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Second-look arthroscopic evaluation of transferred graft integrity during capsular release on patient with adhesive capsulitis after lower trapezius tendon transfer: a case report

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The treatment for posterior superior rotator cuff tears is complex, especially for younger patients and elderly individuals with high activity levels, particularly in the absence of arthritis. Over time, surgical interventions aimed at restoring shoulder function and alleviating pain have evolved, with lower trapezius tendon (LTT) transfer emerging as a notable option. This procedure involves synchronized contraction of the tendon with the native shoulder external rotator muscle. It intricately aligns with the 'line of pull' of the infraspinatus muscle and effectively improves range of motion (ROM).[13,21,22,25]

These biomechanical and anatomical characteristics of LTT transfer are indeed distinct features that contribute to its effectiveness and promising clinical outcomes.[2,3,6,9,10,24,26] However, it remains challenging to analyze the action mechanisms of tendon transfer, particularly with the potential tenodesis effect and the motion of the transferred tendon.[8,11,20] There have been no reports of direct visualization of the integrity of the tendon after LTT transfer. This report presents distinctive arthroscopic findings involving an arthroscopic second look at the graft of the LTT transfer during arthroscopic capsular release in patients who developed secondary adhesive capsulitis 5 months after the LTT transfer.

Case report

Present study is a case report. Written patient consent was received by the patient.

Case description

A 60-year-old right-handed male was admitted to outpatient clinic with a complaint of chronic pain and dysfunction in his right shoulder. The patient's primary concerns were related to pain and weakness during forward flexion and external rotation. His active forward elevation was measured at 40°, abduction at 40°, external rotation at 10°, and internal rotation reached the L1 level (Fig. 1). Functional assessment scores indicated unsatisfactory results, with a Constant score of 53 of 100, a University of California Los Angeles score of 19 of 35, and an American Shoulder and Elbow Surgeons (ASES) Shoulder Score of 55 of 100.

Radiographic evaluation revealed no degenerative changes within the glenohumeral joint, but mild superior translation of the humeral head (Hamada grade 1) was observed (Fig. 2, *A*). Magnetic resonance imaging (MRI) assessment revealed full-thickness tears of the supraspinatus and infraspinatus muscles, both exhibiting retraction toward the glenoid surface with Goutallier grade III fatty infiltration and atrophy (Fig. 2, *B* and *C*). The subscapularis and teres minor muscle remained intact with Goutallier grade I fatty infiltration (Fig. 2, *C*). A discussion regarding treatment options was conducted for the patient's rotator cuff condition. Due to the irreparability of the rotator cuff tears and the absence of significant osteoarthritic changes, soft tissue reconstruction emerged as a suitable approach for our case, instead of opting for reverse total shoulder arthroplasty. Ultimately, the patient chose to proceed with the arthroscopic-assisted LTT transfer.

This study was approved by the Public Institutional Review Board Designated by Ministry of Health and Welfare (No. P01-202305-01-006).

Surgery was performed at Yeosu Baek Hospital.

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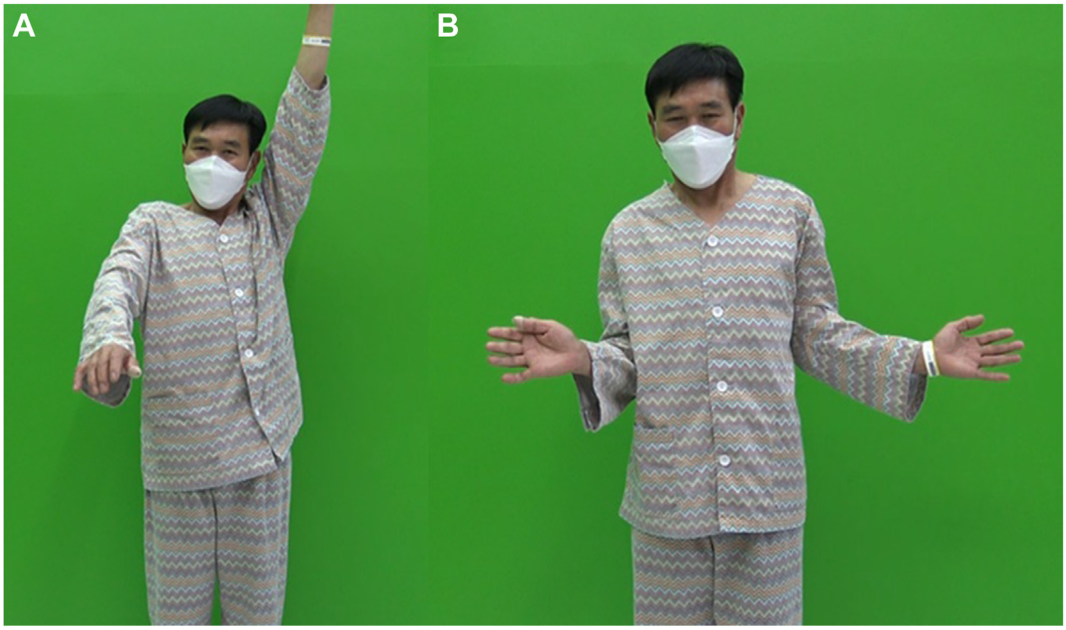

