Original Article
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Serial Changes in Perianchor Cysts Following Arthroscopic Labral Repair Using All-Suture Anchors

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Background: Changes in perianchor cysts around the all-suture anchors, which demonstrate distinguished features from the biocomposite anchors, have not been revealed sufficiently. The purpose of this study was to investigate serial changes of perianchor cysts according to the location of the inserted anchor in the glenoid in arthroscopic labral repair using all-suture anchors.

Methods: We enrolled 43 patients who underwent computed tomography (CT) immediately postoperatively and CT arthrogram (CTA) at 1 year or 2 years after arthroscopic labral repair using a 1.3-mm all-suture anchor for recurrent anterior shoulder dislocation with or without a superior labral tear from anterior to posterior and a posterior labral tear. The mean diameter and tissue density (HU) of perianchor cysts were measured depending on the location in the glenoid. Clinical outcomes, labral healing, and redislocation rate were evaluated at 2 years after surgery.

Results: On functional assessment, the mean American Shoulder and Elbow Surgeons score and Rowe score improved statistically significantly after surgery (from 47.9 ± 14.3 preoperatively to 90.1 ± 9.6 postoperatively and from 45.3 ± 12.4 preoperatively to 92.2 ± 10.1 postoperatively, respectively; $p < 0.01$). Postoperative redislocations were found in 2 patients (4.7%). In radiological evaluation, the mean diameter of perianchor cysts at postoperative 1 year (3.24 ± 0.65 mm) was significantly larger than the immediate postoperative diameter; however, there was no significant difference between postoperative 1 year and 2 years (3.23 ± 0.57 mm). Tissue density at the center of cysts demonstrated no significant difference between 1 and 2 year postoperatively (107.7 ± 29.8 HU [superior], 99.7 ± 31.7 HU [anteroinferior], and 105.1 ± 25.0 HU [posterior] vs. 109.1 ± 26.1 HU [superior], 106.4 ± 30.3 HU [anteroinferior], and 111.0 ± 32.9 HU [posterior]). The mean diameter of perianchor cysts in the anteroinferior position was largest compared with that in superior or posterior positions.

Conclusions: Perianchor cysts associated with all-suture anchors enlarged significantly within 1 year after arthroscopic labral repair regardless of the insertion location in the glenoid. However, the size and tissue density of perianchor cysts were similar at postoperative 1 and 2 years, and satisfactory stability and clinical outcomes were obtained.

Keywords: *Joint instability, Shoulder dislocations, Bankart lesions, Suture anchors, Computed tomography*

For arthroscopic labral repair, all-suture anchors were introduced because of potential and purported advantages, such as minimal glenoid bone loss during insertion due to the small diameter and easy access to the inferior aspect of the glenoid due to higher flexibility relative to previous generations of suture anchors.[1] However, characteristic perianchor cyst formation associated with all-suture an-

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chors in the glenoid after insertion has been reported.[2-4] A histologic examination of all-suture anchors in the dog glenoid revealed enlarged perianchor cysts with a rim of dense lamellar bone only 8 weeks after implantation.[2] Clinically, formation of small cysts and tunnel widening associated with all-suture anchors can be observed in postoperative magnetic resonance imaging (MRI) at a minimum follow-up of 1 year.[3] Furthermore, postoperative glenoid rim fractures around large cysts were noted in young athletes after arthroscopic Bankart repair using all-suture anchors.[5]

Several studies have reported on cyst formation around the anchor complex after glenoid fixation using metal and biocomposite suture anchors.[6-8] In a study by Park et al.,[6] perianchor radiolucency of metal anchors was observed in approximately 26% of patients, which was related with inferior clinical outcomes and anchor arthropathy due to implant loosening. However, according to Milewski et al.,[7] perianchor cysts associated with biocomposite suture anchors in the glenoid were identified in 55% at the initial stage and they were progressively replaced by bone based on serial follow-up radiographs. These radiographic findings have provided important information for assuring the safety of the suture anchors in clinical use. While the bone replacement of perianchor cysts in labral repair with biocomposite anchors is well established, to the best of our knowledge, there are no published data on the serial changes of perianchor cysts associated with all-suture anchors.

The purpose of this study was to investigate the serial changes of perianchor cysts, using computed tomography (CT) or CT arthrogram (CTA), as well as the different characteristics of perianchor cysts according to the location of the inserted anchor in the glenoid in arthroscopic labral repair with all-suture anchors. We hypothesized that a perianchor cyst formed following arthroscopic labral repair using all-suture anchors would considerably increase in size during a certain period after surgery, however the size and attenuation of the cyst would remain unchanged after a certain period of time.

