Editorial Commentary: All-Suture Anchors Are Small, Easier to Revise, and Biomechanically Equivalent to Conventional Implants: They Are the Way of the Future

Ronald S. Paik, M.D., Editorial Board

Abstract: All-suture anchors (ASAs) show biomechanical equivalence to conventional implants. The smaller size and easier ability to revise are important advantages of ASAs. A more vertical insertion angle increases ASA pullout strength. Proper depth of insertion is required to optimally seat ASAs on cortical bone. ASA pullout strength also results from compression of cancellous bone between the anchor and the cortex, and appropriately pretensioning the suture before loading is critical. A larger anchor (and a higher the number of sutures loaded per anchor) leads to a higher pullout strength of the anchor. Understanding the correct implantation technique is important to optimize the strength of ASAs.

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All-suture anchors (ASAs) are becoming widely popular due to their smaller size, ability to easily revise, and equivalent biomechanical properties compared to conventional implants. Biomechanical studies are continually being published on ASAs evaluating the strength of the anchors, comparing them to conventional implants, and confirming that they are strong enough to use in various areas of the body. The majority of these studies have shown that ASAs have equivalent strength compared to conventional implants throughout the body.[1-5] The Midtgaard, Nolte, Miles, Tanghe, Douglass, Peebles, and Provencher study entitled "Pullout Strength of All-Suture and Metallic Anchors in Repair of Lateral Collateral Ligament Injuries of the Elbow"[6] is another one of these biomechanical studies investigating ASAs compared to metallic anchors (MAs) in the lateral epicondyle of the elbow.

The strength of ASAs is affected by bone density, as a thicker cortex or denser bone will reduce the risk of pull-out.[2,7] ASA fixation relies on the anchor hooking on the other side of the bone cortex. This study is novel in that it tests the implants for use on the thin cortex and less dense cancellous bone of the lateral epicondyle of the elbow.

The study evaluates displacement with cyclical loading and ultimate load to failure comparing a MA (3.5-mm CorkScrew with no. 2 Fiberwire, Arthrex, Naples, FL) versus an ASA (2.6-mm FiberTak with 1.3-mm SutureTape, Arthrex). The authors find significant differences with displacement in cyclical loading in favor of metallic anchors starting at cycle 5 (MA .3 mm, ASA .5 mm; $P = .05$) and above up to their last measurement at cycle 1,000 (MA .9, ASA 2.0, $P < .01$). However, the displacement was below the authors' clinical significance cut-off of 2 mm. The ultimate load to failure was significantly better with ASAs (463 N) vs. MAs (297 N; $P < .01$).

The value of any biomechanical study relates to the clinical relevance of the study. This was a well-performed study that found small significant differences in displacement with cyclical loading between MAs and ASA from .2 mm at cycle 5 to 1.1 mm at cycle 1,000. However, is the difference clinically relevant? I agree with the authors' conclusion: probably not. The ASAs outperformed the MAs in ultimate load to failure.

This study is not just your typical load to failure time 0 study, since it also assesses displacement with cyclical load, which is what would be expected in any actual repair in patients as they use the extremity. However, a

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cadaveric biomechanical study cannot mimic the actual biological healing of a repaired ligament that occurs in a patient with time. As a result, testing cyclical load may have limited clinical relevance. Typical rehab protocols would avoid any significant stress to the LCL repair for a minimum of 6 weeks. So, the strength of the repair would increase as a result of some healing of the repair before it is significantly loaded.

Another limitation with any biomechanical study is it may not be accurate to make an across-the-board statement that all ASAs are equal. The designs of the ASAs among the various manufacturers are different and, thus, have different mechanical properties.[2,8] Additionally, size does matter. The larger the anchor and the higher the number of sutures loaded within a similarly designed ASA lead to a higher pullout strength of the anchor.[8]

There are other factors involved with the implantation technique of an ASA that affects the strength of the anchor. The trajectory of the anchor is important, as Oh et al.[7] demonstrated that a more vertical angle showed stronger pullout strength. The depth of insertion affects the strength of the ASA,[9] likely relating the depth of anchor implantation with optimal seating of the anchor on the other side of the cortex, as well as increased strength that results from the additional compression of cancellous bone between the anchor and the cortex. Appropriately pretensioning the suture prior to loading the anchor optimizes the strength of the anchor by pulling the anchor through the cancellous bone and seating it against the cortex.[10]

The Midtgaard et al. study[6] continues to prove that ASAs are equivalent to conventional implants of the past in yet another area of the body: the lateral epicondyle. However, understanding the implantation technique is important to optimize the strength of the anchor.

References

1. Bernardoni ED, Frank RM, Veera SS, et al. Biomechanical analysis of medial-row all-suture suture anchor fixation for rotator cuff repair in a pair-matched cadaveric model. *Arthroscopy* 2019;35:1370-1376.
2. Ergun S, Akgun U, Barber FA, Karahan M. The clinical and biomechanical performance of all-suture anchors: A systematic review. *Arthrosc Sports Med Rehabil* 2020;2:e263-e275.
3. Frank RM, Bernardoni ED, Veera SS, et al. Biomechanical analysis of all-suture suture anchor fixation compared with conventional suture anchors and interference screws for biceps tenodesis. *Arthroscopy* 2019;35:1760-1768.
4. Hong CK, Hsu KL, Kuan FC, Lin CL, Yeh ML, Su WR. Biomechanical evaluation of a transtendinous all-suture anchor technique versus interference screw technique for suprapectoral biceps tenodesis in a cadaveric model. *Arthroscopy* 2018;34:1755-1761.
5. Otto A, Mehl J, Obopilwe E, et al. Biomechanical comparison of onlay distal biceps tendon repair: All-suture anchors versus titanium suture anchors. *Am J Sports Med* 2019;47:2478-2483.
6. Midtgaard KS, Nolte PC, Miles JW, et al. Pullout strength of all-suture and metallic anchors in repair of lateral collateral ligament injuries of the elbow. *Arthroscopy* 2021;37:2800-2806.
7. Oh JH, Jeong HJ, Yang SH, et al. Pullout strength of all-suture anchors: Effect of the insertion and traction angle. A biomechanical study. *Arthroscopy* 2018;34:2784-2795.
8. Barber FA, Herbert MA. All-suture anchors: Biomechanical analysis of pullout strength, displacement, and failure mode. *Arthroscopy* 2017;33:1113-1121.
9. Ruder JA, Dickinson EY, Habet N, Peindl RD, D'Alessandro DF, Fleischli JE. Slight reduction in the insertion depth for an all-suture anchor decreases cyclic displacement in the shoulder glenoid. *Arthroscopy* 2018;34:1384-1390.
10. Dwyer T, Willett TL, Dold AP, et al. Maximum load to failure and tensile displacement of an all-suture glenoid anchor compared with a screw-in glenoid anchor. *Knee Surg Sports Traumatol Arthrosc* 2016;24:357-364.