

Two Cases of Biodegradable Suture Anchor Displacement Diagnosed with Ultrasonography following Arthroscopic Rotator Cuff Repair

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With the advancement of shoulder arthroscopy, use of biodegradable suture anchors in the surgical repair of rotator cuff tears has increased. Because of the radiolucency of these anchors, radiography is not appropriate for early detection of anchor failure. Ultrasonography is an advantageous modality in visualizing biodegradable, radiolucent anchors on a real-time basis without risk of radiation exposure. We report on two cases of displacement of a biodegradable suture anchor diagnosed on ultrasonography during the postoperative follow-up, which has not been previously reported. Because this displacement could be missed in the postoperative follow up ultrasonography, we describe the ultrasonographic features of the displaced biodegradable anchors. Surgeons and radiologists should pay special attention to the possibility of displacement of the suture anchor in patients who underwent rotator cuff repairs using suture anchors.

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Key Words: Rotator cuff; Ultrasonography; Suture anchors; Displacement

With the advancement of shoulder arthroscopy, use of biodegradable suture anchors has increased. Biodegradable fixation devices were originally developed for the alternative use of the metal that produces complications including incarceration of the metal implant within the joint with migration, chondral damage and the imaging artifact on magnetic resonance imaging (MRI) scans.¹⁾ Their biodegradable property may reduce complications from metal anchors. However it is probable that various types of complications may occur in association with their biodegradability; these include foreign body reactions, osteolysis, synovitis, chondrolysis, and implant failure.²⁾ Due to the radiolucency, however, radiography is limited in making a diagnosis of cuff healing and displacement of biodegradable suture anchors. Due to its relatively higher cost, MRI may not be available in a usual clinical setting as an imaging modality for a mid-term follow-up. Ultrasonography (USG) has recently become a popular, valid modality for use in diagnosis of patients with shoulder pathology. However, to the best of our knowledge, there are no reports on the usefulness of USG in detecting the displacement of the

anchor. We experienced two cases of displacement of a biodegradable suture anchor diagnosed on USG during the postoperative follow-up. We report our cases with a review of literature.

Case Report

Case 1

A 61-year-old right-handed man presented with a more than 3-month history of left shoulder pain. The patient underwent MRI at another hospital, which showed a full-thickness rotator cuff tear of 1.1×1.5 cm (anteroposterior dimension/retraction) in size. The patient underwent arthroscopic rotator cuff repair for treatment of severe activity-related pain in the left shoulder. While undergoing arthroscopic surgery, a supraspinatus tendon tear measuring approximately 1.5×2.2 cm was detected. Two 5.0-mm biodegradable suture anchors (Paladin[®]; ConMed Linvatec, Largo, FL, USA) were inserted in the medial row, followed by placement of four mattress transtendon sutures. We also used two lateral suture anchors (Versalok[®]; DePuy Mitek, Raynham,

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MA, USA) to repair the tendon using the suture bridge technique (Fig. 1). A standardized rehabilitation protocol was applied

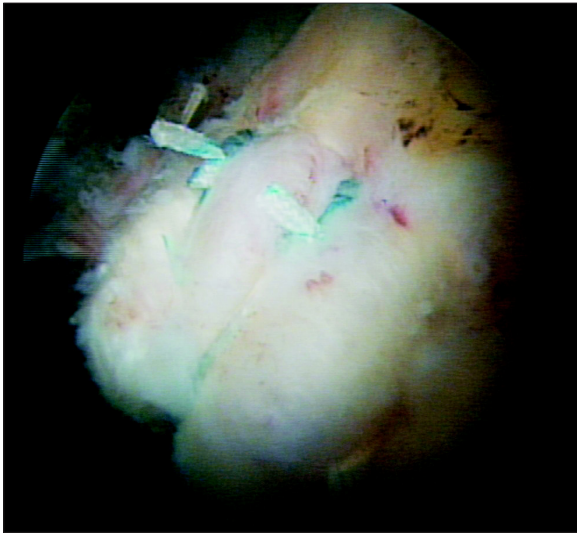


Fig. 1. A 61-year-old male who underwent arthroscopic repair of rotator cuff tears in his left shoulder. Arthroscopic view of the repaired rotator cuff tendon (Case 1).

