Clin Orthop Relat Res (2019) 477:1479-1481
DOI 10.1097/CORR.0000000000000736

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

CORR Insights

Published online: 15 May 2019

CORR Insights®: Biocomposite Suture Anchors Remain Visible Two Years After Rotator Cuff Repair

Xavier Ampuero Duralde MD

Where Are We Now?

The current study by Sgroi and colleagues [11] found that a commonly used bioabsorbable suture anchor containing osteoconductive material resorbed more slowly than one might have anticipated following rotator cuff repair surgery, but at short term, the device seemed not to be associated with the kinds of more-severe implant-related complications that have been associated with some other bioabsorbable devices [1, 6]. Most of these devices (90%; 76 of 84) remained visible in the bone on MRI 2 years after surgery, and only minimal bony ingrowth was noted at the apex and middle of each anchor by that point. Bony ingrowth was related to anchor stress with more ingrowth noted in patients in whom the cuff repair had actually failed. There was no association between implant resorption and overall clinical outcome at 2 years. Sgroi and colleagues [11] developed the current study in part due to their own personal observations that suture anchors were still present in many patients at the time of revision surgery long after anchor resorption should have occurred according to the manufacturer's specifications.

Bioabsorbable suture anchors were introduced in response to complications associated with metal suture anchors including implant loosening, migration, and chondral injury as well as the inability for the clinician to reliably observe the repair site by MRI after surgery because of metal artifact [9]. Generally, clinicians considered bioabsorbable suture anchors as a "temporary solution for a temporary need" indicating that the anchor was only needed until adequate tendon-to-bone healing had occurred. Ideally, the resorbable anchor would show adequate pull-out strength, be made of nontoxic material, resorb within 4 to 6 months of surgery, and be associated with regrowth of bone at the anchor insertion site [13]. Early anchors made of polyglycolic acid polymers degraded rapidly in the first 3 to 4 weeks after implantation and resulted in bone cysts, loose bodies, and synovitis. This led to experimentation with a variety of polymer types including Poly L lactic acid and mixtures of copolymers in an attempt to develop an anchor that would resorb over a more desirable period of time. Most recently, hydroxyapatite has been added to anchors in an attempt to create an osteoconductive anchor that would promote regrowth of bone during anchor resorption and avoid cyst formation. Since their introduction, bioabsorbable suture anchors have demonstrated adequate pullout strength [8] and safety [5] and have been associated with a reliable cuff healing [14].

Despite the general impression by most surgeons that bioabsorbable anchors dissolve by 6 months, implant degradation has not been demonstrated to occur reliably within 2 years. The current study evaluated anchors from one company, but at least one other company claims its anchor has better rates of resorption because of improved anchor geometric design and polymer blend [12]. Multiple unresorbed anchors or postresorption cysts can result in weakening of the bone of the greater tuberosity or glenoid increasing the risk of bony fracture. Other currently available anchors made of PEEK (a type of plastic) and those made entirely of suture material do not run the risk of

This CORR Insights® *is a commentary on the article* "Biocomposite Suture Anchors Remain Visible Two Years After Rotator Cuff Repair" *by Sgroi and colleagues available at:* DOI: 10.1097/CORR.0000000000000665.

The author certifies that he (XAD), or a member of his immediate family, has received or may receive payments or benefits, during the study period, an amount of USD less than USD 10,000, from Smith & Nephew (London, UK).

The opinions expressed are those of the writers, and do not reflect the opinion or policy of *CORR*® or The Association of Bone and Joint Surgeons®.

X. A. Duralde MD (✉), Peachtree Orthopaedic Clinic, 2045 Peachtree Drive, Suite 700, Atlanta, GA 30309 USA, Email: xaduralde@pocatlanta.com

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.