METHODS

Patient Recruitment

This case series study included patients who were treated with arthroscopic labral repair using all-suture anchors for recurrent shoulder dislocation with concomitant labral lesions at Ewha Womans University Seoul Hospital between January 2014 and July 2016.

The labral lesions were categorized as isolated Bankart lesion, Bankart combined with a superior labrum anterior to posterior (SLAP) lesion, Bankart and posterior labral lesion, and pan-labral tear after arthroscopic examination. The inclusion criteria were patients who underwent CT or CTA at least twice within 2 years after surgery and were followed up and evaluated clinically for up to 2 years postoperatively. Exclusion criteria were as follows: (1) an anterior glenoid bone loss more than 20% of the total width, which was treated with an additional reattachment procedure,[9] (2) concomitant rotator cuff tear, (3) cartilage lesion of the glenohumeral joint, (4) multidirectional instability, and (5) revisional labral repair surgery. Of 61 enrolled patients, 43 patients met the inclusion criteria. The Institutional Review Board approved this study protocol (IRB No. EUMC 2018-01-009), and all patients who participated in this study provided informed consent. This work was done at the Department of Orthopedic Surgery, Ewha Womans University Seoul Hospital, Seoul, Korea.

Surgical Technique and Rehabilitation

Arthroscopic labral repair using a 1.3-mm all-suture anchor with a single loaded suture was performed by a single surgeon (SJS) using the same surgical technique for all patients in this study. With the patient placed in a lateral decubitus position, the standard anterosuperior, anteroinferior, and posterior portals were created. Injured and detached labral lesions were debrided using an arthroscopic motorized shaver. For Bankart repair, predrilling was started at 1 mm medial to the edge of the glenoid articular cartilage. A curved guide was used to insert a suture anchor into the most inferior lesion of the glenoid for labral repair, otherwise a straight guide was used. A depth of 21 mm was predrilled before insertion of the 1.3-mm all-suture anchor (Y-Knot; ConMed Linvatec, Largo, FL, USA; ultra-high-molecular-weight polyethylene). Posterior labral repair was performed when the labrum detached from the glenoid was prominently identified through intraoperative probing. A SLAP lesion or posterior labral tear was repaired to reattach the labrum to the anatomical footprint of the glenoid. All labral lesions were repaired with a single-row suture technique using sliding knot tying. An additional Remplissage procedure was performed with a 4.5-mm biodegradable suture anchor (Healix Advance BR; DePuy Mitek, Raynham, MA, USA; poly-L-lactic acid) on the Hill-Sachs lesion where the humeral head was engaged by an arthroscopic maneuver.

The same protocol for postoperative rehabilitation was applied for all patients. Shoulder immobilization supported by an abduction pillow was maintained for the first 4 weeks. Passive range of motion and active assisted exercises were encouraged after discontinuation of the 4 weeks of immobilization. Shoulder muscle strengthening exercises were started at 8 postoperative weeks. Sporting activities were allowed at 6 months postoperatively.

Radiological Evaluation

In accordance with the usual protocol of our institution, CTA was performed once at postoperative 1 year or 2 years to determine the timing for return to weight lifting or sports activities with confirmation of a perianchor cyst or labral healing. CT was performed to investigate for the presence of or change to perianchor cysts at least once in immediate postoperative period and between 1 year and 2 years postoperatively (Fig. 1). For patients who had medical history of allergic reactions to contrast media or refused to take CTA, CT was taken instead of CTA. Regular CT or CTA was performed using a multidetector CT scanner (SOMATOM Sensation 16 or Sensation 64; Siemens, Munich, Germany). The protocol for regular scanning was performed using a 2-mm slice thickness without a slice interval and 120 kV and adjusted mA with 0.6-mm pitch. The obtained images were displayed by a picture archiving and communication system (PACS), which allowed measurement in the axial, sagittal, and oblique coronal planes. At the time of measurement, the number of anchors inserted in the arthroscopic surgery and the number of anchors observed in CT or CTA were found to be the same. In the radiological evaluation, the most optimized image among each plane made from CT or CTA scans was selected based on the agreement of observers for constant measurement of the diameter and attenuation of perianchor cysts. The glenoid region was divided into 3 parts: a 1 o'clock to 11 o'clock area for SLAP repair, a 2 o'clock to 6 o'clock area for Bankart repair, and a 6 o'clock to 11 o'clock area for posterior labral repair. Using the CT or CTA scans at 1 and 2 postoperative years, the diameter of perianchor cyst was documented as the mean diameter of cyst along the insertion site in the axial, sagittal, and oblique coronal planes (Fig. 2). The attenuation of perianchor cyst tissue was defined by the mean value noted in the PACS among 4 points placed at the center of each quadrant of a circle drawn on the perianchor cyst. Compared with those of CT or CTA at postoperative 1 year and 2 years, the anchor holes observed in the CT immediately after surgery were

