Association Between Preoperative Patient Resilience and Patient-Reported Outcomes After Rotator Cuff Repair

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Background: Mental and emotional health can affect outcomes after orthopaedic surgery, and patient resilience has been found to be significantly related to postoperative functional outcomes.

Purpose: To evaluate the relationship between preoperative patient resilience and 2-year postoperative patient-reported outcomes after rotator cuff repair (RCR). It was hypothesized that patients with low preoperative resilience will have worse patient-reported outcomes at 2 years after RCR versus those with high resilience.

Study Design: Cohort study; Level of evidence, 3.

Methods: Patients who underwent primary arthroscopic RCR in 2020 at a single institution and completed the Brief Resilience Scale (BRS) preoperatively were identified. Other inclusion criteria were American Shoulder and Elbow Surgeons (ASES) and Single Assessment Numeric Evaluation (SANE) scores at the 2-year follow-up. Outcomes were compared in patients as divided into low resilience (BRS score >1 SD below the mean), normal resilience (BRS score ≤1 SD of the mean), and high resilience (BRS score >1 SD above the mean) groups.

Results: Overall, 100 patients (52 male, 48 female; mean age, 60 ± 9 years) were included in this study. Mean BRS scores did not change significantly from preoperative to 2-year follow-up (3.8 ± 0.7 vs 3.9 ± 0.8, $P = .404$). All patients had preoperative ASES scores. Low-resilience patients (n = 17) had significantly lower preoperative ASES scores compared with normal (n = 64) and high resilience (n = 19) patients (35 vs 42 vs 54, respectively; $P = .022$). There were no significant group differences in postoperative outcomes (revision rate, ASES score, ASES score improvement from preoperative to 2-year follow-up, or SANE score). Multivariate analysis indicated that preoperative resilience was not significantly associated with ASES score improvement (β estimate = –5.64, $P = .150$), while resilience at 2-year follow-up was significantly related to ASES score improvement (β estimate = 6.41, $P = .031$).

Conclusion: Patient-reported outcomes at 2-year follow-up did not differ based on preoperative patient resilience for arthroscopic RCR patients. Multivariate analysis also showed that preoperative resilience was not associated with improvement in ASES scores; however, resilience at 2-year follow-up was associated with ASES score improvement.

Keywords: arthroscopy; patient-reported outcome; psychology; resilience; rotator cuff; shoulder

As research into behavioral medicine expands, there is greater understanding that psychological factors and concepts surrounding mental health can influence physical health.[1,4,7,17,20,21,28] Mental and emotional health can affect orthopaedic surgery outcomes, with patient resilience being a potentially impactful factor in optimizing recovery.[1,16,19,20,27] Resilience can be defined as the process of adapting well in the face of adversity, trauma, and significant sources of stress.[29]

Since scales to measure patient resilience were introduced, studies have begun to examine the relationship between resilience scores and patient-reported outcomes after orthopaedic surgery. Resilience has been specifically chosen over other tools for evaluating the psychological

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impact on outcomes as the ability to cope with stress is useful in the recovery and rehabilitation after surgery across many fields of medicine.[3,10,16] A recent study evaluating total knee arthroplasty (TKA) patients showed that preoperative resilience is an important predictor of physical and mental health of patients at 3 months and 12 months postsurgery.[16] Further, greater concurrent resilience was associated with better scores across all measured outcomes, which is in contrast to a recent study of TKA patients by Haffar et al[8] which found no significant correlation between resilience and patient-reported outcome scores, both measured 1 year postoperatively.[16] In a similar study, Tokish et al[27] assessed 70 total shoulder arthroplasty (TSA) patients for a minimum of 2 years postoperatively and divided the patients into 3 groups based on Brief Resilience Scale (BRS) scores (low-resilience, normal-resilience, and high-resilience).[27] Postoperative BRS scores were significantly correlated with American Shoulder and Elbow Surgeons (ASES) and Single Assessment Numeric Evaluation (SANE) scores, which is consistent with a more recent study of 73 patients who underwent reverse TSA.[5,27]

