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## *SHOULDER REHABILITATION*

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### INTRODUCTION

Shoulder rehabilitation is an essential component of any treatment plan following shoulder injury or surgery. There are a number of factors that require a surgeon's attention and evaluation. An accurate diagnosis and a well-planned and executed non-operative or operative treatment regimen are certainly a good start. The surgeon has a responsibility to set the patient's level of expectation regarding the anticipated outcome, to assess and influence his or her motivation and to insure that the patient understands the post-operative regimen and timetable for recovery. Communication between the patient, surgeon and therapist create an environment that is conducive to the best possible outcome, and a diligent home-exercise program is a vital component of the rehabilitation. In addition, to implement and monitor a successful rehabilitation program, it is important for the surgeon to have a working understanding of shoulder anatomy, shoulder biomechanics, shoulder kinematics, and the biology of tissue healing. While much of the information to follow is useful in the non-operative treatment of shoulder conditions, the material principally addresses post-surgical rehabilitation.

### PRINCIPLES

The primary goal of a post-surgical rehabilitation program is to control pain, protect repaired tissue during the healing process, restore function and avoid recurrence of symptoms. Controlling pain not only makes the patient (and surgeon) happier, it diminishes the adverse effects of pain on muscle inhibition that contributes to atrophy. Pain control starts by preparing the patient pre-operatively. The choice of anesthesia is considered by some to play a role in post-operative pain relief. Interscalene anesthesia provides intra-operative anesthesia as well as post-operative analgesia. While analgesics are utilized during and following a general anesthetic, titrating these medications as an interscalene block wears off may offer some advantages. Intraoperative percutaneous placement of a catheter to administer a post-operative local anesthetic for analgesia after certain procedures has recently been shown to be effective in reducing post-operative pain and the use of pain medication. However, providing

adequate pain medication during the post-operative period remains essential. The underlying condition, the procedure and patient size are a few of the factors to consider when prescribing medications. Initial immobilization and a specific arm position based on the procedure help to diminish pain. Cryotherapy is useful in the initial post-operative period, particularly following arthroscopic surgery, but also following exercises, to diminish pain by decreasing blood flow and swelling. Additional modalities, such as transcutaneous electrical nerve stimulation (TENS), can be utilized. In the case of TENS, its use remains controversial due to lack of scientific data supporting its efficacy.

The amount of protection that is necessary to promote healing is affected by the quality of the tissue and the surgeon's comfort with the quality of the surgical procedure. This is one area where the surgeon must communicate with the therapist to set initial limits and then advance the rehabilitation. Rigid internal fixation of a fracture may require less "protection" than suture fixation of tendon to bone. A sling is clearly beneficial initially under almost all circumstances following shoulder surgery. The length of time that the sling is used will vary, based on the type of procedure and the quality of the tissue and its repair. Attention to arm position can also serve to protect a tissue repair, such as avoiding extension initially following a large rotator cuff repair to limit tension on the repair. Additional devices may be required, such as abduction wedges of varying degrees, though their use should not be routine. Protecting healing tissue does not mean avoiding motion, as prolonged immobilization and disuse create additional problems. Furthermore, exercise and loading can stimulate a positive response in soft tissues and bone. Here is where an understanding of a tissue's response to injury and its mechanisms of repair are quite helpful. The healing process proceeds in much the same manner for all soft tissues, though a surgical repair creates a more controlled environment. The initial inflammatory phase is followed by a reparative phase. This healing tissue is weaker and at risk of re-tear early on, so a careful regimen to avoid overstressing the repaired tissue is essential. A three to six week time frame for this period has been described. The remodeling phase then progresses for many months and will influence decisions regarding return to activities.

