RESEARCH ARTICLE

Outpatient versus At-Home Physical Therapy Following Distal Biceps Repair

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Abstract

Objectives: Distal biceps repair is a common orthopedic procedure, but there is still debate regarding the optimal post-operative care for patients. The purpose of this study is to assess the efficacy of at-home physical therapy compared to outpatient physical therapy following distal biceps tendon repair.

Methods: A retrospective review of distal biceps repairs performed between 2012 and 2017 by four fellowship-trained orthopedic surgeons at one institution was undertaken. Patients were grouped into outpatient physical therapy and at-home therapy groups. Exclusion criteria included any patients who did not undergo a direct repair of the distal biceps and cases in which allograft augmentation was utilized. Postoperative complications were identified by manual chart review. After a minimum of three years follow-up, demographic information as well as elbow functional outcome scores including the Quick Dash, Mayo Elbow Performance Index, and Oxford Elbow Scores were obtained via phone calls and online surveys.

Results: One hundred and forty-six patients were included in this study at a mean follow-up of 6.3 years for patients who attended outpatient physical therapy and 5.9 years for patients who performed an at-home therapy program. There were twenty-eight patients in the at-home physical therapy group and one hundred eighteen patients in the outpatient physical therapy group. There were two complications: one re-ruptured distal biceps tendon requiring a revision surgery in the at-home patient cohort, and one post-operative posterior interosseous nerve palsy that recovered after 6 months in the outpatient rehabilitation group. We found there was no significant difference between the two groups for any of the three functional elbow scores.

Conclusion: Patients undergoing routine distal biceps repair may achieve similar clinical outcomes with a regimented at-home physical therapy protocol in lieu of formal outpatient physical therapy.

Level of evidence: IV

Keywords: At-home therapy, Distal biceps repair, Distal biceps rupture, Outpatient therapy, Physical therapy

Introduction

Rupture of the distal biceps brachii tendon is a relatively uncommon injury that occurs primarily in the dominant arm of males in their fourth decade of life with an incidence of 1.2 per 100,000 persons per year.[1] The current standard of care for young, active patients is an anatomic repair of the tendon, as non-operative management of complete ruptures has been shown to decrease elbow flexion and supination strength compared to operative treatment.[2–6] Surgical fixation of the tendon to the radial tuberosity can be performed through a one[7] or two[8,9] incision approach via multiple fixation methods including bone tunnels, suture anchors, interference screws, suspensory cortical buttons, or a combination of the above.

Post-operatively, many surgeons utilize a protocol that immobilizes the operative arm for 1-2 weeks followed by bracing that limits full extension for a duration determined by surgeon preference often accompanied by a formal outpatient physical therapy program.[10,11] Despite being many surgeons' standard protocol, formal physical therapy

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after orthopaedic surgery can be both time-consuming and expensive for patients.[12] Multiple studies have evaluated informal at-home physical therapy as an alternative to outpatient physical therapy and demonstrated comparable outcomes when either are used for recovery from various orthopaedic surgeries including joint replacement and fracture care.[13–15] In regards to distal biceps repair, there has been recent interest in optimizing the post-operative protocols, in particular questioning the need for extended immobilization in favor of early motion and rehabiliation.[16,17] However, there remains a lack of data directly comparing functional outcomes between patients who underwent outpatient physical therapy and those who have had a standardized at-home therapy program. This study's hypothesis is that there will be no difference in the postoperative functional outcome scores between patients who participated in formal outpatient physical therapy and those who underwent a structured at-home therapy program.

Materials and Methods

Institutional Review Board approval was obtained prior to data collection. A retrospective review of our practice database was performed to identify all patients who underwent a distal biceps repair (CPT 24342) by one of four fellowship-trained shoulder and elbow surgeons from 2012 to 2017. Two surgeons routinely utilized outpatient physical therapy and two surgeons utilized an at-home rehabilitation program as their postoperative standard of care. Instructions for the at-home program were provided by the surgeon as part of the patient's postoperative care. All surgeons used a similar post-operative rehabilitation protocol regardless of whether the patients attended an outpatient formal physical therapy program or an at-home rehabilitation program [Figure 1]. During the study period, our institution employed a conservative 2-week immobilization period for all patients, despite more recent literature supporting early motion protocols. A review of all patients' charts was performed to evaluate for postoperative complications documented at minimum 12-week postoperative visit, and to ensure patients in the at-home therapy group did not receive an outpatient physical therapy prescription. Exclusion criteria included any patients who did not undergo a direct repair of the distal biceps and cases in which allograft was utilized. Patients who met the above criteria were included in the study population. Demographic data was collected for each patient including age, gender, smoking, diabetes, body mass index (BMI), insurance type, laterality, handedness, date of surgery and incision type. Final functional outcome scores were collected from patients via direct phone calls by study personnel or using data collection software REDCap to obtain Quick DASH (Quick Disabilities of Arm Shoulder Hand Score), Mayo Elbow Performance Index, and Oxford Elbow Scores at a minimum of three years post-operative time.

