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Biomechanical comparison of Superior Capsule Reconstruction with Autograft versus Allograft

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Poster #18

Disclosure of Interest

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- Dr. Koh serves/has served in a leadership role in: AAOS, ACL Study Group, American Orthopaedic Society for Sports Medicine, International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine, American Shoulder and Elbow Surgeons, Arthroscopy Association of North America, Herodicus Society, Illinois Assocation of Orthopaedic Surgeons, International Patellofemoral Study Group, Orthopaedic Journal of Sports Medicine/AOSSM, and Patellofemoral Foundation
- Dr. Athiviraham serves/has served in a leadership role in: AAOS, Arthroscopy Association of North America, American Orthopaedic Association, Arthroscopy: The Journal of Arthroscopic and Related Surgery, American Orthopaedic Society for Sports Medicine, Video Journal of Sports Medicine

Background

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- Superior Capsule Reconstruction (SCR) allows for the repair of irreparable rotator cuff tears in the younger active patient population
- While the use of various graft materials has been described, the choice of using an autograft versus an allograft remains unclear

Objectives

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- This study aimed to biomechanically investigate SCR with the use of a long head of the biceps tendon (LHBT) autograft and human dermal (HD) allograft in regard to functional abduction force and superior translation of the humeral head.

Materials and Methods

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- 8 cadaveric shoulders were dissected to remove all soft tissue except humeral insertions for supraspinatus, infraspinatus, teres minor, subscapularis, deltoid, pectoralis major, and latissimus dorsi
- Using custom apparatus, muscle tendons were loaded with weights via pulleys to achieve balanced state
- Specimens were tested in 5 conditions: (1) intact, (2) complete supraspinatus tear, (3) LHBT autograft, (4) LHBT autograft with side-to-side suturing, and (5) HD allograft with side-to-side suturing

Materials and Methods (continued)

