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Structural Properties of the Intact Proximal Hamstring Origin and Evaluation of Varying Avulsion Repair Techniques: An In Vitro Biomechanical Analysis

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Summary:
This study provides evidence for clinically utilizing a five small (5S) anchor repair for proximal hamstring tears due to no significant difference between this studied repair technique and the intact biomechanical properties.

Abstract:
BACKGROUND
Although surgical repair has been reported to provide improved outcomes compared to non-operative treatment in the management of complete proximal hamstring origin avulsions, no intact or avulsion repair biomechanical data exist to support various repair strategies or guide postoperative rehabilitation.

PURPOSE
To compare failure load among four proximal hamstring tendon conditions: 1) intact, 2) repair with two small anchors (2S), 3) repair with two large anchors (2L), and 4) repair with five small anchors (5S).

METHODS
Twenty-four human cadaveric hemi-pelvises were randomly allocated to one of the four testing groups. Intact and repaired specimens were subjected to cyclic loading at 1 Hz between 25 N and a progressively increasing maximum load that was incremented by 200 N every 50 cycles, beginning at 200 N and increasing to 1600 N. Displacement, maximum load, stiffness, number of cycles to failure, and mode of failure during cyclic loading were recorded and analyzed.

RESULTS
The intact proximal hamstring tendons failed at the highest cyclic force of all tested groups; yet, no significant differences existed between the intact (1405 ± 157 N) and 5S repair (1164 ± 294 N) conditions. Both the 2S and the 2L repair groups failed at a level significantly lower than that of the intact hamstring (474 ± 145 N; $p < 0.001$ and 543 ± 245 N; $p < 0.001$, respectively). The maximum load attained by the 5S repair was significantly greater than the 2S ($p = 0.005$) and 2L ($p = 0.013$) repairs.

CONCLUSION
Repairs utilizing five small anchors (5S) were similar to the intact tendon and were significantly stronger than those using only two large (2L) or two small (2S) anchors in the repair of complete avulsions of the proximal hamstring tendons. Additionally, no significant differences in strength were observed when only anchor size differed.

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CLINICAL RELEVANCE
The 5S repair demonstrated no significant difference in ultimate failure when compared to the intact proximal hamstring and was significantly stronger than repairs with two small or large anchors. This finding supports the clinical investigation of post-operative range of motion rehabilitation protocols that permit full flexion and extension of the hip and knee when a five-anchor repair construct is utilized.