Figure 1 Preoperative clinical photographs. (**A**) The preoperative clinical photos show the patient demonstrating limited active forward flexion and (**B**) external rotation at side of the right shoulder.

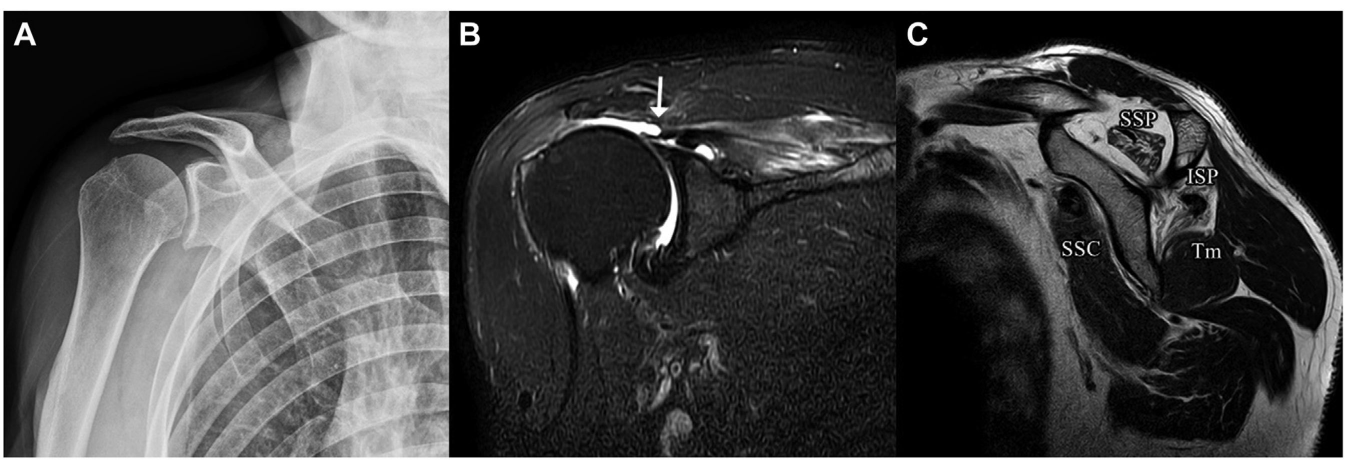

Figure 2 Preoperative radiograph and magnetic resonance imaging (MRIs) of right shoulder. (**A**) Preoperative radiograph with minimal arthritic glenohumeral joint. (**B**) Preoperative MRI of the right shoulder demonstrates the supraspinatus tendon (*white arrow*) retracted to the level of the glenoid in a T2-weighted coronal-view MRI, and (**C**) shows severe fatty infiltration and atrophy of the posterior superior rotator cuffs in a T2-weighted oblique sagittal-view MRI. *SSC*, subscapularis; *SSP*, supraspinatus; *ISP*, infraspinatus; *Tm*, teres minor.

Surgical technique

The patient was positioned in the lateral decubitus position and administered general anesthesia along with an interscalene block. Arthroscopically, rotator interval and capsule release were performed to mitigate postoperative stiffness. Acromioplasty was also carried out to prevent postoperative attrition of the graft due to a subacromial spur. Tenotomy of the long head of the biceps tendon was performed. Débridement of irreparable portions of the rotator cuff was accomplished using a shaver, and the supraspinatus footprint was then prepared (Fig. 3, *A*). Two medial-row anchors (5.5 mm Healix Advance BR 3 Suture Anchors with Permacord; DePuy Mitek, Raynham, MA, USA) were inserted into the supraspinatus footprint and near the articular margin of the greater tuberosity, approximately 1 cm apart.

For graft material, we harvested a fascia lata autograft from the ipsilateral thigh, measuring 16 cm by 4 cm (Fig. 4, *A*). The graft was folded in half, and then augmented with an acellular dermal matrix graft, Surederm (Hans Biomed Co., Daejeon, Republic of Korea) (Fig. 4, *B*). To harvest the LTT, a 5-cm horizontal incision was made along the scapular spine. The lateral border of the LTT was identified above a triangular fatty region, and dissection was then performed to release it from the underlying deep fascial tissues (Fig. 5, *A*). After separating it from the scapular spine, the LTT was secured along its lower margin in a Krackow configuration using a No. 2 nonabsorbable suture.

