



Biomechanical Comparison of Knotted Transosseous Equivalent Versus Knotless Transosseous Equivalent Rotator Cuff Repair Techniques: A Systematic Review



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Background

Biomechanical studies evaluating rotator cuff repair techniques have shown that double-row and transosseous-equivalent (TOE) repairs are superior to single-row repairs in terms of strength and healing. There are limited studies that compare the biomechanical outcomes of knotted TOE versus knotless TOE rotator cuff repair techniques.

Purpose

The purpose of this study was to systematically review the literature in order to compare the biomechanical outcomes of knotted transosseous equivalent (TOE) and knotless transosseous equivalent (KL-TOE) rotator cuff repair (RCR) techniques. We hypothesized that biomechanical studies would show that knotted TOE rotator cuff repairs produce superior biomechanical outcomes compared to KL-TOE repairs in regard to reduced gap formation and improved stiffness, yield load, ultimate load, footprint contact area, and footprint pressure.

Methods

A systematic review was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines using PubMed, Embase, and the Cochrane Library to identify studies that compared the biomechanical outcomes of knotted TOE and KL-TOE (Speed-bridge) rotator cuff repair techniques. The search phrase used was (Double Row) AND (rotator cuff) AND (repair) AND (biomechanical). Data pertaining to the biomechanical properties of each surgical technique were extracted from each study.

Figure 1. PRISMA Flow Chart. Identifies the number of studies reviewed and the main reasons for exclusion.

