Subacromial Balloon Spacers for Massive Irreparable Rotator Cuff Tears

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ABSTRACT

Massive irreparable rotator cuff tears are difficult to treat. Several different treatment options have been explored in the orthopedic realm. A 69-year-old male with a massive irreparable rotator cuff tear was originally treated with a subacromial balloon spacer around five years prior to presentation. The patient started having increasing shoulder discomfort. Treatment options were discussed following review of MRI results and the patient decided to move forward with a second balloon spacer. The patient underwent his revision procedure and noted significant improvement in his pain and function on follow-up. Revision subacromial balloon spacers constitute an effective surgical treatment option that may slow the progression of rotator cuff arthropathy and relieve pain and dysfunction in the setting of massive irreparable rotator cuff tears.

KEYWORDS: rotator cuff; balloon; interpositional balloon; balloon arthroplasty

INTRODUCTION

Massive irreparable rotator cuff tears pose a challenge to shoulder surgeons.[1] This category of rotator cuff tears can be treated in many ways.[1] Management options include living with the symptoms, physical therapy, corticosteroid injections, or undergoing surgical intervention that may include debridement with tuberoplasty, partial rotator cuff repair, utilization of an allograft to attempt tendon reconstruction, superior capsular reconstruction, tendon transfer, or reverse total shoulder arthroplasty.[1,2] Each of these options entails a specific set of strengths and limitations, and may have variable outcomes depending on the patient and their symptomatology.[1,2] Additionally, when patients choose nonoperative management, they run the risk of developing worsening rotator cuff tear arthropathy over time.[1,2] As such, substantial research efforts have been put towards the treatment of massive irreparable rotator cuff tears. There is likely a subset of patients who would benefit from a less invasive treatment that can help mitigate symptoms and improve function without having to resort to shoulder replacement or more involved reconstructive procedures. The subacromial balloon spacer emerged around a decade ago, and has shown potential for a specific subset of patients with massive irreparable rotator cuff tears.[3,4]

The subacromial balloon is a bioabsorbable device that helps patients with massive irreparable rotator cuff tears by increasing the acromiohumeral distance, in theory eliminating the contact of the humeral head with the acromion seen in rotator cuff deficient patients, thus alleviating pain.[5] It also helps alter the biomechanics of the shoulder joint, and redistributes the tension of adjacent musculature in a way that compensates for the deficient rotator cuff.[5,6] As a result, the subacromial balloon has been reported to decrease pain and improve function in certain patients.[6]

Adhering to the strict indications of the device are necessary for achieving optimal results, and these include an intact subscapularis and teres minor muscles, an intact deltoid, the ability to achieve 90 degrees of active forward elevation, and minimal to moderate glenohumeral osteoarthritis.[5,6] In these patients, the balloon has shown generally positive results in the literature, and has been considered a surgical procedure that is easy to perform, minimally invasive, and cost effective when compared to other surgical alternatives.[5-7]

As with other novel surgical procedures, research regarding the balloon remains vital in order to accurately describe the benefits and the utility of this treatment option. In particular, it is important to evaluate the safety and efficacy of the balloon in the long-term, and to assess the changes conducted on the glenohumeral architecture following its placement. There has been controversy regarding the longevity of the benefits of the subacromial balloon spacer following its implantation, with some surgeons sharing the belief that the benefits disappear with its disintegration in the glenohumeral joint.[8,9] Accordingly, it is important to report and describe cases that adequately present the therapeutic effects of the balloon in the long-term, well beyond its resorption in the shoulder joint. In this report, we present the case of a 69-year-old male who underwent a subacromial balloon spacer procedure, and opted for a second revision subacromial balloon spacer procedure in the same shoulder 5 years later. To our knowledge, this is the first reported case of revision subacromial balloon placement, and by presenting it, we aim to comment on the lasting effects and safety of the subacromial balloon spacer, and help describe postoperative prognosis and rehabilitation, based on a holistic review of literature.

CASE PRESENTATION

The patient is a 69-year-old male who presented to the office with increasing discomfort and diminished function in the right shoulder. His symptoms were consistent with rotator cuff disease, and began as pain with reaching, lifting, and overhead movement over the preceding month as well as notably diminished range of motion. The patient had a past medical history significant for heart disease, chronic obstructive pulmonary disease, and prior right sided subacromial balloon spacer procedure performed five years prior to his presentation. He was very satisfied with the procedure, evident by the improvement seen in his previous patient-reported outcome scores **(Table 1).**

Table 1. Patient reported functional outcomes prior to and after the first and second subacromial balloon placement procedures.

