Technical Note

Arthroscopic Labral Repair and Pancapsular Shift With Knotless All-Suture Anchors in the Setting of Multidirectional Instability of the Shoulder

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Abstract: In the management of multidirectional type of shoulder instability (MDI), arthroscopic surgical stabilization is a preferred treatment option after failed conservative therapy regimens because of the ability to easily access all aspects of the capsule with one surgical procedure. As arthroscopic techniques have evolved, factors critical to postoperative success have been elucidated. Currently, optimal arthroscopic treatment of MDI involves circumferentially restoring labral integrity, a tailored, patient-specific surgical reduction of capsular volume, and adequately managing potential lesions of the biceps anchor. The purpose of this article and accompanying video is to present our technique for arthroscopic circumferential labral repair and pancapsular shift using knotless all-suture anchors in the setting of MDI with a concurrent type II SLAP lesion.

Multidirectional instability (MDI) is relatively rare, accounting for approximately 2% to 10% of all cases of shoulder instability.[1] Although definitions have historically varied,[1] MDI according to Neer[2] is defined as symptomatic instability in $\geq$2 directions, one of which is inferior. Although often closely associated, MDI must be differentiated from unidirectional anteroinferior instability with multidirectional hyperlaxity,[3] which has a prevalence of 13% in first-time dislocators.[4] MDI can occur spontaneously and atraumatically or as the result of multiple traumatic events in patients with normal capsular laxity or in the setting of minor traumatic events leading to a decompensation of glenohumeral stability in patients with constitutional or acquired shoulder hyperlaxity.[3,5] Frequently, labral tears are also present.[6,7] A concomitant lesion to the SLAP complex in the setting of MDI adds to the complexity of the injury, as the long head of the biceps (LHBT) can act as a stabilizing structure by contributing to the concavity compression centering the humeral head in the glenoid and resisting torsional forces in abduction and external rotation.[8]

The initial standard of care for symptomatic MDI is nonoperative management, with rehabilitation programs focusing on scapular motion control and centering the humeral head through functional and sports-specific motions.[9] Surgical intervention is reserved for recurrent symptomatic MDI refractory to

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conservative management. The cornerstones of successful surgical management include a circumferential restoration of labral integrity, a tailored reduction of the capsular volume, and repair of the SLAP complex, if a lesion is present.[10]

As arthroscopic techniques have emerged, improvements in the design of fixation devices have followed. To address all pathoanatomic areas appropriately, multiple suture anchors and points of fixation are needed. This can cause problems with weakening of glenoid bone (postage stamp fractures) and suture abrasion on the chondral surfaces, particularly with knotted constructs. Knotless all-suture anchors are small and low profile and were specifically engineered (1) to allow more points of fixation per unit area, (2) to decrease the volumetric amount of bone that is needed to be removed from the glenoid in order to insert the anchors, and (3) to reduce the volume of synthetic suture material that is needed to achieve strong fixation the soft tissues and thus to reduce the potential for suture-mediated abrasion in these multi-anchor repair constructs. In this article, we describe our technique of arthroscopic labral repair and pancapsular shift with knotless all-suture anchors in the setting of MDI with a type II SLAP lesion.

Surgical Technique (With Video Illustration)

The author's preferred technique for arthroscopic circumferential labral repair and pancapsular shift using knotless all-suture anchors in the setting of MDI with a concurrent type II SLAP lesion is presented in the following text as well as in Video 1.

Preoperative Diagnostic Work-Up

The physical examination should include tests for anterior instability (anterior apprehension test, relocation release tests) and posterior instability (Jerk test, Kim test), as well as the load and shift test for increased anterior and posterior humeral translation in the preoperative physical examination. Furthermore, signs of capsular hyperlaxity such as a positive sulcus sign, a positive Gagey-Test, an external rotation $>90°$, and a Beighton score of ≥ 4 points are of relevance, as they influence the amount of intraoperative capsular shift. Furthermore, a positive sulcus sign in 30° of external rotation can suggest rotator interval deficiency and warrant the indication for additional rotator interval closure.

Radiographic assessment consists of standard anteroposterior, axillary, and scapular y-view radiographs, and magnetic resonance imaging to detect signs of bone loss, static humeral head subluxation, chondral lesions, labral lesions or deficiency, and capsular redundancy. If suspicious for significant bone loss, a computed tomography is indicated for exact quantification and risk-analysis of potential off-track Hill–Sachs lesions.

