J Shoulder Elbow Surg (2021) 30, S66–S70

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Journal of Shoulder and Elbow Surgery

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# Outcomes of rotator cuff repair with concurrent microfracture of focal glenohumeral osteoarthritis

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**Background:** The benefit of rotator cuff repair (RCR) in patients with concurrent osteoarthritic changes remains unclear. RCR has the theoretical potential to increase the compressive force across the glenohumeral joint, further exacerbating osteoarthritis pain. The purpose of this study is to investigate pain relief and patient-reported outcomes of patients undergoing simultaneous RCR and microfracture of focal glenohumeral osteoarthritis.

**Methods:** Thirty-four patients undergoing simultaneous RCR and microfracture were retrospectively reviewed at a minimum 1-year follow-up. Patient demographics, preoperative range of motion, functional outcomes (visual analog scale [VAS], Single Assessment Numeric Evaluation [SANE], American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form [ASES], and Simple Shoulder Test [SST]), and operative metrics were recorded. The patients were then contacted to obtain postoperative functional outcome scores (VAS, SANE, ASES, and SST).

**Results:** Twenty-seven patients (11 male/16 female [79%]) were evaluated at a mean follow-up of 25.8 months (range, 12-46). The average age at surgery was 64.9 years (range, 56-78). Chronic tears were more common than acute tears (57.7% vs. 42.3%). The majority of patients had a full rotator cuff tear (89%) involving a mean 1.7 ± 0.8 tendons (range, 1-3). Eighty-eight percent of the humeral lesions were Outerbridge 4 compared with 84% on the glenoid. The mean estimated involvement between the 2 groups with 38.4% ± 18.4% of the humeral head involved and 34.6% ± 18.4% of the glenoid involved. PRO scores improved postoperatively with a reduction in mean VAS (6.6-2.0, $P < .01$), SANE (33.8-79.8, $P < .01$), ASES (38.0-80.9, $P < .01$), and SST (3.07-9.70, $P < .01$) scores. Cumulatively, only 52% (14/27) of the patients improved, however, by the MCID for all collected PROs.

**Conclusions:** Our results demonstrate modest improvements in postoperative pain and functional scores at a minimum of 1-year follow-up in a cohort of patients who have undergone RCR and glenohumeral microfracture. In cases of small focal lesions of full-thickness cartilage loss, RCR with microfracture is a reasonable treatment option; however, patients should be counseled on expectations accordingly.

**Level of evidence:** Level IV; Case Series



**Keywords:** Rotator cuff repair; rotator cuff tear; osteoarthritis; arthritis; microfracture; glenohumeral joint; Outerbridge; shoulder

This study received institutional review board approval from the Thomas Jefferson University Institutional Review Board (study no. 20E.388).

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https://doi.org/10.1016/j.jse.2021.04.008

Rotator cuff tears are a common pathology in the general population for which the prevalence increases with age.[17] The same is true for glenohumeral osteoarthritis (GHOA) and accompanying articular cartilage defects.[3] The concurrent incidence of these 2 pathologies has been reported to range from 12.5%[7] to as high as 28%[16] found incidentally during routine arthroscopic rotator cuff repair (RCR). Chalmers et al[1] followed 67 shoulders for a median duration of 8 years with small to medium asymptomatic rotator cuff tears and found that 22% of patients developed progressive osteoarthritis. Furthermore, in shoulders with cartilage defects, the involved area has been observed to be more extensive in shoulders with rotator cuff tears than in those without tears.[9] However, concurrent treatment of rotator cuff tears in patients with GHOA has the theoretical potential to increase the compressive forces of the glenohumeral joint causing increased pain and arthritic progression.[22] Outcomes of patients with focal GHOA undergoing RCR remain poorly studied.

