

Arthroscopic superior capsule reconstruction using autologous fascia lata and biceps tendon augmentation

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Technical note

Keywords: superior capsule reconstruction (SCR), long head of biceps tendon (LHBT), fascia lata, irreparable, rotator cuff, acromiohumeral distance

Posted Date: April 29th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-23765/v1>

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Version of Record: A version of this preprint was published at Arthroscopy Techniques on June 1st, 2021.
See the published version at <https://doi.org/10.1016/j.eats.2021.02.004>.

Abstract

Background: While arthroscopic superior capsule reconstruction (SCR) has been recently introduced to treat irreparable rotator cuff tear with encouraging outcomes, graft options and fixation remain debated. The purpose of this article is to describe a novel technique and present preliminary results in using long head of biceps tendon (LHBT) as augmentation for SCR with fascia lata autograft.

Methods: Retrospective analysis was performed on 18 patients undergoing arthroscopic SCR with LHBT augmentation for irreparable rotator cuff tear between October 2017 and November 2019. Preoperative radiographic survey confirmed massive rotator cuff tear with moderate to severe muscle fatty infiltration and availability of LHBT. Fascia lata autograft harvested from ipsilateral thigh was folded and securely sutured. The folded fascia graft was then introduced through standard anterolateral portal and fixed to superior glenoid superiorly and greater tuberosity laterally with suture anchors. Anteriorly, fascia lata graft was sutured with proximal portion of LHBT instead of subscapularis tendon. A full coverage of rotator cuff defect by facial graft was then confirmed arthroscopically to allow tension-free suturing between posterior margin of fascia graft and residual infraspinatus tendon. Postoperative abduction brace and regular follow-up was arranged.

Results: Being intact in 4 patients and either partially torn or subluxed in 14 patients, LHBT in all 18 patients were available for augmentation surgery. Preliminary functional survey revealed encouraging outcomes with a mean follow-up of 11.5 months. Nine patients with more than one year follow-up regained full forward elevation; ASES improved from 24.3 to 90.2. Acromiohumeral distance improved from 3.3 mm to 8.6 mm with radiographic analysis in those 9 patients.

Conclusions: Arthroscopically LHBT augmented SCR is a novel technique and can be one of feasible opinions for irreparable rotator cuff tear.

Background

Given tremendous advances in arthroscopic techniques, treatment of massive rotator cuff tear (RCT) remains a challenge to shoulder surgeons. In case that the tear was irreparable or too extensive to have an optimal repair, the rotator cuff muscle became stiffer and atrophy with fatty infiltration. The absence of rotator cuff integrity and coordination leads to proximal migration of humeral head with a loss of balanced force couple [1]. As the condition is progressed, the shoulder becomes significantly painful with diminished range of motion and functional disabling [2].

Clinical presentations of irreparable RCT include chronic pain, functional limitation, weak external rotation, and even pseudoparalysis [3,4].

Superior capsule reconstruction (SCR) is a new technique and has been currently introduced to treat irreparable RCT by using tensor fascia lata (FL) autograft [5] or human dermal (HD) allograft [6]. Both showed encouraging short-term outcomes. SCR was originally designed by Mihata et al. Biomechanical

study showed the interposed patch graft completely restored superior stability in the cadaveric shoulder with massive RTC when the graft was securely attached to the superior glenoid tubercle and sutured to the torn tendons [7]. Despite encouraging outcome in recent reports, debates still exist regarding options and fixation of the graft [8] and the importance of marginal convergence [9]. Owing to proximal availability, long head of biceps tendon (LHBT) has been used to support RCT repair [10]. In this paper, we described an arthroscopic technique of LHBT augmentation in autologous FL SCR for irreparable RCTs.

