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Factors Influencing Final Outcomes in Patients with Shoulder Pain: A Retrospective Review

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1 Factors Influencing Final Outcomes in Patients with Shoulder Pain: A Retrospective

2 Review

3

4 **ABSTRACT:**

5 **Study Design:**

6 Retrospective cohort.

7 **Introduction:**

8 Rehabilitation interventions are commonly prescribed for patients with shoulder pain,
9 but it is unclear what factors may help clinicians' prognosis for final outcomes.

10 **Purpose of the Study:**

11 To determine what factors are the best predictors of improved patient-reported
12 outcomes at discharge in patients with shoulder pain.

13 **Methods:**

14 Retrospective chart review of 128 patients presenting with shoulder pain to an
15 outpatient physical therapy clinic. Chart review captured data regarding patient
16 demographics, treatment interventions, patient history, and patient-reported outcome
17 scores. The primary dependent variable was the overall change score of the
18 QuickDASH (initial – discharge). Thirty-eight predictor variables were entered into a
19 forward stepwise multivariate linear regression model to determine which variables and
20 to what degree contributed to the dependent variable.

21 **Results:**

22 The linear regression model identified five predictor variables that yielded an $R = .74$
23 and adjusted $R^2 = .538$ ($P < .001$). The five predictor variables identified in order of

24 explained variance are QuickDASH change at the 5th visit, a total number of visits, initial
25 QuickDASH score, scapular retraction exercise, and age.

26 **Discussion:** Early change scores, equal to minimal detectable change scores on
27 patient-reported outcomes appear to be strong indicators that patients with shoulder
28 pain are on a positive trajectory to benefit from rehabilitation.

29 **Conclusion:**

30 Using patient-reported outcomes throughout care, not just at the start and end of care,
31 will provide therapist feedback regarding patient's progress and indicate treatment
32 effectiveness.

33 Keywords: Patient-reported outcome, QuickDASH, physical therapy, prognosis

34 **Levels of Evidence: Level: 4**

35

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37

38 **1.0 Introduction:**

39

40 Shoulder pain is a common and debilitating diagnosis in health care with a 1-year
41 prevalence reaching up to 47% in the adult population.¹ It is second, only to low back
42 pain in prevalence of musculoskeletal conditions for those seeking care.² Shoulder pain
43 is often associated with unfavorable outcomes with roughly 40-50% of all new episodes
44 of shoulder pain patients presenting to a primary care setting, who still report symptoms
45 6 to 12 months later.³⁻⁵

46

47 Research to determine which interventions and factors contribute to positive
48 outcomes with rehabilitation intervention is growing but is inconsistent. A systematic
49 search of the literature identified 16 studies that focused on the prognosis of shoulder
50 disorders; only six, were designated as “high quality”.⁶ Strong evidence exists that high
51 pain intensity and middle age (45-54) are associated with poor outcomes. There is
52 moderate evidence that prognostic factors for shoulder pain such as long duration of
53 complaints, and high disability score at baseline predict a poor outcome in primary
54 care.⁶⁻⁸ Many prognostic factors were considered in these 16 studies such as sex,
55 mechanism of injury, psychological factors, work demands, anatomical factors and
56 impairments of motion and strength. ⁶ However the vast majority of the prognostic
57 factors were identified only at baseline.

58 There is compelling evidence in the literature indicating exercise and patient
59 education decreases pain and improves function at short-term and long-term follow-up
60 for patients with impingement syndrome.^{9, 10} Additional interventions such as

61 mobilization, modalities, and stretching interventions are commonly used to treat
62 shoulder impingement syndrome with limited evidence to support their use.¹¹
63 Clinicians are often faced with questions relating to identifying prognostic factors that
64 will determine a patient's positive outcome. Treatment approaches may vary based on
65 the presence or absence of a number of prognostic factors. There are a many factors
66 related to history, co-morbidities, psychological state, physical impairments, work
67 demands, physical examination findings and patient self-report perceptions of function
68 that can contribute to a patient's outcome. It is not known how much each of these
69 items is weighted in contributing to a patient's prognosis.

