Technical Note

Arthroscopic Circumferential Release for Stiff Reverse Total Shoulder Arthroplasty

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Abstract: Stiffness is a well-known complication after reverse shoulder arthroplasty. Although multiple factors may be involved, the main cause for stiffness is rarely identified. Imaging studies frequently are inconclusive in ruling out mechanical or biological causes. Periprosthetic infection should be always suspected, but the absence of major clinical signs and accurate diagnostic tests is frequent. A lack of objective criteria establishing a diagnosis and when to proceed with revision surgery is often present in such cases. Moreover, additional surgical procedures should be carefully evaluated, as they can represent a point of no return. Shoulder arthroscopy plays an increasingly important role in these cases, either as a diagnostic or therapeutic tool. There are no reports about arthroscopy on stiffness after reverse shoulder arthroplasty. In this Technical Note, we describe an arthroscopic technique aimed to identify potential causes of reverse shoulder arthroplasty stiffness. Subsequent circumferential release is described and discussed.

Introduction (With Video Illustration)

Pain and stiffness, especially with restricted rotation, is a well-known complication after reverse shoulder arthroplasty (RSA), which is becoming more prevalent as the use of this procedure is increasing. Mechanical problems restricting humeral excursion, loosening, and prosthetic joint infection are modifiable common causes of painful, stiff RSA that must be ruled out.

Arthroscopy has successfully been used to treat stiffness affecting prosthesis in different joints, such as the knee,[1] as well as different complications of shoulder arthroplasty.[2-5] However, the arthroscopic technique to examine the RSA and to perform a standardized arthroscopic articular release technique has not yet been reported. The purpose of this Technical Note is to describe an arthroscopic technique of complete RSA examination aimed to identify potential causes of RSA stiffness and to perform a subsequent circumferential release of the prosthetic shoulder joint (Video 1).

Technique

Step 1: Preoperative Workup

After a detailed clinical interview focused on medical history and previous shoulder surgeries, a physical examination including deltoid function evaluation, skin appearance, presence of erythema or fistulae, and range of motion (ROM) is performed. Active and passive ROM in all planes must be registered. Laboratory tests include complete blood cell count, erythrocyte sedimentation rate, and C-reactive protein. Conventional shoulder radiographic views including anteroposterior in the scapular plane and axillary views and a computed tomography scan are performed.

Patients typically present complaining of pain and stiffness at the onset of a failed RSA. Every detail concerning previous shoulder surgeries must be investigated and taken into account. Conventional radiographic views may not visualize abnormalities, and a computed tomography scan can help to better evaluate component

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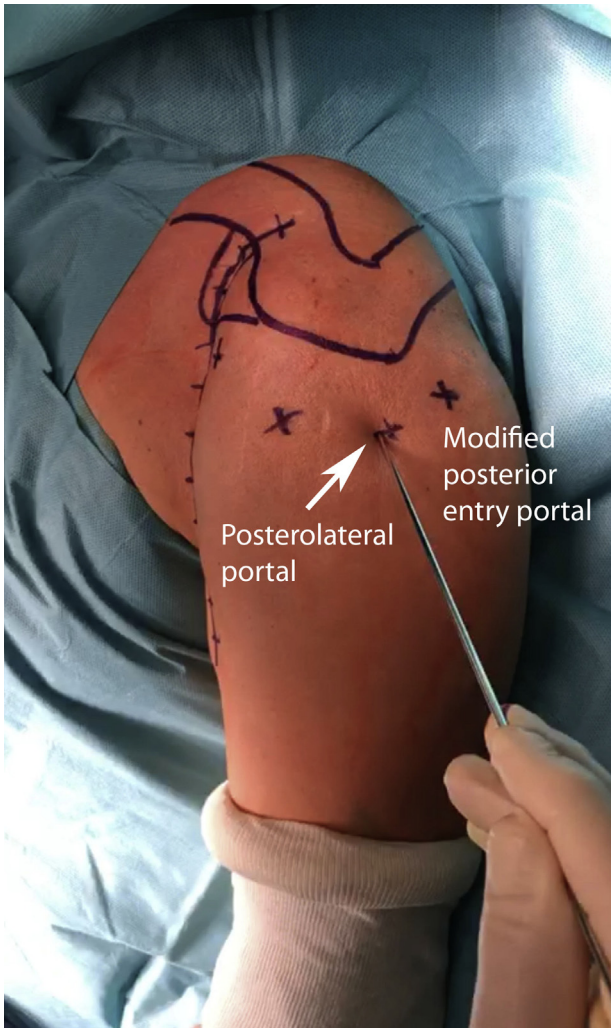