A passage for the graft was created between the infraspinatus muscle and the deltoid muscle. Using a long curved clamp through the opening in the infraspinatus fascia, the graft was retrieved and introduced into the joint. The graft was placed on the supraspinatus

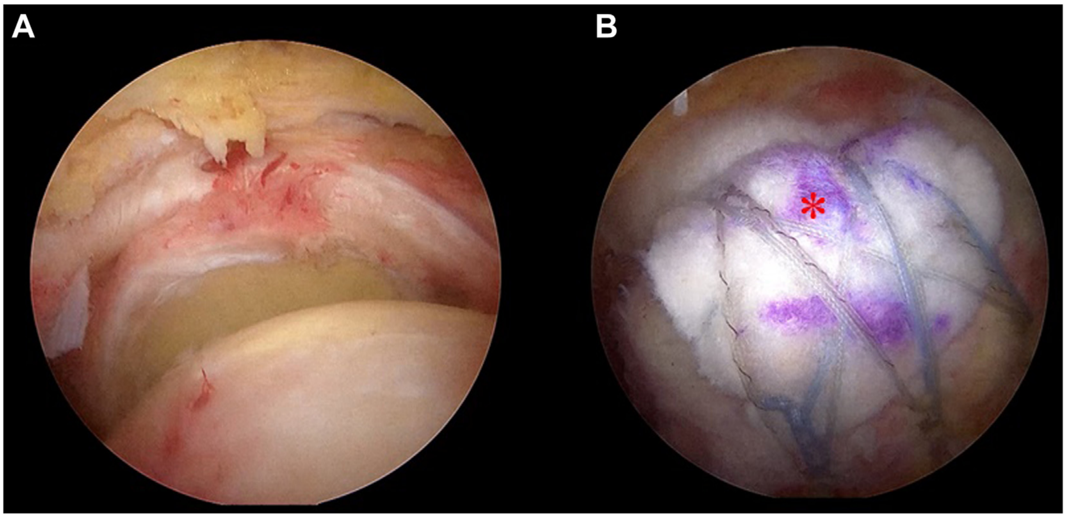

Figure 3 Arthroscopic image of preoperative appearance and final appearance. (**A**) Arthroscopic image from lateral portal of right shoulder shows massive irreparable posterosuperior rotator cuff tear. (**B**) Arthroscopic image from lateral portal of right shower shows final appearance of graft [*red asterisk*] fixed to greater tuberosity of humerus with double-row suture bridge technique.

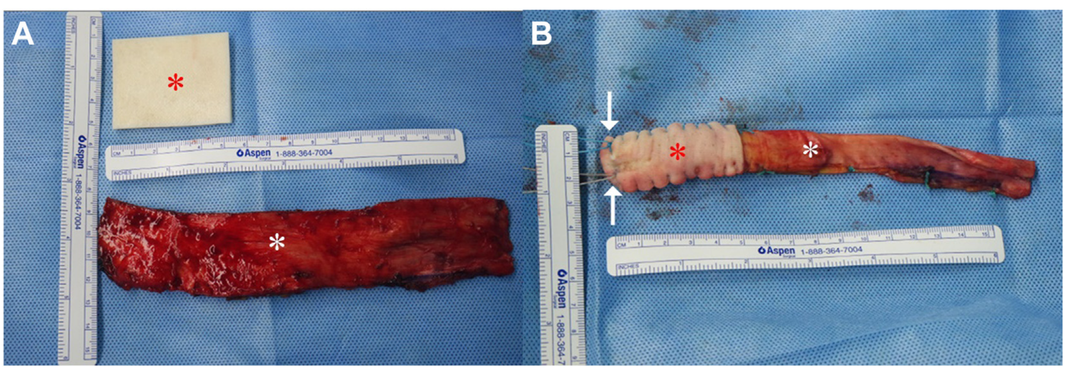

Figure 4 Fascia lata autograft and acellular dermal matrix (ADM) graft augmentation. (**A**) Fasia lata autograft (*white asterisk*), measuring 16 cm by 4 cm, is harvested prepared. (**B**) The graft (*white asterisk*) is folded in half and then augmented with acellular dermal matrix (ADM) graft (*red asterisk*). Two No. 2 nonabsorbable sutures (*white arrow*) are used to augment ADM graft in Krackow configuration.