Anesthesia and Patient Positioning

Local anesthesia by an interscalene block as well as general anesthesia are administered. The patient is positioned in the beach-chair position for sterile preparation and draping. A physical examination under anesthesia assessing pathologic humeral translation and subluxation or dislocation as well as capsular laxity is conducted to confirm the diagnosis.

Diagnostic Arthroscopy

We establish a standard posterior viewing portal 2 cm inferior and medial to the posterolateral corner of the acromion, an anterosuperior portal just inferior and distal to the biceps anchor, and an anteroinferior portal in the rotator interval slightly superior to the subscapularis tendon using 5-mm × 7-cm cannulas (Arthrex, Naples, FL). In a standard diagnostic arthroscopy, labral configuration and lesions, capsular volume, and concomitant pathologies are documented, switching the camera between the posterior and anterosuperior portals to adequately assess all compartments (Fig 1).

Anterior Labral Repair

Labral repair and capsular shift are initiated according to the most symptomatic direction of instability. In the setting of clinically dominant anterior instability, the anterior labral tear is mobilized with a 15° or 30° arthroscopic tissue elevator through the anterosuperior portal. A radiofrequency device (CoolCut, Ablator Hook 90°; Arthrex), placed in the

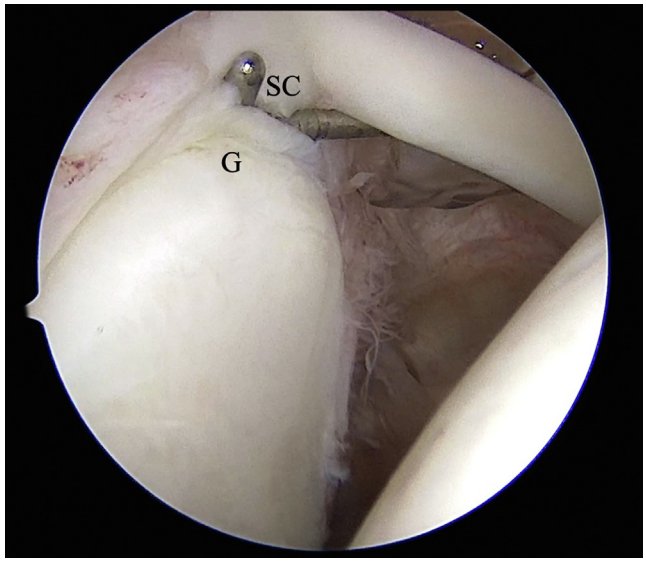

Fig 1. Arthroscopic view of right shoulder from the standard posterior viewing portal showing a SLAP type II lesion and tear of the anterior labrum. The SLAP complex (SC) can be seen shifted off the superior glenoid (G). (HH, humeral head.).

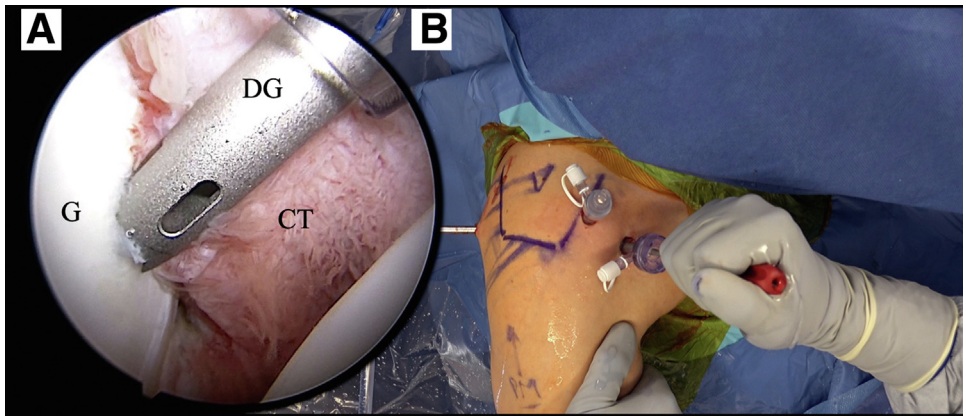

Fig 2. With the patient in the beach-chair position, placement of the first anchor at the 5.30-o'clock position through the anteroinferior working portal is visualized via a standard posterior viewing portal during repair of a right anterior labral tear. A 135° trajectory of the drill guide (DG) relative to the glenoid face (G) is visualized in the arthroscopic (A) and external (B) views, which ensures adequate deployment of the anchor in the subchondral bone. (CT, capsular tissue.).

