Arthroscopic Subacromial Balloon Spacer for Massive Rotator Cuff Tears Demonstrates Improved Shoulder Functionality and High Revision-Free Survival Rates at Minimum 5-Year Follow-up

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INTRODUCTION: When nonoperative measures fail, a host of surgical options are available for massive rotator cuff tear (MRCT), a tear that is challenging to treat, and accounts for 10-40% of rotator cuff abnormalities. There is no consensus on which surgical method is superior and clinical results vary. Here, we aim to investigate the efficacy of arthroscopic subacromial balloon placement for MRCT. This study aimed to investigate the efficacy of arthroscopic subacromial balloon placement for MRCT, assessing patient satisfaction, outcomes, shoulder functionality, pain scores, and revision-free-survivorship up to eight years post the initial surgery.

METHODS: In this retrospective study with prospective data collection, patients with MRCTs undergoing balloon placement from 2014 to 2017 were prospectively enrolled. Their outcomes were analyzed retrospectively over a minimum 5-year follow-up. Demographics, patient satisfaction, reoperations, and complications were documented. Minimal clinically important differences (MCIDs) were calculated for SF-12 scores and Constant-Murley score (CMS) sub-scores. Pre- and post-surgery measures statistically compared for anatomical and functional evaluations.

RESULTS: Initially, 61 participants were enrolled, with 10 lost to follow-up over a mean 3-year interval. Of the remaining 51, 9 (18%) were lost at the latest follow-up. The remaining 42 patients (21 female, 21 male) had a mean age of 63.17 ± 7.66 years and was monitored for 83.98 ± 9.50 months. Revisions occurred in seven participants: six reverse total shoulder arthroplasty (RTSA) and one latissimus dorsi tendon transfer (LDTT) within two years of the initial surgery. No subsequent revisions were performed beyond this period, resulting in an implant survival rate of 83.33% at the latest follow-up. Significant improvements from preoperative to latest follow-up were observed: acromiohumeral interval decreased (7.83 to 6.56, p = 0.004), critical shoulder angle increased (36.10 to 38.24, p = 0.001), osteoarthritis grade increased (1.45 to 2.81, p = 0.001), SF-12 physical score improved (27.40 to 37.69, p = 0.001), and Constant-Murley (CM) total scores increased (26.50 to 68.69, p = 0.001). In the latest follow-up, 4 patients (9.52%) reported excellent satisfaction, 20 patients (47.62%) expressed satisfaction, and 18 patients (42.86%) indicated dissatisfaction. Among patients without revisions, excellent satisfaction was reported by 11.43%, satisfaction by 57.14%, and dissatisfaction by 31.43%.

DISCUSSION AND CONCLUSION: Employing a balloon spacer for MRCTs yielded moderate satisfaction at the 5-year follow-up, with stable revision rates within the first 2 years. Notably, low revision surgery rates, high revision-free-survival, and significant shoulder functionality improvements were observed at a minimum 5-year follow-up with arthroscopic subacromial balloon placement in conjunction with biceps tenotomy and subacromial bursectomy for MRCT.

FIGURE LEGEND
Figure 1: Revision-Free Survival Curve

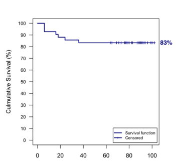

Table 1. Inclusion and exclusion criteria for the selection of patients who received subacromial balloon spacer placement for massive rotator cuff tears between 2014 and 2017.

Inclusion Criteria
Age > 50 year
Persistent shoulder pain and functional disability unresponsive to nonoperative treatment for greater than 6 months
Large posterosuperior rotator cuff tear defined with magnetic resonance imaging*
Exclusion Criteria
Less than 5-year final follow up
Missing clinical and functional outcomes documented preoperatively and postoperatively
Repairable tear confirmed during arthroscopic evaluation
Severe cuff tear arthropathy or osteoarthritis (type 2 or greater)
Concomitant subscapularis repair
Neurologic deficit
Pseudoparalysis
Intraoperative diagnosis of small or medium (<3 cm) rotator cuff tear
Irreparable subscapularis tear
Previous open or arthroscopic surgery on same joint
Severe glenohumeral arthritis (grade 3), rheumatoid arthritis or other systematic diseases, serious psychiatric disease, or active shoulder infection

*Defined as the combination of (1) a complete supraspinatus tear with, (2) a partial or complete tear of the infraspinatus, (3) anteroposterior size greater than 3 cm, (4) retraction greater than 3 cm, and (5) fatty infiltration greater than 50% (grade 3 or 4 on the Goutallier scale).

Table 2 Characteristics of 42 patients who received subacromial balloon spacer placement for massive rotator cuff tears between 2014 and 2017.