X. A. Duralde, Physician, Peachtree Orthopaedic Clinic, Atlanta, GA, USA

cyst formation, but they do not resorb. Unresorbed anchors may represent an obstruction in revision surgery when additional anchor placement is called for if the cuff repair does not heal and more surgery eventually is performed. Therefore, although bioabsorbable anchors have demonstrated some efficacies when compared to metal anchors, studies such as Sgroi and colleagues [11] indicate that these devices have not fulfilled their stated goal of timely resorption.

Where Do We Need To Go?

The first question we must ask is: Do suture anchors play a major role in the future of rotator cuff surgery or do they represent a temporary tool in the early days of arthroscopy? The principal goal of rotator cuff surgery is to reestablish a normal anatomic connection between the rotator cuff tendons and the greater tuberosity. Suture anchors were developed to facilitate arthroscopic rotator cuff repair and avoid the damage to the deltoid muscle incurred in open surgery, and large-database research suggests that arthroscopic rotator cuff repair offers many advantages to open rotator cuff repair [4]. Identification and treatment of associated pathology also is facilitated by arthroscopy. Although cuff healing does occur reliably in small-to-medium tears utilizing modern techniques, large and massive tears and treatment of tears in older patients remains a challenge [7]. Histologic evaluation of the rotator cuff to the bone connection site, however, indicates that this healing occurs by scar formation and not Sharpey's fibers as is seen in the anatomic rotator cuff connection [3]. While suture anchor pullout strength and suture strength are more than enough to withstand deforming forces during cuff healing, the weak link in rotator cuff repair remains the suture-tendon junction. Bone-tunneling techniques that utilize novel arthroscopic drills that create curved tunnels do not require the use of suture anchors and achieve a double-row repair with good apposition of tendon tissue across a broad surface area of the greater tuberosity [10]. But we have not seen the cost-saving benefits for these techniques, as current instrumentation includes disposable drills which rival the cost of suture anchors. Still, this innovative technology has great potential for reducing the current dependence on suture anchors.

Indeed, cost concerns in many parts of the world lead surgeons to favor open rotator cuff repair over arthroscopic techniques to avoid the use of anchors. The ideal suture anchor would be a low-cost device that temporarily fixes the rotator cuff tendon to bone, stimulates a more anatomic tendon to bone healing, resorbs at a reasonable rate that allows solid tendon repair to occur, and is completely replaced by normal bone tissue. Future research in this area then requires the development of suture anchors that will dissolve at a reasonable rate while stimulating bony ingrowth. We still need to evaluate the addition of biologic agents to suture material or interposition of meshes between tendon and bone that may stimulate a more normal anatomic connection between tendon and bone [2]. And while the current study demonstrated that anchor stability influences the rate of anchor resorption and bony ingrowth, future research regarding the creation of stable patterns of anchor placement and repair will be needed to ensure timely anchor resorption.

How Do We Get There?

The study by Sgroi and colleagues [11] indicates that a current anchor in widespread use does not fulfill the criteria for an ideal resorbable anchor with 90% of anchors still only partially resorbed at 2 years following surgery. Newer anchors with open geometry that allow blood and marrow from surrounding cancellous bone to enter the implant do appear to enhance bony ingrowth and minimize the amount of resorption of material required [15]. Further biomechanical studies on anchor geometry and design, as well as more studies [15, 16] documenting the absorption rate of newer polymer compositions by investigators not associated with implant manufacturers are necessary. MRI confirmation of anchor resorption and reconstitution of bony anatomy will reassure surgeons that a resorbable temporary material is actually being utilized. The effect of stress on anchor resorption seen in this study by Sgroi emphasizes the importance of anchor configuration and further biomechanical studies testing anchor configuration will be of benefit. The weak link in rotator cuff healing is the tendon-suture interface and biologic enhancement of this area represents the next frontier in rotator cuff repair research. We are on the threshold of understanding the role of biologic enhancement of suture anchors, sutures and meshes and animal models and MRI studies to evaluate their impact on cuff healing will be of benefit. Finally, design advancements of curved drill systems for anchorless bone tunnels that do not use expensive, disposable components will open arthroscopic approaches to all patients regardless of payment restrictions.

