Arthroscopic Pancapsular Shift With Labral Repair for Multidirectional Instability of the Shoulder

Salvatore J. Frangiamore, M.D., M.S., Sandeep Mannava, M.D., Ph.D., Jonathan A. Godin, M.D., M.B.A., Jack Anavian, M.D., Erik M. Fritz, M.D., and Peter J. Millett, M.D., M.Sc.

Abstract: Initial treatment of shoulder multidirectional instability (MDI) consists of nonoperative modalities of physical therapy and rehabilitation; if this fails, surgical treatment can become necessary. MDI of the shoulder can be challenging to manage in individuals who fail conservative management. Historically, surgical treatment for MDI has been open capsular plication; however, arthroscopic capsular plication has now become the standard of care, with outcomes similar to the open procedure. The purpose of this article and Video 1 is to describe our arthroscopic technique for pancapsular shift with labral repair.

Multidirectional instability (MDI) of the shoulder is defined as symptomatic glenohumeral subluxation or dislocation in more than one direction: anterior, inferior, or posterior.[1] Although the true prevalence of MDI is unknown, it has been correlated with generalized joint hyperlaxity, which has a prevalence of 5% to 15%.[2] In general, patients affected by MDI tend to be young, active patients participating in sports or other repetitive overhead activities. In contrast to anterior instability, MDI affects both males and females approximately equally. In patients with symptomatic MDI, nonoperative management is considered the standard of care and should be attempted prior to surgical intervention.[1] Surgical options are considered only if patients continue to be symptomatic to the point of interference with activities of daily living or recreational activities following nonoperative management. Surgical management aims to reduce the patulous capsular volume seen with MDI.[3] Historically, these cases were managed with an open inferior capsular shift as described by Neer and Foster.[4] Modern-day arthroscopic techniques have demonstrated comparable outcomes to open capsular shift with regards to recurrent instability, return to sport, loss of external rotation, and overall complications and have become the standard for managing operative instability.[5,6] In this article and Video 1, we describe our arthroscopic surgical technique for pancapsular shift with labral repair for the treatment of MDI. The advantages and disadvantages of this technique are outlined in Table 1.

From the Steadman Clinic (S.J.F., S.M., J.A.G., J.A., P.J.M.) and Steadman Philippon Research Institute (S.J.F., S.M., J.A.G., J.A., E.M.F., P.J.M.), Vail, Colorado, U.S.A.

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Address correspondence to Peter J. Millett, M.D., M.Sc., The Steadman Clinic, Steadman Philippon Research Institute, 181 West Meadow Drive, Suite 400, Vail, CO 81657, U.S.A. E-mail: drmillett@thesteadmanclinic.com

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Surgical Technique

Preoperative Planning

Preoperatively, physical examination of MDI may demonstrate generalized ligamentous laxity with elbow and knee hyperextension, evidence of a sulcus sign, increased humeral translation with anterior- and posterior-directed forces, positive anterior apprehension, and positive load and shift tests. Patients are initially managed nonoperatively with 6 months of physical therapy focused on dynamic shoulder stabilization. If symptoms of pain and instability do not improve, surgical treatment is recommended.

Preoperative evaluation with standard, anteroposterior, Grashey, scapular-Y, and axillary radiographs is obtained and reviewed for glenoid and humeral head bone loss, subluxation, and other osseous deformities. Magnetic resonance imaging

Table 1. Advantages and Disadvantages of Arthroscopic Surgical Technique as Compared With Open Technique

Advantages	Disadvantages
Minimally invasive	Technically challenging
Can better visualize and address concomitant intra-articular pathology	Long-term outcomes unknown
Better cosmetic outcome	
Short-term outcomes are as good as the open technique with regard to recurrent instability, return to sport, loss of external rotation, and overall complications.[5]	

evaluation of the shoulder is used to evaluate the chondral surfaces, labrum, capsule, glenohumeral ligaments, and other soft-tissue structures. Computed tomography scan can help evaluate glenoid bone stock and humeral head defects.