70 The role of early response to rehabilitation has demonstrated limited evidence in
71 predicting long-term outcomes. Researchers investigated the effects of early self-
72 reported changes in levels of disability and pain levels in patients with acute back pain
73 seeking chiropractic care.¹² Axen et al.,¹² found that improvement in pain and disability
74 after visit 2 increased the odds of a positive treatment outcome by an 2.9 odds ratio
75 compared to patients with no improvement. This response was further investigated in
76 2422 patients presenting with multiple musculoskeletal conditions to chiropractors in the
77 United Kingdom over an 8 year period.¹³ The best predictor of a positive outcome at the
78 tenth visit in those patients with persistent musculoskeletal pain was self-reported
79 improvement by the fifth visit. These authors suggested that early changes may be
80 more important as predictors in musculoskeletal conditions than variables measured at
81 baseline.¹³

82 It is hoped that the acquired knowledge of the prognostic factors that contribute
83 to the successful outcomes of patients with shoulder pain will help provide more

84 informed clinical decision-making among health care practitioners. The gained
85 information can be provided to patients regarding their plan of care and opportunity for a
86 successful outcome. Based on the previous research we sought to be as inclusive as
87 possible in retrospectively examining the charts plus our own clinical observations led
88 us to incorporate the early treatment interventions and change scores of patient-self
89 reports as prognostic factors accounting for the large number of factors used in this
90 study. The objective of this study was to determine what factors are associated with a
91 positive outcome in patients with shoulder pain presenting to a physical therapy clinic in
92 a general orthopedic practice population. Specifically, we sought to identify which early
93 interventions, historical presentation, and demographic variables are most associated
94 with contributing to a positive outcome in patients presenting with shoulder pain.

95 **2.0 Methods**

96 We conducted a retrospective study involving patients presenting to a single
97 outpatient physical therapy clinic with shoulder pain between the years 2008-2010. The
98 outpatient clinic was located in the southern region of the United States representing a
99 typical general outpatient orthopedic clinic seeking care for shoulder pain. This clinic
100 had instituted patient-reported outcome data collection as a standard operating
101 procedure in the fall of 2006. This clinic used the QuickDASH to track disability scores
102 for upper extremity injuries. Subject data was obtained by performing systematic chart
103 reviews of patients with shoulder pain. Data was subsequently entered into an SPSS
104 version 22 (IBM, Armonk, NY) for statistical analysis. The retrospective chart review
105 was approved by the university's institution review board, IRB# 10-0765-X1B before
106 initiation of this study.

107 The QuickDASH is a shortened version of the original disability of the arm,
108 shoulder and hand (DASH) questionnaire.¹⁴ The QuickDASH is an 11 item disability
109 scale ranging from 0 reflecting no disability to 100 indicating severe disability and has
110 been found to be highly correlated with the full DASH.¹⁴ The QuickDASH has
111 demonstrated excellent reliability in patients with shoulder pain (ICC = 0.90) with
112 minimal detectable change (MDC) = 11.2 and minimally clinically important differences
113 (MCID) =8 in patients with shoulder pain.¹⁵

114 **2.1 Subjects**

115 Two hundred eighty-nine patient charts were reviewed. Potential subjects were
116 excluded from analysis if any of the following were present: a history of shoulder
117 surgery (n=12), neurological involvement (n=26), shoulder instability (n=6), severe loss
118 of motion, suggesting adhesive capsulitis (n=57) or a positive lag sign, suggesting
119 rotator cuff tear (n=1) and if the QuickDASH score at visit 5 was not recorded (n=8).
120 One hundred seventy-nine patient charts were available to extract data. Neurological
121 involvement was identified by an abnormal dermatome, myotome or deep tendon reflex
122 test.¹⁶ A positive apprehension sign, anterior or posterior drawer test was considered
123 indicative of shoulder instability.¹⁷ Severe loss of motion was found to be present if the
124 patient lacked greater than 50% of the normal physiologic range of motion.¹⁸ Finally,
125 lag signs included a positive drop arm test, lift off test or external rotation lag sign.¹⁷

