Rehabilitation of Shoulder Arthroplasty

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John J. Basti

Total shoulder arthroplasty is most frequently used to eliminate pain and restore function for an array of conditions that cause destruction of the articular surfaces of the glenohumeral joint and surrounding soft tissue [1–5]. Optimizing the patient response to these types of surgeries is multifactorial. A positive surgical experience combined with a well-designed postoperative rehabilitation program, including patient education, is key a component to a positive outcome. Several factors contribute to a successful outcome: the pathological condition of the joint, the quality of the bone and soft tissues, the status of the rotator cuff and deltoid, the overall condition of the patient, and their ability to perform, execute, and comply with the rehabilitation program [6, 7]. The team approach is advocated with ongoing communication between the surgeon, patient, and therapist as the rehabilitation program is developed and implemented at each phase of the progression. Rehabilitation of the shoulder can be challenging. The shoulder is a complex structure that has five articulations, i.e., the glenohumeral joint, the coracoacromial articulation, the acromioclavicular joint, the sternoclavicular joint, the only attachment to the axial skeleton, and the scapular thoracic articulation. With little bony stability at the glenohumeral joint, shoulder function for the upper extremity and hand placement is most reliant on the surrounding soft tissues, the capsule, ligaments, rotator cuff, deltoid, and periscapular muscles for static and dynamic stability. Attaining an optimal outcome, establishing normal motion, dynamic stability, and strength is the result of a well-performed surgery, an adaptive progressive system of rehabilitation directed by the surgeon, implemented and executed by the therapist in concert with a cooperative, engaged, and educated patient.

Shoulder rehabilitation for patients with symptoms following trauma or surgery is an essential component for a good recovery. A positive surgical outcome and team approach comprised of the surgeon, therapist, and patient with a well-designed and well-implemented rehabilitation program enhanced by ongoing communication lend itself to improved and hopefully optimal outcomes.

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Treatment Principles

Treatment principles are the cornerstone of a well-organized and appropriately administered rehabilitation program and are as follows:

One: Performing a thorough initial evaluation following the surgical procedure is the first step in

A.D. Armstrong, A.M. Murthi (eds.), *Anatomic Shoulder Arthroplasty*,
DOI 10.1007/978-3-319-29164-2_13

establishing trust in the patient/therapist professional relationship. Obtaining a history with subjective and objective measurements will convey the patient's general postoperative state, their pain level, and their level of understanding of what was done and what's expected, their physical impairments, and functional limitations which are critical points for developing a level of effective intervention.

Two: Control pain and swelling using appropriate analgesics and pain medication coordinated with exercise to limit pain, muscle guarding, and spasm. Application of heat/ice and other physical therapy modalities such as gentle mobilization and therapeutic massage are effective adjuncts to exercise. *Three*: The notion of early passive motion tailored to the surgical repair has been supported in the literature to establish motion and limit the effect of postsurgical soft tissue scarring and adhesions. Strengthening is better served when range of motion has been regained and reactivity has diminished. This is the first step in the rehabilitation process preparing the patient for active assistive and active motion as flexibility and healing progresses [6–8].

Four: The scapular plane has been defined as the plane of maximal elevation [8] (Fig. 13.1). This plane allows the humeral head to be centered on the glenoid and the capsule to be relaxed with appropriate tension on the surrounding ligaments and muscles. Moving the extremity in this plane is more comfortable postoperatively and maximizes functional elevation [7, 8].

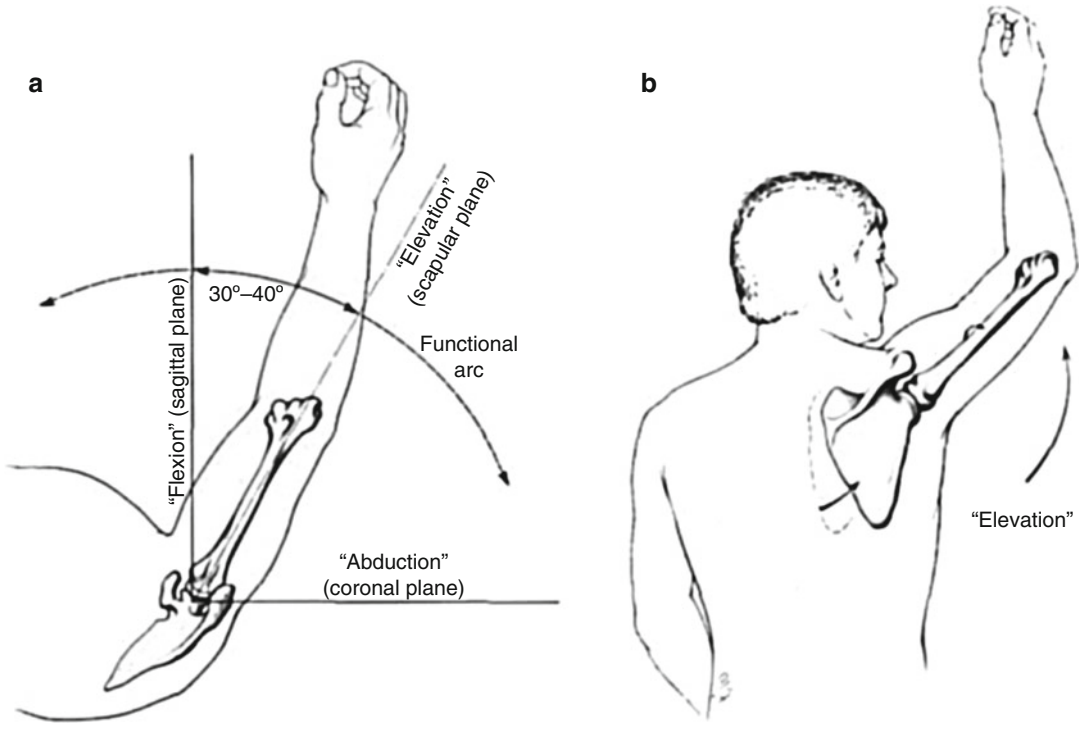

Fig. 13.1 Scapular plane. The plane of maximal elevation is centered on the scapular plane, rather than the coronal plane (abduction) or sagittal plane (flexion). Shoulder movements should be thought to be centered on this plane because (**a**) the capsule of the glenohumeral joint is most relaxed in the scapular plane, allowing the highest upward excision, with the greatest ease and freedom of movement, and (**b**) the glenohumeral joint is most often used in this plane. Movements here occur more naturally and with less effort. The body may be rotated to cause the arm to be raised in the scapular plane rather than the coronal plane. The concept is stressed in the postoperative exercise program (From Neer [12], by permission of WB Saunders)

Five: Proximal and distal joints should be incorporated into the program. Elbow, wrist, and hand motion facilitates improved circulation and reduces edema and stiffness. Attention to proximal musculature provides dynamic stability to the scapula; thus the glenohumeral joint is addressed later in the program, while glenohumeral motion is established.

Six: With patients who have stiffness, the rehabilitation program focuses on range of motion, stretching, and flexibility exercise. With patients who have good flexibility but weakness, the program focuses on strengthening.

Seven: Patient education, compliance, and participation in a home program are some of the most important aspects of the postoperative program. Patients should be given written instruction with the home program providing a clear understanding of the exercise. Review of the use of pain medication and appropriate use of heat and ice should be explained. Lying or sleeping flat in the supine position is rarely tolerated. Positioning for comfort should be demonstrated (a recliner, when possible, with a pillow under the arm in a neutral position (scapular plane) semi-reclined for the shoulder to be above the heart, relative to gravity, facilitating circulation and edema control) with instruction to family and friends.

Eight: Having a good understanding of the surgical procedure, the soft tissue reconstruction and the understanding of early protection of certain structures direct the therapist, tailoring the exercise program to the patient. The exercise program incorporates a progression of passive, active assistive range of motion, gentle isometrics, and active exercise, which initiates strengthening, followed by advanced stretching and progressive resistive exercise [9–13].

Shoulder Arthroplasty and Considerations in Rehabilitation

The indications for shoulder arthroplasty have been well established.

Osteoarthritis is the most common indication for shoulder arthroplasty [2, 7, 14–16]. These patients generally present with significant pain and globally restricted motion, especially external rotation. Rehabilitation focuses on range of motion and flexibility first and then strengthening since these patients usually develop good strength. The soft tissues in this process are preserved but retracted and stiff. Rotator cuff tears occur in only 5–10 % having little effect on outcome since they are usually small 1 cm tears [5, 17]. Rheumatoid arthritis and other inflammatory conditions account for approximately 30 % of all total shoulder replacements. More care must be given to the soft tissues during surgery and rehabilitation secondary to the progressive chronic inflammatory nature of this systemic disease. Rotator cuff tears are significantly higher in these patients and can occur up to 50 % with an average of 25 % occurrence [18]. Rehabilitation is focused on preventing stiffness with gentle range of motion with the limits determined at the time of surgery protecting the rotator cuff repair. In addition, other joint involvements are considered and may necessitate altering and modifying exercises. These patients usually develop good mobility but are slower gaining strength.