Methods

Statement of ethics approval and description of patient data

Ethics committee approval was obtained from our Institutional Review Board for this study. We conducted a retrospective analysis in 18 patients, who underwent the index surgery between October 2017 and November 2019. There were 9 male and 9 female patients with an average of 66.1 years (range, 57 to 73). Time interval of exaggerating disability with the presentation of painful drop arm averaged 6.1 months (range, 2 to 12) according to patients' description. Preoperatively, consensus in clinical impression and radiographic findings have been reached by the orthopedic surgeon and radiologists.

Preoperative Survey

Eligible indications for performing the index surgery are irreparable rotator cuff tear with Goutallier stage 2 to 4 muscle fatty infiltration in the preoperative radiographs. The retracted supraspinatus tendon was confirmed to be irreparable during shoulder arthroscopy as the torn tendon cannot reach to the original footprint [5]. Infraspinatus tendon was completely or partially torn and subscapularis tendon was either intact or only partial articular-side tear. An existing LHBT either intact or partially torn was used and incorporated with FL graft for reconstruction of superior joint capsule. Before surgery, all patients signed informed consents and underwent complete assessment including shoulder physical examination, plain radiographs and magnetic resonance image (MRI) for confirmation of diagnosis and surgical indications.

Surgical Technique

Under general anesthesia, the patient was placed in lateral decubitus position. Longitudinal skin incision was made over lateral thigh of the same side with the lesioned shoulder. Tensor FL graft of about 4 x 15 cm in size was harvested under meticulous dissection and hemostasis. Then the wound was approximated layer by layer with subcuticular suture. After proper dressing, the patient was changed to beach-chair position. Standard arthroscopic portals was used including posterior, posterolateral, lateral, anterolateral, anterior, and Neviaser portals. A meticulous examination was undertaken to confirm the massive RCTs, the availability of LHBT, the condition of subscapularis tendon and articular cartilage. For the articular-sided or upper full-thickness subscapularis tear, approximation with 2.3mm Iconix all-suture anchor (Stryker Endoscopy, San Jose CA) was performed at the tuberosity footprint. Then the arthroscope was introduced into the subacromial space through posterior portal. A motorized shaver and a radiofrequency device (Super TurboVac 90; ArthroCare, Texas, USA) were used for thorough bursectomy,

release of tendon adhesion, and debridement of tendon stump on the greater tuberosity through anterolateral and posterolateral working portals. Acromioplasty was not undertaken routinely unless remarkable anterolateral spur was found and removed by the motorized shaver. Further preparation of supraglenoid fossa and greater tuberosity to facilitate graft-bone healing was performed by a 4.0-mm motorized burr. Then an extended skin incision of 2 cm was made along the lateral portal from acromion margin downward. A 2-cm cannula was inserted through deltoid muscle splitting.

With the shoulder in 30° forward flexion and 30° abduction position and supported stably in an arm holder, the FL graft was then folded and securely sutured to become a 3x4 cm² patch with thickness about 6 to 8 mm. The FL graft patch was then introduced through the anterolateral portal. Two 1.4-mm Iconix all-suture anchors (Stryker Endoscopy, San Jose CA) were used to fix the medial 3-cm side of the graft patch. The lateral portion of the graft patch was then secured to the greater tuberosity in compression suture-bridging technique using two 2.3-mm Iconix all-suture anchors (Stryker Endoscopy, San Jose CA) and two 4.5-mm Reelx anchors (Stryker Endoscopy, San Jose, CA). Then the proximal part of LHBT was sutured to the anterosuperior part of fascia graft (Figure 1). Before suturing the fascia graft to residual infraspinatus posteriorly, the integrity and of graft patch and full coverage of the rotator cuff defect was meticulously confirmed with arthroscopic examination (Video). Then the wounds were closed with 3-0 Nylon suture. Abduction pillow brace was applied for arm immobilization in 45° abduction position.

Postoperative Care

The operation arm was immobilized in 45° abduction brace for 4 weeks. Then the rehabilitation program started with Codman exercise and gentle assisted forward elevation. Active motion was prohibited until full passive elevation was reached, and began at least 4 months after SCR surgery. For patients with inadequate internal rotation, passive stretch was started at least 6 months after surgery. Resistant exercise was allowed at 9 months postoperatively.