anteroinferior portal, may be used to aid in releasing adhesions during mobilization, especially in the case of recurrent instability with defect-healing of the anterior labrum in a medialized position. In a consecutive step, the glenoid bone surface is prepared with an arthroscopic shaver to create a bleeding bed in preparation for the Bankart repair.

The next step involves determining the position of anchor placement. A 15° curved guide (Arthrex) is placed through the anteroinferior cannula and directed toward the chondrolabral junction, approximately 1 to 2 mm off the face of the glenoid, at the most inferior repair position (5:30 o'clock). Once the correct position is obtained in a 135° orientation to the glenoid plane (Fig 2), tunnels are drilled via a flexible 1.8-mm drill without violating the chondral surface. Care should be taken not to alter the drill guide position and orientation upon retracting the drill from the joint. Next, via the drill guide, a 1.8-mm knotless FiberTak anchor (Arthrex) is malleted in the bone as far as the drill guide allows. The handle and drill guide are then gently removed leaving the sutures in place and the sutures are pulled to assess anchor stability.

In the next step, the blue repair suture is retrieved through the anterosuperior portal using a tape retriever. Through the anteroinferior portal, a 25° curved tissue penetrator and shuttling device (SutureLasso; Arthrex) is passed around the anteroinferior labrum at the level of the anchor and inserted into the capsular tissue anterior and inferior to the anchor. The amount grasped depends on the preoperative laxity tests and determines the capsular shift during labral fixation. A grasper can be used to elevate the labrum to ensure sufficient capsular shift. The device is rotated to penetrate the capsule and emerge at the chondrolabral junction just inferior to the anchor site. A nitinol wire is fed through and retrieved through the superior portal and is used to shuttle the repair suture through in standard fashion. Once the repair suture has been passed through the capsulolabral complex and retrieved, it is loaded through the loop end of the shuttling suture. The free (tape) end of the shuttling suture is pulled to shuttle the repair suture through the anchor until the desired tension is achieved (Fig 3). Finally, the suture is cut flush with the tissue. The remaining 2-3 anchors for anterior stabilization are placed ascendingly covering the 4:30-, 4:00-, and 3:00-o'clock positions along the glenoid.

Posterior Capsular Shift

Once the anterior labral repair and capsular shift has been completed, attention is moved to the posterior compartment. Viewing from the anterosuperior portal, a posterolateral working portal 2 cm inferior and lateral to the posterior viewing portal is established and equipped with a 5-mm cannula. In the case of a dysplastic or degenerative posterior labrum in the absence of a full-thickness labral tear, a repair is performed without complete detachment of the labrum from the glenoid. Anchors are placed starting at the 6:30-o'clock position (Fig 4), moving superiorly along the glenoid as with the anterior repair to the 7:30- and 9:00-o'clock positions. The repair and shift is performed in a similar manner to the anterior repair, with the result being a superior shift of the capsule according to the preoperative capsular laxity. A larger shift may be necessary in patients depending on the severity of posterior instability and/or glenoid retroversion.

