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Patient Outcome Following Rehabilitation for Rotator Cuff Repair Surgery: The Impact of Selected Medical Comorbidities

STUDY DESIGN: Prospective, multicenter research design.

OBJECTIVES: To assess functional and health status outcomes in patients following a physical therapy program after rotator cuff repair surgery, and to determine the impact of selected patient medical comorbidities on rehabilitation outcomes.

BACKGROUND: While authors have studied the influence of multiple factors on patient outcomes after rotator cuff repair surgery, little research has been done on the impact of comorbidities, particularly as it relates to establishing an accurate patient prognosis.

METHODS AND MEASURES: One hundred eighteen patients who had recently undergone a rotator cuff repair surgical procedure were recruited at 1 of 30 Physiotherapy Associates, Inc outpatient clinics located in 13 states. A rehabilitation protocol was implemented and included the following interventions, as indicated: therapeutic exercise, manual therapy, electrotherapeutic modalities, and physical agents. Patient health history factors were documented during the initial examination, including age, race, body mass index, smoking, rotator cuff tear size, type of surgical procedure, and selected medications and comorbidities. The Disabilities of the Arm, Shoulder, and Hand (DASH) and the Short-Form-36 (SF-36) were completed prior to rehabilitation, at discharge, and at 6 months postdischarge.

RESULTS: DASH and most SF-36 domain mean scores obtained postrehabilitation were significantly improved from pretherapy scores. Most health status outcomes were maintained at 6-month follow-up, with slight further improvement noted in SF-36 physical dimensions and DASH scores. Having a greater number of comorbidities was associated with worse postrehabilitation SF-36 scores, but not with the DASH shoulder function scores. The mean change scores (difference between prerehabilitation and postrehabilitation status) for the DASH and SF-36 were not significantly different for patients with 0 to 1, 2, or at least 3 or more comorbidities (except for emotional role). In regression analyses a model with baseline physical function score ($P = .0001$), age ($P = .03$), and number of comorbidities ($P = .003$) fitted the data well and explained 38% of the variance in the physical function score at discharge.

CONCLUSIONS: A higher number of comorbidities had a negative effect on general health status outcomes but not on shoulder function outcomes at the time of patient discharge following rehabilitation. Despite a negative effect of more comorbidities on health status outcomes, the specific number of medical comorbidities did not affect the overall level of improvement prerehabilitation to postrehabilitation in function and health status. The findings describing the influence of comorbidities on rehabilitation outcomes may assist therapists in establishing accurate patient prognosis. *J Orthop Sports Phys Ther 2007;37(6):312-319. doi:10.2519/jospt.2007.2448*

KEY WORDS: DASH, general health status, prognosis, SF-36, shoulder

Rotator cuff tears become increasingly common after the age of 40 years, with the incidence of partial thickness tears peaking during the fifth and sixth decade, and full-thickness tears peaking during subsequent decades. Five percent to forty percent of the population over the age of 60 years has evidence of a full-thickness rotator cuff tear.[14,17,25] Rotator cuff tears can have a debilitating effect on activities that require overhead upper extremity motion. Common manifestations associated with the subsequent loss of function are shoulder pain (including night pain), weakness, and decreased range of motion.[2,18] Besides the decreased ability to use the affected limb, these disorders have also been shown to have a negative impact on patients' general health status.[18] Rotator cuff repair surgery is often the choice of intervention for patients who do not respond to conservative care.

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The primary goals of surgical intervention and postoperative management for a majority of patients with rotator cuff tears have traditionally been (1) to decrease shoulder pain, including night pain, (2) to improve shoulder function, and (3) to limit the progression of the rotator cuff tendinopathy.[11] Current guidelines for outcomes assessment recommend including a joint- or limb-specific disability outcome measure along with a general-health status tool for postintervention assessment of a number of common orthopedic conditions including shoulder pain.[3,18]

