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Case Report

Subacromial bone erosion due to suture-knots in arthroscopic rotator cuff repair: A report of two cases

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ABSTRACT

Knot impingement can cause shoulder-joint motion pain after rotator-cuff repair. Previous studies have revealed only subacromial effusion in magnetic resonance imaging (MRI) evaluations of knot impingement. We report two cases of patients with symptomatic knot impingement. In both patients, bursal-side partial-thickness tear of the supraspinatus tendon had been repaired by a single-row technique using one suture anchor and two polyester sutures with a long-chain polyethylene core. Three-dimensional computed tomography and arthroscopy revealed bony erosion at the lateral side of the anterior half of the acromial undersurface in both patients. The size of the erosion was 1.7 cm (anteroposterior direction) × 0.7 cm (mediolateral direction) in one patient and 1.2 cm × 0.5 cm in the other. Arthroscopy showed that suture knots that had been placed at the muscle–tendon junction of the supraspinatus tendon were impinging on the area of bone erosion during shoulder abduction. Although the sutures themselves were of soft material, knot-tying made them stiff and thus led to bone erosion. Surgeons need to be aware of the possibility of subacromial bone erosion caused by suture knots in arthroscopic rotator cuff repair.

Introduction

Although arthroscopic repair improves shoulder function and relieves shoulder pain in patients with rotator cuff tears, recurrent rotator cuff tears remain a postoperative complication that is associated with inferior clinical outcomes.[1–3] In addition, a long-term follow-up study showed that 93% (13 of 14) of patients with postoperative recurrent tears experienced proximal humeral migration or cuff tear arthropathy.[4] To prevent recurrent rotator cuff tears, repair techniques have been developed to increase the security of fixation of the torn tendon to the bone, such as an increase in the number of knots and anchors used,[5] an increase in the bite size,[6] or the use of double-row fixation[1,3,7,8] or suture-bridge fixation.[1,8–14]

A biomechanical study has shown that increasing the number of knots, stitches, and suture anchors significantly increases the primary stability of the various rotator cuff repair interfaces.[5] Some clinical studies have shown that use of a double-row fixation technique, which has more knots and suture anchors, is associated with higher healing rates (as assessed with ultrasonography or magnetic resonance imaging (MRI)[15] and better shoulder strength in patients with large tears compared with single-row repair.[16] These results suggest that secure knot-tying and suturing techniques contribute to improved clinical outcomes after arthroscopic rotator cuff repair. Recently, new rotator cuff repair techniques that use knotless anchors have been developed to make rotator cuff repair easier by decreasing the number of knots at the repair site.[17–19] Nevertheless, in some patients, knot-tying is still required to provide anatomical repositioning of the torn tendon (especially in the case of longitudinal tears)[20,21] or to treat a dog-ear deformity after knotless suture-bridge repair.[22,23]

Knot impingement has recently been reported as a complication after arthroscopic rotator cuff repair; it leads to motion pain in the shoulder joint and necessitates follow-up surgery to remove the knots.[24,25] However, previous studies have revealed only subacromial effusion on MRI used for imaging evaluation of the knot impingement. Therefore, the pathology of knot impingement remains unclear: is it just inflammation, or is there iatrogenic damage to the bone or soft tissue? We report subacromial bone erosion after arthroscopic rotator cuff repair in postoperative three-

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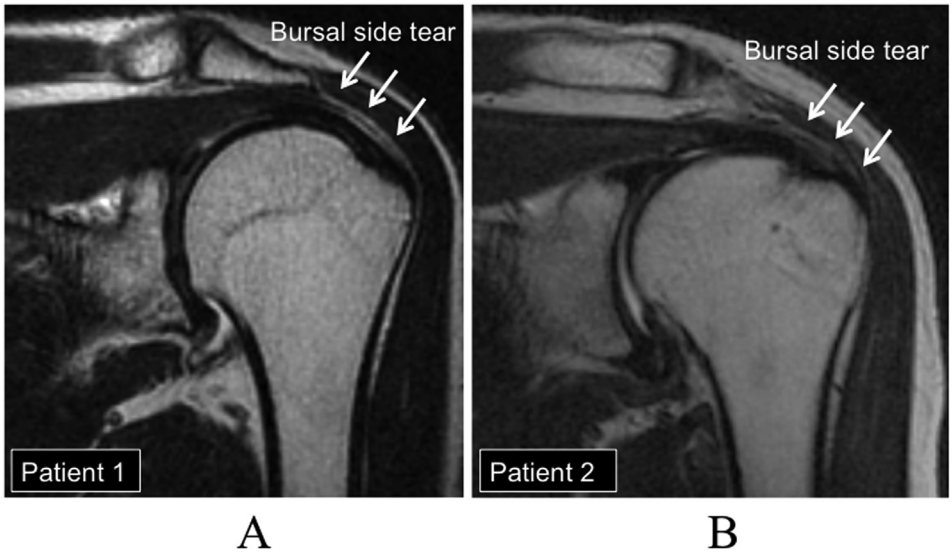

