Arthroscopic Load-Shift Technique for Intraoperative Assessment of Shoulder Translation

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Abstract: Shoulder instability represents a spectrum of disease, ranging from subluxation to dislocation. It may present acutely after trauma or chronically as a result of multiple events. Physical examination is a key component in evaluating the degree of instability and laxity present; however, in-office guarding or apprehension may limit the examination. In addition, patient anatomy or operator technique may limit the accuracy and reproducibility of examination maneuvers such as the load-shift test. We propose an arthroscopic modification to the load-shift technique involving direct visualization to assess the direction and degree of shoulder instability. Our technique allows for the examination of a fully relaxed, anesthetized patient, eliminating guarding, and allows for intraoperative documentation of the patient’s laxity both before and after surgical stabilization. In addition, this allows for custom titration of adjunctive capsulorrhaphy in arthroscopic stabilization cases.

The spectrum of shoulder instability includes subluxation, in which the humeral head translates beyond its physiological limits while maintaining partial contact with the glenoid, and dislocation, in which the humeral head translates to a point at which it no longer engages the glenoid. Although dislocation is the more severe form of instability, subluxation events have been shown to account for up to 85% of instability cases. Because of this, not every patient with an underlying diagnosis of shoulder instability will present after a traumatic event or gross dislocation. Shoulder instability can be a subtle diagnosis to make without the appropriate clinical suspicion and proper physical examination techniques. The load-shift test is one of the hallmark physical examination maneuvers for assessing laxity and instability of the shoulder. It is typically performed with the arm slightly abducted while the examiner supports the patient’s arm with one hand to aid in relaxation. The examiner will place his or her other hand around the proximal humerus on an area below the humeral head with his or her fingers anteriorly and thumb posteriorly on the humerus. The humeral head is loaded anteriorly, posteriorly, and inferiorly, assessing its translation relative to the glenoid. A grade 0 load-shift finding is defined as normal translation. Grade 1 is excessive translation with no subluxation, whereas grade 2 is subluxation to, but not over, the glenoid rim. Finally, grade 3 represents dislocation of the humeral head beyond the glenoid rim. Kolber and Carrao validated this maneuver and found that it has an inter-rater reliability of 0.80. In addition, Tzannes et al. found that the test had the highest intraclass coefficient when performed at 90° of abduction for anterior stability and at neutral abduction for posterior and inferior instability.

Although this test is widely accepted and performed when assessing for shoulder instability, it can have several pitfalls when implemented in the office setting. Patients with an acute injury may present with swelling and guarding that limit the examination. In addition, patients with large arms or obese patients may be difficult to adequately evaluate. For these reasons, we recommend that this examination technique also be performed in the operating room, in all patients, not only preoperatively once they are under anesthesia but also arthroscopically as part of the diagnostic arthroscopy. This allows for determination of the degree of instability under direct visualization and allows the surgeon to record the instability both before and after surgical stabilization.
fixation. We present our method for the evaluation of shoulder instability by the arthroscopic load-shift test (Video 1).

**Surgical Technique**

**Positioning**

The patient is positioned in the beach-chair position for ease of intraoperative evaluation. The operative arm is placed in a Spider limb positioner (TENET Medical Engineering) (Fig 1). Landmarks of the shoulder are palpated and marked. A standard 4-mm arthroscopy camera is used. For our preferred method of instability repair, a standard posterior viewing portal is made, as well as 2 anterior portals. An inside-out technique is used to create a low anteroinferior portal within the deltopectoral interval, entering the joint directly above the subscapularis tendon. An anterosuperior portal is made below the anterolateral border of the acromion, entering the joint immediately lateral to the biceps tendon within the rotator interval. An accessory 5-o’clock portal may be created later in the case if a posterior labral repair is indicated (Fig 2).

**Diagnostic Arthroscopy**

Standard diagnostic arthroscopy is performed with the camera in the posterior portal. The anteroinferior and anterosuperior portals are created under direct visualization, and cannulas are placed.