126 The terminology of shoulder pain was used in this study as this was a
127 retrospective review and all patients were not screened with a standard evaluation for a
128 particular pathology. We made an effort to exclude patients reporting history or physical

129 examination findings consistent with instability, adhesive capsulitis, neurological
130 involvement, and rotator cuff tears, presuming the remaining patients are likely to have
131 rotator cuff impingement, the most common diagnosis in patients with shoulder pain.¹⁹,
132 ²⁰ There is a strong bias that most of these patients had some level of rotator cuff
133 inflammation or impingement which is challenging to classify.²¹ We were unable to
134 confirm this diagnosis, therefore the terminology of shoulder pain was retained for this
135 study.

136 **2.2 Chart Review Procedures**

137 Patient charts were systematically reviewed extracting information regarding
138 exclusion criterion (5 variables), treatment received in first 5 visits (20 variables),
139 treatment frequency (2 variables) demographical information (4 variables), comorbidities
140 (4 variables), historical data (4 variables), physical examination (2 variables) and
141 QuickDASH scores at three time points (initial, visit 5, and discharge). The dependent
142 variable is the Overall QuickDASH change score which was calculated from the change
143 between the initial and discharge QuickDASH scores. The QuickDASH change score at
144 the 5th visit was calculated as the difference between the initial and visit 5 QuickDASH
145 scores. Nine continuous predictor variable were extracted: age, height, weight, duration
146 of symptoms, pain levels, treatment frequency, the total number of treatments, initial
147 QuickDASH score, change at 5th visit QuickDASH score. Descriptive analysis of
148 continuous data is presented with mean and 95% confidence intervals in Table 1.

149 Nine binomial variables were extracted as present or absent and coded as 1 or 0,
150 respectively. The chart was reviewed for the presence of four comorbidities; history of

151 cancer, use of tobacco, use of alcohol, history of diabetes. These were the primary
152 comorbidities filled out on the standard medical history form completed by patients at
153 intake. Additionally, four historical variables, previous injury in the shoulder and work-
154 related injury were coded on the excel spreadsheet. The last two binomial variables
155 coded were mechanism of injury atraumatic = 1, and traumatic = 0 and sex was coded
156 as 1 for males and 0 for females. The final variable from physical examination was the
157 presence of limited elevation which was coded as present if the chart record indicated
158 shoulder elevation less than 140° on the involved shoulder. This value was used based
159 on previous research identifying 156 ± 12° as typical flexion available in patients with
160 shoulder pain.²² The value of 140 was decided upon based on measurement error
161 ranging from 3-7° around 144°.²² The frequency count of all these potential predictor
162 variables are presented in Table 1.

163 **2.3 Treatment Variable Descriptions**

164 The therapist providing treatment recorded the specific modality, if applied, for
165 each treatment and pertinent details of that application including number of minutes
166 applied, specific anatomical site of application and numerical settings on the machine
167 where applicable which is the standard practice for this clinic and is useful for
168 subsequent treatments. The twenty treatment predictor variables were treated as
169 continuous data ranging from 0 to 5 depending on the number of treatments received
170 during the first five visits for the purposes of this project. For example, if a patient
171 received an ultrasound three times during first five treatments they would be coded as
172 three in the ultrasound variable. A zero would be coded in a treatment variable if
173 nowhere in the notes was there an indication that a patient received a particular

174 intervention. The mean, 95% confidence interval, and frequency counts for each
175 treatment category are presented in Table 1. This study only recorded data from the
176 first five visits as our primary interest was how early interventions and early QuickDASH
177 change scores would affect final outcomes. Previous research had demonstrated
178 dramatic changes early during intervention, which was consistent with our clinical
179 observations.²³

