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Effectiveness of nonoperative treatment in patients with glenohumeral osteoarthritis: a prospective cohort study

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Background: There is limited evidence supporting the use of nonoperative strategies in the treatment of glenohumeral osteoarthritis (GHOA). Recent clinical practice guidelines have stated that it is unclear whether nonoperative management of GHOA would produce a clinically important difference in pain or function. Therefore, the purpose of this study was to determine the effectiveness of nonoperative treatment on patient-reported outcomes (PROs) and to identify factors that could predict which patients would undergo total shoulder arthroplasty (TSA).

Methods: 62 patients with primary GHOA were recruited. Patients could choose to receive or refuse different nonoperative modalities, including physical therapy (PT) and corticosteroid injections, based on their preference. American Shoulder and Elbow Surgeons (ASES) score were administered at baseline, 3, 6, and 12 months to evaluate treatment response. Demographic, clinical, and radiographic characteristics were compared between patients who failed and did not fail nonoperative management. Failure was defined as having undergone TSA.

Results: 14 (23%) patients who initially attempted nonoperative management underwent TSA at 7.7 months (range, 1.6-25.2 months). In patients who continued nonoperative management, only 19 (31%) patients met the minimum clinical important difference and 26 (42%) patients achieved patient acceptable symptom state. There was no significant difference in the change in ASES score between patients who did and did not undergo PT ($P = .524$). A lack of belief in PT (HR = 33.6 [95% CI: 5.26-214], $P < .001$), decrease in ASES score (HR = 6.25 [95% CI: 2.04-20.0], $P = .001$]), female sex (HR = 5.38 [95% CI: 1.31-22.1], $P = .020$), and lower resilience (HR = 7.14 [95% CI: 1.78-33.3], $P = .006$) were independently associated with failure of nonoperative treatment. Patients who received at least one glenohumeral corticosteroid injection (HR = 0.16 [95% CI: 0.04-0.67], $P = .012$) or had more joint space remaining (HR = 0.22 [95% CI: 0.06-0.80], $P = .021$) had a decreased risk of failure.

Conclusions: Approximately, 30% of patients with GHOA who chose their nonoperative treatment regimen had clinically meaningful improvements in symptoms. Despite this, patients elected to undergo TSA less than 25% of the time at short-term follow-up. PT was not beneficial in the treatment of GHOA. Screening questionnaires that evaluate a patient's belief in PT and resilience could potentially be used to identify which patients will fail nonoperative treatment.

Glenohumeral osteoarthritis (GHOA) is becoming increasingly common in the United States due to an aging population. Up to 32% of patients over the age of 60 have radiographic evidence of GHOA.[14] While surgery, consisting of anatomic or reverse total shoulder arthroplasty (TSA), is a reliable treatment option, the effectiveness of nonoperative treatment, including activity modification, nonsteroidal anti-inflammatory (NSAID) medications, physical therapy (PT), and corticosteroid injections, have largely been extrapolated from the hip and knee osteoarthritis literature.[12] A combination of conservative therapies has been shown to be efficacious in reducing shoulder pain and improving function up to 3 years.[11] Furthermore, failure rates of nonoperative treatment have been reported to be as low as 5% at 5 years and 13% at 10 years, with eccentric bone loss and avascular necrosis being identified as risk factors for progression to shoulder arthroplasty.[10]

This study was approved by the authors' Institutional Review Board (IRB-20-30405).

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Despite these findings, there is limited evidence on the nonoperative treatment of GHOA in the literature. The American Academy of Orthopaedic Surgeons published a clinical practice guideline summary in 2020 stating that there was insufficient evidence to support whether nonoperative management of GHOA would produce a clinically important difference in symptoms.[12] Studies to date have been limited by small sample sizes, mixing of different shoulder pathologies, and variable methodological quality. As such, they were unable to recommend for or against the use of PT, pharmacotherapy, and injections.[12] Understanding the efficacy of nonoperative treatment is critical in chronic musculoskeletal disease states, as healthcare expenditures tend to be the highest in the year leading up to definitive treatment with little effect on the outcomes or function.[1]

The purpose of this study was two-fold: 1) to determine the effects of nonoperative treatment on patient-reported outcomes (PROs), and 2) to identify factors that predict which patients would fail nonoperative treatment and require TSA. We hypothesized that nonoperative treatment would improve PROs and that PT would be protective against failure.

