Proximal Humerus Fracture After Keyhole Biceps Tenodesis

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Abstract

A biceps tenodesis is a common surgical procedure that is often carried out in conjunction with other surgical shoulder repairs to relieve biceps tendonitis. This case presents a 50-year-old woman who suffered a humerus fracture following an open keyhole biceps tenodesis. The potential reasons for the fracture as well as a brief analysis of the technique itself are presented. To our knowledge, this is the first case report of a humerus fracture following keyhole biceps tenodesis in the English-language literature.

Biceps tendonitis, a relatively common condition that affects the shoulder, causes pain over its anterior aspect, near the bicipital groove and across the biceps tendon.[1,2] It is most often associated with a comorbid injury, such as a superior labral anterior to posterior (SLAP) tear, a rotator cuff tear, impingement, or anterior capsule pathology,[1-4] and occurs alone in only about 5% of cases.[5]

When conservative measures fail to resolve biceps tendonitis, the surgical option of tenodesis can be considered, either alone or with associated procedures, for pain relief and increased range of motion.[1,2,4,6-9] The multiple biceps tenodesis techniques include use of interference screw, suture anchor, ligament washer, bone tunnel, or keyhole.[10,11]

Compared with other techniques, keyhole biceps tenodesis has more potential weaknesses, though all these techniques have similar complications—possibility of tendon rerupture, persistent pain, and infection.[1,2,4] There are only 2 reports of fracture with use of the keyhole biceps tenodesis, but both appeared in the non–English-language literature. The present report on a case of humerus fracture after keyhole biceps tenodesis is the only one published in English. The patient provided written informed consent for print and electronic publication of this case report.

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Case Report

The patient, a 50-year-old woman, underwent left shoulder revision arthroscopic subacromial decompression and open biceps tenodesis. Past medical history was significant for insulin-dependent diabetes mellitus (onset age, 15 years) and hypothyroidism. Past surgical history was notable for left shoulder os acromiale with arthroscopic subacromial decompression performed 7 months before the revision surgery pertinent to this case. Tenodesis of the biceps tendon was indicated on the basis of past surgical history, clinical examination in the office, and intraoperative findings. Imaging studies were not remarkable.

During surgery, the tendon attachment was found to be normal, but the synovial sheath of the tendon was inflamed (it was viewed exiting the glenohumeral joint). The synovitis was confirmed when the biceps was extracted from the open wound. There were no remarkable changes in the chondral surface of the humerus or the glenoid. The rotator cuff was intact. Biceps tenodesis was performed with a modified keyhole technique. After arthroscopic tenotomy, an incision was made at the anteromedial aspect of the arm, just below the pectoralis major muscle. The biceps tendon is consistently located just medial to the attachment of the pectoralis tendon. The biceps tendon was extracted from the groove and out the wound. A No. 2 nonabsorbable braided suture was woven through the tendon approximately 2 to 3 cm proximal to the biceps muscle–tendon junction. The remaining proximal tendon was excised. A Hohmann retractor was placed through the pectoralis tendon to retract the tendon and the muscle in a superolateral direction. A Chandler retractor was placed on the medial border of the humerus to retract soft tissue medially and thereby expose the bicipital groove. In the technique used in this patient's case, a guide pin was placed in the center of the bicipital groove under the pectoralis tendon and without penetrating the opposite cortex. An 8-mm reamer was used to create a hole in the humerus, and then a 2.7-mm drill was used to make 2 holes 1.5 to 2.0 cm distal to the 8-mm hole. The needle from the standard No. 2 suture was used to pass 2 sutures through the distal holes. These sutures were retrieved through the larger, proximal hole; tied around the suture in the tendon; and then pulled back out of the distal holes to

Figure 1. (A) Anteroposterior and (B) lateral radiographs of humerus after fracture.

shuttle the tendon suture into the larger hole and out the smaller holes. The elbow was flexed to take tension off the tendon, and the tendon was inserted into the humeral canal. The 2 sutures were then tied together over the 1-cm bone bridge that separates the distal holes. This technique differs from the traditional keyhole technique, as the tendon was secured with sutures, not by forming a slot in the larger hole and creating a knot of tendon proximally.

After the fracture, a dual-energy x-ray absorptiometry (DXA) scan was reported to be normal for a 50-year-old woman with no evidence of osteoporosis. Referral to a primary care physician or endocrinologist was not indicated. Eight weeks after surgery, the patient noted improvement in preoperative symptoms and was participating in supervised physical therapy.

