

The Arthroscopic “Bellows” Sign Identifies Hidden Rotator Cuff Tears



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Abstract: The intraoperative recognition of rotator cuff tears continues to be a challenge in some cases, despite clinical suspicion, a physical examination suggesting a rotator cuff tear, and detection on preoperative imaging studies. Intraoperative identification can be elusive in partial tears including intratendinous tears and obscured full-thickness tears. The purpose of this Technical Note, and the associated technique video, is to discuss a visual sign for the detection of various rotator cuff tear pathologies. Derived from the dynamic fluid expansion and contraction of the affected tissues, this indicator is termed the arthroscopic “bellows” sign.

The intraoperative recognition of rotator cuff tears continues to be a challenge in some cases despite clinical suspicion, a physical examination suggesting a rotator cuff tear, and detection on preoperative imaging studies. Intraoperative identification can be elusive in partial tears, including intratendinous tears and obscured full-thickness tears. There are several previously published techniques describing the identification of occult rotator cuff tears.¹⁻³ The purpose of this Technical Note, and the associated technique video (Video 1), is to discuss a visual sign for the detection of occult rotator cuff tears, herein called the arthroscopic “bellows” sign.

Surgical Technique (With Video Illustration)

The patient is placed in the beach-chair position. Anesthesia is induced, and the arm is prepped in the usual orthopaedic sterile fashion. Standard posterior and anterior portals into the glenohumeral joint are

established. A diagnostic arthroscopy is performed with a 30° arthroscope (Smith & Nephew, Memphis, TN) from the posterior portal. While visualizing the articular side of the rotator cuff, the influx and efflux of fluid from the rotator cuff, generated via limited motion of the glenohumeral joint, can be visualized by a slight “bellowing” of tissue in and out (Fig 1). The movement to generate the “bellowing” tissue is subtle; just enough to create a pressure gradient within the tendon. Extension of the shoulder to approximately 10° can produce the “bellowing” in the supraspinatus and infraspinatus tendons, whereas slight internal and external rotation can reveal the “bellowing” in the subscapularis. This provides an indication to the surgeon that there is underlying damage of the tissue in this region. The superior capsule in this region can be gently interrogated with an arthroscopic probe or shaver (DYONICS POWERMAX; Smith & Nephew). Care should be taken to debride this region carefully, to prevent iatrogenic injury to the rotator cuff (Fig 2). Subsequently, the damaged portion of the rotator cuff can be tagged with a spinal needle and marking suture (Fig 3).

After moving the arthroscope to the bursal space through the posterior portal, the previously placed marking suture is used to localize any corresponding region of damaged tissue identified on the articular side (Fig 4). Care should also be taken on the bursal side to identify any rotator cuff pathology not associated with the articular sided pathology. The “bellows” sign also can be observed in tears within the rotator cuff tendons. While occult rotator cuff tears are frequently intratendinous or partial thickness, this technique can similarly be used to detect full-thickness rotator cuff tears. Repair or debridement can be undertaken as indicated.

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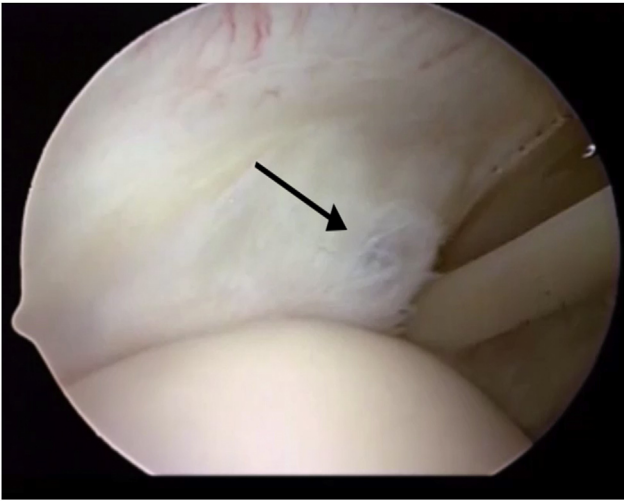


Fig 1. Arthroscopic image of a left shoulder glenohumeral joint viewed from the posterior portal in the beach-chair position showing the influx and efflux of arthroscopic fluid from the rotator cuff tissue (marked by arrow) demonstrating the arthroscopic “bellows” sign.