Methods

Study participants

This prospective, pragmatic, single-armed cohort study was conducted from January 2021 to December 2022 after obtaining the approval by our institutional review board. All new patients with a diagnosis of primary GHOA were included. Patients were excluded if they had a history of shoulder fracture, dislocation, infection, active cancer, full-thickness rotator cuff tear, workers' compensation claim, prior shoulder surgery, or contralateral TSA. Of the 81 patients who met the inclusion and exclusion criteria, 62 (77%) patients elected to participate in the study. A shoulder magnetic resonance imaging or ultrasound was available to confirm the absence of a rotator cuff tear in 39 (63%) patients.

Nonoperative treatment

At the initial visit, demographics and information about prior treatments were collected. All patients were offered various nonoperative treatment modalities, consisting of acetaminophen, NSAIDs, corticosteroid injections, and PT, regardless of prior treatments. A standardized PT protocol that focuses on shoulder motion and strengthening was prescribed for 6 weeks. PT was performed at a location of the patient's choosing. Patients could choose to receive or refuse different modalities based on their preference. Glenohumeral corticosteroid injections were commonly administered under ultrasound guidance and could be repeated every 3 months. After 6 weeks of nonoperative treatment, patients could elect to continue nonoperative treatment or elect to undergo TSA.

Patient-reported outcome questionnaires

Questionnaires, which included the American Shoulder and Elbow Surgeons (ASES) score, brief resilience scale, hospital anxiety and depression scale, perceived stress scale , and pain catastrophizing scale (PCS), were administered to patients at baseline. The ASES score was also collected at 3, 6, and 12 months after enrollment. 54 (87%) patients, 48 (77%), and 33 (53%) patients completed their ASES forms at 3, 6, and 12 months, respectively. Patients received anchor questions at each follow-up at the time of TSA or at study closure. These questions were used to determine minimum clinical important difference (MCID) and patient acceptable symptom state (PASS). The pain anchor question was phrased, "Since the start of the study, has there been any change in the pain in your shoulder?" Responses were graded on a 15-point scale that ranged from −7 ("a very great deal worse") to +7 ("a very great deal better"). The satisfaction anchor was phrased, "Taking into account all activities you have done during your daily life, your level of pain, and also your functional impairment, do you consider that your current state is satisfactory?" Responses were binary.

To assess the impact of a patient's mental state on outcomes, several validated questionnaires were administered. The brief resilience scale assesses the ability for patients to bounce back and recover from stress. It is scored from 1 to 5, with 1 indicating low resilience and 5 indicating high resilience.[26] Hospital anxiety and depression scale is a questionnaire consisting of anxiety and depression subscales each scored from 0 to 21, with higher scores representing more severe mood symptoms.[27] Perceived stress scale measures the degree to which situations in a patient's life are appraised as stressful. It is scored from 0 to 40, with scores above 13 and 26, indicating moderate and severe stress, respectively.[4] PCS evaluates a patient's perception of and response to pain, with scores ranging from 0 to 52. Higher PCS scores indicate a greater degree of pain catastrophizing.[6]

Imaging analysis

All radiographs (Grashey, weighted abducted Grashey, axillary lateral, scapular Y, and acromioclavicular joint views) were evaluated by the lead author (F.S.) for remaining joint space, glenoid retroversion, glenohumeral subluxation, Walch classification, and Samilson–Prieto grade. Remaining joint space was defined as the smallest distance between the humeral head and glenoid on axillary lateral or weighted abducted Grashey radiographs.

Statistical analysis

All statistical analyses were performed using R version 4.2.1 (R Foundation for Statistical Computing, Vienna, Austria). An *a priori* power analysis was performed to determine the effects of nonoperative treatment on ASES scores. For a two-tailed analysis with alpha = 0.05 and beta = 0.20, a total of 58 patients would be needed to identify a clinically significant difference in ASES score of 6.4 points.[19] Failure of nonoperative treatment was defined as undergoing TSA. Univariate analyses were performed using Chi-square test or Fisher's exact test for categorical variables and t-test or Mann-Whitney U test for continuous variables. Log-rank tests were performed to compare Kaplan–Meier survival functions. Differences in PROs between patients who reported no change in symptoms on the pain anchor question (−1 to +1) and improvement (+2 to +7) were used to calculate the MCID. Similarly, differences in PROs between satisfied and unsatisfied patients were used to calculate the PASS. Receiver operating characteristic curve or area under the curve (AUC) analyses were used to evaluate MCID and PASS, with the Youden index used to identify the optimal threshold.