	Pre-Operative First procedure	Post-Operative (1 year) First Procedure	Pre-Operative Second Procedure	Post-Operative (4 months) Second Procedure	Post-Operative (1 year) Second Procedure
Functional Outcome Scores	ASES: 26.62 VAS: 8 SANE: 13.39% SST: 41.67	ASES: 100 VAS: 0 SANE: 100 SST: 91.67	ASES: 60.87 VAS: 4.16	ASES: 78.00 VAS: 1	ASES: 95 VAS: 1

(ASES: American Shoulder and Elbow Surgeons' score; VAS: Visual Analogue Scale; SANE: Single Assessment Numeric Evaluation; SST: Simple Shoulder Test)

On his new presentation, the patient reported new pain and poor function in his shoulder, which he attributed to overexertion and strenuous activity over the last several months. His physical exam showed active forward elevation up to 125 degrees, active abduction to 80 degrees, and external rotation to 10 degrees, with some discomfort. Patient had full passive range of motion, but was inhibited by pain and weakness. The patient had an American Shoulder and Elbow Surgeons (ASES) score of 60.87 and a Visual Analogue pain score of 4 on his visit.

Radiographic imaging taken during the first visit showed minimal changes (**Figure 1**) to prior X-rays from approximately 5 years prior (**Figure 2**). On anteroposterior (AP) view, there was mild glenohumeral arthritis with minimal joint space narrowing (Hamada Grade 2) and slight proximal humeral migration. Acromiohumeral distance was measured to be 5 mm, having been 7 mm prior to his first procedure. Mild AC joint and glenohumeral arthritis were noted as well. Subsequent non-contrast MRI of the right shoulder was performed, which showed massive full thickness tears of the supraspinatus and infraspinatus tendons with retraction to the level of the glenohumeral joint (**Figure 3**). The supraspinatus and infraspinatus tendons were found to be severely atrophied (Grade 4 Goutallier classification) , whereas the teres minor and subscapularis tendons were found to be preserved (**Figure 3**). There was no evidence of the previously implanted subacromial balloon device. These findings were consistent with his past MRI findings prior to his first balloon procedure, which also showed a high riding humeral head, tearing in his supraspinatus and infraspinatus, and mild AC and glenohumeral joint arthritis. Of note, there was minimal rotator cuff arthropathy progression, which is not typically seen 5 years after a massive irreparable rotator cuff tear diagnosis.[10,11]

After discussing potential treatment options and patient goals, the patient decided to have an arthroscopic revision subacromial balloon spacer procedure given the success he had with this same procedure five years prior. Intraoperatively, the patient findings were consistent with the MRI. Systematic examination of the joint demonstrated well preserved articular surfaces with intact subscapularis and teres minor tendons. A minimal bursectomy was performed to improve exposure and visualization. A large subacromial balloon, same size as his initial surgery, was placed in the

Figure 1. X-ray imaging prior to second procedure, 5 years after first X-ray, showing minimal changes in joint architecture and spacing.

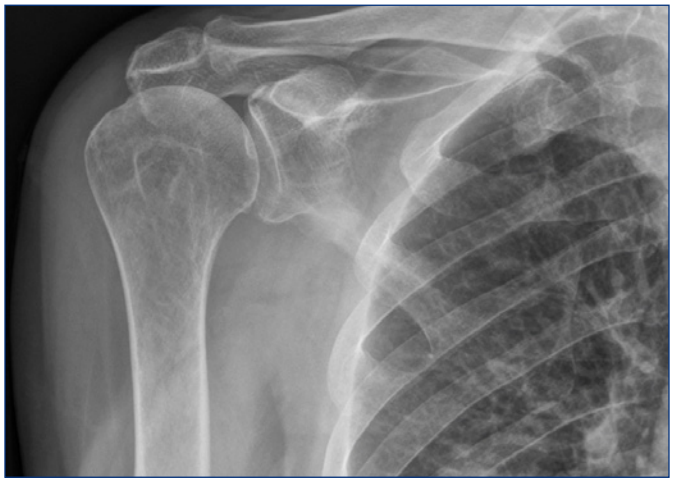


Figure 2. X-ray imaging prior to first procedure.