A number of factors have been considered to impact status following rotator cuff repair, with varying and at times conflicting results. Unsatisfactory outcomes post-rotator cuff repair have been associated with the presurgical presence of a large rotator cuff tear, significant preoperative shoulder external rotation and abduction weakness, advanced age, workers compensation claims, preoperative corticosteroid injections, smoking, and a previous history of shoulder surgery.[6,9,11,13] Conversely, McKee and Yoo[18] reported that patient age and duration of preoperative symptoms were not factors influencing postsurgical outcome. Until recently, the impact of the presence of comorbidity (the patient history of having 2 or more diseases) on postrotator cuff repair surgery outcome had not been studied. Tashjian et al[21] reported that patients with more comorbidities had a worse general health status as measured by the Short Form-36 (SF-36) at 1-year follow-up post-rotator cuff repair. However, when comparing presurgical to postsurgical scores, these patients had greater improvement in overall shoulder pain, function, and quality-of-life scores, as measured by the Disability of Arm, Shoulder, and Hand Questionnaire (DASH) and visual analogue scales for pain, function, and quality of life. The authors concluded that a higher number of patient comorbidities should not be considered a negative influence in determining whether a patient should have a rotator cuff repair procedure. This surprising finding—the lack of impact of comorbidities on post-rotator cuff repair outcomes—runs contrary to postoperative findings for other patient populations.[12,19]

Katz et al[12] reported that the presence of patient comorbidities was associated with poor long-term patient outcomes and functional limitations following decompressive laminectomy for degenerative lumbar stenosis. Cardiovascular and chronic pulmonary diseases, osteoarthrosis, and rheumatoid arthritis were the most frequently noted comorbid conditions. Mofidi et al[19] also noted an association of poor outcome and coexisting medical conditions after surgical decompression for lumbar spinal stenosis. In fact, the presence of comorbid conditions had the strongest correlation with poor symptomatic and functional outcomes.[19] The purposes of this study were to (1) assess functional outcome and perception of general health status in patients following physical therapy management post-rotator cuff repair surgery, and (2) determine the impact of patients' existing health histories on improvement in shoulder function and general health status. Identifying clinical factors that impact recovery following rotator cuff repair may assist clinicians in establishing a more accurate patient prognosis.

METHODS

From May 2002 through June 2003, 118 patients who had recently undergone a rotator cuff repair surgical procedure gave consent to participate in a prospective, multicentered research study. Patient consent was obtained according to the study protocol, as approved by the University of Wisconsin-Madison Health Sciences and Physiotherapy Associates, Inc Institutional Review Boards.

Subjects

One hundred eighteen adults, 45 years or older, who had undergone a rotator cuff surgical repair procedure and were subsequently referred to outpatient physical therapy services for the initiation of rehabilitation (within a range of 2 days to 6 weeks postsurgery) at 1 of 30 Physiotherapy Associates, Inc clinic sites, volunteered to take part in the study. The participating Physiotherapy Associates, Inc clinics are located in 13 states in the South Central, Mountain, South Atlantic, North Central, and Pacific regions, per the United States Census Bureau,[22] with a representation of both metropolitan and rural areas. Subjects were excluded from the study if they had a history of previous shoulder surgery, concurrent significant shoulder injuries such as fracture and dislocation, were receiving workers' compensation or permanent disability for the shoulder condition, or were involved in litigation for the shoulder condition.

Procedure

The participating clinic supervisors selected physical therapists with expertise in the management of patients (based on years of experience working with patients with orthopedic shoulder conditions) presenting with shoulder conditions to provide the rehabilitation. Patient background and health history information (collected on a patient self-administered questionnaire), shoulder function (assessed by the DASH), and general health status (assessed by the SF-36) were collected by the physical therapist at the initial patient visit. The collected health history information included the presence of relevant patient comorbidities, with the patients being asked, "Do you have this problem (yes or no)?" The therapist reviewed with the patient the completed self-administered questionnaire to clarify and confirm accuracy of the provided information. This method of investigating patient health history utilizing a patient self-administered questionnaire was shown to be a reliable and valid approach for patients with orthopedic conditions.[5] The selected illnesses for our sample included (1) asthma, (2) degenerative osteoarthritis, (3) depression,

(4) headache, (5) high blood pressure, (6) kidney disease, (7) pneumonia, and (8) sinus infection. These comorbidities had been identified as those most frequently noted in Physiotherapy Associates, Inc patient populations in a previous study.[4] A body mass index greater than 25 was also included as a comorbidity. Each yes answer was counted as 1 comorbidity. The number of comorbidities was totaled for each patient. The same physical therapist reassessed the patients using the DASH and SF-36 at the point of discharge from rehabilitation and at 6 months postdischarge.