A Cox proportional hazard model was performed to determine risk factors associated with failure of nonoperative treatment as well as predictors for achieving MCID. Variables with P value < .20 on univariate analysis or clinical relevance based on previous literature were entered into the model with a backward selection method. Significance was set at 0.05.

Results

Baseline demographic, clinical, and radiographic characteristics

Table I shows the demographics and clinical characteristics of patients who did and did not fail nonoperative treatment. 14 (23%)

Table I
Demographics and clinical characteristics.

	No failure (n = 48)	Failure (n = 14)	*P* value
Age (y)	70.0 (range, 38.8-88.4)	72.3 (range, 47.6-82.7)	.438
Female sex	18 (38%)	9 (64%)	.075
Follow-up (mo)	20.1 (range, 12.2-29.9)	7.7 (range, 1.6-25.2)	-
Duration of symptoms			.672
6 week-3 mo	8 (17%)	1 (7%)	
3 mo-1 y	12 (25%)	4 (29%)	
≥1 y	28 (58%)	9 (64%)	
BMI (kg/m^2)	26.1 ± 5.9	28.7 ± 4.7	.250
Race			.610
White	41 (85%)	13 (93%)	
Black	2 (4%)	1 (7%)	
Asian	3 (6%)	0 (0%)	
Other	2 (4%)	0 (0%)	
CCI	0.8 ± 0.9	0.6 ± 0.8	.418
Insurance			
Medicare	31 (65%)	12 (86%)	.310
Private	16 (33%)	2 (14%)	
Independent	1 (2%)	0 (0%)	
Smoking	2 (4%)	2 (14%)	.217
Cannabis	8 (17%)	3 (21%)	.699
BRS	4.0 ± 0.8	3.4 ± 0.6	**.005**
PSS	11.0 ± 6.1	11.6 ± 5.3	.684
HADS			
Anxiety	4.4 ± 3.3	5.3 ± 3.3	.390
Depression	3.4 ± 3.0	2.9 ± 2.4	.573
Pain catastrophizing scale	9.2 ± 8.8	9.8 ± 7.6	.798

BMI, body mass index; *CCI*, Charlson Comorbidity Index; *HADS*, hospital and anxiety scale; *BRS*, Brief Resilience Scale; *PSS*: Perceived stress scale.
Bold denotes significance.

patients underwent TSA at a mean follow-up of 7.7 months (range, 1.6-25.2 months). 12 (20%) patients failed nonoperative treatment by 12-months. There were no significant differences in age, sex, duration of symptoms, Charlson Comorbidity Index, or insurance type between failure and nonfailure groups. Patients who failed nonoperative treatment had lower resilience scores than patients who did not (3.4 ± 0.6 vs. 4.0 ± 0.8, *P* = .005). There was no significant difference in perceived stress, pain catastrophizing, and anxiety and depression scores between groups.

Patients who failed nonoperative treatment had less joint space than those who did not (0.13 ± 0.35 mm vs. 0.75 ± 0.92 mm, *P* = .014) (Table II) (Fig. 1, *A*). No patient with more than 2 mm of joint space remaining failed. There was no difference in the glenoid morphology, glenoid retroversion, humeral head subluxation, and Samilson—Prieto grade between failure and nonfailure groups.

Prior to the study, 29 (47%) patients were using acetaminophen, 39 (63%) patients were using NSAIDs, 9 (15%) patients were using opiates, 34 (55%) patients had tried PT, and 25 (40%) patients had tried a corticosteroid injection (Table III). There was no difference in the proportion of patients who previously tried these modalities between failure and nonfailure groups. Among those who have received prior nonoperative treatment, patients who reported PT and corticosteroid injection being helpful in the past had 87% and 85% decreased odds of failure, though this was not significant (*P* = .087 and .075, respectively).