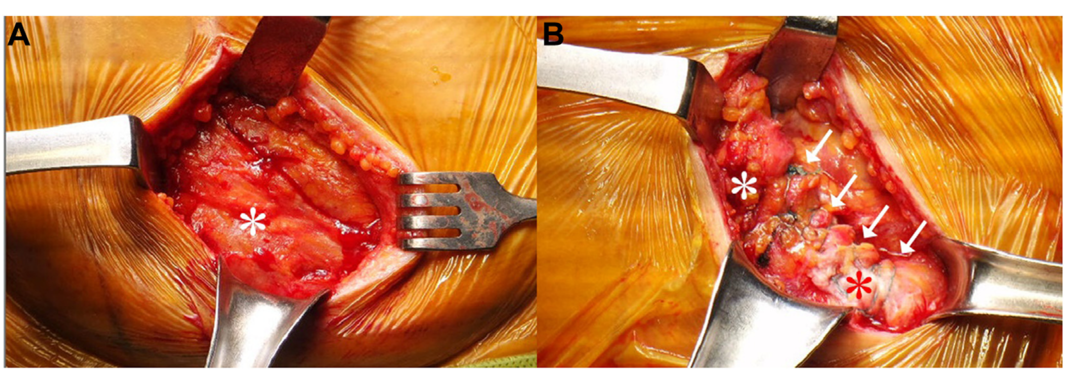

Figure 5 Harvesting lower trapezius tendon (LTT) and graft fixation. (**A**) After 7-cm horizontal incision is made just below the spine of the scapula and removing the triangular fat area underneath it, obliquely and horizontally oriented fiber of lower trapezius tendon [*white asterisk*] is identified. (**B**) Harvested fascia lata autograft [*red asterisk*] is wrapped along the lower border of lower trapezius muscle [*white asterisk*], covering both its anterior and posterior aspect by using nonabsorbable suture [*white arrow*]. The graft is attached to lower trapezius muscle via Krakow configuration.

footprint, ensuring that its edge covered the lateral margin of the footprint. Two threads of the posterior medial-row anchor were passed through the remaining posterior cuff using a Suture Lasso (Arthrex, Naples, FL, USA) to be used for a side-to-side suture with the graft. The remaining threads were passed through the graft in a mattress fashion, and knot tying was performed. Using a double-row suture bridge technique, 3 lateral-row anchors (4.75-mm SwiveLock anchors; Arthrex Inc., Naples, FL, USA) were placed in lateral aspect of the greater tuberosity to secure the graft onto the supraspinatus footprint of the humerus (Fig. 3, *B*).

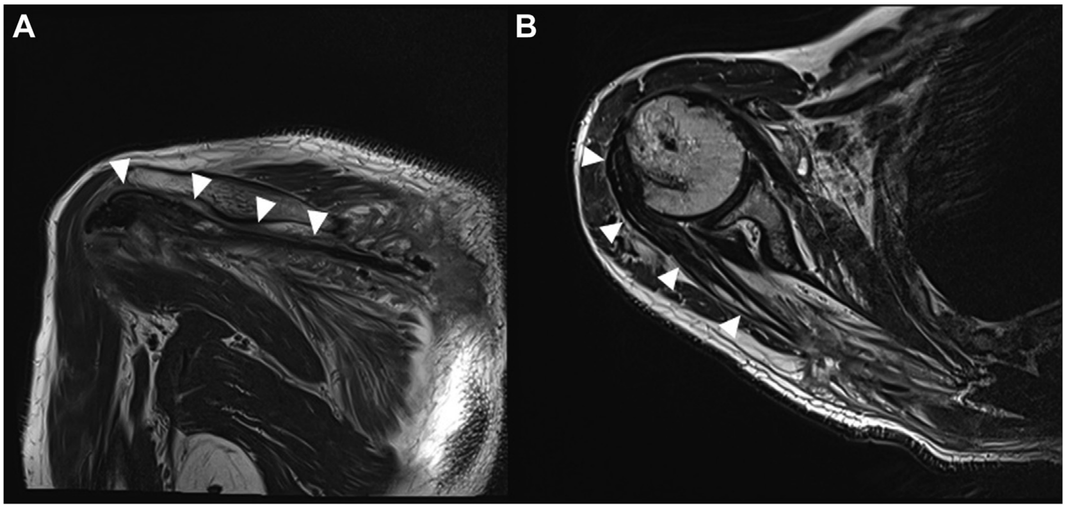

Figure 6 Postoperative magnetic resonance imaging (MRI) of transferred tendon integrity. (**A**) Coronal view and (**B**) axial view show normal integrity of transferred tendon (*white arrow head*).