Anesthesia and Patient Positioning

Anesthesia includes a combination of interscalene block for postoperative pain control and general endotracheal anesthesia. For a patient presenting with MDI requiring both anterior and posterior stabilization, the lateral decubitus position provides effective glenohumeral distraction, allowing access to the anterior and posterior glenohumeral joint and facilitating "reduction" of the capsule-labrum onto the glenoid rim. We position the arm in a vertical suspension with 80° of abduction and minimal forward flexion using 15 pounds of traction. This provides uniform distraction to facilitate access to the inferior (5 to 7 o'clock) labral pathology.

Diagnostic Arthroscopy

The complete surgical technique is demonstrated in Video 1. The posterior portal is created 2 cm inferior and just medial to the lateral edge of the posterolateral acromion. The slightly lateral location facilitates viewing of the labrum and obtaining the appropriate angle for surgical instrumentation. A diagnostic arthroscopy is performed; in our case example, the labrum is detached anteriorly from the 2 to 6 o'clock positions (convention of anterior glenoid representing the 3 o'clock position). Using an 18-gauge needle and dilators, an anterosuperior portal is developed and a 5 mm × 7 cm low profile cannula (Arthrex, Naples, FL) is inserted. The ideal position is just inferior and distal to the biceps anchor to leave adequate room for an additional anteroinferior portal in the rotator interval. The arthroscope is repositioned in the anterior portal to assess the posterior labral injury, which in this case extends from the 7 to 11 o'clock positions, thereby demonstrating an overall panlabral injury (Fig 1A). The arthroscope is returned to the posterior portal, and the second anteroinferior portal is developed and another 5-mm cannula is inserted slightly distal and inferior to the anterosuperior portal and slightly above the subscapularis tendon.

Anterior Capsular Shift

Our preference is to first address the most symptomatic side of instability. If the anterior and posterior sides have equal instability, the posterior side is shifted first. In this case, the principal direction of instability was anterior and inferior; therefore, the anteroinferior anchors are placed first as visualization in this location becomes more difficult after posterior fixation, which constrains humeral head mobility. When a labral tear is encountered, the anterior tear is mobilized with a 15° or 30° arthroscopic elevator working through the anterosuperior, anteroinferior, and posterior portals. An arthroscopic shaver is then used to debride the glenoid bone surface to enhance biologic integration, avoiding any resection of the marginal articular cartilage and bone. Visualization of the subscapularis muscle belly will indicate sufficient mobilization. When there is no glenolabral disruption, the capsule is abraded with a rasp or shaver and a capsular plication is performed.

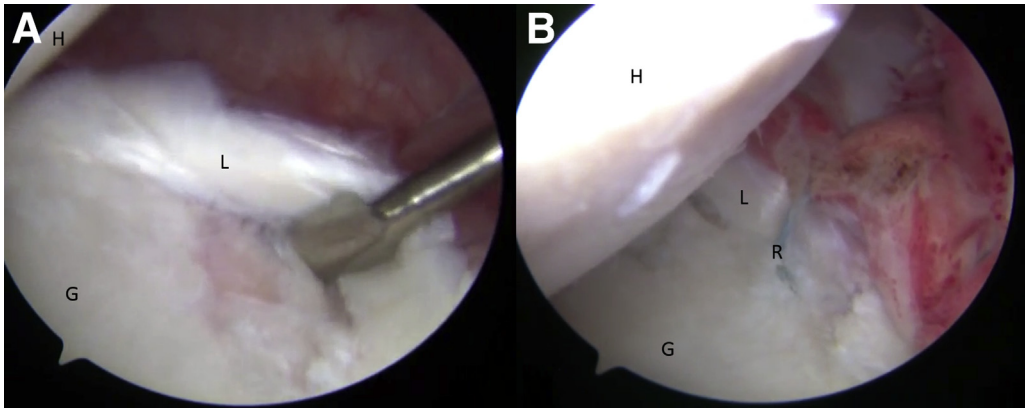

Fig 1. Arthroscopic view from the anterosuperior portal of a right shoulder. (A) A tear of the posterior labrum is visualized from the 7 to 11 o'clock positions. (B) The posterior labrum is visualized following the completion of the posterior capsulolabral repair. (G, glenoid; H, humerus; L, labrum; R, repair suture.)

