Effects of Acetabular Rim Trimming on the Hip Joint Contact Pressure: How Much is Too Much?

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Introduction: In patients with femoroacetabular impingement (FAI), acetabular rim trimming removes the offending cause of pain in patients with pincer-type and mixed-pincer-cam type pathology and helps protect repaired damaged labrum from further injury. Although the clinical benefit of arthroscopic acetabular rim trimming in FAI patients is well established, the threshold at which excessive rim resection results in abnormal hip contact pressures from iatrogenic acetabular dysplasia has never been studied. The purpose of the present study was to investigate the changes in contact areas, contact pressures and peak forces within the hip joint with sequential acetabular rim-trimming.

Methods: A comparative biomechanical analysis of 6 fresh-frozen human cadaver hemi-pelvises was performed. Prior to testing, all specimens underwent a CT scan and were deemed non-dysplastic based on center edge angle measurements. For each specimen, the acetabulum and proximal femur were potted in dental cement and mounted on a materials testing system (MTS Insight 5, Eden Prairie, MN). After resecting the labrum, a contact pressure and area mapping system (Tekscan, Boston MA) was placed within the acetabulum and a 700 N load was subsequently applied resulting in a real-time pressure map. Each specimen was sequentially tested in the intact state as well as anterosuperior acetabular rim-trimming (from the 12 o’clock to 3 o’clock position) of 2mm, 4mm, 6mm and 8mm depth. Each testing condition was examined at two different positions within the natural hip range of motion: 20° extension and 60° flexion. Analysis of total force, contact area, contact pressure and peak force was performed on two regions of interest: the acetabular rim and the acetabular base (deep part of acetabulum). The rim-trimmed states were then normalized with respect to the intact state in order to help account for specimen variability. Statistical analysis was conducted via a Paired and Unpaired Student’s T-test on normalized data.

Results: At 60° flexion, rim-trim depth was significantly correlated to acetabular rim contact area (R=0.769, P<0.0001), rim contact pressure (R=0.908, P<0.0001) and rim peak force (R=0.874, P<0.0001), as well as acetabular base contact area (R=0.536, P=0.002), base contact pressure (R=0.451, P=0.012), and base peak force (R=0.558, P=0.001). At 20° extension, rim-trim depth was significantly correlated to acetabular rim contact area (R=0.722, P<0.0001), rim contact pressure (R=0.732, P<0.0001) and rim peak force (R=0.629, P<0.0001), as well as acetabular base contact area (R=0.362, P=0.49). With regards to the acetabular base, at 60° flexion and 6mm resection there was a statistically significant increase in both base contact area (266.11%±163.09, P=0.49), contact pressure (331.67%±159.13, P=0.013) and base peak force (165.01%±63.16, P=0.007).
Discussion: Resecting more than 4-6mm of bone in an acetabular rim trimming hip arthroscopy procedure may dramatically increase hip joint contact pressures and predispose patients to early osteoarthritis via creation of an iatrogenic acetabular dysplasia. In dysplastic or borderline hips, the amount of safe resection may be even less.

Significance: Even in nondysplastic hips with normal to elevated center edge angles, there is a discrete threshold for acetabular rim trimming (4-6mm) after which an iatrogenic acetabular dysplasia is created.

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