A Clinical Comparison of Home-Based and Hospital-Based Exercise Programs Following Arthroscopic Capsulolabral Repair for Anterior Shoulder Instability

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Context: Ideal rehabilitation method following arthroscopic capsulolabral repair surgery for anterior shoulder instability has not been proven yet. Although rapid or slow protocols were compared previously, home- or hospital-based protocols were not questioned before. **Objective:** The aim of this prospective unrandomized controlled clinical trial is to compare the clinical outcomes of home-based and hospital-based rehabilitation programs following arthroscopic Bankart repair. **Design:** Non-randomized controlled trial. **Setting:** Orthopedics and physical therapy units of a single institution. **Patients:** Fifty-four patients (49 males and 5 females) with an average age of 30.5 (9.1) years, who underwent arthroscopic capsulolabral repair and met the inclusion criteria, with at least 1-year follow-up were allocated into 2 groups: home-based ($n = 33$) and hospital-based ($n = 21$) groups. **Interventions:** Both groups received identical rehabilitation programs. Patients in the home-based group were called for follow-up every 3 weeks. Patients in the hospital-based group admitted for therapy every other day for a total of 6 to 8 weeks. Both groups were followed identically after the eighth week and the rehabilitation program continued for 6 months. **Main Outcome Measures:** Clinical outcomes were assessed using Disabilities of Arm Shoulder Hand, Constant, and Rowe scores. Mann–Whitney U test was used to compare the results in both groups. Wilcoxon test was used for determining the progress in each group. **Results:** Groups were age and gender matched ($P = .61$, $P = .69$). Average number of treatment sessions was 13.8 (7.3) for patients in the hospital-based group. Preoperative Disabilities of Arm Shoulder Hand (27.46 [11.81] vs 32.53 [16.42], $P = .22$), Constant (58.23 [14.23] vs 54.17 [10.46], $P = .13$), and Rowe (51.72 [15.36] vs 43.81 [19.16], $P = .12$) scores were similar between groups. Postoperative scores at sixth month were significantly improved in each group ($P = .001$, $P = .001$, and $P = .001$). No significant difference was observed between 2 groups regarding clinical scores in any time point. **Conclusions:** We have, therefore, concluded that a controlled home-based exercise program is as effective as hospital-based rehabilitation following arthroscopic capsulolabral repair for anterior shoulder instability.

Keywords: Bankart repair, shoulder rehabilitation, home-based rehabilitation, hospital-based rehabilitation

Arthroscopic repair has become the primary surgical option for the treatment of recurrent anterior shoulder instability, as the studies reported comparable outcomes between open and arthroscopic techniques.^{1–3} Advances in surgical techniques and implant quality provided more secure repair of the capsulolabral tissue to glenoid rim and allowed earlier rehabilitation programs to gain range of motion (ROM).⁴ Reported failures of arthroscopic repairs are thought to be related to technical factors and failure to recognize other accompanying pathologies responsible for glenohumeral instability.⁵ Successful operative outcome in patients with shoulder instability depends on accurate preoperative evaluation, careful diagnostic arthroscopy to evaluate concomitant pathologies, proper arthroscopic repair technique, and effective postoperative rehabilitation program. The delicate balance between stability and mobility, as well as the complex interplay between the static and the

dynamic stabilizing factors requires a meticulous rehabilitation approach.⁶

Home-based therapy programs are the mainstay rehabilitation strategy in many clinical conditions. They have clear advantages regarding the work force allocation, cost and management of resources.⁷ Published therapy protocols such as The American Society of Shoulder and Elbow Therapists' guideline on shoulder instability provide reliable and applicable data.⁸ On the other hand, patient adherence to home-based protocols is a common problem affecting results.^{9,10} It was shown that home-based protocols demonstrated the lowest levels of adherence among physical therapy modalities.^{11,12}

Previously, aggressive rehabilitation was associated with recurrence and failure.^{13,14} As reported in more recent studies, improved surgical techniques and implants allowed earlier rehabilitation in selected patient groups with accelerated rehabilitation protocols. As the arthroscopic Bankart repair causes little inflammatory response in the capsule and surrounding tissues, patients are relatively pain free and home-based exercise programs are the first choice in rehabilitation. Immediate postoperative exercise programs are shown to be effective in functional recovery without harm to the repaired tissue.^{15,16}

There is evidence on both safety and efficacy of home-based rehabilitation and necessity of supervised hospital-based approach. Considering the controversies, home- and hospital-based

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rehabilitation protocols should be compared in each clinical setting to established reliable evidence.