Outcome Measures

For this study, the DASH, a limb-specific self-assessment tool, and the SF-36, a general health status instrument, were administered. The DASH instrument was developed to evaluate disability and symptoms in disorders of the upper limb at 1 point or at many points in time.[10] The DASH disability scale provides a single comprehensive score, with 0 being the best score and 100 being the worst score.[20] The DASH has been found to correlate with other measures[10] ($r \geq 0.69$), including the Brigham Questionnaire, the Shoulder Pain and Disability Index, and other markers of pain and function, and to discriminate well, for example, between patients who were working and those who were not.[10] The DASH has also been shown to have good test-retest reliability (ICC = 0.96)[10] and responsiveness to change.[10] A 10-point difference in individual scores on the DASH represents a clinically minimal important change.[3,8]

The SF-36 queries the patient concerning health over the past 4 weeks in 8 different health outcome domains: energy/fatigue, general health perception, mental health, bodily pain, physical functioning, role limitation due to emotional problems, role limitation due to physical problems, and social functioning.[23] Acceptable reliability, validity, and responsiveness to change of the SF-36 have been reported for its use in aggregate analyses and have been used in studies investigating the effectiveness of interventions for orthopedic disorders.[6,15,16,24] For each of the SF-36 scales, responses to the questions were summarized and then transformed to provide scores ranging from 0 to 100, with 100 being the best possible score. The SF-36 provides an overall pro-

TABLE 1 Rotator Cuff Repair Protocol

1-2 wk postoperative
- Modalities as needed for pain: cryotherapy, electrical stimulation, TENS
- Pendulum exercises: gentle flexion/extension, circumduction
- Passive elevation: flexion and abduction to 90°
- Passive ER to 0°
- Hand, wrist, and elbow active and passive ROM
- Home program to be done BID: pendulum exercises; hand, wrist, and elbow AROM

2-3 wk postoperative
- Continue the above
- Add to home program
  - Deltoid submaximal effort isometrics: flexion, extension, and abduction
  - Pulley exercise for passive flexion to 90° as tolerated
  - Wand exercise for passive ER to 0° in supine
  - Scapular strengthening: resistive (manual or Thera-Band) elevation, retraction, protraction with glenohumeral joint in neutral

3 wk postoperative
- Continue the above
- Begin PROM and joint mobilization, all planes
- Continue same home program

5 wk postoperative
- Continue the above
- Begin submaximal effort isometrics for IR and ER
- Scapular strengthening, all planes
- Wand exercises: flexion (supine); IR/extension (standing)
- Add wand exercises to home program

6 wk postoperative
- Begin Thera-Band IR and ER as tolerated
- Deltoid isotonics in POS if rotator cuff strength is at least 3/5 (fair)
- Begin biceps brachii PREs; continue scapular PREs
- Continue same home program

8 wk postoperative
- Begin isokinetic IR/ER in supine or standing
- PREs for large muscle groups: latissimus dorsi, pectoralis major, etc
- Add PREs to home program

12 wk postoperative
- Continue above
- Full active and passive ROM
- Advance all resistive exercises as tolerated
- Plyometric exercises for overhead athletes

16 wk postoperative
- Return to all recreational and sports activities

Abbreviations: AROM, active range of motion; BID, twice a day; ER, external rotation; IR, internal rotation; POS, plane of the scapula; PRE, progressive resistive exercises.; PROM, passive range of motion; ROM, range of motion; TENS, transcutaneous electrical nerve stimulation.

file of health, and a score for each of the 8 health dimensions.

Rehabilitation Program

The postoperative protocol utilized in this study was developed from a literature review of recommended approaches,[9,11] combined with the existing protocols routinely used at Physiotherapy Associates, Inc clinics and the University of Wisconsin Hospital & Clinics Sports Rehabilitation Program in Madison, WI (**TABLE 1**). The protocols utilized by the 2 institutions were developed by senior physical therapists and physicians involved in the care of this population, based on the existing literature and clinical experience. Based on the protocol, standard and usual care was provided by the participating therapists, including deciding when to discharge the patient. The mean number of patient visits was 25, with a mean treatment duration of 13 weeks (**TABLE 2**).