to our case. Immobilization was maintained with an abduction brace at an abduction angle of 30° for five weeks. Immediately after surgery, the patient was encouraged to perform passive motion of the affected shoulder, shrugging of both shoulders, active elbow flexion/extension, active forearm supination/pronation, and active hand and wrist motion. After weaning from the brace, active assisted range of motion exercise using a stick was initiated. Routine USG examination performed at postoperative 3 months demonstrated the presence of fluid in the subacromial space with an intact rotator cuff tendon (Fig. 2A). We then performed the exercise for strengthening of the rotator cuff muscles using an elastic bandage. Routine follow-up USG examination was also performed at postoperative 6 months, and displacement of one biodegradable suture anchor was detected (Fig. 2B). On USG, the suture anchor appeared as a material showing multiple dots in line with a high echogenicity. As the anchor was positioned obliquely to the direction of the sonographic beam, the outer margin of the material was not clearly defined. Despite displacement of the anchor, the patient had a pain visual analog scale (VAS) score of 0 points with a degree of patient satisfaction VAS of 8/10; the American Shoulder and Elbow Surgeons (ASES) score was 91.6 points and Constant score was 65 points.

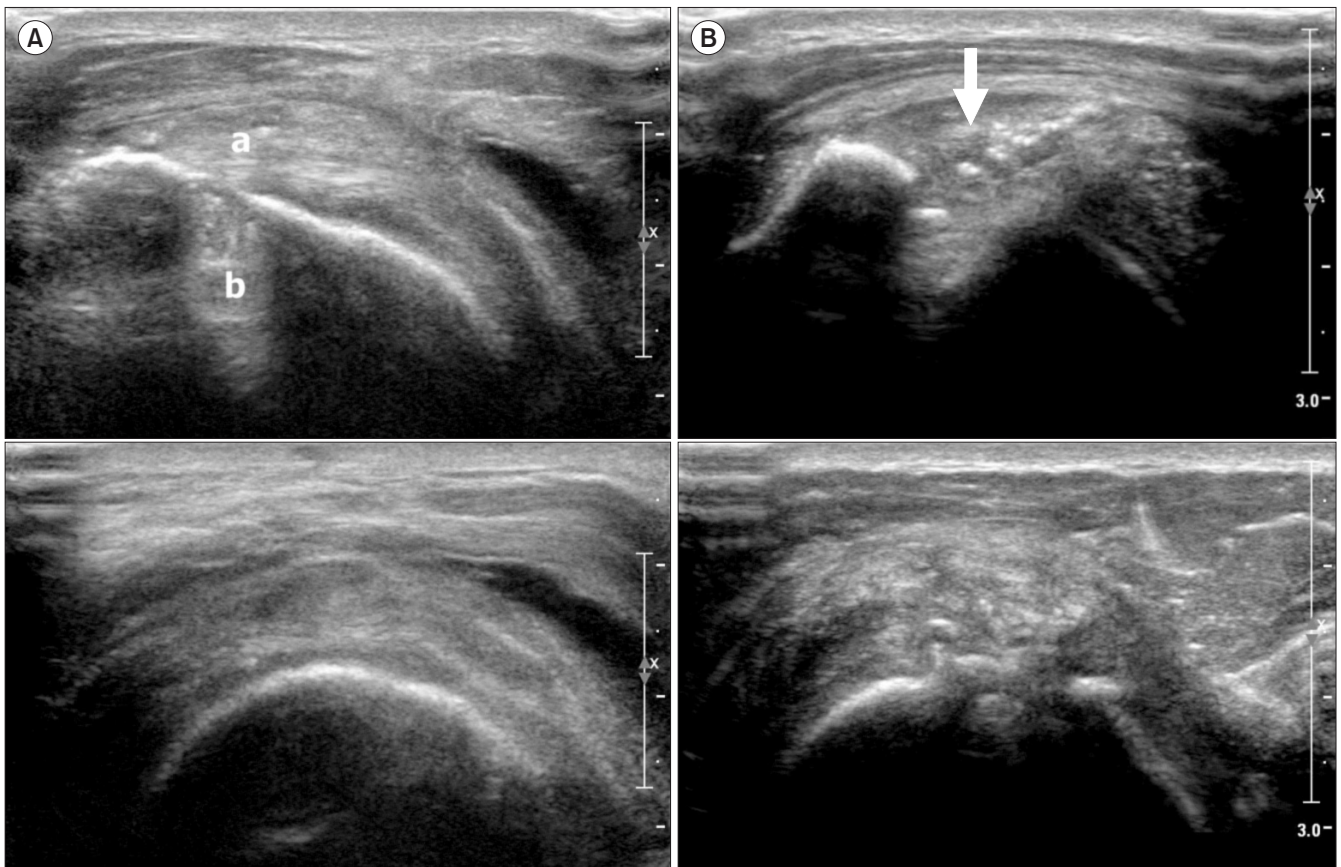


Fig. 2. Ultrasonographic findings at postoperative 3 (A) and 6 months (B) (Case 1). (A) At postoperative 3 months, there was an intact rotator cuff tendon without evidence of displacement of the anchor in the long axis view (upper) and in the short one (lower). (B) At postoperative 6 months, there was displacement of one biodegradable suture anchor. a: supraspinatus tendon, b: a suture anchor inserted, Arrow: a suspected dislodged suture anchor.

As the patient presented with no pain, we determined to monitor the clinical course. Routine MRI examination was performed at postoperative 1 year. As shown in Fig. 3, on MRI scans, the suture anchor was completely dislodged from the greater tuberosity and was located within the supraspinatus tendon proper. The patient also achieved complete healing of the repaired tendon (type II based on Sugaya's classification).