CHAPTER 26 Shoulder Arthroplasty in the Athletic Shoulder

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The most common reasons and diagnostic classifications for which shoulder arthroplasty is performed are degenerative osteoarthritis, secondary degenerative osteoarthritis, capsulorrhaphy arthropathy, and rheumatoid arthritis.[1] Although all four of these can be found in the athletic shoulder, degenerative osteoarthritis occurring solely from repetitive overuse and wear or secondary to athletic trauma, as well as capsulorrhaphy arthropathy, are particularly common indications in the athlete. A brief overview of each diagnostic classification has implications for the role of shoulder arthroplasty in the treatment of arthritis in the athletic shoulder.

DEGENERATIVE GLENOHUMERAL OSTEOARTHRITIS

Degenerative osteoarthritis of the glenohumeral joint is less common than in the weight-bearing joints (e.g.,. hip, knee) of the lower extremity, accounting for only 3% of all osteoarthritis lesions.[2] Osteoarthritis of the glenohumeral joint (GHOA) can be classified as primary or secondary. Primary GHOA usually manifests with no apparent antecedent cause, whereas secondary GHOA results from a preexisting problem, such as a previous fracture, avascular necrosis, burned out rheumatoid arthritis, or crystalline arthropathy.

Athletes at risk include weightlifters, throwing athletes (baseball players, softball players) and those engaged in racquet sports (tennis, racquetball, squash).[3] This degenerative osteoarthritis seems to be the end result of trauma, whether from pure instability, repetitive loading, fracture, rotator cuff arthropathy, or postsurgery. At the macroscopic level of osteoarthritis (OA), cartilage is noted to have irregularity, with delamination of the cartilage surface and eventually frank cartilage loss, resulting in bone on bone contact in the joint. Early in the degenerative process, inflammatory cells are seen, but this effect is transient and inflammation is not considered to play a major long-term role. Biochemically, OA is associated with a decrease in glycosaminoglycan (GAG) levels, including chondroitin sulfate and hyaluronic acid, increased water content because of increased permeability of water diffusing into the cartilage as GAGs are lost, and increased enzymatic activity from metalloproteinases (MMPs). MMPs play an important role in degeneration of the extracellular matrix of cartilage.[4]

Wear patterns in the human shoulder vary based on the types of underlying arthritic condition and causative factors. Characteristic wear of the subchondral bone and glenoid cartilage in the shoulder with degenerative osteoarthritis occurs posteriorly, often leaving an area of intact cartilage anteriorly.[5] The cartilage of the humeral head is typically eroded in a pattern of central baldness, the so-called Friar Tuck pattern (Fig. 26-1). This differs from the pattern of humeral head wear in cuff tear arthropathy, in which a chronic large rotator cuff defect subjects the uncovered humeral head to abrasion against the acromion and coracoacromial arch, resulting in superior rather than central wear patterns. Recent research by Mochizuki and colleagues[6] has identified specific patterns of glenoid load distribution in the throwing shoulder at the anterior, anteroinferior, posterior, and posteroinferior aspects of the dominant glenoid. These were compared with more central glenoid load patterns in the contralateral shoulder and in the shoulder of nonthrowing subjects. The repetitive loading of the athletic shoulder is further compromised in cases of glenohumeral instability.[6,7]

Another important diagnosis for which shoulder arthroplasty is performed is capsulorrhaphy arthropathy.[1] In 1982, Neer and associates[8] initially reported glenohumeral arthritis after anterior shoulder instability in an initial series of 26 patients with prior anterior or posterior instability who underwent shoulder arthroplasty. Many patients in this series had prior stabilization surgery. Samilson and Prieto[9] later suggested the term *dislocation arthropathy* in their study of 74 patients with glenohumeral arthritis with prior anterior and posterior instability.

Neer[10] has further reported on the association of osteoarthritis and glenohumeral instability by finding subluxation of the humerus in the direction opposite that of the initial instability caused by excessive tightening at the time of initial stabilization surgery. Matsen and coworkers[11] have coined the term *capsulorrhaphy arthropathy* for patients who develop OA as a consequence of overly tightened soft tissue structures in the treatment of glenohumeral joint instability. Buscayret and colleagues[12] have reported the incidence of glenohumeral osteoarthritis to range between 12% and 62% following operative treatment of shoulder instability. Factors specific to stabilization procedures that may contribute to the development of glenohumeral arthritis include encroachment on the articular cartilage by hardware, laterally placed bone block in a Bristow or Latarjet procedure, and excessive soft tissue tensioning resulting from a Putti-Platt procedure.[13]