Restoring function begins with restoring motion, utilizing passive (PROM), active-assisted (AAROM) and active (AROM) range-of-motion techniques. Early motion exercises and stretching serve to avoid, or limit, the formation of scarring and adhesions. Attention to specific planes of motion is required. Where to begin and when to advance the patient is the major decision that the surgeon must determine and, as noted above, communicate to the therapist. A surgical approach that detaches and repairs a muscle requires sufficient caution during the healing process to avoid re-detachment. An open anterior procedure that detaches the subscapularis requires initial limits on external rotation that are increased as healing progresses. A total shoulder arthroplasty with a rotator cuff repair may also delay certain aspects of the rehabilitation process for an arthroplasty. A procedure that does not require soft-tissue or bone repair, such as an arthroscopic subacromial decompression, may be advanced more rapidly, often based on the patient's comfort. When full range-of-motion and a normal scapulohumeral rhythm is the goal, the normal contralateral shoulder can be used as a guide. However, when rehabilitation involves the dominant arm of an upper extremity athlete, this may not be the case. For example, greater external rotation, particularly in abduction, is expected for a thrower to resume his/her prior level of function. Application of heat promotes soft-tissue flexibility and facilitates stretching. Slow, gradual stretching exercises are preferred over rapid, ballistic-type movements. Continuous passive motion has been shown to be effective following rotator cuff repair, but it appears to offer no significant difference in outcomes compared with manual PROM exercises.

Equally important to restoring function is strengthening of the affected muscle groups, as well as the entire shoulder girdle. During the initial stages of healing following a repair, gaining motion is the focus of the rehabilitation. However, during this time period, isometric exercises are started for the muscle groups not directly affected by the surgery to avoid atrophy. In this way, muscle contraction is performed without motion of the joint. As tissue healing is achieved, active motion, which requires contraction of the repaired muscle groups, is initiated to begin the strengthening phase. As noted above, it is the surgeon who should decide when to begin active exercises, based on the quality of the tissue and the repair, and communicate this to the therapist and patient. The next stage is adding light resistive exercises, with free weights or elastic tubing. Weights allow for muscle contraction against constant resistance through an arc of motion, known as isotonic exercises. Various machines have been employed to assist with the strengthening phase. Muscle strength further develops by increasing resistance in stages. Functional exercises that are sport- or activity-specific help to maximize the recovery. A patient with a chronic condition and preoperative muscle atrophy may progress more slowly and not achieve the desired level of strength recovery.

Preventing recurrence of symptoms that lead to the initial injury and treatment requires a maintenance program of stretching, strengthening and sport- or activity-specific training exercises. Rotator cuff strengthening is achieved using a low-weight, high-repetition aerobic regimen. Rotator cuff exercises are rarely performed with more than 5 pounds of resistance. These can be performed on a daily basis and serve to restore and maintain muscle endurance. The exercise program should also include strengthening of the periscapular muscles. A high-weight, low-repetition anaerobic program is useful for the larger muscle groups of the shoulder girdle, with alternating days to allow for periods of rest and recovery. Heat prior to sports activity promotes flexibility and ice after these activities limits inflammation and pain.

## POST-OPERATIVE MANAGEMENT GUIDELINES

Most post-operative protocols divide the rehabilitation into successive phases or stages that build upon the gains achieved in a prior phase. Phase I, or the acute or protective stage, is generally designed to control post-operative pain and inflammation, protect the healing repair, initiate PROM then AAROM exercises for the involved joint and isometrics for the unaffected muscles, and resume motion to the uninvolved joints, especially the elbow, wrist, and hand. Initial motion limits and advancing these as tissue healing progresses are based on the surgeon's intraoperative assessment of the safe zone for motion following the repair. Phase II, the subacute or recovery stage, begins when sufficient tissue healing is achieved. The timing is clearly much sooner following an arthroscopic capsular plication than following a massive rotator cuff repair. This phase includes more AROM exercises, advanced stretching to restore full motion, and light then more advanced strengthening of the affected muscles and the entire shoulder girdle.

Phase III, or functional stage, maximizes the strengthening and stretching, and adds sports- or activity-related exercises and a maintenance program. The primary focus of any rehabilitation program is to address the above principles. The primary differences between surgical procedures are when motion limits are advanced and the timing of AAROM and AROM exercises and then the addition of strengthening exercises. Following an arthroscopic subacromial decompression, these stages occur more rapidly as there is no tissue repair that requires protection. However, caution is exercised to avoid creating pain and inflammation by progressing too rapidly. For a proximal humerus fracture treated with hemiarthroplasty with suture fixation of the tuberosities to the humeral shaft, these phases progress more slowly

to allow for the tuberosities to heal. A different fracture treated with more rigid fixation, such as a glenoid fracture, still must heal but likely can be advanced more rapidly. While there is “science” to base specific protocols on, there is clearly an “art” that the successful surgeon develops when determining the pace of a rehabilitation program.