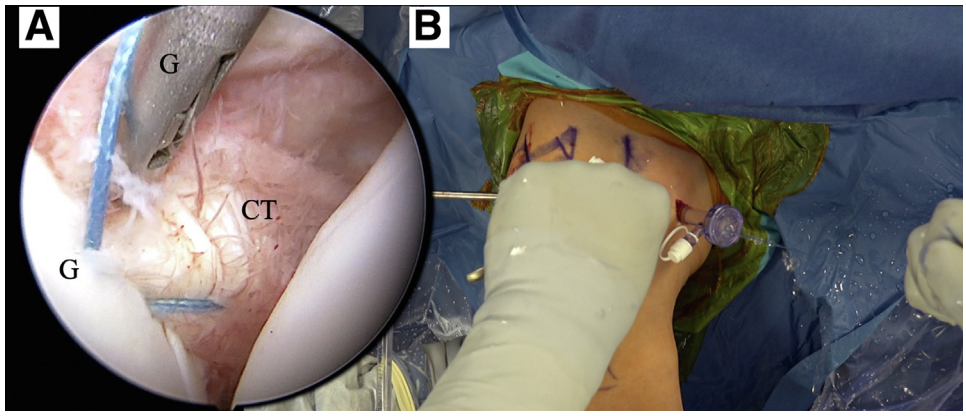

Fig 3. Arthroscopic (A) and external (B) views of a right shoulder via standard posterior viewing portal during repair of a right anterior labral tear to the glenoid (Gl) with the first repair anchor at the 5:30 o'clock position during the tightening of the repair suture. The amount of capsular shift of capsular tissue (CT) in the labral repair construct determines the reduction of capsular volume. Employing a grasper (Gr) ensures anatomic reduction of the labrum–capsule complex to the anterior glenoid.

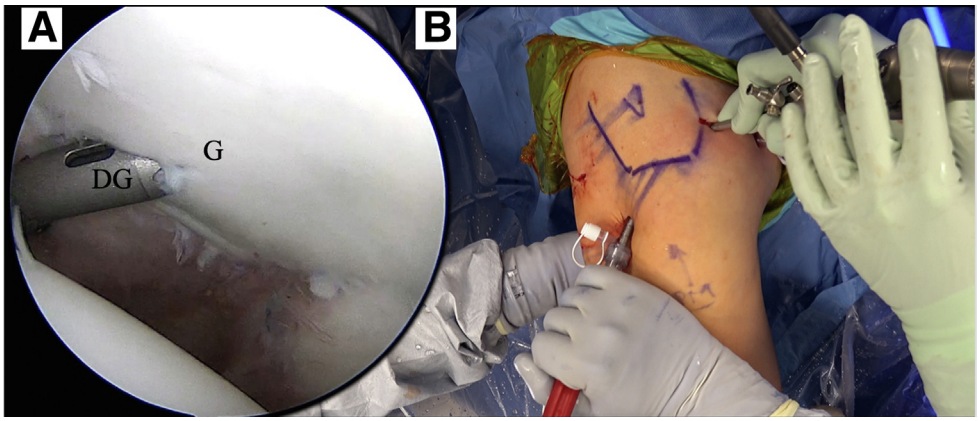

Fig 4. Arthroscopic (A) and external (B) views of a right shoulder via the anterosuperior portal presenting the placement of the first repair anchor for a repair of the right posterior labrum to the glenoid (G) in a 6:30-o'clock position. On both the arthroscopic (A) and external (B) views, the drill guide (DG) trajectory can be visualized.

SLAP Repair

To secure the biceps anchor to the superior glenoid, all-suture anchors are placed at the 11:00 o'clock and 1-o'clock positions via a 15° curved guide. The 1-o'clock anchor is placed through the anteroinferior portal (Fig 5) and the 11:00-o'clock anchor is placed through the posterolateral working portal. The bicipital root is probed to ensure the stability of the final repair construct. The final repair construct can be seen in Figure 6.

Capsular Closure

Once intra-articular work is completed, the cannula from the posteroinferior portal is retracted out of the capsule and the posteroinferior capsular defect created by the portal incision is closed. Viewing from the anterosuperior portal, a QuickPass Lasso is used to shuttle a No. 1 polydioxanone suture through the capsule just lateral to the posterior capsular defect. The polydioxanone suture is retrieved from the anteroinferior portal. A 22° angled suture retriever (BirdBeak; Arthrex) is inserted through the capsule medial to the defect, and the suture is retrieved, tied, and cut.

Postoperative Rehabilitation

Postoperatively, shoulders are immobilized in an abduction sling for 3 weeks. Passive range of motion (ROM) is allowed at 4 weeks, with external rotation limited to 30° and abduction limited to 90°, with full passive ROM allowed at 6 weeks. Active-assisted shoulder ROM is allowed starting at week 6. For the SLAP repair, resisted elbow flexion and resisted forearm supination are limited for 6 weeks. Depending on progress in physical therapy, full return to activity is typically allowed at 4 months postoperatively.