Among the number of options available for the treatment of GHOA, microfracture of focal glenohumeral lesions is an option that has been shown to be beneficial to patients in a number of recent studies.[6,10,18,23] Other available options for treating GHOA include osteochondral autograft transfer, osteochondral allograft transplantation, autologous chondrocyte implantation, and bulk allograft reconstruction; however, these require preoperative planning. Although shoulder arthroplasty remains a definitive option in the management of symptomatic GHOA, joint-preserving interventions such as microfracture may be preferred in younger patients because of a higher demand placed on the prosthesis and the potential for early loosening.[2] In addition, microfracture can be performed arthroscopically and has a low rate of associated patient morbidity.[21]

Rotator cuff integrity is also important to consider in the management of osteoarthritis as it has been shown to independently affect the progression of GHOA.[8] Herve et al[8] retrospectively reviewed 80 patients 20 years after RCR and found significantly more patients with GHOA in the group with retears vs. those who had rotator cuff tendon healing (92.5% vs. 7.5%, respectively, $P < .0001$). Meanwhile, Matsuba et al[15] found that GHOA continued to progress on both the nonoperative shoulder and operative shoulder despite RCR in their 10-year follow-up of 86 patients. GHOA progressed significantly more on the affected side (55% vs. 19%, $P < .001$); however, poor cuff integrity was associated with significantly greater progression of GHOA ($P = .0024$).

Although the benefit of RCR in helping to prevent the progression of GHOA has been established, the benefit of simultaneous RCR and microfracture in patients with concurrent osteoarthritic changes remains unclear. Therefore, the goal of this study is to describe the pain relief and patient-reported outcomes (PROs) of patients undergoing RCR and treatment of GHOA with microfracture.

## Materials and methods

Thirty-four patients were identified in the institutional medical records as having undergone simultaneous RCR and microfracture from 2012 to 2015 using procedural terminology coding (CPT 29827) and word search for "microfracture" or "chondroplasty" in the operative reports, after receiving institutional review board approval. Exclusion criteria included patients who had undergone previous ipsilateral rotator cuff surgery and less than 1 year of follow-up. Of the 34 patients, only 1 had undergone previous shoulder surgery (labral repair).

Patient demographics, preoperative range of motion, PROs (visual analog scale [VAS], Single Assessment Numeric Evaluation [SANE], American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form [ASES], and Simple Shoulder Test [SST]), and operative metrics were extracted via chart review. The intraoperative data collected included glenoid and humeral head articular defects classified by the Outerbridge classification, percentage of glenoid and humeral head with articular defects, presence of full- vs. partial-thickness rotator cuff tear, tendons repaired, and number of anchors used.[20] The glenoid and humeral defects were measured intraoperatively with a calibrated probe and then defined as a percentage of the total humeral articular surface or glenoid. After being identified retrospectively, patients were contacted via telephone to participate at which time the postoperative PROs were obtained (VAS, SANE, ASES, and SST).

Descriptive statistics were used to describe means and standard deviation. Student $t$ tests were used to detect significant differences between pre- and postoperative scores and Pearson correlation coefficient was calculated to detect a correlation between defect size and changes in scores using Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

The delta value of the patient-reported outcome scores (postoperative minus preoperative) was then compared against established minimal clinically important differences (MCIDs) for RCR for the VAS (MCID: 2.4), ASES (MCID: 27.4), SANE (MCID: 13), and SST (MCID: 4.3).[12]

## Results

Twenty-seven patients completed follow-up at a minimum of 1 year (mean 25.8 months; range, 12-46). The average age at time of surgery was 64 years (range, 56-78). Forty-one percent of the patients were male and 59% were female. Chronic tears (57.7%) were more common than acute tears (42.3%). Preoperative range of motion was full for 16.7%, limited for 37.5%, and severely limited for 45.8%. Patient demographics and preoperative function are summarized in Table I.

The majority of patients had a full rotator cuff tear (89%) involving a mean $1.7 \pm 0.78$ tendons (range, 1-3; Table II). Very few shoulders had isolated glenoid lesions requiring chondroplasty as the majority were on the humeral head or both the humeral head and glenoid. (humeral head: 12, glenoid: 1, both: 13). On the humeral side, 88% of the lesions were full thickness (Outerbridge 4) compared with 84% on the glenoid. The mean estimated involvement was also similar

**Table I** Patient demographics and preoperative function

| Parameter | All patients |
|---|---|
| Age, yr, mean ± SD | 64.9 ± 5.9 |
| Sex, female/male, n | 16/11 |
| Chronicity, chronic/acute, n | 15/10 |

*SD*, standard deviation.