Preliminary Results

Under arthroscopic examination, LHBT was available to augmentation surgery in all 18 patients. LHBT was intact in 4 patients and partially torn in 5 patients; in the remaining 9 patients, LHBT was grossly intact but subluxed. Postoperative follow-up averaged 11.5 months (range, 6 to 24); 9 patients were more than one year; 5 patients, 9 months; 4 patients, 6 months. In the 9 patients of more than one year follow-up, residual soreness was only noted in one patient with daily activity; ASES improved from 24.3 (range, 18 to 53) preoperatively to 90.2 (range, 82 to 96). All 9 patients regained full forward elevation with either no or slight limitation of internal rotation Radiographic assessment (Figure 2) in the those 9 patients revealed acromiohumeral distance increased from 3.3 mm (range, 0 to 6.3) to 8.6 mm (range, 5.1 to 9.3).

Discussion

Owing to disruption of shoulder force couple, absence of rotator cuff and superior capsule may change mechanics of shoulder joint with subsequent upper migration of glenohumeral articulation [11,12]. The technique of SCR was designed to provide a biologic constrain to superior migration and thus to obtain a stable fulcrum of humeral head [13,14]. Autogenous FL and allogenic HD patch are two common grafts used for SCR to achieve encouraging outcome. In this report, FL autograft is chosen for SCR simply because it is readily available and patients do not have any payment for the graft patch. Other advantages with FL autograft may include thicker spacing, less elongation [8, 15] and no concerns in immune responses.

In addition, we incorporated LHBT into FL graft for SCR. The rationales are threefold. Firstly, LHBT is regionally available inside the shoulder joint and has been successfully used as augmentations for supporting biomechanical forces in rotator cuff repair [10,16]. Incorporation of LHBT with FL patch may provide additional thickness and stabilizing effect against anterior translation. Secondly, FL patch could be secured antero-superiorly by suturing to LHBT instead of subscapularis tendon since anterior side-to-side suture may not be necessary or even cause concerns of shoulder stiffness owing to closure of rotator interval [15]. Thirdly, LHBT is rich in tenocytes that may imitate the physiological demands of rotator cuff and is thus considered a suitable graft for augmentation in RCT repair and reconstruction [16,17].

Currently, LHBT was adapted as a suitable and locally available graft for SCR [18]. The intraarticular portion of LHBT was cut distally and fixed to greater tuberosity by either suture anchors [18-20] or transosseous suture [21]. While LHBT was used to bridge superior glenoid and greater tuberosity similar to FL in SCR, general concerns in those techniques are regarding the size and quality of tendon graft. LHBT in patients with massive RCT is commonly found to be partially torn or degenerative [22], which is not able to be accurately evaluated before arthroscopy. Instead of using LHBT alone for SCR, we incorporated LHBT to FL autograft for augmentation. By preservation of LHBT insertion and continuity, not only the incorporated LHBT could further secure the FL patch and stabilize the humeral head by creating a downward force [19] but also may provide better vascularity for graft healing [23].

The critical concern of this technique remains on the availability and quality of LHBT. Even though degenerative change and partial tear are commonly seen in massive RCT, our technique could be applied whenever LHBT is available. It is because LHBT is incorporated to FL patch and preservation of tendon vascularity and continuity may enhance tendon-fascia healing. Being different from other techniques using LHBT alone for SCR surgery, our method confirms availability of LHBT from preoperative MRI and thus can be readily planned before surgery. Other limitations and disadvantages include possible pain generator of LHBT, additional suture tangling for LHBT-FL suture, and technically demanding in passing FL patch to superior glenoid in the presence of LHBT. Short term follow-up in our patients as well as surgical outcomes in other reports may minimize the consideration of LHBT complications in serving as a graft for SCR. While incorporation of LHBT to FL patch may create more suture tangling, this technique does not need additional suture anchor fixation and thus skip the possible complications with suture anchor and poor bone quality.