Fig 1. The patient (left shoulder) is positioned in the beach chair position, but the procedure can be performed in lateral position indistinctly. All anatomic landmarks and skin incisions are marked. The "modified posterior entry portal" should be performed in a more superolateral position compared with the standard posterior entry portal.

position and loosening or osteolysis. Ensure that previous available cultures and laboratory tests to rule out infection are negative before surgery.

Step 2: Surgical Positioning, Diagnostic Arthroscopy, and Lateral Release

This surgical procedure can be carried out either in the lateral decubitus or beach chair position. A combined modality of brachial plexus block and general anesthesia is recommended. Prophylactic antibiotics should be delayed until intraoperative cultures and tissue samples to rule out infection have been obtained. Traction use depends on the surgeon's preferences, but free shoulder movement must be ensured intraoperatively to perform the release and to check final ROM. Anatomic landmarks and skin scars are marked preoperatively.

Initial posterior visualization portal varies from a standard shoulder portal. It should be located in a slightly more lateral and superior position (Fig 1), since the aim is not to enter in the joint line between the glenosphere and the polyethylene component but in the subacromial space located superolateral to the glenosphere. Initial orientation could be tricky, as the anatomic references are very different compared with a native shoulder joint. Surgeons have to be aware of the "mirror phenomenon,"[6] which is more important in RSA due to the bulk of the glenosphere as it can amplify the initial perception of disorientation. Once in the joint space, lateral accessory portals are performed inferior and lateral to the anterolateral and posterolateral acromial borders. These portals are more superior and should be oriented medial and inferiorly since the subacromial and glenohumeral space are in continuity creating the so-called subacromial periprosthetic space. Adhesions and scar tissue should be carefully removed throughout until lateral release is completed.

Prosthetic components can now be identified and evaluated from different view portals (Fig 2). Careful insertion and management of arthroscopic instruments is important during the procedure to avoid polyethylene damage. Afterwards, systematic assessment of the articular surface congruence should always be carried out. Bone and prosthesis interfaces must be cleared and examined throughout to rule out complications related to integration (Fig 3). Multiple soft-tissue samples must be obtained to rule out infection, preferably from bone prosthesis interfaces, as it has been shown to offer high sensitivity and specificity[7] (Fig 4). ROM should be tested completely, and any potential mechanical cause of stiffness around the humeral and glenoid components must be searched. This includes component loosening,

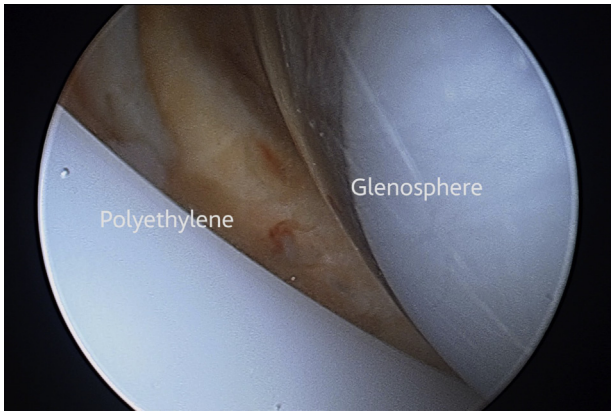

Fig 2. Debridement of periprosthetic scar tissue should be addressed first to clearly identify prosthetic articular surfaces. From the posterior view of the left shoulder, humeral (polyethylene) and glenoid (glenosphere) components are identified. Surgeons should be aware of the "mirror phenomenon" when visualizing the glenosphere, as it can amplify the initial perception of disorientation.