TABLE 2 Patient Characteristics

	Nonparticipants*	Discharge†	6-mo Follow-up‡	*P* Value
Age				NS
Mean ± SD	65.0 ± 9.3	67.0 ± 8.6	67.0 ± 9.1	
Range	47-85	49-82	47-82	
Sex§				NS
Men	18 (56%)	37 (43%)	21 (40%)	
Women	13 (41%)	49 (57%)	32 (60%)	
Race				NS
White	29 (91%)	84 (98%)	51 (96%)	
Black	2 (6%)	0 (0%)	0 (0%)	
Hispanic	0 (0%)	2 (2%)	2 (4%)	
Other	1 (3%)	0 (0%)	0 (0%)	
Tear type§				NS
Type I	8 (25%)	18 (21%)	13 (25%)	
Type II	19 (59%)	58 (67%)	34 (64%)	
Injury type				NS
Acute	5 (16%)	25 (29%)	17 (32%)	
Acute on chronic	7 (22%)	17 (20%)	7 (13%)	
Chronic	20 (63%)	44 (51%)	29 (55%)	
Number of comorbidities				NS
0-1	15 (47%)	30 (35%)	15 (28%)	
2	10 (31%)	30 (35%)	22 (42%)	
⩾3	7 (22%)	26 (30%)	16 (30%)	
Smoke				NS
Yes	4 (13%)	14 (16%)	7 (13%)	
No	28 (88%)	72 (84%)	46 (87%)	
Anti-inflammatory use				NS
Yes	14 (44%)	41 (48%)	29 (55%)	
No	18 (56%)	45 (52%)	24 (45%)	
Treatment duration (wk)				N/A
Mean ± SD	N/A	13.1 ± 5.1	12.9 ± 4.8	
Range	N/A	3-28	3-28	
Number of visits				N/A
Mean ± SD	N/A	25.0 ± 11.5	25.2 ± 10.8	
Range	N/A	4-60	4-60	

Abbreviations: N/A, not applicable; NS, not significant.
** Nonparticipants (n = 32) included patients who started rehabilitation, but for whom discharge data were not obtained.*
† Discharge participants (n = 86) included those patients who completed rehabilitation and from whom discharge data were obtained.
‡ 6-mo follow-up participants (n = 53) were patients from the 86 discharge participants.
§ n may vary due to missing data.

Analysis

Categorical variables were presented as frequencies, and continuous variables were presented as means and standard deviations. Post hoc analysis assessed pairwise differences between assessment measures at initial therapy visit and discharge, and between discharge visit and 6-month follow-up. Pretherapy to posttherapy differences were compared between groups with 0 to 1, 2, and at least 3 or more comorbidities, using a 1-way analysis of variance. All 3 comorbidity groups were combined for linear regression analyses, which were used to determine whether any of the patient variables or the number of comorbidities was predictive of functional outcome. Multivariate regression analysis was used to evaluate the correlation between outcomes at discharge (DASH, SF-36 Bodily Pain, SF-36 Physical Function) and the number of comorbidities. In this analysis, age, sex, smoking, rotator cuff tear size, surgical technique (open, arthroscopic), use of anti-inflammatories, and presurgery physical therapy were used as intervening variables. Hierarchical regression analysis was performed by controlling for baseline scores and by entering all intervening variables in step 1, then sequentially eliminating insignificant variables from the equation. After establishing the best-fitting model, the number of comorbidities was added in step 2. Regression coefficients and significance levels were determined for each multivariate regression. Data were analyzed with Statistical Analysis System software (SAS Institute, Inc, Cary, NC) for descriptive statistics and multiple linear regression. The sta-

tistical significance of linear regression coefficients was assessed by *t* tests. An alpha value of .05 was considered to indicate statistical significance.

RESULTS

Descriptive information concerning selected sociodemographic characteristics of the patients, including age, sex, race, specific shoulder history, general health history, and treatment summary, is presented in **TABLE 2**. No significant differences ($P>.05$) were found between the participants and nonparticipants (those not completing rehabilitation, n = 32) with regard to age, sex, race, rotator cuff tear type, injury type, number of comorbidities, smoking, and use of anti-inflammatory drugs.

The mean assessment measure values at discharge and at 6-month follow-up are shown in **TABLE 3**. Upon completion of rehabilitation, the DASH scores improved in 93% of the patients (range, 10-67 points). Nine patients showed no clinically significant improvement. There were significant improvements in the DASH ($P = .0001$) and the SF-36 emotional role ($P = .01$) and physical role, social function, vitality, bodily pain, and physical function ($P = .0001$). The mean amount of change in the 2 data points was greatest for physical role performance and bodily pain.

No significant differences ($P>.05$) for pretherapy and posttherapy DASH and SF-36 scores were found between the patients who completed therapy (discharge group) and those followed up at 6 months postdischarge. There were significant improvements from time of discharge to 6-month follow-up in the DASH score ($P = .0002$), and the SF-36 physical role ($P = .007$) and physical function ($P = .002$) scores. The SF-36 emotional role, social function, vitality, and bodily pain remained the same at 6 months after therapy as at discharge.