The purpose of this study was to compare the clinical results of patients treated with home-based program and hospital-based therapy, following arthroscopic capsulolabral repair for anterior shoulder instability. We have hypothesized that home-based patient-controlled postoperative rehabilitation after arthroscopic repair would be as effective as a supervised hospital-based rehabilitation.

Methods

Patients who were diagnosed with recurrent anterior shoulder instability and underwent an arthroscopic capsulolabral repair were enrolled into the study. Following the surgery, patients were allocated to home-based or hospital-based groups. Functional outcomes were assessed before the surgery, at the 3rd, 6th and 12th months. During the study period, 65 patients who had arthroscopic Bankart repair were assessed for eligibility and 54 patients with an average age of 30.5 (9.1) were included (Figure 1). Thirty-three patients (29 males and 4 females) with an average age of 29.9 (8.7) were allocated to the home-based therapy group (HB group) and 21 (20 males and 1 female) patients with an average age of 29.9 (8.7) to the hospital-based supervised group (SV group). Group distributions and preoperative scores are summarized in Table 1.

Inclusion criteria were: (1) presence of a traumatic recurrent unidirectional anteroinferior shoulder instability in 1 shoulder, (2) patients aged 16 years and older with closed epiphyseal plate, (3) Bankart lesion with less than 20% bone loss, (4) minimum

follow-up of 1 year, and (5) appropriate patient consent. Exclusion criteria were (1) revision instability surgery, (2) patients with glenoid defect greater than 20%, (3) engaging Hill–Sachs' lesion requiring remplissage, (4) posterior or multidirectional shoulder instability, and (5) associated rotator cuff tear.

Allocation to the rehabilitation group was performed in a nonrandomized fashion, according to the patients' preferences. Patients were allocated into 2 groups: SV group, who received treatment in the outpatient physiotherapy unit of the hospital and HB group, who performed the structured rehabilitation program at home without supervision.

Preoperative and postoperative clinical assessments were performed using a quick version of "Disabilities of Arm Shoulder Hand" (DASH) score, Constant score and Rowe score.^{17–21} The DASH score is a patient-reported upper-extremity outcome questionnaire consisting of 11 questions regarding daily activities, social life, work, pain, and sleep. The Rowe score is a well-recognized score for the postoperative assessment of labral repairs, consisting of 3 questions addressing stability (subluxation and dislocations), motion (external rotation), and function (limitation in daily activities). Constant score is a clinical completed shoulder scoring system consisting of subjective (pain and activity) and objective (range of motion and strength) subsections.

Surgical Technique

Surgeries were performed by the senior surgeon, using the identical repair technique. Patients were prepared in lateral decubitus position under traction. Following arthroscopic examination of the shoulder, ill-healed labrum was detached from the glenoid neck. Three fiberwire loaded knotless anchors (PushLock; Arthrex, Naples, FL) were used for fixation. An arm sling with cushion support for abduction was utilized postoperatively. Patients were discharged from the hospital in the morning following operation.

Rehabilitation Program

Apart from being home or hospital based, rehabilitation programs were constructed to be identical regarding the exercises (Table 2).

Phase I (Maximum Protection Phase, 0–4 Wk)

Arm sling was utilized for 4 weeks following surgeries. Table top activities (writing, eating, using computer, etc) without sling were encouraged. Postural exercises with sling and isometric exercises for deltoid strengthening were initiated on the day after surgery.

Figure 1 — Patient inclusion and exclusion information and final included sample.