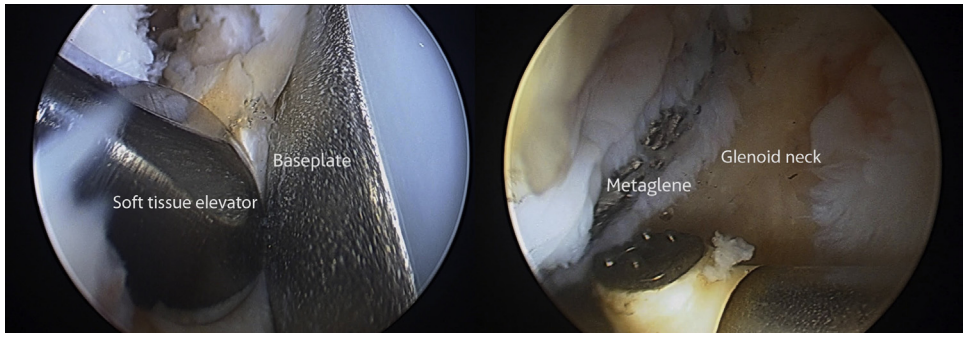

Fig 3. Humeral (baseplate) (left) and glenoid (metaglene) (right) component–bone interfaces must be identified and cleared to rule out loosening. Fixation and stability of prosthetic components should be gently tested. As many portals as needed should be used for this purpose. Lateral (left) and posterior (right) view portals are used systematically.

loose bodies, bony insufficiency, periprosthetic fractures, glenoid notching (Fig 5), or abutment of the humeral component on the undersurface of the acromion. Soft tissues must be also examined, including tissue quality and status of the remaining rotator cuff.

Step 3: Circumferential Release

Once potential causes of joint stiffness have been discarded, the goal is to achieve a sequential 360° arthroscopic circumferential release of the humeral component. Radiofrequency probes and conventional basket forceps are suitable for this part of the procedure. Multiple portals performed under direct visualization from posterior to anterior can be used if needed, although 4 portals (i.e., modified posterior, posterolateral, anterolateral, and anterior) are usually enough (Fig 1). Initially, visualization from a "modified posterior portal" allows us to work from a lateral portal to release the lateral and superior areas, resecting all subacromial adhesions and scar tissue. It is important to keep in mind that this portal should be located in a more lateral and superior position compared with the conventional posterior arthroscopic portal. Once the periprosthetic scar tissue and adhesions have been cleared, the arthroscope is switched to a posterolateral portal to begin with the circumferential release procedure performing an anterior capsulotomy that should be extended medially and posteriorly as far as possible (Fig 6). The arthroscope is now oriented posteriorly to visualize the posterior aspect of the prosthesis, and the posteromedial capsulotomy is performed (Fig 7).

At this point, a posterior working portal is very useful to insert the radiofrequency probe (FLOW 90 wand, WEREWOLF COBLATION SYSTEM, ArthroCare Corp., Austin TX) to release all the medial aspect of the capsule until the posterior and anterior capsulotomy incisions are connected under arthroscopic control with the scope positioned in the anterior portal. Medially, the capsule should be released from the inferior glenoid neck to prevent any inadvertent damage of the axillary nerve. Inferior glenoid neck debridement also provides an excellent metaglene view and the degree of glenoid notching can be evidenced. It is important to visualize the entire circumference of the prosthetic humeral platform and polyethylene to make sure that complete circumferential release has been achieved and to rule out polyethylene wear (Fig 8). The surgical assistant can help performing arm rotations to gain access to the periprosthetic soft tissue as needed during the procedure. As the last step, passive ROM must be checked and registered.

The entire surgical technique is shown in Video 1, which includes audio narration. Tables 1 and 2 present tips, pitfalls, and key points of using this technique.

Step 4: Closure and Physical Therapy

The shoulder is placed on a standard sling for pain control, but physical therapy must be initiated immediately after the surgical procedure to regain ROM.