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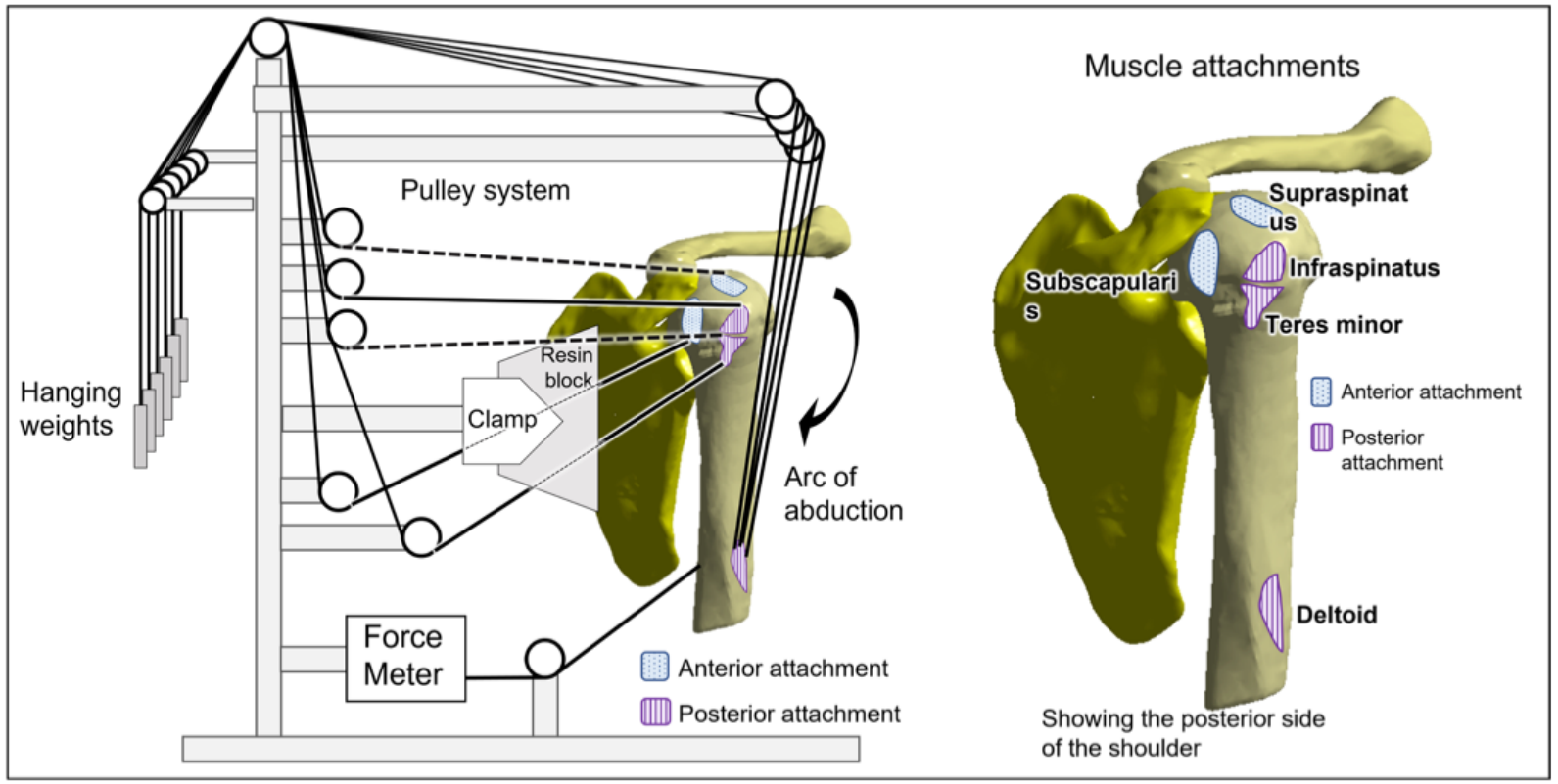
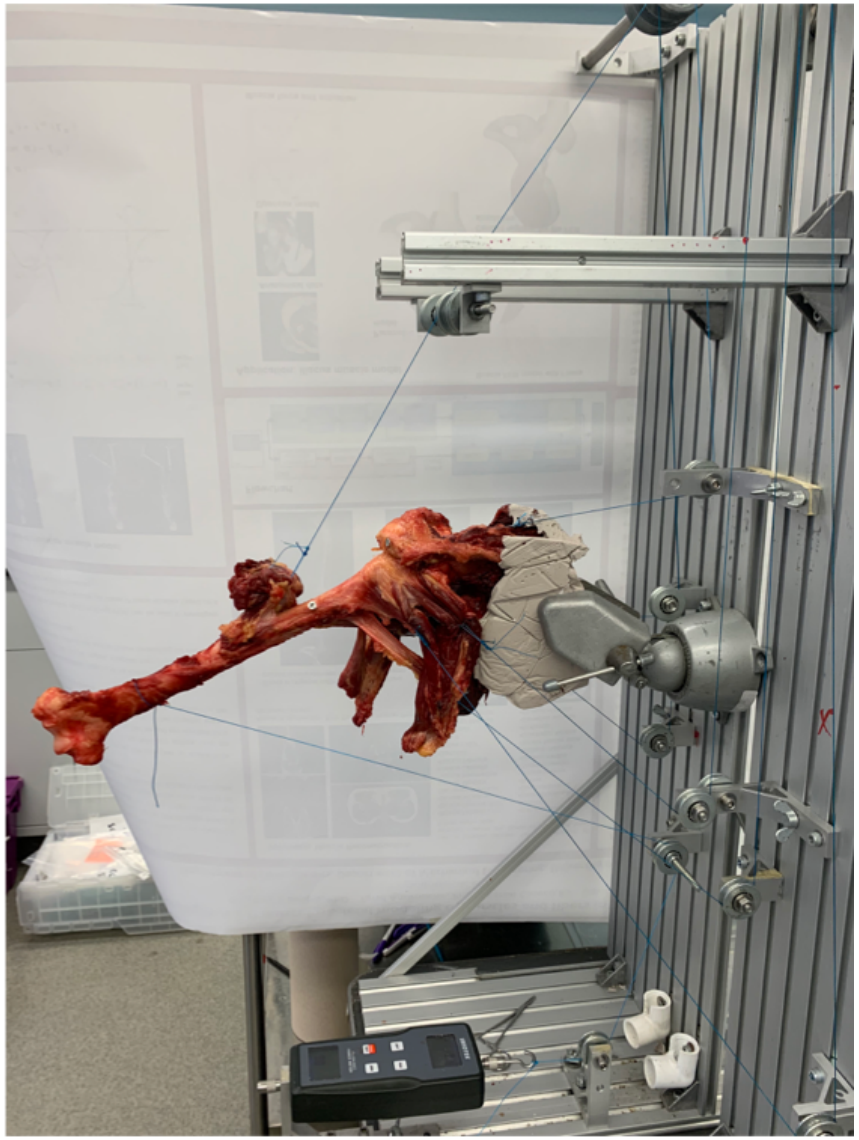
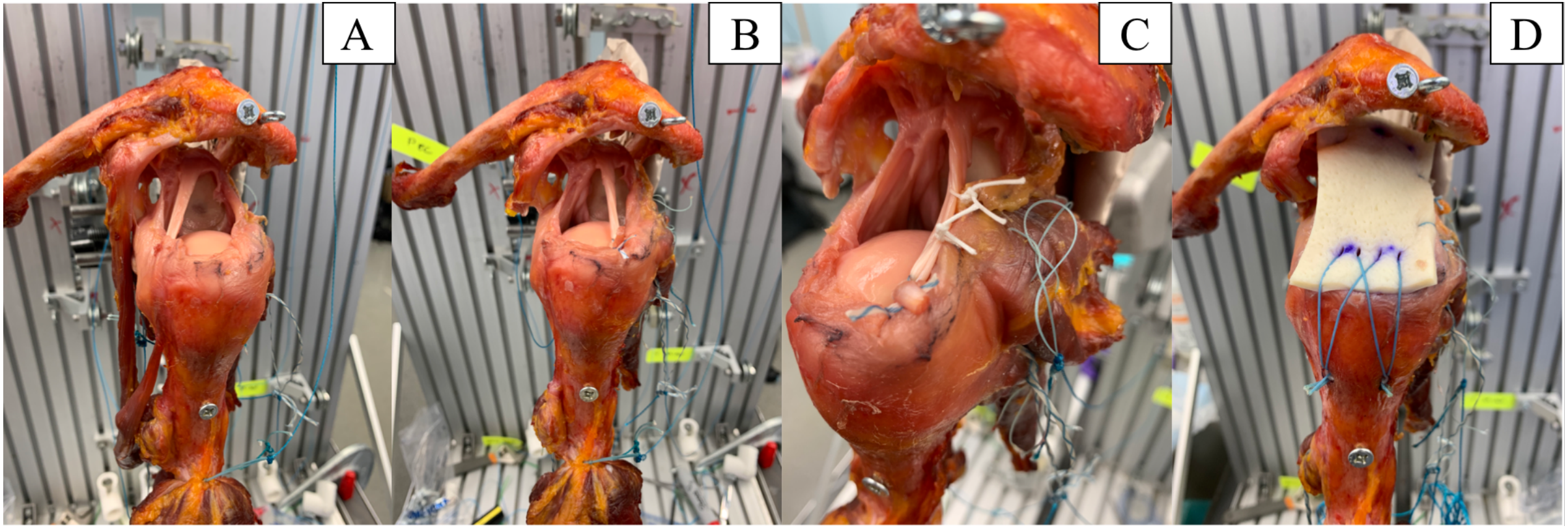
- Functional abduction force, superior translation of the humeral head, translational range of motion, and rotational range of motion were tested at 0º, 30º, 60º, and 90º of abduction within each condition.
- Data was analyzed using analysis of variance with post-hoc Tukey testing for pairwise comparison, with a significance value set at 0.05.


