Rehabilitation of the Shoulder Following Rotator Cuff Injury or Surgery

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Rotator cuff problems are encountered frequently and must be rehabilitated precisely. The pace and intensity of the program are regulated by the degree of pathology and the patient's activity requirements. As our ability to understand the biomechanics of shoulder motion improves, we realize that many rotator cuff problems are secondary to instability. This instability can be subtle. The following article details a rehabilitative program for patients with rotator cuff pathology and includes both conservative and postoperative programs for pathology secondary to instability as well as primary impingement.

Key Words: *rotator cuff rehabilitation, shoulder*

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Rotator cuff injuries occur because of mechanical abrasion within a decreased glenohumeral joint space. However, the most frequent cause in an active young adult is excessive anterior translation of the humeral head within the joint space. The purpose of this article is to describe a comprehensive program for patients with rotator cuff pathology, either primary or secondary to instability.

The rehabilitation program for nonoperative patients takes several factors into account: the degree of instability; whether the condition is acute or chronic; the strength and endurance of the shoulder girdle musculature, particularly the cuff; the patient's performance or activity requirements; and the flexibility of the soft tissues around the shoulder. If surgical repair is necessary, then the specifics of the procedure and the length of the immobilization period are also important.

The most important caveat to any rotator cuff rehabilitation program is avoiding excessive anterior translation of the humeral head as dynamic joint stability is restored. In addition, all strengthening exercises should be modified to allow pain-free motion. "No pain, no gain" is not part of this scheme.

CONSERVATIVE MANAGEMENT

Phase I

To reduce inflammation, the patient needs to modify or refrain from activities that aggravate the condition (4,5). The therapist will apply modalities as needed and perform or direct range of motion exercises. Particular attention should be paid to the posterior capsule to allow the humeral head to sit back in the fossa instead of sliding anteriorly and superiorly (6).

Active strengthening exercises for internal and external rotation are performed with the arm at the side and the elbow flexed to 90°, using surgical tubing or other elastic bands for resistance. If necessary, modify the external rotation exercise by limiting the degree of rotation; this will avoid excessive translation of the humeral head of the fossa and reduce discomfort. If pain continues, switch to isometric exercise, keeping the arm in the same position, ie., at the side with the elbow flexed to 90°. If this still causes discomfort, adjust the shoulder position to allow a bit of abduction and flexion, ie., loose packed position.

As pain decreases and strength increases, progress to free weights. Internal rotation is best done lying on the involved side with a bolster under the lateral chest wall to decrease the joint compression on the involved shoulder (Figures 1A and 1B). Again, limit excursion into external rotation on the eccentric portion of the exercise to minimize stress on the anterior capsule.

External rotation is performed while lying on the uninvolved side (Figures 2A and 2B). The same caution applies about avoiding excessive anterior translation of the humeral head by limiting the degree of external rotation performed. If pain is still a problem, put a pillow or towel roll under the patient's involved shoulder to obtain a position of some abduction and flexion.

If 90° of elevation is available in the scapular plane (20–30° forward of the coronal plane) (Figure 3), add supraspinatus exercise. Alternate these exercises with active shoulder flexion through the pain-free range of motion and shoulder abduction performed in the scapular plane. At some point in the rehabilitation program, attention will need to be paid to developing strength and, more

FIGURE 1. *Exercise for internal rotation. A) Starting position; B) ending position.*

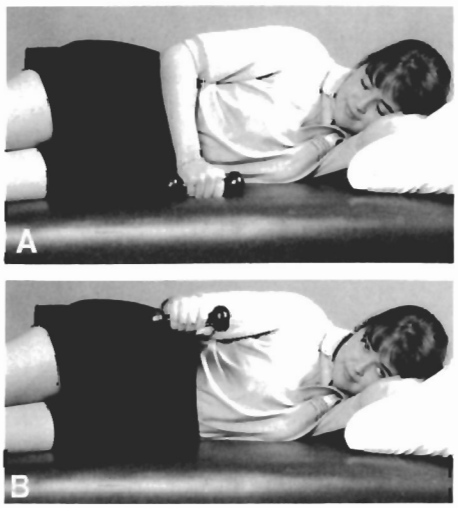

FIGURE 2. *Exercise for external rotation. A) Starting position; B) ending position.*

importantly, endurance in the anterior and middle deltoid in the overhead (ie., above 90° of elevation) position. These exercises need to be performed without irritating cuff structures or the long head of the biceps.