Arthritis of instability falls into two categories, patients who have chronic recurrent dislocation and/or subluxation and those who have had a previous surgical procedure for instability [14]. The patients who have had prior instability surgery tend to be at a younger age with a higher incidence found in the male population [5]. One or more traumatic dislocations can put the individual at risk of developing osteoarthritis of the glenohumeral joint [14, 19]. Stability at the glenohumeral joint is dependent on the balance of the soft tissue envelope surrounding the glenohumeral joint. Patients with instability who undergo surgical stabilization procedures, if not done properly, develop the risk of articular cartilage damage which can result in shoulder arthroplasty. In instances where staples and screws and other hardware are used, migration and malposition can result in additional cartilage damage [20]. In other instances, over-tightening the soft tissues in an attempt to restore stability to either side of the glenohumeral joint for anterior instability or missed multidirectional instability can result in

displacement of the humeral head to the nonoperated (unaddressed) side; this results in a chronically subluxed humeral head away from the surgically repaired side with the consequence of disabling pain, progressive cartilage wear, soft tissue contracture, bone loss, and loss of motion [14, 21].

Rehabilitation Program

The postoperative rehabilitation program is decided at the time of surgery. Usually the program is initiated on the same day as surgery; however, a modification during the surgical procedure may necessitate an alteration in the normal progression of postoperative rehabilitation and may be deferred. With the use of regional anesthesia, the patient is comfortable and can be moved without pain to the passive limits set in surgery. It is believed that early passive motion tailored to the surgical procedure is the cornerstone to a successful outcome, provided the bony repair and soft tissues are not overstressed and adequate pain control is achieved [3, 6–8, 14, 21]. Early passive motion is one of the most important aspects of the rehabilitation program. The application and assessment of intensity of exercise were defined by Mccann et al. [22]. Their electromyographic study of shoulder rehabilitation exercises forms the foundation of this present exercise program. They found that in the supine position, passive external rotation and forward flexion generated the least electrical activity of the rotator cuff and deltoid [22]. They found that there was less activity in the middle deltoid and supraspinatus muscles with the elbow bent versus straight during passive motion. Of course all motion was directed in the plane of the scapula and when compared to elevation with the elbow straight muscle activity was consistently less. It is therefore recommended that early passive motion in the plane of the scapula be performed with a bent elbow. They also felt that verbal cues to relax and to let the arm hang like a "rag doll" further reduced muscle activity [22]. Passive range of motion limits is usually set at 130° of forward elevation in the plane of the scapula and 30° of external rotation. Reverse total shoulder patients may be protected in a sling for 6 weeks or moved to 0° external rotation and 90° of forward elevation which is at the discretion of the surgeon. With the inter-scalene block in place eliminating pain, the patient sees how freely the extremity moves with the new replacement. As the block wears off, the patient begins to regain feeling; however, they are medicated to reduce the intensity of the postoperative pain. Patients are instructed to take their arm out of the sling and do elbow flexion and extension and wrist and hand motion frequently throughout the day. Patients are also instructed in pendulum exercises originally described by Codman (Fig. 13.2). The exercise was originally a momentum exercise. Swaying and rotation of the body implemented a momentum that provided passive painless motion at the glenohumeral joint with the patient bent forward. Teaching these exercises is sometimes a challenge; however, with the patients who have difficulty, teaching them to bend forward and

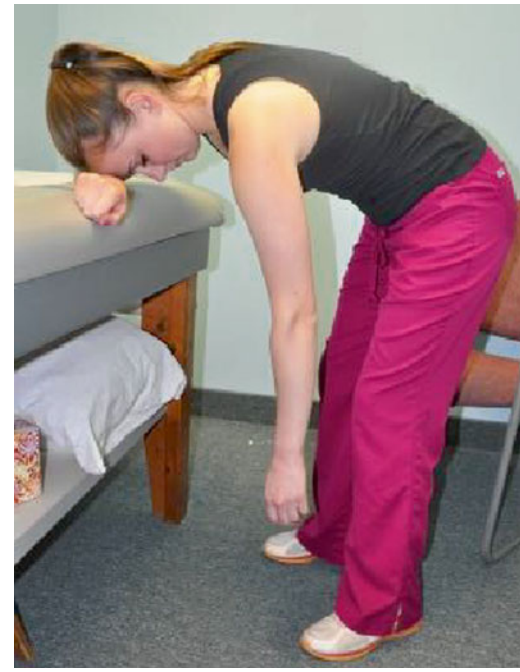

Fig. 13.2 Patient bends forward at the waist supporting the trunk with the uninvolved arm on top of a counter top or dresser. Relax your operated arm, letting it hang straight down. Gently begin to rock your body allowing momentum to move the extremity in small circles, clockwise and counterclockwise

place there opposite extremity on a table or countertop to stabilize their proximal musculature protecting their back facilitates the exercise adequately. Having the upper extremity hang in the dependent position exerts gentle traction with the weight of the extremity reducing the amount of pain, muscle spasm, and tightness at the shoulder complex, accomplishing the goal of the exercise. Gentle small circles clockwise with the thumb leading and palm forward and counter clockwise with thumb leading and palm facing back are gently initiated by the patient. In this case the pendulum is considered a relaxation exercise and a warm-up exercise and a good precursor to following exercises. Supine or semi-reclined passive external rotation in the plane of the scapula is then initiated by the therapist. The patient should be positioned with a pillow underneath the arm keeping it in neutral position avoiding extension with the elbow slightly away from the side (Fig. 13.3). Small circular motions are started with the upper extremity supported at the elbow and held at the wrist. Gentle external rotation is started to the limits of range designated at the time of surgery, usually 30°, or to a point where pain and stiffness are beginning. Forward elevation is accomplished in the same manner to a limit of 130° (Fig. 13.4). Slow easy motion with constant verbal cues to relax and let go is given during these exercises. This approach facilitates trust and cooperation enhancing the relaxation effect to accomplish the goals of treatment. Guarding and resistance with these exercises put the repair at risk whether it is tuberosity fixation, subscapularis repair, or rotator cuff repair. As the surgical procedure permits, usually days 2–3, supine active assistive external rotation with the stick (Fig. 13.5) is initiated followed by

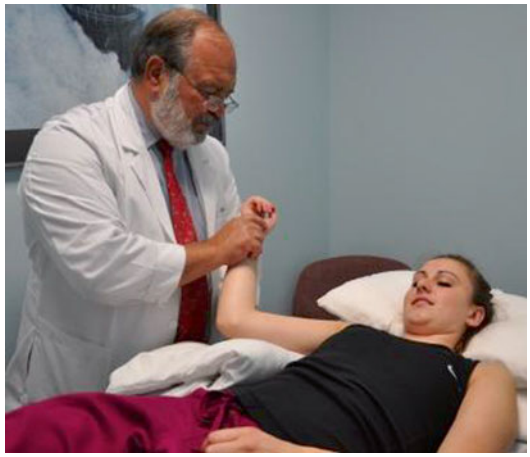

Fig. 13.3 Patient lies supine with pillow supporting elbow comfortably at the side in the plane of the scapular. The therapist supports the wrist and elbow. Passive external rotation is performed to set limits, usually 30°, accompanied by verbal ques to relax the arm

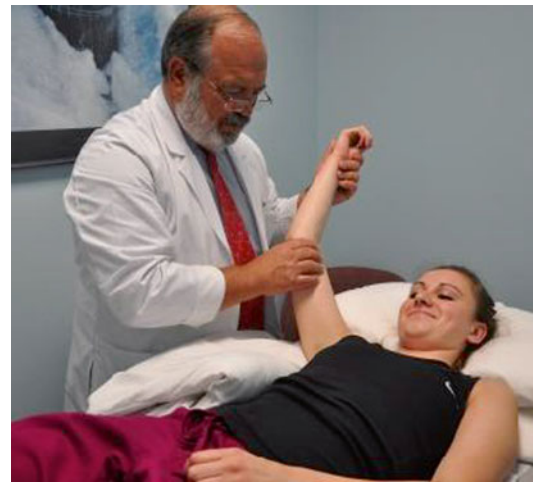

Fig. 13.4 Patient lies supine with pillow supporting elbow comfortably at the side in the scapular plane. The therapist supports the wrist and elbow. Passive forward flexion is performed to set limits, usually 130°, accompanied by verbal ques to relax the arm