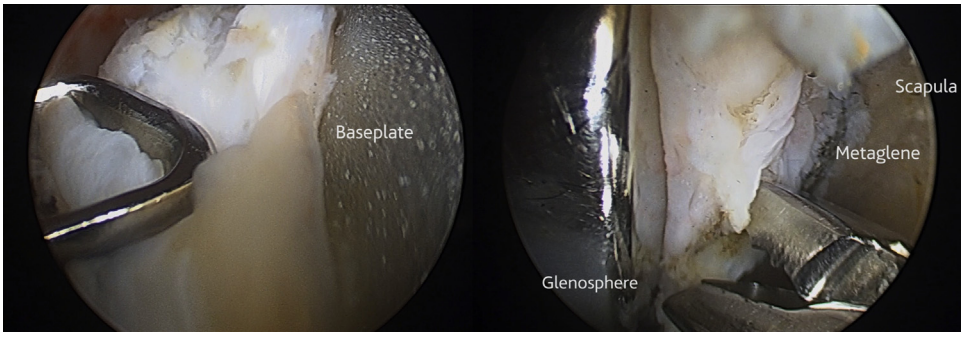

Fig 4. Multiple tissue samples should be procured to rule out infection. Samples are obtained from humeral–baseplate interface using a lateral view portal (left) and metaglene–glenosphere interfaces using a posterior view portal (right).

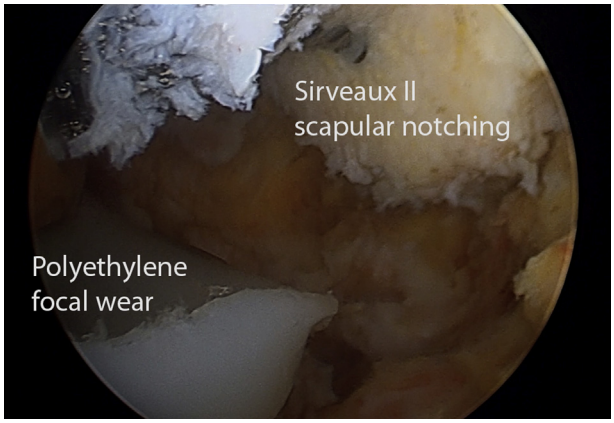

Fig 5. Scapular notching can be evaluated under direct visualization during the diagnostic arthroscopic time. Mirror notching polyethylene damage is defined as the coincidence of the medial polyethylene focal wear in contact with the scapular notching area, and suggests mechanical issue. A Sirveaux grade II scapular notching is evidenced on this image of the left shoulder from a posterior portal view.

Discussion

The value of shoulder arthroscopy for diagnostic purposes, especially to rule out infection or mechanical issues, has already been proven for anatomic shoulder arthroplasty.[2,3,7] Other reports showed that arthroscopy also helps to achieve successful therapeutic intervention in complications related to anatomic shoulder arthroplasty. O'Driscoll et al.[8] reported 5 cases of removal of loosened glenoid component, and Abildgaard et al.[9] also reported 1 case, associated with bone grafting and patch augmentation for glenoid osseous defect. Grieshaber-Bouyer et al.[10] and Gee et al.[11] both reported arthroscopic repair of instability. Freedman et al.[12] described satisfactory results performing arthroscopic acromioplasty for chronic impingement syndrome following total shoulder or hemiarthroplasty. In the series reported by Hersch and Dines,[13] other procedures such as biceps debridement or tenodesis, capsular release, removal of loose bodies, Mumford, and rotator cuff repair are likewise performed sometimes using mini-open approach.

Compared with the anatomic shoulder arthroplasty, there are only a few cases reported referring to the use of arthroscopy in complications secondary to RSA. Garberina and Williams[5] reported for the first time the value of diagnostic shoulder arthroscopy in RSA disclosing a polyethylene dissociation that helped to make the decision of performing revision surgery. Akgün et al.[2] and Doherty et al.[3] reported recently series showing the advantage of arthroscopy in evaluating and making diagnosis of infected shoulder arthroplasties, despite only 1 and 2 cases of RSA respectively being included in these reports, and there was a lack of technical information. The first Technical Note related to therapeutic use of arthroscopy on RSA showed that the technique could facilitate the reduction of chronically dislocated shoulder prosthesis, thus avoiding open surgery.[4]

