Technical Note

Ultrasound-Guided Deflation and Arthroscopic Removal of a Migrated Subacromial Balloon Spacer

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Abstract: Full-thickness massive irreparable rotator cuff tears present a demanding challenge for the surgeon. The subacromial balloon spacer is a novel biodegradable implant used to treat massive, irreparable rotator cuff tears. There have, however, been several isolated reports of balloon migration. This Technical Note describes ultrasound-assisted balloon deflation followed by arthroscopic removal of a symptomatic dislodged balloon.

A biodegradable subacromial balloon (InSpace; Orthospace Ltd, Caeseria, Israel) was first introduced in 2012[1] to potentially reduce subacromial friction and lower the humeral head in cases of irreparable rotator cuff tears. The implant is made of a copolymer poly-L-Lactide-co-ε-capro-lactone that is reported to degrade over 12 months.[2]

Several studies have shown clinical improvement with balloon spacer implantation,[2-7] but there have been several reports of balloon migration[2,7-10] Balloon migration can lead to anterior shoulder pain, cosmetic deformity, and compromised soft-tissue healing. To date, there have been no specific reports published regarding treatment of migrated subacromial balloon spacers. We detail a technique for ultrasound-guided aspiration and arthroscopic removal of an anteriorly displaced balloon.

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Patient Evaluation

A patient with subacromial balloon migration may notice a gradual or sudden increase in anterior or lateral shoulder pain. A thorough history and physical examination should be performed to rule out infection. A dislodged balloon may present as a visible or palpable mass over the lateral or anterior aspect of the shoulder (Fig 1).

Imaging

If there is a history of post-operative trauma, appropriate shoulder radiographs may be obtained to confirm bony integrity. Once it is suspected that a balloon has dislodged or migrated, ultrasonography may be used to confirm the diagnosis and to rule out post operative hematoma or loose hardware. Ultrasonography provides high spatial resolution capabilities, is relatively inexpensive, and allows comparison to the contralateral shoulder. Real-time imaging allows manual compression and comprehensive viewing of the operative shoulder. If ultrasound evaluation is inconclusive, magnetic resonance imaging should be considered.

Indications

Once the diagnosis of a migrated balloon has been confirmed, further intervention should be discussed with the patient. Because the balloon is biodegradable, there may be a role for observation and conservative management. If the displaced balloon remains symptomatic, the patient is offered ultrasound guided deflation to decompress the space-occupying mass. This can be performed in the clinic or in the pre-operative holding area. If symptoms persist after decompression of the balloon, the surgeon may then offer arthroscopic balloon removal.

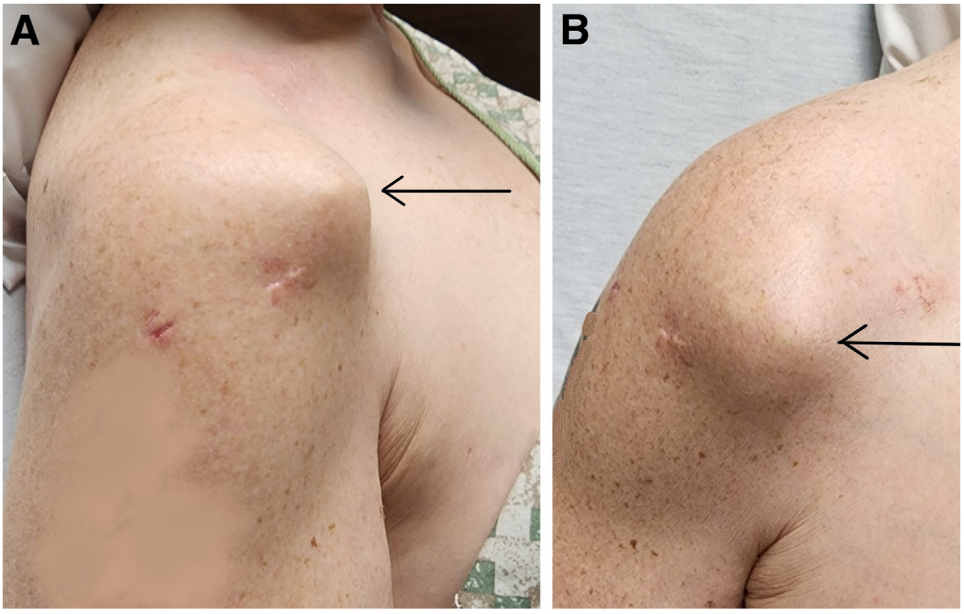

Fig 1. External view of a right shoulder 5 days after arthroscopic partial cuff repair and subacromial balloon insertion. These photos show the location of a painful anterior prominent bulge (black arrow) seen on the (A) lateral view and (B) frontal view.