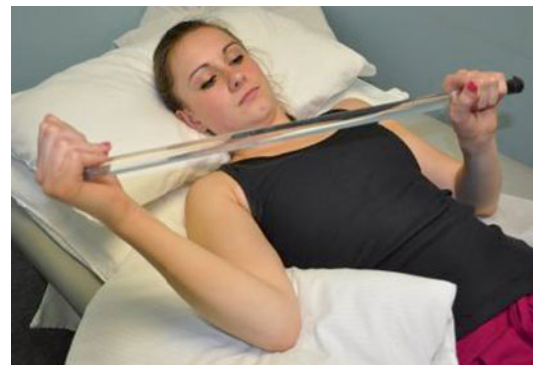

Fig. 13.5 Patient lies on their back with a pillow under the arm. Patient holds a stick with the involved end positioned into the palm. The good hand pushes the affected hand gently outward with the stick. Return to starting position

active assistive supine forward elevation (Fig. 13.6). Patients are instructed in range of motion exercises with the goals of maintaining and accomplishing 30° of external rotation and 130° of elevation. The supine position is preferred since this allows the individual to relax the trunk and cervical muscles and focus on the shoulder. If a physical condition precludes this position, semi-reclined or sitting positions are reverted too. The patients are instructed to proceed to the point of stiffness when performing their exercises and move into it a slight amount to create a gentle stretch and tension but not pain. A count of five to ten with a hold is recommended and then a return to the neutral position with one or two easy short arc oscillations to help with relaxation before repeating the exercise. The exercises are usually repeated for ten repetitions. In the performance of the pulley exercises, the pulley block is located over the shoulder of the operated side so that elevation performed by the opposite extremity elevates the affected extremity in the plane of the scapula (Fig. 13.7). Putting the pulley over the head will bring the upper extremity across the body putting undue stress on the posterior capsule and soft tissues. Patients usually experience pain and have reduced motion when early exercises are performed out of the plane of the scapula. Increased EMG activity of the deltoid and spinati muscles was noted with pulley exercises suggesting more active muscle contraction [22]. Therefore they are deferred with arthroplasty with rotator cuff repairs for fear of re-tear. In these cases pulleys are usually started at 6 weeks or when the surgeon deems that the repair is stable. Independent exercise while in the hospital is encouraged along with review of the exercises with the patient to ensure good execution and understanding of the exercises. Upon discharge the patients are cautioned about the development of a temperature greater

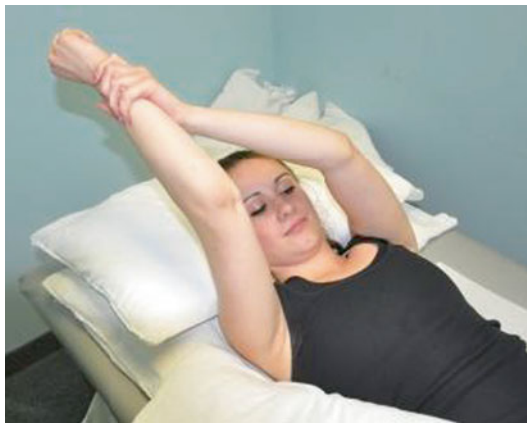

Fig. 13.6 Patient lies on their back with the pillow under the involved arm. With their good hand, they reach across and grasp the involved wrist. The patient smoothly pulls the arm upward above the head

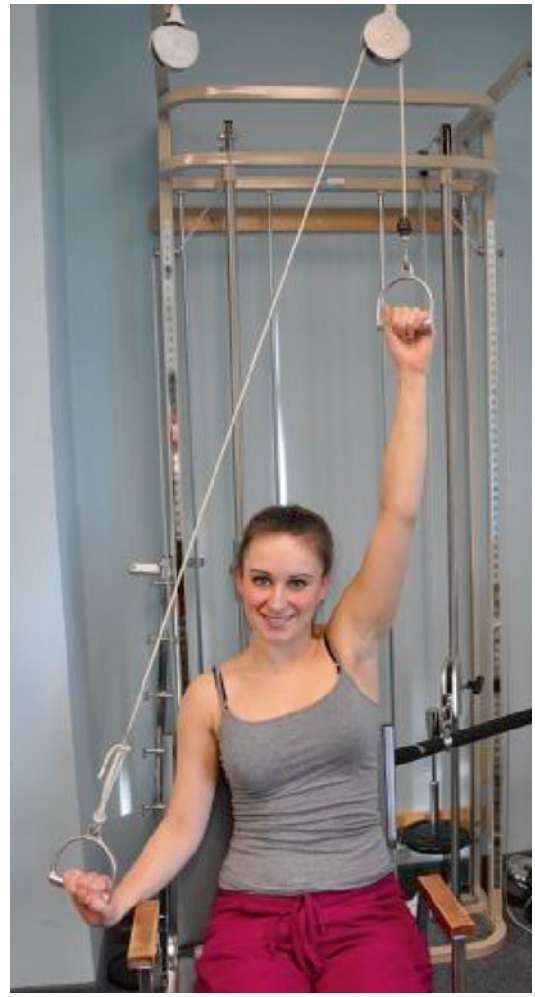

Fig. 13.7 Sit on a chair with the pulley block positioned over the operated shoulder. Patient relaxes the involved arm, while the good arm pulls the involved arm above the head. Gently lower to start position

than 101° Fahrenheit, the onset of severe pain not relieved by medication, intolerance to the pain medication, excessive bleeding from the surgical site, or any additional physical symptoms they may be experiencing.

Outpatient Rehabilitation

After a detailed history and physical exam, goals can be established and a progressive safe outpatient rehabilitation experience can be initiated. Establishing a good rapport with the patient and communicating with the surgeon are the first steps in this process. A postoperative report is very helpful and ensures proper care and supports early safe rehabilitation since the therapist is more aware of what was done at the time of surgery and reinforces the precautions followed during rehabilitation. Review of a home program, including the exercises being performed, the importance of coordinating pain medication with exercises, positioning for comfort, as well as any concerns or difficulty the patient may be experiencing, should be addressed, reviewed, and discussed. The exercise program is initiated and complemented with the use of heat/ice and electrical modalities, followed by gentle mobilization for accessory motion and therapeutic massage to reduce pain, muscle spasm, and stiffness in preparation for exercise.

Active assistive exercises continue for 6 weeks including pendulum, supine external rotation with the stick, active assistive forward flexion supine, and pulley exercises following total shoulder replacement with an intact rotator cuff (Table 13.1). Extension (Fig. 13.8) and internal rotation (Fig. 13.9) are avoided for 6 weeks since they put tension on the repaired subscapularis and arthroplasty with rotator cuff repair for risk of re-tear (Tables 13.2 and 13.3).

Isometric exercise can be initiated at 6–9 days submaximally. A gentle progression of external rotation, flexion, abduction, and extension (Fig. 13.10) is introduced. Internal rotation is deferred since isometrics significantly increase the amount of muscle activity of the subscapularis when evaluated by EMG [22]. Internal rotation resistance is avoided for 6 weeks. Patient's reactivity should be followed with appropriate adjustment of the exercise. Younger patients with

Table 13.1 TSR, intact RC sling 2–3 weeks, and then PRN

Time post-op	Exercise	Exercise program
1–2 days	EPM (early passive motion)	Supine ER to 30°
		Supine FF to 130°
		Elbow/wrist/hand ROM
		Pendulum
3 days	Active assistive	Pendulum
		ER w/stick (to 30°)
		FF (to 130°), pulleys
		No IR[a] no exit. w/stick[a]
6–9 days	Isometrics	ER (no IR), anterior
		Deltoid, posterior deltoid,
		Middle deltoid, multi-angle
Goals: control pain and swelling, protect the anterior capsule and subscapularis tendon repair, prevent adhesion formation, increase ROM (scapular plane), educate (importance of medication, ice heat application, compliance to the program, frequent gentle exercise, rest, positioning for comfort at home, family friend instruction), establish a well-understood home program, with a gradual introduction of exercises		
10 days	Active	Supine FF w/stick
		Supine Ff w/stick + weight (1–2 lb)
		Supine FF
		ER side lying
		Eccentric pulleys
		Standing press w/stick
		Eccentric standing press w/stick
		Prone Ext./Abd to midline
6 weeks	Advanced stretching	Follow exercise figures
	Resistive (scapular)	Follow exercise figures
Goals: control pain and swelling, increase active ROM, increase strength, develop neuromuscular control of the shoulder complex, increase proprioception, normalize response to dynamic challenges		

FF forward flexion, *ER* external rotation, *Abd* abduction, *w* with, *TSR* total shoulder replacement
[a]Ext. (extension) and IR (internal rotation): not performed until 6 weeks post-op

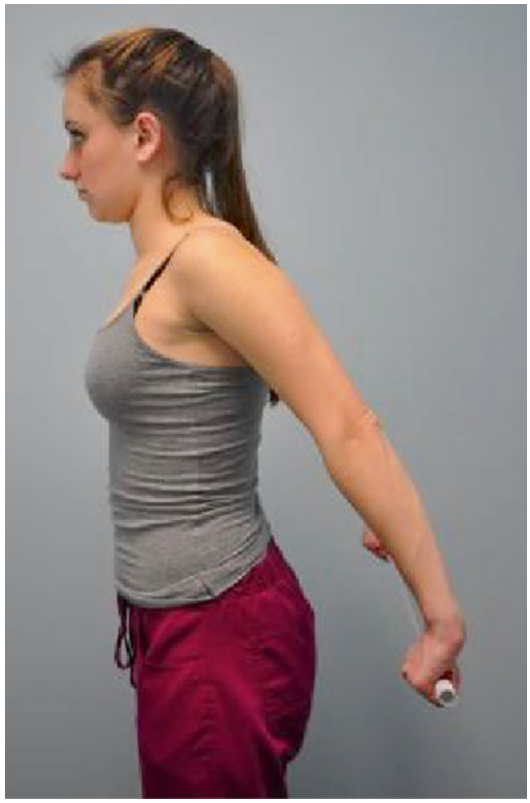

Fig. 13.8 Patient grasps stick behind back. Using your good arm to supply the power, push the stick backward and stretch