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Figure 26-1. **Central pattern of humeral head cartilage wear (Friar Tuck pattern).**

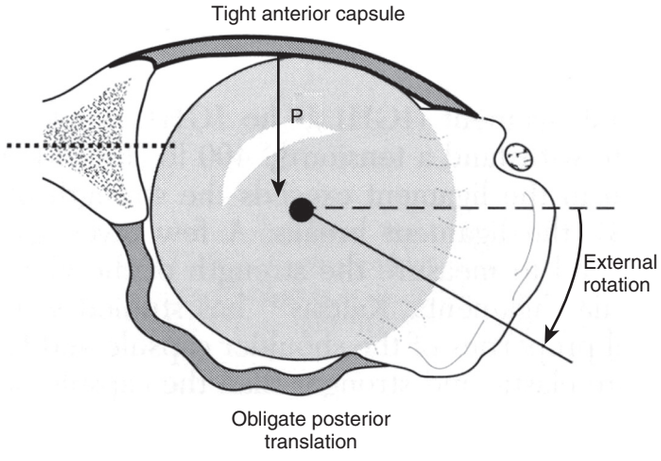

Figure 26-2. **Concept of obligate translation. P, posterior directed translation.**

CONCEPT OF OBLIGATE TRANSLATION

The concept of obligate translation has been applied extensively in orthopedic and sports physical therapy, and in orthopedics in general, since the publication of the study by Harryman and colleagues.[14] They identified increases in anterior humeral head translation and shear following a controlled posterior capsular placation in cadaveric specimens. Obligate translation, defined as the translation of the humeral head in the direction opposite that of the tight capsule and soft tissue structures, has been a paramount concept applied in the treatment of the overhead athlete with subtle anterior glenohumeral joint instability secondary to adaptive posterior rotator cuff and posterior capsule tightness.[15,16] Harryman and associates[17] have also reported the presence of obligate translation in flexion, internal and external rotation, and maximal elevation with shoulder arthroplasty following insertion of an oversized humeral head prosthesis. Shoulder arthroplasty can tend to cause global capsular restriction because of the substitution of a humeral head prosthesis for a degenerative and collapsed humeral head. This overstuffing can prohibit return of optimal range of motion unless the patient undergoes adequate capsular release and early postoperative physical therapy to address capsular tightness.[5] Figure 26-2 demonstrates the concept of obligate translation.

INDICATIONS

Patients who do not respond to nonoperative therapy and have a progressive loss of range of motion and strength are candidates for shoulder arthroplasty. Shoulder arthroplasty and hemiarthroplasty can provide symptomatic relief and restoration of function in individuals with glenohumeral arthritis. The type of surgical procedure chosen is dependent on overall shoulder function, anatomy, condition of bone and rotator cuff tissue, stability, activity level and desire, and age. Hettrich and coworkers[18] have studied preoperative factors in 71 shoulders from 68 patients who underwent shoulder hemiarthroplasty to determine which factors contributed to greater postoperative success. Patients with a preoperative absence of glenoid erosion, no previous surgery, and intact rotator cuff showed significantly greater improvement in active range of motion, more postoperative comfort, and ability to lift weight above shoulder level than patients with glenoid erosion, prior surgery, or rotator cuff tears.

Indications for humeral hemiarthroplasty are primary glenohumeral osteoarthritis, secondary degenerative joint disease, osteonecrosis of the humeral head, and combined loss of glenohumeral joint surface and rotator cuff.[18] Hemiarthroplasty remains an attractive option for younger patients because of concerns about the longevity of the glenoid prosthesis. Additionally, cementless surface replacement arthroplasty replaces only the damaged portion of the joint-bearing surface, with the advantages of minimal bone resection and restoration of normal anatomy, including humeral head version, inclination, and offset without a humeral stem.[19]

Surgical Considerations

Athletes represent a unique subset of patients with shoulder arthritis that may require arthroplasty. The goals must be to restore full motion and strength and preserve the anatomy for potential revision in the future. One must also consider the types of sports involved (collision versus noncollision) and dominance of the extremity.

Conservative measures, such as nonsteroidal antiinflammatory drugs (NSAIDs), steroid injections (occasional), hyaluronic acid preparations (e.g., viscosupplementation), physical therapy to increase motion and restore strength, and arthroscopic débridement, must have failed before considering arthroplasty in the athletic population.

Optimizing rotator cuff status with arthroscopic subacromial decompression, repair of rotator cuff tears, or both may precede the arthroplasty or be done concurrently.

