JSES Reviews, Reports, and Techniques 5 (2025) 46–52

Contents lists available at ScienceDirect

JSES Reviews, Reports, and Techniques

journal homepage: www.jsesreviewsreportstech.org

Anterior glenoid rim resorption after arthroscopic Bankart repair by the footprint fixation technique and its correlation with the healing of the repaired capsulolabral complex: a computed tomography and magnetic resonance arthrography imaging study

Takehito Hirose, MD, PhD[a,*], Makoto Tanaka, MD, PhD[a,b], Hidekazu Nakai, MD[a]

[a]*Department of Orthopaedic Surgery, Osaka International Medical & Science Center, Osaka, Japan*
[b]*Center for Sports Medicine, Osaka International Medical & Science Center, Osaka, Japan*

A R T I C L E I N F O

Keywords:
Glenoid rim resorption
Arthroscopic Bankart repair
Footprint fixation
Capsulolabral complex healing
CT
MR arthrography

Level of evidence: Level IV; Retrospective Case Series

Background: Studies have revealed that anterior glenoid rim bone resorption occurs in the early stage after arthroscopic Bankart repair (ABR) if bony Bankart lesions are absent or fail to heal. However, this structural change has never been studied after repair by footprint fixation (FF). Additionally, the relationship between the extent of rim resorption and healing of the repaired capsulolabral complex (CLC) remains unclear. Therefore, this study aimed to investigate anterior glenoid rim changes after ABR by FF and to elucidate the correlation between rim resorption and the healing of the repaired CLC.
Methods: This was a retrospective study on shoulders that underwent ABR by a combination of knotless twin anchor FF and single row techniques for anterior shoulder instability from January 2022 to June 2023. From 44 shoulders, we included 23 after excluding 14 with preoperative bony Bankart lesions and 7 with missing postoperative imaging. We used 3-dimensional computed tomography scans to calculate the change in glenoid width (Δ%) due to anterior glenoid rim change from baseline to 3 months postoperatively and images from magnetic resonance arthrography, which was performed at around 5 months postoperatively, to evaluate CLC healing according to a 3-point grading scale (*good*, 3 points; *fair*, 2 points; *poor*, 1 point) on 6 oblique axial slices perpendicular to the glenoid long axis. Finally, we calculated the correlation coefficient between Δ% and the healing index, that is, the mean CLC healing grade of the 6 slices.
Results: Glenoid width decreased by 7.2% (range, 2.0%-12.8%; $P < .001$). The mean CLC healing index was 2.59 points (range, 1.8-3.0). The Δ% showed a moderate positive correlation with the healing index (correlation coefficient, 0.55; $P = .006$).
Conclusion: Anterior glenoid rim resorption also occurs after ABR by the combination of FF and single row technique at 3 months postoperatively. Although this is a preliminary result, the extent of rim resorption is greater with better healing of the repaired CLC.

Assessment of preoperative glenoid bone loss (GBL) is an essential step in the successful surgical treatment of anterior shoulder instability because GBL influences glenohumeral stability.[11,23] Surgeons then determine the optimal surgical procedure or augmentation surgery according to the preoperative extent of GBL.[12] However, recent clinical studies revealed resorptive change around the anterior glenoid rim in the early stage after arthroscopic Bankart repair (ABR) if bony Bankart lesions are absent or fail to heal.[8,9] Previous studies reported that this bone resorption leads to a 5% to 9% reduction in glenoid width.[8,16,18] Due to the evidence that GBL increases shoulder instability, this pathological change is relevant for prognosis. In fact, Hirose et al found that glenoid rim resorption is one of the statistical risk factors for recurrence after ABR.[7] Glenoid rim resorption occurs in response to repair of the capsulolabral complex (CLC), so factors related to CLC repair procedures, such as

The institutional review board in Osaka International Medical & Science Center approved the clinical study entitled "Anterior glenoid rim resorption after arthroscopic Bankart repair using footprint fixation technique and its correlation to the healing of repaired capsulolabral complex: an imaging study by CT and MR arthrography" by Takehito Hirose, Makoto Tanaka. (Approval number: 1067, Yoshiki Sawa, M.D., Ph.D., The Director of Osaka International Medical & Science Center).

*Corresponding author: Takehito Hirose, MD, PhD, Department of Orthopaedic Surgery, Osaka International Medical & Science Center, 2-6-40 Karasugatsuji, Tennoji-ku, Osaka-shi, Osaka 543-8922, Japan.
E-mail address: hiroset511@gmail.com (T. Hirose).