The most inferior anchor is placed first, using a 2.4-mm drill and drill sleeve (Arthroscopic Spear; Arthrex) through the inferior cannula. The sleeve should be directed to the chondrolabral interface at the 5 o'clock position, 1 to 2 mm off the face of glenoid. Once the position on the face is secured, while applying downward pressure, the drill sleeve is raised from a horizontal to a more vertical trajectory, which facilitates proper anchor positioning without disruption of the glenoid surface. This maneuver levers the humeral head posteriorly and improves visualization. Once position and trajectory are ideal, the surgeon drills the tunnel, ensuring the chondral surface is not violated, and then the surgeon places the 3-mm anchor (Bioknotless SutureTak; Arthrex). When hard bone is encountered, the drill is cycled in and out 2 to 3 times to ensure shavings and debris are removed from the hole. It is important during this process to stabilize the drill sleeve with the contralateral nondrilling hand to avoid skiving, which can cause articular surface iatrogenic injury or an oblong hole not suited for anchor placement.

After the pilot hole is drilled, the arthroscopic suture anchor is inserted (Fig 2A). We push the anchor in by hand approximately one-third of the way prior to hammering; this ensures the correct anchor trajectory is obtained and avoids suture anchor breakage. The anchor is then malleted into its appropriate depth in the bone. The sutures are then released from the anchor-inserter handle, and the inserter is gently removed with combined rotation and in-line traction. The suture anchor is then checked with a shuck on the sutures. We prefer to use knotless anchors to minimize the risk of abrasion on the humeral articular surface. The planned postlimb of the repair suture (white Fiberwire) is retrieved through the anterosuperior portal with a suture grasper. A 25° angled curved tissue penetrator and shuttling device (SutureLasso; Arthrex) is used to pass around the anteroinferior labrum at or near the level of the anchor (Fig 2B). In a right shoulder, the device must be angled to the right to facilitate ideal trajectory of the suture within the anterior capsulolabral complex. The device is inserted into the anteroinferior capsule 1 to 2 mm anterior and inferior to the anchor with the tip inserted perpendicular to the tissue (Fig 2B). After the capsule is penetrated, the device is rotated 90° by rotating your wrist one half turn counterclockwise in order to penetrate the labrum and present the shuttling device (SutureLasso) at the chondrolabral junction, ideally inferior to the level of the anchor so that the capsule will be shifted not only from lateral to medial but also from inferior to superior (Fig 2B).

The nitinol wire is then looped into the joint and retrieved from the anterosuperior portal (Fig 3A). The repair suture is then loaded through the nitinol loop and delivered through the anteroinferior cannula by retracting the nitinol wire anteriorly. Continued retraction of the nitinol will deliver the repair suture through the labrum and capsule. The repair suture that has been passed through the capsule and labral tissue is then loaded through the loop end of the shuttling suture and secured with one hand. The free end of the shuttling suture is then pulled with the opposite hand to shuttle the repair suture back into the anchor. Advance the shuttle suture with repeated gentle tugs until the suture is passed through the locking mechanism and out of the cannula. The free end of the repair suture can be tightened until desired tension is achieved (Fig 3B). The suture is then cut flush with the tissue. The same process is then completed at the 4 o'clock position.

Posterior Capsular Shift

After 2 inferior anchors are placed anteriorly, posterior repair is initiated. Using a switching stick, the arthroscope is repositioned in the anterosuperior portal. Under direct visualization, a posterolateral portal is developed and a 5.0 mm × 7 cm cannula (Arthrex) is placed for anchor placement and suture shuttling. Starting at the 7 o'clock position, 4 anchors are placed from inferior to superior in a similar fashion to the previously placed anterior anchors, while shifting the capsule 1 to 2 mm superiorly with the inferior 2 anchors. A low-profile shuttling device that fits through

