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Arthroscopic subacromial decompression improved outcomes in situationally depressed patients compared to clinically depressed or nondepressed patients

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Background: The purpose of this study is to evaluate patient reported outcomes after arthroscopic extensive débridement of the shoulder with subacromial decompression (SAD) for subacromial impingement using the Patient-Reported Outcomes Measurement Information System (PROMIS) system and evaluate if depression (Dep) (clinical or situational) impacts patients achieving a Minimal Clinically Important Difference (MCID).
Methods: Preoperative PROMIS Physical function (PF), Mood, and Dep scores were obtained at the closest date prior to arthroscopic rotator cuff repair and postoperative scores were collected at every clinical visit thereafter. Final PROMIS score used for data analysis was determined by the patients final PROMIS value between 90 to 180 days. Clinical Dep was determined by patients having a formal diagnosis of "Depression or Major Depressive Disorder" at the time of their surgery. Situationally depressed patients, those without a formal diagnosis yet exhibited symptomatic depressive symptoms, were classified by having a PROMIS-Dep cutoff scores larger than 52.5.
Results: A total of 136 patients were included for final statistical analysis. 13 patients had a clinical but not situational diagnosis of Dep, 86 patients were identified who had no instance of clinical or situational Dep (nondepressed). 35 patients were situationally depressed. All three cohorts demonstrated a significant improvement in postoperative PROMIS Dep, PI, and PF score relative to their preoperative value ($P = .001$). Situationally depressed patients achieved greater delta PROMIS-Dep compared to patients with major depressive disorder. Depressed patients had a higher chance of achieving MCID for PROMIS-Dep compared to nondepressed patients ($P = .01$). Logistic regression analysis demonstrated that underlying Dep did not alter the odds of obtaining MCID compared to nondepressed patients. Nonsmoking patients had significantly greater odds of achieving MCID for PF ($P = .02$).
Discussion: Patients improved after undergoing SAD regardless of underlying Dep or depressive symptoms. Depressed patients exhibited greater change in PROMIS scores compared to nondepressed patients. Smoking remains a risk factor for postoperative outcomes in patients undergoing SAD for subacromial impingement. Identifying and counseling patients with underlying depressive symptoms without a formal major depressive disorder diagnosis may lead to improved outcomes. These findings may help guide clinicians in deciding who would benefit the most from this procedure.

4.5 million Americans present to physicians each year for shoulder pain, an often-disabling pathology which prevents patients from performing some of the most basic activities of daily life.[21,40] One of the most common causes of shoulder pain include subacromial impingement (SAI) caused by narrowing of the subacromial space, producing functional pain due to compression of the bursa or rotator cuff and an uneven surface associated with possible future arthrosis.[1,8,10,11,13,15,18,31,32] This uneven surface leads to recurrent inflammation and irritation of the nearby rotator cuff, further exacerbating the inflammatory process.[39] First line therapy for shoulder impingement includes antiinflammatory medications, rest, and physical therapy; however, these treatments typically are not effective long-term.[14] Because of the above, surgical

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decompression has been considered for patients who fail conservative management; however, who benefits the most from this procedure remains up for debate.[24,34,55,56]

It has been well characterized that patient-specific psychological factors play a significant negative role in surgical outcomes such as depression (Dep), which has already been shown to worsen patient reported outcomes.[9,26,30,53] This could be due to those who are depressed having thoughts of hopelessness and impending sense of failure which may reduce motivation to attend postoperative physical therapy and or clinic visits, or because Dep affects pain perception due to hyperactivation of pain receptors and increase in pain sensitivity.[19,48] Therefore, patients who are depressed may show reduced improvement in outcomes compared to the standard patient population.[35] The main limitation with this methodology is failure to assess a patient's Dep into a score that can be tracked prospectively, as not all patients have a formal diagnosis of major depressive disorder (MDD) and may instead have situational Dep or merely depressive thoughts. Recently there has been increasing traction for the use of Patient-Reported Outcomes Measurement Information System (PROMIS) to assess levels of situational Dep rather than rely on a diagnosis of MDD alone.[51] To date, there is no study which has assessed if there is a difference in shoulder surgery outcomes for patients who either have a clinical or situational diagnosis of Dep based on PROMIS scores for those undergoing subacromial decompression (SAD) and extensive débridement. Therefore, the purpose of this study is to assess if a there is a difference in outcomes following a SAD for patients without MDD vs. those with MDD or situational Dep.