https://doi.org/10.1016/j.xrrt.2024.08.010
2666-6391/

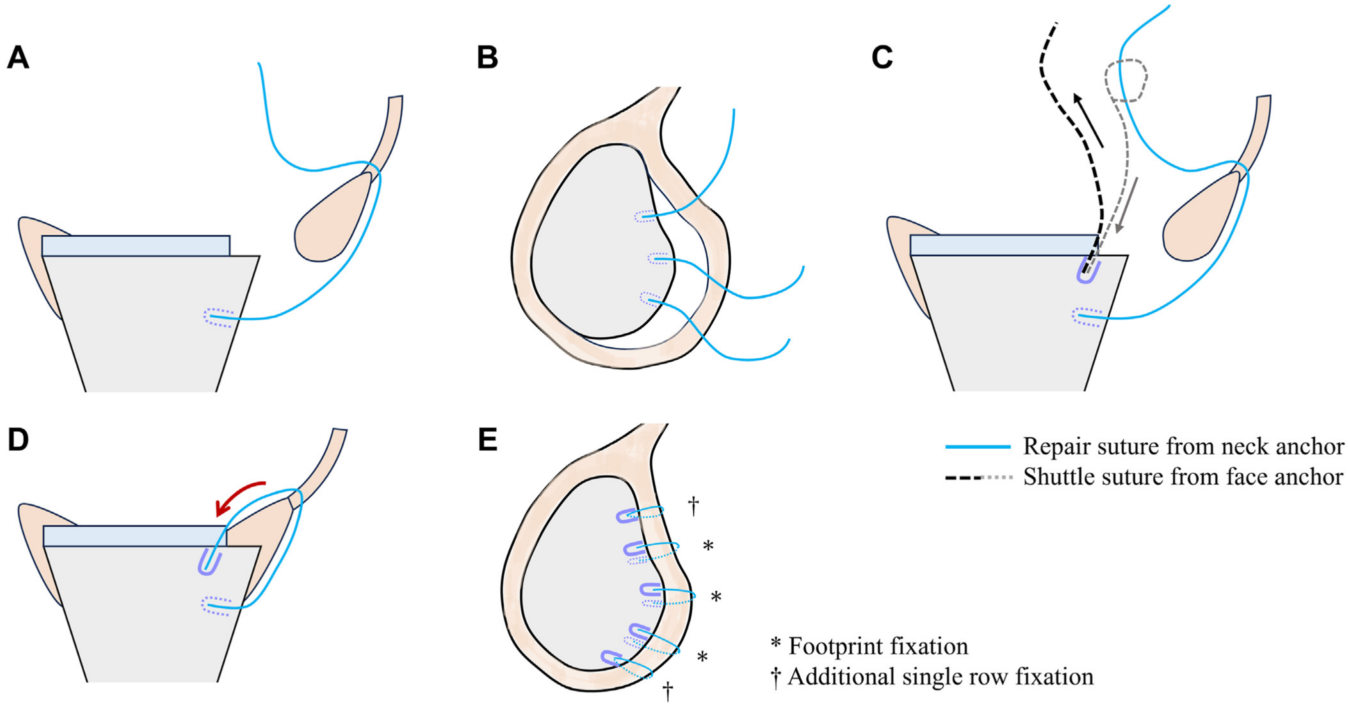

Figure 1 Scheme of the knotless twin anchor footprint fixation technique. (**A**). Three knotless FiberTak anchors are inserted into glenoid neck at the level of 5-7 mm distance from glenoid surface. (**B**). Shuttle sutures of these anchors are all removed leaving repair sutures only. Repair sutures are passed through capsulolabral complex (CLC). (**C**). Three knotless FiberTak for face anchors are inserted immediately posterior to the cartilage trough. Repair sutures after passing CLC are retracted into corresponding face anchor locking mechanism via shuttle sutures from face anchors. (**D**). Tensionable footprint fixation is achieved. (**E**). Single row fixation is routinely performed at 5 o'clock position and usually added at 1 o'clock position.

anchor insertion position,[9] insertion depth,[21] cartilage removal,[15] and stress shielding,[10] have been speculated to be potential contributors to rim resorption, although a definitive primary cause has yet to be identified. Furthermore, despite the pathological changes that occur around the area of the repaired CLC, the relationship between anterior glenoid rim resorption and CLC repair status has not been studied.

Notably, all previous reports of glenoid bone resorption have been based on outcomes after repair by the single-row (SR) technique, in which anchor sutures are passed between the CLC and glenoid rim, resulting in point fixation tissue repair. In this configuration, the sutures touch the rim bone, so there are concerns regarding their direct physical and chemical effects there.

In contrast to the approach in the SR technique, in the footprint fixation (FF) technique, the sutures are passed through the CLC from anchors inserted into the glenoid neck and are connected to anchors on the glenoid face side, that is, they do not pass between the CLC and glenoid rim; this approach enables a bridging fixation, which may result in stronger tissue healing.[1] Therefore, if the direct effects of the anchor sutures on the glenoid contribute to rim resorption, there should be less resorption with the FF technique; however, if the healing of the tissue between the CLC and glenoid rim itself or other factors are responsible for rim resorption, resorption will not be prevented by using the FF technique.

Therefore, the purpose of this retrospective study was to evaluate glenoid bone resorption after ABR with the FF technique and to elucidate the correlation between glenoid rim resorption and repair status of the CLC. We hypothesized that glenoid bone resorption occurs also with the FF method and that the extent of glenoid bone resorption is greater with better healing of the repaired CLC.

Materials and methods

This retrospective study included 23 of 44 shoulders that underwent ABR for anterior shoulder instability by the FF technique from January 2022 to June 2023; 21 shoulders were excluded because they met exclusion criteria, that is, the presence of preoperative bony Bankart lesions ($n = 7$) and missing postoperative computed tomography (CT) and magnetic resonance (MR) examinations ($n = 14$). There were no cases of revision surgery or cases in which additional rotator interval closure or Hill-Sachs remplissage was performed at the operation. The study was approved by the institutional review board of our hospital (approval number; 1067). At the initial visit, all patients were informed of the option to opt out of inclusion in the study.