The selected implant should provide immediate stability to limit micromotion with therapy and sports and be durable, revisable, and allow for anatomic reconstruction. The need to replace the glenoid may dictate overall postoperative ability to participation in sports, because this is still the weak link in shoulder arthroplasty. Placement of a glenoid component entails the risk of early loosening with more physical activities. Performing a more anatomic reconstruction theoretically may reduce the incidence of radiographic and real glenoid loosening by limiting eccentric loading of the component. Restoring the anatomy will also ensure optimal kinematics to maximize motion, strength, and recovery potential.

In general, surgical considerations must first include anatomic joint reconstruction with a well-fixed stable implant. This is done with a humeral head resurfacing implant or a third- or fourth-generation stemmed implant. The ultimate goal is to match the native humeral version, inclination, offset, and height. The glenoid can then be resurfaced with a prosthesis or managed with a number of nonimplant resurfacing techniques. Finally, the soft tissues must be released, balanced, and repaired to allow for adequate restoration of long-term function.

Although every surgeon may have a preference, we use resurfacing primarily for those patients who desire to return to high-demand activities, such as strength training, collision sports (e.g., skiing, football, mountain biking), tennis, basketball, and martial arts.[20] We also have chosen to avoid placing a glenoid component in these individuals to avoid the potential pitfalls of loosening and revision. Other alternatives we have used include microfracture, reaming the glenoid to restore version, and bone grafting cysts and defects with biologic covering of the glenoid surface with autograft or allograft tissue.

Key to the success of arthroplasty in any patient, but especially in those who desire to return to more demanding sports, is restoration of soft tissue tension. Specifically, a complete 360-degree subscapularis release is needed to increase excursion and restore external rotation. Lengthening the tendon is not needed and will ultimately weaken this structure, with the potential for delayed rupture. This release will allow the humeral head to return to the center of the glenoid and permit the normal obligate translation that occurs with rotational motion. This in turn helps restore the normal forces across the glenohumeral joint and leads to decreased pain, improved strength, and function (Figs. 26-3, 26-4, and 26-5).

Rehabilitation considerations must take into account the amount of motion obtained under anesthesia after subscapularis closure. This should be communicated to the patient and therapist. The goal is to obtain normal motion, which can be achieved in almost all cases. The subscapularis repair must be sound and protected for the first 6 weeks; external rotation is limited to 30 to 45 degrees. If a larger rotator cuff repair is performed, these precautions should also be instituted according to the surgeon's confidence in the repair. Full passive range of motion (ROM) can be obtained immediately, with rapid progression to active-assisted and active ROM during the initial 6 weeks. Communication with the therapist is critical; we encourage preoperative evaluation to meet the specific needs and desires of the patient after surgery.

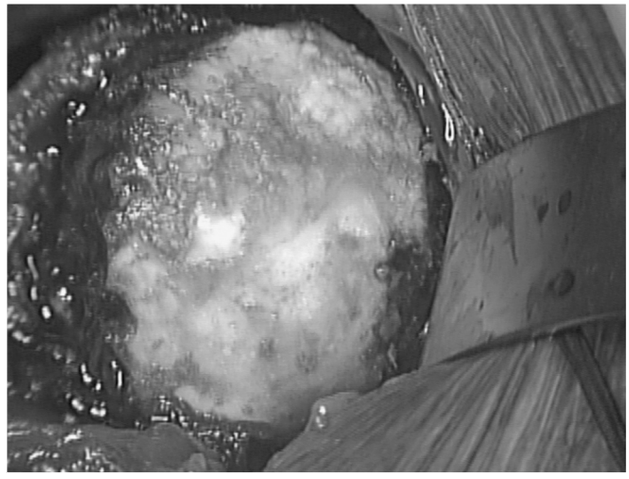

Figure 26-3. Shoulder arthroplasty. Intra-operative photo of a severely arthritic humeral head in a young patient, resulting in poor function and pain.

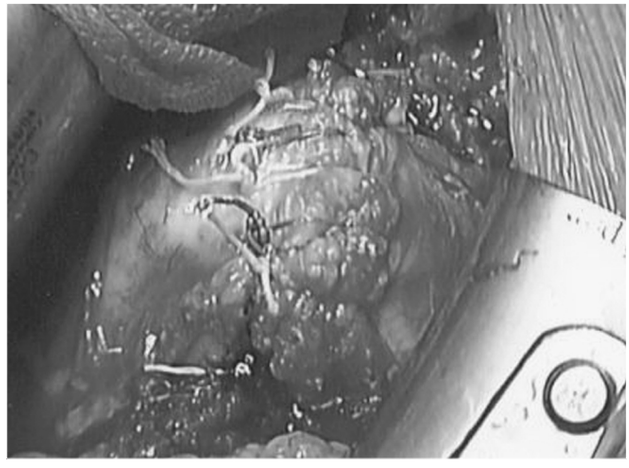

Figure 26-4. Shoulder arthroplasty. Subscapularis closure after shoulder arthroplasty. The repair must be protected post-operatively, while attempting to regain motion of the shoulder in rehabilitation.