Standardized Rehabilitation Program for Distal Biceps Repair

I. **Phase I(Weeks 0-2 Postoperatively)**
   a. Posterior splint or hinged elbow brace at 90 degrees
   b. Wrist and finger range of motion / grip exercises
   c. No active supination

II. **Phase II (Weeks 3-5 Postoperatively)**
   a. Discontinue use of splint or hinged elbow brace
   b. Begin passive and active assisted ROM: flexion/extension and pronation/supination (with elbow flexed at 90 degrees) hold 5 seconds in each direction - repeat 5 times with five sets spaced throughout the day
   c. No range of motion limit, perform exercises within patient tolerance

III. **Phase III (Weeks 6-10 Postoperatively)**
   a. Continue passive and active assisted range of motion exercises, can be more aggressive at end range of motion
   b. Begin adding in bicep curls performed with arm in full extension and forearm in neutral rotation then curl arm to full flexion and supinate the arm at full flexion then lower back to the starting position
   i. Start with one pound - perform up to 20 reps every other day (can progress up to a 5-pound weight limit)

IV. **Phase IV (Weeks 11-14 Postoperatively)**
   a. Unrestricted stretching and range of motion exercises
   b. Advance the weight on the bicep curls – patient to continue to work in the high repetition range (10-15) stopping when fatigued

V. **Phase V (Weeks 15+ Postoperatively)**
   a. Start being more aggressive with strengthening, focusing on higher weights with lower repetitions
   b. Return to sports-related activities

Figure 1. Standard Post-operative Rehabilitation Protocol Following Distal Biceps Repair

Statistical Methods

A statistical analysis was performed comparing functional outcome scores between the two physical therapy protocols. Normality was assessed by performing Shapiro-Wilks test. Mann Whitney U tests were used to compare continuous data and Chi-square or Fisher's Exact test were used to compare categorical data. A post hoc power analysis was performed for each outcome variable, for which we utilized previously published minimal clinically important different (MCID) values of 15 for the Mayo score, 10-17 for the Quick DASH[18] and 10 for the Oxford Elbow Score.[19]

Results

We identified 211 patients who met inclusion criteria for the study. Of those patients, 149 patients were contacted and consented to follow up via an online or telephone administered survey. Three patients were excluded due to the use of an allograft during distal biceps repair, two from the at-home cohort and one from the outpatient rehab cohort. There were 28 patients in the informal at-home rehabilitation group and 118 patients in the formal outpatient physical therapy group. The mean follow-up time for the outpatient rehab cohort was 6.26 years (SD: 1.66) and 5.93 years (SD: 1.76) for the at-home cohort. There was no statistically significant difference between groups with respect to age, gender, smoking, injury to dominant arm, BMI or incision type [Table 1]. We did find differences between groups with respect to race and Worker's Compensation status, with a greater proportion of Caucasians in the at-home group (100%) than in outpatient rehab (70.3%) and a greater proportion of patients with Worker's Compensation insurance in the outpatient rehab group (45.8%) than the at-home group (7.1%).

The vast majority (n=132; 90%) of our patients had the distal biceps tears repaired utilizing a two-incision approach. Specifically, 23/28 (82%) patients in the at-home rehabilitation group underwent a two-incision repair and 109/118 (92%) of patient in the outpatient rehabilitation group underwent a two-incision repair. Multiple techniques were used for fixation depending on surgeon preference, including cortical buttons, bone tunnels, suture anchors.

There were two major complications found during the follow-up period. One patient re-ruptured his distal biceps tendon requiring a revision surgery in the at-home patient cohort. The re-rupture occurred within the first two weeks postoperatively, during which the patient was non-compliant with postoperative immobilization. Additionally, one patient had a post-operative posterior interosseous nerve palsy that recovered after 6 months in the outpatient rehabilitation cohort. There was no cross-over identified between the groups during manual chart review.