Operative procedure

The operations were performed by 3 different shoulder surgeons (one with over 20 years of experience, one with 15 to 20 years' experience, and one with 10 to 15 years' experience) and supervised by the surgeon with over 20 years of experience (MT). All operations were performed under general anesthesia with an interscalene brachial plexus block, with the patient in the beach chair position. Bankart repair was performed in all cases the hybrid technique combining knotless twin anchor footprint fixation and SR method. (Fig. 1) A posterior portal was established for visualization, and then anterior and anterosuperior portals were created for the surgical procedures. The torn labrum was detected and adequately detached as inferiorly as possible from the glenoid by using a radiofrequency device and Bankart elevator. A ring curette or shaver was used to remove 2 mm of cartilage at the anterior glenoid rim and expose the subchondral bone, with the aim of promoting healing of the repaired tissue.[3]

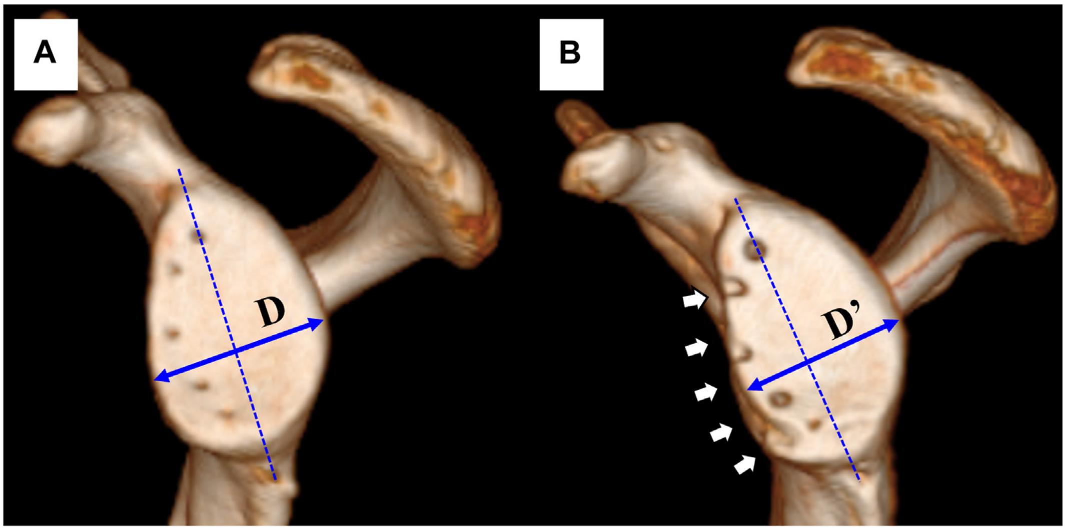

Figure 2 Measurement of glenoid width change by 3-dimensional computed tomography. (**A**). Baseline computed tomography (CT) scan (1 day postoperatively): *Line D* represents the maximum width perpendicular to the long axis of the glenoid. (**B**). Second CT scan (3 months postoperatively): *White arrows* indicate anterior rim resorption, and *line D'* indicates the maximum width perpendicular to the long axis of the glenoid at this time. The percentage change in glenoid width (Δ%) was calculated as follows: $\Delta\% = (1\text{-}(D'/D)) \times 100$.

First, one or two all-suture knotless FiberTak (KL-FT) (Arthrex, Naples, FL, USA) are inserted at the 5-6 o'clock position of the glenoid edge, and SR fixation is performed. Their repair sutures were passed through the optimal position of the CLC and left in place in a pretightening condition. FF is then applied from the 4 to 2 o'clock positions. KL-FT anchors were used for both the neck and face sides of the anchors. If necessary, a 5 o'clock portal was created using the inside-out technique to enable easy access to the glenoid neck.[2] Neck anchors were inserted via the anterior portal by a curved drill guide or via a 5 o'clock portal by a straight drill guide. Depending on the extent of the detached labrum, two or three pairs of neck-face anchors were inserted into the glenoid within the range of 4 to 2 o'clock in the right shoulder clock position, and the neck anchor suture was passed through the CLC. The inferior SR fixation was then tied before finalizing the FF. Finally, the repair sutures from neck anchors were retracted into the locking mechanism of the suture splice on the corresponding face-side anchor. These bridging sutures were tied with sufficient tension so that the CLC was reattached at least 1 hour above its detached position. A SR repair at 1 o'clock was added by KL-FT, if necessary.

Postoperative rehabilitation

The shoulder was immobilized postoperatively for 4 weeks in internal rotation using a Shoulder Brace IR (ALCARE, Tokyo, Japan). Passive forward elevation in the supine position was started 2 weeks after surgery. Active forward elevation and external rotation were started 6 weeks after surgery, and usual daily activities were allowed thereafter. Strengthening exercises were started three months after surgery, as needed. Patients were permitted to return to playing sports after 6 months at the earliest, depending on the results of a comprehensive assessment of muscle strength and range of motion.

Imaging evaluations

Imaging evaluations included baseline CT scans performed on the day after surgery and follow-up CT scans at 3 months postoperatively. Additionally, magnetic resonance arthrography (MRA) was performed at around 5 months postoperatively to assess healing of the repaired CLC, just before initiating intensive strength training or sport-specific training.