Fig. 1. Preoperative coronal T2-weighted MRI of patient 1 (a) and patient 2 (b). White arrows indicate a bursal-side, partial-thickness tear in the supraspinatus tendon.

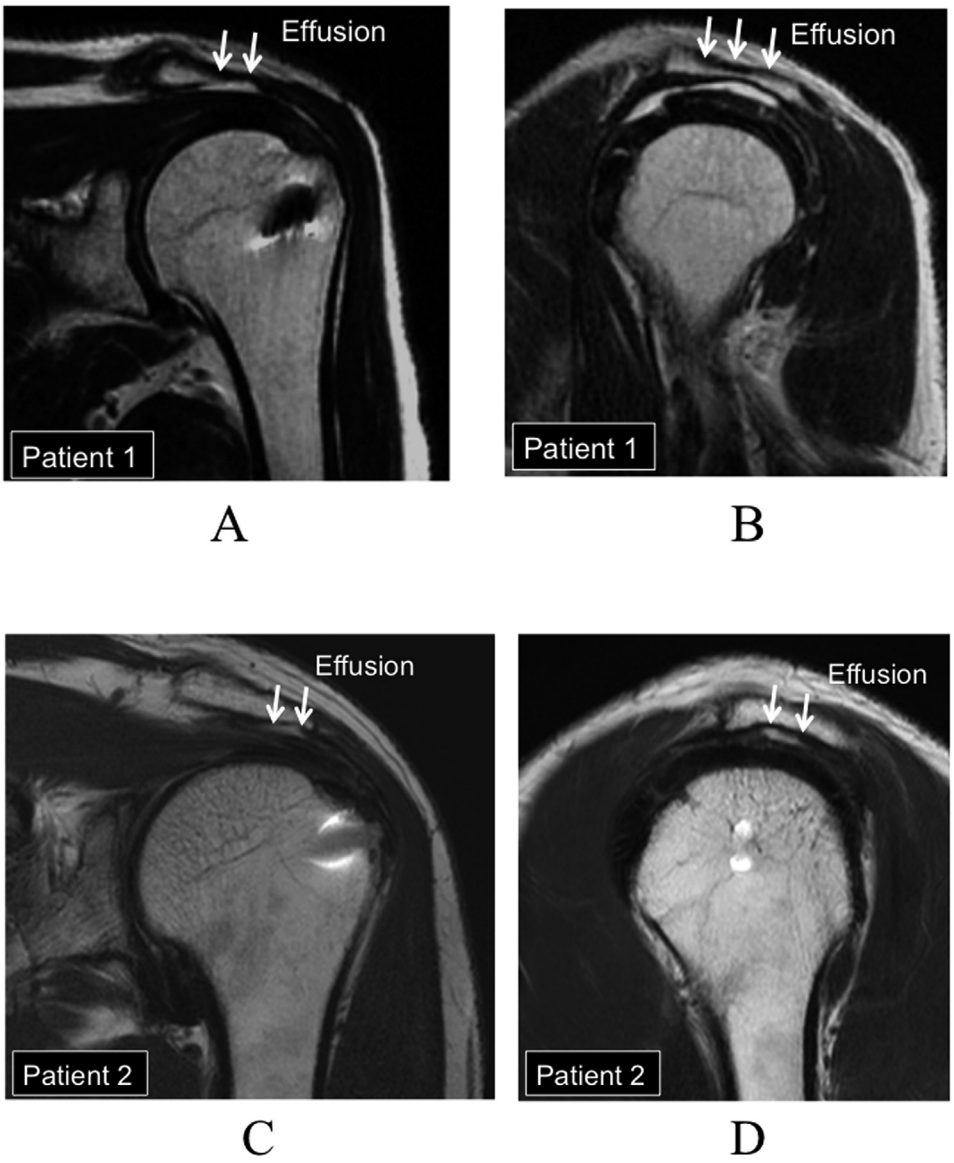

Fig. 2. Coronal T2-weighted MRI 4 years after rotator-cuff repair in patient 1 (a: coronal image, b: sagittal image) and 18 months after rotator cuff repair in patient 2 (c: coronal image, d: sagittal image). White arrows indicate subacromial effusion. The repaired tendon has healed in both patients.

dimensional computed tomography (Toshiba, Japan, 64 detector rows, 1.00-mm-thick slices, 120 kV, 92.5 mAs) and arthroscopy. Informed consent was received from both patients.

Case report

Case 1

A 69-year-old man visited our clinic with chief complaints of pain and limited active elevation of the left shoulder. Four months before his visit he had had a fall. Active range of motion and muscle strength in the left shoulder were 140° and 4 (manual muscle testing: MMT) in abduction, 60° and 4 in external rotation at the side, L3 and 5 in internal rotation at the side. Subacromial impingement tests, (namely, the Neer and Yocum tests), were positive. MRI showed bursal-side partial-thickness of supraspinatus tendon tear (Fig. 1a). For this patient, arthroscopic rotator cuff repair was performed using single-row technique (one anchor and two knots). Any pathological bursal tissue was removed. Arthroscopic acromioplasty was added to create a flat acromial undersurface. Bony spurs at the anterior and lateral side of acromion, in the inferior part of the acromioclavicular joint and at the distal end of the clavicle were removed. At 3 years after surgery, his pain was decreased, but he had still pain during shoulder elevation and positive subacromial impingement test (Neer and Hawkins tests). Active shoulder range of motion was 180° (both sides) in abduction, 40° (left) and 70° (right) in external rotation, and L3 (left) and T12 (right) in internal rotation at the side. All muscle strengths in abduction, external rotation and internal rotation were 5-. Plain radiographs demonstrated no abnormal finding. MRI revealed subacromial effusion after rotator cuff repair, but it did not show bony erosion clearly (Fig. 2a–b). Sugaya classification of MRI finding was type I. Three-dimensional computed tomography showed bony erosion at the lateral side of the anterior half of the acromial undersurface (Fig. 3a). The size of the erosion was 1.7 cm (anteroposterior direction) × 0.7 cm (mediolateral direction). He couldn't play baseball or golf even after rotator cuff repair. Therefore, we decided to make shoulder arthroscopy.

