

Borderline Acetabular Dysplasia: Three-Dimensional Deformity Predictors of the Diagnosis of Symptomatic Instability Treated with Periacetabular Osteotomy

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INTRODUCTION:

Borderline acetabular dysplasia is classically defined as a lateral center edge angle (LCEA) of 20-25 degrees. The optimal treatment strategy in this patient group remains controversial, with some patients having primarily hip instability-based symptoms, while others have primarily impingement-based symptoms (non-instability). The purpose of the current study was to define the 3D characteristics on low-dose CT that differentiate patients with instability symptoms from those without instability in the setting of borderline acetabular dysplasia.

METHODS:

Seventy consecutive hips with borderline acetabular dysplasia undergoing surgical treatment were included in the current study. All patients underwent low-dose pelvic CT with femoral version assessment for preoperative planning. CT measurements included alpha angle and radial acetabular coverage (RAC) at standardized clockface positions (9:00-posterior to 3:00-anterior), central and cranial acetabular version. RAC was assessed in three sectors (anterior, superior, and posterior) and defined (relative to published normative data) as normal (-1 SD, +1 SD), undercoverage (<-1 SD), or overcoverage (>+1 SD). Statistical analysis was performed to compare the CT characteristics of the symptomatic instability and non-instability groups.

RESULTS:

Of the 70 hips, 62.9% had the diagnosis of symptomatic instability, while 37.1% had no instability symptoms. Hips with instability (compared to non-instability) had significantly lower alpha angle (maximal difference at 1:00 - 47.0° vs. 59.4°), increased femoral version (22.3° vs. 15.3°), and decreased radial acetabular coverage (maximal difference at 1:00 - 59.9% vs. 62.2%) (all $p < 0.001$). Multivariate analysis identified femoral version (OR 1.1, $p = 0.02$), alpha angle at 1:00 (OR 0.91, $p = 0.02$), and RAC at 1:00 (OR 0.46, $p = 0.003$) as independent predictors of the presence of instability. The model combining these three factors had excellent predictive probability with a c-statistic 0.92.

DISCUSSION AND CONCLUSION:

We found significant differences in the 3D hip morphology of the symptomatic instability and non-instability subgroups within the borderline dysplasia cohort. In the setting of borderline dysplasia, three-dimensional deformity characterization with low-dose CT allowed for differentiation of patients diagnosed with underlying instability vs. non-instability. Femoral version, alpha angle at 1:00, and radial acetabular coverage at 1:00 were identified as independent predictors of diagnosis in borderline acetabular dysplasia.