Proximal Humerus Osteolysis After Revision Rotator Cuff Repair With Bioabsorbable Suture Anchors

Andrew Y. Park, MD, and Joshua D. Hatch, MD

Abstract

Biodegradable anchors were designed to provide secure fixation while allowing for later resorption and replacement by host tissue. First-generation implants degraded relatively rapidly and caused foreign-body reactions, synovitis, fragmentation, and osteolysis. Newer implants have similar complications. It is not known if the primary cause of the osteolysis is biological (precipitated by breakdown products of the polymer) or mechanical (caused by initial loss of implant stability). Case reports have described glenoid osteolysis around biodegradable suture anchor placement for shoulder stabilization, but up until now, to our knowledge, only 1 case of proximal humerus osteolysis has been reported for these implants. Here we describe a semicrystalline, poly-L-lactic acid bioabsorbable suture anchor failure after revision rotator cuff repair with subsequent humeral tuberosity osteolysis.

Biodegradable anchors, composed of synthetic polymers, were designed to provide secure fixation while allowing for later resorption and replacement by host tissue. These anchors have pullout strengths similar to those of their metallic counterparts and have performed similarly in terms of overall fixation strength when used in osteopenic bone.[1,2] Absorbable implants have the advantage of limiting stress-shielding by gradual resorption, reducing the need for hardware removal, and facilitating postoperative radiography, as with magnetic resonance imaging (MRI).

First-generation, polyglycolic acid (PGA) implants degraded relatively rapidly and caused foreign-body reactions, synovitis, fragmentation, and osteolysis.[3] Later materials, such as poly-L-lactic acid (PLLA), were designed to degrade slower and extend mechanical functioning. The increased crystallinity of these newer polymers slowed material breakdown relative to more amorphous mixtures. Recent materials also have been designed for improved biocompatibility. However, study results suggest that newer biodegradable polymer implants have complications similar to those of PGA implants.[4-6] In terms of osteolysis, it is not known if the primary cause is biological (precipitated by breakdown products of the polymer) or mechanical (caused by initial loss of implant stability).

Radiographic changes associated with bioabsorbable implants can vary from mild cystic, cavitary lesions to more diffuse, osteolytic changes, and can be associated with both first-generation, PGA implants, and newer implants.[7] Cases of glenoid osteolysis after shoulder stabilization have been reported.[5,8,9] Up until now, to our knowledge, there has been only 1 report of proximal humerus osteolysis in the literature—an asymptomatic case in a young man who returned to competitive collegiate football after rotator cuff repair.[10]

Here we describe a semicrystalline, PLLA bioabsorbable suture anchor failure after revision rotator cuff repair with subsequent humeral tuberosity osteolysis. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

The patient, a 48-year-old, right-hand–dominant man, presented originally with chronic right shoulder pain. MRI showed a complete supraspinatous tear, retracted to the mid-humeral head. Subsequent right shoulder arthroscopy confirmed a full-thickness rotator cuff tear. The tear was repaired with 2 Arthrex Bio-Corkscrew anchors and 3 Arthrex PushLock anchors (Arthrex, Naples, Florida).

Six weeks after surgery, active shoulder motion was initiated. One week later, the patient developed acute right shoulder pain while working on active motion. MRI showed a recurrent rotator cuff tear (Figure 1).

Repeat arthroscopy showed a rotator cuff tear along the mid and anterior portions that had retracted medial to the glenoid. The previous sutures were found directly over the tuberosity, demonstrating a failure at the tendon–suture interface. There was no evidence of osteolytic changes at this point. A mini-open rotator cuff repair was performed after mobilization of the

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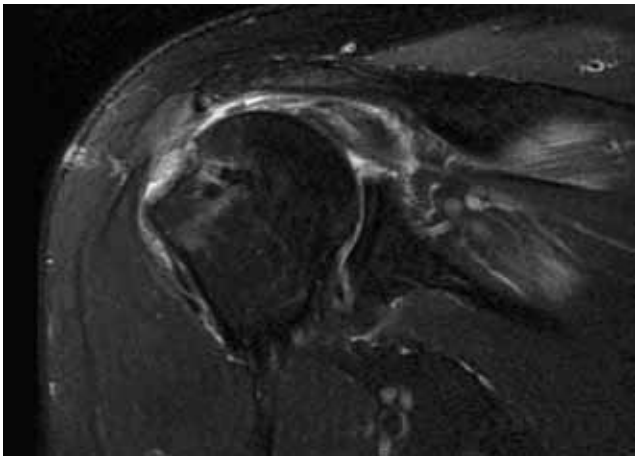

Figure 1. Magnetic resonance imaging of right shoulder 7 weeks after index surgery.

tissue and removal of the previous sutures and anchors. The repair was completed with placement of 3 Bio-Corkscrew anchors and 2 PushLock anchors between where the earlier anchors had been removed. Although the punch and taps for the anchors passed easily, the anchors appeared to have adequate bony purchase.

The patient wore a shoulder immobilizer for 8 weeks after surgery. Physical therapy was resumed 6 weeks after the repeat arthroscopy. Two weeks into therapy, the patient's shoulder pain recurred. Active range of motion showed 90° of forward flexion as well as abduction with noted crepitation. Shoulder strength testing showed marked weakness. Radiographs showed erosion of the greater tuberosity. MRI showed a re-tear of the rotator cuff tendons with retraction and confirmed the marked proximal humerus osteolysis. Computed tomography delineated the extent of the osteolysis (Figures 2, 3). The patient underwent latissimus dorsi tendon transfer.