Table 1 Both Groups Were Age and Gender Matched, Number of Dislocations and Duration of Symptoms Were Similar

	Home-based group (n = 33)	Supervised group (n = 21)	P value ^a
Age, y	29.9 (8.7)	31.5 (9.6)	.61
Gender M/F	29/4	20/1	.64
Number of dislocations	4.9 (4.5)	3.0 (2.0)	.18
Duration of symptoms, mo	37.0 (60)	11.56 (14.87)	.18
DASH	27.46 (11.81)	32.53 (16.42)	.22
Constant	58.23 (14.23)	54.17 (10.46)	.13
Rowe	51.72 (15.36)	43.81 (19.16)	.12

Abbreviations: DASH = Disabilities of Arm Shoulder Hand; M = male; F = female. Note: Preoperative DASH, Constant, and Rowe scores were also statistically similar.

^aMann–Whitney *U* test.

Table 2 Durations, Goals, and Key Aspects of the Therapy Program in Each Phase

Rehabilitation phases	Goals	Activities and exercises
I: Maximum protection phase (0–4 wk)	Allow healing of capsule ligament— abrum complex	Sling for 4 wk Table top activities Isometric deltoid strengthening Postural exercises with sling No shoulder ROM ROM for elbow, wrist, and fingers
II: Limited motion phase (5–8 wk)	Preserve the fixation while gradually increasing ROM	Passive shoulder ROM Forward flexion max 140° External rotation max 20° Active-assisted ROM with L-bar and pulley Isometric exercises for IR and ER Isometric scapulothoracic exercises No external rotation over 60° abduction
III: Medium protection phase (9–12 wk)	Full and pain-free ROM	Active ROM exercises Full elevation External rotation max 40° Isotonic flexion, ER, IR, and extension strengthening exercises (dumbbell or thera band)
IV: Minimum protection phase (13–21 wk)	Improvement of neuromuscular control, advancement in proprioception and gaining agility	Capsular stretching exercises for full ROM Strengthening for rotator cuff and scapular stabilizers (dumbbell and thera band) Closed kinetic chain exercises for scapular stabilizers (push-up, press-up, and rowing) Plyometric exercises after 16th wk
V: Functional phase (22nd wk and later)	Return to sport	Functional strengthening to shoulder and scapulothoracic muscles Proprioceptive exercises Plyometric exercises

Abbreviations: ER, external rotation; IR, internal rotation; ROM, range of motion.

Phase II (Limited Motion Phase, 5–8 Wk)

After the fourth week, sling support was ceased, passive and active ROM exercises were begun. At this point, group allocation was performed. Patients in home-based exercise group were instructed to fill exercise checklist daily and were called for follow-up every 3 weeks. Patients in SV group were called for therapy on every other day (3 times weekly). Follow-up was identical for both groups after the eighth week. Active assisted ROM exercises were performed in addition to isometric strengthening exercises. External rotation over 60° abduction was not allowed in any of the patients.

Phase III (Medium Protection Phase, 9–12 Wk)

At the end of this period, patients were expected to gain pain-free full ROM. Active ROM exercises were performed. Isotonic strengthening exercises were initiated with dumbbell or Thera band.

Phase IV (Minimum Protection Phase, 12–21 Wk)

Strength, proprioception, and agility exercises were initiated. Capsular stretching exercises were used for full ROM when necessary. Strengthening exercises for rotator cuff and scapular stabilizers, closed kinetic chain exercises were initiated. Plyometric exercises were also initiated after the fourth month.

Phase V (Functional Phase)

Aggressive strengthening exercises and plyometric exercises was added to the rehabilitation program. Returning to sports was aimed for selected patients.

Rehabilitation program continued for 6 months. To complete each phase and proceed to the next, an agreed decision was formed between the surgical and rehabilitation teams. Functional status of the patients was assessed using DASH, Constant, and Rowe scores at 3rd, 6th, and 12th months.

Statistical analyses were performed using SPSS software (IBM, New York, NY). In addition to descriptive methods such as average and SD, Mann–Whitney *U* test was used to compare the results in both groups, and Wilcoxon test is used to measure the progress in each group. *P* value below .05 was considered as statistically significant in all tests.