The mean number of patient comorbidities was 2.01 (range, 0-7). The most frequently noted comorbidities were a body mass index of greater than 25 (84%), high blood pressure (43%), and degenerative osteoarthritis (21%). The frequency of conditions for the 86 discharged patients by number of comorbidities is shown in **TABLE 4**.

When comparing differences among groups with 0 to 1, 2, and at least 3 or more comorbidities, all groups showed significant improvement ($P<.05$) from pretherapy to posttherapy in the DASH and SF-36 physical role, social function, bodily pain, and physical function. Only emotional role for the groups with 2 comorbidities ($P = .21$) and at least 3 or more comorbidities ($P = .83$), and vitality for the group with at least 3 or more comorbidities ($P = .09$), did not improve significantly. There were no significant differences ($P>.05$) in mean change scores among the 3 groups, with the exception of SF-36 emotional role. The patient group with 0 to 1 comorbidities had significantly more improvement in emo-

TABLE 3 Functional Assessment Measures*

	Discharge†	6-mo Follow-up‡
DASH		
Initial	52.0 ± 18.3	49.2 ± 19.3
Discharge	18.2 ± 12.8	16.1 ± 10.4
Follow-up	...	10.1 ± 9.8
SF-36		
Emotional role		
Initial	79.7 ± 26.4	83.2 ± 24.4
Discharge	87.5 ± 20.2	89.6 ± 17.6
Follow-up	...	91.0 ± 15.3
Physical role		
Initial	37.9 ± 25.5	39.5 ± 24.2
Discharge	66.4 ± 22.9	71.4 ± 21.0
Follow-up	...	82.1 ± 18.9
Social function		
Initial	69.6 ± 23.4	75.7 ± 21.3
Discharge	88.5 ± 16.6	94.0 ± 11.2
Follow-up	...	95.0 ± 10.2
Vitality		
Initial	57.4 ± 17.8	59.6 ± 15.2
Discharge	67.6 ± 15.5	69.0 ± 13.7
Follow-up	...	73.1 ± 14.1
Bodily pain		
Initial	43.0 ± 19.9	47.1 ± 17.9
Discharge	67.0 ± 18.4	69.2 ± 17.0
Follow-up	...	73.6 ± 21.0
Physical function		
Initial	61.3 ± 21.1	61.9 ± 18.5
Discharge	74.7 ± 18.6	76.2 ± 18.0
Follow-up	...	81.5 ± 16.7

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand Questionnaire (scale, 0-100, lower numbers indicating better function); SF-36, Short-Form-36 (scale, 0-100, higher numbers indicating better function).

** Data are mean ± SD.*

† Discharge participants (n = 86) included those patients who completed rehabilitation and from whom discharge data were obtained.

‡ 6-mo follow-up participants (n = 53) were patients from the 86 discharge participants.

tional role than patient groups with 2 or at least 3 or more comorbidities.

The results of multiple-regression models, with the DASH, SF-36 Bodily Pain, and SF-36 Physical Function scores as the outcome variables, are presented in **TABLES 5** through **7**. The number of comorbidities had an adverse impact on bodily pain and physical function outcomes but not on disability of the arm, shoulder, and hand, as measured by the DASH. In addition, those individuals who had open surgical technique had poorer outcomes in the DASH and SF-36 bodily pain than those who had arthroscopic technique.

In terms of goodness of fit, the percentage of variance explained by the regression was 22% in the DASH model, compared to 38% with the SF-36 Physical Function model.

DISCUSSION

The purposes of this study were to assess the functional outcome and perception of general health status in patients following rehabilitation post-rotator cuff repair, and to determine the impact of pre-existing patient health history factors on both patient functional status at the time of discharge and on the change in scores from pre- to post-physical therapy status (at discharge). The data analysis demonstrated that after completion of the postoperative rehabilitation program provided by physical therapists patients noted enhanced function and general health status (**TABLE 3**). Importantly, the prerehabilitation-to-postrehabilitation improvement was maintained, and in some cases increased further during the 6 months following discharge from rehabilitation. The mean number of patient visits (25) over a mean of 13 weeks reported by the participating therapists falls within the recommended range of visits for patients being seen for impaired joint mobility, motor function, muscle performance, and range of motion associated with bony or soft tissue surgery (range of 6 to 80 visits over 1 to 8 months).[7]