1 Glenoid width change

Postoperative change in the glenoid rim was evaluated by CT scans performed with an Aquilion scanner (Canon Medical Systems Corporation, Ohtawara, Japan). Imaging data were obtained with a slice thickness of 0.6 mm and reconstructed into 3-dimensional models of the glenoid, and the percentage change (Δ%) from baseline in the maximum glenoid width perpendicular to the long axis of the glenoid was calculated.[8] (Fig. 2) This measurement method was used because it has high reproducibility, as evidenced by high intraclass and interclass correlation coefficients.[9]

2 CLC healing

CLC healing was assessed by MRA. Beforehand, 10 mL of 1% xylocaine was injected into the glenohumeral joint under ultrasound guidance, and within 60 minutes, an MR scan was performed.[14] For the MR scan, we used a MAGNETOM Spectra 3T scanner (Siemens Healthineers, Erlangen, Germany) with the patient's arms positioned by their side in neutral rotation. Then, oblique axial slices were created at 3-mm intervals perpendicular to the long axis of the glenoid,[17] CLC healing was evaluated on each slice by using a 3-point grading scale.[20] (Fig. 3) CLC healing was classified as *good* (and assigned 3 points) if no white slit was observed between the repaired CLC and the glenoid; as *fair* (and assigned 2 points) if a partial slit was observed that did not reach the glenoid neck; and as *poor* (and assigned 1 point) if a complete slit was observed that extended to the glenoid neck. Images were assessed by 3 different evaluators, and in cases where opinions differed, a majority decision was made. Then, the mean value of the 6 slices for each shoulder was calculated and defined as the healing index.

Finally, we calculated the correlation coefficient between Δ% and the healing index.

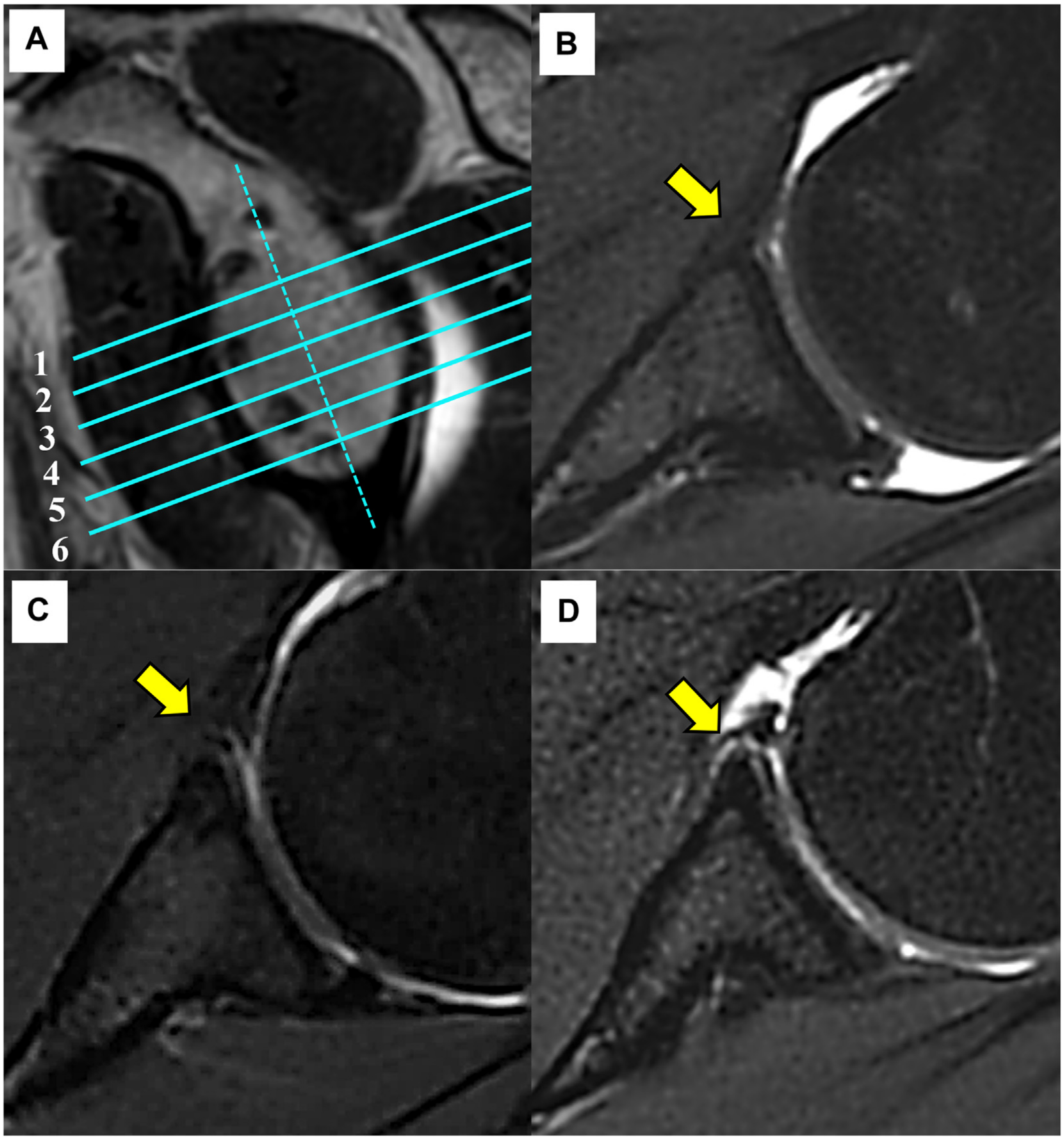

Figure 3 Evaluation of capsulolabral complex healing by magnetic resonance arthrography. (**A**). Creation of 6 oblique axial slices, each of which was perpendicular to the long axis of the glenoid. Slices are shown from proximal to distal in numerical order. The most distal slice was located at 5 o'clock on the *right* shoulder. (**B**). Healing grade *good* (3 points): No white slit was observed between the repaired capsulolabral complex (CLC) and the glenoid rim. (**C**). Healing grade *fair* (2 points): A partial white slit was observed between the repaired CLC and the glenoid rim. (**D**). Healing grade *poor* (1 point): A complete white slit extending to the glenoid neck was observed between the repaired CLC and the glenoid rim.

