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Chapter 4

"SHOULDER REHABILITATION: IS THERE A ROLE FOR HOME THERAPY?"

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ABSTRACT

Formal post-operative physical therapy is the standard of care following shoulder surgeries to include arthroscopic reconstructions, decompressions, rotator cuff repairs, and arthroplasties. A significant amount of health care resources are spent on these rehabilitation programs, however their cost-effectiveness and necessity have not been established.

A retrospective analysis conducted of 2 consecutive groups of patients undergoing total shoulder arthroplasty (TSA) for primary osteoarthritis is reviewed. One group was treated with formal physical therapy (PT), and one group was treated with home-based, physician-guided PT. ASES and Simple Shoulder Test (SST) scores significantly improved in both groups at all follow-up periods. Forward flexion and abduction were significantly improved in the home-based group at all time points, whereas an initial improvement in forward flexion and abduction in the formal PT group was lost at final follow-up. There were no significant differences in final ASES or SST scores between groups at final follow-up. However, forward flexion, abduction, and the Short Form-36 physical component summary scores in the home-based group were significantly better than those patients with formal PT at final follow-up. No significant improvements in internal rotation or SF-36 mental component summary were seen within or between the groups at final follow-up. Overall, there was no difference in patient satisfaction.

A home-based, physician-guided therapy program may provide adequate rehabilitation after TSA, allowing for a reduction in cost for the total procedure. Based on these results, we have developed home therapy programs for shoulder surgeries to include arthroscopic procedures in addition to arthroplasties. By focusing on patient-oriented, home-based therapy programs, we allow patients to take full responsibility for their recovery and not rely on an outside agency to be responsible for their result. Based on our early results we suggest this approach works well for many patients, however, supervised PT may still be required for patients who are not progressing as expected. Close physician follow-up and referral to formal PT may be necessary for patients who are not able to meet rehabilitation

guidelines on their own. Better collaboration between PT and surgeons can lead to better clinical outcomes, but further studies with valid evaluation of outcome data are necessary.

INTRODUCTION

The number of shoulder surgeries performed by Orthopaedic surgeons has increased markedly over the past two to three decades. Much of this has been to dramatic advancements in arthroscopic procedures, allowing for surgeries previously done as open procedures to be performed with a much less invasive technique.[55] Early results lagged that of their open counterparts, but as these techniques improved, the results have become increasingly equivocal and arthroscopic rotator cuff repair and arthroscopic shoulder reconstructions have become the norm and the preferred technique by many shoulder surgeons [14,42,54,55] As the population ages, osteoarthritis of the glenohumeral joint is a frequent source of shoulder pain and dysfunction. Total shoulder arthroplasty (TSA) is an effective treatment for relieving pain and improving function. [2, 3, 4, 5, 6, 16, 17, 18, 22, 23, 24, 25, 30, 32, 33, 41, 43, 45, 46, 50, 51, 57, 58, 59, 60, 61, 64] Initially, a surgery performed only at "shoulder institutions" and infrequently in the community, the increased number of patients and refinement of techniques has allowed the community Orthopaedic surgeon to take on these surgeries. Finally, the development of the reverse total shoulder arthroplasty (r-TSA) for the treatment of rotator cuff arthropathy has added a successful surgery for a previously very difficult diagnosis. [9, 28] As Orthopaedic surgeons become more adept at this procedure, it is anticipated that the number of these procedures will grow at a substantial rate. With the exception of instability surgery, the final motion and function achieved following all of these surgeries is typically improved compared with preoperative motion. However, the reported improvement in range of motion (ROM) postoperatively is quite variable, and may be related to both preoperative and postoperative factors. [2, 7, 15, 21, 31, 36, 39, 47]