The technique here described is useful to better analyze prosthetic joint low-grade infection and to procure multiple tissue samples at the bone—implant interfaces. This approach can be useful considering that infection could be present although clinical signs and laboratory tests are negative. Blood tests commonly used, such as C-reactive protein and erythrocyte sedimentation rate, as well as shoulder aspiration, have been shown to have low efficacy in low-grade prosthetic joint infection.[14] Arthroscopy can also identify potential mechanical causes of stiffness under direct visualization. In this case, a clear polyethylene impingement and glenoid notching could be identified. Furthermore, arthroscopy allows surgeons to perform minimally invasive release of a well-fixed RSA, avoiding open surgery and decreasing the risk of secondary infection. These technical strengths should be kept in mind considering the increasing use of RSA in the orthopaedic community worldwide.

The main limitation of this technique is that some causes of pain or stiffness that could be potentially found intraoperatively may require an open approach to perform revision surgery. In this scenario, findings on the arthroscopic procedure may help to plan the next surgery. This technique includes all common risks that

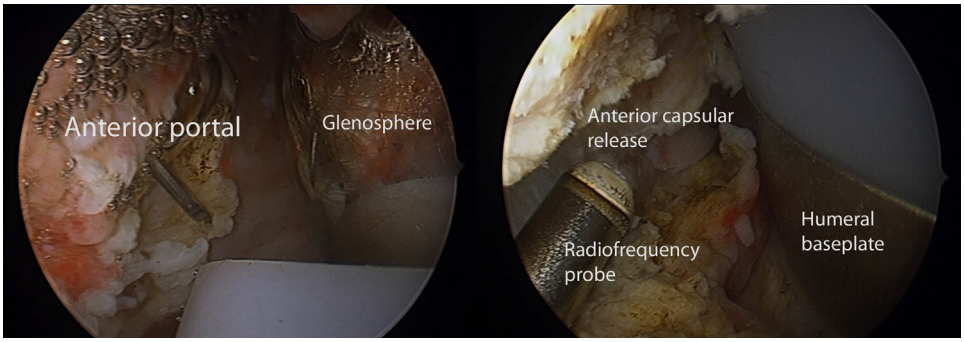

Fig 6. Anterior capsular release. An anterior work portal at the level of glenosphere—polyethylene interface is performed on this left shoulder under a lateral portal visualization (left). Capsular release is carried out towards the medial capsule using a radiofrequency probe (FLOW 90 wand, WEREWOLF COBLATION SYSYEM, ArthroCare Corporation, Austin TX) (right).

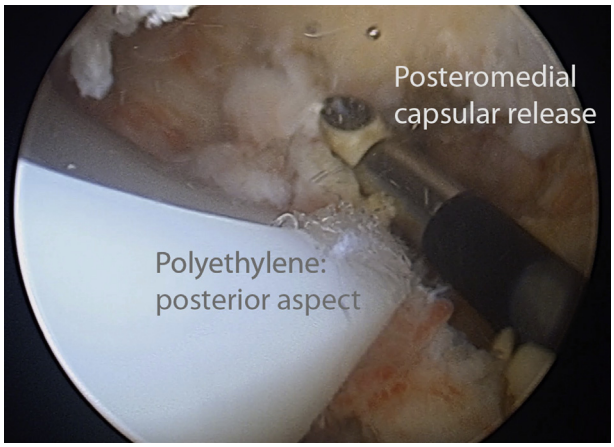

Fig 7. Posteromedial capsular release. The posterior aspect of the joint on this left shoulder is visualized from a posterolateral portal and the posteromedial capsule is released working from a posterior portal. The help of the assistant performing shoulder rotations is very useful in this step.

also appear in other arthroscopic shoulder procedures, plus the additional risk of damaging nerve structures due to the distortion of the native anatomy. Medial soft tissue should be released from the inferior glenoid neck to prevent inadvertent damage of the axillary nerve. Another potential risk, avoidable through careful insertion and management of arthroscopic instruments, is damage of the prosthetic components.