Results

No significant difference was observed in gender distribution ($P = .64$) and age ($P = .61$). Fifty-two of the patients reported participation in sports at a recreational level and 2 patients at a professional level (Table 1). Average number of dislocations (HB: 4.9 [4.5], SV: 3.0 [2.0]) and duration of symptoms from the first dislocation (HB: 37.0 [60] mo, SV: 11.56 [14.87] mo) were statistically similar between groups ($P = .17$ and $P = .17$, respectively). Average number of treatment sessions was 13.8 (7.3) in SV group. There were no missing patients at the final follow-up.

Preoperative DASH (HB: 27.46 [11.81] vs SV: 32.53 [16.42], $P = .22$), Constant (HB: 58.23 [14.23] vs SV: 54.17 [10.46], $P = .13$), and Rowe (HB: 51.72 [15.36] vs SV: 43.81 [19.16], $P = .12$) scores were statistically similar between groups (Table 1).

Postoperative DASH, Constant, and Rowe scores at sixth month were significantly improved when compared with preoperative scores in each group ($P = .001$; Table 3).

Table 3 Patients Improved Significantly After the Surgery as Shown in DASH, Constant, and Rowe Scores

	Preoperative	3 mo	6 mo	1 y
DASH				
Home-based group	27.46 (11.81)	7.93 (8.4)	4.44 (4.48)	1.79 (2.34)
Supervised group	32.53 (16.42)	11.08 (11.41)	5.32 (5.24)	3.16 (4.09)
Constant				
Home-based group	58.23 (14.23)	85.29 (14.02)	93.27 (4.99)	96.54 (4.36)
Supervised group	54.17 (10.46)	85.03 (17.92)	92.54 (8.13)	95.97 (5.68)
Rowe				
Home-based group	51.72 (15.36)	86.79 (15.64)	95.71 (4.01)	98.21 (2.79)
Supervised group	43.81 (19.16)	87.0 (12.04)	94.25 (10.16)	98.0 (4.70)

Abbreviation: DASH = Disabilities of Arm Shoulder Hand.

Table 4 No Significant Difference was Observed Between Groups in Any Time Point

	Preoperative ^a	3 mo ^a	6 mo ^a	1 y ^a
DASH				
HB vs SV	0.215	0.561	0.373	0.215
Constant				
HB vs SV	0.133	0.828	0.768	0.731
Rowe				
HB vs SV	0.120	0.777	0.815	0.645

Abbreviations: DASH = Disabilities of Arm Shoulder Hand; HB, home-based group; SV, supervised hospital-based group.

^aMann-Whitney *U* test was used for comparison.

There was no difference in DASH, Constant, and Rowe scores at 3rd month ($P = .56$, $P = .83$, $P = .78$, respectively), 6th month ($P = .37$, $P = .77$, $P = .82$, respectively), and 12th month ($P = .22$, $P = .73$, $P = .65$, respectively) between groups (Table 4).

There were no complications in the early postoperative period. Two recurrent dislocations due to major traumatic event were observed. One patient from HB group had traumatic subluxation following a fall injury on outstretched hand at 24 months after the surgery. Another patient from the SV group had traumatic subluxation following a fall on a shoulder at 17 months after the surgery. None of the patients were reoperated and were conservatively treated. These patients were not excluded.

Discussion

Our concept of home-based rehabilitation originated from the observation that some of our patients showed poor compliance in attending our physiotherapist assisted rehabilitation protocol due to financial issues, transportation problems, or other personal reasons and still had a stable and functional shoulder at the end of 12th week. In this prospective study, we have found that there was no significant difference in clinical outcome scores of patients who were rehabilitated with home-based exercise program versus those who were rehabilitated in the physiotherapy unit, after arthroscopic anterior capsulolabral repair. Our results supported the initial hypothesis, the home-based approach providing the same results with SV therapy. The standardized rehabilitation protocol used in this study was safe and effective as a HB and SV program.

