Increased Allograft Width for Circumferential Labral Reconstruction Better Restores Hip Suction Seal

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INTRODUCTION: The function and importance of the acetabular labrum has previously been determined.1 Labral tears are one of the most common findings in the field of hip preservation and are often associated with femoroacetabular impingement syndrome (FAIS). Restoration of labral anatomy and function has demonstrated to improve patient-reported outcomes following hip arthroscopy in the context of FAIS.2-4 Circumferential labral reconstruction (CLR) is a well-described procedure used to restore labral function when faced with an irreparable labral tear. Although, Suppaussorn et al. recently reported that 7 out of 8 cadaver specimens lost suction seal after CLR with iliotibial band (ITB) allografts that averaged 5mm in width.5 Therefore, the purpose of the present study was to determine whether CLR performed with wider ITB allografts (>6.5mm) can improve the destructive stability force (suction seal) of the hip toward that of the intact labrum compared to narrow allografts (<6.5mm).

METHODS: Institutional review board approval was not required for this laboratory investigation utilizing de-identified cadaveric specimens. Seven fresh-frozen all male pelvises with attached femurs (n=14 matched hemipelvess, age <70 years; body mass index < 35 kg/m2) were procured with intact pubic symphysis and sacrum and without history of previous hip surgeries or injuries. Each specimen was screened radiographically to ensure there was no evidence of advance osteoarthritis (Tonnis grade >1) or acetabular dysplasia (lateral center-edge angle < 18°). Hips were dissected free of all soft tissue including the hip capsule. Afterward, each intact hemipelvis was potted, placed in the saline bath, and securely fixed to the frame of a hydraulic testing system with the hip placed in 30° of abduction, Figure 1A and B. A 500 N m compressive load was applied to the acetabulum followed by distraction at the rate of 5.0mm/s. Force and displacement were recorded throughout until the suction seal ruptured, which was detected by an abrupt drop in force to zero. After intact testing, the labrum was excised, and specimens were re-tested using the same protocol. CLR was subsequently performed twice (order randomized) using (1) an ITB allograft with a width > 6.5mm (7.5-8.0mm) and (2) an ITB allograft with a width >6.5mm (4.5-5.0mm). Specimens were re-tested after each CLR. Force (N) and femoral distraction (mm) required to break the suction seal were determined and compared between the four testing states (intact, deficient, CLR<6.5mm, and CLR>6.6mm) using repeated measures ANOVA.

RESULTS SECTION: On average, intact specimens required 148.4±(±33.1) N of force to break the hip suction seal, which was significantly decreased to 26.5±(±44.3) N in the labral deficient state (p<0.001), Figure 2. CLR performed with narrow allografts (<6.5mm) did not improve the suction seal force from the deficient state (p=0.42) and remained significantly lower than the intact state (p<0.01). CLR with wider (>6.5mm) allografts recorded significantly greater force to break the suction seal compare to both the deficient and narrow CLR states, p<0.01, with an average force comparable to the intact labrum (p=0.59). The amount of femoral distraction to break the suction seal demonstrated similar findings.

DISCUSSION: The main finding of this study was that using a wider allograft (> 6.5mm) during CLR significantly increases the force and femoral distraction required to break the suction seal of the hip toward that of the intact labrum. The native labrum functions to distribute intraarticular cartilage surface pressure, effectively reducing contact stress on the hip joint. Previous studies demonstrate that labral resection decreases hip joint contact area and elevates femoroacetabular contact pressure, which has proven to be an independent predictor of early hip osteoarthritis. Thus, labral reconstructions that effectively maintain the function of the native labrum may reduce the potential towards hip osteoarthritis.

SIGNIFICANCE/CLINICAL RELEVANCE: The results of this cadaveric investigation suggest selecting a labral allograft with a width greater than 6.5mm during CLR will improve suction seal and therefore increase the immediate postoperative stability of the hip, although further studies are required to determine whether this translates to improved clinical outcomes.


Figure 1. Methods. The hip was housed in an acrylic tank secured to a mechanical testing system (A). The tank was filled with saline and heated to 37°C (B). Hips were tested intact, deficient, and after CLR with a >6.5mm graft (C) and a <6.5mm graft (D). G=graft, FH=femoral head, AM/PL=anteromedial/posterolateral aspect, A=acetabulum, LT=ligamentous teres

Figure 2. Force to break the suction seal for each condition. CLR with a smaller graft (<6.5mm) remained significantly lower than intact and was not statistically different compared to the deficient state. *p<0.05 compared to intact. **p<0.05 compared to CLR with a >6.5mm graft.