Demographic Characteristic	Mean ± SD (Range) or Percent (N)
Age at Surgery, years	63.17 ± 7.66 (50, 78)
Sex	
Male	50.00% (21)
Female	50.00% (21)
BMI	28.85 ± 3.81 (23, 37)
Surgery on Dominant Side	
Yes	73.81% (31)
No	21.43% (9)
Ambidextrous	4.76% (2)
Follow Up Time, months	
Initial	37.62 ± 10.84 (24, 56)
Final	83.98 ± 9.50 (64, 102)
Tendon Retraction	
Grade 2	38.10% (16)
Grade 3	61.90% (26)
Muscle Atrophy	
Grade 2	61.90% (26)
Grade 3	38.10% (16)
Subscapularis Involvement	
Grade 1	57.14% (24)
Grade 2	23.81% (10)
Grade 3	9.52% (4)
Grade 4	9.52% (4)
Balloon Size (n = 40 / 42)	
S	2.50% (1)
M	77.50% (31)
M/L	5.00% (2)
L	15.00% (6)

Data are presented as Mean ± Standard Deviation (Range) or Percent (N). BMI, body mass index.

Table 3. Clinical and radiographic outcome measures of 42 patients who received subacromial balloon spacer placement for massive rotator cuff tears between 2014 and 2017.

	Mean ± SD						
Outcome Measure	Preoperatively	1 Day Post-op	2019	2023 Follow Up	Mean Difference between 2023 Follow Up and Preoperative (CI)		
Acromiohumeral interval, mm	7.83 ± 1.84	10.60 ± 3.30	7.00 ± 2.58	6.56 ± 2.35	**-1.27****	**(-2.20, -0.34)**	0.0038
Critical shoulder angle, degrees	36.10 ± 4.13	35.20 ± 4.46	37.32 ± 4.14	38.24 ± 3.33	**2.13***	**(0.48, 3.78)**	0.0104
Osteoarthritis	1.45 ± 0.71	1.45 ± 0.89	2.24 ± 1.12	2.81 ± 1.09	**1.36*****	**(0.95, 1.76)**	< 0.001
SF-12 Score							
Physical	27.40 ± 5.18	49.59 ± 7.83	—	37.69 ± 10.48	**10.30*****	**(6.65, 13.94)**	< 0.001
Mental	44.76 ± 14.32	55.67 ± 9.72	—	44.38 ± 15.83	**-0.39**	**(-7.04, 6.27)**	0.915
Constant-Murley Score							
Pain	0.88 ± 2.16	11.81 ± 4.27	—	8.85 ± 4.02	**7.96*****	**(6.54, 9.39)**	< 0.001
Daily Living	2.55 ± 0.89	16.50 ± 4.88	—	15.69 ± 5.45	**13.14*****	**(11.42, 14.86)**	< 0.001
Range of Motion	10.86 ± 5.41	33.00 ± 7.72	—	27.81 ± 9.54	**16.95*****	**(13.53, 20.37)**	< 0.001
Strength	12.88 ± 5.86	27.40 ± 12.96	—	19.28 ± 12.05	**6.40****	**(2.22, 10.57)**	0.001
Total	26.50 ± 7.71	74.07 ± 18.27	—	68.69 ± 23.35	**42.19*****	**(34.53, 49.85)**	< 0.001

Data are presented as Mean ± Standard Deviation (Range) or Mean (CI). CI = 95% confidence interval; SF-12, 12-Item Short Form Health Survey.
P values were determined by paired t-test. "—" indicates that this data at this time point was recorded.

Table 4. Patient-reported satisfaction

	2019 Follow Up	2023 Follow Up
Revision-Free Survival	83.33% (35)	83.33% (35)
All 42 Patients		
Follow Up Time, months	37.62 ± 10.84 (24, 56)	83.98 ± 9.50 (64, 102)
Excellent Satisfaction	61.90% (26)	9.52% (4)
Satisfied	16.67% (7)	47.62% (20)
Dissatisfied	21.43% (9)	42.86% (18)
35 Patients with Revision-Free Survival at 2023 Follow Up		
Follow Up Time, months	37.14 ± 11.31 (24, 56)	83.83 ± 10.26 (64, 102)
Excellent Satisfaction	74.29% (26)	11.43% (4)
Satisfied	20.00% (7)	57.14% (20)
Dissatisfied	5.71% (2)	31.43% (11)

Data are presented as Mean ± Standard Deviation (Range) or Percent (N).

Table 5. MCID scores and the percent of patients that met or exceeded the MCID for patient reported outcomes.

Outcome Measure	MCID	Percent of Patients that Met or Exceeded MCID
SF-12 Score		
Physical	5.30	69%
Mental	11.58	33%
Constant-Murley Score		
Pain	2.21	93%
Daily Living	2.79	93%
Range of Motion	5.66	83%
Strength	6.00	57%
Total	11.78	88%