REHABILITATION

The surgical exposure used during shoulder arthroplasty has significant ramifications for the immediate postoperative management of these patients. Two approaches are typically used—the deltopectoral approach and anterosuperior or

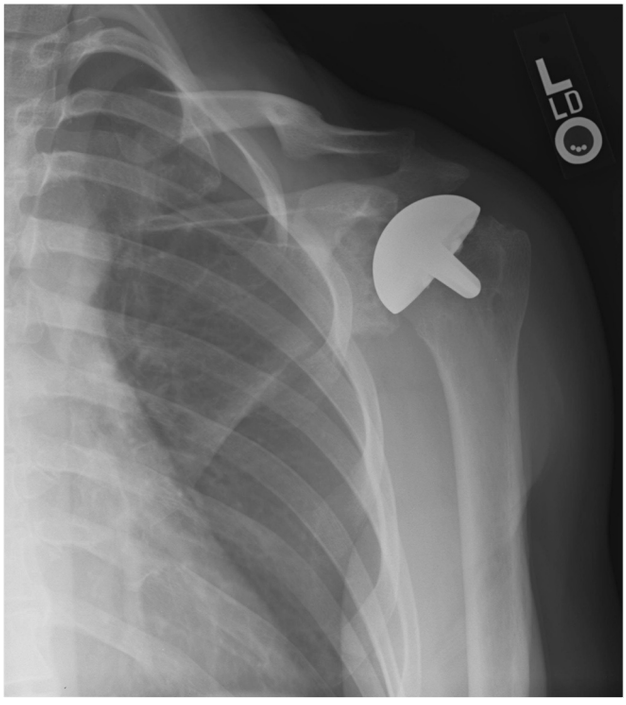

Figure 26-5. *X-ray of shoulder arthroplasty.* Radiograph of a cementless humeral resurfacing arthroplasty in a young patient with a history of glenohumeral arthrosis.

Mackenzie approach.[21] The skin incision for the anterosuperior approach extends distally in a straight line from the acromioclavicular (AC) joint for a distance of 9 cm. The anterior deltoid fibers are split for a distance of not more than 6 cm to protect the axillary nerve. The acromial attachment of the deltoid is detached to expose the anterior aspect of the acromion. The subscapularis is completely released and held by stay sutures and detached. The long head of the biceps can be dislocated posteriorly over the humeral head as the humeral head is dislocated anteriorly.[19,21] The complete release and detachment of the subscapularis with this approach are required to gain exposure for preparation of the humeral head during hemiarthroplasty, as well as during total shoulder arthroplasty (Table 26-1).

Subscapularis Precautions

For the first 6 weeks, specific subscapularis precautions must be followed to protect this important structure postoperatively. This entails limitation of passive or active external rotation ROM and no active resistive exercise for internal rotation. Although gentle attempts at passive external rotation can occur to as far as 30 to 45 degrees of external rotation beyond neutral, techniques that place increased or undue tension on the anterior capsule and subscapularis are avoided for the first 6 weeks following surgery. Additional precautions may be needed, depending on the repair of additional rotator cuff tendons at the time of surgery, as well as whether bicep tenolysis, tenodesis, or tenotomy has been performed. Specifically,

TABLE 26-1 Factors Affecting Progression of Rehabilitation Following Arthroplasty

Factor	Indication
Subscapularis release and repair—exercise in first 6 weeks postoperatively	Limitation of external rotation ROM and resistive internal rotation
Supraspinatus tear and repair—elevation, delayed active abduction range of motion (ROM)	Delayed reattainment of antigravity
Biceps tenolysis and tenodesis—6 weeks postoperatively	No resistive elbow flexion exercise in initial 6 weeks postoperatively
Age, tissue quality	Delayed return of active ROM

resistive exercise for the biceps brachii is not performed for the first 6 weeks postoperatively if a release of the biceps long head or tenodesis has been performed to minimize the chance of rerupture and reappearance of a Popeye deformity. It is beyond the scope of this chapter to discuss the entire rehabilitation process following shoulder arthroplasty; a detailed summary of our postoperative protocol is presented in Box 26-1.