Pulley system
Hanging weights
Resin block
Clamp
Arc of abduction
Force Meter
Anterior attachment
Posterior attachment
Muscle attachments
Supraspinatus
Infraspinatus
Subscapularis
Teres minor
Deltoid
Anterior attachment
Posterior attachment
Showing the posterior side of the shoulder





- (A) torn supraspinatus condition exposing the intact biceps tendon, (B) long head of the biceps tendon (LHBT) where the tendon was tenotomized underneath the bicipital groove and anchored in the footprint of the supraspinatus tendon, (C) LHBT+ suture, where posterior side-to-side suturing was added (white suture shown), and (D) human dermal allograft where posterior side-to-side suturing was added (HD+ suture; blue suture shown)

Results

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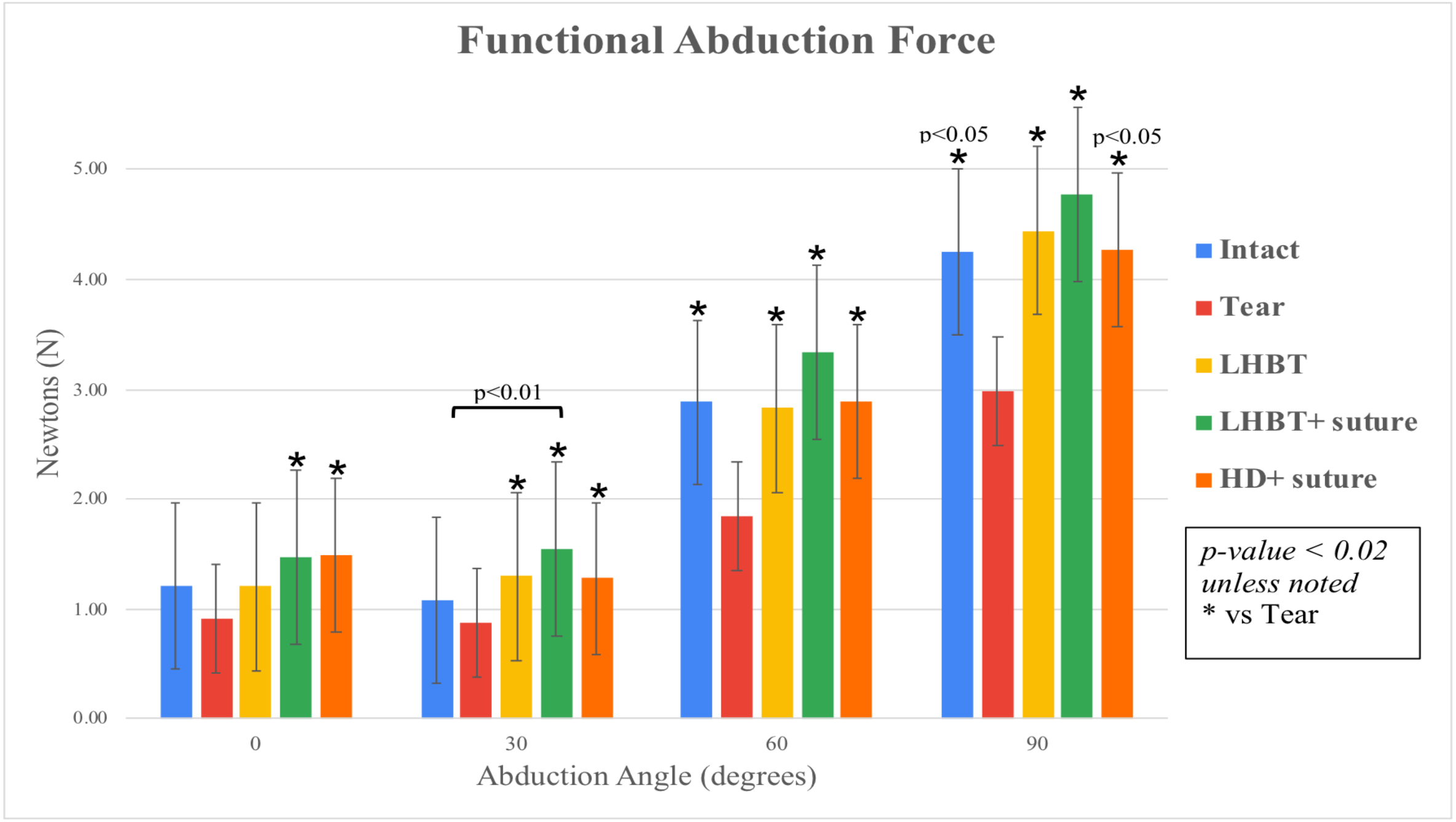