Surgical Technique (With Video Illustration)

Ultrasound-Guided Balloon Aspiration

The patient is assessed in the clinic with a full history and physical examination. In most cases, the migrated balloon will be palpable under the skin. If there is a history of postoperative trauma, appropriate imaging of the shoulder should be obtained to include a transscapular Y view, anteroposterior glenoid (Grashey) view, and axillary views.

Ultrasound assessment may be performed in the clinic or ultrasound suite. Familiarity with a high-frequency ultrasound is a necessity for this procedure. The patient is positioned in a lateral, supine, or semi-reclined position. The location of the mass is confirmed by digital palpation when possible. In the pictured case, a Sonosite X Porte high-definition ultrasound (Fujifilm Sonosite, Bothell, WA) is used with a HFL50XP 15-6 MHz 6 cm transducer with in-plane needle guidance capability. Imaging is initially performed with a high-frequency linear-array transducer to enable visualization of the entire shoulder girdle. If the balloon is deeper than expected, or in a patient with a high body mass index, a lower frequency or curved-array transducer may be used to assess the deeper structures.

The suspected region of the migrated balloon should be imaged with an adequate amount of gel to minimize transducer pressure. The shoulder should be examined in at least two planes to allow appropriate visualization. The examiner is looking for a well-defined anechoic or hypoechoic mass that matches the volume and shape of the inflated balloon (Fig 2). A postoperative fluid collection or hematoma with not have the well-defined walls of a balloon. A nonmigrated balloon may be difficult to fully image due to the overlying acromion. A dislodged balloon will usually be found in the anterior subdeltoid space or subcoracoid bursa.

To deflate the balloon, the shoulder is prepped and local anesthetic is injected over the proposed aspiration site. The transducer is oriented longitudinally anterior to the acromion and an 18-gauge needle is placed in-phase with the transducer (Fig 3A). A palpable pop is often noted as the needle pierces the balloon, and imaging should confirm the needle tip within the balloon. Saline is then aspirated from the balloon (Fig 3B), and imaging should confirm adequate deflation of the

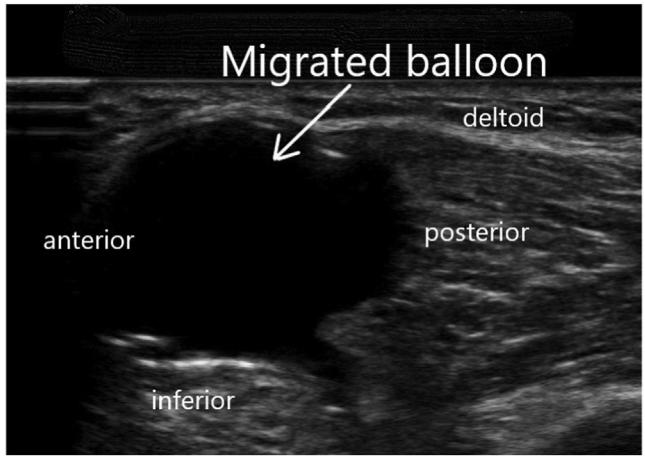

Fig 2. Ultrasound image of the right shoulder of the same patient. The transducer is oriented in the sagittal plane with anterior to the left and posterior to the right. Ultrasonic imaging of the symptomatic bulge reveals an anechoic mass in the subdeltoid space consistent with a fully inflated displaced balloon (arrow).