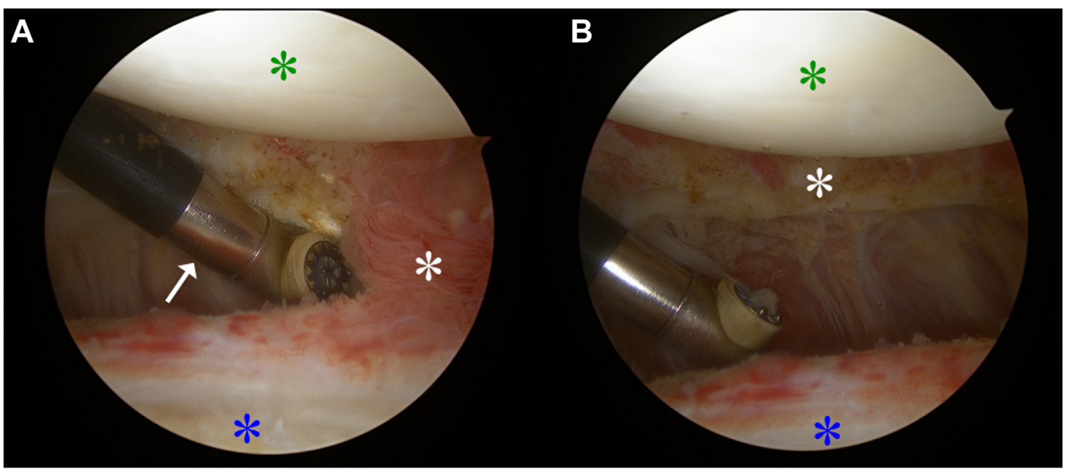

Figure 7 Arthroscopic pan-capsular release. (**A**) This arthroscopic image, taken from the anterior portal of the right shoulder, depicts adhesive capsulitis [*white asterisk*] with a thickened anterior/inferior capsule being released using a radiofrequency device [*white arrow*]. (**B**) The capsule [*white asterisk*] has been fully released, resulting in the widening of the glenohumeral joint space. Glenoid [*blue asterisk*]; Humeral head [*green asterisk*].

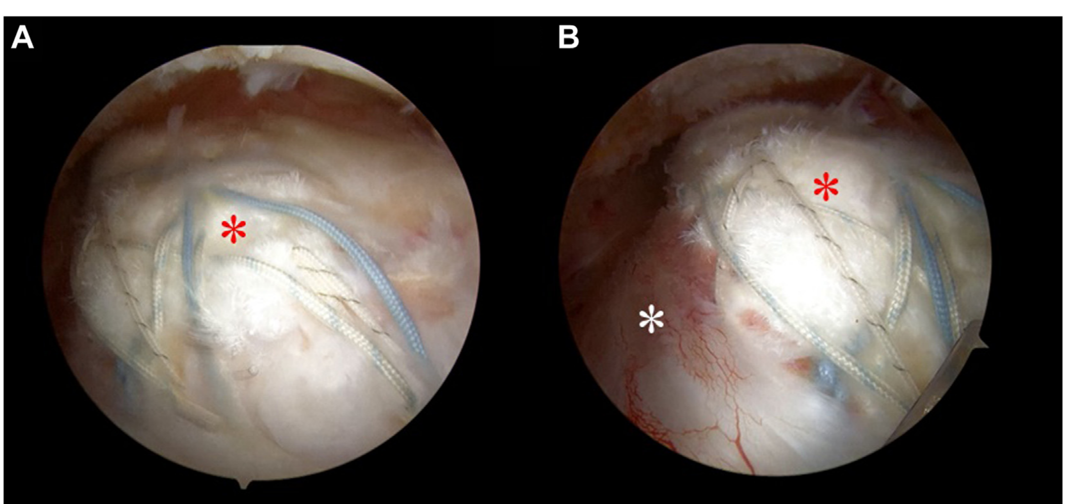

Figure 8 Arthroscopic image of integrity of graft after lower trapezius tendon (LTT) transfer. (**A**) Arthroscopic image from lateral portal of right shoulder shows no tear and firm attachment of LTT graft [*red asterisk*] to greater tuberosity of humerus. (**B**) Vascularization is observed in the previous site [*white asterisk*] of the side-to-side suture, and posterior cuff is connected to the LTT graft [*red asterisk*] without any gap.