Several studies also have evaluated the effects of patient resilience on arthroscopic surgery outcomes.[6,9,23,30] For example, a previous study found that, in knee arthroscopy patients, only those with higher preoperative BRS resilience scores saw significant improvement from preoperative to 6-month postoperative International Knee Documentation Committee and Knee injury and Osteoarthritis Outcome Score values.[6] Several studies have evaluated the effects of patient resilience on rotator cuff repair (RCR) outcomes.[9,23,30] Two studies evaluated outcomes at 6 months and 1 year.[9,30] Neither found a correlation between BRS and ASES scores after surgery; however, 1 concluded that a patient's psychological well-being was more indicative of outcomes, and the other found BRS to correlate with Patient-Reported Outcome Measurement Information System Global-10 scores.[9,30] A third study lasting 4 years found that Life Orientation Test-Revised (LOT-R) scores, a test of patient resilience and optimism, was significantly correlated with patient-reported outcomes in 49 RCR patients. Although this study had longer-term follow-up, LOT-R scores do not isolate patient resilience, and preoperative LOT-R scores were not included in the study.[23]

The primary purpose of this study was to evaluate the relationship between preoperative patient resilience and 2-year postoperative patient-reported outcomes in RCR patients, with a secondary purpose of evaluating whether resilience is static or changes over time. We hypothesized that patients with low preoperative resilience would have worse patient-reported outcomes at 2 years after RCR compared with those with high resilience. Secondarily, the authors hypothesized that resilience is static over time.

METHODS

Inclusion/Exclusion Criteria

The protocol for this retrospective cohort study was approved by our Institutional Review Board. Patients who underwent arthroscopic RCR with Current Procedural Terminology code 29827 from January 1 to August 31, 2020, at a single multicenter institution were identified from the medical records. Patients who underwent primary RCR who completed the BRS preoperatively through a standard-of-care patient-reported outcome system were considered for inclusion. Patients were excluded if they had not completed the BRS preoperatively or the BRS, ASES, and SANE surveys at the 2-year follow-up. Also excluded were patients who only underwent subscapularis repair, those who underwent RCR due to an automobile accident, and those who underwent revision RCR.

Data Collection

The Outcomes Based Electronic Research Database (OBERD) was screened to identify primary RCR patients who completed the BRS preoperatively. Chart review was then performed on all eligible RCR patients to collect demographic variables including preoperative sports participation, mental health conditions, rotator cuff tear size, and concomitant procedures. Throughout data collection, self-reported mental health conditions such as anxiety and depression were recorded from the patient charts. Two-year follow-up data were collected via patient-reported outcome surveys through RedCap (Vanderbilt University) and included reoperations and the ASES, SANE, and BRS scores. Both ASES and SANE scores range from 0 (poor) to 100 (healthy). A general survey asking about subsequent ipsilateral shoulder surgery was also included to capture potential reoperations at other institutions.

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Ethical approval for this study was obtained from Thomas Jefferson University (ref No. 19E.943).

Preoperative ASES scores were available for all included patients. ASES score improvement was calculated as the difference between the ASES score at 2-year follow-up and the preoperative ASES score. Rates of achieving minimal clinically important difference (MCID), substantial clinical benefit (SCB), Patient Acceptable Symptom State (PASS), and maximal orthopaedic improvement (MOI) were calculated based on ASES score improvement using the previously published MCID, SCB, and PASS values for RCR (21.0 points, 26.0 points, and 78.0, respectively).[13] The MOI was calculated for each patient by subtracting the preoperative score from the 2-year follow-up score and dividing this by the maximal possible improvement in ASES score.[2]

Statistical Analysis

Outcomes were compared in patients with low resilience, normal resilience, and high resilience, defined as follows[27]: patients with preoperative BRS scores >1 SD below the mean were considered low resilience, those with scores ≤1 SD of the mean were considered normal resilience, and those with scores >1 SD above the mean were considered high resilience. Comparisons were made among resilience groups based on preoperative BRS scores and based on BRS scores at 2-year follow-up. Similar subanalyses were performed after removing patients who self-reported experiencing any mental health conditions (ie, anxiety or depression). Comparisons for continuous data were performed using analysis of variance or Kruskal-Wallis tests, and comparisons for categorical data were done using chi-square tests.