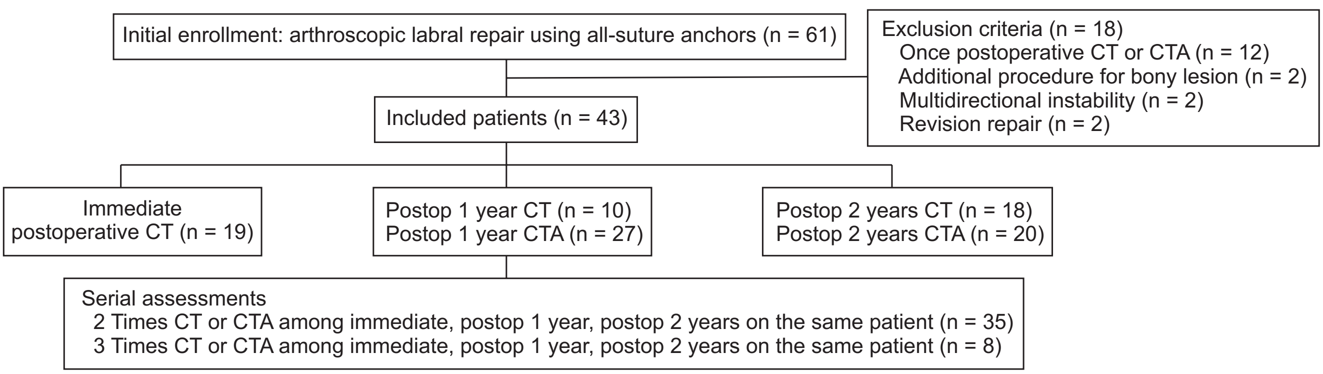


Fig. 1. Schematic flow of postoperative computed tomography (CT) or CT arthrogram (CTA) acquirement. Postop: postoperative.

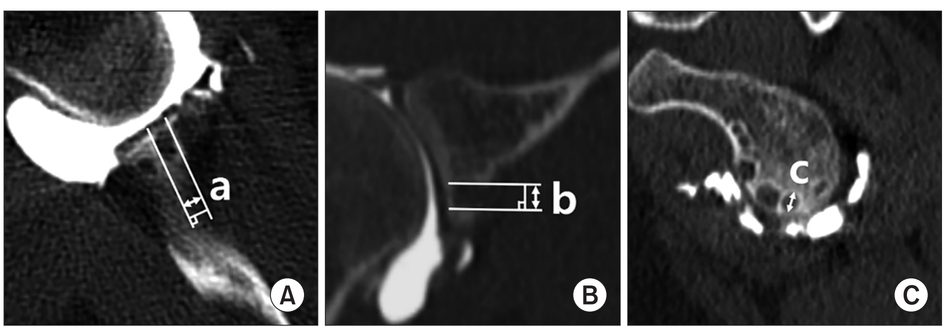


Fig. 2. Measurement of the cyst diameter on the axial, oblique coronal, and sagittal planes of computed tomography (CT) or CT arthrogram (CTA). (A) The estimated diameter (a) on the axial image was measured perpendicular to the direction of the anchor. (B) The estimated diameter (b) on the oblique coronal image was measured perpendicular to the direction of the anchor. (C) The diameter (c) was determined in a circle, which was in contact with the border of the anchor tunnel. The mean value of the measured diameters on three planes was referred to as the diameter of the perianchor cyst.

too small to measure the diameter. Therefore, the diameter of drilling hole (1.3 mm) was regarded as the reference value. The breakage of far cortex along the anchor insertion site was also counted in the 1- and 2-year postoperative CT or CTA when breakage was confirmed in 1 of the axial, sagittal, or oblique coronal planes. Two orthopedic surgeons (JHL and IP) independently measured the mean diameters and extent of attenuation of perianchor cysts and counted the number of suture anchors and breakage of far cortex. Repeated measurements of the same object with time intervals of 10 days were performed to assure intraobserver reliability.