Statistical analysis

Statistical analysis was performed with JMP Pro Version 17 (SAS Institute Inc., Cary, NC, USA) and G*Power Version 3.1.9.7 (Heinrich Heine University, Dusseldorf, Germany). The Wilcoxon signed-rank test was used to analyze changes in glenoid width, and Pearson's correlation analysis was used to analyze correlations between changes in glenoid width and the healing index. An a priori power analysis performed for the correlation analysis determined that a minimum of 23 samples were required to detect a correlation coefficient of 0.55 with 80% power and a significance level of less than 0.05. Therefore, the sample size for this study was considered sufficient to statistically validate a moderate correlation.

Results

Patients' mean age at operation was 18.7 ± 4.3 years (range, 14-31 years). Of the 23 shoulders, 7 were first-time injuries (4 for subluxation and 3 for dislocation), while 16 had recurrent instability episodes. In 13 shoulders, the preoperative glenoid structure was normal, and in the remaining 10 shoulders, it was erosion type as defined in the report by Sugaya et al.[19] For the 10 shoulders with erosion type, glenoid bone loss recorded an average of 7.9 ± 5.1% (range, 2.9%-18.1%). In cases of unilateral involvement, it was calculated by comparing with the unaffected side, while in cases of bilateral involvement, the best-fit circle method was used on the affected side. Hill-Sachs lesions were detectable on preoperative CT in 21 of the 23 shoulders. All of patient demographic are shown in Table I.

We utilized a hybrid technique combining FF and SR repair, with an average of 5.9 (range, 4-8) anchors for FF and 1.7 (range, 1-2) anchors for SR in each shoulder, resulting in an average total of 7.6 (range, 6-10) anchors, and the mean operative time was 118 ± 35 minutes. Intraoperatively, we identified anterior cartilage lesions in only 5 shoulders (2 with International Cartilage Research Society grade 1, 1 with grade 2, and 2 with grade 4) and a minor SLAP lesion

Table I
Patient demographics.

N	23
Age at surgery (y.o)	18.7 ± 4.3 (range; 14-31)
Gender	
Male	16
Female	7
History of instability	
First time subluxator	4
First time dislocator	3
Recurrent	16
Duration from initial injury to surgery (mos)	30.4 ± 41.1 (range; 1-144)
Preoperative glenoid structure	
Normal	13
Erosion	10
Bony fragment	0 (excluded)
Shoulders with a Hill-Sachs lesion	21

in the long head of the biceps in 10 shoulders (4 with Snyder type 1 and 6 with type 2).

Glenoid rim resorption

At baseline on the day after surgery, the mean glenoid width was 26.3 ± 3.0 mm (range, 21.0-31.8 mm), and at the second CT scan performed at 3.3 ± 0.9 months postoperatively, it was 24.4 ± 2.9 mm (range, 19.0-30.4 mm). The percentage reduction in width from baseline to the second CT scan was significant 7.2 ± 3.1% (range, 2.0%-12.8%, $P < .001$). There was no significant difference between different preoperative glenoid structures (6.5 ± 2.8% in normal type, 8.1 ± 3.5% in erosion type, $P = .34$) No shoulder showed structural changes around the posterior rim of the glenoid; in other words, the glenoid width decreased because of anterior glenoid rim resorption.

CLC healing index

The CLC healing grades for all cases at 5 months postoperatively is presented separately for each slice in Supplemental Table S1. The mean CLC healing index was 2.59 points and ranged from 1.8 to 3.0 points.

Correlation coefficient

The correlation coefficient between the percentage reduction in glenoid width and the CLC healing index was statistically significant, with an r value of 0.55 and a P value of .006, indicating a moderate positive correlation. (Fig. 4)

Representative case

Fig. 5 shows findings in a 14-year-old boy as a representative case. The glenoid width had decreased by 12.8% at 3 months postoperatively because of anterior glenoid rim resorption, but there was no recurrence. At 5 months, MRA revealed that the CLC was completely healed throughout the anterior glenoid rim (all slices were graded as *good*).

Discussion

The significant findings of this study were that anterior glenoid rim resorption also occurs after ABR by the FF technique and that the extent of rim resorption is greater with better healing of the repaired CLC.

Previous reports, all of which were based on results obtained after use of the SR technique, indicated that post-ABR glenoid rim resorption ranges from 5% to 9%.[8,16,18] In our series, all cases were treated by a hybrid technique combining knotless twin anchor footprint fixation and SR repair, which includes the FF technique for CLC repair. We also found that with this repair method, the glenoid width decreased by 7%, which was comparable to the results after use of the SR technique. This finding suggests that rim resorption in the early stage after ABR cannot be prevented by using the FF technique. If the direct physical or chemical effects of anchor sutures passing between repaired tissue and bone affected rim resorption, one would expect that the FF technique would prevent resorption. However, using the FF technique appeared to have no protective effect. On the other hand, in this series, although the number of anchors used intraoperatively was higher than with the SR technique only, the amount of bone resorption seemed to be comparable to previous reports of the SR technique alone. Therefore, it was unlikely that the increase in the number of anchors due to using the FF technique had a significant influence on bone resorption.