Multivariate linear regressions were performed with ASES score improvement as the dependent variable and BRS score, age, sex, sport participation, mental health status, and tear size as independent variables. P values <.05 were deemed significant. All statistical analyses were performed using R Studio (Version 3.6.3; R Foundation for Statistical Computing).

RESULTS

Patient Characteristics

There were 100 RCR patients included in the study (low resilience, n = 17; normal resilience, n = 64; high resilience, n = 19) (Figure 1). Patients had a mean age of 60 ± 9 years, with 52% being male.

There were significant shifts in individual patient resilience groupings from preoperative to 2-year follow-up ($P < .001$), with 38 patients (38%) switching groups (Table 1). Of these 38 patients, 21 moved to a higher resilience group and 17 moved to a lower resilience group. However, across the full cohort, the mean BRS scores did not change significantly from preoperative to 2-year follow-up (3.8 ± 0.7 vs 3.9 ± 0.8; $P = .404$).

Low resilience patients were more likely to self-report anxiety and/or depression (low resilience: 41% vs normal resilience: 6% vs high resilience: 10%; $P = .001$) and had lower preoperative ASES scores than normal and high resilience patients (35 vs 42 vs 54; $P = .022$) (Table 2). No other demographic differences were observed among the study groups.

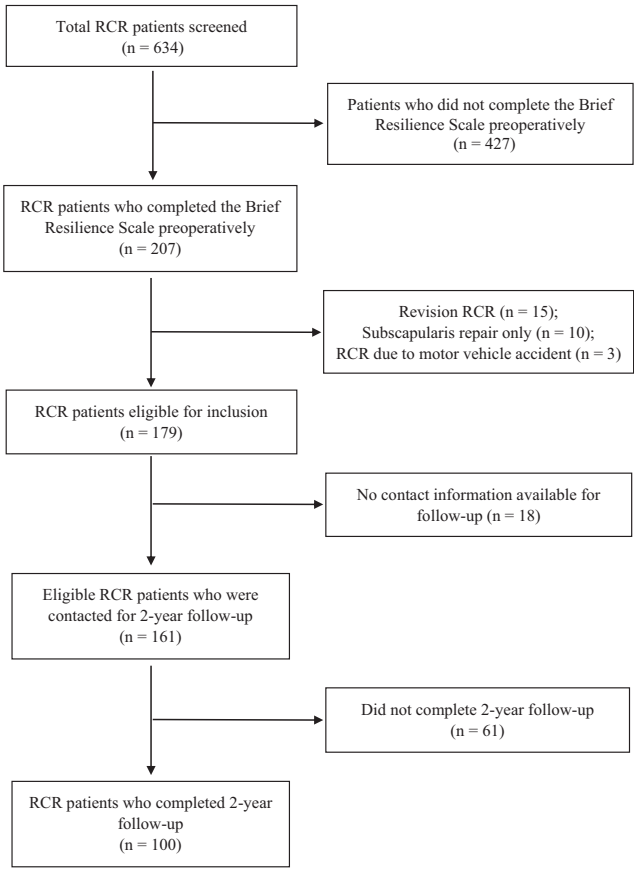

Figure 1. Flowchart of RCR patient inclusion/exclusion process. RCR, rotator cuff repair.

Overall, 87% of patients met MCID, 84% met SCB, and 81% met PASS for ASES score at 2-year follow-up; 5 (5.0%) patients required a revision RCR. Postoperative outcomes did not differ among the groups (Table 3).