180 Treatment counts were used in this study as this was a retrospective study. The
181 specific parameters of each treatment were not documented and varied between
182 therapists based on individual therapist clinical decisions for their patient. We chose to
183 use treatment counts to document what occurs in a typical rehabilitation intervention for
184 shoulder pain. Ideally, having a standard treatment protocol for all patients would have
185 strengthened the study but this would not represent what is typically occurring in
186 outpatient physical therapy clinic with multiple therapists treating patients. Five
187 treatment modalities were recorded to indicate if a patient either did or did not receive
188 the intervention as part of their treatment for each of the five visits. The modality had to
189 be directed to the shoulder to be counted. Manual therapy interventions were
190 categorized into three variables. Spine mobilizations were treatment interventions
191 directed at cervical and thoracic joints regardless of the intensity of the mobilization.
192 Glenohumeral mobilization was manual therapy treatment to gain range of motion in
193 any direction of the shoulder regardless of the intensity. Soft-tissue mobilization was a
194 massage or myofascial release techniques directed at surrounding shoulder and
195 scapular musculature. Various exercises were prescribed so instead of specifying each
196 exercise we categorized exercises into eleven components based on mode and

197 direction. The mode was either passive range of motion (PROM), active assistive range
198 of motion (AAROM), or resistive range of motion (RROM). The three primary directions
199 identified were flexion regardless of the plane of elevation, internal and external rotation
200 irrespective of the amount of arm abduction. Strengthening exercises at this clinic
201 focused on scapular exercises, so two additional categories of RROM were added for
202 scapular protraction and retraction: exercises representing scapular punches and
203 pinches using various resistive loads. Education regarding postural correction for
204 forward head or shoulders was counted as a postural exercise intervention.

205 When examining the data entered into the excel spreadsheet 51 subjects had at
206 least one missing predictor variable, therefore, these subject were removed, leaving 128
207 subjects available for the forward stepwise regression model.

208 <<Insert Table 1>>

209 **2.4 Data Analysis**

210 A multivariate linear regression analysis was conducted to determine which of
211 the 38 predictor variables were most prognostic in estimating final outcome on the
212 QuickDASH score. The outcome or dependent variable (Y) was the overall QuickDASH
213 change score. The predictor variables were entered into a forward stepwise linear
214 regression using SPSS version 22 (IBM, Corporation, Armonk NY). A forward stepwise
215 method places the predictor variable with the highest correlated to the outcome variable
216 into the equation first. A p-value of $\leq .05$ was required for a predictor variable to enter
217 the equation at each step requiring that the addition of other predictor variables had to
218 contribute to estimating the outcome variable significantly. Additionally, at each step a

219 p-value ≥ 0.1 was used to remove a predictor variable that exceeded this value at each
220 step in developing the regression model. The adjusted R^2 value was determined at
221 each step to evaluate the explained variance by the predictor variables. The variable
222 inflation factor was monitored at each step to assure predictor variables entered were
223 not highly correlated and identify potential multicollinearity between predictor variables
224 added to the equation.

225 **3.0 Results**

226 The multivariate linear regression analysis revealed a model with an adjusted R^2
227 = .538 ($P < .001$) accounting for 5 variables entered into the equation. (Table 2) The five
228 variables in order were QuickDASH change score at 5 visits, Total visits, Initial
229 QuickDASH score, RROM Scapular retraction, and Age. The resulting regression
230 equation was able to account for approximately half of the variance of the change in
231 perceived level of disability measured by the QuickDASH in patients with shoulder pain
232 with a standard error of the estimate equal to 10.5 points. The resulting equation:

233 Y (Overall QuickDASH change score) = $.62(\text{QuickDASH change score at 5}^{\text{th}} \text{ visit}) +$
234 $.73(\text{Total visits}) + .238(\text{Initial QuickDASH score}) + 1.22(\text{RROM scapular retraction}) -$
235 $.165(\text{Age}) - 4.69.$

236 <<Insert Table 2>>

237 **4.0 Discussion**

238 The objective of this study was to determine what factors are associated with a
239 positive outcome in patients with shoulder pain presenting to a physical therapy clinic in

240 a general orthopedic practice population. With the recent emphasis on value-based
241 health care^{24, 25} and estimating final outcomes through the use of G-codes²⁶ clinicians
242 need to establish and refine reasonable predictors for patient outcomes. The current
243 study predicts short-term outcomes, as indicated by patient self-reported outcomes
244 using the QuickDASH change scores and provides clinicians a potential tool to estimate
245 outcome change scores in patients with shoulder pain.

246 **4.1 Comparison to Previous Studies**

247 Previous studies have investigated short-term outcome predictors for patients
248 with shoulder pain. A systematic review of shoulder disorders found strong evidence
249 that high pain intensity predicts poor outcomes in primary care populations. It also
250 revealed moderate evidence for long duration of complaints and high disability score at
251 baseline.⁶ Similar findings were obtained in another systematic review, which found only
252 two prognostic factors associated with outcome in two or more studies, duration of pain
253 and baseline function.²⁷ All of these measures were included in this study however our
254 results differed. Baseline pain level was not predictive of an overall change of the
255 QuickDASH score, and higher initial QuickDASH scores were associated with greater
256 change scores. It is logical and commonly reported that higher scores are predictive of
257 greater change as there is more opportunity for change.²⁸ Based on previous studies we
258 expected the duration of symptoms and pain levels to be predictive of change scores.⁶
259 ²⁷ These results were not observed in this study. The previous systematic reviews were
260 primarily in prospective cohort studies and the current study is a retrospective cohort
261 limiting the impact of this study's findings related to these two variables. In reviewing our
262 data duration of symptoms ranged from very acute at .2 months to very chronic - 161

263 months. However, duration of symptoms was skewed toward the acute end of the
264 continuum as 61% of all 128 subjects identified their duration of symptoms as less than
265 or equal to 4 months. This relatively tight distribution was observed for baseline pain
266 measures as 64% of all subjects rated their pain between 4 and 7 on a numeric pain
267 rating scale. The lack of variability for each of these predictor variables likely contributes
268 to their absence in the final regression model.

269 Previous studies investigating short-term outcomes of physical therapy lasting 3
270 months in duration found older age to predict greater disability at discharge.^{29, 30} The
271 use of age as a predictor is consistent with the results from the current study. We
272 identified age as a negative predictor, indicating the greater the age, the poorer our
273 outcome. However, this is a non-modifiable predictor variable and was a significant but
274 weak predictor of final outcome as it was the last variable included in the regression
275 model. Clinicians need to remember that in a regression model, it is the combination of
276 variables that create the model, rather than a single variable and the relative importance
277 is indicated by explained variance which in this case only contributed 1.5% of the
278 explained variance.

279 The current study supports previous research that identified incorporating active
280 interventions as prognostic of positive outcomes in patients with shoulder pain.^{9, 10} It is
281 interesting to note that no other intervention was strongly correlated with a positive
282 outcome other than resistive scapular retraction exercises.²⁹ A substantial number of
283 the patients included in this study exhibited signs and symptoms of impingement
284 syndrome, though we did not specifically limit this study to patients with symptoms of
285 impingement alone. Because we excluded patients with significant motion restrictions

286 and clinical findings consistent with shoulder instability, the majority of the remaining
287 patients demonstrated rotator cuff involvement. Exercises focusing on scapular
288 retraction provide benefit by increasing subacromial space^{31, 32} and thereby reducing
289 shoulder pain and dysfunction.^{23, 33, 34} Experienced therapists note that scapular
290 exercise is a fundamental element in their treatment of patients with shoulder pain likely
291 to have sub-acromial impingement.³⁵