At the baseline visit, 35 (57%) patients continued using acetaminophen, 36 (58%) patients continued using NSAIDs, 9 (15%) patients continued using opiates, 37 (60%) were prescribed PT, and 24 (39%) received a glenohumeral corticosteroid injection (Table IV). Of the patients who received a glenohumeral injection, 15 (63%) were administered under ultrasound guidance. There was no difference in the proportion of patients who received these modalities between failure and nonfailure groups (Fig. 1, *B*).

Table II
Baseline radiographic measures.

	No failure (n = 48)	Failure (n = 14)	*P* value
Walch classification			.344
A1	20 (42%)	4 (29%)	
A2	8 (17%)	6 (43%)	
B1	8 (17%)	2 (14%)	
B2	11 (23%)	2 (14%)	
B3	1 (2%)	0 (0%)	
Joint space remaining (mm)	0.75 ± 0.93	0.14 ± 0.35	**.014**
Samilson—Prieto grade			.100
Mild	10 (21%)	0 (0%)	
Moderate	7 (15%)	1 (7%)	
Severe	31 (65%)	13 (93%)	
Retroversion (°)*	10.1 ± 8.2	10.1 ± 5.2	.995
Glenohumeral subluxation (%)	53.0 ± 4.9	53.2 ± 4.8	.901

Bold denotes significance.
*Missing 4 patients due to inadequate radiographs.

Patients who disagreed that PT would be beneficial had 3.75-fold increased odds of failing nonoperative treatment [OR = 3.75 (95% CI: 1.02-13.8), *P* = .039] (Fig. 1, *C*).

Patient-reported outcomes

The MCID for ASES was 6.0 points with an AUC of 0.74. The PASS for ASES was 68.1 points, with an AUC of 0.96. Only 19 (31%) patients met MCID, and 26 (42%) patients achieved PASS at final follow-up.

Patients who failed nonoperative treatment had lower ASES scores at baseline compared to those who did not fail (51.5 ± 16.2 vs. 62.2 ± 17.1, *P* = .043) (Table V). The change in ASES scores among patients who failed nonoperative treatment was also less than that of patients who did not fail (−5.2 ± 8.4 vs. 5.6 ± 15.0, *P* < .001) (Table V). There was no difference in the baseline ASES score or the change in ASES scores between patients who did and did not undergo PT (*P* = .698 and .524, respectively). The change in ASES score between patients who received and did not receive a corticosteroid injection was similar (*P* = .669). Patients with less joint space had lower ASES scores at baseline, though this finding was not significant (*P* = .080). There was no difference in the change in ASES scores among patients with less than 1 mm, 1 to 2 mm, and more than 2 mm of joint space (*P* = .970).

Predictors for failure of nonoperative treatment

On multivariate analysis, a lack of belief in PT (HR = 33.6 [95% CI: 5.26-214], *P* < .001), decrease in ASES score (HR = 6.25 [95% CI: 2.04-20.0], *P* = .001), lower resilience (HR = 7.14 [95% CI: 1.78-33.3], *P* = .006), and female sex (HR = 5.38 [95% CI: 1.31-22.1], *P* = .020) were independently associated with failure of nonoperative treatment (Table VI). Patients who received at least one corticosteroid injection (HR = 0.16 [95% CI: 0.04-0.67], *P* = .012) or had more joint space remaining (HR = 0.22 [95% CI: 0.06-0.80], *P* = .021) had a decreased risk of failure. Age, baseline ASES score, and PT were not predictive of failure.

Predictors for achieving MCID

On multivariate analysis, lower baseline ASES scores was the only factor associated with achieving MCID (HR = 1.38 [95% CI: 1.09-1.79], *P* = .008) (Table VII). PT and corticosteroid injections were not predictive of achieving MCID at 3 months or final follow-up.