Range of Motion and Optimization of Capsular Relationships

Concomitant with therapy during the initial stages of postoperative rehabilitation are the use of mobilization and passive stretching to decrease abnormal glenohumeral joint shear forces[14,15] and improve gross glenohumeral joint ROM. Typical patterns of ROM loss following shoulder injury adhere to the predictable pattern described by Cyriax and Cyriax,[22] which states that external rotation, abduction, and internal rotation are most limited, followed by forward flexion, which is least limited.[22] To address selective capsular tightness, posterior glides of the humeral head relative to the glenoid, with varying degrees of internal rotation of the glenohumeral joint, are used to mobilize the posterior capsule and address limitations in internal glenohumeral joint rotation. Anterior glides of the humeral head are often used later in the rehabilitation process once initial subscapularis healing has occurred to address limitations in external rotation, if indicated. Optimization of capsular length between the anterior and posterior capsule is theoretically purported to minimize humeral head shear within the glenoid with glenohumeral joint movement.[14,15] In addition to the use of glenohumeral joint mobilization, application of passive stretching using the low-load, long-duration stretching concept is also recommended.[23]

BOX 26-1. Rehabilitation Following Glenohumeral Joint Arthroplasty

General Guidelines

- Sling use and duration as directed by surgeon in postoperative instructions
- Immediate postoperative passive and active-assisted range of motion (ROM) consisting of stomach rubs, sawing movements, and elbow range of motion as instructed following hospital discharge

Postoperative Weeks 1-4

1. Modalities to decrease pain and inflammation
2. Passive range of motion initiated, with no limitation in flexion, abduction, or internal rotation; no external rotation stretching or anterior capsular mobilization in this rehabilitation phase to protect subscapularis repair; movement-ROM into 30-40 degrees external rotation with 30-45 degrees abduction allowed by therapist, provided it is not against tension
3. Elbow, wrist, and forearm ROM and stretching
4. Manually applied scapular resistive exercise for protraction and retraction, submaximal biceps and triceps manual resistance with shoulder in supported position supine
5. Ball approximation (closed-chain Codman's exercise) using Swiss ball or tabletop

Postoperative Weeks 2-4

1. Initiation of active-assisted ROM using pulley for sagittal plane flexion and scapular plane elevation

Postoperative Weeks 4-6

1. Continuation of above program
2. Initiation of submaximal multiple-angle isometrics and manual resistive exercises for shoulder external rotation, abduction and adduction, flexion and extension
3. Upper body ergometer (UBE)
4. External rotation isotonic exercises using pulley, weights, or tubing, with elbow supported and glenohumeral joint in scapular plane and 10-20 degrees of abduction (towel roll or pillow under axilla)

Postoperative Weeks 6-8

1. Initiation of passive external rotation ROM and stretching beyond neutral rotation position
2. Initiation of internal rotation submaximal resistive exercise progression
3. Traditional rotator cuff isotonic exercise program
   a. Side-lying external rotation
   b. Prone extension
   c. Prone horizontal abduction—limited from neutral to scapular plane position initially, with progression to coronal plane as ROM improves
4. Biceps and triceps curls in standing position, with glenohumeral joint in neutral resting position
5. Oscillation exercise with resistance bar or Bodyblade (Hymanson, Marina Del Rey, Calif)
6. Rhythmic stabilization in open and closed kinetic chain environments

Postoperative Weeks 8-12

1. Continuation of resistive exercise and ROM progressions
2. Addition of ball dribbling and upper body plyometrics with small Swiss ball

Postoperative Weeks 12-24

1. Continuation of rehabilitation
2. Isometric internal and external rotation strength testing and assessment in neutral scapular plane position
3. Subjective rating scale completion
4. ROM assessment

Strengthening

Early strengthening following glenohumeral arthroplasty focuses on the scapular stabilizers and safe, submaximal rotator cuff activation.[16,24] Techniques described in Chapter 50 show manual scapular stabilization for retraction and protraction. This allows for early contraction of the lower trapezius and serratus anterior force couple components without stressing the glenohumeral joint. Multiple sets to induce muscular fatigue of these important muscles are indicated.[16]