Twelve weeks after surgery, however, there was acute onset of severe left shoulder pain after she pushed a revolving door. Radiographs showed an oblique proximal humerus fracture originating in the drill hole used to anchor the biceps tendon and extending distally into the diaphysis (Figures 1A, 1B). The patient's arm was initially placed in a coaptation splint and then in a Sarmiento brace, and she was regularly followed up (Figure 2). She was again followed up 47 months after fracture. At that time, she had a Constant score of 80.89, an American Shoulder and Elbow Surgeons (ASES) score of 100, a Single Assessment Numeric Evaluation (SANE) score of 98, and full range of motion in comparison with the other arm. Overall, the patient reported no limitations in daily activities and satisfaction with the final outcome.

Discussion

This article is the first case report of a (low-energy) humerus fracture sustained after modified keyhole biceps tenodesis in a middle-aged woman with a history of diabetes.

There are no English-language reports on humerus fracture after biceps tenodesis and only 2 non–English-language reports. In Germany, Friedel and colleagues[12] noted a humerus fracture 6 weeks after keyhole biceps tenodesis in a 69-year-old man. They described the keyhole biceps tenodesis performed 3 cm below the bicipital groove, a proximal hole 1 cm in diameter, and a distal extension 0.5 cm wide × 1.5 cm long. Six weeks after surgery, there was acute onset of pain while the patient was rolling up a garden hose. Radiographs showed a proximal humerus spiral fracture, which the authors attributed to an excessively distal keyhole osteotomy. In Hungary, Gyulai[13] reported on 2 cases of humerus fracture after biceps tenodesis but did not provide intraoperative technical details and indicated only that the fractures occurred 61 and 126 days after surgery.

In a long-term follow-up study of keyhole biceps tenodesis, 15 patients were evaluated a mean of 7 years after surgery.[14] Eight (53.3%) of the 15 reported excellent results; 1 (6.7%), good results; 4 (26.7%), fair results; and 2 (13.3%), nonfracture failures. In another study, Froimson and O[15] reported that all 11 patients within the study had excellent or good results after this procedure, and there were no humerus fractures.

Regarding strength of the keyhole technique, results are mixed. Kusma and colleagues[10] reported that tendon

Figure 2. Radiograph of humerus after closed reduction.

displacement was larger with use of the keyhole technique after 200 cycles of strain than with use of a suture anchor, interference screw, or ligament washer, but smaller with use of bone tunnel fixation. Similarly, in another cadaver study, load to failure was less with use of the keyhole technique than with use of tunnel fixation, interference screw, and suture anchor methods.[11] In a third cadaver study, however, Jayamoorthy and colleagues[16] reported that initial fixation with use of the keyhole technique was stronger than that with use of an interference screw. Nevertheless, failure in these studies involved tendon pullout, and in no case was there a fracture of the cadaver arm.

The humeral fracture complication is theoretically present because of the stress riser formed by the hole drilled in the humerus to accept the tendon. Empty screw holes place the patient at risk for fracture. Up to a 50% decrease in torsional peak load to failure can result from a hole encompassing only 20% of the diameter of the cortex, which demonstrates the major weakening factor of a screw hole.[17] Torsional stresses can potentially result in a fracture propagating through the stress riser in the humeral diaphysis.[2] Alford and colleagues[17] found that insertion of a resorbable screw increased the torque needed to cause fracture both immediately after and 13 weeks after the surgery. Some modified keyhole techniques involve insertion of an interference screw into the diaphyseal hole to reduce the stress riser and increase overall bone strength.[18] Any technique that involves a large drill hole, however, can potentially act as a stress riser. Newer biocomposite materials may allow bone ingrowth into the cortical defect and reduce fracture potential.

When deciding how to surgically treat proximal biceps tendonitis, one must weigh the risks and benefits of tenotomy versus tenodesis. Although keyhole tenodesis is usually not associated with cosmetic deformity or late cramping, torsional stresses through the hole made in the humerus for embedding the biceps tendon can increase the potential complications of the procedure. For cases in which a hole is made in the humerus to insert the biceps tendon, we recommend that a nonabsorbable interference screw be placed to minimize the open-hole effect of reducing the torsion strength of the bone. Less secure fixation can be achieved with techniques that do not involve making a hole in the humerus. The surgeon should also consider patient factors, such as age, bone quality, medical comorbidities, medications, and demand, before proceeding with biceps tenodesis.

Authors' Disclosure Statement

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