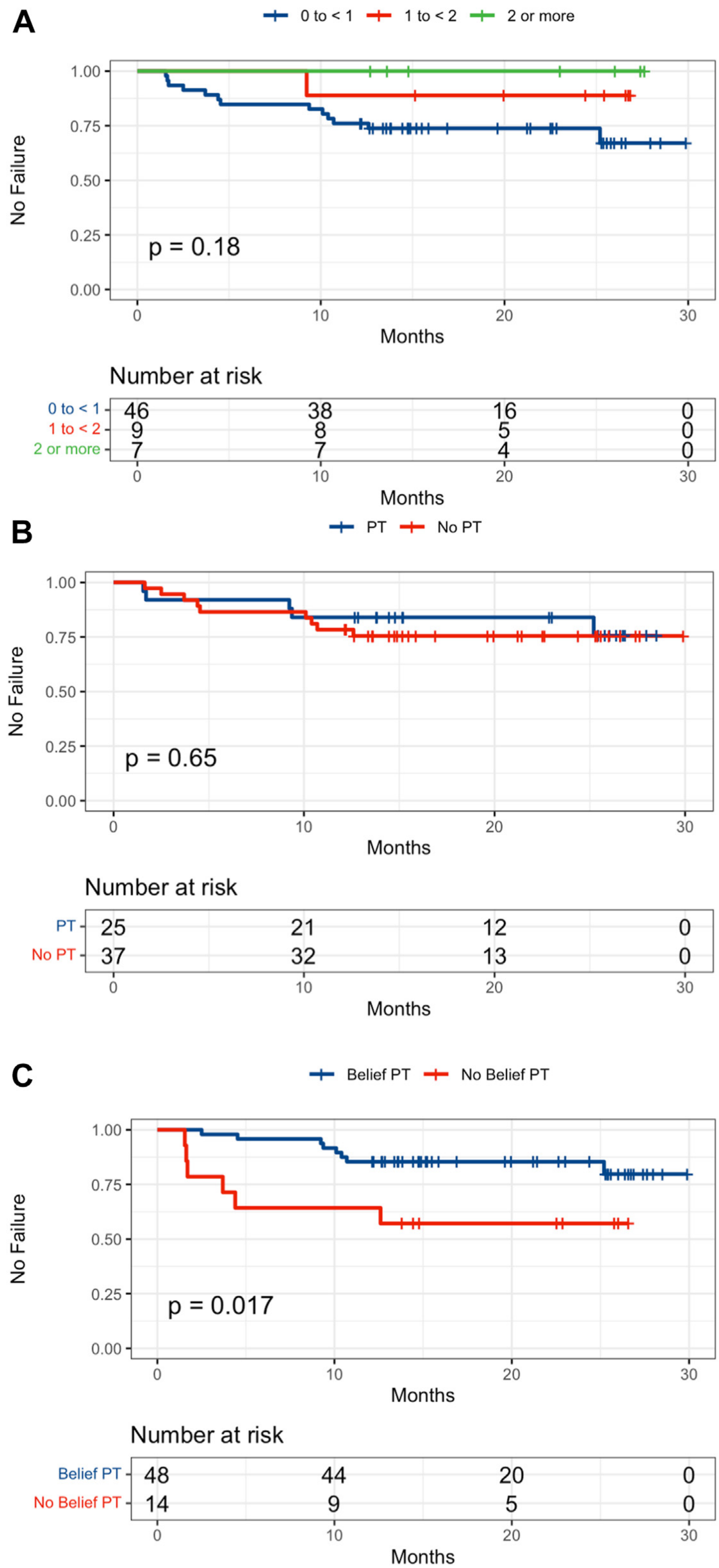

Figure 1 Kaplan–Meier survival curves for failure of nonoperative treatment stratified by (**A**) joint space remaining (mm), (**B**) physical therapy, and (**C**) belief in PT. *PT*, physical therapy.

Discussion

In this study, we treated patients with primary GHOA nonoperatively and observed that 23% of patients failed and underwent TSA at a mean follow-up of 7.7 months. Furthermore, only 31% of patients achieved a clinically meaningful improvement, and only 42% reported that they were satisfied after nonoperative treatment. It is interesting to note that PT was not beneficial in improving

Table III
Prior treatments received before study enrollment.