Self-Reported Mental Health Conditions Excluded

After removing 13 patients who self-reported experiencing mental health conditions (ie, depression or anxiety), there were 87 RCR patients included in the subanalysis. Low-resilience patients had lower preoperative ASES scores than normal resilience and high resilience patients, and normal resilience patients also had lower preoperative ASES scores than high-resilience patients (low resilience: 29 vs normal resilience: 41 vs high resilience: 55; $P = .008$). No other demographic differences were observed among groups.

After removing patients who self-reported experiencing mental health conditions, significant differences in preoperative ASES scores (low resilience: 29.4 ± 17.7 vs normal

TABLE 1
Changes in Resilience Groupings Among Patients From Preoperative to 2-Year Follow-up[a]

Variable	Resilience Group Preoperatively[b]			*P*
	Low Resilience (n = 17)	Normal Resilience (n = 64)	High Resilience (n = 19)	
Resilience group at 2-y follow-up[b]				**<.001**
Low resilience (n = 15)	8 (47.1%)	7 (10.9%)	0 (0.0%)	
Normal resilience (n = 63)	8 (47.1%)	45 (70.3%)	10 (52.6%)	
High resilience (n = 22)	1 (5.9%)	12 (18.8%)	9 (47.4%)	

[a]Data are presented as n (%). Boldface *P* value indicates statistically significant difference among groups ($P < .05$).
[b]Low resilience, BRS score >1 SD below the mean; normal resilience, BRS score ≤1 SD of the mean; high resilience, BRS score >1 SD above the mean. BRS, Brief Resilience Scale.

TABLE 2
Comparison of Demographics Among Patients by Resilience Group[a]

Variable	Low Resilience (n = 17)	Normal Resilience (n = 64)	High Resilience (n = 19)	*P*
Age, y	61.1 ± 7.7	59.4 ± 9.8	60.1 ± 8.3	.777
Male sex	7 (41.2%)	33 (51.6%)	12 (63.2%)	.417
BMI	30.0 ± 6.0	29.3 ± 5.2	27.9 ± 3.3	.742
Surgery on dominant side	10 (58.8)	37 (57.8)	12 (63.2)	.917
Preop sport participation	1 (5.9)	21 (32.8)	4 (21.1)	.062
Mental health condition				**.001**
None	10 (58.8)	60 (93.8)	17 (89.5)	
Depression	3 (17.6)	0 (0.0)	1 (5.26)	
Anxiety	2 (11.8)	4 (6.25)	1 (5.26)	
Depression and anxiety	2 (11.8)	0 (0.0)	0 (0.0)	
Tear size				.691
Small to medium	2 (11.8)	15 (23.4)	3 (15.8)	
Large	10 (58.8)	38 (59.4)	13 (68.4)	
Massive	5 (29.4)	11 (17.2%)	3 (15.8)	
Subscapular tear	3 (17.6)	19 (29.7)	7 (36.8)	.456
Concomitant biceps tenodesis	5 (29.4)	28 (43.8)	9 (47.4)	.494
Concomitant subacromial decompression	9 (52.9)	36 (56.2)	12 (63.2%)	.809
Preoperative ASES score	35.0 ± 19.1	42.1 ± 18.4	53.6 ± 20.2	**.022**

[a]Data are presented as mean ± SD or n (%). Resilience groups were defined using preoperative BRS scores. Boldface *P* value indicates statistically significant difference among groups ($P < .05$). ASES, American Shoulder and Elbow Surgeons; BMI, body mass index; BRS, Brief Resilience Scale; Preop, preoperative.

resilience: 41.3 ± 18.6 vs high resilience: 54.6 ± 20.2; $P = .008$) were observed among groups, while all other demographic variables were similar among groups (all $P > .05$). A total of 78% of patients met MCID, 77% met SCB, and 82% met PASS for ASES score at 2-year follow-up; 2 (2.3%) patients required a revision RCR. Low resilience patients had significantly lower SANE scores at 2-year follow-up compared with normal resilience and high resilience patients (low resilience: 75 vs normal resilience: 87 vs high resilience: 93, $P = .019$) (Table 4). All other postoperative outcomes did not differ among groups (all $P > .05$).