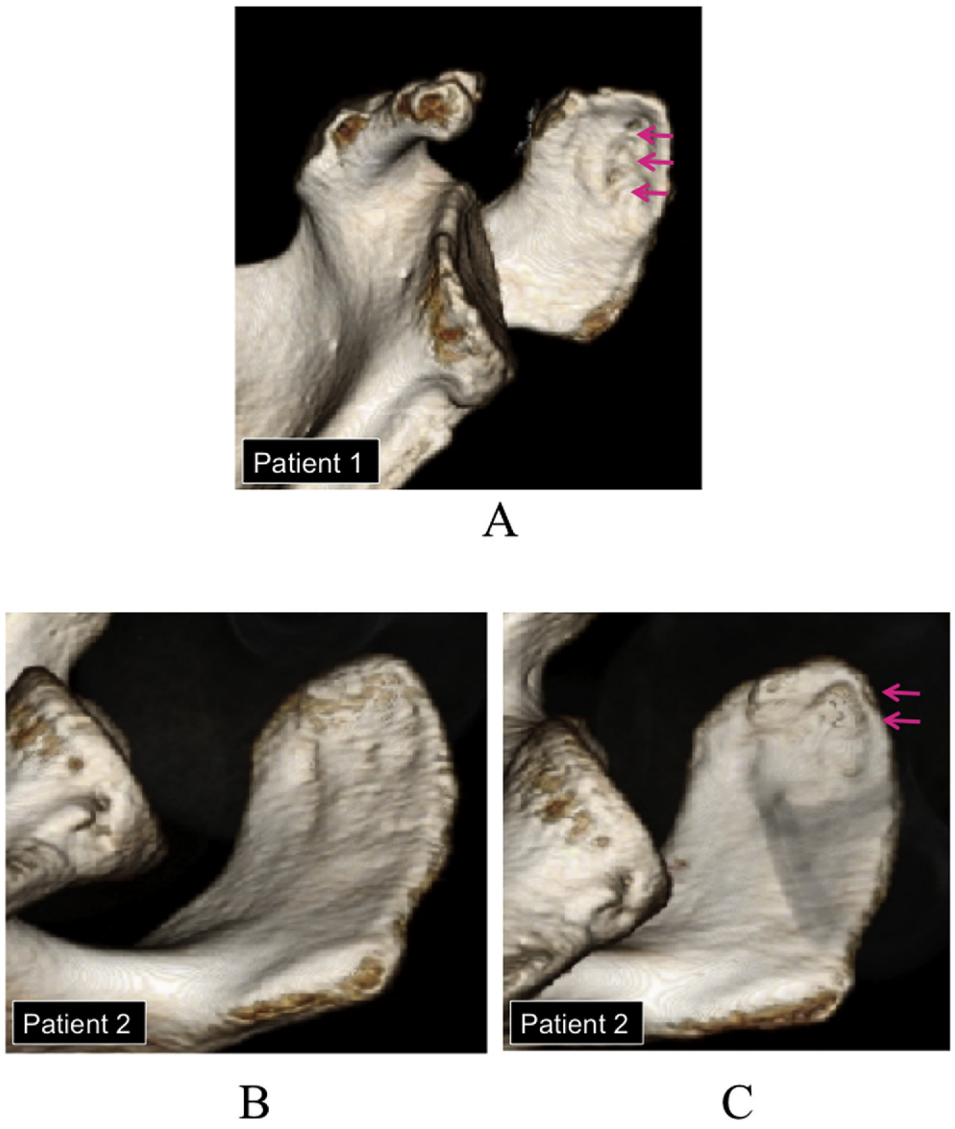

Fig. 3. Three-dimensional computed tomography. (a) Subacromial bone erosion due to knot impingement 4 years after rotator cuff repair in patient 1. Pink arrows indicate bone erosion at the lateral side of the anterior half of the acromion. (b) No erosion was apparent 6 months after rotator cuff repair in patient 2. (c) Bone erosion (pink arrows) at the lateral side of the anterior half of the acromion was present 18 months after rotator cuff repair in patient 2.