³⁾ On T2-weighted MRI scans, the normal marrow fat around the suture anchors was replaced with tissue with a signal hypointense to water. This was accompanied by enlargement of the anchor insertion hole as compared with the anchor insertion site of the lateral row. In noticing that the patient presented with no pain in the affected shoulder, we determined to follow-up the patient for one year without performing further surgical interventions.

Case 2

A 75-year-old right-handed woman presented with a more than 6-month history of right shoulder pain. On physical examination, the patient had a marked limitation in the range of mo-

tion of the affected shoulder as compared with the contralateral side (125° of passive forward flexion, 30° of passive external rotation and the first lumbar level of passive internal rotation at back). On MRI scans, the patient had a full-thickness rotator cuff tear of 1.3×2.6 cm (Fig. 4). The patient also concurrently had severe fatty degeneration of rotator cuff muscles (Goutallier's grade 4/1/2, respectively, for supraspinatus/infraspinatus/subscapularis).⁴⁾ The patient preoperatively underwent dual energy X-ray absorptiometry (DXA), thus showing T-scores of -4.7. These findings are suggestive of severe generalized osteoporosis. While undergoing arthroscopic surgery, the patient had a supraspinatus tendon tear of approximately 1.5×3 cm in size. As there was a moderate to severe degree of medial retraction, two 5.0 mm biodegradable suture anchors (Paladin®) were inserted in the medial row of the greater tuberosity. This was followed by placement of four simple transtendon sutures. Loosening of the anterior suture anchor was detected during the knot tying process. Therefore a metallic suture anchor (ThRevo®; ConMed Linvatec) was inserted as a buddy anchor. Thus, the solid fixation of the anchor was confirmed (Fig. 5). Postoperatively, a



Fig. 3. Oblique coronal (A) and oblique sagittal image (B) of magnetic resonance imaging scans at postoperative 1 year. There was complete dislodging of the suture anchor from the footprint showing complete healing of the rotator cuff tendon with increased signal intensity (Case 1). Arrows: the dislodged suture anchor.