292 Another factor that was a positive predictor of overall change in QuickDASH
293 score in the current study was the total number of therapy visits. Though the aim of any
294 treatment protocol is to achieve established goals in as timely a manner as possible,
295 this information suggests there is important value in ultimate patient outcome by
296 persisting with a treatment regimen, even if progress occurs at a slow pace. Given this
297 evidence, therapists should be encouraged to persist in pursuing treatment goals and
298 continue to evaluate specific features of treatment interventions, especially working to
299 see that patient's "buy in" to the value of disciplined compliance with the prescribed
300 exercise regimen.³⁵ In making this recommendation, it is recognized that beyond some,
301 as yet, unidentified upper threshold of visit number, the positive predictive characteristic
302 indicated by our research probably fades in value. We did not seek to establish that
303 upper limit of visits as that was not the focus of the current study.

304 The results of the current study provide treating clinicians with useful information
305 to track patient progress and modify treatment interventions based on that progress.
306 The variable in our study most closely associated with predicting a successful patient
307 response was the QuickDASH change score at the 5th therapy visit. This variable by
308 itself was capable of explaining 40% of the variance of the overall change in the

309 QuickDash score at discharge. Tate et al.,²³ demonstrated graphically in their report
310 that patients with shoulder impingement who exhibited significant improvement had at 2
311 weeks improved by approximately 15 points. Their sample was only 10 patients, but our
312 findings agree and support their conclusions and a similar trend of early improvement in
313 patient-reported outcomes. This is consistent with the current study as the average
314 improvement of all patients in our study was 11 points improvement with a 95%
315 confidence interval ranging from 9-13 points. This meets and exceeds the minimally
316 clinically important difference of 8 points identified as meaningful improvement in
317 patients with shoulder pain.¹⁵ The use of patient-reported outcomes throughout the
318 course of care, and not just at the beginning and end of treatment, is valuable as
319 indicated by the results of the current study. This is important as it allows therapists the
320 opportunity to adjust therapeutic intervention in an effort to prevent protracted pain and
321 disability when patients do not self-report clinically meaningful functional progress.
322 Failure to note substantial progress during the first five therapy visits should alert
323 clinicians to examine the range of interventions for any given patient.¹³

324 **4.2 Clinical Implications**

325 The linear regression equation created from this dataset provides clinicians with
326 a tool to estimate QuickDASH change score at discharge. This equation indicates that
327 all variables are positive predictors of the overall QuickDASH change score except for
328 age. The age variable has a negative sign indicating that for every year older the overall
329 QuickDASH change score is decreased by .16 units. Any value can be applied to
330 estimate the overall change in QuickDASH score. For the following example, the mean
331 values for each predictive variable from Table 1 were used.

332 QuickDASH change score at 5th visit =11

333 Total visits = 12

334 Initial QuickDASH score = 40

335 RROM scapular retraction = 4

336 Age = 50

337 Constant = -4.69

338 Equation $(.62(11) + .73(12) + .238(40) + 1.22(4) - .165(50) - 4.69) = 17$

339 Applying the regression equation presented in the results section with mean
340 values yields an estimated change score equal to 17 points. In applying this equation,
341 the standard error of estimate, which equals 10.5 also has to be taken into
342 consideration. The standard error of estimate for a regression equation functions similar
343 to a standard deviation of the mean, which would indicate that change score could vary
344 from 6.5 to 27.5 points. The wide range of scores is explained by the fact that the
345 equation only explains approximately 50% of the variance of the overall QuickDASH
346 change score and indicates that other factors not considered may contribute to the final
347 outcome. This equation is not a perfect estimator of final change score but provides
348 clinicians with the major predictor variables to consider and a useful tool to estimate
349 prognosis.