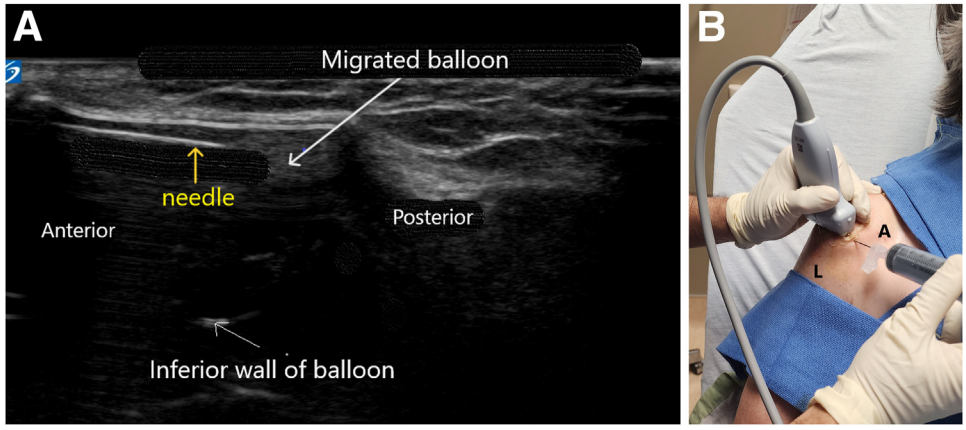

Fig 3. (A) Ultrasound image of the right shoulder. The transducer is oriented in the sagittal plane and an 18-g needle has been placed in plane from anterior under the transducer and is visualized (needle) in the center of the balloon. The inferior wall of the balloon is seen as labeled. (B) External view of the patient's right shoulder while in the semi-upright position with the transducer aligned in the sagittal plane. "A" is anterior and "L" represents the lateral aspect of the shoulder. A total of 17 cc of saline is aspirated from the balloon.

balloon. If the patient continues to have significant pain over the retained deflated balloon (Fig 4) arthroscopic balloon removal is offered to the patient.

Arthroscopic Balloon Removal

The patient is identified in the preoperative holding area and surgical consent is verified. The appropriate limb is marked for the procedure. The patient may undergo a preoperative nerve block by the anesthesia team to minimize postoperative pain. The patient is taken to the operating room and placed in a lateral or beach-chair position based upon the surgeon's preference (Fig 5A). Appropriate intravenous antibiotics are administered. Standard skin preparation and draping is performed, and an operative timeout is confirmed. The portals from the previous surgery are used for this procedure. The posterior viewing portal is initially used to assess the glenohumeral joint and subacromial space. If the balloon has migrated to the anterior subdeltoid bursa, it is best visualized from a posterolateral portal (Video 1, Fig 5B). The anterolateral portal can be minimally enlarged to allow the deflated balloon to be easily extracted with an arthroscopic grasper (Fig 6). The balloon should be noted to

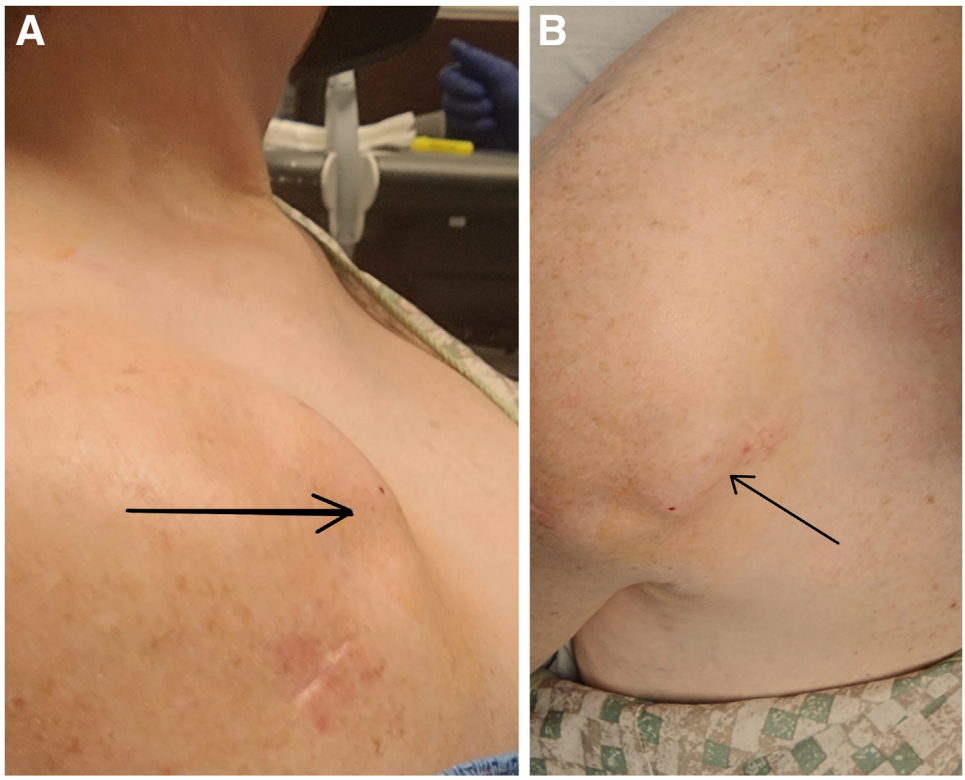

Fig 4. External view of right shoulder. After balloon deflation, the patient continues to complain of significant anterior shoulder pain. The deflated balloon remains palpable and is visible anteriorly as seen on the (A) lateral and (B) frontal views.