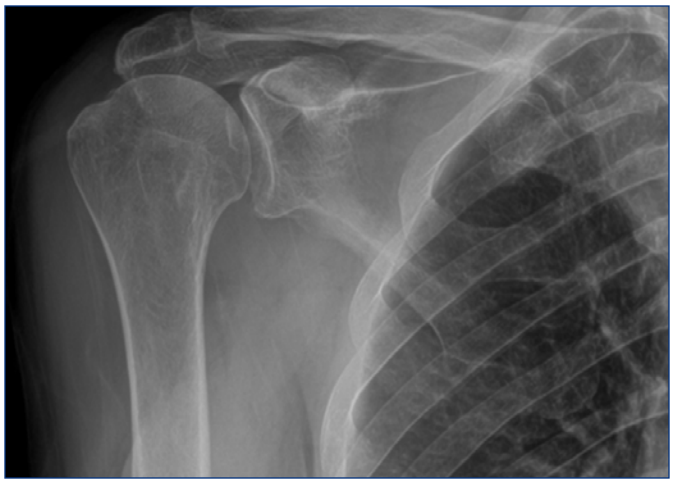
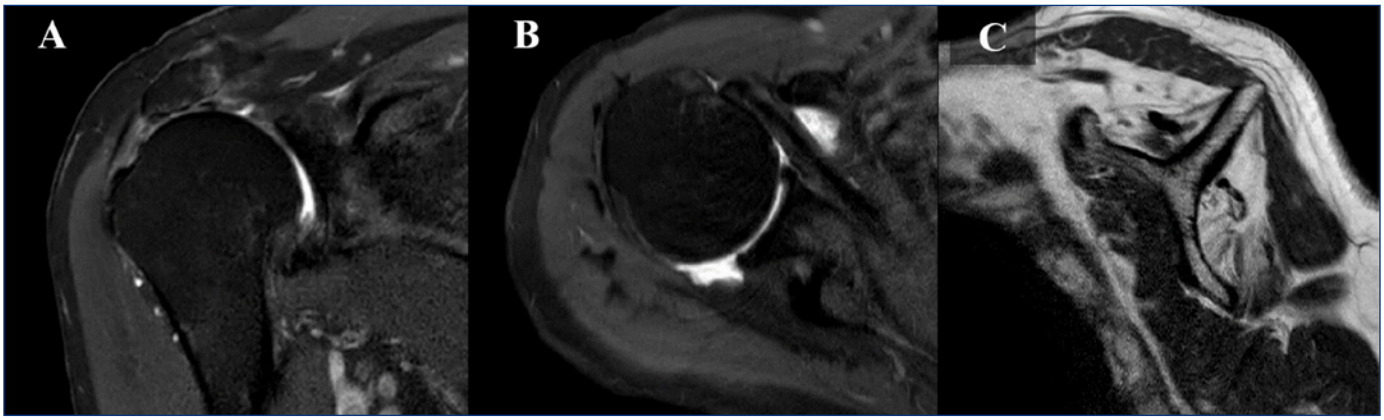


Figure 3. MRI findings prior to the patient's second subacromial balloon placement procedure showing:
(**A**) a massive full thickness superior rotator cuff tear (supraspinatus and infraspinatus) with retraction to the level of the glenoid,
(**B**) intact subscapularis tendon with a torn infraspinatus tendon, and
(**C**) severe fatty infiltration of supraspinatus and infraspinatus muscle tendons.



subacromial space, and the patient tolerated the procedure without any surgical complications. Surgical time was approximately 20 minutes from initial incision to closure, and blood loss was minimal. Patient was placed in a sling and instructed to return to clinic around 10 days following procedure.

On his first postoperative visit, the patient noted improvement in pain and mobility. He was instructed to start physical therapy and rehabilitation at 2 weeks following the procedure. At 4 months post-op, his ASES score improved to 78 and his VAS pain score dropped to 1. At 6 months following the procedure, the patient had no pain (VAS pain score was 0), and was able to return to his leisure activities like fishing. He was able to forward elevate his shoulder to 180 degrees, abduct to 90 degrees, and externally rotate his shoulder to 40 degrees. The patient was very content with the improvement in pain and function he received. One year out from the surgery his ASES improved to 95, and he reported resumption of his normal daily life and leisure activities without pain, and retainment of full range of motion **(Table 1)**.