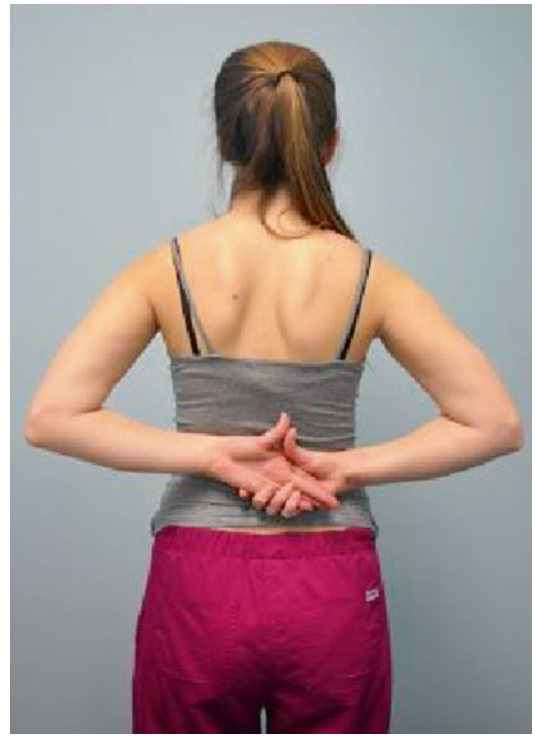

Fig. 13.9 Use your good hand to grasp the involved wrist. Let the good hand supply the power to slide up the middle of the back

good strength move quickly through this phase. Older patients with long-standing pathology may be slower to respond to this process. In patients with small to medium rotator cuff tears, isometrics are not initiated until 2–3 weeks. With the larger massive repairs, submaximal progressing to maximal isometrics is started at approximately 6–8 weeks.

Active Exercise (Early Strengthening)

Application of exercise is a procedure and soft tissue repair dependent. This phase of the exercise program is comprised of initial closed loop supine forward flexion using a stick. This allows the patient to actively use the deltoid and rotator cuff with reduced load in the supine position with the support and stability from the opposite extremity avoiding pain (Fig. 13.11). As the patient becomes more comfortable with that exercise, a 2 lb weight (Fig. 13.12) is added to improve strength in the supine position. The patient then progresses to active supine forward flexion with the extremity alone (Fig. 13.13). This can be initiated at 10 days after total shoulder replacement and humeral head replacement with an intact rotator cuff. Arthroplasty with rotator cuff tear due to the requirement of bone and soft tissue healing is begun at 4–6 weeks and as late as 8 weeks with massive rotator cuff tears. Side-lying external rotation is initiated in this phase with a bolster between the elbow and trunk to maintain the glenohumeral joint in the plane of the scapula (Fig. 13.14). The loading of the shoulder is then progressed to eccentric pulleys in the sitting position (Fig. 13.15). This helps the patient begin to reestablish neuromuscular control of the rotator cuff, deltoid, and periscapular muscles. This exercise is comfortable and protected under full control of the patient

Table 13.2 TSR, w/cuff involvement, medium repair approx. 2–3 cm

Time post-op	Exercise	Exercise program
1–2 days	EPM (early passive motion)	Supine ER to 30°
		Supine FF to 130°
		Elbow/wrist/hand ROM
		Pendulum
3 days	Active assistive	Pendulum
		ER w/stick (to 30°)
		FF (to 130°), pulleys
		No IR[a] no Ext. w/stick[a]
2–3 weeks	Isometrics	ER (no IR), anterior deltoid
		Posterior deltoid
		Middle deltoid, multi-angle
Goals: control pain and swelling, protect the anterior capsule and subscapularis tendon repair, prevent adhesion formation, increase ROM (scapular plane), educate (importance of medication, ice/heat application, compliance to the program, frequent gentle exercise, rest, positioning for comfort at home, family/friend instruction), establish a well-understood home program, with a gradual introduction of exercises		
3–4 weeks	Active	Supine FF w/stick
		Supine FF w/stick + weight (1–2 lb)
		Supine FF
		ER side lying
		Eccentric pulleys
		Standing press w/stick
		Eccentric standing press w/stick
		Prone Ext./Abd
6 weeks	Advanced stretching	Follow exercise figures
	Resistive (scapular)	Progress as tolerated
Goals: control pain and swelling, increase active ROM, increase strength, develop neuromuscular control of the shoulder complex, improve proprioception, normalize response to dynamic challenges		

Sling 2–3 weeks and then PRN
FF forward flexion, *ER* external rotation, *Abd* abduction, *w* with, *TSR* total shoulder replacement
[a]Ext. (extention) and IR (internal rotation) not performed until 6 weeks post-op

Table 13.3 TSR, w/cuff involvement large rotator cuff repair 3–5 cm massive repair >5 cm

Time post-op	Exercise	Exercise program
1–2 days	EPM (early passive motion)	Supine ER to 30°
		Supine FF to 130°
		Elbow/wrist/hand ROM
		Pendulum
6–8 weeks	Active assistive	Pendulum
		ER w/stick (to 30°)
		FF (to 130°), pulleys
		No IR[a] no Ext. w/stick[a]
6–8 weeks	Isometrics	ER (no IR), anterior
		Deltoid, posterior deltoid,
		Middle deltoid, multi-angle
Goals: control pain and swelling, protect the anterior capsule and subscapularis tendon repair, prevent adhesion formation, increase ROM (scapular plane), educate (importance of medication, ice/heat application, compliance to the program, frequent gentle exercise, rest, positioning for comfort at home, family/friend instruction), establish a well-understood home program, with a gradual introduction of exercise		
8 weeks	Active	Supine FF w/stick
		Supine FF w/stick + weight (1–2 lb)
		Supine FE
		ER side lying
		Eccentric pulleys
		Standing press w/stick
		Eccentric standing press w/stick
		Prone Ext./Abd
12 weeks	Advanced stretching	Follow exercise figures
	Resistive (scapular)	Progress as tolerated
Goals: control pain and swelling, increase active ROM, increase strength, develop neuromuscular control of the shoulder complex, improve proprioception, normalize response to dynamic challenges		

Sling 6–8 weeks
FF forward flexion, *ER* external rotation, *Abd* abduction, *w* with, *TSR* total shoulder replacement
[a]Ext. (extention)/IR (internal rotation and performed until 10–12 weeks post-op)

while the hand follows the dowel down to a resting position. Standing press with the stick (Fig. 13.16) is advanced to an eccentric exercise (Fig. 13.17) which incrementally further loads and challenges the shoulder. With this progression of exercises, the therapist should be mindful of altered mechanics such as a shoulder shrug indicating weakness

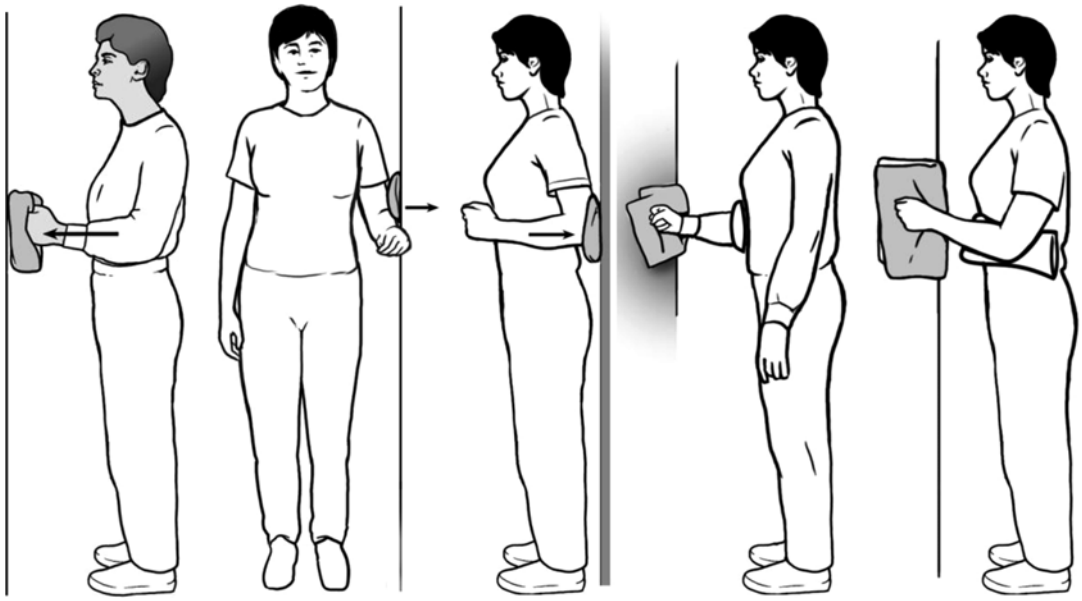

Fig. 13.10 Place towel between the extremity and door frame. Push into door frame first flexion, followed by abduct, extension, external rotation, and internal rotation. Hold for the count of five to ten submaximal contractions at first

