

The Effect of an Acetabular Labral Tear, Repair, Resection, and Reconstruction on the Hip Fluid Seal

Jeffrey J. Nepple, MD¹, Kevin J. Campbell, B.S.², Coen A. Wijdicks, PhD², Kyle Jansson, BS², Grant Dornan², Robert F. LaPrade, MD, PhD², Marc J. Philippon, MD²

¹Washington University Orthopaedics, St. Louis, MO, USA, ²Steadman Philippon Research Institute, Vail, CO, USA

Objectives: The acetabular labrum is theorized to have an important role in the normal function of the hip through the hip fluid seal. The hip fluid seal functions to create intra-articular fluid pressurization and stability to distractive forces. Yet, the effect of a labral tear or partial labral resection, and interventions including labral repair and labral reconstruction, on the hip fluid seal remain to be defined. The purpose of the current study was to characterize the hip fluid seal, including intra-articular fluid pressurization and stability to distraction, in six different labral conditions: (1) intact, (2) labral tear, (3) labral repair, (4) partial resection, (5) labral reconstruction with iliotibial band, and (6) complete resection. Additionally, the current study investigates the effect of looped (3a) and through (3b) type labral suture repairs on the hip fluid seal.

Methods: Eight cadaveric hips with a mean age of 47 (range 41-51) years were included in the study. Hips were compressed using an Instron testing device with a force of 2.7 times body weight (2118 N), simulating the single leg stance phase of gait, while intra-articular pressure was continuously measured with three miniature 1.0 x 0.3 mm pressure transducers. Additionally, the distractive strength of the hip fluid seal was recorded after each loading cycle. Three loading trials were performed for each labral condition. Specimens were randomized to looped or through type labral suture repairs within matched hips. Peak intra-articular pressures and distractive strength measurements for each condition were normalized relative to the intact state of each hip (percentage of intact state). Statistical analyses were performed utilizing a general linear model with repeated measures analysis for several predetermined comparisons of labral conditions.

Results: Intra-articular fluid pressurization of the intact state varied from 78 to 422 kPa, while the distractive strength of the hip fluid seal ranged from 124 to 150 N. Labral tear, partial resection, and complete resection resulted in average decreases in pressurization of 25%, 47%, and 76%, and decreases in distractive strength of 24%, 71%, and 73% respectively, compared to the intact state. Through type labral suture repair resulted in significantly greater improvement in fluid pressurization, compared to the labral tear state, than the looped type repair (+66.4% vs. -12.5%, $p=0.029$). Labral reconstruction resulted in a mean normalized pressurization of 110% and distraction of 66%, with an improvement in pressurization of 53% and distraction of 37% compared to a partial labral resection ($p=0.012$ and $p=0.021$, respectively). A moderate positive correlation between peak fluid pressurization and distractive strength was present (Pearson correlation coefficient 0.435, $p=0.016$).

Conclusion: The presence of a labral tear or partial labral resection results in decreases in intra-articular fluid pressurization and stability to a distractive force. Through type labral suture repair restores the hip fluid seal significantly better than a looped type repair at time zero. Labral reconstruction with an iliotibial band graft significantly improves pressurization (to levels similar to the intact state) and stability to distractive force, compared to a partial labral resection.

Figure 1. Experimental testing setup including (A) Instron, (B) potted femoral specimen, (C) potted acetabular specimen, and (D) heated saline bath.

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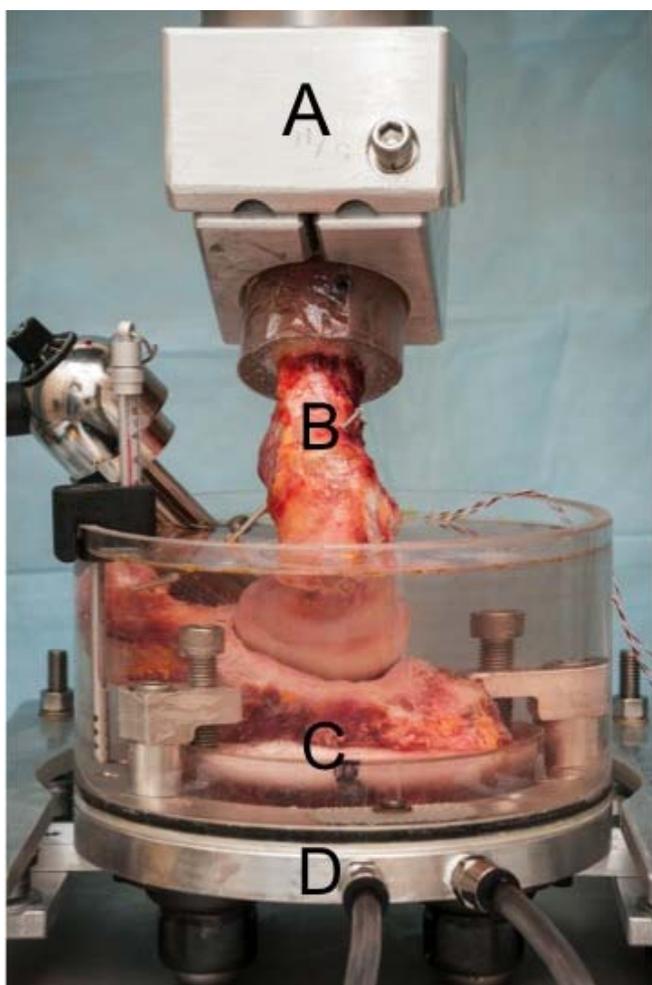


Table 1. Fluid Pressurization and Maximal Distractive Strength of Hip Seal for Each Labral Condition

	Fluid Pressurization		Maximal Distractive Strength	
	Mean (SD)	Mean Change from Intact	Mean (SD)	Mean Change from Intact
Intact	100%		100%	
Labral Tear	75.1% (32.8)	-24.9%	75.6% (34.4)	-24.4%
Labral Repair	102.1% (68.7)	+2.1%	84.0% (19.8)	-16.0%
-Looped repair	69.8% (39.0)	-30.2%	75.2% (24.0)	-24.8%
-Through repair	134.3% (82.0)	+34.3%	92.1% (12.1)	-7.9%
Partial Resection	53.2% (37.4)	-46.8%	29.2% (26.4)	-70.8%
Labral Reconstruction	109.5% (37.8)	+9.5%	66.0% (35.1)	-34.0%
Complete Resection	24.1% (17.7)	-75.9%	26.9% (22.0)	-73.1%