DISCUSSION

This case provides insight on the efficacy, longevity, and safety of the subacromial balloon placement procedure in the setting of massive irreparable rotator cuff tear. The patient in our report opted for subacromial balloon spacer placement initially, and the positive outcomes exhibited by the procedure prompted him to repeat it five years later. After doing the second procedure, the patient noted improvement in pain and function, as seen by his clinical results and his patient reported outcome scores. The benefits of the subacromial balloon spacer stem from its ability to increase the distance between the acromion and the humeral head.[5,6,12] The benefits of the balloon have been well documented in the literature. Vecchini et al explored two populations of patients with irreparable massive rotator cuff tears, and reported significant improvements in Constant score, range of motion, and visual analogue pain score before and after operation.[13] Similarly, Kaisidis et al conducted a retrospective study that involved 47 patients treated with subacromial balloon spacers for massive irreparable rotator cuff tears, and noted significant improvements in range of motion and patient-reported outcomes at a mean follow-up of 24.6 months.[14] One multi-center randomized controlled trial by Verma et al compared partial cuff repair to subacromial balloon spacers for the treatment of massive irreparable rotator cuff tears, and noted excellent patient-reported outcomes and range of motion measurements following both procedures, while noting a significantly earlier functional recovery and pain relief in the balloon group.[6] The trial found that the subacromial balloon provides an appropriate alternative to partial cuff repair in patients that fit that indications for the device. Several other studies showed similar results, supporting the use of this device in the setting of irreparable rotator cuff tears.[15,16] In our case, the patient had improved pain and function after both his first and second balloon procedures. Moreover, the patient was in line with the indications of the subacromial balloon spacer procedure: he had an intact subscapularis, minimal osteoarthritis, and had the ability to forward elevate the arm to at least 90 degrees.[4,17] As such, he was a good candidate for the procedure on both occasions.

This case also provides insight into the longevity of the subacromial balloon. The therapeutic effects of the first procedure persisted for years prior to reimplantation. While the literature suggests that the balloon device itself is absorbed by the body within 12 months, its effects on the glenohumeral joint are noted well beyond its absorption.[17,18] Similar

findings have been noted in the literature.[9,19,20] For example, Senekovic et al monitored the progress and the development of the balloon following implantation using ultrasonography, and noted detectable devices in only 54.5% of his cohort at 6-month follow-up.[9] Nevertheless shoulder pain and function continued improving in the majority of the patients.[9] While the persistence of improvement beyond balloon degradation has been noted in many studies, clear timelines are yet to be determined and underlying mechanisms need to be investigated.[9,19,20]

In addition, this case demonstrated that the subacromial balloon is a safe procedure that does not cause permanent harm or detriment to the glenohumeral joint following its implantation. Upon performing the second procedure, arthroscopic evaluation of the subacromial space showed that the architecture of the joint remained similar when compared to the first procedure, as there was no negative impact on nearby structures or adjacent musculature, and there was no significant progression of rotator cuff arthropathy. This is important in that it suggests that the subacromial balloon spacer is a safe management option that may not burn bridges with regards to future revision surgeries, as seen with more invasive options like the reverse shoulder arthroplasty. As such, it can act as a salvage procedure and a rehabilitation accelerator that can delay the need for more aggressive options like shoulder arthroplasty until further stages.

CONCLUSION

Patients who have massive irreparable rotator cuff often have limited, more invasive options such as partial cuff repair, superior capsular reconstruction, or shoulder replacement. Recently, a new option has been added to the shoulder and elbow repertoire. The insertion of a subacromial balloon spacer can be a feasible option for patients with minimal osteoarthritis and whose goals are to relieve pain from massive irreparable rotator cuff tears. Additionally, as seen in this case, patients are able to regain function after completing postoperative physical therapy.

Our case is interesting in that it suggests that the subacromial balloon spacer helped delay progression of rotator cuff tear arthropathy, as evident by the minimal closure of the acromiohumeral interval (closure of around 2 mm) and little glenoid erosion, five years after the procedure. We would expect to see worsening rotator cuff tear arthropathy five years following initial presentation. This case further supports the use of the subacromial balloon spacer in patients who meet the right indications for the procedure.

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