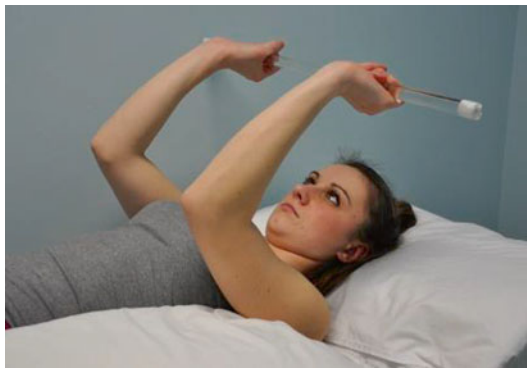

Fig. 13.11 Hold stick in both hands and raise over head with the assist of the nonoperated arm

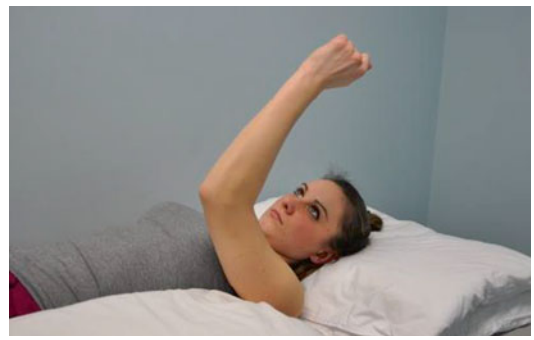

Fig. 13.13 The patient elevates in the supine position starting with a bent elbow at 90° and straightens arm as they reach up over head

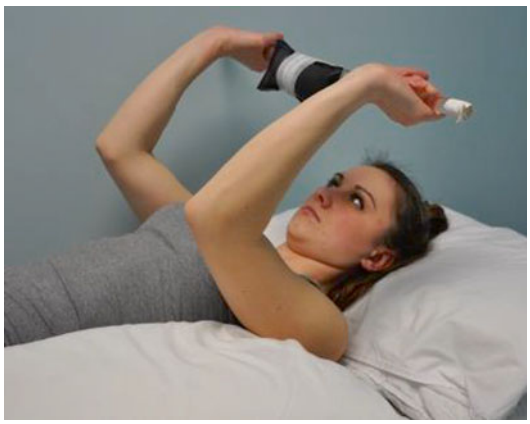

Fig. 13.12 Hold stick in both hands and raise overhead with a 1–2 lb weight

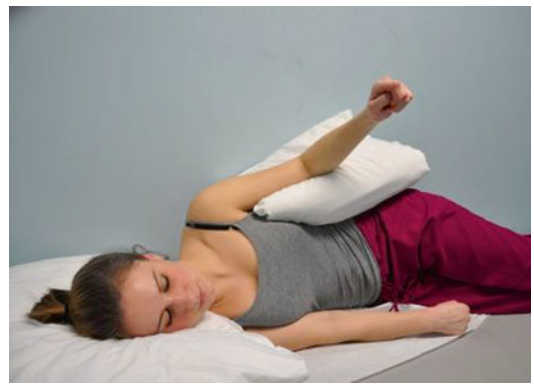

Fig. 13.14 With a bent elbow at 90° supported on a pillow, the patient slowly raises their hand away from the body

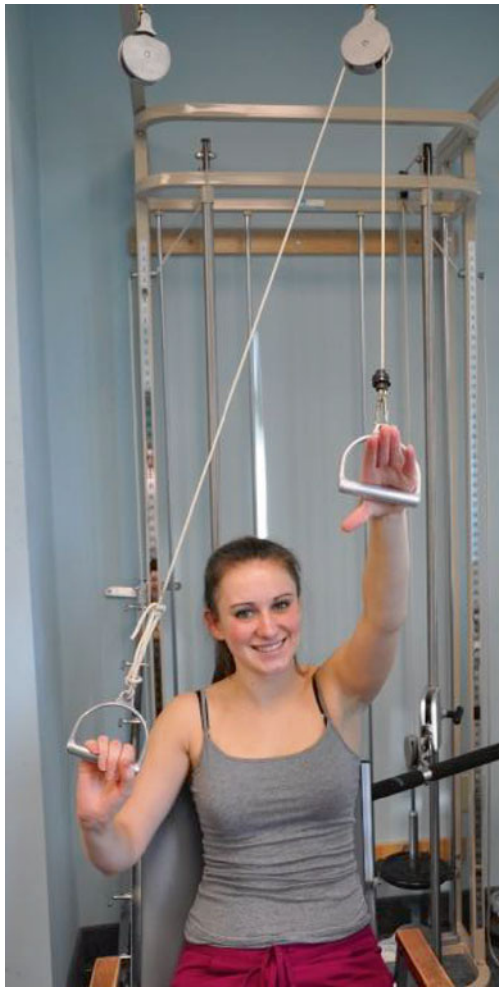

Fig. 13.15 Patient raises the involved arm as high as it can go with the pulley; open the hand and slowly follow the handle down to the starting position

and overloading of the rotator cuff and its inability to maintain the humeral head centered on the glenoid. The patient should return to the previous exercise and continue to strengthen until good mechanics are achieved before advancing. Failure to do this will result in impingement with riding up of the humeral head under the coracoacromial arch creating an inflammatory response of the underlying soft tissue. With a watchful attentive therapist, this pitfall can be avoided. Prone extension (Fig. 13.18) and abduction (Fig. 13.19) are then initiated to isolate the posterior structures during strengthening of the posterior cuff and periscapular muscles.

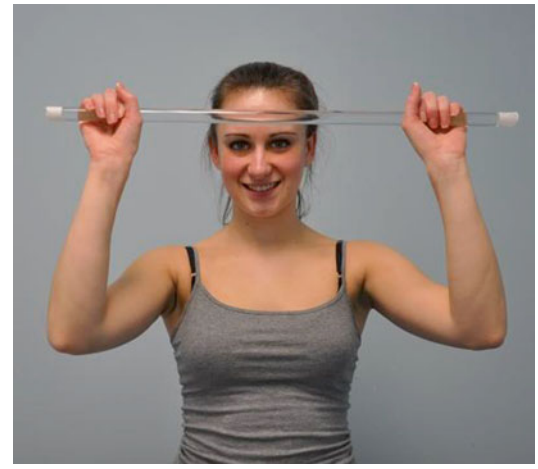

Fig. 13.16 Patient holds stick at chest level, raising the stick overhead keeping it level

Fig. 13.17 Patient holds stick at chest level, raising the stick overhead to maximum height, lifts the involved hand off the stick, and slowly follows the stick to starting position

Fig. 13.18 Lying prone the arm is extended to midline

Fig. 13.19 Lying prone the arm is abducted to midline palm down or thumb pointing up

Advanced Stretching Exercise

Stretching exercises become more aggressive as the healing progresses and the planar motion increases. Advanced stretching is not initiated until the sixth postoperative week since the intensity of the exercises directs stretching in combined planes of motion and toward maximum range and flexibility. With massive and large rotator cuff repairs and humeral fractures, advanced stretching is deferred until 12 weeks when healing is suitable to accept the stretching. At this point in the program if there is excessive stiffness, emphasis is placed on stretching with less attention paid to strengthening. Functional range of motion, above and below the horizontal, with full end range, with combined movement is the goal of the advanced stretching program. During stretching the patient is instructed to move to the point of stiffness, apply additional force slightly into the stiff range, and hold for the count of five to ten. This should be repeated for five to ten repetitions and can be adjusted according to the patient's tolerance and response to treatment. The one-arm wall stretch is started with the patient holding the wrist of the affected extremity and sliding it up the wall (Fig. 13.20). As the patient begins to reach up, the wrist is released and the patient stretches up and leans his axilla and arm into the wall. The goal of the exercises is to have the patient's axilla and arm flat against the wall. After 140° of forward elevation is comfortably obtained, combined flexion, external rotation, and abduction stretching can be initiated (Fig. 13.21). This position can be challenging for the patient with end range stiff-

Fig. 13.20 Patient places hand on a door, reaches up, and stretches to the top of the door, attempting to press their armpit onto the door