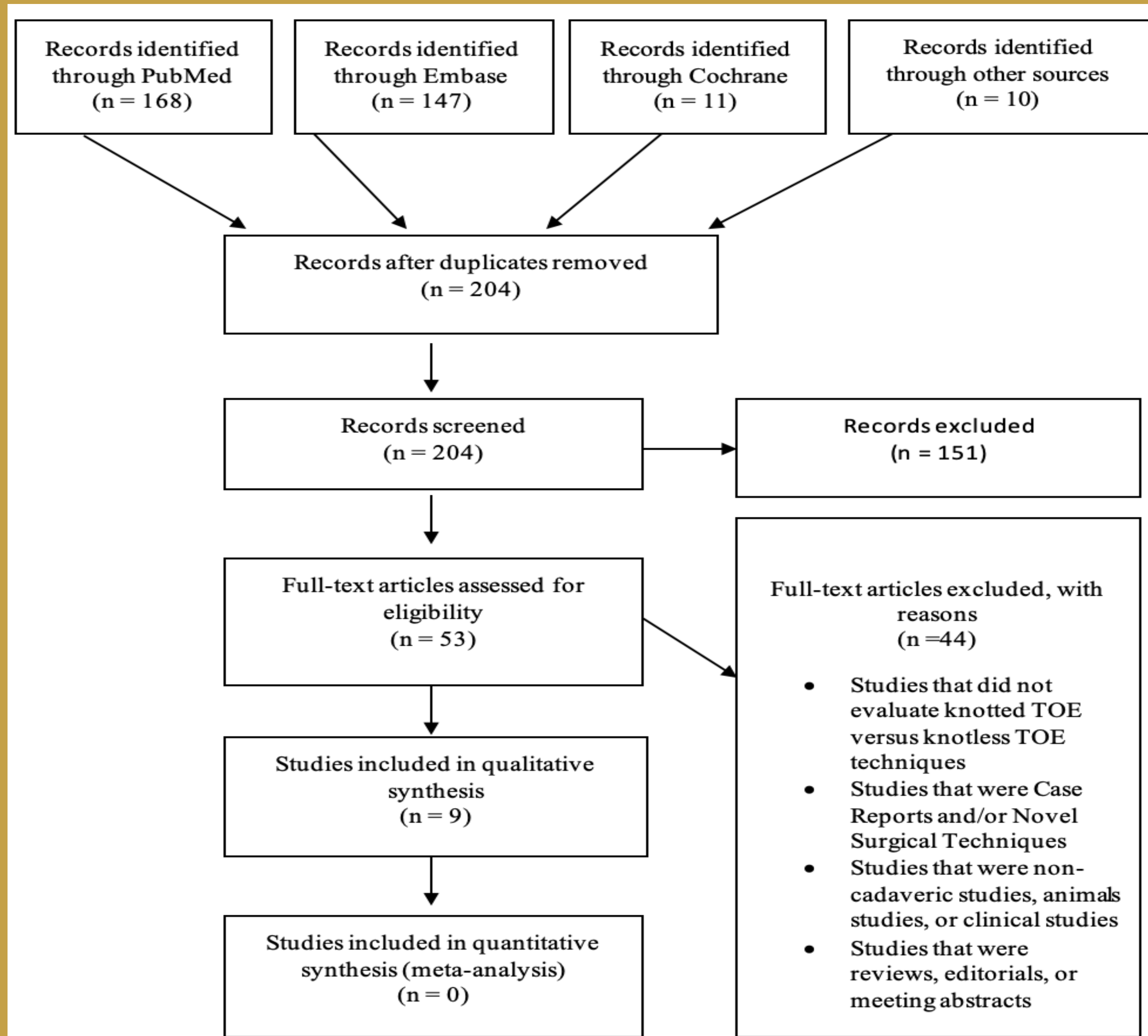
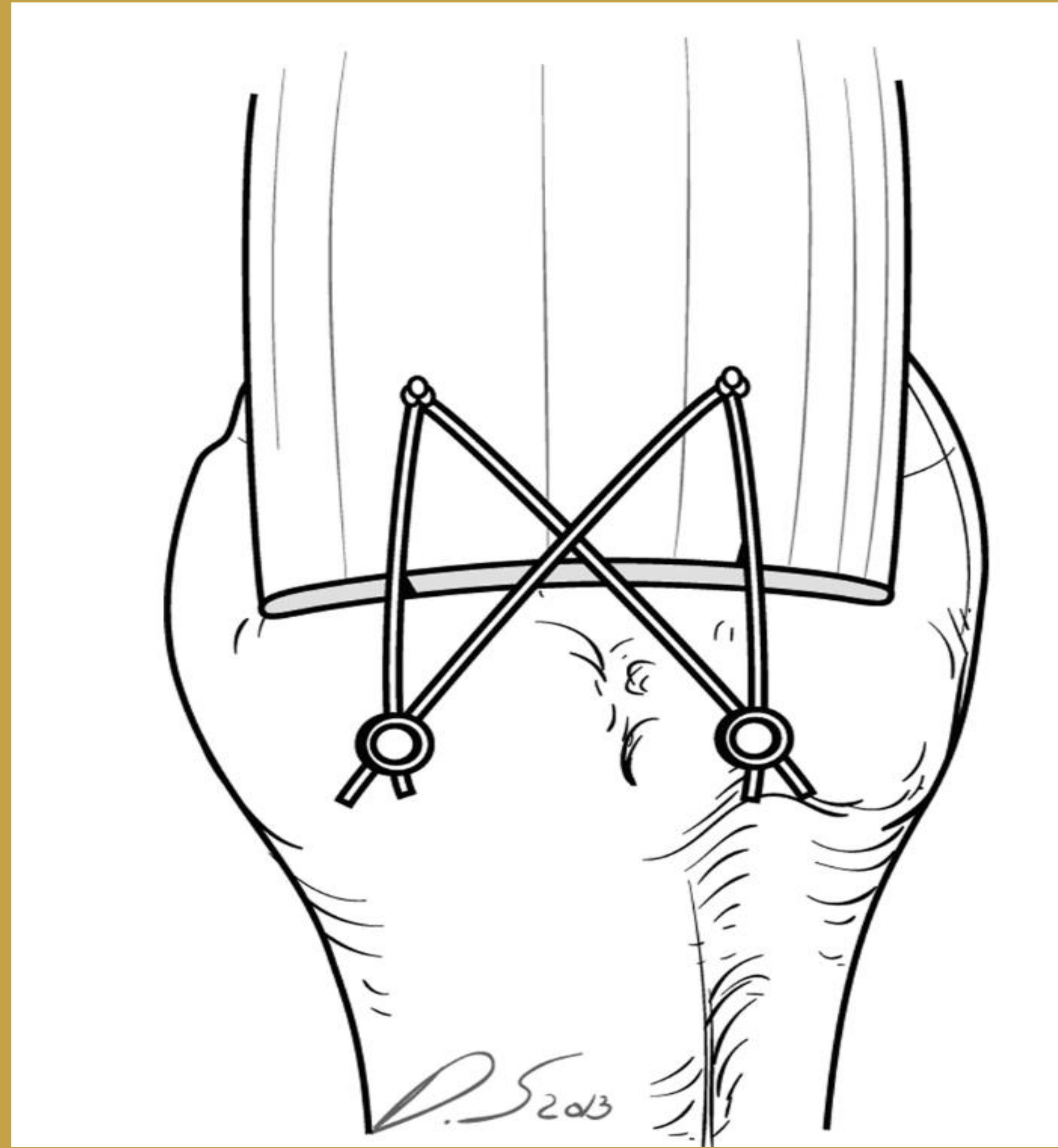