Assessment of Clinical Outcomes

All patient data for injury mechanisms, age at the time of first dislocation, number of dislocations, and demographic information were documented. An independent assistant (JYP) recorded the Rowe score and the American Shoulder and Elbow Surgeons (ASES) score preoperatively and at 2 years after surgery. Postoperative redislocation was only recognized when the physicians reduced dislocated shoulder after radiographic confirmation of glenohumeral dislocation. Subjective instability was defined as a persistent subjective complaint of apprehension and a positive apprehension test at 2 years after surgery.

Statistical Analysis

The quantitative data of demographics and radiographic findings were compared using the independent *t*-test. The paired *t*-test was applied to analyze the differences between preoperative and 2-year postoperative Rowe and ASES scores. The mean diameter of a perianchor cyst and tissue density were compared among the 3 different positions of suture anchors using analysis of variance with Bonferroni correction. Categorical variables, such as subjective instability and redislocation, were compared using Pearson's chi-square test. The intra- and interobserver reliability for mean values of suture anchor tunnel diameter was analyzed using the intraclass correlation coefficient (ICC). An ICC was calculated via a 2-way mixed effect for absolute agreement between mean values of each observer's measurements. An ICC value of 0.75 or greater was considered to reflect an excellent reliability.[10] All statistical analyses were performed using IBM SPSS ver. 21.0 (IBM Corp., Armonk, NY, USA), and a $p < 0.05$ was considered statistically significant.

RESULTS

Preoperative Demographics and Intraoperative Findings

Of 43 patients, 34 were men and 9 were women, and their mean age was 24.3 ± 6.8 years. Preoperative demographic data are summarized in Table 1. Eight patients (18.6%) had bony Bankart lesions, which were treated by conventional labral repair. The mean value of glenoid bone loss was 11.9% ± 3.7% among the 8 patients. Concomitant Remplissage procedure for engaging Hill-Sachs lesions was performed for 2 patients (4.7%) due to the definite engagement of the glenohumeral joint under manual drawing of the humeral head.

Table 1. Patients' Demographic Data

Variable	Value
Age at first dislocation (yr)	22.7 ± 4.9
Age at operation (yr)	24.3 ± 6.8
Sex (male : female)	34 : 9
Dominant shoulder	34
Number of dislocations	6.0 ± 4.1
Follow-up duration (mo)	25.6 ± 1.9
Bony Bankart lesion	8 (18.6)
Cause of dislocation	
No association with injury	4 (9.3)
Injury-associated dislocation	39 (90.7)
Fall	13 (30.2)
Sports activity	18 (41.9)
Work or traffic accident	8 (18.6)
Preoperative functional score	
ASES	47.9 ± 14.3
Rowe	45.3 ± 12.4
Treated labral pathology	
Isolated Bankart lesion	28 (65.1)
Bankart + SLAP lesion	7 (16.3)
Bankart + posterior labral tear	5 (11.6)
Bankart + SLAP + posterior labral tear	3 (7.0)

Values are presented as mean ± standard deviation or number (%).
ASES: American Shoulder and Elbow Surgeons, SLAP: superior labrum anterior to posterior.

Analysis of Radiographic Findings in CT or CTA Scans

Nineteen patients underwent immediate postoperative CT scans within 3 days after surgery. At 1 year postoperatively, 27 and 10 patients underwent CTA and CT scans, respectively. The number of patients evaluated by CTA and CT at 2 years postoperatively was 20 and 18, respectively. Of 43 patients, 35 patients underwent CT or CTA twice and 8 patients underwent CT and CTA 3 times during the study period. The respective ICCs for intra- and interobserver reliability were 0.941 and 0.913 for tunnel diameter and 0.987 and 0.981 for tissue density.

The largest number of anchors was fixed in the anteroinferior position (Table 2). Of the 34 patients who underwent CTA at 1 or 2 years after surgery, labral healing was identified at the superior, anteroinferior, and posterior glenoid. Patients who did not achieve labral healing at the superior location had no clinical symptoms. Far cortical breakage at the anchor insertion site was observed in only the anteroinferior and posterior locations.

The mean diameter of perianchor cysts at postoperative 1 year was significantly larger than the mean diameter of perianchor cysts in the immediate postoperative CT scans ($p < 0.01$) (Fig. 3). However, there was no significant difference in the mean diameter of perianchor cysts between postoperative year 1 and postoperative year 2 ($p = 0.565$). The largest mean perianchor cyst diameters at 1 year after surgery (anteroinferior, 3.31 ± 0.65 mm; superior, 2.60 ± 0.67 mm; and posterior, 2.93 ± 0.51 mm) and at 2 years after surgery (anteroinferior, 3.30 ± 0.55 mm; superior, 2.44 ± 0.38 mm; and posterior, 2.78 ± 0.40 mm) were at the anteroinferior position ($p < 0.01$). Central perianchor cyst tissue density demonstrated no significant difference between 1 year and 2 years postoperatively ($p = 0.10$) (Fig. 4). There was also no significant difference among the 3 positions (Fig. 5).