Fig. 13.21 Patient clasps their hands and raises them in one motion over their head placing them behind the head. They try to spread their elbows out to the side and touch the mat and then bring them together

ness. This stretch focuses on the inferior and anterior structures of the shoulder most especially at the glenohumeral joint. With these advanced stretching exercises, planar motion can be normal; however, there can be quite a bit of stiffness with combined rotational components which may result in soreness after performing these exercises. One should proceed in a gentle slow progression of intensity of stretching since patients can become sore with these exercises. The over-the-door hang (Fig. 13.22) is one of the more aggressive exercises using the weight of the patient, controlled by the patient, in the overhead stretch position. This is a hang-down exercise. Stretch is applied by the patient bending knees and relaxing the shoulders and arms and clasping the top of the door with their fingertips. A chin-up bar can also be used for this exercise. This stretch should be gradual and controlled. The standing 90/90 corner stretch (Fig. 13.23) continues to address combined motion and resulting stiffness. Patients may demonstrate good external rotation in the plane of the scapula; however, if they elevate to 90° and attempts to externally rotate, their shoulder adducts and external rotation is limited usually less than 90° in abduction. The patient is directed to walk toward the corner of a room, place his arms at 90° abduction approaching external rotation as far as he can and place his hands on the wall with his elbows and forearms, and lean into the corner of the wall. If the patient has limited external rotation, it may be difficult to assume this position so modification should be made. With younger patients, supine external rotation at 90° of abduction at 90° of elbow flexion may be initiated with a stick pushing the hand further into external rotation (Fig. 13.24). Advanced internal rotation stretch incorporates a towel or scarf (Fig. 13.25). This is especially effective for people to have difficulty

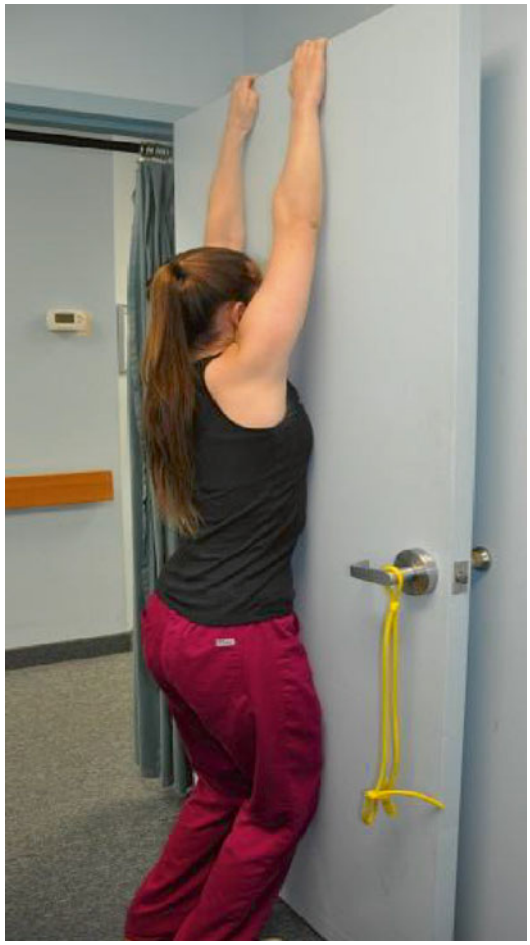

Fig. 13.22 Patient slides hands to the top of the door and grasps with their fingertips. Relaxing their shoulders and bend their knees, gently, to apply weight and stretch their shoulders

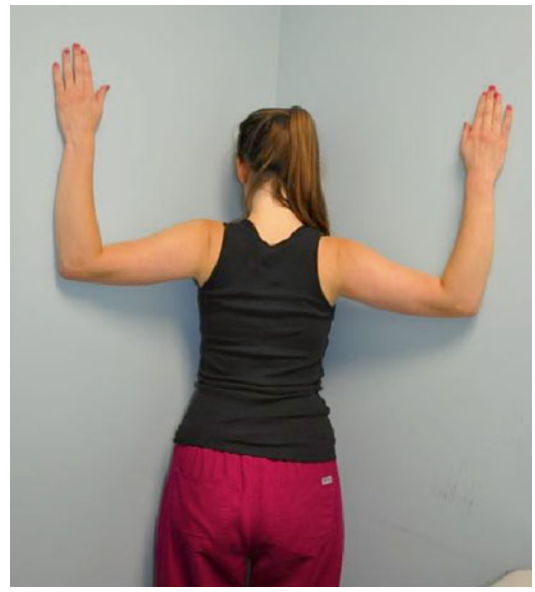

Fig. 13.23 With arms out to the side with elbow bent to 90°, the patient gently leans their body forward into the corner

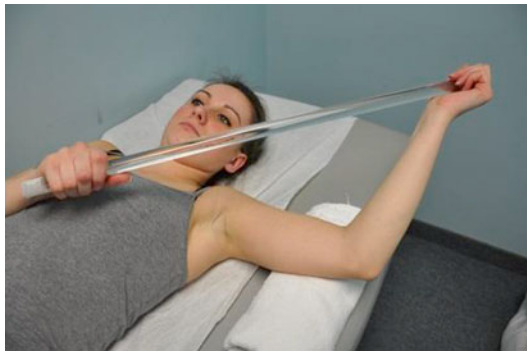

Fig. 13.24 Place a pillow under the elbow with the arm abducted to 90°. With the scapular stabilized against the mat, the patient bends the elbow to 90° and pushes the hand toward external rotation

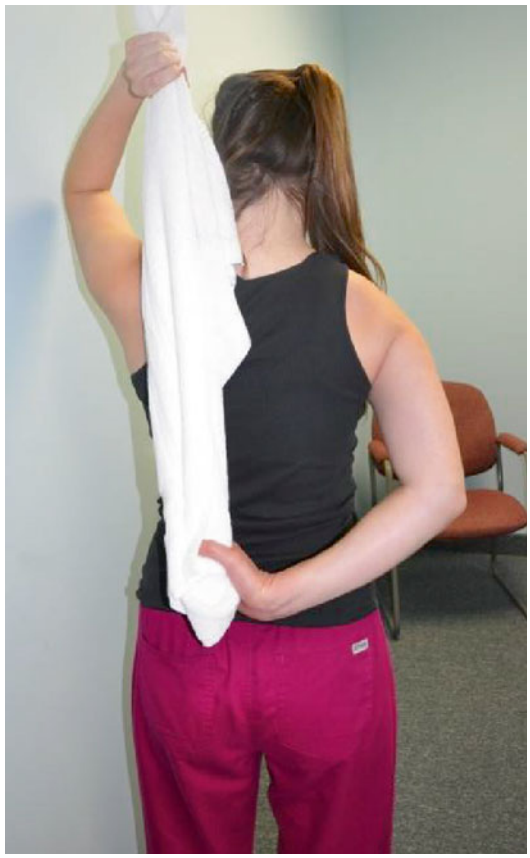

Fig. 13.25 The patient grasps a towel or old silk tie using their uninvolved arm to pull the involved arm up the center of the back

using their opposite hand behind the back. Standing with the hand on the counter is an alternative to this exercise (Fig. 13.26). If posterior

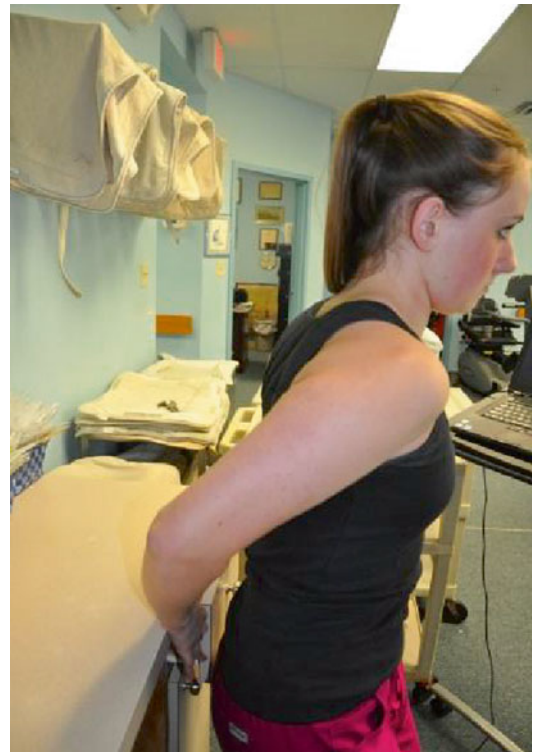

Fig. 13.26 The patient places the hand in the center of the back, leans into the counter top, and grasps it with their hand and bends at the knees

capsular tightness is present, the cross-body adduction stretch (Fig. 13.27) will help stretch the posterior aspect of the shoulder. If the scapula is very mobile, lying supine stabilizes the scapula toward the thorax and will help facilitate isolated posterior capsular stretching.