Conclusions

With the advantages in augmenting antero-superior glenohumeral stability while skipping anterior side-to-side suture to avoid potential stiffness, we believe the proposed technique by incorporating LHBT with FL autograft for SCR can be one of useful options in irreparable massive RCT.

List Of Abbreviations

RCT: massive rotator cuff tear

SCR: superior capsule reconstruction

FL: fascia lata

HD: human dermal

LHBT: long head of biceps tendon

MRI: magnetic resonance image

ASES: American Shoulder and Elbow Society

Declarations

Ethics Approval and Consent to participate: Institutional review board approval (IRB no. 202000604B0) from Chang Gung Medical Foundation was obtained to perform a review of patient records and radiographs. Informed consent was obtained from all patients.

Consent for publication: Not Applicable.

Availability of supporting data: The datasets generated during the current study are available from the corresponding author on reasonable request.

Competing interests: No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article. The authors report no competing interests.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions: In this study, ACYC is the single surgeon for all cases and responsible for study design. CHH is contributed to data collection and major writing of this article. CHC and KYH contributed to statistical analysis and manuscript review. CJW assisted in radiographic assessment. YSC together with ACYC is contributed to arthroscopic data reading. All authors read and approved the final manuscript.

References

1. Burkhart SS. A stepwise approach to arthroscopic rotator cuff repair based on biomechanical principles. *Arthroscopy*. 2000;16(1):82-90.
2. Dines DM, Moynihan DP, Dines J, McCann P. Irreparable rotator cuff tears: what to do and when to do it; the surgeon's dilemma. *J Bone Joint Surg Am*. 2006;88(10):2294–2302.
3. Khair MM, Gulotta LV. Treatment of irreparable rotator cuff tears. *Curr Rev Musculoskelet Med*. 2011;4(4):208–213.
4. Tokish JM, Alexander TC, Kissenberth MJ, Hawkins RJ. Pseudoparalysis: a systematic review of term definitions, treatment approaches, and outcomes of management techniques. *J Shoulder Elbow Surg*. 2017 Jun;26(6):e177-e187.
5. Mihata T, Lee TQ, Watanabe C, Fukunishi K, Ohue M, Tsujimura T, Kinoshita M. Clinical results of arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. *Arthroscopy*. 2013 Mar;29(3):459-70.
6. Burkhart SS, Denard PJ, Adams CR, Brady pc, HartzlerRU. Arthroscopic superior capsular reconstruction for massive irreparable rotator cuff repair. *Arthrosc Tech*. 2016;5(6):e1407–e1418.
7. Mihata T, McGarry MH, Pirolo JM, Kinoshita M, Lee TQ. Superior capsule reconstruction to restore superior stability in irreparable rotator cuff tears: a biomechanical cadaveric study. *Am J Sports Med*. 2012;40(10):2248-2255.
8. Mihata T, McGarry MH, Kahn T, Goldberg I, Neo M, Lee TQ. Biomechanical effect of thickness and tension of fascia lata graft on glenohumeral stability for superior capsule reconstruction in irreparable supraspinatus tears. *Arthroscopy*. 2016;32(3):418-26.
9. Shambaugh BC, Morales H, Ross G. Posterior interval tear after superior capsule reconstruction: a case report. *J Shoulder Elbow Surg*. 2018;27(7):e225-e229.
10. Neviasser JS. Ruptures of the rotator cuff of the shoulder: new concepts in the diagnosis and operative treatment of chronic ruptures. *Arch Surg*. 1971;102 (5):483-485.
11. Nimura A, MD, Kato A, Yamaguchi K, Mochizuki T, Okawa A, Sugaya H, Akita K. The superior capsule of the shoulder joint complements the insertion of the rotator cuff. *J Shoulder Elbow Surg*. 2012;21(7):867-872.
12. Dyrna F, Kumar NS, Obopilwe E, Scheiderer B, Comer B, Nowak M, Romeo AA, Mazzocca AD, Beitzel Knut. Relationship between deltoid and rotator cuff muscles during dynamic shoulder abduction: a biomechanical study of rotator cuff tear progression. *Am J Sports Med*. 2018; 46(8):1919-1926.
13. Adams CR, DeMartino AM, Rego G, Denard PJ, Burkart SS. The rotator cuff and the superior capsule: why we need both. *Arthroscopy*. 2016;32(12):2628–2637.
14. Hartzler RU, Burkhart SS. Superior capsular reconstruction. *Orthopedics*. 2017;40(5):271–280.