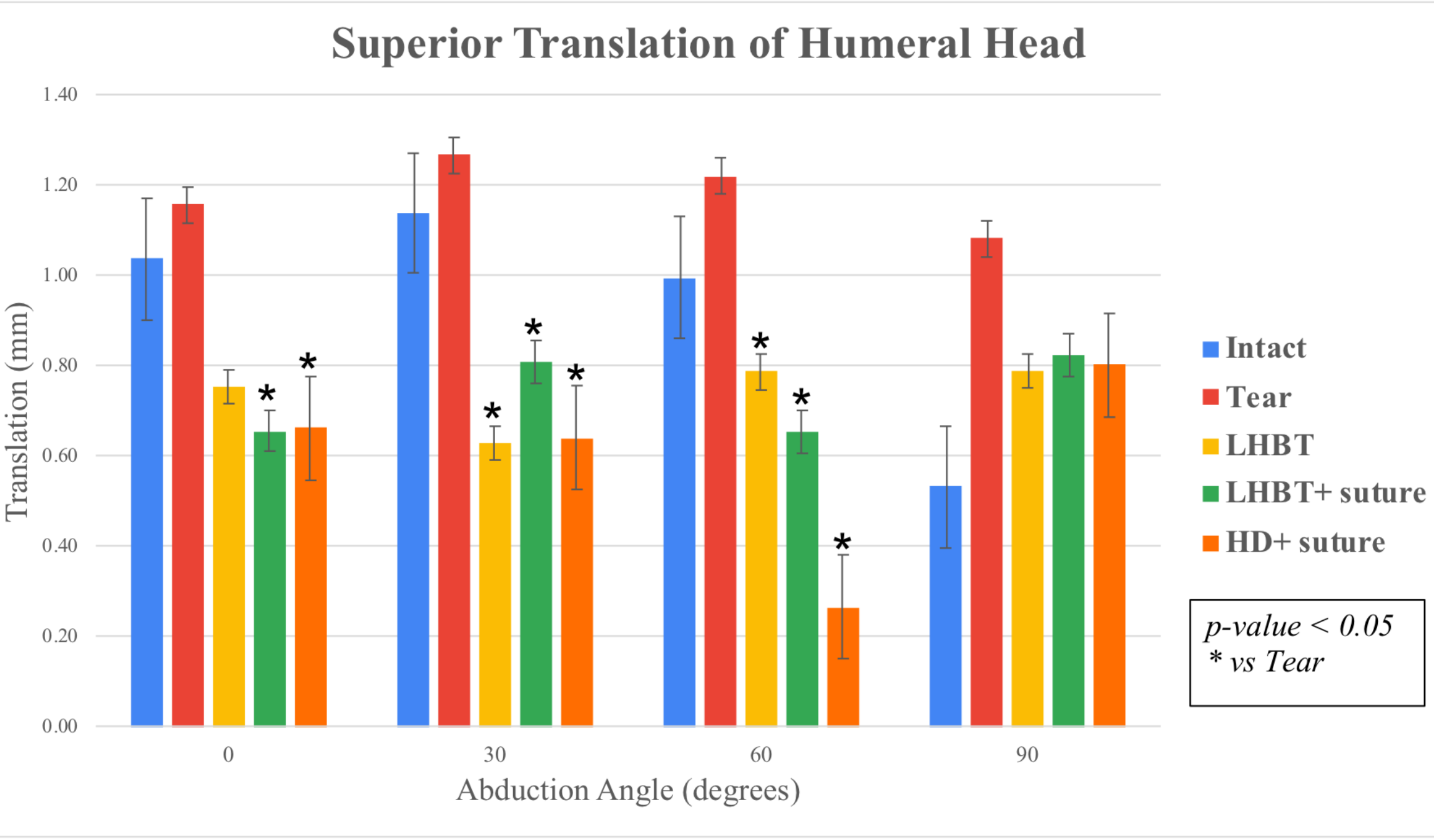
- Functional abduction force in the LHBT, LHBT+ suture, and HD+ suture conditions was significantly increased compared to the supraspinatus tear condition at abduction angles of 30º (p=0.011, 0.001, and 0.017 respectively), 60º (p=0.004, 0.001, and 0.002 respectively), and 90º (p=0.013, 0.001, and 0.038 respectively).
- Superior translation of the humeral head in the LHBT, LHBT+ suture, and HD+ suture conditions was significantly decreased compared to the tear condition at abduction angles of 30º (p=0.03, 0.049, 0.03 respectively) and 60º (p=0.02, 0.04, 0.03 respectively).
- All 3 reconstructive techniques were statistically identical to the intact rotator cuff condition in regard to translational and rotational range of motion.