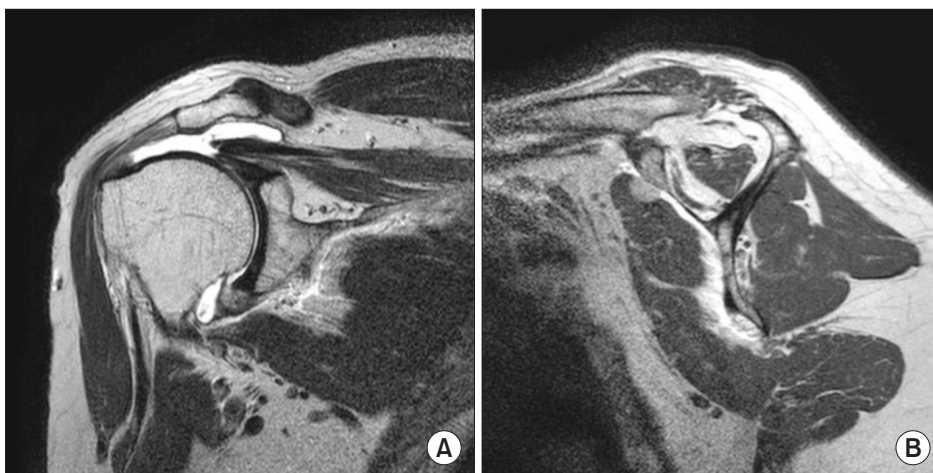


Fig. 4. Oblique coronal (A) and oblique sagittal images (B) of preoperative magnetic resonance imaging scans. There was a full-thickness tear of the rotator cuff tendon with severe fatty degeneration of the supraspinatus muscle (Case 2).

standardized rehabilitation protocol was applied to the patient. Immobilization was maintained using an abduction brace for six weeks. Routine USG examination performed at postoperative 3

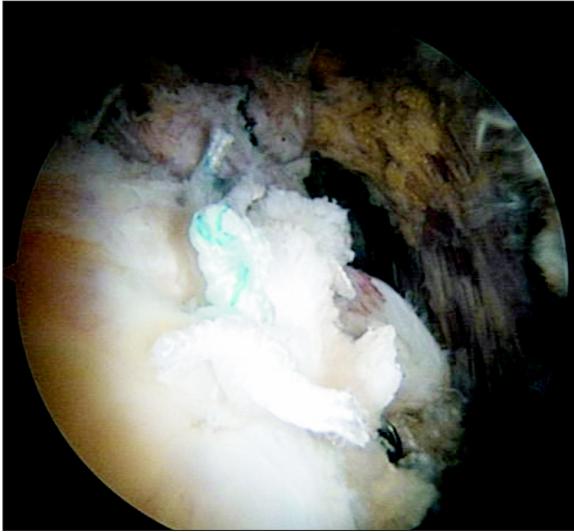


Fig. 5. A 75-year-old female who underwent arthroscopic repair of rotator cuff tears in her right shoulder. Arthroscopic view of the repaired rotator cuff tendon (Case 2).

months demonstrated a minimal amount of fluid in the subacromial space with an intact rotator cuff tendon (Fig. 6A). However the displacement of the suture anchor was not recognized at the time. During a retrospective review of the USG images, we detected the subtle change in the suture anchor, suggestive of partial dislodgement of the suture anchor. Routine follow-up USG examination performed at postoperative 6 months demonstrated the complete displacement of one biodegradable suture anchor (Fig. 6B). The suture anchor was clearly visible, showing the outer margin of thread as it was placed vertical to the direction of the USG beam, thus minimizing the effects of anisotropy. The patient had a pain VAS score of 0 points and a degree of patient satisfaction VAS score of 7/10. The patient also had an ASES score of 100 points and a Constant score of 75 points. We therefore determined to monitor the clinical course. Routine MRI examination of the shoulder performed at postoperative 1 year (Fig. 7) showed displacement of the suture anchor in the subacromial space. This was accompanied by the medial retraction of the torn end of the repaired supraspinatus tendon. The patient presented with no symptomatic aggravation. Therefore, we performed a follow-up of the patient without performing further surgical interventions. USG examination performed at postoperative 2 years demonstrated the previous defect was