Methods

Ethical approval from the institutional review board was received prior to data collection and analysis. Billing CPT codes was used to identify patients who underwent SAD and extensive débridement from January 1, 2015, to October 31, 2021. Demographic and surgical data was retrospectively extracted from the electronic medical record. Subjects included in the study consisted of those of 18 years or older who had a clinical diagnosis of subacromial shoulder impingement and underwent SAD with concomitant débridement by 5 board-certified fellowship trained orthopedic surgeons. Exclusion criteria consisted of patients who shoulder pathologies included: rotator cuff tear, long head biceps tendonitis and labral tear. The primary outcome of the study was to assess the impact of Dep on preoperative and postoperative PROMIS Dep, and Physical Function (PF) scores at more than 3 months after surgery.

As part of a standardized process, patients who presented for any clinical encounter with the sports medicine orthopedic team were asked to complete PROMIS questionnaires on a tablet. Specific PROMIS categories collected for data analysis consisted of Pain Interference (PI), PF, and Dep. PROMIS scores identified for data analysis included the preoperative PROMIS score that was closest to the subject's surgery date along with each clinical visit regarding their injury thereafter. Patients who failed to complete a PROMIS questionnaire at or beyond 6 months from their surgical intervention were excluded from further data analysis. Preoperative PROMIS PF, and Dep scores were obtained at the closest date prior to arthroscopic rotator cuff repair and postoperative scores were collected at every clinical visit thereafter. Final PROMIS score used for data analysis was determined by the patients final PROMIS value between 90 and 180 days.

Dep was determined by patients having a diagnosis of "Depression or Major Depressive Disorder" at the time of their surgery or by having a PROMIS Dep score > 52.5 based upon established correlation to the validated Patient Health Questionnaire-9. This grouping allows us to capture patients who have either not yet been formally diagnosed with Dep or maybe situationally depressed during this study.

Unadjusted bivariate t-test analysis was performed to assess differences in continuous variables between depressed and nondepressed patients. Minimal Clinically Important difference (MCID) was determined as one-half of a standard deviation of a given preoperative PROMIS value. Logistic regression was performed to assess if Dep type would impact ability to achieve MCID. Two sample t test was used to perform a power analysis to detect an improvement in MCID between depressed and nondepressed patients and found that 44 patients were needed in each cohort to achieve a power of 0.8.

Results

Descriptive summary

A total of 136 patients met the final inclusion and exclusion criteria. The average time of the final follow-up was 6 ± 2.5 months. Among the patients, 86 were classified as nondepressed, while 48 were classified as depressed (13 with clinical Dep and 35 with PROMIS Depressed). There were significantly more females in the depressed group than in the nondepressed group (59.6% vs. 33.3%, $P = .003$). There were no significant differences in age, BMI, insurance, smoking status, and time of final follow-up between the depressed and nondepressed patients (Table 1).

PROMIS unadjusted bivariate analysis

Patients in the depressed cohort had significantly worse pre PROMIS-PI ($P = .01$), PF ($P = .001$), and Dep ($P = .001$) scores compared to nondepressed patients (Table 2, Fig. 1). However, the depressed group demonstrated significantly greater improvement in change in PROMIS-Dep scores ($P = .007$) (Table 2). There were no significant differences identified in the change in PROMIS values for PI ($P = .82$) and PF ($P = .68$) between depressed and nondepressed patients (Fig. 1). Nevertheless, both depressed and nondepressed patients showed significant improvement at final follow-up compared to their respective preoperative PROMIS scores for PI, PF, and Dep ($P = .001$, respectively) (Fig. 1). A sub analysis was performed to assess differences in PROMIS scores between clinically depressed and situationally depressed patients. The analysis revealed that situationally depressed patients had significantly worse preoperative PROMIS scores in PI ($P = .003$), PF ($P = .01$), and Dep ($P = .001$) (Table 3). Furthermore, the sub analysis showed that situationally depressed patients demonstrated a significantly greater improvement in delta PROMIS-Dep scores compared to clinically depressed patients (-6.80 ± 8.2 vs 0.58 ± 9.2; $P = .01$). However, there was no significant difference found for delta PROMIS-PI ($P = .07$) or PF ($P = .10$) scores.