Resistive Exercise

At 6 weeks strengthening is also initiated since the soft tissues are intact and the subscapularis tendon repair is sufficiently healed. With large to massive rotator cuff repairs, resistance does not start until 12 weeks since the soft tissues require longer protection for adequate healing. Joint reaction force at the normal glenohumeral joint, while raising the arm in abduction, approximates body weight [23]. During resistive exercises, the amount of force generated at the glenohumeral joint should be considered. Overloading the joint with resistive exercises will alter arthro-kinematics

Fig. 13.27 Patient raises the involved arm to the horizontal position. With the other hand, they push their elbow toward the opposite shoulder

Fig. 13.28 Patient holds the elastic tubing in both hands with a towel placed between the involved elbow and the waist to maintain the scapular plane. With the elbow pressed to the towel, the patient pulls outward and slowly returns to the starting position

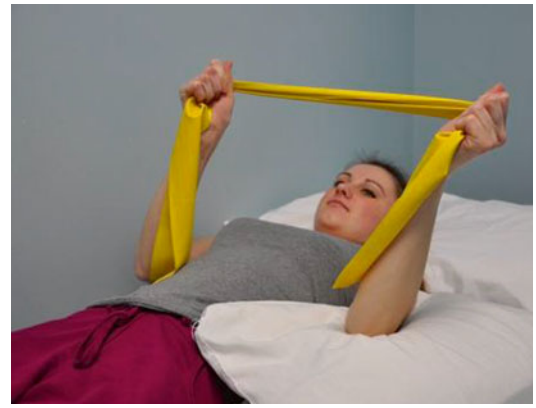

Fig. 13.29 To help avoid substitution, the patient is placed supine to stabilize the trunk and scapular with a towel or pillow under the arm to maintain the scapular plane. Holding the elastic band in both hands, the patient pulls outward and returns slowly with the elbow maintained at 90°

and should be avoided. Pain should also be avoided during strengthening. A progression of light to heavy elastic tubing is incrementally introduced as the patient begins to strengthen. As he becomes more comfortable with the resistive exercises, free weights are then introduced. The goal of this part of the exercise program is to strengthen with proper mechanics keeping the humeral head centered on the glenoid avoiding a shrug sign and riding up. If this occurs, or if there is pain, the resistance should be reduced. External rotation with resisted tubing initiates strengthening to the rotator cuff (Fig. 13.28). The patient should place a towel between his arm and trunk as demonstrated and externally rotate avoiding substitution. If substitution is unresolved, the supine position can be reverted too (Fig. 13.29). Resistive internal rotation is performed in the same position with controlled inward rotation to the belly press position followed by slow release with controlled eccentric rotation to the starting position (Fig. 13.30). This motion may be weak due to the direct effects of the surgery and contracture released. The subscapularis strength is pivotal in maintaining the stability of the shoulder. Strength may be slow to return since it is the only muscle released during the surgery [8, 18]. Resisted abduction and combined external rotation is a complex exercise. It involves combined strengthening and coordination directed at the periscapular muscles, deltoid infraspinatus, and teres minor

Fig. 13.30 The elastic tub is attached to the doorknob. With a bolster under the elbow, the patient takes a large step away from the door. Holding the elbow against the bolster, the patient internally rotates the hand toward the stomach and slowly allows it to return to the starting position

Fig. 13.31 While holding the elastic band with both hands with elbows maintained at 90°, the patient starts by pulling their hands apart outward and upward and at the same time lifting their elbows away from the body. It important to lead with the hands not the elbows

muscles for abduction and external rotation (Fig. 13.31). Weakness of either group results in upward rotation of the scapula and drifting of the hand and forearm inward. Placing an elastic band on a doorknob stepping back and pulling in straight back strengthens the posterior deltoid (Fig. 13.32). This exercise usually is not problematic. The uppercut or punch upward strengthens the rotator cuff and anterior deltoid (Fig. 13.33). A band is attached to the doorknob and the patient punches up to the horizontal. Riding up of the shoulder as well as pain should be monitored. If

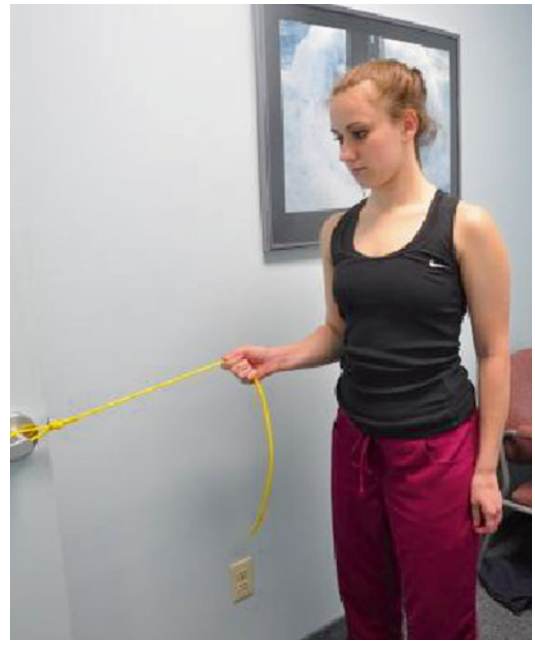

Fig. 13.32 The elastic tub is placed on the doorknob. Patient takes a large step back. Patient pulls straight back until the hand is at the waist and then returns to the starting position

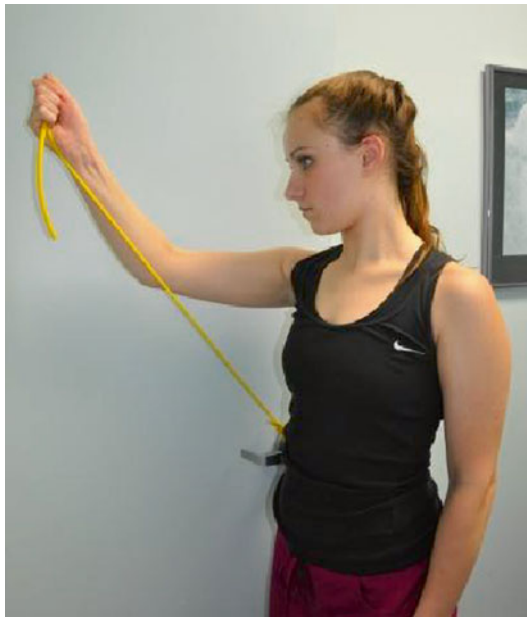

Fig. 13.33 The elastic band is attached to the doorknob. Standing with the shoulder next to the door and your elbow at the doorknob and waist, the patient performs an uppercut raising their hand above the head and shoulder motion approaching 90° and then slowly returns to the starting position

Fig. 13.34 Patient holds a bar or a stick beginning with a 1–2 lb weight and performs a standing press raising the bar as high as possible and then returns to the starting position

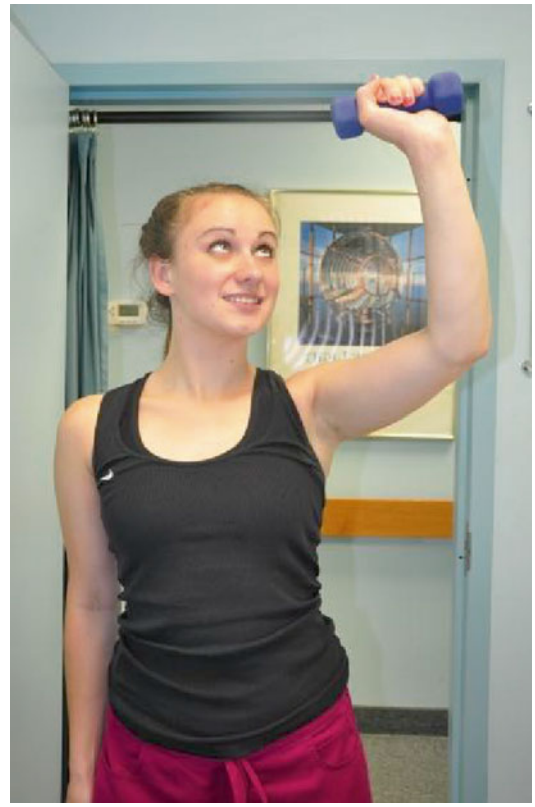

Fig. 13.35 Patient holds a weight 1–5 lb with palm out at shoulder level. Patient then presses weight upward until the arm is straight and then returns to the starting position

either is present, reduction in the amount of resistance is recommended. Standing press with the stick and a weight is the next exercise (Fig. 13.34). Symmetry should be evaluated. This exercise is then followed by the one-arm press without a weight and then adding a 1–2 lb weight (Fig. 13.35). Care should be taken to monitor and evaluate the quality of movement and kinematics as the therapist progresses the patient through these strengthening exercises. Improper exercise execution and/or overloading can result in painful inflamed soft tissues and rotator cuff. As range of motion and flexibility improve with gains in strength, the scapular and periscapular muscles are addressed. Setting of the scapula with an upward rotation movement maintaining the humeral head centered in the glenoid is necessary for proper overhead function. Abnormal scapular mechanics in this scenario is usually due to presurgical glenoid or glenohumeral pathology and stiffness. With range of motion and strength being restored at the glenohumeral joint, it is not uncommon to see normal scapulothoracic/humeral mechanics develop without focus on the periscapular muscles during early rehabilitation. However, if periscapular muscle dysfunction is present after