[Video 1](#) provides several specific examples of the arthroscopic “bellows” sign. The initial examples are of partial-thickness tears of the supraspinatus tendon, which are visualized only on the articular surface. They are debrided and further evaluated with arthroscopic instruments. In these cases, the bursal surface does not show any signs of pathology and only the marking suture clearly correlates the articular sided pathology to the corresponding bursal tissue of interest. The next example in the video is a larger articular-sided tear, which is clearly visible on the bursal surface as well.

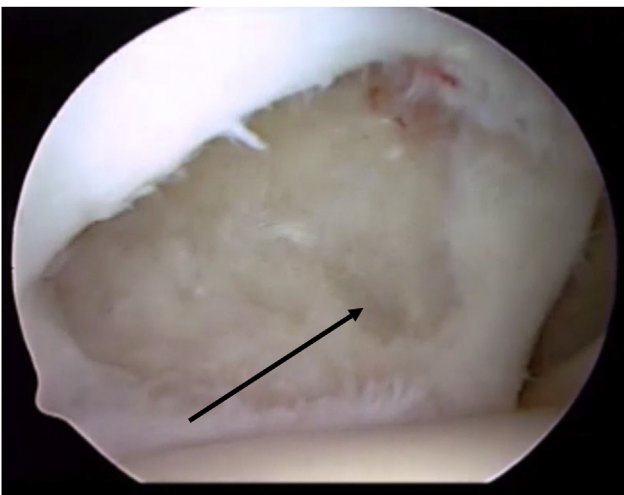


Fig 2. Arthroscopic image of a left shoulder glenohumeral joint viewed from the posterior portal in the beach-chair position demonstrating a defect (indicated by arrow) in the rotator cuff tissue after debridement of the superior capsule in the location identified by the arthroscopic “bellows” sign.

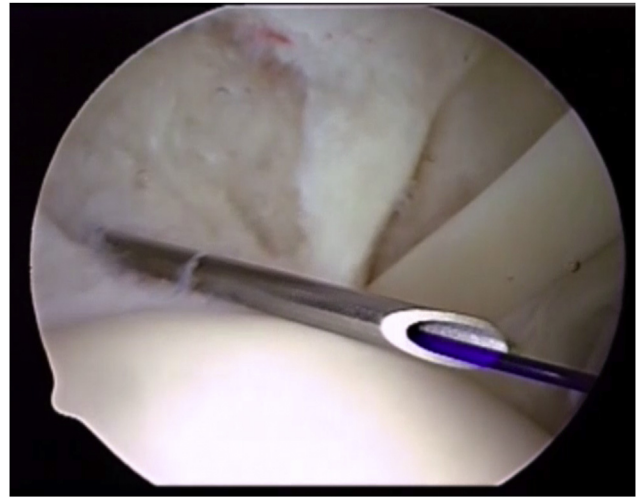


Fig 3. Arthroscopic image of a left shoulder glenohumeral joint viewed from the posterior portal in the beach-chair position demonstrating a marking suture placed through a spinal needle identifying the defect in the rotator cuff tissue after debridement of the superior capsule in the location previously identified by the arthroscopic “bellows” sign.

Finally, 2 examples of subscapularis tendon tears are shown, both of which require debridement and the last requiring fixation with a suture anchor (HEALICOIL; Smith & Nephew) (anchor placement not shown). [Table 1](#) details the advantages and disadvantages of the disclosed technique.