Shoulder extension exercise can be done either prone or standing (bending forward from the waist) (Figure 4). The involved shoulder should not be moved behind the plane of the body. The shoulder extensors also function as depressors of the humeral head and, thus, resist the upward migration of the humeral head and decrease the likelihood of further impingement (3).

FIGURE 3. *Exercise for supraspinatus.*

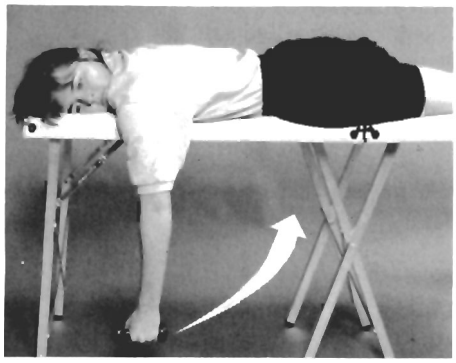

FIGURE 4. *Prone position for shoulder extension.*

Shoulder shrugs can be a problem for the patient with primary impingement. When the glenohumeral space is decreased, it is necessary to apply gentle, controlled traction to the humerus to keep it from riding up in the glenoid fossa during the exercise. When excessive laxity is present and is multidirectional, this corrective traction is contraindicated.

Finally, even early in the rehabilitation program, shoulder endurance exercises should be included. As soon as adequate pain-free range of motion is present, add arm ergometer exercise. Begin with short duration, low intensity, and frequent rest periods; increase duration and intensity and decrease rests as recovery and tolerance proceed.

Phase II

If necessary, continue posterior cuff and capsule stretching and shoulder range of motion exercises. As healing progresses, more aggressive stretching may be warranted if adequate range has not yet been obtained.

If there is no pain and no significant edema, begin isokinetic programs for both strength and endurance. Use speeds in excess of 200°/sec for shoulder internal and external rotation. The best and safest patient position is standing with the dynamometer head tilted and the shoulder in the scapular plane, arm at the side (Figure 5).

In the free weight portion of the exercise program at this stage, eccentric contraction of the rotator cuff and the posterior shoulder girdle musculature is emphasized. To this end, add active horizontal adduction exercise, with the starting position in the scapular plane. Both military presses (Figures 6A and 6B) and push-ups are added now. Wall push-ups are the first phase, concentrating on protraction of the scapula to emphasize serratus anterior function. Pay special attention to getting full extension of the elbows and an extra "push" into full scapular protraction at the end of the exercise. Do not lower the trunk below elbow level. This caution is necessary during the descent phase to avoid excessive anterior translation of the humeral head. Later, move on to modified (hands and knees) push-ups and,

