Contribution of the Medial Iliofemoral Ligament to Hip Stability after Total Hip Arthroplasty through Direct Anterior Approach

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INTRODUCTION:
Dislocation after total hip arthroplasty (THA) is one of the primary reasons for THA revision in the US. During THA through the direct anterior approach (DAA), the iliofemoral ligament, which provides the main resistance to external rotation of the hip, must be partially transected. While transecting this ligament creates concerns for anterior dislocation of the hip, especially during external rotation with the leg in extension, the extent of the transection remains variable: some surgeons keep the medial aspect of the ligament intact, others transect and repair it, and others transect the ligament without repairing it. Our current ability to adequately manage the anterior hip capsule during DAA-THA is hampered by a lack of understanding of the biomechanical consequences of these surgical choices. Therefore, we asked two questions: 1) what is the contribution of the medial iliofemoral ligament to resisting anterior dislocation after DAA-THA? 2) How much resistance to anterior dislocation can be obtained by repairing the medial iliofemoral ligament?

METHODS:
Seven cadaveric hemi-pelvis to knee specimens were procured. A fellowship trained orthopaedic surgeon performed THA through a standard DAA, using a cementless acetabular cup and a cemented femoral component. The specimens were CT scanned before and after implantation (Fig 1). Prior to testing, the external rotation ROM of each specimen to impingement (either intra- or extra-articular) in 10º of extension was computationally determined. 3D-printed specimen specific guides were used to define the anatomic coordinate systems of the femur and pelvis (Figs. 1 and 2). Each specimen was tested on a six-degree of freedom robotic manipulator utilizing hip-testing specific control software (Fig. 2). During testing, the pelvis was placed in 10º of extension. The femur was externally rotated until reaching the specimen-specific impingement target. Throughout testing, we applied compressive, medial, and posterior forces of 10N to ensure the femoral head remained seated in the acetabular liner. Total external rotation torque was recorded throughout the motion of each hip with the medial iliofemoral ligament intact, after transecting the ligament, and after repair. Each test was repeated three times. We determined the impingement point by the change in slope in the rotation-torque curve of the transected condition. Torque at impingement was calculated for each condition. To isolate the contribution of the native ligament, the impingement torque for the transected state was subtracted for both the intact and repaired conditions.

RESULTS: The average combined anteversion was 34.9 degrees (SD 14.3) and the average cup inclination was 28.9 degrees (SD 7.6). The contribution of the iliofemoral ligament varied between specimens with an average contribution of 54% (SD 31%) of the total torque at the instant of impingement (Fig 3). When the ligament was repaired after being transected, it contributed to 12% (8%) of the torque to impingement across specimens, thus only restoring 22% of the native resistance against dislocation.

DISCUSSION AND CONCLUSION: The medial iliofemoral ligament was a significant contributor to the hip torque at impingement during external rotation of the hip when intact. Repairing the ligament could only restore one fifth of its ability to generate torque to resist anterior hip dislocation.