Figure 2. Knotted TOE Surgical Technique. One variation of the knotted medial row technique⁴



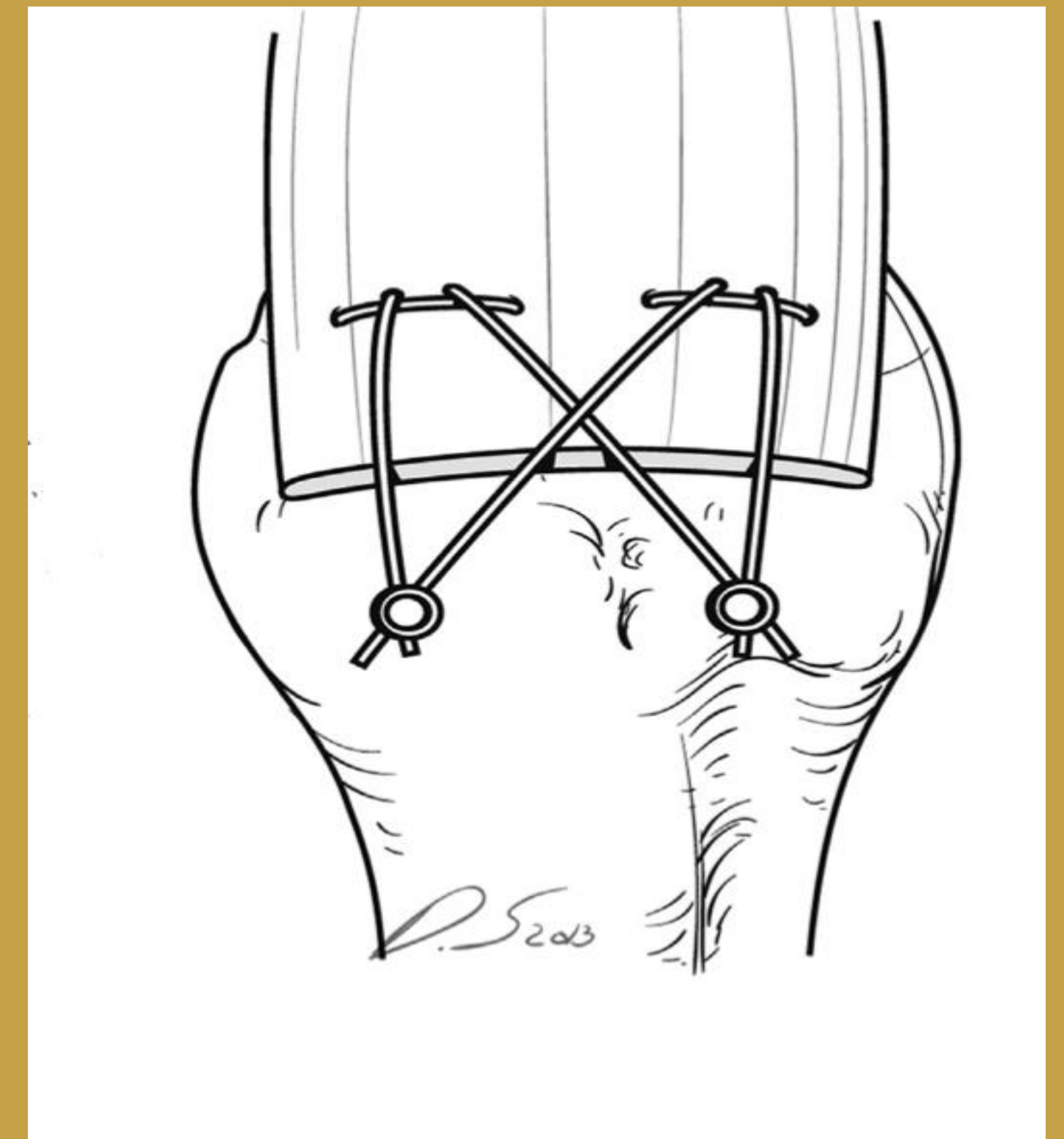
Results

A total of 9 studies (150 cadaveric shoulders) met the inclusion criteria. Of the 9 studies, 6 showed improved biomechanical properties using the knotted TOE method compared to KL-TOE RCR technique. Ultimate load to failure ranged from 310 ± 82 N to 549 ± 163 N in knotted TOE repairs while ranging from 166 ± 87 N to 416.8 ± 120.0 N in KL-TOE repairs. 1 study found no significant difference in medial row fixation point displacement, construct stiffness, and ultimate load to failure when comparing knotted and knotless medial anchor fiberwire sutures in a transosseous-equivalent double-row rotator cuff repair. Of the remaining 2 studies, 1 indicated that KL-TOE repair shows an improved self-reinforcement effect, without diminishing footprint contact, compared to the same repair with medial knots. The other study suggested that the strain at the medial suture level was significantly greater when the medial sutures were tied compared with those untied. Qualitative and quantitative analyses of the data are still underway, furthermore the data must be evaluated for biases before final conclusions can be drawn.