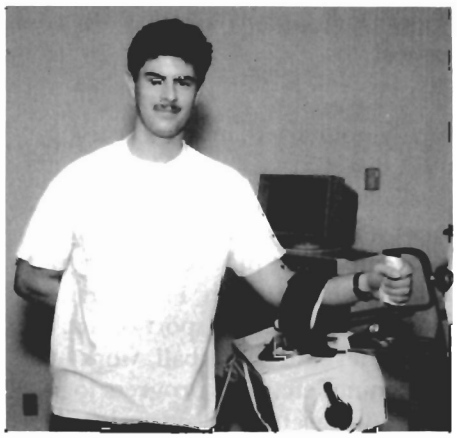

FIGURE 5. *Proper position for isokinetic strengthening of the rotator cuff.*

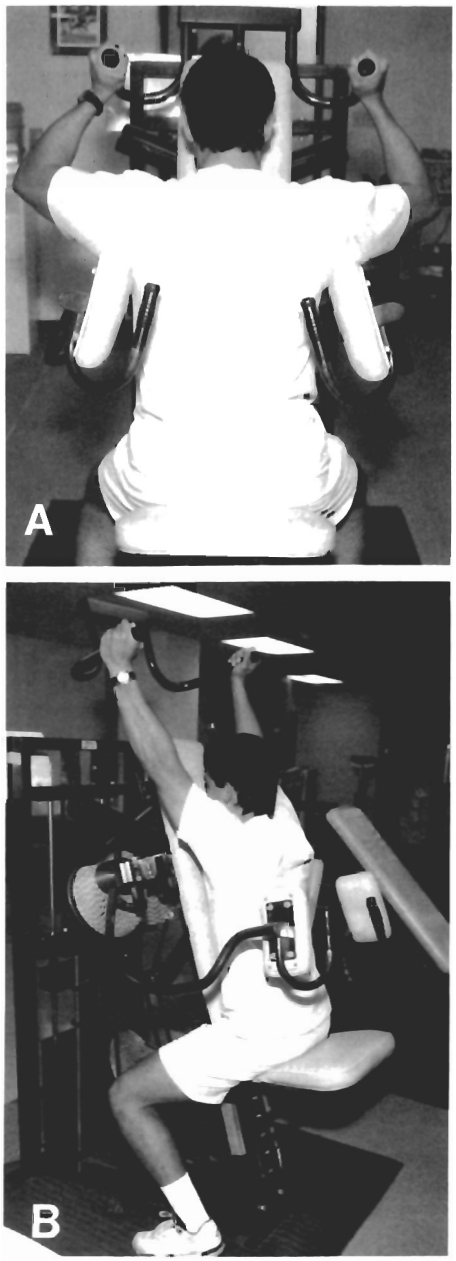

FIGURE 6. *Military press. A) Starting position; B) ending position.*

finally, military (hands and toes) push-ups.

For patients, skill development—or retrieval—feels like the most important part of the program. At this time, begin at a low intensity level for the specific sport or activity, eg., volleyball, basketball, work hardening, etc., and progress logically and carefully. Progression involves intensity, distance, and endurance in an interrelated fashion.

Step 1
Toss the ball, with no windup, against a wall on alternate days. Start with 25 to 30 throws, increasing to 70, while gradually increasing the distance.
20 throws for 20 ft (warm-up)
25–40 throws for 30 to 40 ft

Step 2
Toss the ball, ie., play catch with an easy windup, on alternate days.
10 throws for 20 ft (warm-up)
10 throws for 30 to 40 ft
30–40 throws for 50 ft

Step 3
Continue to increase the throwing distance while using the easy windup and toss.
10 throws for 20 ft (warm-up)
10 throws for 30 to 40 ft
30–40 throws for 50 to 60 ft

Step 4
Increase throwing distance to 60 ft; continue to toss the ball, with an occasional throw at half speed
10 throws for 30 ft (warm-up)
10 throws for 40 to 45 ft
30–40 throws for 60 to 70 ft

Step 5
Increase throwing distance to 150 ft, gradually.
1. 10 throws for 40 ft (warm-up)
   10 throws for 50 to 60 ft
   15–20 throws for 70 to 80 ft
   10 throws for 50 to 60 ft
2. 10 throws for 40 ft (warm-up)
   10 throws for 50 to 60 ft
   20–30 throws for 80 to 90 ft
   20 throws for 50 to 60 ft
3. 10 throws for 40 ft (warm-up)
   10 throws for 60 ft
   15–20 throws for 100 to 110 ft
   20 throws for 60 ft
4. 10 throws for 40 ft (warm-up)
   10 throws for 60 ft
   15–20 throws for 120 to 150 ft
   20 throws for 60 ft