References

1. Böstman OM, Pihlajamäki HK. Adverse tissue reactions to bioabsorbable fixation devices. *Clin Orthop Relat Res*. 2000: 371:216–227.
2. Cheung EV, Silverio L, Sperling JW. Strategies in biologic augmentation of

rotator cuff repair: A review. *Clin Orthop Review Res*. 2010;468:1476-1484.
3. Cooper J, Mirzayan R. Acellular dermal matrix in rotator cuff surgery. *Am J Orthop (Belle Mead NJ)*. 2016;45:301-305.
4. Day M, Westermann R, Duchman K, Gao Y, Pugely A, Bollier M, Wolf B. Comparison of short-term complications after rotator cuff repair: Open versus arthroscopic. *Arthroscopy*. 2018;34:1130-1136.
5. Dhawan A, Ghodadra N, Karas V, Salata MJ, Cole BJ. Complications of bioabsorbable suture anchors in the shoulder. *Am J Sports Med*. 2012;40:1424-1430.
6. Glueck D, Wilson TC, Johnson DL. Extensive osteolysis after rotator cuff repair with a bioabsorbable suture anchor: a case report. *Am J Sports Med*. 2005;33:742–744.
7. Gwark JY, Sung CM, Na JB, Park HB. Outcomes of arthroscopic rotator cuff repair in patients who are 70 years of age or older versus under 70 years of age: A sex- and tear size-matched case-control study. *Arthroscopy*. 2018;34:2045-2053.
8. Meyer DC, Fucentese SF, Ruffieux K, Jacob HA, Gerber C. Mechanical testing of absorbable suture anchors. *Arthroscopy*. 2003;19:188-193.
9. Ozbaydar M, Elhassan B, Warner JP. The use of anchors in shoulder surgery: A shift from metallic to bioabsorbable anchors. *Arthroscopy*. 2007:23:1124-1126.
10. Seidl AJ, Lombardi NJ, Lazarus MD, Black EM, Maltenfort MG, Pepe MD, Austin LS. Arthroscopic transosseous and transosseous-equivalent rotator cuff repair: An analysis of cost, operative time, and clinical outcomes. *Am J Orthop (Belle Meade NJ)*. 2016;45:415-420.
11. Sgroi M, Friesz T, Schocke M, Reichel H, Kappe T. Biocomposite suture anchors remain visible two years after rotator cuff repair. *Clin Orthop Relat Res*. [Published online ahead of print]. DOI: 10.1097/CORR.0000000000000665.
12. Smith & Nephew. The HEALICOIL™ Suture Anchor Family: Open to more possibilities through a unique combination of innovative design and materials – PEEK or REGENESORB. Available at: https://www.smith-nephew.com/global/assets/pdf/products/surgical/sportsmedicine/healicoil_regen_bro_4_sho17_00613_v2.pdf. Accessed February 28, 2019.
13. Speer KP, Warren RF, Pagnani M, Warner JJ. An arthroscopic technique for anterior stabilization of the shoulder with a bioabsorbable tack. *J Bone Joint Surg Am*. 1996;78:1801-1807.
14. Tanaka M, Hayashida K, Kobayashi A, Kakiuchi M. Arthroscopic rotator cuff repair with absorbable sutures in the Medial-Row anchors. *Arthroscopy*. 2015;31:2099-2105.
15. Vonhoegen J, John D, Hägermann C. Osteoconductive resorption characteristics of a novel biocomposite suture anchor material in rotator cuff repair. *J Orthop Surg Res*. 2019;14:12.
16. Walsh WR, Morberg P, Yu Y, Yang JL, Haggard W, Sheath PC, Svehla M, Bruce W. Response of a calcium sulfate bone graft substitute in a confined cancellous defect. *Clin Orthop Rel Res*. 2003;406:228-236.