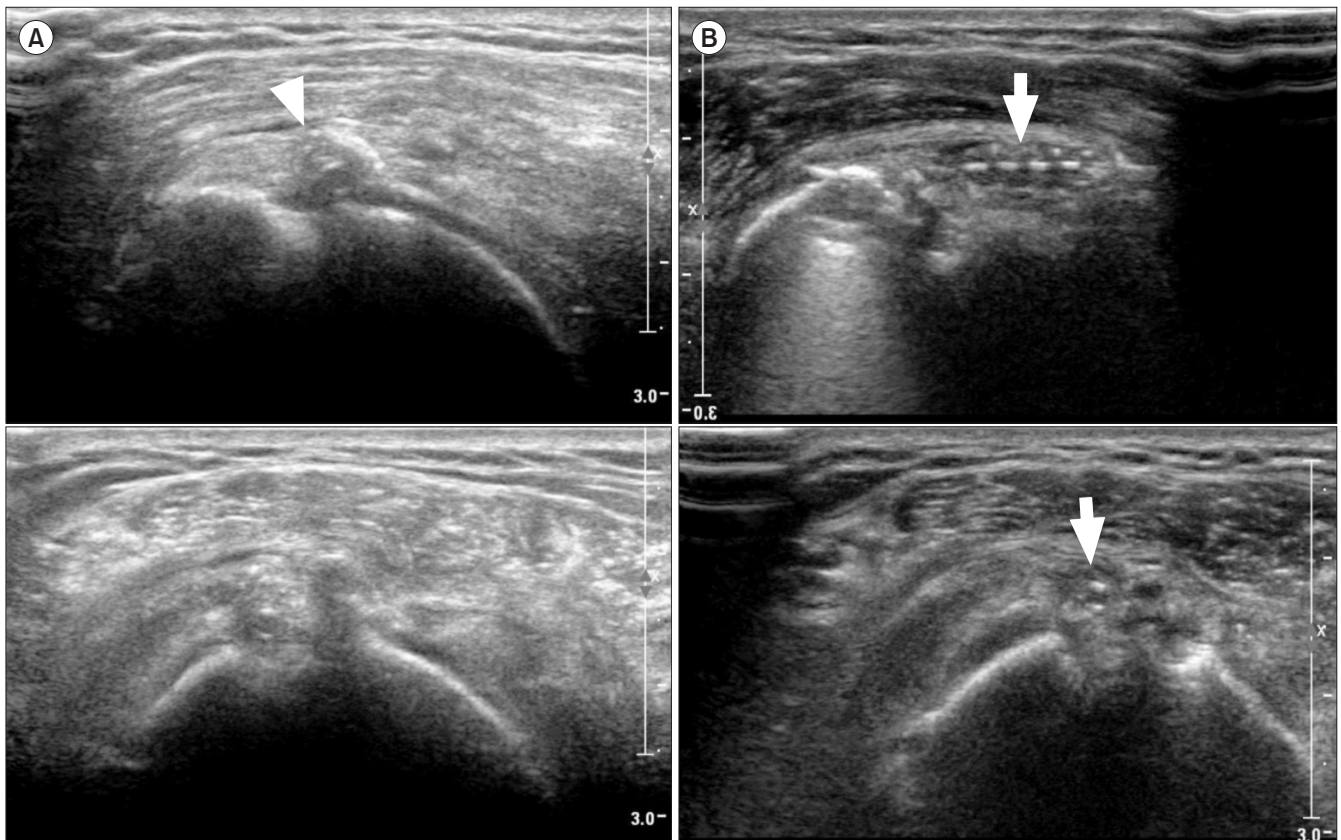


Fig. 6. Ultrasonographic findings at postoperative 3 (A) and 6 months (B) (Case 2). (A) At postoperative 3 months, there was an intact cuff tendon with subtle evidence of displacement of the anchor in the long axis view (arrow head, upper) and in the short one (lower). (B) At postoperative 6 months, there was complete displacement of one biodegradable suture anchor (arrows).