Step 6
Throw from the mound at one-half to three-quarters speed using proper body mechanics: stay on top of the ball (keep forearm pronated), keep the elbow up, follow through with the arm and trunk, and use the legs to push.
1. 10 throws for 50 ft (warm-up)
   10 throws for 120 to 150 ft ("lobbing")
   30 throws for 45 ft (off the mound)
   10 throws for 60 ft (off the mound)
2. 10 throws for 50 ft (warm-up)
   10 throws for 120 to 150 ft ("lobbing")
   20 throws for 45 ft (off the mound)
   20 throws for 60 ft (off the mound)
3. 10 throws for 50 ft (warm-up)
   10 throws for 60 ft
   10 throws for 120 to 150 ft ("lobbing")
   10 throws for 45 ft (off the mound)
   30 throws for 60 ft (off the mound)
4. 10 throws for 50 ft (warm-up)
   10 throws for 120 to 150 ft ("lobbing")
   10 throws for 45 ft (off the mound)
   40–50 throws for 60 ft (off the mound)

If Step 6.4 has been completed without discomfort and the patient is throwing at about three-quarters speed, move on to Step 7, "Up/Down Bullpens." This phase simulates a game situation, with the pitcher pausing between a series of pitches to reproduce the rest occurring between innings.

Step 7
Up/Down Bullpens

Day 1 10 warm-up throws for 120 to 150 ft ("lobbing")
10 warm-up pitches for 60 ft (off the mound)
40 pitches for 60 ft (off the mound)
REST 10 MINUTES
20 pitches for 60 ft (off the mound)

Day 2 NO THROWING

Day 3 10 warm-up throws for 120 to 150 ft ("lobbing")
10 warm-up throws for 60 ft (off the mound)
30 pitches for 60 ft (off the mound)
REST 10 MINUTES
10 warm-up throws for 60 ft (off the mound)
20 pitches for 60 ft (off the mound)
REST 10 MINUTES
10 warm-up throws for 60 ft (off the mound)
20 pitches for 60 ft (off the mound)

Day 4 NO THROWING

Day 5 10 warm-up throws for 120 to 150 ft ("lobbing")
10 warm-up throws for 60 ft (off the mound)
30 pitches for 60 ft (off the mound)
REST 8 MINUTES
20 pitches for 60 ft (off the mound)
REST 8 MINUTES
20 pitches for 60 ft (off the mound)
REST 8 MINUTES
20 pitches for 60 ft (off the mound)

By now, the patient is ready to begin a regular routine, from throwing batting practice to pitching in the bullpen. The throwing program should be adjusted as needed to suit the recovery needs of each individual. Each step may be lengthened or shortened as the patient's progress dictates.

TABLE 1. *Rehabilitation throwing program for pitchers.*

Throwers initiate their programs with emphasis on technique and endurance. The actual number of throws and the time spent throwing should be small initially and increased as tolerated. If pain occurs or recurs with any progression of the program, retreat to the previous level until equilibrium is restored. At this beginning stage, the throw is

Each step should be repeated three times. All throws should have an arc or "hump." The maximum distance thrown by infielders and catchers is 127 ft. The maximum distance thrown by outfielders is 200 ft.

Step 1
Toss the ball with no windup. Stand with feet shoulder width apart and face in the direction you are throwing. Concentrate on staying on top of the ball.
5 throws for 20 ft (warm-up)
10 throws for 30 ft

Step 2
Stand sideways with feet shoulder width apart. Close up and pivot onto the back foot as you throw.
5 throws for 30 ft (warm-up)
5 throws for 40 ft
10 throws for 50 ft

Step 3
Same position as Step 2. Follow through with pivot leg.
5 throws for 50 ft (warm-up)
5 throws for 60 ft
10 throws for 70 ft

Step 4
Assume pitcher's stance. Lift and stride with lead leg. Follow through with pivot leg.
5 throws for 60 ft (warm-up)
5 throws for 70 ft
10 throws for 80 ft

Step 5
OUTFIELDERS: Lead with glove-side foot forward. Take one step, crow hop, and throw the ball.
INFIELDERS: Lead with glove-side foot forward. Take a shuffle step and throw the ball. Throw the final five in a straight line.
5 throws for 70 ft (warm-up)
5 throws for 90 ft
10 throws for 100 ft
5 throws for 80 ft (cool-down)

