight studies (548 hips). No significant difference was identified between positions (mean difference: +0.99°, 95% CI [–0.19, 2.16]; $P = 0.10$, with non-significant findings reproduced in both femoroacetabular impingement (FAI) (+0.97°, $P = 0.28$) and developmental dysplasia of the hip (DDH) (+1.03°, $P = 0.24$) isolated subgroup analyses.