Clinical Outcomes

Postoperative redislocation and subjective instability were noted in 2 patients (4.7%) and 4 patients (9.3%), respectively. Mean ASES (90.1 ± 9.6) and Rowe scores (92.2 ± 10.1) improved after surgery ($p < 0.01$). The causes of redislocation were direct collisions while snowboarding and

Table 2. Number of Inserted Anchors, Labral Healing, Far Cortex Breakage According to the Glenoid Location

Variable	Superior (n = 10)	Anteroinferior (n = 43)	Posterior (n = 8)
Total number of anchors	19	193	24
Mean number of anchors	1.90 ± 0.79	4.50 ± 0.61	3.00 ± 1.16
Labral healing	9 (90)	39 (90.7)	8 (100)
Far cortex breakage	0	17/193 (8.8)	1/24 (4.2)

Values are presented as mean ± standard deviation or number (%).

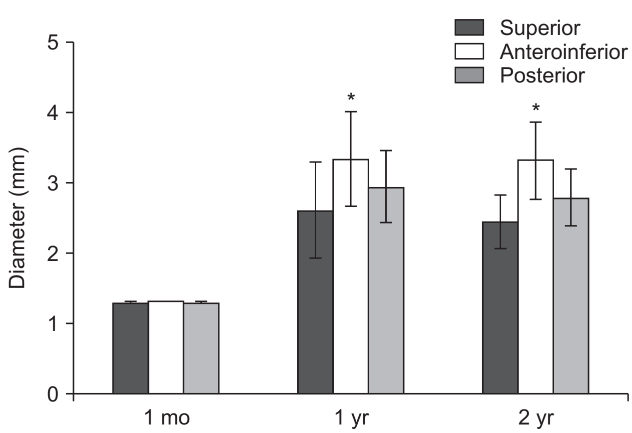


Fig. 3. The mean diameter of perianchor cysts was measured during the immediate postoperative period and at 1 year and 2 years postoperatively using computed tomography scans. *Significant differences between the immediate postoperative period and 1 year after surgery and between the immediate postoperative period and 2 years after surgery.

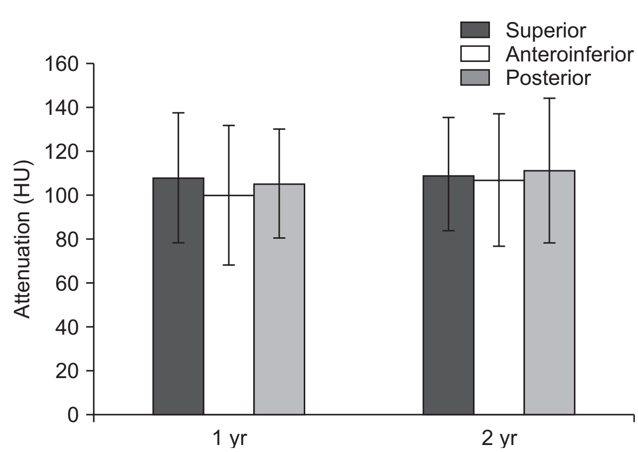
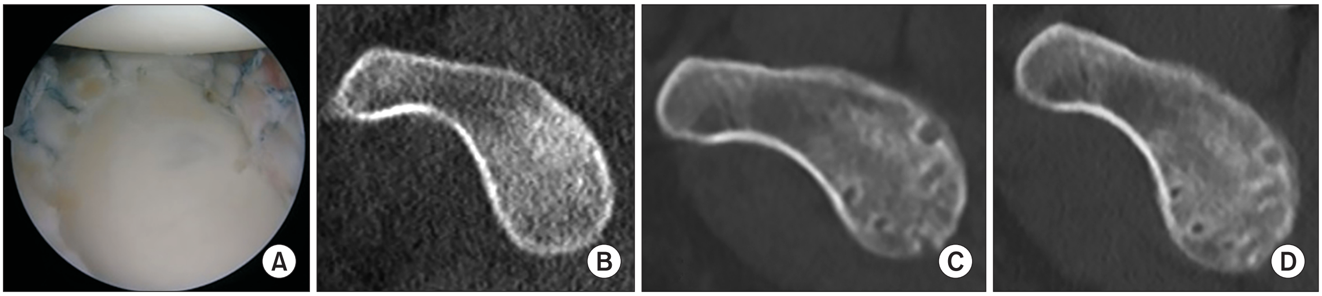


Fig. 4. The mean attenuation (HU) of the perianchor cyst was measured at 1 year and 2 years postoperatively by computed tomography scans. No significant differences were found.



