ORIGINAL RESEARCH

DESCRIPTIVE REPORT OF SHOULDER RANGE OF MOTION AND ROTATIONAL STRENGTH SIX AND 12 WEEKS FOLLOWING ARTHROSCOPIC SUPERIOR LABRAL REPAIR

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ABSTRACT

Objectives. To measure short-term post surgery glenohumeral internal and external rotation strength, shoulder range of motion (ROM), and subjective self-report ratings following arthroscopic superior labral (SLAP) repair.

Background. Physical therapists provide rehabilitation for patients following arthroscopic repair of the superior labrum. Little research has been published regarding the short-term results of this procedure while the patient is typically under the direct care of the physical therapist.

Methods. Charts from 39 patients (7 females and 32 males) with a mean age of 43.4 $\pm$14.9 years following SLAP repair were reviewed. All patients underwent rehabilitation by the same therapist using a standardized protocol and were operated on and referred by the same orthopaedic surgeon. Retrospective chart review was performed to obtain descriptive profiles of shoulder ROM at 6 and 12 weeks post surgery and isokinetically documented internal and external rotation strength 12 weeks post surgery.

Results. At 12 weeks post-surgery, involved shoulder flexion, abduction, and external rotation active ROM values were 2-6 degrees greater than the contralateral, non-involved extremity. Isokinetic internal and external rotation strength deficits of 7-11% were found as compared to the uninjured extremity. Patients completed the self-report section of the Modified American Shoulder Elbow Surgeons Rating Scale and scored a mean of 37/45 points.

Conclusion. The results of this study provide objective data for both glenohumeral joint ROM and rotator cuff strength following superior labral repair at time points during which the patient is under the direct care of the physical therapist. These results show a nearly complete return of active ROM and muscular strength following repair of the superior labrum and post-operative physical therapy.

Key Words: glenohumeral joint, labrum, rehabilitation

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INTRODUCTION

The glenoid labrum serves several important functions including deepening the glenoid fossa to enhance the concavity and serving as the attachment for the glenohumeral capsular ligaments. Injury to the labrum can compromise the concavity compression phenomena by as much as 50%.[1] Individuals with increased capsular laxity and generalized joint hypermobility have increased humeral head translation which can subject the labrum to increased shear forces.[2] In the athlete performing overhead throwing, large anteriorly directed translational forces are present at levels up to 50% of body weight during arm acceleration of the throwing motion with the arm in 90 degrees of abduction and external rotation.[3] This repeated translation of the humeral head against and over the glenoid labrum can lead to labral injury. Labral injury can occur as either tearing or as actual detachment from the glenoid and can occur in virtually any location around the circumference of the glenoid fossa. Two of the most common areas for labral detachment encountered by physical therapists in orthopaedic and sports rehabilitation are the Bankart and SLAP lesion. In 1906, Perthes[4] was the first to describe the presence of a detachment of the anterior inferior labrum in patients with recurrent anterior instability. Bankart[5,6] initially described a method for surgically repairing this lesion that now bears his name.

In addition to labral detachment in the anterior inferior aspect of the glenohumeral joint, similar labral detachment can occur in the superior aspect of the labrum and have been defined as superior labrum anterior posterior, (SLAP) lesions. Snyder et al[7] classified superior labral injuries into four main types. Type I shows labral degenerative changes and fraying at the edges, but no distinct avulsion. Type II are the most commonly reported superior labral injuries[8] and have been described as complete labral detachment from anterosuperior to posterosuperior glenoid rim with instability of the biceps long head tendon noted. Morgan et al[8] have further sub-classified the type II superior labral lesion into type II anterior, type II posterior and type II anterior and posterior. Of significance is the increased (three times more) likelihood of type II posterior SLAP lesions in athletes that throw, as well as the finding of the Jobe subluxation relocation test as the most accurate and valuable test to identify the type II posterior lesion.[8] Type II anterior SLAP lesions are most commonly associated with trauma and are less likely to be found in athletes performing overhead activities. A type III labral injury involves the displacement of the free margin of the labrum into the joint in a bucket-handle type fashion with no instability of the biceps long head tendon noted. A type IV labral lesion is similar to a type III lesion with a bucket handle displacement of the glenoid labrum, however, a type IV lesion involves a partial rupture in the direction of its fibers of the the biceps long head tendon.[7]