Another valuable finding of this study is that the extent of rim resorption was statistically correlated with CLC healing. MRA showed that robust tissue healing was significantly associated with marked rim resorption. This finding implies that bone loss during soft tissue healing may be an unavoidable reaction in the process of tissue remodeling. Indeed, a previous study in a canine model of tendon laceration and repair showed significant decreases in bone density and notable osteoclast activation around the repaired tendon-bone interface, suggesting that bone loss is an inherent part of tissue remodeling around repaired soft tissue.[4] In fact, within the field of shoulder surgery other than glenohumeral instability, there have been reports of bone resorptive changes after soft tissue repair, such as rotator cuff repair[5] and latissimus dorsi transfer.[22] Although the primary cause of this pathology has not been elucidated, it may represent an aspect of the tissue healing response at the healing sites. The positive correlation between the degree of CLC healing and glenoid rim resorption observed in the present study suggests a significant paradox in surgical treatment for anterior shoulder instability, where even though tissues exhibit adequate healing, structural bone reduction could compromise bony stability. As previously reported, greater bone resorption in the early stage after ABR might be a significant risk factor for postoperative recurrence as well as preoperative glenoid bone loss.[7]

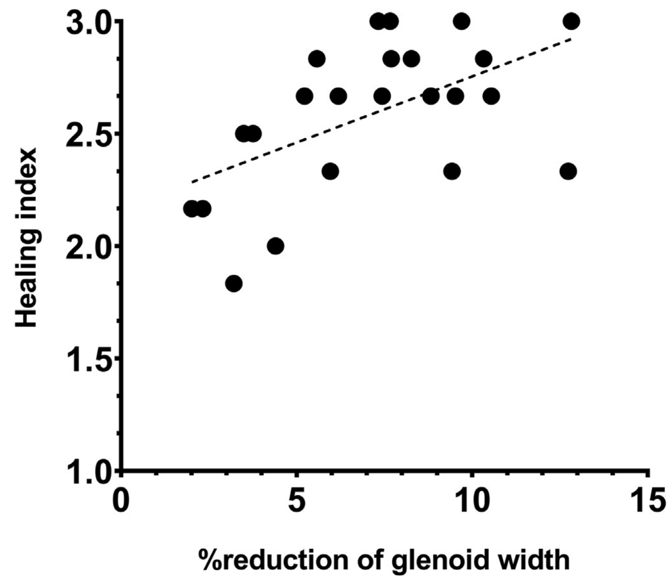

Figure 4 Correlation between the percentage reduction in glenoid width and the capsulolabral complex healing index.