Results of Multivariate Analyses

Preoperative resilience was not associated with ASES score improvement (β estimate = –5.64; $P = .150$); however, large rotator cuff tear size was significantly associated with ASES score improvement (β estimate = –14.13; $P = 035$) (Table 5). Resilience at 2-year follow-up associated with ASES score improvement (β estimate = 6.41; $P = .031$) (Table 6).

DISCUSSION

Our study hypothesis was not supported, as ASES and SANE scores did not differ among the resilience groups at 2-year follow-up. Multivariate analysis also showed that preoperative resilience was not associated with ASES score improvement after arthroscopic RCR; however, resilience at 2-year follow-up was found to be associated with ASES score improvement (β estimate = 6.41; $P = .031$).

TABLE 3
Comparison of Postoperative Outcomes Among Resilience Groups[a]

Variable	Low Resilience (n = 17)	Normal Resilience (n = 64)	High Resilience (n = 19)	*P*
Revision RCR	1 (5.9)	3 (4.7)	1 (5.3)	≥.999
Nonrevision reoperation	1 (5.9)	2 (3.1)	0 (0.0)	.505
ASES score	82.1 ± 20.3	87.6 ± 16.8	92.6 ± 9.3	.164
ASES score improvement[b]	47.0 ± 23.9	45.0 ± 23.3	38.2 ± 20.5	.406
Met ASES MCID	16 (94.1)	51 (87.9)	11 (73.3)	.229
Met ASES SCB	15 (88.2)	50 (86.2)	11 (73.3)	.400
Met ASES PASS	11 (64.7)	53 (82.8)	17 (89.5)	.168
ASES MOI, %	75.2 ± 25.1	80.5 ± 20.4	83.6 ± 19.7	.521
SANE score	79.9 ± 23.4	86.1 ± 15.3	92.4 ± 7.3	.093
Met SANE PASS	15 (88.2)	56 (87.5)	19 (100)	.339

[a]Data are presented as mean ± SD or n (%). Resilience groups were defined using preoperative BRS. ASES, American Shoulder and Elbow Surgeons; BRS, Brief Resilience Scale; MCID, minimal clinically important difference; MOI, maximal orthopaedic improvement; PASS, Patient Acceptable Symptom State; RCR, rotator cuff repair; SANE, single assessment numeric evaluation; SCB, substantial clinical benefit.
[b]From preoperative to 2-year follow-up.

TABLE 4
Comparison of Postoperative Outcomes Among Resilience Groups for Patients Without Self-Reported Mental Health Conditions (n = 87)[a]

Variable	Low Resilience (n = 10)	Normal Resilience (n = 60)	High Resilience (n = 17)	*P*
Revision RCR	1 (10.0)	1 (1.7)	0 (0.0)	.254
Nonrevision reoperation	1 (10.0)	3 (5.0)	0 (0.0)	.520
ASES score	79.5 ± 22.8	88.2 ± 15.8	92.7 ± 9.5	.101
ASES score improvement[b]	50.1 ± 30.1	46.5 ± 21.9	37.1 ± 19.4	.175
Met ASES MCID	9 (90.0)	49 (90.7)	10 (76.9)	.336
Met ASES SCB	9 (90.0)	48 (88.9)	10 (76.9)	.500
Met ASES PASS	6 (60.0)	50 (83.3)	15 (88.2)	.193
ASES MOI, %	72.9 ± 28.8	81.8 ± 20.0	84.3 ± 19.5	.372
SANE score	75.1 ± 27.6	86.8 ± 13.8	92.8 ± 7.0	**.019**
Met SANE PASS	9 (90.0)	53 (88.3)	17 (100)	.427

[a]Data are presented as mean ± SD or n (%). Resilience groups were defined using preoperative BRS scores. Boldface *P* value indicates statistically significant difference among groups ($P < .05$). ASES, American Shoulder and Elbow Surgeons; BRS, Brief Resilience Scale; MCID, minimal clinically important difference; MOI, maximal orthopaedic improvement; PASS, Patient Acceptable Symptom State; SANE, single assessment numeric evaluation; SCB, substantial clinical benefit.
[b]From preoperative to 2-year follow-up.