Consequences of a superior labral injury include significant losses in the static stability of the human shoulder.[9] Cheng and Karzel[9] demonstrated the important role the superior labrum and biceps anchor play in glenohumeral joint stability by experimentally creating a SLAP lesion between the 10 and 2 o'clock positions in cadaveric shoulders. They found 11 to 19% decreases in the glenohumeral joints ability to withstand rotational force, as well as 100 to 120% increases in strain on the anterior band of the inferior glenohumeral ligament after a SLAP lesion. These changes demonstrate a significant increase in the load on the capsular ligaments in the presence of superior labral injury.

Arthroscopic surgical repair of the detached superior labral lesion has evolved from the use of bioabsorbable tacs[10] to the use of direct suture techniques using suture anchors.[11,12] Cadaveric research has shown that increases in glenohumeral translation created with experimentally induced labral detachment are only partially restored during repair of the human labrum.[13] Patients are referred to physical therapy following arthroscopic SLAP repair to restore both range of motion and important muscular strength to provide dynamic stabilization following the repair.

The purpose of this descriptive study was to objectively measure and report shoulder range of motion (ROM) and muscular strength following arthroscopic SLAP repair the results of the study will show the effectiveness of rehabilitation using a standardized rehabilitation protocol.

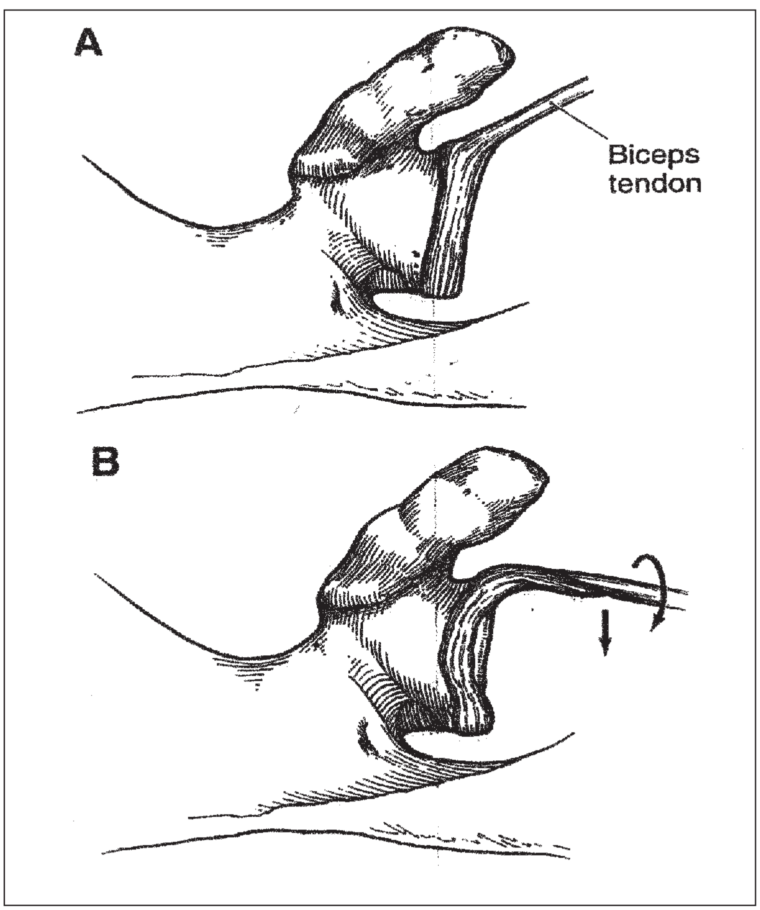
METHODS

Patients

A retrospective review was undertaken of patients who underwent arthroscopic SLAP repair and were referred to Physiotherapy Associates Scottsdale Sports Clinic over a three year period (2003-2006) for rehabilitation by the senior author (TE) using a standard rehabilitation protocol for rehabilitation following superior labral repair *(Appendix)*. Subjects were not included in the chart review if concomitant procedures were performed including rotator cuff repair, thermal capsulorraphy, or capsular plication. To be included in the study, subjects had to free from injury or surgery in the contralateral extremity as that extremity served as the baseline for bilateral testing in this investigation. To be included in this study, subjects had to have a type II labral tear which required arthroscopic surgical repair using direct suture technique and suture anchors. Patients with labral debridement were not included in this investigation. The research procedure was reviewed and approved by the Institutional Review Board of Physiotherapy Associates (Memphis, TN).