Table 1. Demographic and Surgical Variable Comparison of Treatment Groups

	No Rehab (N=28)	Rehab (N=118)	P Value
Age	52.7 (12.0)	55.2 (9.30)	0.306
Sex:			
Female	0 (0.00%)	1 (0.85%)	1.000
Male	28 (100%)	117 (99.2%)	
Race:			
White	28 (100%)	83 (70.3%)	0.002
Other	0 (0.00%)	35 (29.7%)	
Smoking:			
No	17 (60.7%)	72 (61.0%)	1.000
Yes	11 (39.3%)	46 (39.0%)	
DM Type II:			
No	25 (89.3%)	115 (97.5%)	0.085
Yes	3 (10.7%)	3 (2.54%)	
DM Type I:			
No	27 (96.4%)	117 (99.2%)	0.348
Yes	1 (3.57%)	1 (0.85%)	
DM:			
No	24 (85.7%)	114 (96.6%)	0.044
Yes	4 (14.3%)	4 (3.39%)	

Table 1. Continued			
Workers Comp:			
No	26 (92.9%)	64 (54.2%)	<0.001
Yes	2 (7.14%)	54 (45.8%)	
Injury to Dominant Arm:			
No	9 (32.1%)	50 (42.4%)	0.437
Yes	19 (67.9%)	68 (57.6%)	
Laterality:			
Left	11 (39.3%)	51 (43.2%)	0.868
Right	17 (60.7%)	67 (56.8%)	
Handedness:			
Left	2 (7.14%)	12 (10.2%)	1.000
Right	26 (92.9%)	105 (89.0%)	
Both	0 (0.00%)	1 (0.85%)	
BMI	30.8 [27.9;35.2]	30.3 [28.0;33.2]	0.457
Number of Incisions:			
1	5 (17.9%)	9 (7.63%)	0.145
2	23 (82.1%)	109 (92.4%)	

Table Legend: [1]Continuous data is presented as either mean (standard deviation) or median [1st quartile; 3rd quartile] depending on its normality. Categorical data is presented as cell count (%). T-tests or Mann-Whitney U tests were used to calculate continuous data and Chi-Square or Fisher's Exact was used for categorical data.

For the outpatient rehab cohort, the mean and median Mayo score were 97.1 (SD: 9.6) and 100, respectively, compared to the at-home rehabilitation of 96.4 (SD: 6.2) and 100, respectively. The mean and median Quick DASH scores for the outpatient group were 2.7 (SD: 6.9) and 0, respectively, compared to 0.8 (SD: 1.5) and 0 for the at-home group. Lastly, the mean and median Oxford Elbow scores for the outpatient group were 46.3 (SD: 4.8) and 48, compared to 47.5 (SD: 1.0) and 48 for the at-home group. There were no significant differences in functional outcome scores between the two groups [Table 2]. A post hoc power analysis was performed using established MCID values resulting in $\beta = 0.07$, 0.43, and 0.37 for Mayo, Quick DASH, and Oxford scores, respectively, indicating that our retrospective analysis was underpowered. The sample size estimate for an adequately powered trial was 4,216 for Mayo score, 268 for Oxford score, and 222 for DASH score, assuming equal participation in both groups.

Table 2. Functional Outcome Score Comparison of Treatment Groups			
	No Rehab (N=28)	**Rehab (N=118)**	**P Value**
MAYO	100 [95.0;100]	100 [100;100]	0.054
QDASH	0.00 [0.00;2.27]	0.00 [0.00;1.70]	0.982
OXFORD	48.0 [47.8;48.0]	48.0 [47.0;48.0]	0.650

Table Legend: [1]Data is presented as median [1st quartile; 3rd quartile] due to the normality of their distribution. P-values based on Mann-Whitney U tests. MAYO = Mayo Elbow Performance Index, DASH = Quick Disabilities of Arm Shoulder Hand Score, OXFORD = Oxford Elbow Score.

Discussion

The goal of this study was to compare functional outcomes between patients who participated in formal outpatient physical therapy and those who underwent a structured at-home therapy program following distal biceps repair. We hypothesized that there would be no difference in the postoperative functional outcome scores between these two groups. Our results confirmed our hypothesis, with the caveat of an underpowered study cohort. We found that there was no difference in functional outcome scores (Mayo, Quick DASH, Oxford Elbow) between patients who underwent formal in-person physical therapy versus

patients who had a structured at-home therapy program at minimum three year follow up. Given our results, patients undergoing routine distal biceps repair procedure may benefit from having the option of following a regimented at-home physical therapy protocol in lieu of formal outpatient physical therapy.