Minimal difference

The change in PROMIS value required to achieve MCID was a difference at the final PROMIS follow-up from the preoperative score of −2.9 for PI, 3.6 for PF, and −4.8 for Dep. The depressed group had a significantly greater percentage of patients within their respective group who reached MCID for Dep compared to the nondepressed group (42.6% vs. 22.4%; $P = .01$) (Fig. 2). However, there were no significant differences in the percentage attaining MCID between depressed and nondepressed patients for PI (58.3% vs. 53.4%; $P = .36$) and for PF (50.0% vs. 56.5%, $P = .30$) (Fig. 2). Regression analysis demonstrated that Dep was a nonsignificant predictor for the odds of reaching MCID for PI (odds ratio [OR] .81;

Table I
Demographics of nondepressed vs. depressed patients.

	Nondepressed		Depressed		*P* value
Age (M, SD)	55.6	10.9	56.1	9.3	.67
Final follow-up (Mo, **M, SD**)	5.3	2.5	5.5	2.5	
BMI (N, %)					.27
Nonobese	40	47.1%	25	54.3%	
Obese	45	52.9%	21	45.7%	
Gender (N, %)					**.004**
Female	56	33.3%	28	59.6%	
Male	28	66.7%	19	40.4%	
Insurance (N, %)					.44
Commercial	50	59.5%	21	44.7%	
Medicaid	6	7.1%	5	10.6%	
Medicare	17	20.2%	13	27.7%	
Workers Compensation	11	13.1%	8	17.0%	
Smoking status (N, %)					
Nonsmoker	78	90.7%	41	87.2%	.37
Current-Smoker	8	8.3%	6	12.8%	

M, mean; *SD*, standard deviation; *BM*, body mass index; *N*, total number.
Bolded *P* values are significant as they are below .05.

Table II
PROMIS outcomes between nondepressed and depressed patients.

PROMIS domain	Nondepressed		Depressed		*P* value
	M	SD	M	SD	
Pain interference					
Preoperative	58.2	5.8	60.8	5.6	**.01**
Postoperative	53.2	8.5	56.1	7.9	**.04**
Delta	−4.9	8.3	−4.6	7.2	.82
Physical function					
Preoperative	42.3	6.9	37.9	6.7	**.001**
Postoperative	46.0	8.8	42.3	8.7	**.02**
Delta	3.8	9.0	4.4	8.1	.68
Depression					
Preoperative	40.0	6.1	54.5	7.6	**.001**
Postoperative	39.0	6.4	49.5	8.6	**.001**
Delta	−1.1	7.0	−4.9	9.0	**.007**

M, mean; *PROMIS*, Patient-Reported Outcomes Measurement Information System; *SD*, standard deviation.
Bolded *P* values are significant as they are below .05.

95% confidence interval [CI] .38-1.73; $P = .58$), PF (OR 1.53; 95% CI .70-3.37; $P = .29$) but trended towards significance for Dep (OR .81; 95% CI .19-1.02; $P = .06$). Additionally, nonsmoking patients had significantly greater odds of achieving MCID for PF (OR: 5.55; 95% CI 1.37-22.4; $P = .02$).