Rehabilitation Program

Additional information regarding the post-operative rehabilitation protocol is described to provide insight into the specific treatment each patient received following the arthroscopic SLAP repair. Sling use was directed by the physician with the recommendation for use in precarious situations (such as when outside the home or work environment) and to provide comfort. No specific objective criterion were used to monitor and direct sling use. Due to the possible attenuation of the superior labral repair during forceful muscular contraction of the biceps brachii, patients were instructed to avoid lifting objects and to wear the sling to prevent and minimize biceps muscle contraction in the immediate post-operative period. The time interval between surgery and the initial visit of physical therapy post surgery was 2.6 $\pm$ 1.93 weeks for the 39 patients in this study. Patients were given instructions for gentle active assistive ROM including Codman's pendulum exercises by the referring physician to perform until reporting for their initial post surgical rehabilitation visit.



Early passive, active assistive, and active ROM and glenohumeral joint mobilization was initiated in all planes of motion. Basic science research has provided guidance to the provision of early range of motion for patients following superior labral repair. Morgan and Burkhart[14] have identified the concept of the "peel back" mechanism. *(Figure 1)* The peel back mechanism occurs with the glenohumeral joint in 90 degrees of abduction and external rotation; in a position simulating the throwing motion. In this position, the biceps tendon force vector has been found to assume a more vertical and posterior direction creating the peel back of the superior labrum.

In the first 6 weeks following surgery, all patients were not placed in the abduction - external rotation position with any external load applied to minimize the effects of the peel back mechanism. Kuhn et al[15] tested cadaveric specimens in the abduction-external rotation "peel back position" as well as simulating the "follow-through phase" of the throwing motion (60 degrees abduction and 15 degrees horizontal adduction). They found significantly less load to failure of the biceps labral complex in the peelback position as compared to the follow-through position, thereby, supporting the vulnerability of the shoulder and, specifically, the biceps labral complex in the abducted externally rotated position. Glenohumeral external rotation range of motion and stretching was performed in 0-45 degrees of abduction during this time period. Terminal ranges of motion were targeted in all other planes of motion using primarily physiologic mobilization and end range stretching techniques. The use of accessory mobilization during this time period was limited to minimize glenoid shear over the repaired labral structure.

Patients also performed active assistive range of motion on a multiple daily basis (2-3 times a day) at home using an overhead pulley to address elevation range of motion in the scapular plane, In addition, a stick or cane was used in the supine position.

In the early post-surgical phase (weeks 1-3) submaximal resistive exercise was initiated for the rotator cuff. The primary movements initiated were internal and external rotation, and prone shoulder extension and horizontal abduction. These movements were targeted due to activation of the infraspinatus, teres minor, and subscapularis muscles and use of protective positions below 90 degrees of elevation, short lever arms, and positioning of the glenohumeral joint in or anterior to the scapular plane.[16,17,18,19] Use of tan level Thera-band tubing (Hygenic Corp, Akron, OH) and little or no added weight to the extremity was recommended initially to minimize substitution. Moncrief et al[20] have shown how the use of these resistive exercise patterns can lead to increases in rotator cuff strength using a low resistance high repetition format utilized in this study.

In the early post-operative rehabilitation phase, patients performed isolated manual resistance of the scapula in the motions of protraction and retraction. Exercises emphasizing scapular retraction and depression were given to recruit the serratus anterior and lower trapezius force couple without the use of rowing and other traditional scapular exercises that utilize substantial elbow flexion muscle activity. Use of early active shoulder flexion in the balance point position refers to the use of a supine patient position with the extremity in 90 degrees of flexion. In this position the patient is able to balance their extremity with minimal muscular activation and perform short active motions of flexion and extension and horizontal abduction/adduction with the therapist guiding the patient's ROM. At 6 weeks post surgery, progression of the balance point work to the integration of rhythmic stabilization to this balance point position is also followed using the command "hold, don't let me move you" while the patient holds the 90 degree flexed extremity stabilizing against external challenges in multiple directions of movement by the therapist.[21] A position of scapular protraction or "plus" position is employed with this exercise, as well, based on the concepts of Mosley et al[22] and Decker et al[23] to increase activation of the serratus anterior.

