

# 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 [1]. During THA through the direct anterior approach (DAA), the iliofemoral ligament, which provides the main resistance to external rotation of the hip [2], 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. The 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:** Three cadaveric pelvises to bilateral knee specimens (6 hips total) without any signs of prior trauma or surgery of their hips were procured. Prior to implantation, CT-markers were placed on each femur and hemipelvis. A fellowship trained orthopaedic surgeon (JR) performed THA through a standard DAA, using a cementless acetabular cup and a cemented femoral component. The medial aspect of the iliofemoral ligament was retained during the approach. The physical implantations were computationally reproduced by aligning the markers visible on preoperative and postoperative CT-scans of the specimens (Fig.1). The pelvic reference frame was defined at the center of the acetabular cup, with the line connecting both Anterior Superior Iliac Spines (ASIS) parallel to the medial-lateral axis (X) and the Anterior Pelvic Plane (APP), which was defined from both ASIS and the pubic symphysis, parallel to the frontal (XZ) plane. The femoral reference frame was defined at the center of the femoral head, with the line connecting the center of the femoral head and the deepest point in the trochlear groove parallel to the superior-inferior axis (Z) and the posterior condylar axis parallel to the frontal (XZ) plane [3]. The reference hip position (i.e., full extension) was defined by making the reference frames of the femur and pelvis coincident. Each specimen was tested on a six-degree of freedom robotic manipulator (KR300 Ultra 2500, Kuka), equipped with hip-testing specific software (SimVitro). Before experimental testing, the femur was cut at the mid-shaft and potted (Fig. 2) in epoxy (Bondo, 3M). The hemipelvis was potted at the iliac crest (Fig. 2). Because the landmarks in the contralateral pelvis and distal femur required to define the coordinate systems were absent during testing, we designed and 3D-printed specimen specific guides with the required fiducial landmarks to define the reference frames of the femur and pelvis (Figs. 1 and 2). Prior to testing, the external rotation ROM of each specimen to impingement between either the femoral component and the acetabular liner or the femoral and pelvic bones in 10° of extension was computationally determined. During testing, the pelvis was placed in 10° of extension, and we externally rotated the femur in rotation control until the specimen-specific impingement target was reached. Throughout testing, compressive, medial, and posterior forces of 10N were applied to ensure the femoral head remained seated in the acetabular liner. The total torque and the displacement of the center of the femoral head were recorded throughout motion. Each hip was tested with the medial iliofemoral ligament intact (i.e., native condition), after transecting the medial iliofemoral ligament (i.e., transected condition), and after repairing the medial iliofemoral ligament (i.e., repaired condition). This was repeated three times, verifying the consistency of the torque at the extreme of ROM. The impingement point was determined by the change in slope in the rotation-torque curve of the transected condition. Torque at impingement was calculated. The contribution of the native ligament and the repair were isolated from the total torque by subtracting the impingement torque measured for the transected condition. We reported results as percent of total torque at impingement.

**RESULTS:** The average combined anteversion was 43.5 degrees (SD 10.6) and the average cup inclination was 39.8 degrees (SD 9.2). The contribution of the iliofemoral ligament varied between specimens with an average contribution of 73% (SD 13%) of the total torque at the instant of impingement (Fig 3). When the ligament was repaired after being transected, it contributed to 14% (SD 11%) of the torque to impingement across specimens, thus only restoring 19% of the native resistance against dislocation.

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

**SIGNIFICANCE/CLINICAL RELEVANCE:** To maximize resistance against anterior dislocation, surgeons should make efforts to preserve the medial iliofemoral ligament during THA through DAA, as repairing the ligament can only partially restore its ability to resist external hip rotation.

**REFERENCES:** [1] AJRR 2021 report. [2] van Arkel; J Bone Joint Surg. 2015;97:484–491. [3] Kubiak-Langer; Clin Orthop Relat Res. 2007:117-124.

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**IMAGES AND TABLES:**



Fig. 1 – Preoperative (transparent beige) to postoperative (orange) CT-scan alignment

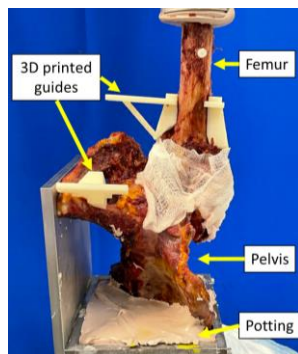


Fig 2 – Specimen with 3D printed guides

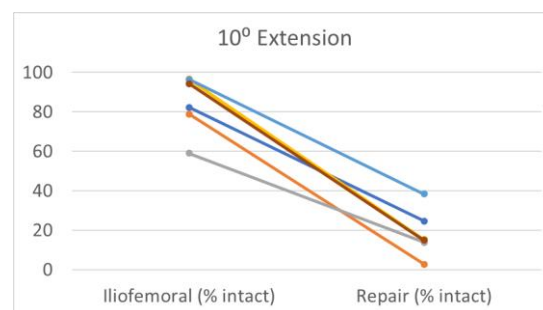


Fig. 3 – Torque provided by the ligament and the repair