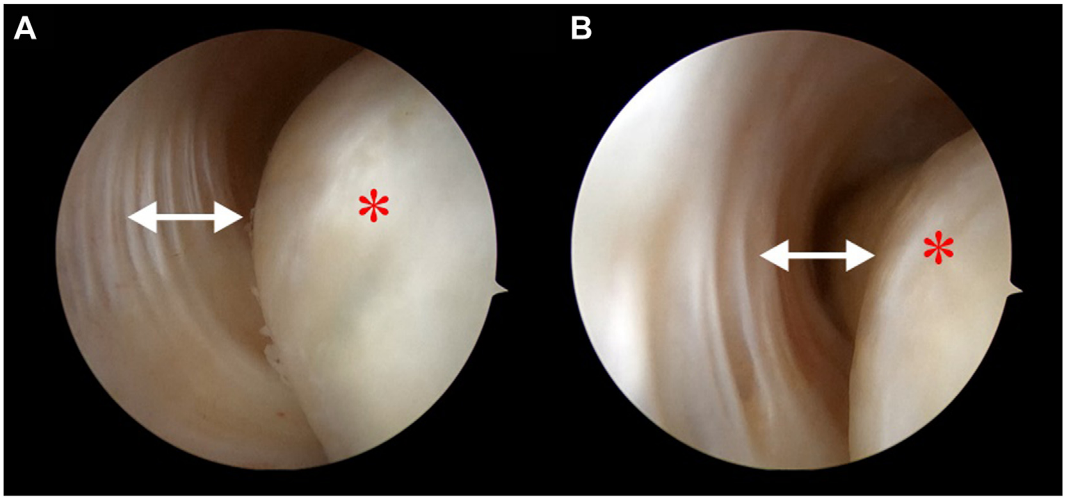

Figure 9 Arthroscopic image of synovialization of graft after lower trapezius tendon (LTT) transfer. (**A** and **B**) Arthroscopic image from lateral portal of right shoulder shows synovialization of the graft [*red asterisk*], and a smooth passageway [*white double arrow*] has been established along the graft without any adhesion.

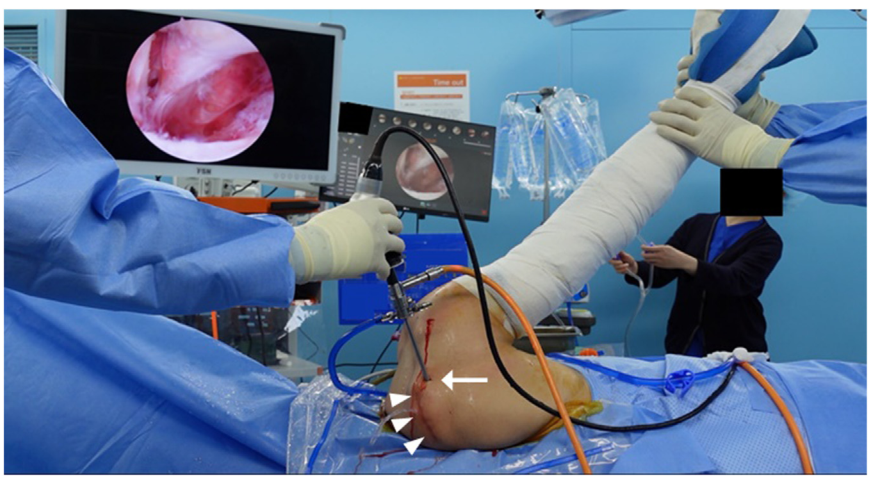

Figure 10 Examination of attachment site between lower trapezius (LTT) tendon and the graft. Intraoperative image of the right shoulder demonstrates the use of arthroscopy to directly examine the LTT tendon and graft attachment site through the subcutaneous portal [*white arrow*] located just beneath the lateral aspect of the scapular spine. Previous incision line [*white arrow head*].

The graft was attached to the LTT while the patient's arm was positioned at maximal external rotation within a 60° abduction angle, allowing for physiological tensioning. Finally, the graft was attached along the lower border of the LTT using a continuous locking suture technique (Fig. 5, *B*). The arthroscopy portals were then closed with 2-0 Ethilon (Ethicon, Piscataway, NJ, USA), and the LTT incision site was closed with 0-Polysorb (Covidien, Mansfield, MA, USA) and secured with staples for the skin. Conventional dressings were subsequently applied.

Postoperative rehabilitation

For postoperative rehabilitation, the patient was kept in an abduction brace that maintained their shoulder in a stable position of 0° external rotation for the initial 4 weeks after the operation. During this period, intermittent mobility of the elbow, wrist, and fingers was allowed while wearing the brace, enabling the patient to engage in routine tasks such as eating and writing, albeit with some limitations. After 4 weeks, the use of the abduction brace was discontinued, and the patient transitioned to a phase of active-assisted ROM exercises. This progression subsequently included the incorporation of full ROM exercises and the gradual introduction of gentle strengthening maneuvers. Hard labor and extreme sports were prohibited until 6 months postoperatively.