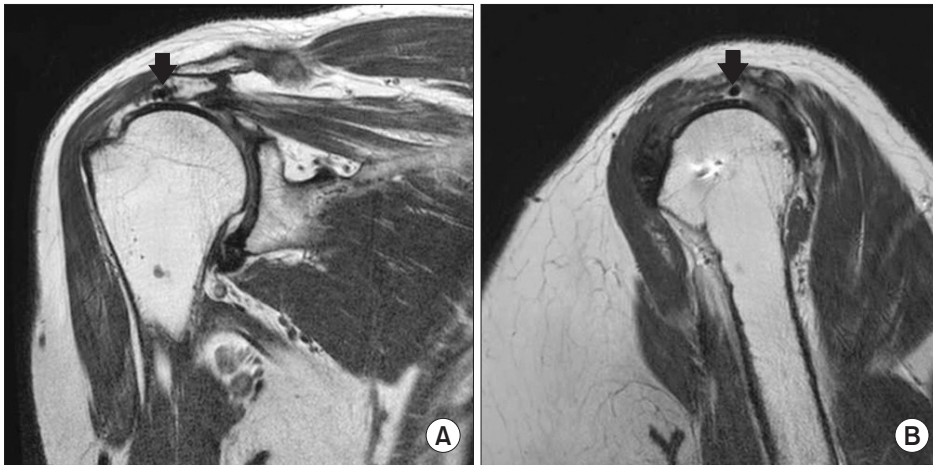


Fig. 7. Oblique coronal (A) and oblique sagittal images (B) of magnetic resonance imaging scans at postoperative 1 year (Case 2). There was displacement of the suture anchor in the subacromial space (arrows), accompanied by the medial retraction of the repaired supraspinatus tendon.