Technique Pearls/Pitfalls and Advantages/Disadvantages

Pearls and pitfalls as well as advantages and disadvantages of the technique are described in Tables 1 and 2.

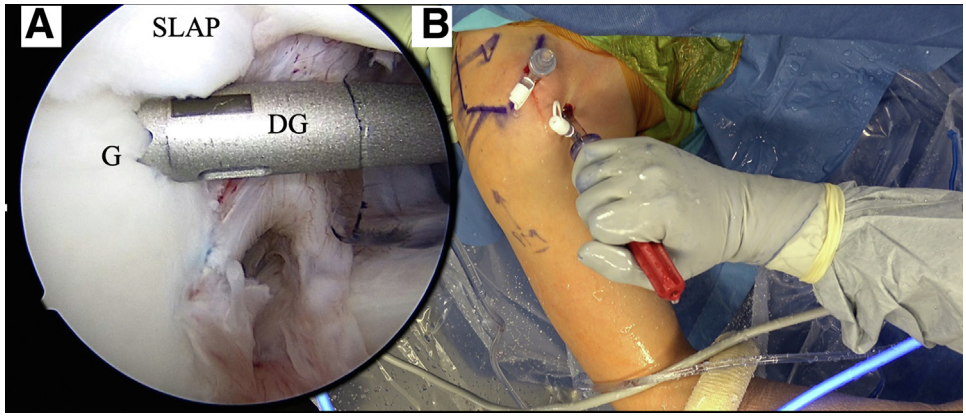

Fig 5. Arthroscopic (A) and external (B) views of a right shoulder via standard posterior viewing portal during repair of a SLAP type II lesion at the 1:00 o'clock position during placement of the first anchor with the drill guide (DG). Glenoid (G).

Discussion

Reports on multiple surgical techniques for the treatment of MDI have demonstrated that comprehensive management of all morphologic changes related to MDI, tailored to the specific etiology,[3,11] is crucial for successful outcomes in this challenging patient collective.[1] Factors critical to postoperative success include meticulous circumferential restoration of labral integrity, which is oftentimes challenging due to the dysplastic labral configuration,[1] and reducing the oftentimes increased capsular volume in patients with MDI.[12] By either employing a capsular shift or capsular plication,[1] a symmetric antero- and posteroinferior capsular volume reduction as opposed to unidirectional capsular shift has been advocated to avoid a unidirectional shift of the humeral head associated with degenerative joint wear.[13] The importance of LHBT preservation is supported by biomechanical studies demonstrating its stabilizing function.[8] A contemporary meta-analysis demonstrated favorable clinical outcomes in LHBT-preserving surgery in the setting of shoulder instability with a concomitant SLAP lesion.[14]

Regarding clinical outcomes, Raynor et al.[6] reported favorable survivorship rates of 87% following arthroscopic pancapsular capsulorrhaphy and labral repair with suture anchors for MDI. In a subgroup analysis,

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Placement of the anterosuperior portal, penetrating the joint capsule just lateral and inferior to the biceps anchor provides sufficient space for the anteroinferior portal	Suboptimal portal placement may result in an inadequate trajectory during drilling and anchor positioning
A slightly lateralized position of the posterior, posterolateral, as well as anteroinferior portal facilitates a favorable trajectory for visualization as well as anchor placement	Anchor malpositioning due to insufficient trajectory may result in chondral damage
Initialization of the repair with the inferior anchors closest to the 6:00-o'clock position secures generous instrument mobility	Increasingly limited capsular width with additional anchors and capsulolabral plications may limit the space required for optimal operation of the instruments
A curved drill guide in conjunction with the use of a flexible drill enables an optimal placement position of the 5:30-o'clock anchor without the need to create an additional transtendinous 5:30-o'clock anterior working portal	If repeated advancement and retraction of the drill are not performed to ensure optimal clearing of the bone debris in the tunnel, anchor deployment may be impaired
A gentle tapping of the drill guide with a mallet to secure the position can improve the ability to sustain the adequate trajectory and position of the drill guide between drilling and insertion of the anchor.	Shifting of the drill guide between drilling and anchor placement may require repeated drilling
A reduction of the capsulolabral tissue to the glenoid with a grasper during tightening of the suture anchor is helpful to achieve optimal reduction of the labrum	An overly aggressive capsular shift may restrict the postoperative range of motion of the patient accustomed to hypermobility
Due to the structural weakness specific to the posterior capsule, a closure of the posterolateral working portal should be considered	Missing a connective tissue disorder in the hypermobile patient with multidirectional instability may result in the inability to offer comprehensive perioperative care and postoperative rehabilitation to the patient