Postoperative stiffness

Following the completion of the postoperative rehabilitation regimen, the patient did not achieve a satisfying improvement in shoulder ROM. At 5 months postoperatively, despite attempts at conservative management, including ROM exercises and manual therapy, the patient's passive ROM remained limited: flexion at 90°, abduction at 90°, external rotation at 15°, and internal rotation extending to the level of buttock. MRI revealed adhesive capsulitis, accompanied by minor fluid accumulation within the subacromial space, while the continuity of the tendon transfer was maintained (Fig. 6).

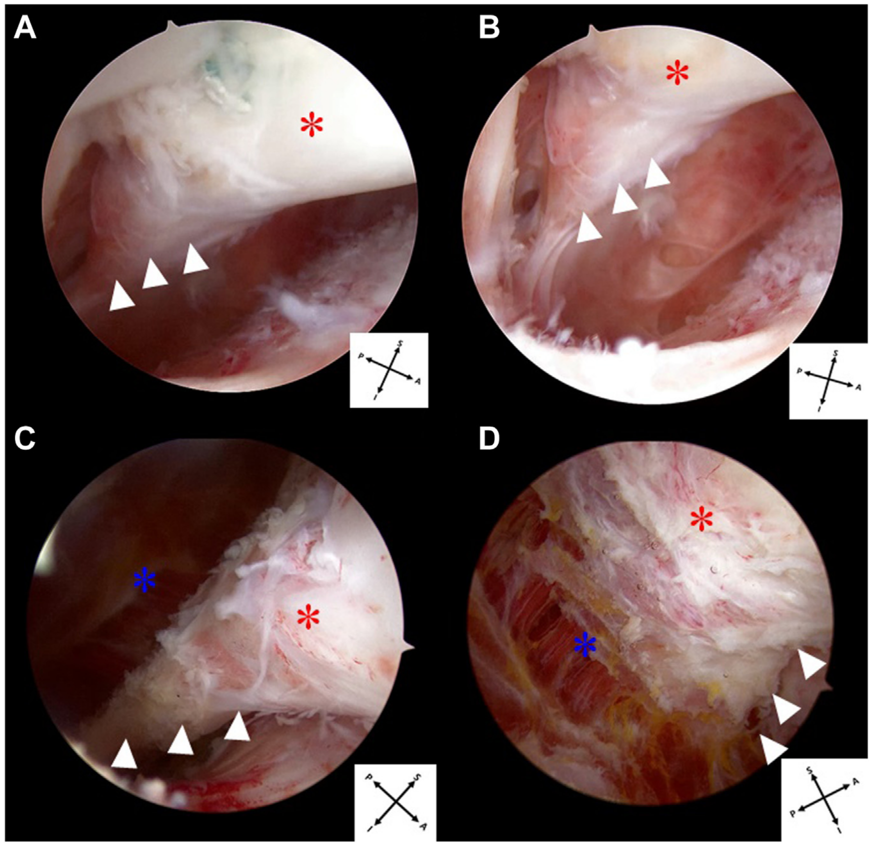

Figure 11 Arthroscopic image of attachment site for graft and lower trapezius tendon (LTT). Arthroscopic image of right shoulder from viewing portal in the back demonstrates (**A**) visualization of suture materials [*white arrow*] connecting the graft and LTT. (**B** and **C**) Full incorporation of the graft [*red asterisk*] along the previously attached site along the lower border [*white arrow head*] of LTT muscle with no adhesion in surrounding tissue. (**D**) Visualization of LTT muscle fibers [*blue asterisk*]. Orientation is being lettered as follows: *A*, Anterior; *P*, Posterior; *S*, superior; *I*, inferior.

Figure 12 Postoperative clinical photographs. (**A**) Two months postoperative after the arthroscopic pan-capsular release, clinical photos demonstrate the patient's improved active forward flexion and (**B**) external rotation at side of the right shoulder.

Arthroscopic capsular release and second look examination of LTT transfer

In response, the patient underwent arthroscopic capsular release and a second-look examination of the LTT transfer. The arthroscopic findings indicated a moderate degree of adhesive capsulitis, and a pan-capsular release was performed (Fig. 7). Additionally, an assessment of the LTT graft's integrity was conducted. The graft was firmly attached to the supraspinatus footprint without any signs of tear (Fig. 8, *A*). Synovialization was observed along the graft, and small portion of vascularization was noted in the area where side-to-side sutures were previously performed between the remnant posterior cuff and the graft (Fig. 8, *B*). Furthermore, a smooth tunnel, without adhesions, was established along the passage of the graft connected to the LTT muscle (Fig. 9). Arthroscopic exploration continued along the graft from the subacromial space to the overlying surface of the LTT by creating a new portal subcutaneously just above the lateral edge of the LTT where the graft was attached (Fig. 10). The view from this new portal revealed that there was full incorporation between the LTT muscle and the graft. Also, no significant adhesions surrounding both the LTT muscle and graft were observed. When rotating the arm, we observed a smooth excursion of the graft without and the LTT and the graft moved as a single unit (Fig. 11).