**Table II** Intraoperative data

| Parameter | Average | Range |
|---|---|---|
| Outerbridge humeral head grade, mean ± SD | 3.9 ± 0.3 | 3-4 |
| Outerbridge glenoid grade, mean ± SD | 3.8 ± 0.6 | 2-4 |
| Chondroplasty location, n | | |
| Humeral head | 12 | |
| Glenoid | 1 | |
| Both | 13 | |
| Percentage humeral head with defect, mean ± SD | 38.4 ± 18.4 | 10-80 |
| Percentage glenoid with defect, mean ± SD | 34.6 ± 18.4 | 5-70 |
| Full-thickness cuff tear, n | 24 | |
| Partial-thickness cuff tear, n | 3 | |
| Number of tendons repaired, mean ± SD | 1.7 ± 0.78 | 1-3 |
| Number of anchors used, mean ± SD | 2.3 ± 1.4 | 1-5 |

*SD*, standard deviation.

between the 2 groups, with 38.4% ± 18.4% of the humeral head involved and 34.6% ± 18.4% of the glenoid involved.

Preoperative VAS was available for 26 patients (mean=6.6, range 2-10) and had improved in all shoulders (mean=2.0, range 0-6; Table III). PROs demonstrated significant improvements from pre- to postoperatively (Table III). No correlation was observed between chondral defect size and changes in pain and functional scores (defect size and change in VAS, $r = 0.00$; defect size and change in SANE, $r = 0.02$). Additionally, no differences in PROs were seen between unipolar vs. bipolar lesions ($P > .05$).

After evaluating if the patients improved by the MCID, 74% (20/27) had adequate improvement for VAS, 78% (21/27) for ASES, 85% (23/27) for SANE, and 74% (20/27) for SST. Cumulatively, only 52% (14/27) of the patients improved, however, by the MCID for all collected PROs.

**Table III** Pre- and postoperative functional scores

| Functional scores | Preoperative | Postoperative | *P* value |
|---|---|---|---|
| ASES | 38.0 ± 16.5 | 80.9 ± 19.4 | <.01 |
| SANE | 33.8 ± 25.0 | 79.8 ± 20.7 | <.01 |
| SST | 3.07 ± 2.19 | 9.7 ± 2.51 | <.01 |
| VAS | 6.6 ± 2.32 | 2.0 ± 2.06 | <.01 |

*ASES*, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; *SANE*, Single Assessment Numeric Evaluation; *SST*, Simple Shoulder Test; *VAS*, visual analog scale.

## Discussion

There is a paucity of data detailing the simultaneous treatment of rotator cuff tears and GHOA changes in patients who exhibit both pathologies. The purpose of this study was to describe the short-term (1-year) outcomes in patients undergoing concurrent RCR and microfracture surgery. The results demonstrated that RCR with microfracture relieved pain and improved PROs at the short-term follow-up of a mean 25.8 months. Further, it did not appear that bipolar disease influenced PROs; however, the overall improvement was modest.

Several studies have evaluated the progression of osteoarthritis after attempted RCR.[4,5] Both Herve et al[8] and Matsuba et al[15] reported the integrity of the RCR was significant in slowing the progression of the disease. Kukkonen et al[13] retrospectively reviewed 82 shoulders that had undergone repair of isolated full-thickness supraspinatus tendon tears. The authors identified preoperative osteoarthritis on radiographic evaluation in 26.8% (22/82) of the cohort and 46.3% (38/82) of the patients when combined with arthroscopic evaluation. The authors found that any type of preoperative osteoarthritis was associated with a lower postoperative Constant score at 1-year follow-up (82.8 [–] arthritis vs. 73.9 [+] arthritis, $P = .0074$). However, the authors did not report any intervention to address the GHOA. In the current study, microfracture was attempted at the same time as RCR and all patients improved with respect to pain and patient-reported outcomes collected at a minimum 1-year follow-up.

Microfracture in isolation has been demonstrated to be a reasonable option for younger patients presenting with GHOA. Frank et al[6] found a statistically significant decrease in VAS scores (5.6-1.9, $P < .01$) after microfracture surgery as well as improvements in SST (5.7-10.3, $P < .01$) and ASES scores (44.3-86.3, $P < .01$) in a retrospective review of 14 patients with a minimum 1-year follow-up. This compares to our findings of a reduction in mean VAS scores (6.6-2.0, $P < .01$) and improvement in ASES (38.0 vs. 80.9, $P < .01$) and SST scores (3.07-9.70, $P < .01$) with a minimum 1-year follow-up as well. The results of microfracture may be lasting as well. Wang et al[24] found an overall survival rate of 76.6% after microfracture, with an average of 10-year follow-up in 13 patients. The authors also reported statistically significant improvements in VAS, SST, and ASES, without any significant change from the short-term (mean, 2.3 years) to long-term (mean,

10.2 years) follow-up. Only 21.4% of patients required conversion to arthroplasty within the 10 years after the index microfracture procedure.