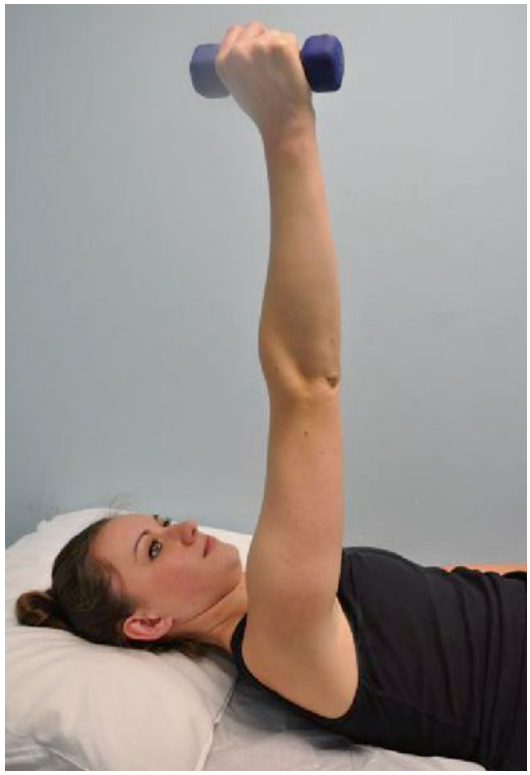

Fig. 13.36 Patient lies supine with a 1–5 lb weight in the hand with a straight arm at 90° shoulder flexion. With a locked elbow, the patient raises the shoulder reaching toward the ceiling and then slowly returning to the starting position

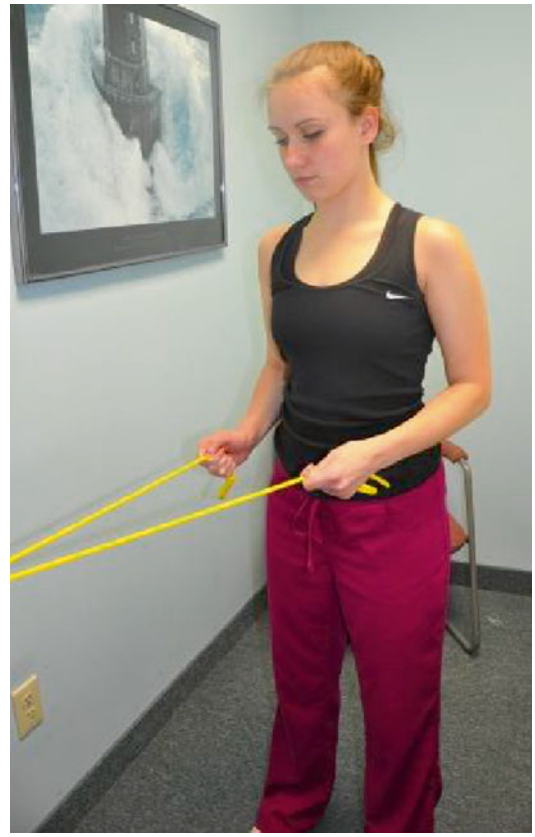

Fig. 13.37 Elastic bands are attached to the doorknob. Patient takes a large step back and, with bands in both hands, pulls back till elbows approach the waist at the point the patient pulls his scapular together and pinches their center back together

glenohumeral motion and strength are established, strengthening of these muscles will ensure continued proper function below and above the horizontal. Strengthening is started in the supine position with scapular protraction. The patient performs a reach up plus with the one or 2 lb weight or appropriate resistance (Fig. 13.36). The second exercise is scapular retraction using the elastic bands. The elastic band is attached to the door and held in two hands. The patient has his arms outstretched in front and isolates bringing their scapula together as the patient expands their chest up and out (Fig. 13.37). For younger patients, the quadruped push-up plus is effective in developing strength and control for proper mechanic at the scapular thoracic articulation (Fig. 13.38).

Fig. 13.38 Patient assumes the quadruped position. Patient locks their elbows and pushes the center of the back toward the ceiling and then returns to the starting position

Exercise Strategy for the Weak Shoulder

In some instances the attempt to repair and rehabilitate long-standing destruction of the biomechanical and neuromuscular components of the shoulder to regain shoulder function requires an altered strategy of rehabilitation to attain an optimal outcome. Patients with severe weakness following long-standing disease or following severe trauma involving muscular and neurovascular injury may not progress as expected in the recovery process. The primary goal of function above the horizontal may be slow to realize. Inability to raise the upper extremity in the erecting position above the horizontal due to weakness may require a modified rehabilitation approach to regain function. These patients can be challenging and require closer attention to techniques in strengthening exercises that will allow them to realize their full potential. The weak shoulder program focuses on supine exercise with the effects of gravity reduced on the weight of the extremity. The program is a progression from supine to the erecting sitting position moving from 0 to a 30° elevation of the trunk to a 60 and then 90° position which gradually increases the effect of gravity on the extremity as the patient approaches the critical range of 60–120° of shoulder elevation. The patient starts at a comfortable position supine where elevation can be accomplished, closed loop using a stick, with good mechanics (Fig. 13.39). Avoiding anterior superior translation of the numeral head with a shrug sign assures appropriate resistance. The rotator cuff in this position is not overloaded and performs its function of centralization and control as the deltoid powers through to elevate the extremity. Strengthening with progressive forms of resistance such as weights, elastic bands, and manual resistance imparted by the therapist is administered. The patient is advanced to the next level of

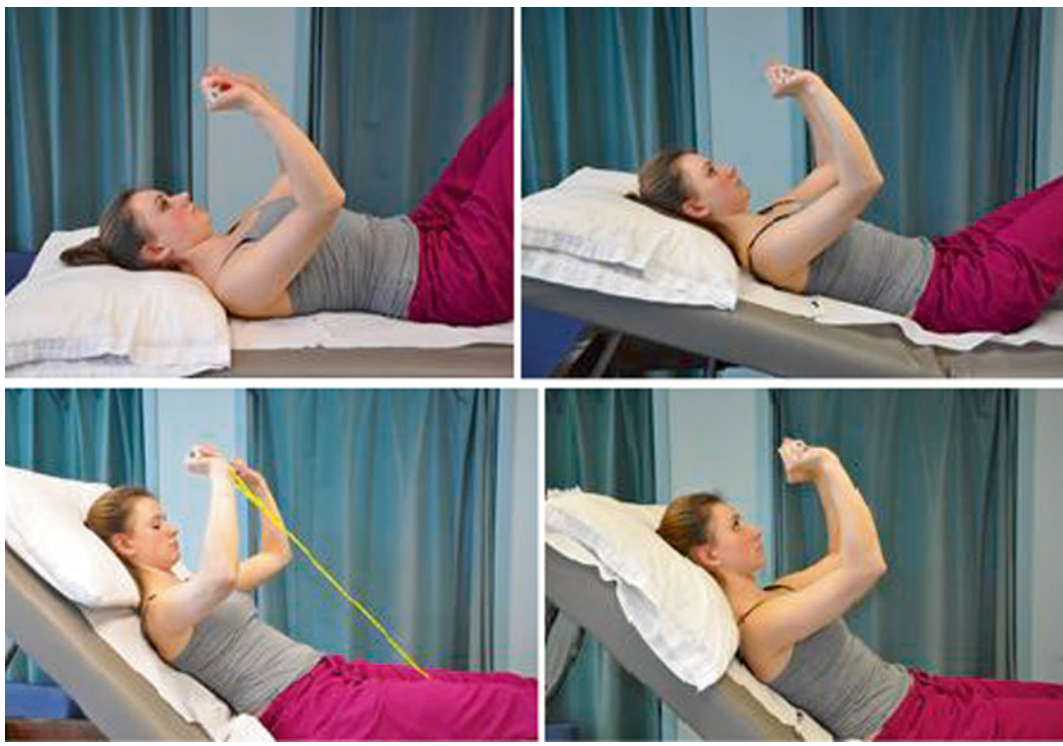

Fig. 13.39 Patient is progressed from supine to 30° to approximately 60° and finally to 90° (not pictured). The effect of gravity and the weight of the upper extremity approaching 60–120° of elevation is increased at each position

trunk elevation when a shrug sign is no longer apparent and motion is smooth and comfortable. Active elevation of the extremity with good mechanics is the goal. This process may be slow. Patients are advised to be patient and not to become frustrated since gains in strength may be protracted. Functional gains can be realized up to 1 year to 18 months and sometimes longer if there is an associated neurovascular injury or complications during surgery.

In conclusion, rehabilitation of shoulder arthroplasty requires an understanding of the pathology, complexity of the surgery, and postoperative management in order to accomplish the best possible outcome. The concept of early controlled range of motion has been presented with a logical progression of exercise and its application with respect to the surgical procedure, soft tissue reconstruction, healing, and exercise intensity. Certain potential complications have been addressed and should always be considered in the rehabilitation process. Team approach has been emphasized and its importance in the care of the patient maximizing recovery and outcome. The guidelines have been presented with a specific exercise program that has an ordered intensity of exercise. A modified strengthening program has been presented to manage those patients who present with significant weakness and have difficulty gaining forward elevation. The programs presented are flexible working modules that can be applied and adjusted to any shoulder patient, at any point in the rehabilitation process to attain an optimal outcome.

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