Discussion

The most important findings in our study are that patients in general benefit from an SAD procedure regardless of having no clinical diagnosis of MDD or being situationally depressed based on preoperative PROMIS-Dep scores, and depressed patients demonstrated higher delta PROMIS-Dep scores compared to nondepressed patients, reflecting a greater perception of depressive symptoms in this patient population. This was especially true in the situationally depressed cohort. Depressed patients were more likely to achieve MCID for PROMIS-Dep compared to nondepressed patients; however, underlying Dep ultimately did not alter the odds of obtaining MCID for any PROMIS variable. Smoking was also predictive for not achieving MCID for PF. Therefore, based on our PROMIS data SAD has a role in improving the perceived outcomes of SAI on all patients, even if they have been formally diagnosed with MDD or exhibit situationally dependent depressive symptoms.

SAI remains a common yet debilitating cause of shoulder pain and restricted movement with no clear, satisfying treatment options for patients who fail nonoperative management.[6] With the advent of arthroscopy, SAD, the ability to resect/débride bone spurs off the acromion as well as any inflamed soft tissue or bursa, has increasingly been performed as a potential solution to those who fail nonoperative management regardless of any comorbidities.[23,47] However, the literature remains at odds with how effective SAD truly is, whether it be from a clinical or cost perspective. eg, there is evidence suggesting the SAD is effective in selected patients with demonstratable shoulder impingement in addition to pain, or those who fail extensive physical therapy.[4,25,29] Fanfares et al[16] recently showed that long-term outcomes (10 years) after surgical management of SAI rendered superior results than nonoperative management alone. Butt et al in turn found that SAD led to significant improvements in Oxford Shoulder Scores and mean health utility measures (such as the EQ-5D, with QALY of almost 6000 dollars per patient), thus arguing that SAD highly cost effective.[7]

However, there remains a significant body of literature suggesting that SAD in turn provides no clinically significant benefits compared to arthroscopic sham procedures alone, with questions as to whether this procedure can be both clinically and cost effective given the amount of instrumentation and operative time necessary to perform the procedure compared to nonoperative management.[2,22,27,38,43] Therefore, it is important to better understand if there is a specific patient population of patients who perhaps may benefit more from having this procedure vs. offering SAD to all patients with SAI.

Clinical MDD is a major comorbidity in Orthopedics, influencing perception of outcomes, pain, and ability to maximize physical therapy outcomes.[17,36,37,42,44,52] In regard to SAI, while it has been assumed that MDD may play a role in worse outcome, there is limited literature directly addressing the role of MDD in SAI patients. Dekker et al[12] used the Hospital Anxiety and Depression Scale to screen for possible MDD in their SAI population and found that those patients undergoing SAD with higher Hospital Anxiety and Depression Scale scores > 11 had worse functional outcomes and patient satisfaction at follow-up. Thorpe et al[52] found that patients who scored poorly on psychologic measures regarding MDD or coping skills tended to have worse American Shoulder and Elbow Surgeons Standardized Scores at all time points, but patients with depressive symptoms (though not clinically diagnosed with MDD) still benefited from surgery showing significant postoperative improvement. Baker et al[3] found that postoperative PROMIS-PF was negatively influenced by lower PROMIS-Dep and PROMIS-anxiety scores in patients undergoing shoulder surgery, but patients still showed improvement postoperatively. Our findings ultimately did show that the change in PROMIS scores was similar whether patients were depressed or not, though MDD or underlying depressive symptoms did negatively influence scores at average 6 month follow-up compared to nondepressed patients.

Previous studies addressing other shoulder procedures in MDD patients have also shown similar findings compared to nondepressed patients, and in fact depressed patients may show a greater improvement after surgery even if their final postop scores are somewhat lower than nondepressed patients.[28,54] Lau et al[28] found that patients who had mood disorders directly related to their shoulder symptoms also showed significant improvement after rotator cuff surgery. Therefore, patients with MDD or situational Dep related to their SAI may be more ideal candidates to attempt SAI after failure of nonoperative management, as remains the importance of managing expectations after SAD. However, given our findings, it cannot be more emphasized