Utilization of an at-home therapy program may prove to be part of a more convenient and cost-effective postoperative approach for patients recovering from distal biceps repair. While our study did not evaluate direct costs, a prior cost-analysis of distal biceps repair showed that postoperative physical therapy accounts for on-average 8% of total cost, with bracing accounting for an additional 12% of costs.[20] While some of these costs may be covered by insurance, patients may avoid expensive co-pay charges by opting for at-home rehabilitation or avoiding bracing altogether. It should be noted that our study did not involve the elimination of immobilization and/or bracing postoperatively. Our study should be viewed in the context of multiple recent patient cohort studies which have assessed outcomes related to variations in the initial immobilization period, questioning the value of postoperative resource utilization. For example, Cheung et al.[16] evaluated early motion following distal biceps repair, reporting on 13 patients managed with immediate postoperative range of motion in a hinged brace with progressive extension blocks, and found their patients to achieve early gains in motion with no poor effect on repair healing or strength recovery. Smith and Amirfeyz[21] described good outcomes using an even less cautious strategy in which 22 patients repaired with a cortical button were provided no splint or brace postoperatively and allowed to begin active, unsupervised motion immediately. Their patients were referred to physiotherapy to begin range of motion exercises at two weeks and strengthening at six weeks, with full activity resumed at 12 weeks. Lastly, Bergman et al.[17] randomized the initial six week postoperative course in patients repaired with a cortical button to either 1) immediate mobilization as tolerated with a sling for comfort or 2) splint in 90° flexion for two weeks, followed by splint removal five times a day with progressive elbow extension until the six week mark. The authors found no clinically important differences and concluded that early motion is well tolerated and not associated with poor outcomes.

Prior to this recent literature published on safety of early mobilization, our institutional postoperative protocol utilized in this study still employed two weeks of immobilization postoperatively to protect the repair and surgical site. Additionally, while patients were able to begin progressive strengthening at six weeks, they maintained a five-pound weight restriction until the 10-week mark. This enabled a reasonable goal for return to sport/activity at 14 weeks for all patients. Despite our use of postoperative immobilization, our study contributes to a growing body of literature that challenges traditional approach to rehabilitation. It suggests that some patients may be appropriate for self-directed rehabilitation and in doing so can still achieve excellent long-term results. Importantly, however, our study population demonstrated a greater usage of at-home physical therapy among certain demographic groups including those of Caucasian race and those without Worker's Compensation claims. This highlights a possible bias and shows that at-home therapy may not be as readily available or attractive to patients of all demographics or insurance types, which could affect its implementation in various practices.

There were limitations to our data set. We were able to follow up with 70.6% of our population of identified patients. Our power analysis showed that a larger sample size may have been useful for detecting clinical differences. Additionally, follow up was variable between subjects but was kept to a three-year minimum, and we could not retrospectively assess short term outcome differences between study groups. Because our final outcome data were collected remotely as opposed to in-person, this could have resulted in under-reported complications. We also did not collect the length of time patients followed physical therapy protocols in either cohort which could have an influence on our results. Further, because patients' postoperative rehab program was assigned primarily by surgeon preference, we lacked the ability to control for important variables including surgeon experience and technique, which may make our results not generalizable to every patient who undergoes a distal biceps tear. Lastly, our results are based solely on functional outcome scores and not specific measurements i.e., elbow range of motion or strength assessments. However, the three functional scores utilized have been validated in previous studies and are a more important proxy for everyday use than specific measurements.

Conclusion

The goal of this study was to compare functional outcomes between patients who participated in formal outpatient physical therapy and those who underwent a structured at-home therapy program following distal biceps repair. Our results confirmed our hypothesis demonstrating no significant difference between these two groups across three reliable outcome measures, suggesting that structured at-home physical therapy may be a reliable alternative to traditional outpatient therapy following this surgery. Future studies should explore the cost effectiveness of at home informal physical therapy as compared to that of in-person outpatient physical therapy. Additionally, length of physical therapy protocol adherence and overall patient compliance with postoperative care should be investigated in order to clarify any confounding factors underlying this type of study.

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