15. Mihata T, Bui CNH, Akeda M, Cavagnaro MA, Kuenzler M, Peterson AB, McGarry MH, Itami Y, Limpisvasti O, Neo M, MD, Lee TQ. A biomechanical cadaveric study comparing superior capsule reconstruction using fascia lata allograft with human dermal allograft for irreparable rotator cuff tear. *J Shoulder Elbow Surg.* 2017;26(12):2158–2166.
16. Veen EJD, Stevens M, Diercks RL. Biceps autograft augmentation for rotator cuff repair: a systematic review. *Arthroscopy.* 2018;34(4):1297-1305.
17. Pietschmann MF, Wagenhäuser MU, Gülecyüz MF, Ficklscherer A, Jansson V, Müller PE. The long head of the biceps tendon is a suitable cell source for tendon tissue regeneration. *Arch Med Sci.* 2014;10(3):587–596.
18. Boutsiadis A, Chen S, Jiang C, Lenoir H, Delsol P, Barth J. Long head of the biceps as a suitable available local tissue autograft for superior capsular reconstruction: "the Chinese way". *Arthrosc Tech.* 2017;6(5):e1559-e1566.
19. Kim YS, Lee HJ, Park I, Sung GY, Kim DJ, Kim JH. Arthroscopic in situ superior capsular reconstruction using the long head of the biceps tendon. *Arthrosc Tech.* 2018;7(2):e97-e103.
20. Kim D, Jang Y, Park J, On M. Arthroscopic superior capsular reconstruction with biceps autograft: snake technique. *Arthrosc Tech.* 2019;8(10):e1085-e1092.
21. Chillemi C, Mantovani M, Gigante A. Superior capsular reconstruction of the shoulder: the ABC (Arthroscopic Biceps Chillemi) technique. *Eur J Orthop Surg Traumatol.* 2018;28(6):1215-1223.
22. Dimock RAC, Malik S, Consigliere P, Imam MA, Narvani AA. Superior capsule reconstruction: what do we know? *Arch Bone Jt Surg.* 2019;7(1):3-11.
23. Hana F, Kong CH, Hasanb MY, Ramruttunc AK, Kumar VP. Superior capsular reconstruction for irreparable supraspinatus tendon tears using the long head of biceps: A biomechanical study on cadavers. *Orthop Traumatol Surg Res.* 2019; 105(2):257-263.