Our study design, although not modeled exactly as Tashjian et al's,[21] is similar enough for a number of direct comparisons to be made regarding the impact medical comorbidities had on patient outcomes. The mean number of comorbidities found in our patients was similar to that of patients studied by Tashjian et al[21]: a mean of 2.01 (range, 0-7) and a mean of 1.91 (range, 0-6), respectively. In addition, patients in both studies showed significant improvement at the point of discharge (postrehabilitation scores) in SF-36 subsections and in the DASH scores. Also consistent with Tashjian et al's[21] results was our study's findings of a higher number of comorbidities associated with lower postrehabilitation SF-36 emotional role, bodily pain, and vitality scores. In addition, in our study a lower score was noted in the SF-36 physical role, social function, and physical function subsections. Lastly, in both studies no correlation was found between number of comorbidities and postintervention DASH scores.

In terms of increased number of comorbidities and the association with degree of change between the preintervention score and postintervention scores, Tashjian et al[21] did not find a correlation with postintervention improvement on the 8 SF-36 subsections and, surprisingly, found greater improvement in DASH scores. Our results were similar in that there were no significant differences in mean change scores between groups in relation to the number of comorbidities, with the exception of SF-36 emotional role. The patient group with 0 to 1 comorbidities had significantly more improvement in emotional role than pa-

TABLE 4 Frequency of Conditions for the 3 Comorbidity Groups*

	Number of Comorbidities		
Condition	**0-1 (n = 30)**	**2 (n = 30)**	**≥3 (n = 26)**
Asthma	1 (1.2)	2 (2.3)	9 (10.5)
Degenerative osteoarthritis	2 (2.3)	5 (5.8)	11 (12.8)
Depression	0 (0)	0 (0)	2 (2.3)
Headache	0 (0)	1 (1.2)	6 (7.0)
High blood pressure	0 (0)	18 (20.9)	19 (22.0)
Kidney disease	0 (0)	1 (1.2)	3 (3.5)
Pneumonia	0 (0)	0 (0)	3 (3.5)
Sinus infection	1 (1.2)	3 (3.5)	14 (16.3)
Body mass index >25 kg/m^2	20 (23.3)	30 (34.9)	22 (25.6)

** Values expressed in n (% of patients); n = 86.*

TABLE 5 Summary of Hierarchical Regression Analysis for Variables Predicting DASH*

	Model 1			Model 2		
Variable	***β***	***t***	***P***	***β***	***t***	***P***
Baseline score	0.279	4.01	.0001	0.27	3.89	.0002
Age	0.063	0.45	.6511	0.058	0.42	.6757
Surgical technique	−9.925	−2.29	.0250	−11.087	−2.51	.0142
Number of comorbidities				1.375	1.27	.2067
R^2	0.20			0.22		
Adjusted R^2	0.18			0.18		

** n = 86.*
Abbreviation: DASH, Disabilities of the Arm, Shoulder, and Hand Questionnaire (scale, 0-100, lower numbers indicating better function).

tient groups with 2 or at least 3 or more comorbidities. Tashjian et al[21] hypothesized that the counterintuitive finding of a significant positive correlation between increased number of comorbidities and improvement in functional outcome scores might be explained by the fact that patients with more comorbidities may start out with worse functional scores and subsequently have more potential for postoperative improvement. Post hoc analysis of our data revealed that this was generally not the case in our patients. Significant positive correlations between the number of comorbidities and pretherapy scores were only found for SF-36 physical function ($r = -.464$, $P = .014$) and general health ($r = -.523$, $P = .0001$) domains. In summary, considering that a higher number of comorbidities did not appear to significantly affect final shoulder function, as assessed by the DASH, or the extent of improved change from preintervention to post intervention, as assessed by the DASH and SF-36 (with the exception of emotional role), our results lend support to the Tashjian et al[21] conclusion that a higher number of comorbidities should not be considered a negative factor in determining whether a patient should undergo rotator cuff repair and subsequent rehabilitation. In terms of establishing a patient prognosis, however, the results from the 2 studies support the notion that, although patients will improve relatively the same amount regardless of the presence of comorbidities, more comorbidities are associated with lower general health status outcomes.