Two months after arthroscopic pan-capsular release

Two months after the arthroscopic pan-capsular release along with formal physical therapy rehabilitation protocol, the patient expressed satisfaction with the procedure's outcomes. His ROM had significantly improved, with an active forward elevation of 150°, an abduction of 150°, and a 35° active external rotation. Additionally, his internal rotation had improved, reaching the level of L3 on his back (Fig. 12). His clinical score had improved, with Constant score of 76 of 100, a University of California Los Angeles score of 27 of 35, and an ASES score of 79 of 100.

Discussion

Recent systemic review[7] has documented complications after LTT transfer, including seroma, hematoma, infection, re-tear, and nerve injury. Despite following the standard postoperative rehabilitation protocol, the patient exhibited a limited ROM and developed secondary adhesive capsulitis. This could be attributed to patient's comorbidity. As in our case, the patient was being treated for diabetes mellitus, which is a known risk factor for developing adhesive capsulitis.[4,23,27] When conservative treatments do not yield satisfying results, arthroscopic pan-capsular release can be considered to improve postoperative stiffness, as was observed in our case.

LTT transfer has been shown to yield satisfying clinical outcomes in many previous studies.[2,3,7,9,10,24,26] Nonetheless, analyzing the mechanisms underlying tendon transfer remains a challenge, particularly in distinguishing between the functional improvements resulting from the tendon transfer effect and the tenodesis effect.[8,11,20] This distinction continues to be a topic of debate. Previous studies involving electromyography assessments of transferred tendons in cases of posterior superior rotator cuff tears have confirmed electrical activity in the transfer muscle.[1,12,14] However, its specific role in facilitating active external rotation remains variable and subject to ongoing debate. During our second look at LTT transfer, we observed a smooth tunnel around the graft leading to its attachment site on the LTT. We observed smooth tendon excursion during arm rotation, without any adhesion around the graft. The absence of adhesion suggests that the role of the lower trapezius tendon transfer may encompass not only the tenodesis effect but also the action of the transferred tendon, or possibly both. Finally, arthroscopic finding of smooth tendon excursion provides insights into the importance of postoperative rehabilitation, as it helps to prevent adhesions.

In our practice, we consistently use side-to-side suturing whenever feasible, with the primary goal of enhancing shoulder stability during the LTT transfer procedure. The importance of side-to-side suturing was highlighted in a biomechanical study by Mihata et al.[18] The author demonstrated that side-to-side suturing in superior capsule reconstruction results in reduced glenohumeral superior translation and a significant decrease in subacromial peak contact pressure, ultimately improving the overall stability of the shoulder joint. During the arthroscopic second-look examination, we observed no evidence of tears at the previous side-to-side suture and observed vascularization originating from the side-to-side suture. Previous studies[15,17] have elucidated that the revascularization takes place during the graft maturation phase and plays a crucial role as a prerequisite for synovialization and graft incorporation in anterior cruciate ligament reconstruction. Although the clinical implications of graft synovialization are not yet fully understood,[5,16,19] vascularization in close proximity to the side-to-side suture may facilitate graft incorporation by supporting synovialization. This further underscores the importance of the side-to-side suture technique. Nevertheless, histological and biological studies are needed to explore whether the graft underwent neovascularization and whether this process contributed to graft healing. Also, further studies should be conducted to gain a deeper understanding of the role of vascularization and synovialization and their implications for clinical outcomes.

Conclusion

MRI scan and sonography are usually used as a tool to evaluate postoperative integrity of transferred tendon. Yet, the ideal modality for evaluating grafts is arthroscopy, as it allows for direct visualization of graft integrity. However, it is not routinely recommended due to its invasive nature. This case has provided valuable arthroscopic findings, demonstrating the smooth excursion of the LTT without any adhesions along the graft at the 5-month postoperative mark. Additionally, vascularization at the side-to-side suture site was observed. While this case report offers meaningful insights by allowing for direct visualization of the LTT transfer during second-look arthroscopy, it is important to recognize that this case report should not be overinterpreted as it is based on observations from a single patient. However, it still offers meaningful insights into the direct visualization from the second look of the LTT transfer.

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