Intraoperative | Postop 3 days | Postop 1 year | Postop 2 years

Fig. 5. (A) A 22-year-old male underwent arthroscopic Bankart and posterior labral repair using seven 1.3-mm single-strand all-suture anchors. (B) An immediate postoperative sagittal computed tomography (CT) scan showing small holes matching the diameter of the drill, which cannot be measured using the picture archiving and communication system. (C) A CT scan at 1 year postoperatively showing multiple enlarged perianchor cysts with pronounced rim. (D) A CT scan at 2 years postoperatively showing perianchor cysts without significant differences in size and tissue density. Postop: postoperative.

playing basketball. One patient underwent open Latarjet reconstruction and 2 patients underwent arthroscopic revision Bankart repair.

DISCUSSION

The perianchor cysts significantly enlarged within 1 year after operation using all-suture anchors. However, the mean diameter of perianchor cysts did not change after postoperative 1 year regardless of insertion site in the glenoid. Cyst tissue density remained consistent without significant change between postoperative 1 year and 2 years. Although there was no evidence of bone replacement in radiographic assessments, satisfactory stability and clinical outcomes were obtained after arthroscopic labral repair using all-suture anchors at postoperative 2 years.

Several clinical studies have revealed satisfactory labral healing without the formation of a large perianchor cyst at 1 year after arthroscopic labral repair.[3,11] Tompane et al.[11] analyzed 91 all-suture anchors for arthroscopic shoulder stabilization procedures and identified a significant increase in the tunnel volume in CT images at 6 and 12 months after surgery. They defined cystic change as a non-uniform change of anchor insertion site, and tunnel expansion was defined as a cylindrical increase of more than 1 mm in diameter relative to the initial drilling on any CT scan. Therefore, they demonstrated a low rate of cyst formation and no association with the initial tunnel location. In the current study, we defined perianchor cysts in the same way as Tompane et al.[11] defined tunnel expansion because all end points of the bony enlargement associated with all-suture anchor sites in the axial and oblique coronal planes seemed irregularly round or oval rather than square or rectangular. Despite the different definitions of bony lesions related with all-suture anchors among previous studies, the characteristic findings in CT scans at 1 year after surgery were similar.[4,7,8]

The typical tunnel widening of biocomposite suture anchors, demonstrating cylindrical expansion of the abutting bone along the anchor, has been shown to be well replaced by bone until 24 months of follow-up.[7] However, the perianchor cyst size changes over time, indicating that the changes in all-suture anchors are different from those in biocomposite anchors, which induce resorption with progressive bone ingrowth in arthroscopic labral repair. The biodegradable components and fixation mechanism of biocomposite anchors result in bridging of the surrounding cancellous bone and gaps in the initial fixation, leading to gradual bone ingrowth over time.[2,7,12] In our study, all cyst changes occurred within 1 year postoperatively and no significant changes were found in the perianchor cyst size afterwards. The all-suture anchor is composed of ultra-high-molecular-weight polyethylene, which is not biodegradable. In terms of fixation mechanism, micromotion, which might be generated in the loose connection between the cancellous bone and the deployed all-suture anchor by repetitive pullout force, is considered as a leading cause of cyst enlargement.[2] Our study demonstrated that perianchor cyst tissue density also did not change 1 year postoperatively. Based on these results, all-suture anchors seem to have a low level of reaction with surrounding bone and no possibility of resorption and bone ingrowth until 2 years after surgery.

The mean size of perianchor cysts associated with all-suture anchors inserted at the anteroinferior and posterior aspects of the glenoid was significantly larger than that of anchors inserted at other positions. Milewski et al.[7] described that more tunnel widening of biocomposite anchors was identified in anteroinferior and posterior glenoid lesions than that of anchors inserted at the superior location. They suggested that differences in the forces across the inserted anchors, depending on the different locations, might result in varying patterns of tunnel widening. Repairs for the superior or posterior labral lesions are usually performed to relieve pain through labral reattachment without capsular plication. Meanwhile Bankart repair is intended to restore the capsulolabral complex for stability.[13-16] Therefore, the direction and degree of force applied to the anchor, according to the anchor position, are presumed to be different.