Home-based rehabilitation programs are considered to be effective in many clinical conditions. McDermott et al previously

reported that the patient-controlled home-based rehabilitation protocol was safe and effective in open Bankart repair.^{15,16} Although there is a vast amount of publications published on both approaches, limited comparative studies are available which report similar efficacy.^{22,23} Ismail and El Shorbagy²⁴ recently compared home-based and supervised therapy programs after anterior shoulder instability surgery, in a randomized clinical trial. Similar to our data, they have also reported that a home-based program was as effective as a supervised program in increasing shoulder ROM and function after surgery.

Home-based protocols were criticized previously with low patient adherence.^{25,26} Essery et al⁷ reported that intention to engage in the home-based programs, self-motivation, self-efficacy, previous adherence to exercise-related behaviors, and social support were key factors in patient adherence. In this study, it is the patients' own decision to be enrolled in the home-based group and having a surgical intervention for recovery facilitates self-motivation and self-efficacy in patients. We believe that these factors provide high adherence to home-based protocols when efficient protocols are available.

Recent studies on the role of mechanobiology in soft tissue healing revealed that controlled loading can enhance healing.^{27,28} On the other hand, immobilization in the sling creates a time window for soft tissue healing. Therefore, a fine balance is critical to achieve soft tissue healing while improving ROM.^{27,29} Immobilization period after open Bankart repair ranges from 2 days to 5 weeks in the literature.^{1,16,18} We preferred 4 weeks of immobilization, as in similar studies. Patients were not allowed to perform external rotation at abduction.^{1,4} American Society of Shoulder and Elbow Therapist consensus guideline also suggests avoiding excessive stress in the first 12 weeks, where strength of the repair is solely based on the anchor fixation. Sling immobilization with shoulder ROM less than 30° was recommended.³⁰ We have also allowed all table top activities without sling, during the immobilization period. It was shown that absolute immobilization has no beneficial effects on healing and currently is not recommended after shoulder immobilization surgery.¹⁵

In a randomized controlled trial, an accelerated rehabilitation program was assessed in a selected patient group. The authors reported that early mobilization of the operated shoulder after arthroscopic Bankart repair does not increase the recurrence rate; accelerated rehabilitation program with passive ROM exercises at the first postoperative day promoted functional recovery, reducing postoperative pain, and allowing patients an early return to desired activities.¹⁵ In this study, we have shown that a home-based program is also safe regarding the recurrence and is effective in

clinical scores. From these 2 studies, it can be concluded that accelerated home-based rehabilitation protocols can be tested in selected patients, against SV accelerated protocols.

Hospital-based rehabilitation allows therapists to follow detailed and structured programs, which were thought to be more efficient compared with conventional care. For that reason, American Society of Shoulder and Elbow Therapist guidelines were constructed in a very detailed manner to facilitate clinical outcomes. However, it was shown that detailed and structured rehabilitation programs have no superiority over conventional standard care.⁸ This study also supported their results, stating that a strict supervision was not necessary as patients showed similar outcomes.

In our series, we have observed recurrent dislocation in 2 patients (one from each group), which was related to significant traumatic event. All other patients remained stable at the end of the first year. Therefore, it can be concluded that HB and SV rehabilitation protocols are both safe. In addition, patient selection was another key factor to achieve these results. Results following revision Bankart surgery, posterior instability, glenoid bone loss, and patients with specific comorbidities may differ from our cohort.

In this study, the method for patient selection can be considered as a limitation. Although a nonrandomized allocation was preferred, there was no significant difference between the 2 groups. Patient education has a paramount importance in the success of home-based therapy programs. Well-educated and motivated patients may perform better with home-based programs. We did not utilize any outcome measures to reveal the effects of education and motivation on the programs. Randomized studies comparing HB and SV rehabilitation approaches may overcome this limitation. Also, accelerated home-based protocols can be tested against conventional approaches.

Conclusion

A home-based, patient-controlled rehabilitation program following 4 weeks of immobilization is a safe and effective method for the rehabilitation of patients after arthroscopic Bankart repair. Meticulous patient selection and surgical technique allowing optimal capsular shift and tensioning is still the most important factor affecting patient outcomes.

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