Effect of Capsulotomy on Hip Stability and Range of Motion: Should Capsules be Repaired after Hip Arthroscopy?

Suenghwan Jo, M.D., PhD, Alexander W. Hooke, M.A., Kai-Nan An, Ph. D, Rafael J. Sierra, M.D., Robert T. Trousdale, M.D..
Mayo Clinic, Rochester, MN, USA.

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Introduction: A capsulotomy is commonly performed during hip arthroscopy to improve visualization of intra-articular pathology and to facilitate movement of surgical instruments. A commonly used capsulotomy is done by connecting two conventionally used portals (interportal capsulotomy) or with the addition of a horizontal incision (T-shape capsulotomy) to better access intra-articular pathology. However, as a capsulotomy often involves partial disruption of the iliofemoral ligament, it has been suggested that failure to repair it may result in an alteration of hip joint biomechanics. This cadaveric biomechanical study aims to compare the range of motion (ROM) and femoral head translation among different capsulotomy conditions commonly performed during hip arthroscopy.

Methods: The left hip joint of eight fresh-frozen cadaveric pelvises (8 hips) with mean age of 63 years at time of death were utilized in this study. Each specimen was radiologically and arthroscopically examined prior to the experiment and confirmed to have no labrum injury or bony abnormality. All pericapsular soft tissues were carefully dissected and the iliofemoral ligament was identified. The specimen was then mounted on a custom testing jig with the pelvis in an upright position. Stabilizing forces of 15 N were applied along the course of gluteus medius muscle to maintain femoral head contact with the acetabulum (Figure 1). 6 degree-of-freedom-motion tracking sensors (Polhemus, Colchester, VT) were rigidly attached to the pelvis and femur, and an axial rotation torque was applied manually along the mechanical axis of the femur using a torque wrench, which recorded applied torque in real time. The end range of motion was extracted when 2.5Nm of torque was applied to the femur. External rotation range of motion was extracted with the femur in -10°, 0°, 30°, 60°, 90°, and 110° of flexion and internal rotation range of motion was measured in -10°, 0°, and 30° of flexion. The test was repeated in three different capsule conditions: 1) intact, 2) interportal capsulotomy, and 3) T-shape capsulotomy. The translation of the femoral head was identified at 2.5Nm torque, and was measured in the antero-posterior, medio-lateral, and superior-inferior directions.

Results: The external rotation ranges of motion at 2.5Nm torque are plotted in Figure 2. There was a significant difference in external rotation range of motion between the intact and both the interportal and T-shape capsulotomy conditions with the largest difference occurring at 10 degrees of hip extension (p = 0.0123, 0.0089). No differences in internal rotation range of motion were observed between the three capsulotomy conditions. When femoral head translation distances were compared, significant differences in medio-lateral translation between capsulotomy conditions were present at at -10 , 0, and 30 degrees of flexion were present.

Discussion: The iliofemoral ligament is known to play a significant role in restricting external rotation and anterior femoral translation in its normal state. During conventional hip arthroscopy, portals are
made within the iliofemoral ligament and this capsulotomy may disrupt part of this ligament. Recently, cases of dislocation were reported following hip arthroscopy, and the question has been raised as to whether capsulotomy could contribute to instability of the hip joint. The result of this study shows that the external rotation range of motion increased throughout the flexion plane in both the interportal and T shape capsulotomy conditions relative to the intact state, with the trend most pronounced in the hip extension position (10 degree extension). However, this additional external rotation only affected femoral head translation when the hip was in less than 30 degrees of flexion. When the interportal capsulotomy was compared with the T shape capsulotomy, no difference in axial rotation range of motion or femoral head translation was detected, indicating that an additional incision parallel to the ligament does not result in additional instability. Overall, the result from the current study suggests that a partial capsulotomy tear during hip arthroscopy could result in instability when hip is in the extended position.

**Significance:** This study suggests the repair of the joint capsule after hip arthroscopy is performed. However, further study is required to confirm whether this additional motion has clinical significance. Figure 1. Test set up. Figure 2. Comparison of mean external rotation in different hip flexion plane.