Discussion/Conclusions

The preliminary results of this systematic review indicate that the biomechanical properties of yield load, ultimate load, footprint contact area, and footprint pressure are significantly improved with reduced gap formation in knotted TOE rotator cuff repairs compared to KL-TOE repairs. The knotted medial stitch increases the strength of the construct, but some studies found it may also increase tears. Clinical outcomes with specific indications based upon these findings require further investigation.

Figure 3. Knotless TOE Surgical Technique. One variation of the knotless medial row technique⁴



References

1. 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 May;36(5):901-6. doi: 10.1177/0363546507312640. Epub 2008 Mar 6. PMID: 18326033.
2. Chu T, McDonald E, Tufaga M, Kandemir U, Buckley J, Ma CB. Comparison of completely knotless and hybrid double-row fixation systems: a biomechanical study. *Arthroscopy.* 2011 Apr;27(4):479-85. doi: 10.1016/j.arthro.2010.09.015. Epub 2011 Feb 1. PMID: 21277733.
3. Kaplan K, ElAttrache NS, Vazquez O, Chen YJ, Lee T. Knotless rotator cuff repair in an external rotation model: the importance of medial-row horizontal mattress sutures. *Arthroscopy.* 2011 Apr;27(4):471-8. doi: 10.1016/j.arthro.2010.11.006. PMID: 21444008.
4. Kim SJ, Kim SH, Moon HS, Chun YM. Footprint Contact Area and Interface Pressure Comparison Between the Knotless and Knot-Tying Transosseous-Equivalent Technique for Rotator Cuff Repair. *Arthroscopy.* 2016 Jan;32(1):7-12. doi: 10.1016/j.arthro.2015.07.004. Epub 2015 Sep 15. PMID: 26382638.
5. Mijares MR, Hiller A, Alhandi A, Kaimrajh D, Milne T, Latta L, Baraga MG. Is it necessary to tie the medial row in rotator cuff repair double-row constructs when using suture tape? *J Clin Orthop Trauma.* 2020 May;11(Suppl 3):S378-S382. doi: 10.1016/j.jcot.2020.02.007. Epub 2020 Feb 21. Erratum in: *J Clin Orthop Trauma.* 2020 Sep 26; PMID: 32523297; PMCID: PMC7275275.
6. Nagamoto H, Yamamoto N, Shiota Y, Kawakami J, Muraki T, Itoi E. Transosseous-equivalent repair with and without medial row suture tying: a cadaveric study of infraspinatus tendon strain measurement. *JSES Open Access.* 2017 Jun 28;1(2):104-108. doi: 10.1016/j.jses.2017.05.001. PMID: 30675549; PMCID: PMC6340858.
7. Park MC, Peterson AB, McGarry MH, Park CJ, Lee TQ. Knotless Transosseous-Equivalent Rotator Cuff Repair Improves Biomechanical Self-reinforcement Without Diminishing Footprint Contact Compared With Medial Knotted Repair. *Arthroscopy.* 2017 Aug;33(8):1473-1481. doi: 10.1016/j.arthro.2017.03.021. Epub 2017 Jul 3. PMID: 28684147.
8. Pauzenberger L, Heuberger PR, Dyrna F, Obopilwe E, Kriegleder B, Anderl W, Mazzocca AD. Double-Layer Rotator Cuff Repair: Anatomic Reconstruction of the Superior Capsule and Rotator Cuff Improves Biomechanical Properties in Repairs of Delaminated Rotator Cuff Tears. *Am J Sports Med.* 2018 Nov;46(13):3165-3173. doi: 10.1177/0363546518796818. Epub 2018 Oct 4. PMID: 30285460.
9. Wu Z, Zhang C, Zhang P, Chen T, Chen S, Chen J. Biomechanical Comparison of Modified Suture Bridge Using Rip-Stop versus Traditional Suture Bridge for Rotator Cuff Repair. *Biomed Res Int.* 2016;2016:9872643. doi: 10.1155/2016/9872643. Epub 2016 Nov 15. PMID: 27975065; PMCID: PMC5126390.

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