	No failure (n = 48)	Failure (n = 14)	OR (95% CI)	P value
Acetaminophen	21 (44%)	8 (57%)	1.71 (0.52-5.70)	.377
Helpful	7 (33%)	1 (13%)	0.29 (0.03-2.80)	.381
NSAIDs	29 (60%)	10 (71%)	1.63 (0.45-5.99)	.453
Helpful	14 (48%)	4 (40%)	0.71 (0.17-3.08)	.726
Opioids	6 (13%)	3 (21%)	1.91 (0.41-8.88)	.409
Helpful	2 (33%)	1 (33%)	1 (0.05-18.9)	1.000
PT	27 (56%)	7 (50%)	0.78 (0.24-2.56)	.764
Helpful	16 (57%)	1 (14%)	0.13 (0.01-1.18)	.087
Steroid injections	18 (38%)	7 (50%)	1.67 (0.50-5.53)	.402
Helpful	13 (72%)	2 (29%)	0.15 (0.02-1.07)	.075
PRP injections	0 (0%)	0 (0%)	-	-
Other treatments*	7 (15%)	1 (7%)	0.45 (0.05-4.01)	.670
Helpful	5 (71%)	1 (100%)	-	-

OR, odds ratio; *CI*, confidence interval; *NSAID*, non-steroidal anti-inflammatory drug; *PRP*, platelet-rich plasma; *PT*, physical therapy.
*Other treatments included manipulation, cold or heat therapy, acupuncture, lidocaine patches, and osteopathy.

Table IV
Treatments prescribed or continued on study enrollment.

	No failure (n = 48)	Failure (n = 14)	OR (95% CI)	P value
Acetaminophen	26 (54%)	9 (64%)	1.52 (0.44-5.22)	.502
NSAIDs	27 (56%)	9 (64%)	1.40 (0.41-4.80)	.592
Opioids	6 (13%)	3 (21%)	1.91 (0.4-8.88)	.409
PT	28 (58%)	9 (64%)	1.28 (0.37-4.42)	.689
Steroid Injections				
One	20 (42%)	4 (29%)	0.56 (0.15-2.04)	.535
Multiple	8 (19%)	0 (0%)	-	-
PRP injections	1 (2%)	0 (0%)	-	-
Other treatments*	6 (13%)	2 (14%)	1.17 (0.21-6.54)	1.000

OR, odds ratio; *CI*, confidence interval; *NSAID*, non-steroidal anti-inflammatory drug; *PRP*, platelet-rich plasma; *PT*, physical therapy.
*Other treatments included manipulation, cold or heat therapy, acupuncture, lidocaine patches, and osteopathy.

Table V
Change in ASES scores with nonoperative treatment.

	Baseline	Final follow-up	Change	P value*
Failure				**<.001**
Yes	51.5 ± 16.2	47.6 ± 15.3	−5.2 ± 8.4	
No	62.2 ± 17.1	67.7 ± 17.3	5.6 ± 15.0	
Sex				.511
Male	61.6 ± 16.9	63.5 ± 18.4	1.9 ± 14.2	
Female	57.5 ± 18.0	61.9 ± 19.8	4.4 ± 14.9	
PT				.524
Yes	59.1 ± 17.4	63.0 ± 19.0	3.9 ± 15.5	
No	60.9 ± 17.5	62.5 ± 19.0	1.6 ± 12.9	
Corticosteroid injection				.669
Yes	55.6 ± 17.9	59.6 ± 19.3	4.0 ± 16.2	
No	62.5 ± 16.7	64.8 ± 18.5	2.3 ± 13.4	
Joint space remaining				.970
0 to <1 mm	57.0 ± 16.7	59.7 ± 17.8	2.7 ± 15.8	
1 to <2 mm	66.5 ± 17.4	70.6 ± 21.1	4.1 ± 10.8	
≥2 mm	70.0 ± 17.5	73.1 ± 18.9	3.1 ± 9.1	

ASES, American Shoulder and Elbow Surgeons score; *PT*, physical therapy.
Bold denotes significance.
*Comparison between change in ASES, score.

Table VI
Cox model of risk factors for failure of nonoperative treatment.