Figures

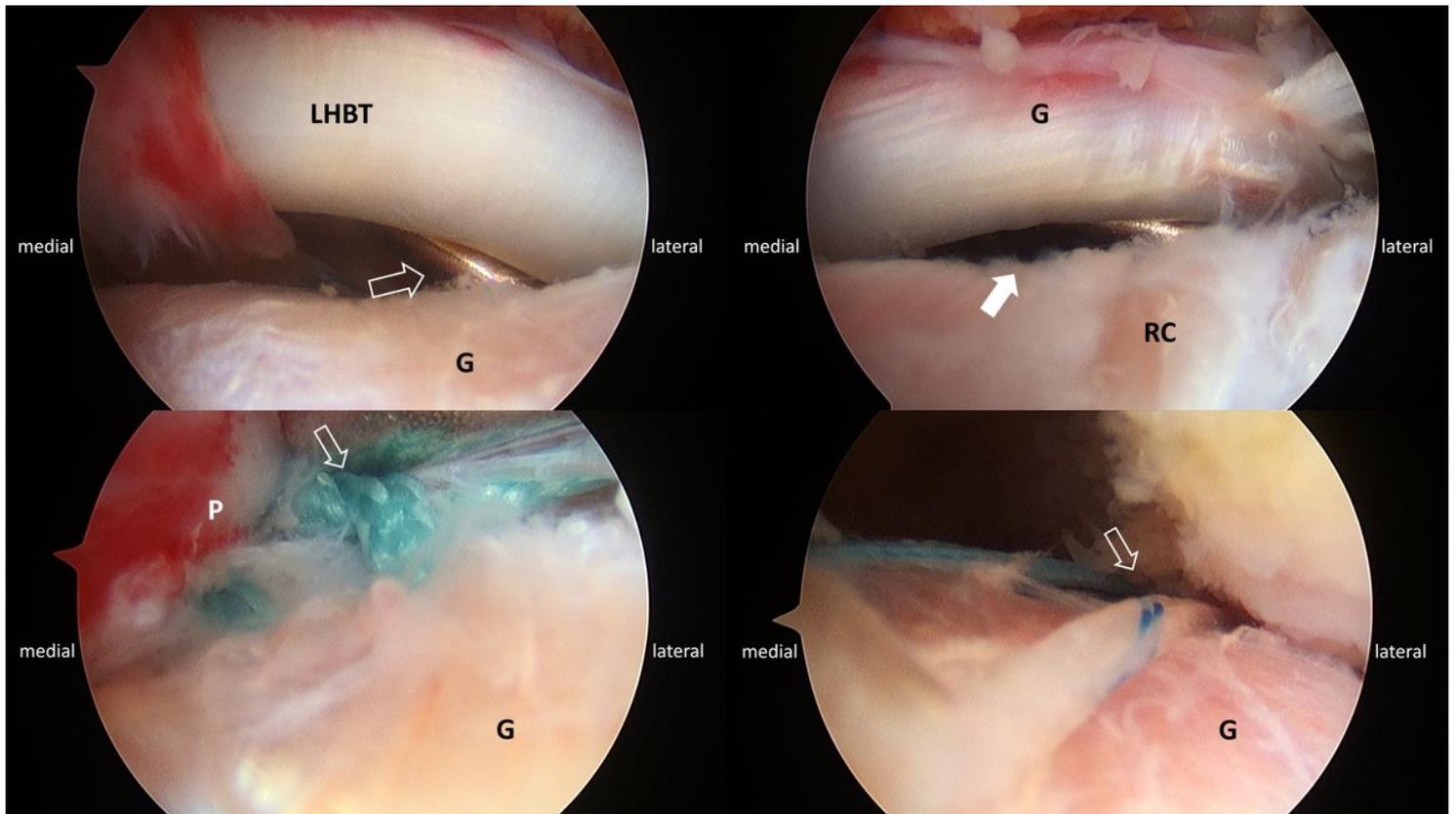


Figure 1

A 30° Arthroscope is introduced via standard posterior portal in right shoulder of 67 year-old female patients. [A] Anteriorly, identifying long head of biceps tendon (LHBT) above the fascia graft (G) by probing (hollow arrow). [B] Posteriorly, confirming optimal size and location of fascia graft (G) to fully cover the rotator cuff defect and reach the margin (white arrow) of residual rotator cuff tissue (RC). [C] Proximal part of the LHBT (P) is then sutured (hollow arrow) the fascia graft (G). [D] Laterally, fascial graft (G) is fixed to graft tuberosity using suture bridging technique (hollow arrow).