One factor that may influence final function and patient satisfaction is the postoperative rehabilitation protocol. As with other surgeries, patients undergoing shoulder surgery rely on postoperative physical therapy (PT) to regain motion and strength after surgery. Most PT protocols follow a logical progression that begins with gentle, passive mobilization, advances to active motion, and ultimately incorporates muscle strengthening. [7, 10, 12, 35, 37, 65] This progressive PT must carefully balance the need for adequate soft tissue healing while preventing postoperative stiffness. If the postoperative PT program is too protective, stiffness may become a problem. [34] Conversely, an aggressive PT program could jeopardize the integrity of the subscapularis repair and compromise stability and function. Unfortunately, there is a paucity of information in the literature addressing therapy after shoulder surgery. Published clinical series include a variety of rehabilitation protocols, ranging from home therapy programs with minimal therapist direction to fully supervised physical therapy programs. [7, 10, 12, 35, 37, 38, 65]

To our knowledge, only one study has directly compared home versus formal rehabilitation protocols after TSA, and this study demonstrated favorable results after TSA with a home based rehabilitation program. This study was generated out of concern for subscapularis dysfunction following surgery, often as a result of too aggressive rehabilitation either by the therapist or the patient. This study compared the clinical outcomes of patients after TSA who received formal PT with those treated with a home-based, physician-directed program. We hypothesized that patients with a formal postoperative PT protocol would have significantly better postoperative clinical outcomes compared with patients with no formal PT. Both authors (M.A.F and P.St.P.) independently changed their postoperative rehabilitation program from a formal

protocol, carefully supervised and directed by physical therapists, to one that is home-based and directed by the orthopedic surgeon, with no involvement of therapists once the patient is discharged from the hospital. The home-based rehabilitation program advocated in this chapter results from collaboration by the two authors after publication of the aforementioned study.

The study initiating this change in practice included all patients undergoing a primary TSA for a diagnosis of primary osteoarthritis between January 2002 and July 2004 as identified from the senior author's (M.A.F.) database. The indication for surgery was a diagnosis of primary osteoarthritis that was unresponsive to nonoperative management. When adequate preoperative radiographs were available, including a true anteroposterior and axillary lateral, the degree of glenoid erosion was graded according to Rispoli et al.[52]

All surgeries were performed by a single, high-volume shoulder and elbow surgeon with more than 10 years of experience before the start of the study period. A deltopectoral approach and subscapularis tenotomy, as well as a single implant, were used in all cases. Beyond surgeon experience, the only major difference in patient care that we could detect was the change in the postoperative rehabilitation.

Before February 2003, patients were routinely prescribed formal PT postoperatively. After February 2003, the senior author stopped prescribing PT and switched to a home-based, physician-directed rehabilitation program. This allowed a unique opportunity to compare 2 consecutive groups of patients: those having a primary TSA between January 2002 and February 2003, combined with formal postoperative PT (group A); and those having a primary TSA between January 2004 and July 2004 with home-based, physician-directed rehabilitation (group B).

For a patient to be included in the study, preoperative data with respect to the outcome data analyzed must have been available. Of the 50 patients eligible for inclusion in group A, 7 were excluded due to incomplete preoperative data, leaving 43 for inclusion. Of the 44 patients eligible for inclusion in group B, 2 were excluded because they lacked preoperative data and 4 patients were lost to follow-up, leaving 38 for inclusion. All patient data were collected in a prospective manner and reviewed retrospectively for the purpose of this study. Data that were available for analysis and comparison between the 2 groups included patient medical records, radiographs, self-assessed ROM, and patient questionnaires.

Patient questionnaires were provided for all visits and the following information was recorded: (1) Visual analog scale (VAS) for pain, (2) VAS for function, (3) American Shoulder and Elbow Surgeons (ASES) score for pain, (4) ASES score for function, (5) total ASES score, (6) Simple Shoulder Test (SST) score, (7) Short Form-36 version 2 (SF-36v2) score, and (8) patient satisfaction (excellent, good, satisfied, or unsatisfied) with the surgery and patient-assessed ROM.

ROM was determined by the patient self-assessment forms as follows: patients were shown pictures of various arm positions in forward flexion, abduction or internal rotation, and were asked to mark the picture which most closely corresponded to their motion. [56] These answers were converted to degrees for forward flexion and abduction. For internal rotation, the pictures corresponded to the gluteal fold, sacrum, L5, L1, T12, and T6. These, in turn, were given numeric values from 0 (gluteal fold) to 8 (T6) for statistical analysis. Results for internal rotation are reported both by spinal level and numerically.