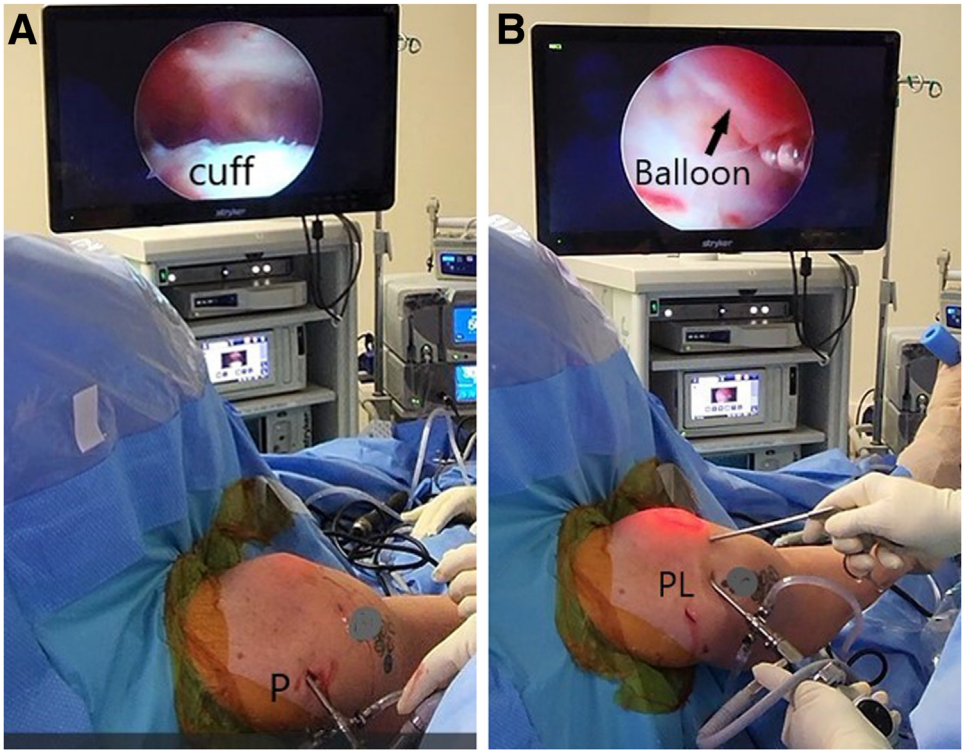

Fig 5. External view of the right shoulder with the patient placed in a beach chair position in the operating room. (A) The previous posterior portal (P) is initially used to visualize the prior cuff repair site which was intact (cuff). (B) The arthroscope is then placed in the posterolateral portal (PL), which allows visualization of the anteriorly displaced balloon (balloon).

be intact after removal (Fig 7). A thorough arthroscopic evaluation is completed to ensure there is no further pathology. The portals are closed in the standard fashion and the patient is placed in a sling for comfort. Sutures are removed in 10 to 14 days and the patient is returned to the original post-operative protocol if indicated.

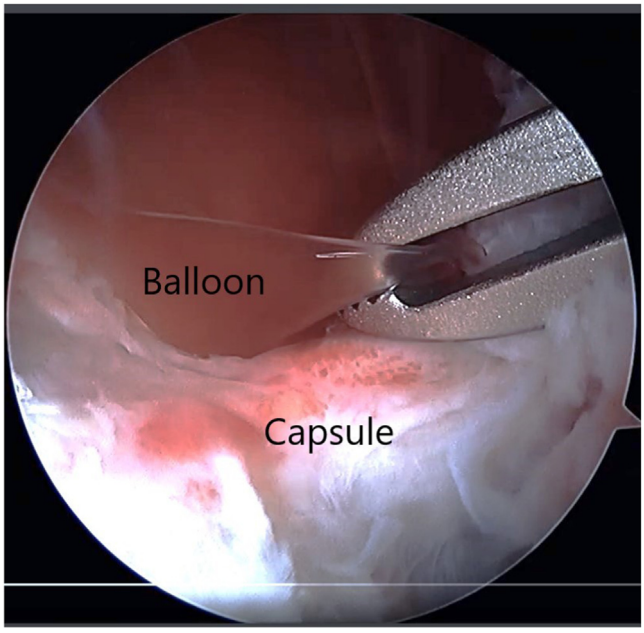

Fig 6. Arthroscopic view of the right shoulder from the posterolateral portal revealing the anteriorly displaced balloon superior to the capsule. The locking grasper is brought in from an anterolateral portal to secure and remove the balloon.