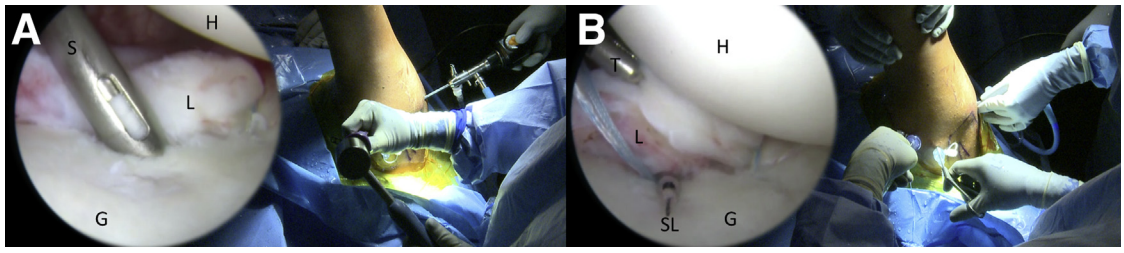

Fig 2. Arthroscopic and external views of a right shoulder with the arthroscope in the posterior portal visualizing the anterior labrum with suture anchor insertion and suture passage. (A) Visualization of drill sleeve positioning anterior to the glenoid prior to anterior suture anchor insertion via the anteroinferior portal. (B) View of the SutureLasso via the anteroinferior portal shifting the capsulolabral tissue and positioned at the chondrolabral junction. (G, glenoid; H, humeral head; L, labrum; S, drill sleeve; SL, SutureLasso; T, tissue grasper.)

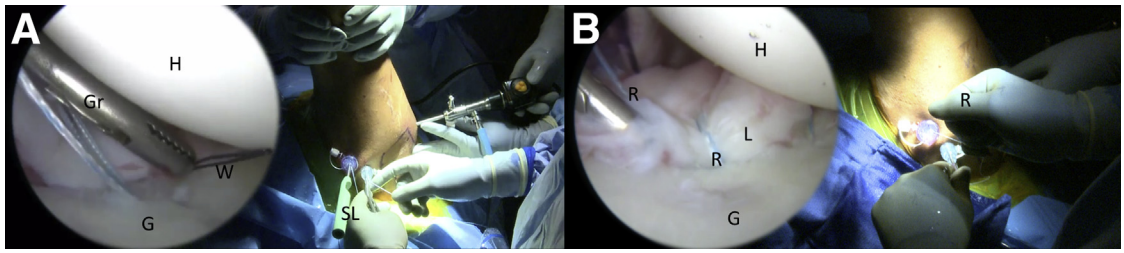

Fig 3. Arthroscopic and external views of a right shoulder with the arthroscope in the posterior portal visualizing the anterior labrum with repair suture passage and tensioning, thus completing placement of the anchor. (A) Via the anteroinferior portal, the nitinol wire is passed through the SutureLasso and passed through the anterosuperior portal using the arthroscopic grasper; not visualized, the repair suture is then looped into the nitinol wire and passed out the anteroinferior portal. (B) The repair suture is then tensioned over the labral tissue into the anterior suture anchor while using an arthroscopic grasper to aid in shifting the capsulolabral tissue by the desired amount. (G, glenoid; Gr, grasper; H, humerus; L, labrum; R, repair suture; SL, SutureLasso; W, wire.)

the 5-mm cannula (Crescent SutureLasso) is used to pass the posterior sutures. This shuttling device allows for a larger shift and allows for the use of only a 5-mm cannula, which disrupts the posterior capsule less and takes up less space, thus allowing for easier manipulation of the tissues. A larger shift is especially important for patients with severe capsular laxity and a patulous posterior capsule or those with increased glenoid retroversion.

After the labral repair is complete, the cannula is removed and the working posterior portal can be closed using a no. 2 absorbable suture (PDS II, polydioxanone, Johnson and Johnson, New Brunswick, NJ) to enhance capsular integrity. This is performed first by shuttling the suture through the capsule proximal to the portal with the shuttling device (Crescent SutureLasso). Next, a 2.7 mm 22° penetrating suture retriever (Birdbeak, Arthrex) is passed through the capsule distal to the portal and the suture is retrieved and delivered out of the joint through the cannula where it is tied creating an outside-in capsular repair, without incorporating any rotator cuff or deltoid fibers. The arthroscope is repositioned into the original posterior viewing portal, and additional anterior anchors can be placed to complete the SLAP repair as needed. Pearls and pitfalls of the complete procedure are outlined in Table 2.