In addition to the scapular stabilization exercise, early application of external rotation exercise is initiated. As noted, internal rotation strengthening cannot commence before 6 weeks postoperatively to protect the subscapularis muscle tendon unit. Progression of rotator cuff strengthening follows patterns outlined in the literature, with documented high levels of activation of the posterior rotator cuff to enhance recruitment and improve local muscular endurance with multiple sets of 15 to 20 repetitions.[25-28] Additional application of resistive exercise and proprioceptive training occurs in the supine position; the patient places the shoulder in 90 degrees of shoulder flexion with assistance from the therapist. This position is termed the *balance point position* because patients can balance the extremity in this position despite being unable to elevate the shoulder to 90 degrees

independently. From this position, the therapist can progressively apply manual contacts or modified rhythmic stabilization while the patient provides cocontraction to maintain this position. Additionally, in this early stage, external rotation isometrics with elastic resistance using a Thera-Band (Hygenic, Akron, Ohio) are performed (Fig. 26-6). The neutral position is used, with a towel roll placed under the axilla. This is maintained during the exercise and the patient steps laterally away from the attachment point of the tubing. After a several-second pause at the point of increased tension, the patient is directed to step back toward the attachment point of the tubing again. Actual motion at the glenohumeral joint does not occur but variable loading during this isometric exercise is transmitted to the glenohumeral and scapulothoracic muscles. This exercise is well tolerated and safe, and can be used as a home exercise program to facilitate development of the posterior rotator cuff and scapular stabilizers.

Rotator Cuff and Scapular Exercise Progression

Gradual progressions in rotator cuff and scapular strengthening occur with increased intensity and variety following 5 to 6 weeks postoperatively. The important role of the rotator cuff musculotendinous units in controlling and centering the humeral head, especially during midrange movement patterns, cannot be underestimated.[29] Submaximal strengthening methods to recruit the rotator cuff musculature selectively, using exercise patterns that place the shoulder in neutral nonimpinging positions, forms the basis for in-clinic and home-based rehabilitative exercise programs. Exercises such as side-lying external rotation, prone extension, and prone horizontal abduction are used and recommended, based on electromyographic research studies that documented high levels of posterior rotator cuff activation.[25-28] As a general rule, shoulder exercises that keep the shoulder below 90 degrees of elevation and the arm slightly anterior to and in the scapular plane are recommended.[16]

Figure 26-6. Dynamic isometric step-outs. This exercise uses elastic resistance, with the patient holding the arm in neutral rotation with a towel roll or bolster under the involved arm. Holding the arm in this position, the subject repeatedly takes a large step away from the attachment site of the tubing while holding the extremity stationary. A step back to the starting position completes one repetition of this exercise.

Progressive advances in exercise for the muscles that stabilize the scapula are also indicated. Exercises that strengthen the serratus anterior and lower trapezius are particularly recommended to improve scapular upward rotation during elevation.[30] Resistance patterns with light weights, medicine balls, or a Thera-Band can be used to perform shoulder punches, with emphasis on the position of maximal scapular protraction (termed the *plus position*) to recruit the serratus anterior.[31,32] Scapular retraction exercises, such as rowing with multiple positions of arm abduction, are also indicated.

Lower resistance levels allow rotator cuff activation, with less compensation and shoulder girdle elevation that often accompany independent exercise programs with higher resistance levels and movement patterns characterized by full, end-range, overhead elevation. Care must be taken to ensure that resistive exercise does not elevate pain levels, which lead to muscular inhibition and compensation. The restoration of optimal muscle balance is imperative during the rehabilitation of all shoulder injuries and pathologies, but it is particularly important following shoulder arthroplasty. Figures 26-7 and 26-8 illustrate the effect of unbalanced muscular forces during shoulder muscular contraction and volitional movement. Unbalanced internal rotation strength or dominant anterior muscular strength development can lead to anterior translation of the humeral head relative to the glenoid.[29] Similarly, excessive posterior development can accentuate posterior subluxation from an eroded posterior glenoid and overly tight anterior structures (obligate translation) and produce posterior instability.

Optimal muscle balance between the external and internal rotators has been reported and recommended in the range from 66% to 75% external rotation (ER) to internal rotation (IR).[33,34] This can be assessed with a hand-held dynamometer or isometric function of an isokinetic dynamometer system to ensure proper restoration of this optimal muscle balance.[33,35] Patients frequently present with overly dominant anterior muscular strength, which can