The size and location of the articular lesion may be of importance. In the current study, there was no correlation between outcomes and the size of the defect, which ranged from an approximately focal defect to 80% of the humeral head surface ($r = 0.02$-$0.00$). This is contradictory to previous reports, however, as Kerr and McCarty identified that bipolar Outerbridge grade IV cartilage lesions fared worse than monopolar lesions, which were less severe.[11] Importantly, Kerr and McCarty performed microfracture in only 2 of the 19 patients they included in their study.

The mean age of the current cohort was 64.9 years (range, 56-78 years), which some may consider to be an appropriate age for joint replacement surgery. However, preoperative range of motion was nearly full or only partially limited in 50% of our cohort, precluding the surgeons involved from recommending a reverse shoulder arthroplasty. Performing an anatomic total shoulder arthroplasty in the same setting as RCR results in less predictable outcomes when compared with anatomic total shoulder arthroplasty and a well-functioning rotator cuff. Levesey et al[14] reviewed 45 patients with either high-grade partial- or full-thickness rotator cuff tears who underwent an anatomic total shoulder arthroplasty and concomitant RCR. Nearly one-third of patients (31%) were labeled as having a poor result and 18% required revision surgery with a relatively short minimum 2-year follow-up. Similar results were reported by Simone et al,[19] who identified 45 patients (4.8%) who had a full-thickness RCR and anatomic shoulder replacement. It seems that tear size may matter as the authors described a greater improvement in forward elevation for those with a smaller tear and higher Neer satisfactory outcomes (100% for small, 79% for medium tears, and 78% for large tears) in the final cohort of 33 patients.

There are multiple limitations to this study. This was a retrospective review and as such has all the inherent limitations of such a study design. Initially, we identified 34 patients; however, only 27 were available for follow-up (79%). Additionally, some of the preoperative values were not available for all patients. To assess the PROs, the delta values were assessed vs. the MCID as reported in the literature. The values that were chosen were selected based on RCR, but there has been some discrepancy in the MCID values, and potentially arthritis values would have been better. Additionally, it was not always clear if the patients had symptoms of rotator cuff tears or GHOA. This is difficult to tease out clinically, and the retrospective nature of the study made it impossible to delineate. This was further limited because we did not have the recorded size of rotator cuff tears apart from the number of tendons torn. Because of the retrospective nature of the study, we limited the analysis to descriptive statistics to avoid finding any inadvertent correlations. The study also lacked a matched cohort of patients undergoing only RCR or only microfracture in isolation at the same institution and was not powered to make many associations. Kukkonen et al[13] identified an association between preoperative GHOA and poorer Constant scores at 1-year follow-up. It would have strengthened the current study if we could have shown microfracture to be beneficial and included patients with RCR and GHOA but did not undergo microfracture or patients who only underwent microfracture. In addition, 1-year follow-up may be too short a duration to see the effects of concomitant procedures, and longer-term follow-up would be ideal. Lastly, rotator cuff tear chronicity and osteoarthritis grade were determined based on physician documentation. Images were not reviewed to confirm no high-grade fatty atrophy for those with reported acute tears.

## Conclusion

The body of evidence for the use of microfracture is growing, and this is the first study to look at outcomes among patients undergoing simultaneous RCR and microfracture. Given the high incidence of glenohumeral cartilage defects in patients with rotator cuff tears, there exists a significant population of patients who could benefit from concurrent treatment. Our results demonstrate that patients who underwent surgical repair of rotator cuff tears and microfracture of their glenohumeral lesions reported modest improvements in pain and function at a minimum 1-year follow-up without any significant complications.

## Disclaimer

The authors received funding in the form of institutional research support through the Division of Shoulder and Elbow Surgery at the Rothman Institute of Orthopedics, although funding is not related to the topic of this article (simultaneous treatment of rotator cuff tear and osteoarthritis).

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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