Discussion

This case demonstrates proximal humerus osteolysis after revision rotator cuff repair with semicrystalline, PLLA biodegradable suture anchors. Both mechanical and biological theories explain the cause of osteolysis with use of bioabsorbable implants.

Degradation products of the bioabsorbable polymer have been implicated in foreign-body reactions causing synovitis and osteolysis.[3,4] The polymer first is hydrolyzed at the amorphous phase of the implant. This causes loss of structural integrity and fragmentation, which initiates the biological response of clearing polymeric debris. With PLLA, this process may take up to several years.[11,12] Although there has been no specific identification of the critical factors leading to an osteolytic reaction, an immunologic basis has been proposed.[13] Another hypothesis is that there is a critical clearing capacity of the polymeric debris by the host phagocytic response that triggers lysis.[7,14] In materials

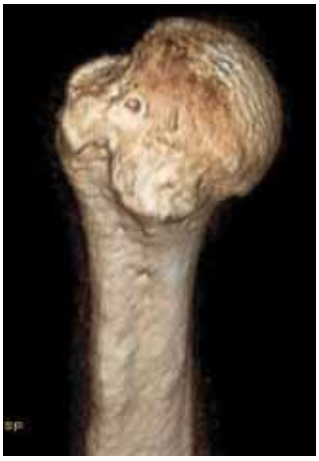

Figure 2. Computed tomography scan, showing osteolytic reaction after revision surgery.

such as polyethylene, the macrophage activation leads to cytokine-induced osteoclast activation. A similar inflammatory response to PLLA could cause the osteolysis seen in this case, particularly if more substrate in the form of additional anchors is introduced at a time when the biological degradation process already is overwhelmed.

Some authors have suggested that a mechanical etiology is the primary cause of osteolysis. Glueck and colleagues[10] reported a case in which poly-(L-lactide-co-D, L-lactide) suture anchors were placed both in the proximal humerus (for rotator cuff repair) and in the glenoid (for repair of a superior labral anterior posterior tear). Only the humeral head anchor developed osteolysis, suggesting a more focal cause. A biological cause likely would have precipitated more diffuse changes, affecting both areas. Why the humeral head anchor but not the glenoid component failed can be explained mechanically by the fact that rotator cuff repair is subjected to higher loads than an anchor is for labral or capsular repair.[15] In addition, proximal humeral bone density is lower than glenoid bone stock density. Athwal and colleagues[8] had a similar hypothesis with regards to a mechanical cause, as de novo osteolysis would likely affect all anchors in a given patient. This suggests that osteolysis develops secondary to micromotion and loss of initial implant stability.

Barber and Dockery[16] examined potential osseous ingrowth into screw sites where bioabsorption had occurred. They found that trabecular bone had not replaced the screw sites, and there was only occasional calcified fibrous tissue infiltration. With cavitary lesions being documented around anchor sites,[5,9,17] Magnusson and colleagues[18] raised concerns of bioabsorbable implants leaving cystic changes in bone that is already of inferior quality. This combination of osteopenic bone and cavitary lesions may be a double-hit phenomenon that contributes to osteolysis.

Although osteolysis has been associated with use of bioabsorbable implants, the rate of complications is low. Dr. Hatch, the senior author, has inserted more than 1000 bioabsorbable anchors and has had only 1 case of osteolysis, which was in the revision setting. There have been no osteolysis complications with primary soft tissue repair. In 2005, Burkhart[15] cited 2 cases of osteolysis with the Arthrex Bio-Corkscrew with more than 5000 anchors inserted. Both of these

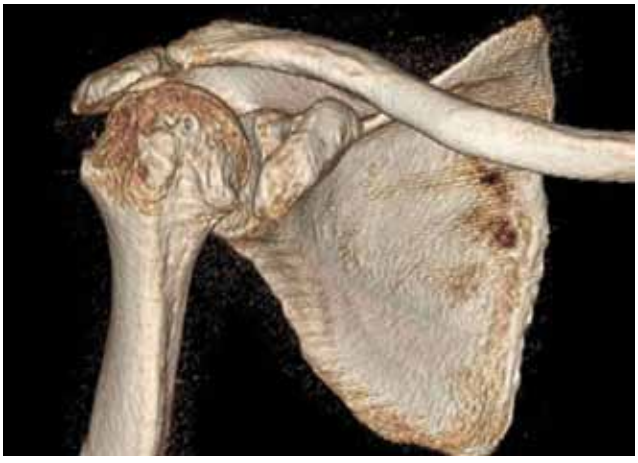

Figure 3. Computed tomography scan, showing osteolytic reaction after revision surgery.

cases demonstrated relatively osteoporotic bone with suboptimal fixation.

Newer generation bioabsorbable anchors have low complication rates and, despite our incomplete understanding of the host response to polymer breakdown products, remain an excellent option for repairing soft tissue around the shoulder. However, in the revision setting with osteopenic bone and cavitary lesions, combined with a potentially overwhelmed phagocytic response to existing polymeric debris, the anticipated results are less clear. Alternative methods of repair, such as with transosseous tunnels or with alternative anchor materials, may be considered in revision surgery. As discussed by Nho and colleagues, nonabsorbable polyaryletheretherketone (PEEK) may be a suitable alternative to bioabsorbable anchors,[19] and newer biocomposite anchors may be considered as well. We agree that these may be viable options if bone quality is suspect and subsequent osteolysis is a concern.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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This paper will be judged for the Resident Writer's Award.