The postoperative rehabilitation protocols are summarized below with the group A patients receiving formal PT in a 4-phase rehabilitation program supervised by a physical therapist, as follows:

- Phase I (weeks 0 to 3): An immobilizer was used at all times, except during bathing and exercising; active ROM (AROM) of the elbow, wrist and hand; and supine passive ROM (PROM) to a maximum of 20° of external rotation (ER) and 120° of elevation in the scapular plane (scaption).
- Phase II (weeks 4 to 6): Patients continued to use the immobilizer, except during bathing and exercising. Patients progressed to resisted elbow, wrist, and hand exercises; supine active-assisted ROM (AAROM) of the shoulder with a wand, isometric shoulder exercises, and closed chain kinetic shoulder exercises.
- Phase III (weeks 7 to 9): The immobilizer was discontinued. AAROM of the shoulder, isometrics, and closed chain kinetics were continued; and supine and prone AROM of the shoulder was initiated.
- Phase IV: Added were shoulder AROM in the standing position, resistive strengthening exercises, and activities of daily living (ADLs).

The group B patients received a physician-directed rehabilitation program, as follows:

- Phase I: Patients wore immobilizers for 6 to 8 weeks, except during bathing and pendulum exercises.
- Phase II: After 6 to 8 weeks, the patients returned for follow-up, the immobilizer use was discontinued, and they were given a sling to wear when leaving the house. In addition to performing supine, active-assisted forward flexion exercises from this follow-up visit, patients were allowed to use their arms for ADLs.
- Phase III: After 14 weeks, the patients were allowed to participate in any activities they chose that comfort and confidence allowed.

Patient demographic data were compared between groups A and B and no significant differences were detected with regard to age, gender, preoperative ROM, or functional scores (SST and ASES), except for internal rotation, which was significantly better in group A (L1) than group B (L5; P = .02; Table I, Table II). Adequate preoperative radiographs were available for 35 patients from group A and 36 from group B. In group A, 7 patients had no glenoid erosion, 17 had mild, 10 had moderate, and 1 had severe erosion. In group B, 8 patients had no glenoid erosion, 16 had mild, 12 had moderate, and 0 had severe glenoid erosion. There were no significant differences between the 2 groups (Table I). No glenoid bone grafting was required in any patients from either group.

Postoperative data were collected for patients at 3, 6, and 12 months, and at the most recent follow-up. This was at an average of 52 months (range 24-82 months) for group A and 39 months (range 24-51 months) for group B. When preoperative and postoperative data were compared, group A had significant improvements in ASES and SST at all time points evaluated (Table II). Initially, forward flexion and abduction showed significant improvement at 3, 6, and 12 months; however, the improvements in forward flexion preoperatively vs postoperatively (102° vs 119°, P = 0.24) and abduction (73°vs 108°, P = .053) did not reach significance at final follow-up (Table II). Internal rotation in group A did not show significant improvement at any time point (Table II).

Group B had significant improvements in ASES, SST, forward flexion, and abduction at all time points (Table II). The physical component summary (PCS) of the SF-36v2 was also significantly improved postoperatively in group B. Compared with preoperative internal rotation, postoperative internal rotation was significantly improved at 6 and 12 months in group B, but this improvement was not sustained at final follow-up (1.6 vs 2.6, P = .053).

When the postoperative values were compared between groups A and B, few differences reached significance (Table II). No differences were detected in the ASES or SST scores at any time point evaluated. A difference was detected in internal rotation at 3 months that was better in group A (L1) than in group B (L5; P = .002). This difference was not sustained, however, and no differences were seen at further follow-up. Conversely, although no differences were detected in forward flexion and abduction between groups at 3, 6, and 12 months, significant differences were seen at final follow-up. Group B showed significantly more forward flexion (154° vs 119°, P = .024) and abduction (147° vs 108°, P = .03) than group A (Table II). Group B also showed a significantly better PCS of 43 compared with group A (43 vs 38, P = .037).