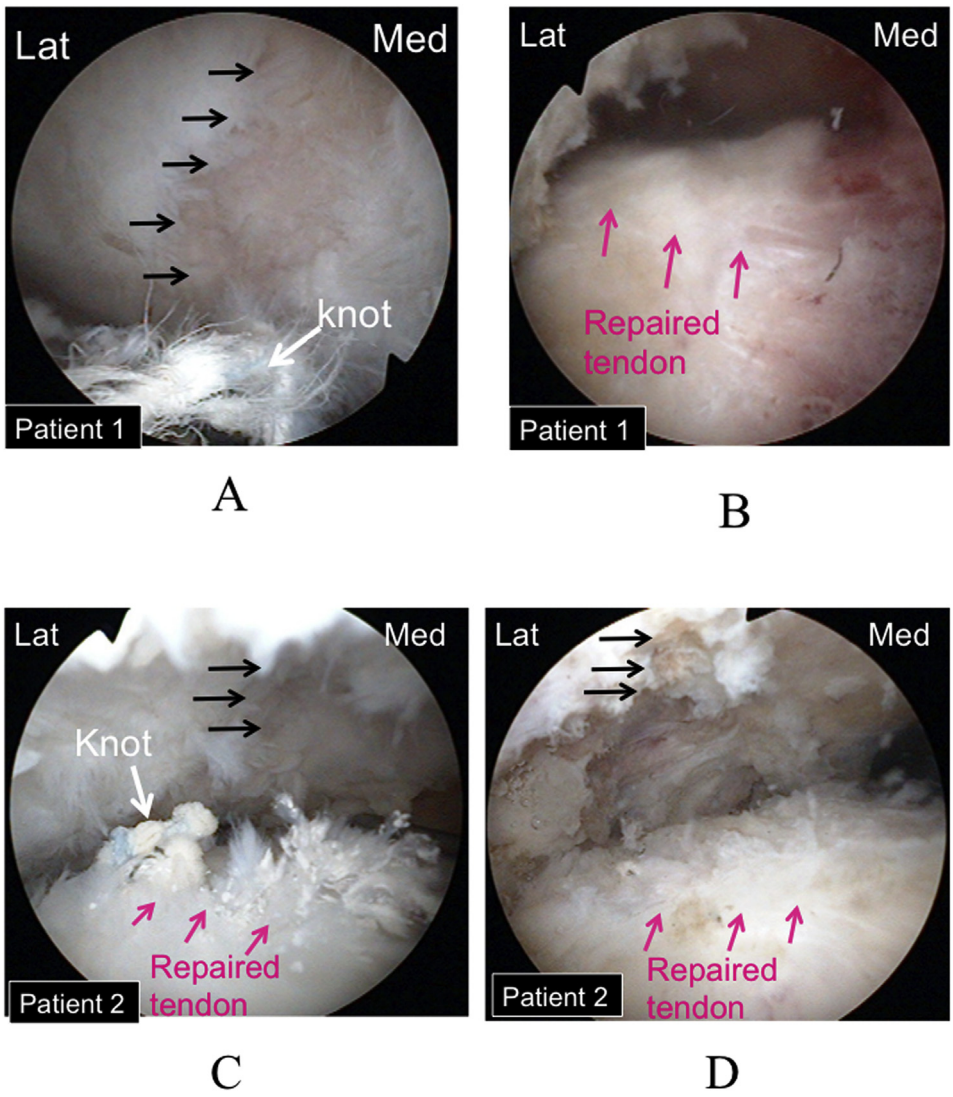

Fig. 4. Arthroscopic images of left shoulder, taken from the posterior portal. (a) Before knot removal in patient 1. (b) After knot removal in patient 1. (c) Before knot removal in patient 2. (d) After knot removal in patient 2. The repaired supraspinatus tendon has healed. In both patients, knots were placed at the tendon–muscle junction of the supraspinatus. Pink arrows show healing of the repaired supraspinatus tendon. Black arrows indicate bone erosion on the undersurface of the acromion, which is in contact with the suture knots.

In the second arthroscopy at 3 years and 11 months after arthroscopic rotator cuff repair, subacromial bone erosion was found at the same location as was shown by the three-dimensional computed tomography (Fig. 4a–b). Also, arthroscopy showed that both suture knots, which had been placed at the muscle–tendon junction of the supraspinatus tendon, were impinging on the area of bone erosion during 60 to 120 degrees of shoulder elevation, or external–internal rotation in the abducted shoulder. Mild synovitis around the suture knots was debrided. All suture knots were removed arthroscopically. Healing of the repaired torn tendon was also confirmed. Examination under anesthesia showed no shoulder stiffness and also capsular laxity was normal in the glenohumeral joint. At 2 months after knot removal, active range of motion and muscle strength fully recovered without subacromial impingement pain. At 3 months, the subacromial effusion present after rotator cuff repair disappeared (Fig. 5a–b) and he returned to baseball and golf without shoulder pain.

Case 2

A 31-year-old man visited our clinic with chief complaints of pain and limited range of motion in the left shoulder. Six months before his visit he had had a fall. Active range of motion was 120° in abduction, 50° in external rotation at the side, L5 in internal rotation at the side. Abduction strength was 4 in MMT. Neer and Yocum subacromial impingement tests were positive. MRI showed bursal-side partial-thickness of supraspinatus tendon tear (Fig. 1b). For this patient, the torn tendon was repaired arthroscopically with single-row technique (one anchor and two knots). Arthroscopic acromioplasty was added in the same manner as case 1. Although he had still shoulder pain during elevation, no abnormal finding was found in three-dimensional computed tomography and MRI at 6 months after arthroscopic rotator cuff repair. However, at 18 months, he had still shoulder pain and positive subacromial impingement test (Neer, Hawkin, and Yocum tests). Active shoulder range of motion was 170° (left) and 180° (right) in abduction, 30° (left) and 60° (right) in external rotation, and L1 (left) and T12 (right) in internal rotation at the side. Muscle strengths in abduction, external rotation and internal rotation were 5-. Three-dimensional computed tomography showed bony erosion at the lateral side of the anterior half of the acromial undersurface