Risk of perforating the far cortex of the glenoid has been reported to increase when the most inferior anchor is inserted through the anteroinferior portal.[17,18] One biomechanical test for pull-out strength and insertion angle of all-suture anchors supports our clinical results.[19] Based on the biomechanical results, no perforation of anchors at the 2:30 and 4 o'clock positions was found; however, a 33% perforation rate for suture anchors was observed only at the 5:30 position. The diameter of the all-suture anchors was small immediately after surgery, and it was difficult to confirm the presence of far cortex perforation; however, a prominent increase in diameter was observed in the clinical observation at 1 year after surgery. Glenoid rim fractures after repair using solid anchors have been reported in several studies, and in the case of all-suture anchors, a similar problem has been reported.[5,20,21]

Regarding the clinical outcomes of arthroscopic labral repair, labral healing is considered an important component of postoperative stability.[22,23] To lower the recurrence rate after Bankart repair, there have been efforts to recreate the native anatomy and biomechanical properties of the capsulolabral complex.[24-27] Despite the commonly observed early displacement and cyst formation associated with all-suture anchors,[2,28,29] satisfactory clinical results were obtained in the current study. The relatively high rate of labral healing at 1 year after labral repair might have contributed to the satisfactory clinical outcomes. As the repaired labrum healed mainly within a few months after surgery, it seems to be an important factor for healing and stability to apply adequate pull-back tension to maintain the initial stiffness of the all-suture anchors for deployment and settlement in the glenoid with an appropriate number of anchors.[16,29,30]

This study has several limitations. First, there was no control group for comparison of radiologic changes to all-suture anchors. Second, the number of enrolled patients was relatively small, and the patients who underwent CT or CTA at all 3 follow-up sessions were few. Because there was no previous study that directly compares radiologic findings, it was difficult to determine an appropriate sample size before the analysis. Furthermore, we were not able to evaluate serial CT or CTA scans for each patient due to radiation exposure. We, therefore, performed a low-dose CT or CTA to minimize radiation exposure derived from additional CT scans without measurement bias.

Perianchor cysts associated with all-suture anchors enlarged significantly within 1 year after arthroscopic labral repair regardless of the insertion location in the glenoid. The size and tissue density of perianchor cysts were similar at 1 year and 2 years after surgery. Satisfactory stability and clinical outcomes were obtained using all-suture anchors for labral repair, despite perianchor cysts persisting up to 2 postoperative years.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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REFERENCES

1. Erickson J, Chiarappa F, Haskel J, et al. Biomechanical comparison of a first- and a second-generation all-soft suture glenoid anchor. Orthop J Sports Med. 2017;5(7):232596 7117717010.

2. Pfeiffer FM, Smith MJ, Cook JL, Kuroki K. The histologic and biomechanical response of two commercially available small glenoid anchors for use in labral repairs. J Shoulder Elbow Surg. 2014;23(8):1156-61.

3. Willemot L, Elfadalli R, Jaspars KC, et al. Radiological and clinical outcome of arthroscopic labral repair with all-suture anchors. Acta Orthop Belg. 2016;82(2):174-8.

4. Van der Bracht H, Van den Langenbergh T, Pouillon M, Verhasselt S, Verniers P, Stoffelen D. Rotator cuff repair with all-suture anchors: a midterm magnetic resonance imaging

evaluation of repair integrity and cyst formation. J Shoulder Elbow Surg. 2018;27(11):2006-12.

5. Nakagawa S, Hirose T, Tachibana Y, Iuchi R, Mae T. Postoperative recurrence of instability due to new anterior glenoid rim fractures after arthroscopic Bankart repair. Am J Sports Med. 2017;45(12):2840-8.

6. Park JY, Lhee SH, Park HK, Jeon SH, Oh JH. Perianchor radiolucency after knotless anchor repair for shoulder instability: correlation with clinical results of 69 cases. Am J Sports Med. 2009;37(2):360-70.

7. Milewski MD, Diduch DR, Hart JM, Tompkins M, Ma SY, Gaskin CM. Bone replacement of fast-absorbing biocomposite anchors in arthroscopic shoulder labral repairs. Am J Sports Med. 2012;40(6):1392-401.

8. Kim SH, Kim DY, Kwon JE, Park JS, Oh JH. Perianchor cyst formation around biocomposite biodegradable suture anchors after rotator cuff repair. Am J Sports Med. 2015;43(12):2907-12.

9. Shin SJ, Kim RG, Jeon YS, Kwon TH. Critical value of anterior glenoid bone loss that leads to recurrent glenohumeral instability after arthroscopic Bankart repair. Am J Sports Med. 2017;45(9):1975-81.