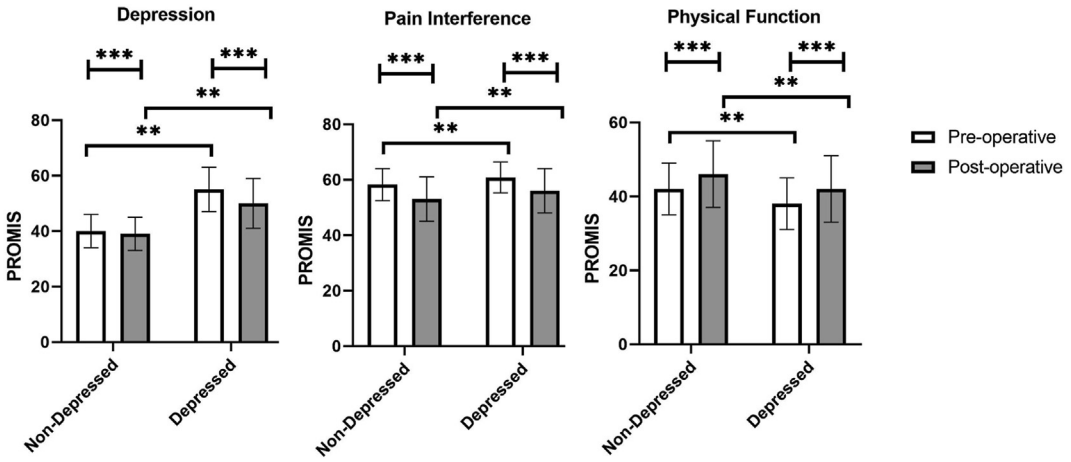

Figure 1 Comparison of PROMIS scores between nondepressed and depressed patients. Asterisks signify $P < .05$. *PROMIS*, Patient-Reported Outcomes Measurement Information System.

Table III
Comparison of PROMIS scores between clinically and situationally depressed patients.

PROMIS	Clinically depressed		PROMIS-depressed		*P* value
	M	SD	M	SD	
Preoperative					
Pain Interference	57.2	5.9	62.0	4.9	**.003**
Physical Function	41.9	7.2	36.5	6.0	**.01**
Depression	44.3	6.5	57.9	4.0	**.001**
Delta					
Pain Interference	−1.45	5.0	−5.80	7.6	.07
Physical Function	1.65	8.1	5.4	7.9	.10
Depression	0.58	9.2	−6.80	8.2	**.01**

M, mean; *PROMIS*, Patient-Reported Outcomes Measurement Information System; *SD*, standard deviation.
Bolded *P* values are significant as they are below .05.

that screening patients for Dep remains of utmost importance in providing multimodal care for Orthopedic patients. The psychological aspect of perception of care and recovery necessitates further study for SAI and other sports related Orthopedic procedures overall.

Of note, smoking has long been known to have deleterious effects on postoperative outcomes and risk of complications within Orthopedics. Our study's findings that PROMIS-PF may be adversely affected by smoking is in line with previous literature highlighting potentially worse reported and physical outcomes,[5,20,33,45] though smokers do still have improved outcomes compared to their preoperative state.[33] Therefore, it remains of utmost importance for surgeons to screen for smoking status and encourage smoking cessation at least two weeks before their procedure to minimize risk of complications.

Regardless of baseline MDD or situational depressive symptoms, what is clear is that physical therapy remains the first line treatment option for SAI. Multiple Randomized Controlled Trials and meta-analyses have concluded that SAD provides no benefit over exercise therapy on pain, general function, and return to work at up to 5-year follow-up.[27,41] However, despite many patients showing at minimum marginal improvement in symptoms (with a sizable cohort having resolution of symptoms), a significant number of patients still complained of debilitating symptoms despite physical therapy for up to 12 months.[49] Therefore, in addition to physical therapy, cortisone injections have also been employed, with effective short-term success.[41] It is recommended that cortisone injections not be employed without physical therapy, which would incur inferior outcomes.[29] Overall, it is important to note that depressed patients are more likely to fail with nonoperative management compared to nondepressed patients when it comes to sports related conditions, though there is limited literature addressing physical therapy adherence in SAI patients.[37,46]