Patient satisfaction was also compared. In group A, 88% of patients were satisfied (excellent, good, and satisfied), with 54% rating their outcome as excellent. Group B reported higher satisfaction, with 95% of patients being satisfied and 76% rating their outcome as excellent. The results of $\chi 2$ analysis of satisfied and excellent patients between groups A and B were not significant ($\chi 2 = 0.471$; P = .4924; $\chi 2 = 3.162$, P = .0754, respectively).

The use of a formal physical therapy program has been accepted as the "gold standard" following shoulder surgery. However, this has not been established to be more effective in obtaining a better clinical outcome than that of a physician supervised home-based physical therapy program. In an effort to study this, the reviewed study was undertaken to determine if the clinical results following formal therapy was significantly better than a home-based program. This study supports the findings of previous studies that TSA has been shown to be a successful procedure for glenohumeral osteoarthritis. It provides significant and lasting improvements in pain relief, function, and patient satisfaction. [17, 43, 45] Improvements were noted in both groups for ROM and functional scores, including ASES, SST, and SF-36 PCS. Interestingly, although group A initially showed significant improvements in forward flexion and abduction, these improvements were not maintained at final follow-up. Significant improvements were maintained at final follow-up in group A for ASES and SST scores. Group B, however, made significant improvements in forward flexion, abduction, ASES, SST, and SF-36 PCS that were maintained at final follow-up. The failure to maintain ROM in group A could be related to the therapy program, the longer follow-up (52 months vs 39 months), or other factors that could not be accounted for in this study. Nevertheless, patients in both groups were very satisfied with their outcomes (88% in group A and 95% in group B).

Although much has been published about outcomes after TSA, little attention has been given to postoperative PT programs or their effects on final outcomes. Boardman et al[7] compared postoperative ROM with preoperative and intraoperative ROM. With a simple, home-based PT program, the postoperative ROM was comparable to the ROM obtained intraoperatively. Most studies in the English literature that have evaluated the results of TSA in patients with primary osteoarthritis, give little or no details regarding the postoperative therapy, and those that are mentioned vary widely from no therapy to intensive, inpatient PT. None of the studies, and no others that we are aware of, directly compare postoperative PT protocols.

Interestingly, the multicenter study by Norris and Iannotti [45] allowed the postoperative PT protocol to be at the treating surgeon's discretion. Nevertheless, the authors state that the outcomes were uniform, although no comparison of outcomes according to the treating surgeon was performed. This study suggests that the postoperative PT protocol may not have a significant effect on the outcome of TSA for primary osteoarthritis. The results show that a simple home therapy program does not negatively affect the outcomes after TSA for primary arthritis. In fact, group B performed better than group A in all parameters and at all time points except internal rotation and abduction at 3 months after TSA.

The strengths of the study include 2 patient populations that appear well matched and a short gap of less than 1 year between the end of the collection period for group A and the start of the collection period for the group B. In addition, all procedures were performed by a single surgeon using the same operative technique and a single implant.

This study has several weaknesses, however. First, the retrospective nature of the study presented problems with our data analysis. Although our data were collected prospectively in the clinic as a routine part of patient follow-up, some of the records did not contain data for every time point evaluated. Therefore, the number of patients in each group varied depending on the information available.

Second, the patients are two consecutive series of patients treated during different time periods. Although, the surgeon made no significant changes in surgical technique and already had more than 10 years of experience, group B was treated later, and the experience gained over time could be considered learner bias.

Third, subtle differences in the patient population or other confounding variables that might influence outcome could not be accounted for.

Fourth, we had no way of measuring patient compliance with the postoperative rehabilitation protocols. This would be particularly important for group A, because outcomes could certainly be influenced by compliance with the PT protocol.

Finally, the average follow-up was different between the 2 groups, and the length of follow-up could influence some of the outcomes measured.