	HR	95% CI	P value
No belief in PT	33.6	5.26-214	**<.001**
Decrease in ASES (10 points)	6.25	2.04-20.0	**.001**
Lower BRS (1 point)	7.14	1.78-33.3	**.006**
Female	5.38	1.31-22.1	**.020**
Corticosteroid injection	0.16	0.04-0.67	**.012**
Joint space remaining (mm)	0.22	0.06-0.80	**.021**

HR, Hazard Ratio; *CI*, Confidence Interval; *ASES*, American Shoulder and Elbow Surgeons score; *BRS*, Brief Resilience Scale; *PT*, physical therapy.
Variables considered in backward selection method: age, sex, physical therapy, belief in physical therapy, change in ASES, score; BRS, baseline ASES, score, corticosteroid injection, joint space remaining.
Bold denotes significance.

patient symptoms and function. Several risk factors were identified to be associated with failure of nonoperative treatment, including lack of a belief in PT, decrease in ASES scores with time, lower resilience, and female sex. Conversely, corticosteroid injections and more joint space remaining were found to be protective against failure.

The rate of conversion from nonoperative treatment to TSA was higher in this study than what has been previously reported in the literature. In our study, 23% elected to undergo TSA at a mean follow-up of 7.7 months. Conversely, in a study of 129 Chinese patients with GHOA treated conservatively, Guo et al found significant improvements in PROs, with 69% of patients reporting that their shoulder was better or much better.[11] Additionally, no patient underwent shoulder arthroplasty. They attributed their low shoulder arthroplasty rates to Chinese cultural differences in that Chinese patients may be more willing to use complementary and traditional care modalities that does not include surgery. Their study also did not account for the severity of arthritis. In another retrospective case series, Fardet et al reported that 5% and 13% of patients with GHOA underwent TSA after being medically managed for 5 and 10 years, respectively.[10] Furthermore, 55% of patients thought that nonsurgical management was satisfactory. The low rates of conversion to surgery and higher satisfaction rates may be due to a greater mean joint space of 1.6 mm in their patients at baseline. This is consistent with our data, which showed that patients with more than 2 mm of joint space were

Table VII
Cox model of predictors for achieving MCID.

	HR	95% CI	*P* value
Lower baseline ASES score (10 points)	1.38	1.09-1.79	**.008**
Female	2.44	0.94-6.34	.068
BRS	0.67	0.37-1.23	.200

MCID, minimum clinical important difference; *HR*, Hazard Ratio; *CI*, Confidence Interval; *ASES*, American Shoulder and Elbow Surgeons score; *BRS*, Brief Resilience Scale; *PT*, physical therapy.
Variables considered in backward selection method: age, sex, baseline ASES, score; BRS, PT, corticosteroid injection, joint space remaining.
Bold denotes significance.

more likely to continue with nonoperative management for the study duration.

Although supervised therapy has been shown to be beneficial in the nonoperative treatment of hip and knee osteoarthritis, it was not associated with reduced pain and improved function in the conservative management of GHOA.[2,21] These findings were surprising because PT is frequently prescribed for its theoretical benefits of reducing inflammation, preserving joint mobility, and strengthening of shoulder and periscapular muscles.[15] One possible explanation for the lack of improvement could be due to the strengthening component of the exercise program, as increased loads across the glenohumeral joint could exacerbate symptoms.[22] It is also important to note that a lack of belief in PT was the strongest predictor for patients undergoing TSA. Prior studies evaluating the effectiveness of PT in the treatment of atraumatic full-thickness rotator cuff tears have also found that low expectations about PT were the strongest predictor in the failure of nonoperative treatment.[9] These results suggest that patients who have high expectations about the effectiveness of PT are more averse to having surgery. Our findings also challenge the necessity of insurance companies mandating the use of PT prior to TSA, especially if the patient does not believe in its efficacy. It has been estimated that PT accounts for 9.9% of the total healthcare costs accrued by patients in the year leading up to TSA.[16] As healthcare costs continue to rise, it may become increasingly important to curtail ineffective resource utilization, such as PT, prior to undergoing TSA and to save the limited number of therapy sessions for after surgery.