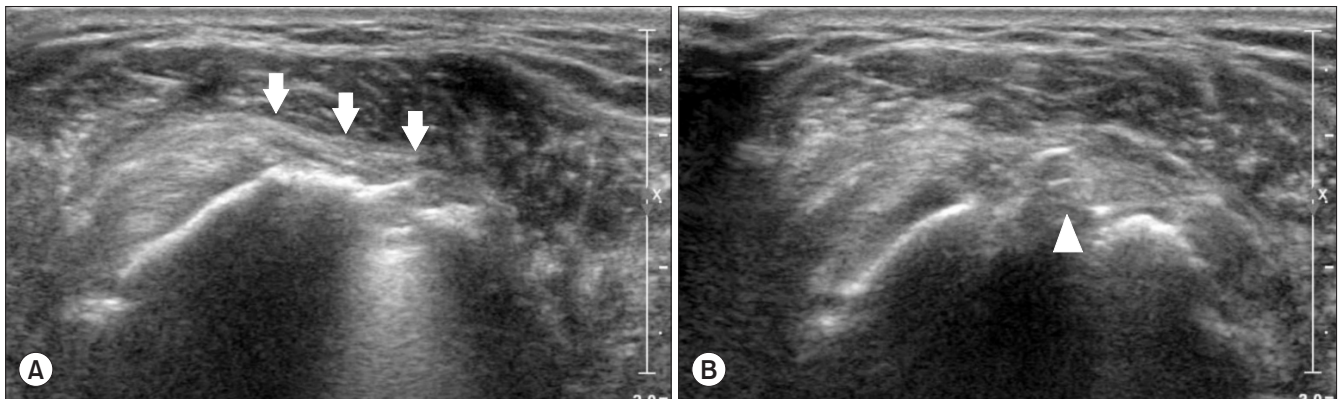


Fig. 8. Ultrasonography at postoperative 2 years (Case 2). At 2-year follow-up, there was a complete displacement of one biodegradable suture anchor (arrows) in the long axis view (A) and in the short one (B). The rotator cuff footprint defect was filled with thin scar tissue. The possible dislodging of the suture anchor is marked (arrow head).

filled with thin scar tissue. This was accompanied by the residual presence of the displacement of the suture anchor in the soft tissue (Fig. 8).

Discussion

In our cases, a diagnosis of the displacement of biodegradable suture anchors was made on follow-up USG images. Because of the radiolucency, radiography is not appropriate for early detection of anchor-related problems. MRI is known to have a higher diagnostic accuracy in the detection of rotator cuff tears, particularly in the case of partial thickness tears than USG and it also provides us with more information regarding the global status of the shoulder joint. However, the clinical feasibility of USG is superior to that of MRI in the aspect of cost and accessibility. Hence, USG is an advantageous modality in visualizing the object on a real-time basis at lower cost without risk of radiation exposure as a postoperative follow-up imaging in rotator cuff repair patients. There is variability in the USG findings

depending on the position of suture anchors; this arises from the effects of anisotropy. The displaced suture anchor appeared as a material showing multiple dots in line with a high echogenicity. According to the position of the anchor, the outer margin of thread could be visualized or not due to the effect of anisotropy. Clinical suspicion is most important in routine postoperative USG with reminding of these ultrasonographic features. Our cases were followed up without performing additional surgeries for removal of displaced anchors because the patients were asymptomatic with a good postoperative function. In the first case, the corresponding patient achieved complete healing of the rotator cuff despite the displacement of the suture anchor on MRI scans. Displacement of the suture anchor shows an asymptomatic course, however its long-term prognosis remains a concern. We will follow two of our patients with the expectation of self-degradable property of the anchor.

The first case is unique because the displacement of poly-L/D-lactic acid (PLDLA) anchor occurred relatively later and the rotator cuff healed well considering the fact that repaired rota-

tor cuff tendon is usually presumed to heal within postoperative 3 months. This indicates that there was loosening between the anchor and bone after the suture anchor was well fixed. At postoperative 1 year, T2-weighted MRI scans showed enlargement of the site of the initial insertion of the anchor with low signal intensity areas. Despite a lack of the fluid signal, it may have undergone cystic widening of the space followed by the ingrowth of granulation tissue. On the other hand, in the second case it can be inferred that the degree of the initial fixation was relatively lower between the suture anchor and the bone bed considering that the patient was relatively older and had systemic osteoporosis. However, little is known about the definite pathophysiology underlying the displacement of the anchor. This is because there are no available MRI scans showing changes in the site of the insertion of anchor between postoperative 3 and 6 months.