350 Through examining the data from a different perspective, clinicians should focus
351 on achieving an eleven point change or greater in the first five visits. The data was
352 further evaluated to determine how likely a change of 11 points at visit 5 predicts a

353 QuickDASH change score of 17 or greater at discharge. Fifty-five out of the 128 patients
354 had an overall QuickDASH change score greater than 17. Forty-one out of 55 or 74.5%
355 of those patients had a change of 11 or more points on the QuickDASH at visit 5. This
356 left 73 patients with an overall QuickDASH change score under 17 points. Fifty-three out
357 of 73 or 72.6% of those patients had a QuickDASH change score under 11 points at
358 visit 5. This change value has been found to be the minimal detectable change score
359 with the QuickDASH in patients with shoulder pain.¹⁵ This demonstrates that early use
360 of patient-reported outcomes provide clinicians with the patient's perspective of how
361 they are recovering from their shoulder injury and is essential in patient-centered
362 evidence-based rehabilitation.³⁶⁻³⁹

363 **4.3 Limitations**

364 A number of limitations exist in the present study. This is a retrospective study
365 which has a common limitation of missing data. This study is no different. A lack of
366 objective data in the chart reviews relating to inclusion criteria limited our ability to
367 diagnose patients with a specific condition such as subacromial impingement syndrome.
368 It is very challenging, and much debate is ongoing in the literature regarding how to
369 categorize these patients.^{21, 40} We attempted to include potential patients by using
370 reasonably strict exclusion criterion to limit our patient population, since advanced
371 imaging was not available for all patients during this retrospective review of physical
372 therapy notes. As a retrospective study all patients information is derived from either
373 self-report or from therapist reported findings. There are details that could have
374 contributed to the explaining final outcomes that were not able to be obtained or coded
375 in a manner to allow adequate investigation such as continuous measures of motion

376 and strength measures in a standard manner. Future studies may be designed to create
377 a more stringent inclusion criteria related to diagnosing sub-acromial impingement and
378 using a prospective, rather than a retrospective design.

379 Another significant limitation refers to the generalizability of the results. The
380 study was conducted in a single outpatient facility in the south region of the United
381 States with only four treating therapists. It is unknown whether the results of our study
382 will apply to other patient populations in different clinical settings. Future research
383 should seek to replicate the present study in various regions of the country with a
384 different cohort of patients to improve the generalizability of these results. Additionally,
385 the specific intervention parameters were not well defined in this study. For example, it
386 is not clear what aspects of the joint capsule were targeted with glenohumeral
387 mobilization. More accurate treatment descriptions in a prospective, more controlled
388 study may assist future therapists in determining specific treatment plans for their
389 patients. Finally, the number of patients included in this study (n=128) was relatively low
390 considering the number of variables considered in the regression model and may have
391 led to less reliable results. Future research would benefit from including a larger
392 number of patients in a similar study.

393 **4.4 Conclusion**

394 The goal of this study was to identify the best predictors of patient-reported
395 outcome change scores at discharge in patients with shoulder pain. We identified four
396 positive predictive factors with the greatest predictor being QuichDASH change score at
397 visit 5 using a retrospective design. The other three positive predictive factors were the

398 number of patient visits, initial QuickDASH score, and incorporation of scapular
399 retraction resistive exercises. The only negative predictor was the age of the patient,
400 which is not modifiable. A change score of 11 points, equivalent to the minimal
401 detectable change score for the QuickDASH, early in rehabilitation is a positive
402 indication that patients with shoulder pain are on a positive trajectory to achieving a
403 good outcome with rehabilitation.

404

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524

Table 1. Description of data extracted from 128 patients' charts. Continuous data presented with means, standard deviation and 95% confidence intervals of the means. Binomial data is presented as frequency counts.