Planes of motion that are usually stressed include forward flexion (in the plane of the scapula and in the sagittal plane), external rotation with the arm at the side, internal rotation with the arm at the side, external rotation in abduction (typically at 90° of abduction), and internal rotation in abduction. Following a capsulorrhaphy, internal and external rotation motions can be initiated in the scapular plane to reduce stress on the capsule and protect the repair. Full abduction (in the coronal plane) and cross-chest (horizontal) adduction are also stressed. For some conditions, such as following a global arthroscopic capsular release for adhesive capsulitis, motions in between these positions may require additional attention. Range-of-motion exercises are performed in a variety of ways. These include the supine, prone, sitting and standing positions, and they are utilized for different situations. For example, the supine position decreases the effect of gravity with forward flexion, and is especially helpful when someone is assisting the patient with motion exercises. Prone and standing positions are used more often for strengthening exercises. Exercises are usually performed as one or two sets of 10-20 repetitions, sometimes to a five second count, though these parameters can be variable.

The rehabilitation begins in the operating room as the surgeon assesses the repair and tests for safe motion limits. Intraarticular or extraarticular placement of catheters for local anesthetic infusion can be placed. Following closure, cryotherapy is often applied. A typical Phase I program includes the pendulum, stick and pulley exercises to begin range-of-motion. The pendulum, or Codman, exercises depend on body momentum and not muscular contraction to initiate motion. The Neer program distinguishes between hand positions such that for a right shoulder the palm is facing forward for the clockwise motion and the palm is facing backward for the counterclockwise motion. Forward to backward pendulums and side-to-side pendulums may be used. While this is considered a PROM exercise, the uninformed patient often contracts shoulder muscles to perform it. PROM by a therapist or an educated family member begins, with limits set by the surgeon. Stick exercises are AAROM with both hands on the stick so that the uninvolved arm assists with moving the involved arm. With a secure repair, this is performed in extension, external rotation with the arm at the side and forward flexion initially, with external rotation in abduction and other planes added as able. However, if the limits set do not allow forward flexion above 90°, external rotation in abduction and other planes are not initiated until these limits are advanced.

Pulley exercises are AAROM and are performed sitting, or standing, with the involved arm attached to or grasping a handle at one end. The uninvolved arm pulls down on the handle at the other end to raise the involved arm. Pulley exercises are often delayed when the tissue quality after a repair is not ideal, such as in a massive rotator cuff repair, or when fixation and healing require initial protection, such as following a modified Weaver-Dunn stabilized with coracoclavicular sutures. Pulley exercises should be delayed until there is some function of the rotator cuff muscles to control the position of the humeral head. Pulley exercises are often started too early in the rehabilitation when the rotator cuff muscles cannot adequately stabilize and depress the humeral head. This results in pain as the humeral head rides up into the subacromial space and causes impingement. Wall-climbing exercises can be added along with other AAROM exercises. The principles noted above for control of pain

and inflammation and the use of cold and heat are always followed, as well as including motion of the uninvolved joints and appropriate isometrics.

During the first phase, seven isometric exercises can be used, including four starting with the arm at the side and the elbow at 90° of flexion for internal rotation, external rotation, elbow flexion and elbow extension. The opposite hand provides resistance. The other three isometric exercises are for the anterior, middle and posterior deltoid in the same arm position, and a door jam can provide resistance. The isometric for elbow flexion is avoided after a SLAP repair, while the posterior deltoid is not included in isometrics initially following an open excision of a ganglion cyst for suprascapular nerve entrapment syndrome performed with a partial deltoid detachment. Unless the trapezius has been violated, shoulder shrug exercises can be added. Judicious use of premedicating with analgesics for home exercise and physical therapy should be considered. Continuous passive motion has been reported, but its efficacy compared with standard regimens is not proven. Ultrasound is often utilized by therapists to provide a deeper thermal effect on tissue to assist with stretching. Phonophoresis uses ultrasound to help a steroid penetrate into tissue to diminish inflammation. Both of these modalities may add no significant benefit compared with standard ROM regimens.

