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The TENDON SEAM Construct: a biomechanical evaluation of gap formation, strength and durability under cyclic loading[1]

Triplet JJ, Harris HW, Connor PM et al. Biomechanical analysis of rotator cuff repair utilizing the tendon-to-bone seam technique. *Muscles Ligaments Tendons J.* 2026;16(3).

Available at: Muscle, Ligaments and Tendons Journal



Background

- RCR (Rotator Cuff Repair) has clinical challenges, including repair failure in 20–40% of repairs (up to 90% in some studies) and a prolonged period of immobilization and rehabilitation[2,3]
- The tendon-bone interface is a key area of consideration in RCR, requiring adequate footprint contact and compression, together with minimal movement while tendon-to-bone healing takes place[4]
- The TENDON SEAM Construct uses a transtendinous technique with multiple fixation points, designed to distribute compressive forces across the footprint to reduce stress at each anchor[5]

Scan or click to learn more about the TENDON SEAM Construct in Arthoscopy Techniques

Key points

When results of biomechanical testing in human cadavers were benchmarked against prior literature on knotless and knotted TOE, the TENDON SEAM Construct demonstrated:



10x **less** gap formation[1,6,7]



2x **stronger** repair (measured by yield strength)[1,6,7]



Ability to maintain integrity under loads estimated to be experienced during healing*[1,8]

Study overview

- A cadaveric model (n=11) was used to simulate surgical repair of full-thickness supraspinatus tears (approximately 2–3cm) and evaluate the biomechanical performance of the TENDON SEAM Construct[1]
- **TENDON SEAM Construct:**[1,5]
  - The TENDON SEAM Construct was comprised of a medial seam perpendicular to the direction of load, interconnected to a 'zig-zag' pattern laterally, created with individually tensioned 2 x 10mm toggling PEEK anchors (Figure 1)
- Previously published TOE repair data was used as the comparator[6,7]



Figure 1. TENDON SEAM Construct



Figure 2. Comparator TOE

The TENDON SEAM Construct biomechanical testing protocol[1]

The repaired tissue (n=11) underwent cyclic loading:

- 30 cycles from 10N to 180N to align with historical testing protocols
- 500 cycles from 4N to 302N to further challenge the construct at the high end of functional loads

Endpoints

- Gap formation (mm): displacement between lateral edge of tendon and bone after loading
- Yield load (N): force where permanent deformation begins

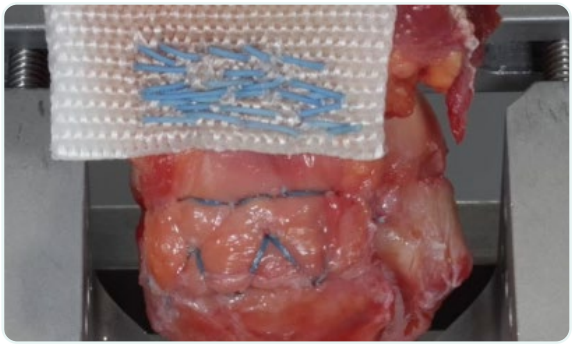

Figure 3. Biomechanical testing example image

*As measured by gap formation, 500 cycles from 4N to 302N to further challenge the construct at the high end of functional loads estimated to be experienced during healing period and activities of daily living.[8]

Results: comparative summary

Table 1. The TENDON SEAM Construct demonstrated lower gap formation, higher load tolerance, and maintained integrity under cyclic loading when compared to literature on TOE techniques

Measure	TENDON SEAM Construct[1]*	Knotted TOE[6†]	Knotless TOE[7†]
Gap formation, 1 cycle @180N (mm ± SD)	0.30 ± 0.47	2.38 ± 0.84	5.05 ± 1.93
Gap formation, 30 cycles @180N (mm ± SD)	0.33 ± 0.55	3.74 ± 1.51 (p=0.003)[‡]	8.10 ± 3.76 (p=0.004[‡])
Gap formation 500 cycles @302N (mm ± SD)	0.90 ± 1.03	Not studied	Not studied
Gap formation at yield (mm ± SD)	1.21 ± 1.26	6.11 ± 1.97 (p=0.001)[‡]	9.91 ± 3.34 (p=0.002)[‡]
Yield strength (N)	600.7 ± 93.6	260.3 ± 69.5	183.0 ± 41.0

SD = standard deviation.
*Biomechanical testing in human cadavers. †TOE data from published literature. ‡Compared to TENDON SEAM Construct.