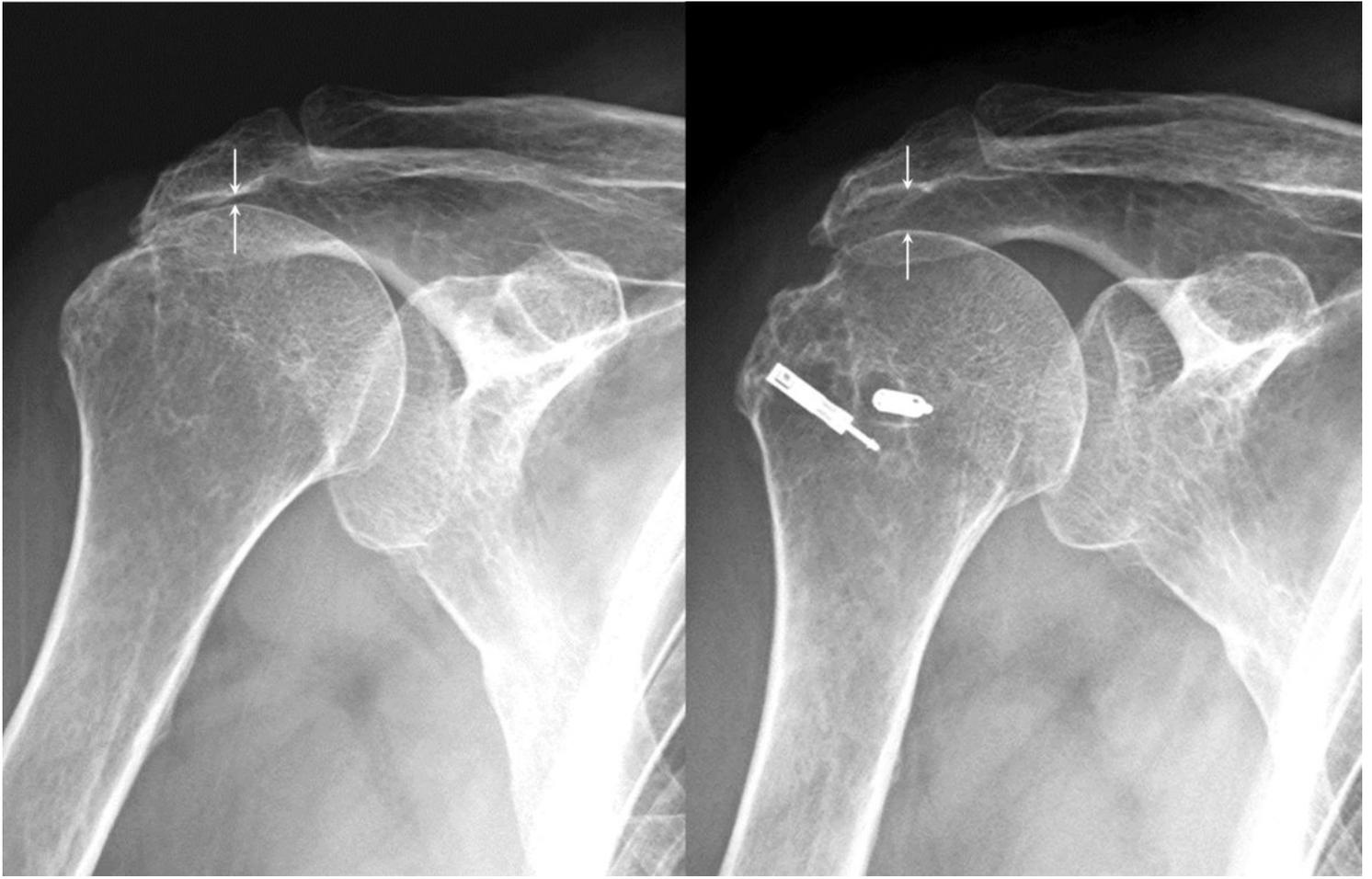


Figure 2

Radiographic assessment for acromiohumeral distance (white arrows). [A] Before surgery. [B] One year after surgery.

Supplementary Files

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