RECOMMENDED PROTOCOL

In an effort to standardize a home-based rehabilitation program for most shoulder surgeries, we have developed a program that includes safe, simple exercises that can be easily reproduced in the home environment. These exercises do not require specialized equipment and can be performed after viewing a web-based program that can be repeatedly viewed by patients at their leisure and based on their need. Just as with all other programs, the initial emphasis is on protection of rotator cuff repair, slow restoration of passive motion to avoid stiffness, progressive active assisted motion, gradual strengthening and return to activities of daily living. By focusing on patient-oriented, home-based therapy programs, we allow patients to take full responsibility for their recovery and not rely on an outside agency to be responsible for their result.

Previous authors have evaluated muscle activity during shoulder rehabilitation exercises and have noted substantial activity even during simple, light exercises. Although this activity is desired for rehabilitation once the rotator cuff has healed, excessive forces are to be avoided while the healing is taking place. This is as true for the repair of the subscapularis following arthroplasty as it is for primary rotator cuff repair. A motivated patient, with the correct guidance, may be the best person to manage their therapy. Pain is a Core strengthening and scapular stabilization are two components of shoulder rehabilitation that are often neglected. Failure to address these components may lead to scapular dyskinesis and asymmetry. [20, 34, 38] These components are easily included in the following protocol using simple to follow exercises that can be performed at home.

Perhaps the most important visit, either with a therapist or with a physician's assistant, would be in the preoperative period. Often termed "prehabilitation", a session or two of instruction to go over the postoperative rehabilitation program is very helpful to the patient. Emphasis is placed on understanding the goals of therapy and practicing their exercises before they experience postoperative pain and immobilization. Immediate postoperative issues such as dressing, bathing, and activities of daily living are addressed so that the patient feels comfortable with those activities prior to surgery. This is very important for elderly patients who live alone and are concerned about their ability to comply with the restrictions following surgery.

- •Phase 0: (prehabilitation)
  All phases of recovery and rehabilitation are reviewed and practiced with patient
  Activities of daily living are practiced in a sling to simulate recovery
- Phase I (weeks 0 to 3):
  Cryotherapy is recommended.
  An immobilizer is to be used at all times, except during bathing and exercising;
  Core strengthening exercises: Single-leg stand against door; lawnmower starts in sling;
  Active ROM (AROM) of the elbow, wrist and hand;
  Scapular/ deltoid exercises: Scapular contractions.
- Phase II (weeks 4 to 6):
  Cryotherapy is recommended following exercises.
  An immobilizer is to be used at all times, except during bathing and exercising;
  Active ROM (AROM) of the elbow, wrist and hand;
  Scapular/ deltoid exercises: Scapular contractions; deltoid isometric exercises in sling;
  Core strengthening exercises: Single-leg stand - unsupported; lawnmower starts in sling;
  Initiate table slides[a] and supported pendulum exercises.
  Initiate AAROM wand exercises in supine position.
- Phase III (weeks 7 to 12):
  The immobilizer is discontinued;
  Scapular/ deltoid exercises: Scapular rows with theraband; deltoid strengthening with theraband;
  Core strengthening exercises: Single-leg stand -unsupported; wall sits and squats;
  Continue table slides and unsupported pendulum exercises as warm-up.
  Continue AAROM wand exercises in supine position. Add standing wand behind back.
  Initiate wall slide program[b]. Wall slides only to full elevation for most tears. Wall slides with lift-off for small tears.

a Table slides are accomplished in a seated position by placing the hand of the affected extremity on a table and pushing the arm forward passively by flexion of the body at the waist. Alternative exercises include bowing exercises or desk slides. Desk slides are performed by placing the hand on a desk and sitting on a rolling chair or stool. The passive motion is accomplished by pushing the chair backwards with the legs to generate passive motion of the shoulder. Bowing is accomplished by placing the hand on a higher platform and bowing forward to generate passive motion of the shoulder. All three exercises accomplish the same objective and can be directed individually depending on the patient.

- Phase IV: (weeks 13 to 26)
  Scapular / deltoid / rotator cuff: Theraband exercises to include rows, three-way deltoid, IR and ER. Increase resistance of bands as tolerated.
  Wall push-ups.
  Core strengthening exercises: Transition to exercise ball – crunches / bridges.
  Continue wall slide program. Progress as tolerated to Wall Slides with lift-off, Wall Slides with lowering, Wall Slides with resisted lowering for eccentric strengthening.
  Return to sport as tolerated when indicated by strength, symptoms and demand of the sport.