As noted in the Introduction, this equivocal impact of comorbidities on post-rotator cuff repair outcomes runs contrary to postoperative findings for other patient populations. The question is raised, what accounts for the inconsistent impact of comorbid conditions when comparing different orthopedic populations? In part, it is difficult to compare the results from the Tashjian et al[21] study and our study with the above-mentioned studies because of the differences[12,19] in how comorbidity was assessed. For example, Katz et al[12] utilized the Cumulative Illness Rating Scale, which rates the severity of comorbid illness in the 13 organ systems on a scale of 0 to 4 points, Tashjian et al[21] and Modifi et al[19] used the MODEMS (Musculoskeletal Outcomes Data Evaluation and Management System), and we used a total number of comorbidities from a list of 9 most frequently noted illnesses in our population. Maybe the impact on functional outcome and levels of disability is contingent on the presence of certain comorbidities and not of others. Possibly the health histories of those undergoing rotator cuff repair are different from those with surgical decompression for lumbar stenosis, in terms of number of illnesses and which specific illnesses are present. In addition, patient factors other than comorbid history unique to patients with low back pain, versus those with rotator cuff disease, may have influenced outcomes. Future research may begin to provide clarity to the disparity of findings when comparing different patient populations.

TABLE 6 Summary of Hierarchical Regression Analysis for Variables Predicting Bodily Pain*

	Model 1			Model 2		
Variable	**β**	***t***	***P***	**β**	***t***	***P***
Baseline score	0.373	4.13	.0001	0.373	4.31	.0001
Age	−0.372	−1.91	.0500	−0.365	−1.96	.0500
Surgical technique	11.620	1.88	.0600	15.186	2.51	.0140
Number of comorbidities				−4.28	−2.91	.0050
R^2	0.22			0.30		
Adjusted R^2	0.19			0.26		

* $n = 86$.

TABLE 7 Summary of Hierarchical Regression Analysis for Variables Predicting Physical Function*

	Model 1			Model 2		
Variable	**β**	***t***	***P***	**β**	***t***	***P***
Baseline score	0.460	5.61	.0001	0.401	5.0	.001
Age	−0.391	−2.12	.037	−0.39	−2.22	.029
Surgical technique	4.91	0.83	.410	7.81	1.36	.178
Number of comorbidities				−4.32	−3.02	.003
R^2	0.31			0.38		
Adjusted R^2	0.28			0.35		

* $n = 86$.

Limitations

The lack of a control group and the use of multiple tests of significance in developing the regression analysis may limit the extent to which the study results can be generalized to the target population of patients who are candidates for the rehabilitation protocol. Also, regarding the protocol, it served as a general guideline, providing therapists with timelines for progression and goal setting. The therapists had latitude to deviate from the recommended timeline per the patient's status (eg, the patient hadn't progressed adequately for starting the next phase of rehabilitation). Any limitations related to generalizability were minimized because there were no differences in terms of characteristics and elements of health history (**TABLE 2**) between participants (patients who completed rehabilitation)

and nonparticipants (those patients who did not). We believe that our participants were representative of the outpatient orthopedic patients typically seen within the Physiotherapy Associates, Inc network of clinics. In addition, previous research has demonstrated that Physiotherapy Associates, Inc outpatient populations are similar to other large outpatient physical therapy populations in terms of presenting diagnoses.[4] Finally, as with Tashjian et al,[21] we assumed that the studied comorbidities had equal potential influence on outcome and were, therefore, scored equally, with the understanding that certain comorbidities may have greater impact on functional and general health status. As with Tashjian et al,[21] we chose not to weigh or rank comorbidities by perceived impact due to the arbitrary nature of such a process. Lastly, considering comorbidities other than those selected for our study may impact prognosis (eg, diabetes), conclusions can only be drawn regarding the 9 comorbidities we studied. The reason for selecting the 9 comorbidities (including obesity) for our investigation was that these were the most frequently noted in the Physiotherapy Associates, Inc outpatient population.[4] In addition, a number of our comorbidities are among the most frequently noted in the general United States population, including obesity, high blood pressure, degenerative osteoarthritis, and depression.

CONCLUSION

Our results add support to the opinion[21] that the presence of medical comorbidities should not be considered a negative factor when determining whether a patient should undergo rotator cuff repair and subsequent rehabilitation. Our findings do suggest that physical therapists should consider the impact patient comorbidities can have on the general health status of patients' postrehabilitation for rotator cuff repair when establishing patients' prognoses. At the point of discharge, patients with at least 3 or more of the studied 9 comorbidities may not be functioning at as high a level compared to those with less than 3.

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