Resilience is a complex psychological construct that is broadly defined as the ability to adapt to significant sources of stress.[20] In this study, patients with lower resilience were more likely to undergo surgery, suggesting that they are less able to cope with their shoulder pain with nonoperative management. This finding has important implications because patients with lower resilience have also been shown to have inferior outcomes after surgery.[7,23] In a study of 70 patients undergoing anatomic TSA, Tokish et al found that low resilience patients had outcome scores 30-40 points lower than high resilience patients.[23] Similarly, Dombrowsky et al reported that patients with low resilience had outcome scores that were up to 19 points lower than that of high resilience patients after reverse TSA.[7] Based on these findings, we currently recommend screening patients' resilience as it may help aid the surgeon in counseling the patient on what to expect with treatment. Furthermore, screening allows surgeons to offer simple interventions, such as cognitive behavioral therapy and psychoeducation, to improve resilience in patients at risk for poor outcomes.[13] Vranceanu et al performed a randomized trial comparing cognitive behavioral and relaxation response therapy to standard care in patients with musculoskeletal trauma and showed that the intervention significantly improved patients' pain, level of function, and mental health.[24]

We found that increased severity of radiographic arthritis was associated with a higher likelihood of failing nonoperative treatment. In addition, no patients with more than 2 mm of joint space remaining underwent TSA during the study period. This may be due to patients with less joint space having lower mean ASES scores at baseline. Another possible explanation is that surgeons may perceive patients with more advanced radiographic arthrosis as being more likely to benefit from surgery, and thus, discuss the success rates of nonoperative management differently in patients with varying degrees of arthritis.[5,8] In contrast to our findings, Metzger et al found that the survival rate of requiring a secondary intervention after receiving a corticosteroid injection was not associated with the radiographic severity of the arthritis.[18] However, their study used the Samilson–Prieto grade to classify radiographic arthritis and did not perform a multivariate analysis to account for potential confounders. Interestingly, our study also showed no association between the clinical response to nonoperative treatment and the amount of joint space narrowing. This implies that patients with less severe arthritis are not more likely to improve than patients with more severe radiographic arthrosis and is consistent with prior studies.[17,18]

Our analysis also identified corticosteroid injections to be independently associated with a decreased risk for failure of nonoperative treatment, but was not associated with achieving MCID at 3 months or final follow-up. One explanation for this seemingly counterintuitive finding is that patients who prefer to avoid surgery may continually exhaust all potential treatment options even though they do not provide any long-term clinical benefit. The injections, however, did not appear to be detrimental either, as patients who received an injection improved a mean ASES score of 4.0 points. It should be noted that the survival analysis of corticosteroid injections in delaying surgery may be limited by surgeon-dependent factors. Although there are no formal guidelines regarding the timing of TSA after injection, our practice generally avoids TSA within 3 months of a corticosteroid injection due to potential risk of infection.[25] Consequently, the protective effects of corticosteroid injections on failure of nonoperative treatment may be confounded. Furthermore, the lack of an association with meaningful clinical improvement at 3 months and longer follow-up may be due to the transitory effects of the injection. In a retrospective series of 33 patients with GHOA, Merolla et al found that intra-articular corticosteroid injections improved symptoms for 1 month before pain and disability returned at 3 months.[17] Another study using image-guided corticosteroid injections for GHOA found that improvement in the Oxford Shoulder Scale exceeded the MCID for only 4 months.[18]

The primary limitation of this study is that patients received various treatments prior to the investigation and were prescribed nonoperative treatment modalities based on their preferences, which likely introduces some selection bias. However, the pragmatic study design more accurately replicates real-world clinical practices. Additionally, there could be performance bias for we did not examine all possible pain-relieving medications and treatments. Another limitation was that PT compliance was not tracked, and the lack of improvement could potentially be attributed to noncompliance. Serial radiographs were not routinely obtained at follow-up visits and the effect of progressive wear on failure rate and outcome scores were not evaluated. In addition, we could not confirm the absence of concomitant rotator cuff pathology in a third of patients, though the prevalence of rotator cuff tear in the setting primary GHOA has been suggested to be low.[3] Lastly, the sample size of this study was relatively small.

Conclusion

Nonoperative treatment of GHOA has limited effectiveness and only meaningfully reduced pain and improved function in 31% of patients. Although 42% of patients were satisfied with treatment, patients elect to undergo TSA less than 25% of the time. Supervised therapy was not associated with clinical improvement or with decreasing the risk of surgery. Moreover, a lack in belief in PT and lower resilience were predictors for failure of nonoperative treatment and conversion to TSA. Screening questionnaires that evaluate a patient's belief in PT and resilience could potentially be used to identify which patients will be more likely to undergo surgery.

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