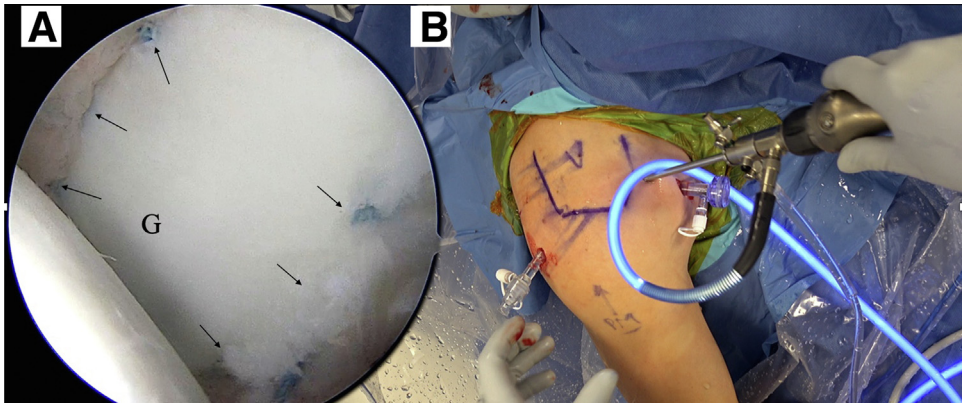

Fig 6. Arthroscopic (A) and external (B) views view of right shoulder via an anterosuperior viewing portal showing the completed panlabral repair using 9 knotless, all-suture anchors (arrows) (6 visible). Due to the capsular shift resulting in a reduced capsular volume, this is the broadest overview to be obtained at this point. (G, glenoid.).

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
The use of all-suture anchors enables optimal preservation of glenoid bone stock in the multianchor repair constructs	The technique described requires a certain amount of experience in the process of capsular plication to achieve optimal postoperative range of motion
The use of all-suture anchors facilitates the use of curved drill guides to ensure optimal anchor positioning, particularly of the inferior anchors	The technique described is unable to address glenoid bone loss and thus only recommended in patients with subcritical glenoid bone loss
The use of knotless anchors minimizes the risk for knot-induced abrasion of the articular cartilage in those multianchor constructs	
The technique combines labral repair with capsular plication, addressing both components of multidirectional instability	
The technique described allows for a targeted reduction of the capsular volume tailored to the patient's specific pathoanatomy	

they observed that among all subjects, male patients with a traumatic onset of MDI had the most favorable outcomes. The favorable outcomes using this technique could be confirmed at long-term follow-up.[11] Similar results were reported after 270° arthroscopic stabilization with labral repair in a subset of patients with multidirectional shoulder instability and full-thickness labral tears, with a survivorship rate of 85% at a minimum of 2 years.[15] Especially in the patient population affected by a traumatic etiology of MDI, favorable outcomes after arthroscopic 270° labral repair seem to be sustained long-term, with a failure rate of 14.2% at 10 years.[16] Although favorable outcomes have been reported after capsulolabral repair in patients with MDI and acquired hyperlaxity,[17,18] the durability of this procedure in patients with connective tissue disorders has been questioned due to poor tissue quality and stretching of the capsule over time.[19]

Given the requirement for multianchor repair constructs in the treatment of the MDI population, single loaded knotless all-suture anchors offer the advantage of reduced synthetic material and decreased suture-mediated abrasion, theoretically minimizing the risk for progressive suture anchor arthropathy in this mostly young patient population.[20] While these anchors represent a relatively new innovation, recent case series show promising clinical results at early follow-up time points.[21-23]

Clinical outcome data demonstrate that favorable clinical results can be achieved in the arthroscopic management of MDI with appropriate patient selection. Future outcome studies aimed at investigating the postoperative long-term outcome as well as survivorship after panlabral labral repair and pancapsular shift should be performed to evaluate the effect of knotless all-suture anchors.

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