Although resilience may have been suggested to be relatively static in part due to its correlation with personality characteristics, previous studies that have explored its change over time have demonstrated it to be more dynamic. Specifically, it has been suggested that resilience can increase in response to stressors such as the COVID-19 pandemic, with positive changes indicating improved adaptations.[12,14,24] The 38% of patients in this study who changed resilience groups (21 moving up, 17 moving down) is consistent with the idea of resilience as dynamic and may indicate the variable response to stress that resilience can take. Whereas individual patients were seen to shift across resilience groups over time, the overall mean BRS score of the full cohort was similar from pre- to postoperatively. This is similar to the findings of Magaldi et al,[16] who noted consistency from preoperative to 3- and 12-month postoperative resilience scores in TKA patients, and also to the findings by Wilson et al,[30] who found no significant difference in resilience at 3- or 6-month follow-up for RCR patients (both also measured using the BRS). The current study went a step further and stratified patients into resilience groups,[27] which may help identify changes in individual resilience over time, something that previous studies could not assess with a lumped mean resilience score.[16,30]

While several studies previously examined preoperative BRS scores and postoperative RCR outcomes, many of these studies utilized either shorter-term follow-up or less specific measures of resilience. For example, 1 study found no correlation between preoperative mental health and ASES outcomes measured at 3 and 6 months after RCR,[30] while another found no correlation between preoperative resilience and the ability to reach a predetermined ASES SCB threshold at 6-month or 1-year follow-up.[9] Unlike these previous studies, the current study evaluated the effects of preoperative resilience on RCR patients at

TABLE 5
Multivariate Regression Evaluating Association of Preoperative Resilience and Other Variables with ASES Score Improvement[a]

Variable	β Estimate (95% CI)	*P*
Preop resilience	−5.64 (−13.26 to 1.97)	.150
Age	0.18 (−0.38 to 0.74)	.528
Sex	4.50 (−6.03 to 15.02)	.405
Preop sport participation	−1.32 (−13.16 to 10.51)	.827
Mental health		
None	Reference	–
Depression	−5.76 (−29.68 to 18.15)	.638
Anxiety	−4.08 (−22.68 to 14.52)	.669
Both	−18.49 (−52.48 to 15.50)	.290
Tear size		
Small/medium	Reference	–
Large	−14.13 (−27.07 to –1.22)	**.035**
Massive	−8.52 (−24.71 to 7.66)	.305

[a]Boldface *P* value indicates statistical significance ($P < .05$). Dashes indicate areas not applicable. Preop, preoperative.

TABLE 6
Multivariate Regression Evaluating Association of Resilience at 2-Year Follow-up and Other Variables With ASES Score Improvement[a]

Variable	β Estimate (95% CI)	*P*
2-year resilience	6.41 (0.68 to 12.14)	**.031**
Age	−0.004 (−0.52 to 0.51)	.987
Sex	1.01 (−8.53 to 10.55)	.836
Preop sport participation	−4.02 (−14.84 to 6.81)	.469
Mental health conditions		
None	Reference	–
Depression	−4.73 (−26.50 to 17.05)	.672
Anxiety	−3.10 (−20.26 to 14.06)	.724
Both	−13.64 (−56.06 to 28.79)	.531
Tear size		
Small/medium	Reference	–
Large	−9.69 (−21.76 to 2.39)	.120
Massive	−5.78 (−20.58 to 9.02)	.446

[a]Boldface *P* value indicates statistical significance ($P < .05$). Dashes indicate areas not applicable. Preop, preoperative.

a longer-term follow-up time point of 2 years; however, findings still aligned with these previous studies as preoperative resilience was not associated with improvements in ASES score in the current study.