**Intraoperative Load-Shift Test**

To perform the load-shift examination, the camera is first placed in the anterosuperior portal. The pneumatic arm holder is adjusted to place the shoulder in varying degrees of abduction ranging from neutral to 90° (we prefer around 45°). The assistant or scrub technician should hold the camera, allowing the surgeon to perform the arthroscopic load-shift test with both hands. The load-shift test is performed under direct visualization. The surgeon should position his or her body slightly behind the patient’s abducted arm to aid in leverage. The surgeon’s hand opposite the operative limb (i.e., right hand for left shoulder or left hand for right shoulder) should grab around the proximal...
humerus on an area below the humeral head with his or her fingers anteriorly and thumb posteriorly on the humerus. The other arm can gently be placed around the forearm for added support. The humeral head is then translated anteriorly, posteriorly, and inferiorly, assessing its relation relative to the glenoid. Images and video should be taken to document the maximal amount of translation as well as any other underlying pathology (Figs 3-5). This allows for confirmation of the direction and degree of shoulder instability. After the evaluation and confirmation of instability, the appropriate stabilization procedure is performed. Once stabilization is completed, the camera is again placed in the anterosuperior portal. An additional load-shift test is performed and documented as described earlier (Fig 6).

**Discussion**

Although this technique may seem like a simple and obvious technique, we believe that intraoperative documentation of the direction, degree, and subsequent improvement of a patient’s laxity is crucial. There are several keys to this technique (Table 1). By performing the load-shift examination under direct visualization while the patient is anesthetized, the examiner can most accurately determine the amount of laxity present to ensure that it is completely addressed at the time of

**Fig 3.** View of left shoulder from anterosuperior portal. The arthroscopic load-shift test is performed with the humeral head translated in the anterior direction. The humeral head translates to the glenoid rim (arrow). (A, anterior; P, posterior.)

**Fig 4.** View of left shoulder from anterosuperior portal. The arthroscopic load-shift test is performed with the humeral head translated in the posterior direction. The humeral head translates to the glenoid rim (arrow). (A, anterior; P, posterior.)

**Fig 5.** View of left shoulder from anterosuperior portal. Further abducting the arm and performing the load-shift test can determine whether the patient’s Hill-Sachs lesion (HS) engages. (A, anterior; HH, humeral head; P, posterior.)

**Fig 6.** View of left shoulder from anterosuperior portal. The humeral head (HH) is well centered after the stabilization procedure. (A, anterior; G, glenoid; P, posterior.)
Table 1. Pearls and Pitfalls

| Pearls                                                                 | Pitfalls                                         |
|-----------------------------------------------------------------------|--------------------------------------------------|
| Using an arm holder will increase the ease of positioning the arm in various amounts of abduction to adequately assess stability in all planes of motion. | Lateral decubitus positioning will make the described maneuver difficult unless tension is removed from the arm positioner. |
| Testing the arm at extremes of motion can assess for engagement of any existing Hill-Sachs lesion in real time. | Incorrect portal placement may limit the ability to completely visualize the glenoid rim. |
| Beach-chair positioning increases the ease of performing the load-shift examination. | Outflow can potentially be impaired when viewing from the anterosuperior portal. |

Disadvantages. Although this is useful, recurrence of repairs postoperatively. The most widely accepted dif... of an anterior cruciate ligament reconstruction post-reinjury. In addition, unlike determining the stability especially in highly active patients who are at risk of reinjury. In addition, unlike determining the stability of an anterior cruciate ligament reconstruction postoperatively with serial Lachman examinations, it is difficult to monitor the ‘‘stability’’ of shoulder instability repairs postoperatively. The most widely accepted metric used in the literature is recurrent subluxation or dislocation. Although this is useful, recurrence of instability would represent a catastrophic failure of the repair. The load-shift test allows the examiner to serially determine the degree of shoulder laxity after repair, making its intraoperative documentation imperative. This test is extremely useful in cases of bidirectional instability because it allows the surgeon to titrate the repair based on the patient’s amount of humeral head translation in the anterior and posterior direction (Table 2). Although there are few studies evaluating the difference between the load-shift test preoperatively and postoperatively, glenohumeral contact pressures have been measured in cadaveric specimens. Yamamoto et al. showed that patients with Bankart lesions, as well as those with glenoid bone loss ranging from 10% to 30%, had increased mean contact pressures compared with physiologically normal shoulders. These pressures returned to baseline after instability repair in all groups, except the 30% bone loss group. Yamamoto et al. commented that although contact pressure is restored, further investigation is warranted regarding overall glenohumeral instability and resistance to dislocation. We believe that assessing the quality of the instability repair by the arthroscopic load-shift test is a good way to evaluate the stability of the glenohumeral joint at the time of intervention to establish a baseline for the future care of the patient postoperatively.

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