Functional Abduction Force
Newtons (N)
5.00
4.00
3.00
2.00
1.00
0.00
p<0.01
p<0.05
p<0.05
*
0
30
60
90
Abduction Angle (degrees)
Intact
Tear
LHBT
LHBT+ suture
HD+ suture
p-value < 0.02 unless noted
* vs Tear


Superior Translation of Humeral Head
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Translation (mm)
0
30
60
90
Abduction Angle (degrees)
Intact
Tear
LHBT
LHBT+ suture
HD+ suture
p-value < 0.05
* vs Tear

	Abduction angle			
Functional Abduction Force (N)	**0º**	**30º**	**60º**	**90º**
Intact	1.22 (1.15-1.29)	1.08 (0.99-1.16)	2.88 (2.35-3.41)	4.25 (3.53-4.97)
Tear	0.92 (0.78-1.06)	0.87 (0.74-0.99)	1.85 (1.61-2.07)	2.98 (2.54-3.41)
LHBT	1.20 (1.03-1.38)	1.30 (1.07-1.53)	2.83 (2.59-3.07)	4.45 (3.98-4.92)
LHBT+suture	1.47 (1.17-1.76)	1.55 (1.31-1.79)	3.35 (2.96-3.73)	4.78 (4.04-5.52)
HD+suture	1.49 (1.18-1.8)	1.28 (1.1-1.46)	2.89 (2.46-3.31)	4.28 (3.57-4.98)
P-value				
Tear vs LHBT	0.36	0.011*	0.004*	0.013*
Tear vs LHBT+suture	0.006*	0.001*	0.001*	0.001*
Tear vs HD+suture	0.003*	0.017*	0.002*	0.038*
Intact vs Tear	0.32	0.49	0.002*	0.044*
LHBT+suture vs Intact	0.41	0.004*	0.45	0.74

Conclusions

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- SCR with LHBT autograft without side-to-side suturing, LHBT with posterior side-to-side suturing, and HD allograft with posterior side-to-side suturing all equivalently restore functional abduction force and decrease superior translation of the humeral head after a complete supraspinatus tear.

Significance

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- To our knowledge, only a few studies have used functional abduction force as an outcome in cadaveric biomechanics research related to SCR
- Our study builds on previous research by directly comparing SCR with a dermal allograft and a biceps tendon autograft

Limitations

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- Static loading of the muscles was used during shoulder testing to approximate *in vivo* muscle loading, similar to the methodology described in previous studies
- Scapulothoracic motion was restricted, differing from physiologic shoulder movement in which both glenohumeral and scapular motion contribute to arm elevation, in accordance with previous biomechanical studies.