Discussion

This technique is highly useful in that it adds a simple and safe tool for identification of elusive rotator cuff

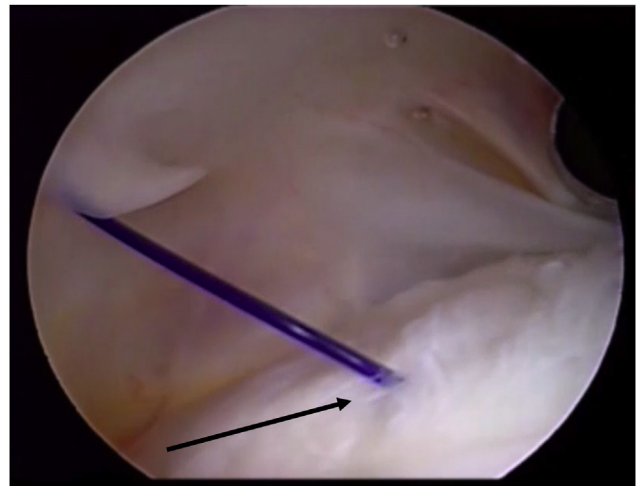


Fig 4. Arthroscopic image of a left shoulder bursal space viewed from the posterior portal in the beach chair position demonstrating a marking suture previously placed in [Figure 3](#) in the glenohumeral joint view, without apparent disruption of the bursal side of the rotator cuff tissue (indicated with arrow).

Table 1. Advantages and Disadvantages for the Discovery of Occult Rotator Cuff Tendon Tears Using the Arthroscopic “Bellows” Sign

Advantages	Disadvantages
Quick to perform	Overly aggressive debridement can cause iatrogenic injury to the tissue
Minimally invasive	It is a subtle sign – consistent recognition can be difficult
Standard arthroscopic setup and portals	Sensitivity / specificity unpredictable, due to variations in tear morphology
No special equipment required	
Low-risk technique to improve visualization of occult pathology	

tear pathology. It can quickly be performed during standard diagnostic arthroscopy without complicated maneuvers and without specialized instrumentation. In addition, it is not technically complex to perform beyond the skills of standard arthroscopic surgery. However, the “bellows” sign can be quite subtle and is likely present more frequently than inadvertently noticed. Thus, the most challenging part of this technique is consistent recognition of this very subtle sign (Table 1).⁴ It is our hope that the description in this manuscript, as well as the examples provided in the associated video, will expand the use of this detection method for occult rotator cuff tears. A limitation of this sign is that we do not know the sensitivity or specificity of the test (Table 2), due to its dependence upon the unique anatomy of each individual tear.

Additional signs for the detection of occult rotator cuff tears have been reported. There are several previously published techniques describing the identification of occult rotator cuff tears.¹⁻⁴ The bubble sign is a method to evaluate the integrity of the rotator cuff during diagnostic shoulder arthroscopy, by injecting saline into a suspected lesion and observing an expansion of the rotator cuff.^{1,5} This should not be confused with another bubble sign, which describes that visible bubbles during the introduction of arthroscopic equipment into the glenohumeral joint defines an intact rotator cuff.² Other arthroscopic indicators of rotator cuff tissue damage are tissue fibrillation and congestion.³ The arthroscopic “bellows” sign does not specifically change the management of rotator cuff tears but rather fully elucidates rotator cuff pathology enabling the correct treatment to be chosen. The literature has demonstrated that after diagnosis, partial tears have been successfully treated with either debridement or repair, with or without acromioplasty.⁶ Debridement can be successfully chosen for tears less than 50% of their

Table 2. Pearls and Pitfalls of Using the Arthroscopic “Bellows” Sign in the Discovery of Occult Rotator Cuff Tears

Pearls	Pitfalls
Can localize tears with spinal needle and polydioxanone suture (PDS)	Overly aggressive with debridement can cause iatrogenic rotator cuff injury
Gentle debridement can help reveal tears	The “bellows” sign may be visually subtle
Can be used with supraspinatus, infraspinatus, or subscapularis tears	
There can be separate articular and bursal sided tears	

thickness and repairs for tears more than 50%. If debridement is chosen over repair, there may be an increased risk of tear progression.⁷ Table 2 further lists pearls and pitfalls associated with the “bellows” sign maneuver.

In conclusion, effective management of rotator cuff pathology critically relies on initial identification of all cuff tears. Therefore, nonobvious, partial and/or obscured full tears present relatively common and challenging scenarios for optimal case management. The “bellows” sign technique offers a simple, quick, and safe method for potentially revealing otherwise-hidden cuff pathology.

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