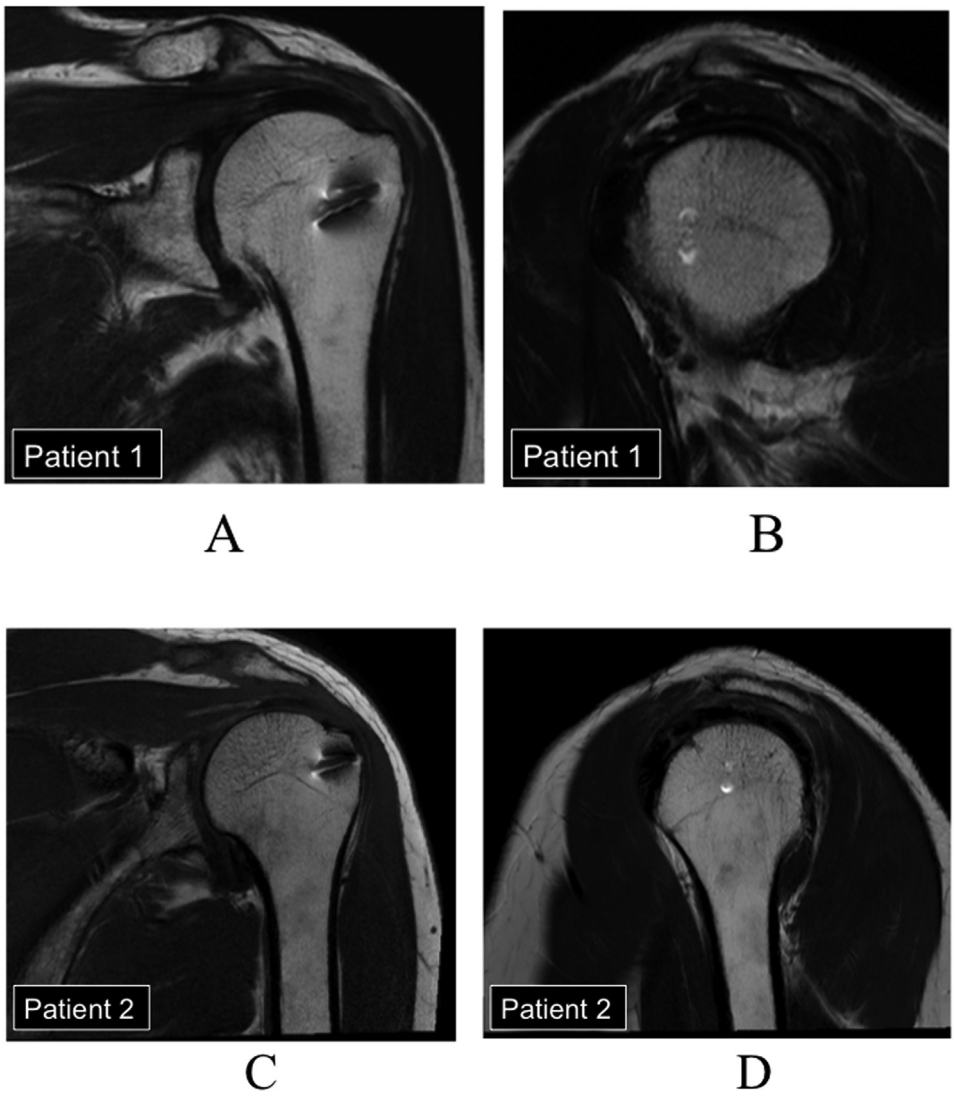

Fig. 5. Coronal T2-weighted MRI 3 months after arthroscopic knot removal. (a) Coronal image in patient 1. (b) Sagittal image in patient 1. (c) Coronal image in patient 2. (d) Sagittal image in patient 2. In both patients, the subacromial effusion has disappeared and the repaired supraspinatus tendon has healed.