Key results

TENDON SEAM demonstrated at least ten times less gap formation under cyclic loading compared with that reported in the literature for TOE repair.

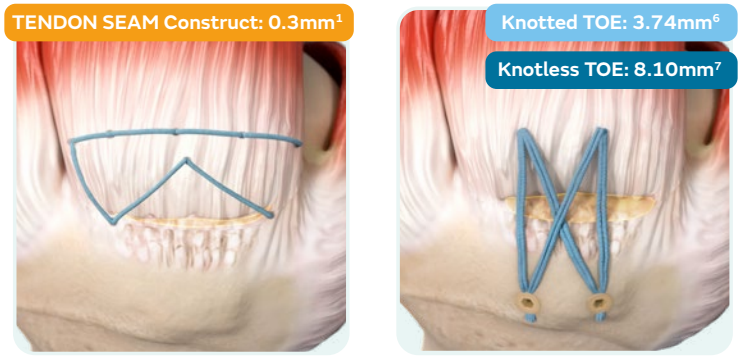

Figure 4. Illustrative comparison of gap formation for TENDON SEAM Construct and TOE after 30 cycles at 180N

*Biomechanical testing in human cadavers. †TOE data from published literature.
‡Compared to TENDON SEAM Construct[1].

TENDON SEAM demonstrated more than twice the strength compared to literature on TOE repair in biomechanical testing (Figure 5).

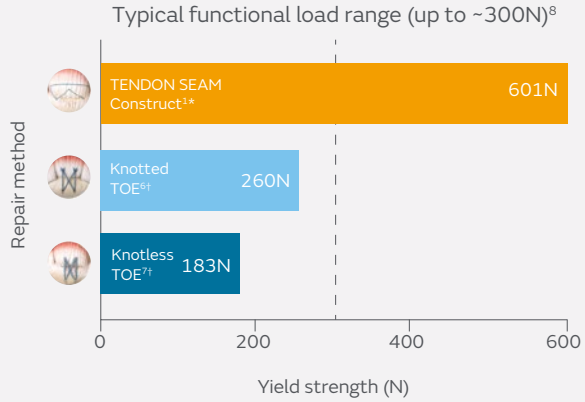

Figure 5. Repair with the TENDON SEAM Construct is stronger than both TOE techniques

Conclusions

In a biomechanical model, the TENDON SEAM Construct demonstrated lower gap formation, higher load tolerance, and maintained integrity throughout cyclic loading compared with published transosseous-equivalent repair data, supporting the potential to aid in recovery and early mobility.

Abbreviations: N = newton (SI unit of force); PEEK = polyether ether ketone; RCR = rotator cuff repair; SD = standard deviation; TOE = transosseous-equivalent.

References: 1. Triplet JJ, Harris HW, Connor PM, et al. Biomechanical analysis of rotator cuff repair utilizing the tendon-to-bone seam technique. *Muscles Ligaments Tendons J.* 2026;16(3). **2.** Swansen T, Wright MA, Murthi AM. Postoperative rehabilitation following rotator cuff repair. *Phys Med Rehabil Clin N Am.* 2023;34(2):357–364. **3.** Young BL, Bitzer A, Odum S, Hamid N, Shiffern S, Connor PM. Healthcare costs of failed rotator cuff repairs. *JSES Rev Rep Tech.* 2023;3(3):318–323. **4.** Rossi LA, Rodeo SA, Chahla J, Ranalletta M. Current concepts in rotator cuff repair techniques: biomechanical, functional, and structural outcomes. *Orthop J Sports Med.* 2019;7(9):2325967119868674. **5.** Frix JT, Serbin R, Harris HW, Labbe MR, Connor PM. The tendon-to-bone seam: a transtendinous approach to rotator cuff repair. *Arthrosc Tech.* 2026;15(8):e70093. **6.** Park MC, Tibone JE, ElAttrache NS, Ahmad CS, Jun BJ, Lee TQ. Part II: biomechanical assessment for a footprint-restoring transosseous-equivalent rotator cuff repair technique compared with a double-row repair technique. *J Shoulder Elbow Surg.* 2007;16(4):469–476. **7.** Busfield BT, Glousman RE, McGarry MH, Tibone JE, Lee TQ. A biomechanical comparison of 2 technical variations of double-row rotator cuff fixation: the importance of medial row knots. *Am J Sports Med.* 2008;36(5):901–906. **8.** Burkhart, SS. A stepwise approach to arthroscopic rotator cuff repair based on biomechanical principles. *Arthroscopy.* 2000.16(1):82–90.

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