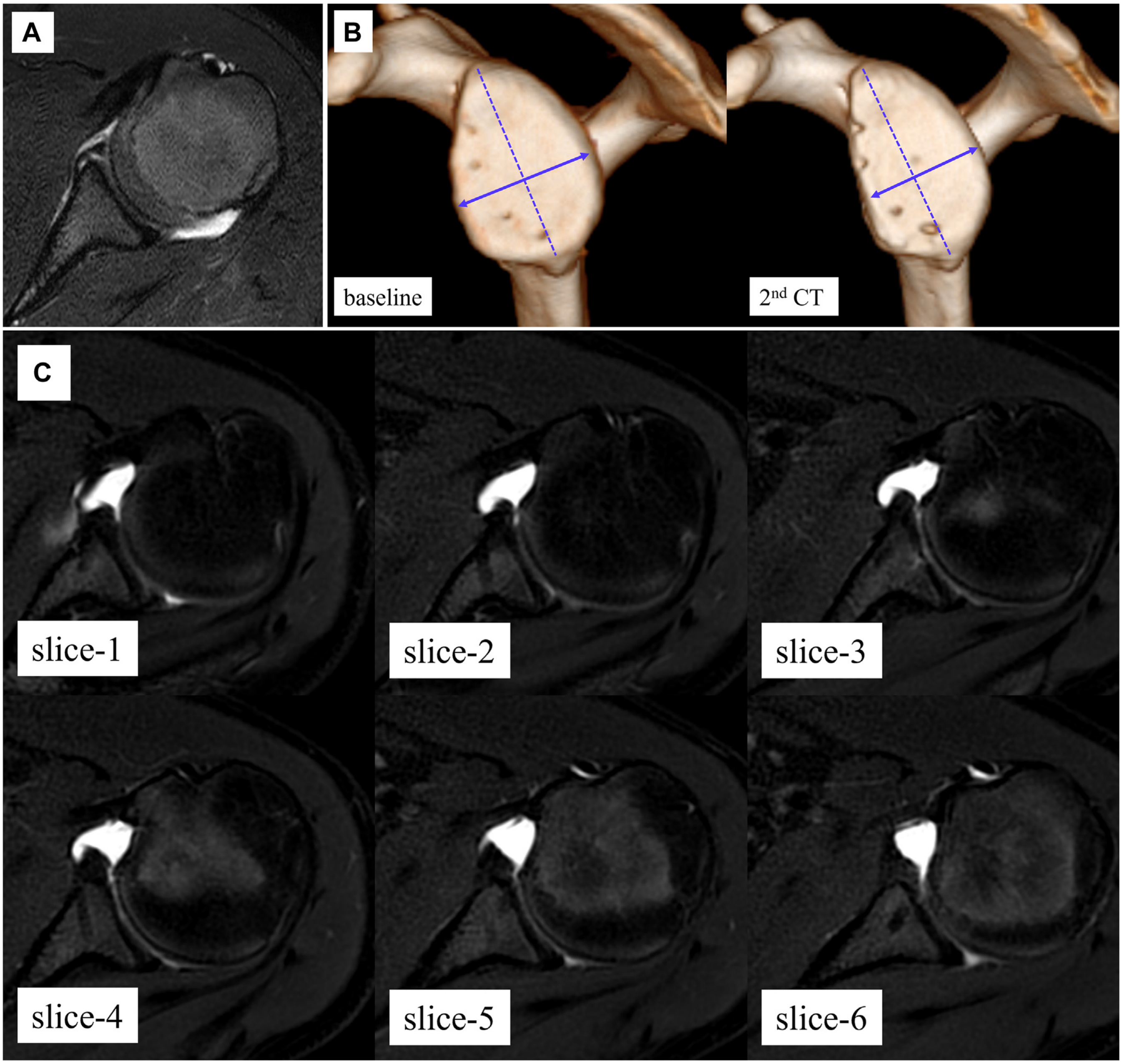

Figure 5 Findings in a 14-year-old boy as a representative case. The image shows marked anterior glenoid rim resorption but complete healing of the capsulolabral complex. (**A**). Preoperative magnetic resonance image revealed an anterior labrum tear (Bankart lesion). (**B**). Compared with baseline, the second computed tomography scan at 3 months postoperatively showed marked anterior rim resorption, which corresponded to a reduction in glenoid width of more than 12%. (**C**). At 5 months postoperatively, magnetic resonance arthrography showed complete healing of the repaired capsulolabral complex in all 6 slices.

Based on the results of the current study and previous reports, we speculate that the principal factor for glenoid rim resorption is the biological reaction around the bone-soft tissue interface.[6] We consider that osteoclast activation and bone resorption start in the early postoperative period up to 3 months after ABR surgery and are followed by progression of tissue healing over the subsequent 6 months to a year, potentially leading to a phase of bone formation. In fact, a previous study indicated a trend towards bone recovery at the CT examination performed around 1 year postoperatively.[8] At present, to our knowledge, no articles have reported on long-term bone morphology after ABR, so the longer-term prognosis is unknown; however, bone formation may be more vigorous at later stages and the once-lost rim bone may recover significantly. Nevertheless, it should be noted again that at 6 months postoperatively, the tissue likely still contains scar tissue, and bone morphology shows the most effects; consequently, the period around 6 months, which is often considered as the time of return to playing sports, may be a relatively risky period. Therefore, stricter decision-making regarding returning to playing sports in patients with excessive bone resorption during follow-up may help to reduce recurrence rates after ABR. Future studies should focus on observing long-term bone morphological changes after ABR, irrespective of preoperative glenoid structure.

This study has some limitations. First, this is a retrospective single arm design study with a small number of subjects. Although we performed power analysis to determine an adequate sample size, it was sufficient only for detecting a moderate correlation coefficient. It should be noted that the possibility of other factors related to the resorption of glenoid rim, such as cartilage removal, the number of anchors, the type of anchors, and the tension of the anchor sutures, still remains. In the future, studies using two group comparison and multivariate analyses should be conducted. Second, no histological evaluation of the repaired tissue was performed, so future studies need to perform detailed assessments, such as whether there is scarring at the repair site and whether tissue has matured completely or not. Third, because this study only investigated the relationship between bone and tissue healing within 6 months, further research is required to determine whether outcomes such as clinical scores and recurrence rates over 2 years are linked to the extent of glenoid rim resorption after FF repairing. Another surgeon who performs ABR using a technique similar to ours describes favorable clinical outcomes[13] despite disregarding bone morphology. Although FF did not show superiority in bone preservation compared to SR, it may still have the potential for superior clinical outcomes. Of course, long term change in bone structure must also be examined in the future research, considering the bone remodeling effect after FF.

Conclusions

Anterior glenoid rim resorption also occurs after ABR by the combination of FF and SR technique at 3 months postoperatively. Although this is a preliminary result, the extent of rim resorption is greater with better healing of the repaired CLC.

Acknowledgments

The authors would like to thank Yamada Translation Bureau, Inc. (https://www.ytrans.com/index.html) for the English language review.

Disclaimers:

Funding: No funding was disclosed by the authors.
Conflicts of interest: The authors, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to improve language and readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.xrrt.2024.08.010.

