Surgical Reconstruction for Chronic Hamstring Injury: A Biomechanical study

Justin F.M. Hollenbeck[1], Alexander R. Garcia[1], Haruki Nishimura[1], Kohei Yamaura[1], Kohei Stetzelberger[1], Justin R. Brown[1], Scott Tashman[1], Mitchell S. Mologne[1], Wyatt H. Buchalter[1], Soshi Uchida[1], Marc J. Philippon[2]
[1]Steadman Philippon Research Institute, Vail, CO, [2]The Steadman Clinic, Vail, CO
Jhollenbeck@sprivail.org

Disclosures: Justin F.M. Hollenbeck (N), Alexander R. Garcia (N), Haruki Nishimura (N), Kohei Yamaura (N), Vera Stetzelberger (N), Justin R. Brown (N), Scott Tashman (N), Mitchell S. Mologne (N), Wyatt H. Buchalter (N), Soshi Uchida (N), Marc J. Philippon **(**1-Smith+Nephew, Arthrosurface, Bledsoe, ConMed Linvatec, DJO, SLACK, and Elsevier; 4-Arthrosurface, MJP Innovations, Vail Valley Surgery Center, Vail MSO Holdings, MIS, EffRx, Olatec, iBalance (Arthrex), Manna Tree Partners, Stryker, Trimble, 3M, Bristol Myers Squibb, Pfizer, AbbVie, and Johnson & Johnson; 8-The International Society for Hip Arthroscopy; 9-Steadman Philippon Research Institute and Vail Health; 5-Smith+Nephew, ConMed Linvatec, Ossur, Arthrex, Siemens Medical Solutions, and Steadman Philippon Research Institute (SPRI). SPRI is a a 501(c)(3) non-profit institution supported financially by private donations and corporate support, including Arthrex, DJO, MLB, Ossur, Siemens, Smith & Nephew and XTRE; 2,3B-Smith+Nephew, MIS, Olatec, and NICE Recovery Systems**)**

INTRODUCTION: Over 700,00 musculoskeletal injuries were recorded in 2006 with nearly 4% of these injuries involving the pelvis, hip, and thigh region. Proximal hamstring injuries are common with athletes, but, in the chronic phase, the treatment is more challenging. Surgical reconstruction utilizing autografts is often required in chronic cases whose hamstring has retracted more than 5 cm. However, no prior biomechanics studies have evaluated the reconstructive procedures that utilize the two most popular autografts, distal hamstring (DH) and fascia lata (FL). The purpose of this study is to compare the failure load and elongation at failure between the proximal hamstring tendon reconstruction with DL and FL, and the stiffness between these two reconstructions and the native state.

METHODS: Seven pairs of human cadaveric hemi-pelvises with no evidence of prior injury or abnormality were dissected to the proximal hamstring origin. The specimens were mounted to a dynamic tensile testing machine with the potted bone secured to the machine base, and the tendon clamped to the end effector of the testing machine. Each specimen underwent a 1 Hz cyclic loading protocol with loads cycling from 25 N to a maximum load that increments by 75 N every 50 cycles. After this cyclic loading step, the tendon was distracted to 20 mm to determine the stiffness of the native specimen. Each pair of specimens was then assigned to undergo a proximal hamstring reconstruction with DH and a reconstruction with FL. After reconstruction, each specimen underwent the same cyclic loading protocol followed by a pull to failure. The failure load, elongation at failure, and mode of failure were determined for each repair, and stiffness of each repair was calculated as the slope of the linear portion of each specimen's force-displacement curve.

RESULTS: The DH group exhibited stronger failure load (334±108 N; $p = 0.0081$) and significantly higher stiffness (47.6±16.0 N/mm; $p = 0.0085$) than the FL group (179±78 N; 23.0±11.2 N/mm). While stiffness of the repair state in the DH group (61.4±13.4 N/mm) was not significantly different than the native state (47.6±16.0 N/mm), stiffness of the repair state in the FL group (23.0±11.2 N/mm) was significantly lower than the native state (60.1±17.7 N/mm; $p < 0.0001$).

DISCUSSION: The DH group was superior to the FL group in terms of failure load and stiffness, and stiffness of the DH group was equivalent to the native tendon. The proximal hamstring reconstruction with distal hamstring grafts should be the preferred surgical treatment for chronic hamstring injury over reconstruction with fascia lata grafts. The failure load of reconstruction with DH was inferior to primary suture anchor, suggesting that rehabilitation after reconstruction should not be more aggressive than standard postoperative rehabilitation protocol for acute repair.

CLINICAL RELEVANCE: This study demonstrated that the proximal hamstring reconstruction with distal hamstring grafts should be the preferred surgical treatment for chronic hamstring injury over that reconstruction with fascia lata grafts. However, the biomechanical strength of reconstruction with distal hamstring graft is inferior to that of primary suture anchor repair, suggesting that rehabilitation after the reconstruction should not be more aggressive than the current standard postoperative rehabilitation protocol for acute hamstrings injury.

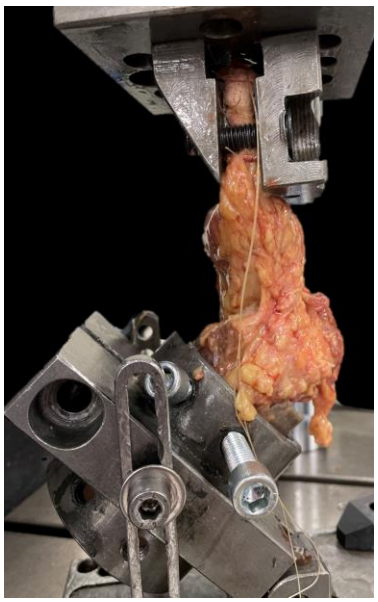

Fig. 1. Mechanical testing set up.

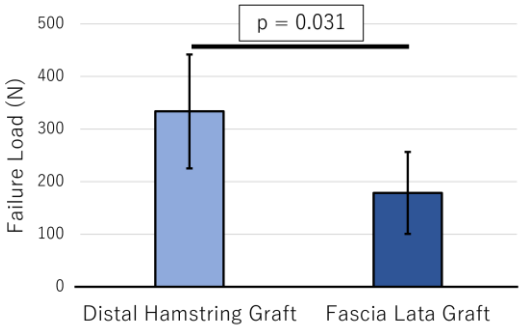

Fig. 2. Failure load of DH and FL reconstructions.

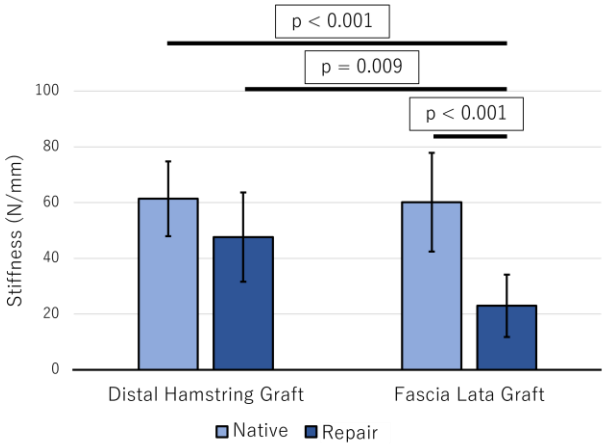

Fig. 3. Stiffness of DH and FL reconstructions.