(Fig. 3b–c). The size of the erosion was 1.2 cm (anteroposterior direction) × 0.5 cm (mediolateral direction). MRI revealed subacromial effusion although repaired tendon was healed (Sugaya classification type I) (Fig. 2c–d).

Since he couldn't return to his work (construction worker) even after rotator cuff repair, shoulder arthroscopy was performed at 2 years after the first surgery.

In the diagnostic arthroscopy, subacromial bone erosion was found at the lateral side of the anterior half of the acromial undersurface (Fig. 4c–d). During 60 to 120 degrees of shoulder elevation, external–internal rotation in the abducted shoulder, or horizontal abduction at 90 degrees of shoulder abduction, suture knots, which had been placed at the muscle–tendon junction of the supraspinatus tendon, were impinging on the area of bone erosion. Mild synovitis around the suture knots was debrided. Repaired supraspinatus tendon was healed very well. All suture knots were removed arthroscopically. No shoulder stiffness was found under anesthesia and also glenohumeral capsular laxity was normal. He returned to his previous work without any pain at 3 months after knot removal. Postoperative MRI showed the subacromial effusion present after rotator cuff repair disappeared (Fig. 5c–d).

Discussion

Knot impingement after arthroscopic rotator cuff repair can cause motion pain in the shoulder joint and necessitate knot removal. Hotta and Yamashita[25] reported that nine (2.1%) of 434 patients who underwent arthroscopic rotator cuff repair had osteolysis due to knot impingement on the undersurface of the acromion. Park et al.[24] reported erosion of the acromion in two of 118 (1.7%) patients after arthroscopic single-row repair and in one of 103 (1.0%) patients after arthroscopic suture-bridge repair. However, in previous studies, knot impingement had been diagnosed through the presence of subacromial effusion on MRI.[25] Subacromial effusion can be seen in re-tear of repaired rotator-cuff tendons[1,3] and in subacromial impingement due to other factors, including muscle imbalance and shoulder stiffness.[26] Therefore, to investigate the pathology of the knot impingement, we examined subacromial bone erosion after arthroscopic rotator cuff repair by using three-dimensional computed tomography and arthroscopy. The patients, who had shoulder pain due to subacromial impingement after rotator cuff repair and whose pain was relieved after removal of the suture knots, had subacromial bone

erosion. Therefore, we believe that the pathology of symptomatic knot impingement involves not only inflammation but also iatrogenic bone erosion on the undersurface of the acromion caused by the presence of the suture knots.

Here, we confirmed knot impingement by dynamic assessment during shoulder arthroscopic surgery. The suture knots were revealed to be engaged with the eroded bone during 60 to 120 degrees of shoulder elevation (Neer test), external–internal rotation in the abducted shoulder (Hawkins test), or horizontal abduction at 90 degrees of shoulder abduction (Yocum test). Thus bone erosion on the undersurface of the acromion resulted from impingement of the suture knots. Furthermore, the bone erosion was longer in the anteroposterior direction, suggesting that external–internal rotation increases the size of the erosion.

We found symptomatic knot impingement only in patients with small partial-thickness rotator cuff tears, even though the number of knots increases as the size of the tear increases. Therefore, the number of knots may not be a risk factor for knot impingement. Also, both patients with symptomatic knot impingement had suture knots at the muscle–tendon junction. This result suggests that the location of the knot-tying affects the likelihood of subacromial impingement of the suture knots.

In this series, symptomatic knot impingement did not occur in patients in whom knots were placed at the muscle–tendon junction of the supraspinatus during surgery for medium, large, or massive tears. A potential explanation for this finding is that the torn supraspinatus tendon is thicker in partial-thickness tears than in complete medium to massive tears, in which the tendon is often severely atrophied or degenerated.[1,27,28] The presence of a thick tendon may increase the risk of knot impingement by decreasing the distance between the knot and the undersurface of the acromion. When partial-thickness tears of the supraspinatus tendon are repaired arthroscopically, use of a knotless repair technique may help to prevent symptomatic knot impingement after rotator cuff repair.

In conclusion, although the suture material itself was soft, knot-tying made it stiff, thus causing bone erosion. Surgeons need to be aware of the possibility of subacromial bone erosion due to the presence of suture knots in arthroscopic rotator cuff repair.

Conflict of interest

No conflict of interest is reported by the authors.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.asmart.2018.11.006.

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