Phase II can begin when healing will permit loading of the tissue. Following an arthroscopic distal clavicle resection, this phase can start at times within a week or two after the procedure, based on patient comfort. A patient after an arthroscopic repair of a small rotator cuff repair will probably advance to this stage sooner than after a large, retracted tear is repaired through an open deltoid-detaching approach. In this last case, the deltoid re-attachment should also be protected until sufficient healing allows for tissue loading. The deltoid-splitting mini-open rotator cuff repair approach preserves the deltoid origin, avoiding this issue. While AROM is added, continued PROM and AAROM, including more advanced AAROM exercises, continue. Stretching toward the end ranges of each motion plane is emphasized during this phase. Using a doorway can help achieve motion. Internal rotation in abduction while lying on the affected side to stabilize the scapula as well as horizontal adduction across the chest help to stretch the posterior capsule. This is sometimes not emphasized enough, and is important to obtain a balance of motion to restore normal kinematics. Periscapular exercises are also emphasized.

While strengthening is often described to be performed in various planes of motion such as flexion or abduction, there are advantages to positioning the arm to target specific muscles. The supraspinatus is isolated for strengthening, while sitting or standing, by elevating the arm in the scapular plane. The “full can” position, with the thumb up, may cause less problems than the “empty can” position, with the thumb down. In the prone position, horizontal abduction with the arm in external rotation until parallel to the floor is utilized. External rotation performed while sitting, standing or lying on the uninvolved side strengthens the posterior rotator cuff. External rotation with the arm at the side of the body can be used to strengthen the infraspinatus. Prone external rotation in abduction with the elbow flexed and then rotated until the forearm is parallel to the floor strengthens the teres minor. Performing prone extension with the arm externally rotated, such that the palm faces the floor, can also strengthen the teres minor. The posterior rotator cuff is sometimes neglected and is important to emphasize, especially in throwers, to insure muscle balance. Internal rotation does not really isolate the subscapularis, though strengthening of this muscle does not usually present problems. Biceps strengthening is always included in a program, but it is not clear if the long head really contributes to humeral head depression. The periscapular muscles are also worked on as this phase progresses. After gravity is added and mastered, resistive exercises,

utilizing weights of one to five pounds, therabands, or other devices, achieve further strengthening.

Phase III is a continuation of the stretching and, especially, the strengthening from the prior phases. The goal is to restore the strength, endurance and skills that are necessary to return the patient to his or her sport or activity, including manual labor. It is important for the patient to have proper mechanics as he or she enters this phase. Plyometric exercises, such as utilizing a medicine ball, are added if they were not started earlier. Training for proprioception and neuromuscular control are particularly important following instability repairs. For throwers, an interval throwing program that progressively adds distance and velocity over time is essential to return the athlete safely to the prior level of function. Finally, the maintenance program is initiated.

For specific diagnoses, these programs will vary, but will follow the principles outlined. Without a repair, the program progresses more rapidly, such as following an arthroscopic glenohumeral debridement or an arthroscopic removal of a loose body. After an arthroscopic release of calcium, a slightly slower progression is followed to control the inflammation caused by the calcium and to avoid further inflammation. An arthroscopic Bankart repair can progress more rapidly than an open repair in most areas, except for increasing external rotation. These patients are seen more often early in the post-operative period to tailor the range-of-motion exercises. A routine total shoulder arthroplasty performed through the deltopectoral interval without deltoid detachment and without a subscapularis lengthening must first control pain and inflammation, but only requires caution as the subscapularis heals. A frozen shoulder requires special attention to stretching following a capsular release to insure that the gains achieved in the operating room are not lost. A patient that appears "tight" at two to three weeks is advanced sooner, and a patient that appears loose might be delayed slightly. These are the circumstances where the art and intuition (from experience) come into play, taking into account all of the preoperative assessments. The surgeon must be reassuring and help the patient gain confidence as the rehabilitation progresses. The patient and surgeon almost form a partnership. A large portion of the surgeon's work, which he or she enjoys, is completed within a few hours. However, it may take the patient many months of difficult and, at times, painful work, which is usually not enjoyed, to achieve the desired outcome. C'est la vie.

\*Note: Specific Shoulder Rehabilitation protocols are not included in this handout as they are available for a variety of procedures in the handouts, published textbooks, journal articles and on the Internet. If you cannot locate a specific protocol that suites your needs, feel free to contact me at [jticker@shoulders.md](mailto:jticker@shoulders.md) and I will try to assist you.

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