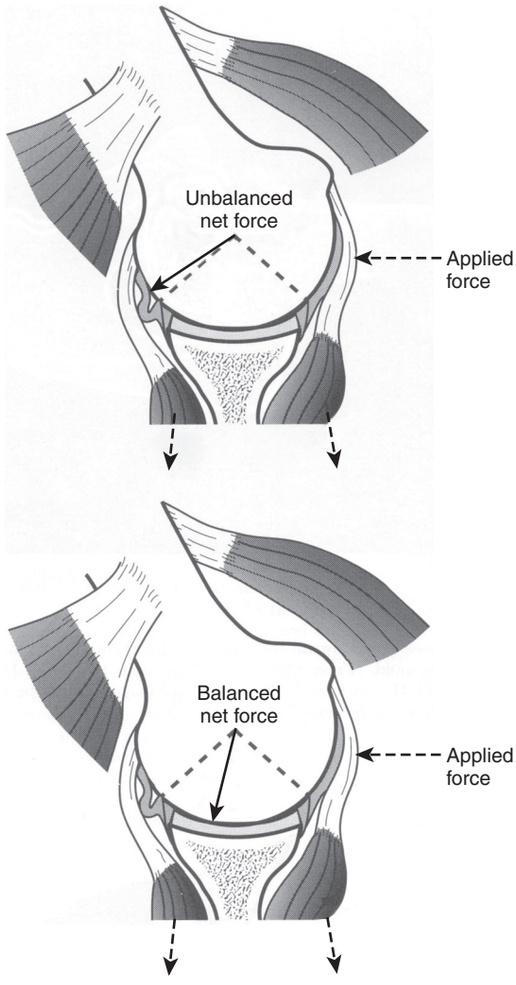

Figure 26-7. Diagrammatic representation of unbalanced muscular force.

jeopardize glenohumeral mechanics and lead to complications and functional impairment. The rocking horse phenomenon (see Fig. 26-8) can lead to implant loosening, one of the most frequently encountered complications following total shoulder arthroplasty.[5,11] Restoration of proper muscular balance via monitoring and addressing the ER/IR strength ratio, as well as application of ROM, physiologic stretching, and accessory mobilization techniques during postoperative rehabilitation, ensure proper capsular excursion and minimize the effects of obligate translation. Research studies[14,15,36] have shown the effects of capsular tightness on glenohumeral kinematics.

Progression to elevated positions of rotator cuff and scapular stabilization is indicated to assist patients with the return of shoulder elevation against gravity following these extensive surgical procedures. Figure 26-9 shows an exercise position using the scapular plane, 80 to 90 degrees of elevation, and an exercise ball. The patient is asked to maintain his or her position on the ball while the therapist provides challenges or perturbations to the extremity in all

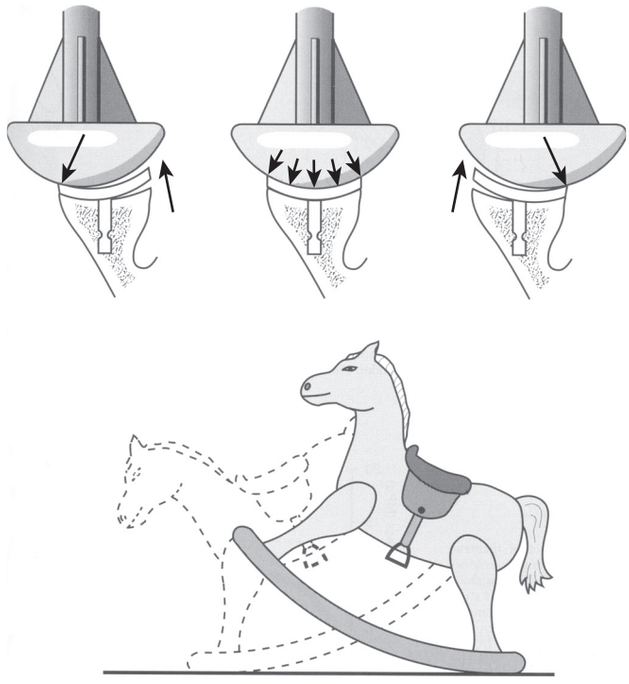

Figure 26-8. Rocking horse phenomenon. Loosening of the glenoid component results when translation of the head on the glenoid produces eccentric forces on the glenoid component. *(From Matsen FA III, Lippitt SB, Sidles JA, and Harryman DT II. Practical evaluation and management of the shoulder. Philadelphia, WB Saunders, 1994.)*

directions to elicit muscular activation in this functional position. As with all shoulder elevation exercises, great care is taken to avoid the presence of excessive scapular elevation, which results in the shoulder hiking during exercise.[37] This compensatory pattern leads to the development of inappropriate motor patterns and produces long-term scapular pathology with arm elevation. The exercises listed in this chapter minimize positions and movement patterns that increase glenohumeral contact forces and compressive loading.[38] The use of closed kinetic chain exercise in the

Figure 26-9. Closed-chain scapular plane exercise using exercise ball on the wall (exercise ball from Hygenic, Akron, Ohio.)

form of weightbearing is minimized in the initial postoperative rehabilitation exercise progression.[38,39]