Discussion

Biodegradable subacromial balloon spacer insertion for massive irreparable rotator cuff tears was first described by Savarese and Romeo in 2012.[1] Several preliminary studies[2-4,6] have demonstrated pain reduction and functional improvement after balloon implantation, whereas other studies show less favorable results.[9,11] Some authors have described augmented fixation of partial cuff repairs with subacromial balloons[12] as opposed to spacer insertion with debridement alone.[11]

Although most studies show a relatively low complication rate,[4,12] a review of 19 studies by Johns et al.[3] noted 11 of 350 patients required reoperation after balloon implantation including 5 (1.42%) for balloon migration. In separate review, Stewart et al.[2] noted complications in 2.1% of patients, including 3 patients with balloon migration. Included in that review was work reported by Deranlot et al.,[7] which described removal of a dislodged balloon and replacement with a second subacromial balloon. A recent case report by Calvo et al.[13] describes a foreign body reaction secondary to a subacromial balloon implantation, which required arthroscopic debridement.

Fig 7. Outside view of the right shoulder with the intact deflated balloon outside the anterolateral portal after removal with the arthroscopic grasper.

In a technical note, Szöllösy et al.[10] note one case of balloon spacer dislocation. The authors recommend retaining the balloon if there is no pain or functional impairment as the balloon would deflate in 3 months. They recommend piercing and deflating the balloon if painful but state that removal is not necessary as the spacer should disintegrate within 1 year. There is no specific detail of technique of piercing the balloon, but ultrasound guidance allows improved accuracy of diagnosis and needle placement. Garríguez-Pérez et al.[9] describe one case of lateral balloon migration that required open removal of the implant.

As the popularity of subacromial balloon spacer implantation increases,[14] there may be more complications noted, such as migration of the balloon. The advantages of our technique of ultrasound-guided balloon deflation include immediate confirmation of balloon location and improved accuracy of needle placement (Table 1). Complete deflation can be determined by the ultrasound images and by the amount aspirated compared with the initial inflation volume. The majority of reported cases show anterior subdeltoid migration, but other authors note subcoracoid migration,[10] in which case ultrasound guidance may be crucial for needle accuracy.

If pain resolves after balloon deflation there may be a role for observation to allow balloon disintegration as suggested by some authors.[10] In most cases, however, balloon removal is indicated to prevent continued irritation or further migration. Our described technique of arthroscopic removal requires no special instrumentation or training (Table 2). This allows a straightforward

Table 1. Advantages and Disadvantages of Ultrasound-Guided Deflation and Arthroscopic Removal of a Migrated Subacromial Balloon Spacer

Advantages	Disadvantages
US allows immediate imaging with no radiation exposure	Requires high-frequency US
US verifies balloon location and delineates surrounding structures	MRI may provide better imaging
Confirms accuracy of needle location and balloon decompression	Requires technical proficiency
Decompression of balloon may relieve pain	Retained device may remain symptomatic
Arthroscopic removal is simple, effective	Requires return to operating room
Decompression of balloon may relieve pain	
Arthroscopic removal is simple, effective	
No special equipment needed	

MRI, magnetic resonance imaging; US, ultrasound.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
Be familiar with sonographic anatomy	Requires US ownership and technical expertise
Use high-frequency US transducer with in-plane needle localization capability	Subdeltoid fluid collection or anisotropy artifact may be mistaken for balloon
Displaced balloon has distinct hypoechoic fluid center with defined echogenic walls	Consider MRI if US inconclusive
Optimize image depth and focal zone prior to needle insertion	Improper needle control can result in iatrogenic injury
Use 18-g needle for fluid aspiration	Avoid disruption of prior cuff repair
Low threshold for arthroscopic balloon removal	Risk of portal irritation or infection
Use appropriate portal for visualization and balloon removal	

MRI, magnetic resonance imaging; US, ultrasound.

and minimally invasive method to remove a displaced and symptomatic subacromial balloon.

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