It was found that the displacement of the suture from the tissue is the weakest link in tendon repair using suture anchors.⁵⁾ Failure at the bone-anchor interface is mainly related to the density of the bone and the design of the anchor.⁶⁾ In the second case, local osteoporosis at the site of insertion of the anchor may have contributed to the displacement of the suture anchor. This is because the patient had systemic osteoporosis on DXA scans and the associated shoulder stiffness may have worsened the local osteoporosis of the shoulder. In the first patient, however, because the T-score suggested normal bone density (T-score=-0.7), it is impossible to explain the displacement of the suture anchor based on the presence of systemic osteoporosis. The first patient was suspected of having cystic changes in the site of insertion of the anchor on MRI scans at postoperative 1 year (Fig. 3). In addition, the patient had a hypointense signal to water in the hole for the insertion of the anchor despite a lack of the fluid signal on T2-weighted MRI scans. Presumably, this might arise from the complete healing of the repaired tendon, thus suggesting no channel between the site of insertion of the anchor and joint space for the fluid leakage. It is accepted that biodegradable suture anchors may be replaced with autologous bone. However there are also some reports that osteolysis occurred at the site of insertion of the anchor after rotator cuff repair.^{7,8)} Glueck et al.⁷⁾ reported a case of rotator cuff repair with development of extensive osteolysis in the humeral head. At postoperative 8 and 16 months, there were findings suggestive of significant osteolysis at the site of insertion of the anchor. However the above mentioned authors failed to demonstrate the status of biodegradable suture anchors because there were no available advanced imaging modalities such as USG or MRI, although the patient was reported to be asymptomatic. In a study⁹⁾ comparing outcomes between patients with osteolysis on post-repair MRI and those who did not have such osteolysis, no significant differences in the clinical and functional outcomes were observed between the two groups. The rate of rotator cuff healing was not

influenced by the presence of osteolysis. However, there was no comment regarding the displacement of suture anchors. It can be inferred that the clinical outcome is usually favorable even in the presence of osteolysis unless the stability of anchors is threatened.

The outcomes of rotator cuff repair surgery could be dependent on the material property of suture anchors due to their different degradation profile.²⁾ The anchors displaced in this report were made from 96L/4D poly-L-lactic acid (PLDLA 96L/4D). PLDLA is an amorphous copolymer, designed to degrade at a faster rate than the homopolymer poly-L-lactic acid (PLLA).⁷⁾ There are several reports regarding the complications of PLDLA suture anchors. Park et al.¹⁰⁾ reported that superior labrum anterior to posterior repair surgery was repeated at a rate of 24% and 4% in the PLDLA 96L/4D group and the PLDLA 70L/30D group, respectively, compared to the rate of 0% in the nonabsorbable anchor group. PLDLA anchors were developed to replace the PLLA anchors, which had a slow degradation rate of up to 5 years.⁶⁾ The authors suggested that subtle differences in the manufacturing processes of PLDLA, oxidative degradation during or after manufacturing, and different isomer compositions between manufacturers may contribute to the different chemical properties of the final products and could have resulted in the differences in reoperation rate, loss of fixation or osteolysis. Pilge et al.⁸⁾ reported a high rate of osteolysis after rotator cuff repair with PLDLA suture anchors. Of a total of 70 PLDLA anchors, 22 showed osteolytic changes on MRI scans without affecting the clinical outcomes after rotator cuff repair. There are some controversies regarding whether the cause of osteolysis is mechanical or biological.^{7,8)} It is not known whether the difference in the polymer contents may be more or less likely to cause an osteolytic reaction. Also in our cases, the exact role of premature anchor degradation through the process of anchor displacement is still inconclusive as there are no serial images showing the change of anchor insertion site.

Several factors may have influenced the loosening of the anchor, including the property of anchors, underlying osteoporosis, rehabilitation protocol, cyclic loading caused by daily activity, and osteolysis at the site of insertion of the anchor. It could also be considered that the differences in bone mineral density between the regions in the greater tuberosity and different mechanical loading to the anchors account for the differences in outcomes between the anchors as only one was displaced. However, we should be concerned that the late displacement of a suture anchor may be the result of accelerated degradation property of PLDLA anchors by hydrolysis. Further studies are therefore warranted to determine the definite cause of late displacement pertaining to biodegradable PLDLA anchors.

In conclusion, despite the well-established effectiveness and safety profile of biodegradable sutures, surgeons and radiologists should be cautious about the displacement of suture anchors

when following patients who underwent rotator cuff repair surgery with these anchors even after three months postoperatively. USG is potentially useful for early detection of biodegradable anchor-related problems in such patients. Further studies are warranted to clarify the etiology of displacement of PLDLA suture anchors and to evaluate their long-term outcomes.

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