10. Lachin JM. The role of measurement reliability in clinical trials. Clin Trials. 2004;1(6):553-66.

11. Tompane T, Carney J, Wu WW, et al. Glenoid bone reaction to all-soft suture anchors used for shoulder labral repairs. J Bone Joint Surg Am. 2018;100(14):1223-9.

12. Barber FA, Dockery WD. Long-term absorption of beta-tricalcium phosphate poly-L-lactic acid interference screws. Arthroscopy. 2008;24(4):441-7.

13. Lazarus MD, Sidles JA, Harryman DT 2nd, Matsen FA 3rd. Effect of a chondral-labral defect on glenoid concavity and glenohumeral stability: a cadaveric model. J Bone Joint Surg Am. 1996;78(1):94-102.

14. Hagstrom LS, Marzo JM. Simple versus horizontal suture anchor repair of Bankart lesions: which better restores labral anatomy? Arthroscopy. 2013;29(2):325-9.

15. Aboalata M, Plath JE, Seppel G, Juretzko J, Vogt S, Imhoff AB. Results of arthroscopic Bankart repair for anterior-inferior shoulder instability at 13-year follow-up. Am J Sports Med. 2017;45(4):782-7.

16. Durban CM, Kim JK, Kim SH, Oh JH. Anterior shoulder instability with concomitant superior labrum from anterior to posterior (SLAP) lesion compared to anterior instability without SLAP Lesion. Clin Orthop Surg. 2016;8(2):168-74.

17. Lim TK, Koh KH, Lee SH, Shon MS, Bae TS, Park WH, et al. Inferior anchor cortical perforation with arthroscopic Bankart repair: a cadaveric study. Arthroscopy. 2013;29(1):31-6.

18. Frank RM, Mall NA, Gupta D, et al. Inferior suture anchor placement during arthroscopic Bankart repair: influence of portal placement and curved drill guide. Am J Sports Med. 2014;42(5):1182-9.

19. Lee JH, Itami Y, Hedayati B, et al. Biomechanical effects of position and angle of insertion for all-suture anchors in arthroscopic Bankart repair. Clin Biomech (Bristol, Avon). 2018;60:45-50.

20. Fritsch BA, Arciero RA, Taylor DC. Glenoid rim fracture after anchor repair: a report of 4 cases. Am J Sports Med. 2010;38(8):1682-6.

21. Park JY, Lee SJ, Oh SK, Oh K, Noh Y, Suh KT. Glenoid rim fracture through anchor points after arthroscopic Bankart repair for shoulder instability. Int Orthop. 2015;39(2):241-8.

22. Park JY, Lee SJ, Lhee SH, Oh JH. Change in labrum height after arthroscopic Bankart repair: correlation with preoperative tissue quality and clinical outcome. J Shoulder Elbow Surg. 2012;21(12):1712-20.

23. Kim JY, Chung SW, Kwak JY. Morphological characteristics of the repaired labrum according to glenoid location and its clinical relevance after arthroscopic Bankart repair: postoperative evaluation with computed tomography arthrography. Am J Sports Med. 2014;42(6):1304-14.

24. Nho SJ, Frank RM, Van Thiel GS, et al. A biomechanical analysis of anterior Bankart repair using suture anchors. Am J Sports Med. 2010;38(7):1405-12.

25. Slabaugh MA, Friel NA, Wang VM, Cole BJ. Restoring the labral height for treatment of Bankart lesions: a comparison of suture anchor constructs. Arthroscopy. 2010;26(5):587-91.

26. Kim SJ, Kim SH, Lee SK, Lee JH, Chun YM. Footprint contact restoration between the biceps-labrum complex and the glenoid rim in SLAP repair: a comparative cadaveric study using pressure-sensitive film. Arthroscopy. 2013;29(6):1005-11.

27. Yamamoto N, Muraki T, Sperling JW, et al. Does the "bumper" created during Bankart repair contribute to shoulder stability? J Shoulder Elbow Surg. 2013;22(6):828-34.

28. Mazzocca AD, Chowaniec D, Cote MP, et al. Biomechanical evaluation of classic solid and novel all-soft suture anchors for glenoid labral repair. Arthroscopy. 2012;28(5):642-8.

29. Dwyer T, Willett TL, Dold AP, et al. Maximum load to failure and tensile displacement of an all-suture glenoid anchor compared with a screw-in glenoid anchor. Knee Surg Sports Traumatol Arthrosc. 2016;24(2):357-64.

30. Abe H, Itoi E, Yamamoto N, et al. Healing processes of the glenoid labral lesion in a rabbit model of shoulder dislocation. Tohoku J Exp Med. 2012;228(2):103-8.