Discussion

Arthroscopic pancapsular shift has demonstrated comparable results to open capsular shift with regards to recurrent instability, return to sport, loss of external rotation, and overall complications.[5] Raynor et al.[6] retrospectively reviewed our outcomes using this technique in 45 shoulders with MDI treated with arthroscopic stabilization in patients who were a minimum of 2 years out postoperatively; stability was achieved in 90.7%, and recurrence of instability requiring additional surgery occurred in 9.3% of patients at 2 years. Jacobson et al.[5] performed a systematic review of 7 Level IV studies: 3 assessed open capsular shift

Table 2. Pearls and Pitfalls of Arthroscopic Surgical Technique

Pearls	Pitfalls
Placement of arm in vertical suspension with 80° of abduction and minimal forward flexion with 15 pounds of traction provides uniform distraction to facilitate access to the inferior labral pathology.	It is more difficult to lever the humeral head posteriorly after posterior labral repair and plication.
A slightly lateralized posterior portal facilitates labrum visualization with the appropriate angle for instrumentation.	When drilling, stabilize the drill sleeve with the contralateral nondrilling hand to avoid skiving.
The anterosuperior portal is inserted just inferior and distal to the biceps anchor; this leaves adequate room for a second anteroinferior portal.	Incorrect anterior portal placement can make instrumentation difficult, lead to cannula interference, and negatively impact suture anchor trajectory, thereby risking hardware failure.
Place anteroinferior anchors first; anteroinferior visualization becomes more difficult after posterior fixation.	Care must be taken to ensure there is enough slack on the nitinol looped wire so it is not damaged with retrieval, as the end of the SutureLasso is sharp.
When placing anterior suture anchors, lever the humeral head posteriorly to improve visualization and facilitate proper anchor position. Be sure the drill sleeve is 1 to 2 mm on the glenoid face.	
If the anchor fails or pulls out due to poor bone quality, a larger diameter 3.7-mm suture anchor can be used.	
The working posterior portal is closed using a suture to enhance capsular integrity.	

outcomes (137 total patients), and 4 highlighted arthroscopic capsular plication outcomes (92 total patients). Recurrence of instability occurred at a rate of 11.7% for the open group and 20% for the arthroscopic group, although the difference did not reach statistical significance.[5] The groups experienced similar levels of return to sport: 80% and 86% for the open and arthroscopic groups, respectively ($P > .05$).[5] Complication rates were also similar: 4 patients in the open group (3 wound infections, 1 musculocutaneous nerve injury) and 2 patients in the arthroscopic group (pain from suture knot).

Most recently, Witney-Lagen et al.[7] performed the largest series in the literature, retrospectively reviewing 50 patients who underwent arthroscopic plication for MDI; the authors had positive results, with 95% of patients experiencing good or excellent postoperative Oxford Instability Scores with an average of improvement from 16.2 preoperatively to 42.5 postoperatively. Moreover, only 2 patients experienced recurrent instability, all patients returned to work, 90% of patients were able to return to the same level of sport, and 47 of 50 patients were satisfied.[7]

The effect of arthroscopic capsular plication has also been investigated biomechanically.[8,9] Shafer et al.[9] performed a study in which cadaver shoulders were stretched to 10% beyond maximum range of motion (ROM), and arthroscopic anterior plication, posterior plication, and rotator interval closure were then performed. Glenohumeral ROM and humeral head translation were assessed following each step. The authors found that anterior capsular plication reduced ROM to the intact state; however, anterior-posterior and superior-inferior humeral head translation significantly decreased only following the rotator interval closure.[9] Moreover, this decrease in translation exceeded that in a normal shoulder, and the authors concluded that to avoid overtightening the shoulder, each patient should be individually evaluated to determine whether rotator interval closure is needed.[9]

Sekiya et al.[8] also performed a biomechanical study in which volume reduction of arthroscopic capsular plication was compared to that of open inferior capsular shift. Cadaver shoulders were dissected down to capsule then treated with arthroscopic anterior, posterior, and inferior capsular plication. Sutures were then cut, and open inferior capsular shift was performed. The authors found that the capsule volume was significantly lower following arthroscopic technique (58% volume reduction) compared with the open technique (45% volume reduction).[8]

Outcomes and biomechanical studies demonstrate that arthroscopic pancapsular plication is a safe, effective, and reliable alternative to open capsular shift for MDI of the shoulder. Long-term studies should be performed to study restoration of shoulder stability and function following arthroscopic pancapsular plication and labral repair.

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