From a technical point of view, 3 principles should be followed for arthroscopic release of a stiff RSA. First, it is necessary to be aware of the anatomy of the prosthetic RSA shoulder, which is different than the healthy joint and different than a total shoulder arthroplasty. Accordingly, rules of conventional shoulder arthroscopy do not completely apply. The joint line is displaced inferiorly and medially. The aim is to enter in the subacromial space located lateral and superior to the glenosphere. For this reason, a "modified posterior entry portal" should be performed in a more superolateral position comparing to the standard posterior entry portal. Second, the "mirror phenomenon," common to all prosthetic arthroscopic procedures, is increased in RSA due to glenosphere volume. Finally, soft-tissue circumferential release around the humeral and glenoid components should be ascertained to regain ROM and to rule out implant loosening, humeral abutment on the undersurface of the acromion, polyethylene wear, impingement, and glenoid notching.

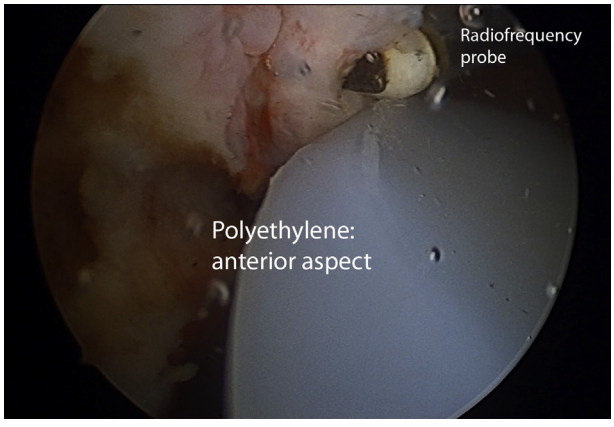

Fig 8. Complete circumferential capsular release should be confirmed from anterior and posterior portals. This figure shows how a posterior working portal is used to insert the radiofrequency probe (FLOW 90 wand, WEREWOLF COBLATION SYSTEM, ArthroCare Corporation, Austin, TX) to release all the medial aspect of the capsule until the posterior and anterior capsulotomy incisions are connected under arthroscopic control with the scope positioned in the anterior portal.

Table 1. Procedural Pearls and Pitfalls

Pearls
• The initial entry portal should be located in a slightly more lateral and superior position compared with the conventional posterior shoulder arthroscopic portal.
• All accessory portals should be oriented medial and inferiorly since the subacromial and glenohumeral space are in continuity creating the so-called subacromial periprosthetic space.
• Multiple soft-tissue samples must be obtained to rule out infection, preferably from bone prosthesis interfaces.
• It is important to visualize the entire circumference of the prosthetic humeral platform and polyethylene to make sure that complete circumferential release has been achieved and to rule out polyethylene wear.
• The surgical assistant can help performing arm rotations to gain access to the periprosthetic soft tissue as needed.
Pitfalls
• Prophylactic antibiotics should be delayed until tissue samples to rule out infection have been obtained.
• Initial orientation could be tricky, as the anatomic references are very different compared with a native shoulder joint. Surgeons must be aware of the "mirror phenomenon."
• Careful insertion and management of arthroscopic instruments is important during the procedure to avoid polyethylene damage.
• Medial soft tissue should be released from the inferior glenoid neck to prevent inadvertent damage of the axillary nerve.

Table 2. Procedural Advantages and Disadvantages

Advantages
• This procedure allows a complete examination to identify potential mechanical causes of stiffness under direct visualization.
• This procedure allows one to obtain soft-tissue samples from bone prosthesis interfaces to rule out periprosthetic joint infection.
• This procedure is useful not only to identify potential causes of stiffness, but also to perform minimally invasive release of a well-fixed reverse-shoulder arthroplasty avoiding open surgery.
• The information obtained intraoperatively and identification of a specific cause of stiffness not approachable by arthroscopy can be very helpful to plan revision surgery.
Disadvantages
• Some causes of stiffness that could be potentially found intraoperatively may require an open approach to perform revision surgery.

In conclusion, the arthroscopic approach to the stiff RSA is an excellent option that allows the surgeon not only to find potential mechanical or biological causes for stiffness but also to perform a circumferential release.

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