Data Category	Variable	Mean	Standard Deviation	95% CI Lower Boundary	95% CI Upper Boundary	Present	Absent
Dependent Variable	Overall Change QuickDASH score	16.72	15.54	14.03	19.42		
Comorbidities	Cancer					6	122
Comorbidities	Alcohol					94	34
Comorbidities	Tobacco					18	110
Comorbidities	Diabetes					15	113
Dash Score	Initial QuickDash score	39.81	16.55	36.95	42.68		
Dash Score	QuickDash change score at 5 th visit	11.10	12.91	8.87	13.34		
Demographics	Age	52.83	12.23	50.71	54.95		
Demographics	Sex					74 females	54 males
Demographics	Height (cm)	170.51	10.59	168.68	172.34		
Demographics	Weight (kg)	83.79	21.68	80.04	87.55		
History	Mechanism					90 atraumatic	38 traumatic
History	Duration of symptoms (months)	7.61	17.02	4.66	10.56		
History	Work related					18	110
History	Previous injury					39	89
Physical Exam	Limited shoulder elevation					79	49
Physical Exam	Pain (NPRS)	5.60	2.09	5.24	5.96		
Treatment	IFC	0.59	1.61	0.31	0.87	16	112
Treatment	TENS	1.97	2.40	1.55	2.39	55	73
Treatment	Muscle stimulation	1.45	2.24	1.06	1.84	39	89

Treatment	Iontophoresis	3.31	2.28	2.92	3.71	89	39
Treatment	Ultrasound	3.76	2.12	3.39	4.12	100	28
Treatment	Spine Mobilization	0.63	1.57	0.36	0.90	20	108
Treatment	Glenohumeral mobilization	3.73	1.73	3.43	4.03	111	17
Treatment	Soft tissue mobilization	0.72	1.66	0.43	1.01	22	106
Treatment	PROM flexion	0.64	1.57	0.37	0.91	21	107
Treatment	PROM external rotation	2.57	2.25	2.18	2.96	80	48
Treatment	PROM internal rotation	1.25	2.00	0.90	1.60	40	88
Treatment	AAROM flexion	2.45	2.29	2.05	2.84	73	55
Treatment	AAROM external rotation	0.38	1.23	0.17	0.60	13	115
Treatment	AAROM internal rotation	0.10	0.67	-0.02	0.22	3	125
Treatment	RROM internal rotation	2.41	2.26	2.02	2.81	75	53
Treatment	RROM external rotation	2.73	2.18	2.35	3.10	87	41
Treatment	RROM scapular protraction	1.00	1.76	0.69	1.31	38	90
Treatment	RROM scapular retraction	4.13	1.70	3.83	4.42	112	16
Treatment	RROM flexion	1.01	1.85	0.69	1.33	34	94
Treatment	Posture exercises	1.50	2.18	1.12	1.88	43	85
Treatment frequency	Total visits	12.18	5.83	11.17	13.19		
Treatment frequency	Visits per week	2.08	0.60	1.97	2.18		

CI = Confidence Interval

NPRS = numerical pain rating scale

Present = number of people in the sample that received the treatment or had the condition

Absent = number of people in the sample that did not receive the treatment or did not have the condition

Rx = Treatment category

IFC = Interferential current

TENS = Transcutaneous electrical nerve stimulation

PROM = Passive range of motion

AAROM = Active assistive range of motion

RRROM = Resistive range of motion

Table 2. Regression analysis results with predictor variables present in order of entry into the forward stepwise regression model

Variable	R value	Adjusted R ²	Beta	Beta CI ₉₅ Lower Boundary	Beta CI ₉₅ Upper Boundary	Significance	VIF
QuickDash change score at 5 th visit	.636	.400	.620	.459	.780	.000	1.24
Total visits Initial	.690	.468	.730	.402	1.058	.000	1.062
QuickDash score RROM	.723	.510	.238	.108	.361	.000	1.266
scapular retraction	.735	.525	1.22	.100	2.345	.033	1.061
Age	.746	.538	-.165	-.318	-.013	.034	1.01

R = regression correlation values

VIF = Variable inflation factor

CI = Confidence Interval