Step 6
Repeat throwing technique as in Step 5. Assume normal playing position. Infielders and catchers do not throw more than 127 ft. Outfielders do not throw farther than 150 ft (mid-outfield).
5 throws for 80 ft (warm-up) (all positions)
5 throws for 80 to 90 ft (infielders), 90 to 100 ft (outfielders)
5 throws for 90 to 100 ft (infielders), 110 to 125 ft (outfielders)
5 throws for 110 to 120 ft (infielders), 130 to 150 ft (outfielders)
5 throws for 80 ft (cool-down) (all positions)

Step 7
Assume normal playing position.
5 throws for 80 ft (warm-up) (all positions)
5 throws for 80 to 90 ft (infielders), 110 to 130 ft (outfielders)
5 throws for 90 to 110 ft (infielders), 150 to 175 ft (outfielders)
5 throws for 110 to 120 ft (infielders), 180 to 200 ft (outfielders)
5 throws for 80 ft (cool-down)

Step 8
Repeat Step 7. Use a fungo bat to hit to the infielders and outfielders playing in their normal position.

TABLE 2. *Rehabilitation program for catchers, infielders, and outfielders.*

more of a toss; add a windup next (throwing protocol, Tables 1 and 2).

Conditioning for the rest of the body is appropriate during this phase, remembering to include exercises for the forearm, wrist, and fingers. Though not part of the pathological process or picture, these structures usually are weaker because the entire extremity has been used less during the injury and recovery periods. Lunges (Figure 7), squats, trunk strengthening and flexibility, and general cardiovascular conditioning should be added now. Isokinetic testing of the shoulder internal and external rotators may be indicated at this point, as a way point in the rehabilitation process.

Phase III

The culmination of the rehabilitation program involves continuation of the total body conditioning program and progressive throwing program, emphasis on the eccentric phase of rotator cuff strengthening, and progressively more difficult isotonic exercises. Isokinetic flexion/extension and abduction/adduction exercise may be added, along with longer bouts on the arm ergometer. Skill refinement includes work at an increased intensity, sustained for an extended time. A second isokinetic test for internal and external rotation is administered, as well as one for flexion/extension and abduction/adduction.

POSTOPERATIVE REHABILITATION

When conservative care is insufficient, a surgical repair may be indicated. Such procedures will address the underlying pathology of inadequate glenohumeral joint space, or excessive joint laxity or frank muscle tears. The timing of the rehabilitation program, not its principles, is dependent on the specifics of the surgery.

Phase I

If the patient has had an open rotator cuff repair, no active shoulder flexion or abduction is allowed for the first month. Immobilization is for comfort, using a sling except for gentle passive range of motion in flexion, abduction, and external rotation. With the arm at the side and the elbows extended, active shoulder internal and external rotation is permitted. Modalities and mobilizations are used for pain control. Active exercises include shoulder shrugs, pendulum exercises, and ball squeezes.

If the patient has had an anterior capsulolabral reconstruction, he or she may be in a pillow abduction splint or an "airplane" type splint for a period of a few days to 2 weeks. While in the splint, the patient should be instructed in active and active-assisted elevation exercises, lifting the arm up and out of the restraint. Elbow flexion and extension,

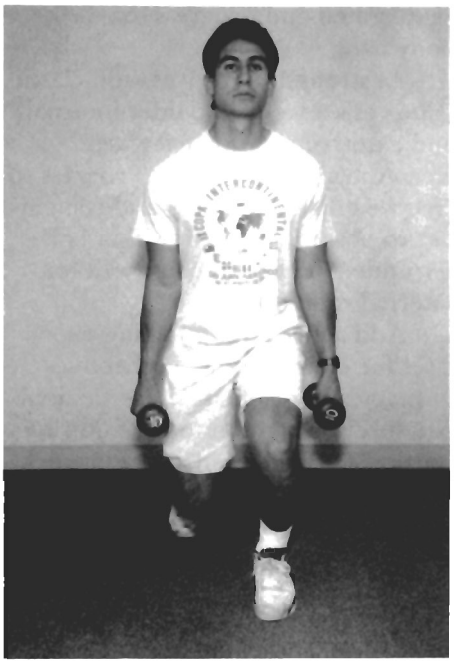

FIGURE 7. *Lunge.*

wrist motion, and ball squeezes are also required.