Resilience also has been shown to correlate with patient-reported outcomes after arthroplasty procedures. For example, Tokish et al[27] and Dombrowsky et al[5] found concurrent resilience scores (measured with BRS) correlated with ASES, SANE, and Penn Shoulder scores at 2-year follow-up after TSA and reverse TSA, respectively. This study showed that outcome scores in the low resilience group averaged 40 points lower than outcome scores in the high resilience group for SANE scores.[27] Magaldi et al[16] found similar findings when evaluating patients after TKA, with a significant correlation between concurrent resilience (BRS score) and Knee injury and Osteoarthritis Outcome Score-Joint Replacement scores at 3 and 12 months postoperatively. The current study also found that SANE scores were lower in patients with lower preoperative resilience.

The BRS has been validated as a reliable single factor scale even when discriminated against the Big 5 personality traits (openness, conscientiousness, extroversion, agreeableness, and neuroticism), life satisfaction, positive and negative affect, and perceived stress.[18,25,31] However, the significant variability in resilience with time seen in this study suggests that other external factors can influence one's resilience. For example, Thomeé et al[26] found that patients' self-efficacy in knee function before anterior cruciate ligament reconstruction could predict physical activity levels, symptoms, and muscle function 1 year after their procedure.[7,26] Thus, further studies evaluating factors that influence resilience may lead to identification of modifiable factors that can improve patient resilience and, ultimately, postoperative outcomes.

Although the relationship between various aspects of mental health and resiliency is complicated, some research has been performed in an effort to clarify this relationship. For example, research evaluating juveniles placed in educational centers found that resilience was a predictor of mental health (depression, satisfaction, well-being), and that coping strategies also played an important role in this relationship.[15] Psychologic health conditions besides resilience have also been investigated to understand their influence on orthopaedic surgical outcomes. Johnson et al[11] examined the relationship between depression and anxiety and postoperative outcomes in 816 patients who underwent RCR, finding that patients with depression and anxiety reported higher pain and lower patient-reported assessments scores at initial and final postoperative assessment. In a study of 144 patients who underwent RCR, Park et al[22] also examined the relationship between depression and anxiety on clinical outcomes and similarly found that patients with these conditions had higher pain and decreased shoulder range of motion. However, in contrast to the findings of Johnson et al,[11] there were no differences in clinical and patient-reported outcomes between groups at final follow-up (6 months) in Park et al.[22] In the current study, there was a significant difference in the rate of depression, anxiety, or both between different resilience groups and, when patients with these conditions were included in analysis, there was no difference in postoperative outcome. These conditions also were not related to ASES score improvement in multivariate analysis, suggesting that these variables may not be significant confounding variables in the analysis of patient resilience.

Limitations

This study is not without limitations. First, there are many patients who underwent RCR during our study period who did not complete the BRS, which may have led to bias in our results. Also, the electronic medical records and the Current Procedural Terminology code 29827 were used to

identify RCR patients. This methodology relies on accurate coding and billing, which introduces the possibility of some eligible patients not being identified for inclusion. In addition, achievement of MCID was determined using cutoffs from a previous study,[13] which may not be an ideal representation of the current study cohort due to patient differences. Finally, although we attempted to adjust for anxiety and depression, other psychological factors (stress, grit, optimism, etc) may be confounding variables also affecting outcomes in addition to resilience.

CONCLUSION

Patient-reported outcomes at 2-year follow-up did not differ based on preoperative patient resilience for arthroscopic RCR patients. Multivariate analysis also showed that preoperative resilience did not correlate with ASES score improvement after RCR; however, resilience at 2-year follow-up instead correlated with ASES score improvement.

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