Post-operative follow-up with the surgeon is recommended at the end of each phase to assess progress with consideration of transition to formal therapy as each case requires. Referral to formal PT should be considered in patients who are developing greater than expected stiffness or if they demonstrate the inability to follow the home-based program.

A formal PT program is also considered after Phase IV if the patient needs assistance to progress to sports specific activity that requires a higher level of performance. We view this as a very important role for the therapist to help the patient enhance their recovery following initial recovery from these surgeries. Once the patient's rotator cuff repair (as the primary procedure or as part of an arthroplasty) has healed, therapists are extremely effective in evaluating scapular dynamics and can direct therapy to correct any residual dyskinesia. In doing this, the therapist can fine tune shoulder function and focus on return to desired activities and adjusting for any residual disability following surgery. Such activities may include tennis, golf, weight lifting or yoga.

The results of this review and the TSA study may have significant financial implications. As the burden of health care costs continues to rise, reducing or eliminating spending is becoming more important. A typical 1-hour PT visit is estimated to cost $100. Considering that the number of shoulder surgeries is increasing, the cost of PT after TSA places a significant financial burden on the health care system. Any estimation of cost would also fail to account for the lost time and cost of traveling to the therapy visits, not only for the patients but also for their caregivers who must sacrifice their time to travel with the patient. Increasing, a larger portion of the PT costs are borne by the patient in the form of co-pays in addition to their health insurance premium. If patients are prescribed the usual course of two times a week for up to three months, and pay a $20 co-pay, their individual cost can be close to $500. Therefore, if physical therapy is not an essential component to the patients overall outcome, the overall costs of PT places a significant financial burden on an overextended health care system and the patient.

However, we are not advocating the elimination of formal PT. Indeed, we feel strongly that there is an extremely important role for the physical therapist. Formal PT is used in most patients before surgery is considered, and often is effective in decreasing pain, restoring function, and obviating the need for surgical intervention. PT is also useful in the patients described above who are having problems with their home exercise program and need further assistance. For these

b Wall slide progression starts with pushing the hand up the wall to achieve forward flexion. Initially, the non-operative hand can be used to assist. Wall walking with the fingers tends to initiate deltoid and rotator cuff contraction and we feel a sliding motion leads to a more passive exercise. Once range of motion is achieved wall slides with lift-off is initiated. In this exercise the patient performs a wall slide and then lifts the hand off the wall overhead and holds for 3 – 5 seconds. The hand is placed back on the wall and slides down the wall to the starting position. Wall slides with eccentric lowering adds to the lift –off by turning away from the wall and lowering the hand in the scapular plane with the elbow extended. A final phase of this progression is to add weight. The patient uses a 1 lb. weight or water bottle to push up the wall and then lower eccentrically. This technique adds eccentric exercise which has been used in tendon repair rehabilitation.

patients there is an inherent need to have better communication between the therapist and the surgeon to optimize the patient's result. Additionally, we need better outcome studies evaluation not only the effectiveness of treatment, but also its relative value and cost-effectiveness in this changing medical environment.

CONCLUSION

After review of the published studies, we do not find support that patients with formal postoperative PT have better postoperative clinical outcomes. In fact, in the study reviewed in detail, the data showed that there was no difference between the postoperative rehabilitation groups, with trends towards better outcomes in patients with no formal rehabilitation. This has broad implications, not only for the way in which surgeons must think about postoperative rehabilitation for TSA but also for all shoulder rehabilitation protocols. We propose in this chapter, and are currently using in our practices, a home-based, patient-centered, postoperative PT program for patients undergoing arthroscopic rotator cuff repair, TSA, and r-TSA. Our findings warrant a more rigorous investigation of the uses of formal physical therapy following shoulder surgery with randomized clinical trials. Naturally, a more cost-effective use of formal physical therapy could lead to a substantial reduction in health care expenditures, which would be a welcome change to the ever-rising burden that healthcare places on the economy.

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