References

1. Ahmad CS, Galano GJ, Vorys GC, Covey AS, Gardner TR, Levine WN. Evaluation of glenoid capsulolabral complex insertional anatomy and restoration with single- and double-row capsulolabral repairs. J Shoulder Elbow Surg 2009;18:948-54. https://doi.org/10.1016/j.jse.2009.03.022.
2. Davidson PA, Tibone JE. Anterior-inferior (5 o'clock) portal for shoulder arthroscopy. Arthroscopy 1995;11:519-25.
3. Desai SS, Singh V, Mata HK. Arthroscopic Bankart repair with and without curettage of the glenoid edge: a prospective, randomized, controlled study. Arthroscopy 2021;37:837-42. https://doi.org/10.1016/j.arthro.2020.11.042.
4. Ditsios K, Boyer MI, Kusano N, Gelberman RH, Silva MJ. Bone loss following tendon laceration, repair and passive mobilization. J Orthop Res 2003;21:990-6. https://doi.org/10.1016/s0736-0266(03)00112-8.
5. Furuhata R, Matsumura N, Matsuo T, Kimura H, Suzuki T, Nakamura M, et al. Evaluation of radiographic changes 5 years after arthroscopic rotator cuff repair. Orthop J Sports Med 2022;10:23259671221126095. https://doi.org/10.1177/23259671221126095.
6. Galatz LM, Sandell LJ, Rothermich SY, Das R, Mastny A, Havlioglu N, et al. Characteristics of the rat supraspinatus tendon during tendon-to-bone healing after acute injury. J Orthop Res 2006;24:541-50. https://doi.org/10.1002/jor.20067.
7. Hirose T, Nakagawa S, Hanai H, Nishimoto R, Mizuno N, Tanaka M. Anterior glenoid rim erosion in the early stage after arthroscopic Bankart repair affects postoperative recurrence. JSES Int 2023;7:121-5. https://doi.org/10.1016/j.jseint.2022.10.005.
8. Hirose T, Nakagawa S, Iuchi R, Mae T, Hayashida K. Progression of erosive changes of glenoid rim after arthroscopic Bankart repair. Arthroscopy 2020;36:44-53. https://doi.org/10.1016/j.arthro.2019.07.019.
9. Hirose T, Nakagawa S, Uchida R, Yokoi H, Ohori T, Tanaka M, et al. On-the-edge anchor placement may be protective against glenoid rim erosion after arthroscopic Bankart repair compared to on-the-face anchor placement. Arthroscopy 2021. https://doi.org/10.1016/j.arthro.2021.10.013.
10. Inoue K, Suenaga N, Oizumi N, Yamaguchi H, Miyoshi N, Taniguchi N, et al. Glenoid bone resorption after Bankart repair: finite element analysis of postoperative stress distribution of the glenoid. J Shoulder Elbow Surg 2021;30:188-93. https://doi.org/10.1016/j.jse.2020.04.023.
11. Itoi E, Lee SB, Berglund LJ, Berge LL, An KN. The effect of a glenoid defect on anteroinferior stability of the shoulder after Bankart repair: a cadaveric study. J Bone Joint Surg Am 2000;82:35-46.
12. Itoi E, Yamamoto N, Kurokawa D, Sano H. Bone loss in anterior instability. Curr Rev Musculoskelet Med 2013;6:88-94. https://doi.org/10.1007/s12178-012-9154-7.
13. Itoigawa Y, Uehara H, Koga A, Morikawa D, Kawasaki T, Shiota Y, et al. Arthroscopic Bankart repair with additional footprint fixation using the double-row technique at the 4 o'clock position anatomically restored the capsulolabral complex and showed good clinical results. Knee Surg Sports Traumatol Arthrosc 2022;30:3827-34. https://doi.org/10.1007/s00167-022-06974-9.
14. Kuratani K, Tanaka M, Hanai H, Hayashida K. Accuracy of shoulder joint injections with ultrasound guidance: confirmed by magnetic resonance arthrography. World J Orthop 2022;13:259-66. https://doi.org/10.5312/wjo.v13.i3.259.
15. Nagaya LH, Yamamoto N, Shinagawa K, Hatta T, Itoi E. Does glenoid remodeling occur with an erosion-type bone loss after arthroscopic Bankart repair? JSES Int 2020;4:814-7. https://doi.org/10.1016/j.jseint.2020.06.002.
16. Nishimoto R, Goto K. Glenoid rim morphological changes after arthroscopic Bankart repair. Shoulder Joint 2020;44:32-8. https://doi.org/10.11296/katakansetsu.44.32.
17. Sasaki T, Saito Y, Yodono H, Prado GL, Miura H, Itabashi Y, et al. Labral-ligamentous complex of the shoulder. Evaluation with double oblique axial MR arthrography. Acta Radiol 2003;44:435-9. https://doi.org/10.1080/j.1600-0455.2003.00091.x.
18. Sugawa K, Matsuura T, Nakai H. Glenoid width changes after arthroscopic Bankart repair. Shoulder Joint 2016;40:539-42. https://doi.org/10.11296/katakansetsu.40.539.
19. Sugaya H, Moriishi J, Dohi M, Kon Y, Tsuchiya A. Glenoid rim morphology in recurrent anterior glenohumeral instability. J Bone Joint Surg Am 2003;85:878-84. https://doi.org/10.2106/00004623-200305000-00016.
20. Suzuki K, Tsutsui H, Mihara K, Makiuchi D, Nishinaka N. Postoperative evaluation of healing in Bankart lesions with MR arthrography after scopic Bankart repair using suture anchors. Shoulder Joint 2007;31:489-92. https://doi.org/10.11296/katakansetsu.31.489.
21. Uchiyama Y, Omi H, Imai K, Shinpuku E, Watanabe M. Anchor insertion depth in recurrent shoulder dislocation and subluxation worsens postoperative anterior glenoid rim morphology. Shoulder Joint 2019;43:429-32. https://doi.org/10.11296/katakansetsu.43.429.
22. Valenti P, Zampeli F, Caruso G, Nidtahar I, Martinez-Catalan N, Kazum E. Proximal humeral bone defect in reverse shoulder arthroplasty combined with latissimus-dorsi transfer is not related with a poor outcome. Orthop Traumatol Surg Res 2022;108, 103263. https://doi.org/10.1016/j.otsr.2022.103263.
23. Yamamoto N, Itoi E, Abe H, Kikuchi K, Seki N, Minagawa H, et al. Effect of an anterior glenoid defect on anterior shoulder stability: a cadaveric study. Am J Sports Med 2009;37:949-54. https://doi.org/10.1177/0363546508330139.