After the appropriate time interval for each patient, active assistive exercises, eg., wall climb, wand, etc., and active range of motion exercises begin, using joint mobilization to improve motion if necessary. Begin isometric internal and external rotation, abduction, flexion, and extension in a number of positions throughout the pain-free range (multiple-angle isometrics).

Active resistive exercises begin with shoulder internal and external rotation, arm at the side, using elastic bands or tubing. Add active shoulder extension either prone or standing while bending at the waist and extend the arm to the plane of the trunk. As tolerated, add horizontal adduction while supine. As in the nonoperative rehabilitation program, this exercise should be started with the arm in the scapular plane.

Phase II

Continue range of motion exercises and more vigorous stretching of capsular tissues, if warranted. Hanging from an overhead bar is a more aggressive stretch for shoulder motion. Begin by taking as much weight as tolerated and progress to a full body hang.

As strength improves, add elastic band resistance to shoulder internal and external rotation exercises. Keep the arm at the side. Progress to free weights in sidelying and remember to position the arm with a bolster under the lateral chest wall for internal rotation.

Add active strengthening exercises for elevation: flexion, abduction, and supraspinatus. For flexion, pay special attention to the anterior portion of the deltoid and add work in the 110–125° range. Limit abduction to 90° since deltoid activity peaks at that angle (2). Supraspinatus exercise and flexion exercise should be performed in a pain-free range of motion only.

Begin active horizontal abduction exercise, either prone or leaning over from the waist. Limit motion to the plane of the trunk at the end of the exercise, still allowing the scapular adductors to perform. Make certain that the initial motion is occurring at the glenohumeral joint; scapular adduction and trunk rotation can disguise horizontal abduction, making it appear that more motion is occurring than is actually the case.

Phase III

By this time, the patient should have full passive and active range of motion. Continue isotonic rotator cuff exercises, with emphasis on eccentric strengthening as well as strengthening elbow and wrist musculature as necessary.

Begin military press exercise. This should be done with the arm in front of, rather than behind, the chest to decrease the load on the cuff (1). Begin push-ups with emphasis on protraction at the end of the exercise. Start with wall push-ups, move on to modified hands-and-knees push-ups, and, finally, use the full hands and toes variety.

When the patient has the ability to lift 5–10 lbs in external rotation and 15–20 lbs in internal rotation, is pain free, and has no significant edema, begin isokinetic strength and endurance training at 200+°/sec. Add arm ergometer work and include conditioning for the rest of the body as well. Include significant workouts for lower extremity and trunk musculature.

Phase IV

It is important for isokinetic testing to demonstrate that the involved shoulder has at least 90% of the strength and endurance of the uninjured shoulder before progressing to sports- or activity-specific exercise (7). Throwing athletes may then proceed to a throwing program, and others may proceed to their appropriate programs. Tables 1 and 2 provide details of sports-specific drills.

Meanwhile, total body conditioning continues, and abduction/adduction, horizontal abduction/adduction may be added if warranted.

CONCLUSION

We have presented the rehabilitation program in sections or phases, but it is not necessary to adhere to them rigidly. Some overlap may be advisable for both effective and efficient treatment. In general, the initial phase emphasizes range of motion and pain relief, the next phase concentrates on strengthening the shoulder through a full range of motion, and the final phase(s) focuses on progressive isotonic and isokinetic exercise in preparation for reacquisition of sports- or work-specific skills.

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ACKNOWLEDGMENTS

The authors acknowledge the assistance provided by Judy Seto, RPT; Kevin Tollefson, RPT; and Dr. Frank Jobe, Ted Polakowski, ATC, and Karl Kuchl in the preparation of this article.

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