Another important aspect of our study is the use of PROMIS data to evaluate preoperative and postoperative outcomes in patients undergoing SAD. The American Shoulder and Elbow Surgeons score, Constant Score and Simple Shoulder Test, Short Form-36 Health Survey, and other legacy outcome measurements have long been used to evaluate patients with SAI undergoing SAD.[38] PROMIS instruments were developed using computerized adaptive testing to allow for efficient administration of disease-specific patient reported outcomes, reducing patient burden while also capturing all points of clinical interest.[50] Strong et al[50] confirmed that use of PROMIS instruments demonstrated high efficiency and excellent person reliability to American Shoulder and Elbow Surgeons Standardized Scores, providing further validation in their use for this patient population. Therefore, based on our findings in comparison to the literature, both preoperative and postoperative clinical outcomes in patients undergoing SAD can likely be appropriately captured with PROMIS variables. Our findings also suggest that a distinction is present between clinically depressed patients vs. those who are situationally depressed, which can further impact postoperative outcomes not just for SAD but for any surgical procedure. If one were to define clinical Dep solely on preoperative PROMIS Dep, then a sizable cohort of patients with situational Dep can conflate the results of those with clinical MDD, which was seen in Scahffer et al's[46] recent study and ours as well, where situationally depressed patients may report worse preoperative scores, thus affecting postoperative outcomes.

There are multiple limitations in this study, most significantly this study is underpowered to determine differences in PROMIS outcome scores between clinically and situationally dependent patients. Because this was a retrospective study, clinical diagnosis of MDD was based on chart review alone, which may have not captured all patients with clinical MDD in our study. A selection bias may have also occurred regarding which patients may have chosen to fill out PROMIS scores. Furthermore, our follow-up is limited to around 6 months after surgery, though there already is established literature on general outcomes of

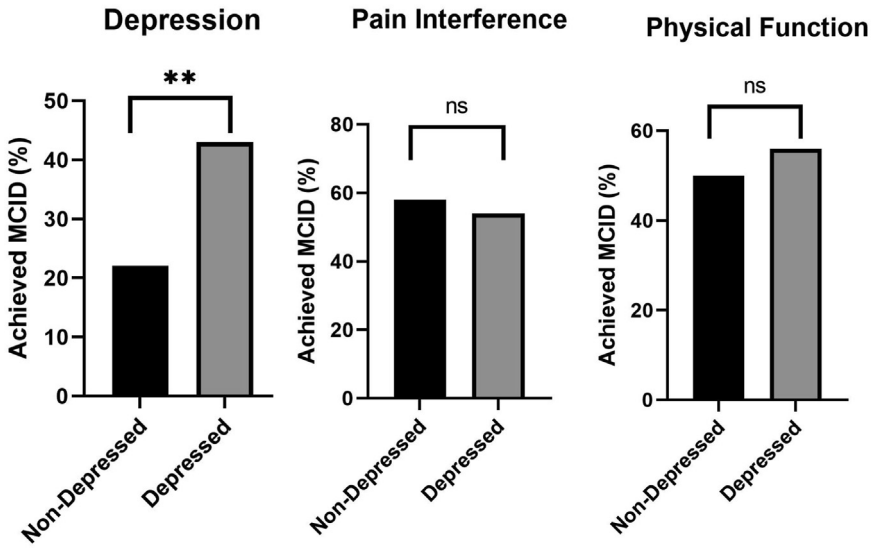

Figure 2 Comparison of patients achieving MCID for measured PROMIS scores between nondepressed and depressed patients. Asterisks signify $P < .05$. *MCID*, Minimal Clinically Important Difference.

SAD up to 5 years after surgery. This is in part due to our surgeons not routinely following up with patients beyond 6 months if they have otherwise recovered from surgery and are not reporting any complications inhibiting them from gradual return to activity.

Conclusion

Patients regardless of having underlying clinical or situation Dep improve after SAD for SAI. Depressed patients reported significant improvements in PROMIS-Dep compared to nondepressed patients despite reporting significantly worse preoperative scores. Situationally depressed patients were more likely to report improved PROMIS-Dep scores compared to clinically depressed patients after SAD. Smokers are at risk of having less improvement after SAD compared to nonsmokers.

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