OUTCOMES

Following arthroplasty, careful monitoring of the patient for ROM and muscular strength enables the progression of mobilization and stretching using objectively based guidelines to be monitored. We have determined ROM, strength, and functional rating scores 12 weeks following total arthroplasty (PROMOS stemmed implant, Promos Shoulder System, Smith-Nephew Orthopaedics, Memphis, TN) and hemiarthroplasty (Copeland shoulder, Biomet, Warsaw, Ind) when the patient is still typically under the care of a physical therapist in a supervised rehabilitation program.[38] Our results show average antigravity flexion and abduction ROM to be approximately 135 degrees, 70 degrees of external rotation with 90 degrees of abduction, and 35 degrees of internal rotation with 90 degrees of glenohumeral joint abduction. Muscular strength measured isometrically using a dynamometer revealed a 47% deficit in external rotation strength compared with the contralateral extremity and a 35% deficit in internal rotation strength. The self-report section of the Modified ASES rating scale produced values of 31 of 45 points in these patients following total and hemiarthroplasty, with comparable values of 38 of 45 points in patients following mini-open rotator cuff repair in the same 12-week postoperative time frame.

Longer term follow-up has been done following hemiarthroplasty and total shoulder arthroplasty, although limited data are available on younger, more athletic patient populations at present. Levy and Copeland[19] have reported on long-term results (more than 2 years; mean, 7.6 years) following Copeland cementless humeral resurfacing (Biomet, Warsaw, Ind) in 42 elderly patients. Constant scores improved from 20 points preoperatively to 61.9 points postoperatively at final follow-up. Of particular importance was the improvement of active elevation from a mean of only 59.9 degrees preoperatively to 128 degrees postoperatively for those undergoing total shoulder replacement and 124 degrees postoperatively for those undergoing hemiarthroplasty. Of these patients, 89.9% considered their shoulder much better or better following the procedure.

Matsoukis and colleagues[13] have evaluated 55 patients who had suffered a prior dislocation 45 months following shoulder arthroplasty. The mean delay between the instability event and arthroplasty was 24.2 years, with an average age of 55.9 years; 24 patients had undergone a prior stabilization procedure to address their instability, including coracoid transfers and Putti-Platt–type soft tissue transfer procedures. Constant scores improved from 30.8 preoperatively to a mean of 65.8 at follow-up. Active forward elevation improved from 82 degrees preoperatively to 138 degrees at final follow-up. Similar increases in active external rotation were reported, ranging from 4 to 38 degrees. Results were reported as good or excellent in 50 of 55 patients. Further research is clearly needed to establish the short- and long-term outcomes of patients following hemiarthroplasty and total shoulder arthroplasty, particularly in the younger, active athletic patient. The American Shoulder and Elbow Surgeons Society has recommended guidelines for return to sports activity following shoulder arthroplasty (Table 26-2).

Current research continues to identify osteoarthritic changes in the overhead athlete.[40,41] Maquirrain and associates[41] have reported a 33% incidence of osteoarthritic changes in older tennis players (mean age, 57.2 years). The incidence of glenohumeral arthritic changes was higher in this study than in age-matched sedentary control subjects. Additional research on specific populations of overhead athletes will likely identify early degenerative changes in the shoulder that may ultimately require shoulder arthroplasty.

SUMMARY

The combination of high-load activity and repetitive overuse can lead to osteoarthritic changes in the athletic shoulder. Early recognition and treatment of the arthritic shoulder in the athlete, coupled with advances in humeral and glenoid components, have allowed patients to return to higher levels of function following shoulder arthroplasty.

TABLE 26-2 Activity Recommendations After Total Shoulder Arthroplasty

Recommended	Allowed With Experience	Not Recommended
Bicycling	Golf	Football
Swimming	Ice skating	Hockey
Cross-country skiing	Shooting	Gymnastics
Speed walking	Downhill skiing	Rock climbing
Jogging		
Doubles tennis		
Low-impact aerobics		
Bowling		
Canoeing		
Croquet		
Shuffleboard		
Horseshoes		
Ballroom dancing		

*Based on 1999 American Shoulder and Elbow Surgeons Society recommendations.
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The rehabilitation guidelines discussed have included the protection of anterior structures during initial range-of-motion and progressive resistive exercises for the return of rotator cuff and scapular strength. These are keys for successful rehabilitation programs for these patients. Further advances in orthopedic technology and research, including biologic resurfacing[42] and microfracture, may lead to additional options for the younger active patient with glenohumeral arthritis. More basic science and patient outcomes research studies are needed to develop optimal patient management techniques for glenohumeral arthritis in the athletic shoulder.

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