The use of shoulder flexion initially in an active assistive role and then active and eventually resisted role is warranted based on the work of Yamaguchi et al[24] and Levy et al.[25] These studies have shown minimal levels (1.7-3.6% of maximal voluntary contraction) of muscle activation of the biceps long head during multiple directions of shoulder movement such as scapular plane elevation and glenohumeral rotational movements. This basic science research helps to differentiate early exercise and active range of motion patterns for clinicians to utilize while protecting the repaired superior labrum and biceps long head anchor. Resistive exercise for the elbow flexors is delayed until between 6-8 weeks post-surgery and is applied in the form of rowing variations, upper body ergometry, and isolated elastic and isotonic resistance exercise.

At 10-12 weeks post-surgery, patients were introduced to the isokinetic dynamometer at submaximal intensities. The accommodative resistance, ability to exercise via a sequence of progressively increasing contractile velocities, and objective feedback all provide the rationale for inclusion of this type of resistive exercise.[26] Additionally, previous studies have reported significant increases in glenohumeral joint internal and external rotation following isokinetic training.[27,28] Upper extremity plyometrics were also introduced during this time interval to provide both concentric and eccentric muscle activation.

Outcome Measures

Variables included in the retrospective review were, subject age, dominant arm, estimated time from injury to surgery, time from surgery to initiation of physical therapy, as well as objective measures of ROM and strength. Range of motion was measured passively in the supine position at 6 weeks post-surgery for forward flexion and abduction with a universal goniometer and standardized measurement techniques.[29] Internal and external rotation was measured actively with 90 degrees of glenohumeral joint abduction and scapular stabilization.[30,31] At 12 weeks post-surgery, active ROM measurements were taken with the subject in a seated position such that antigravity forward elevation and abduction were measured, in addition to supine active internal and external rotation with 90 degrees of abduction with scapular stabilization.[30] The identical active ROM procedure was used to document the ROM of the uninjured extremity during the initial post-operative evaluation. Measurements were recorded to the nearest degree. All measures were taken by the senior author as part of the rehabilitation process with prior test-retest reliability of the glenohumeral joint rotational measures published previously.[30]

Isokinetic strength testing was performed on all 39 patients 12 weeks post-surgery using a Cybex 6000 Isokinetic dynamometer (Stoughton, MA). Testing was performed with the patient in a standing position with the dynamometer placed in 30 degrees of tilt from the horizontal base position and placed the patient's shoulder in 30 degrees of elevation in the scapular plane.[26] A ROM of 70 degrees of internal rotation and 30 degrees of external rotation was set using ROM stops. Four gradient (ie 50, 75, 90 and 100% of maximal effort) submaximal warm-up repetitions were used followed by five maximal effort repetitions for data collection at the testing speeds of 90, 210 and 300 degrees per second with 30 seconds rest between testing speeds followed. Testing was performed at three test speeds to provide information from the patient's ability to generate resistance at slow, intermediate, and a fast testing speed. Testing was performed on the uninjured extremity first without randomization of testing speed sequence to enhance reliability.[32]

Following testing on the uninjured extremity, identical set-up and testing procedures were used on the post-operative extremity. Isokinetic parameters chosen to represent muscular strength in this sample were the single repetition work value calculated by the Cybex 6000 software as the area under the torque curve versus joint angle curve for the best repetition of the five performed by the subject. Additionally, the external/internal rotation unilateral strength ratio was recorded as calculated by the Cybex 6000 software by dividing the external rotation work value obtained at each speed by the corresponding internal rotation value. The reliability of the Cybex 6000 concentric isokinetic dynamometer has been previously published,[33] as has the reliability specific to the application of isokinetic testing to the glenohumeral joint.[34]

The self report section of the modified American Shoulder Elbow Surgeons (ASES) rating scale was administered at 12 weeks post-surgery.[35,36] Patients answered the series of 15 questions following standardized instructions estimating their ability to perform the activities with their injured extremity at time the instrument was completed. Each patient's responses were tallied to form a composite score against 45 possible points. The modified ASES rating scale has been studied and found to have excellent test-retest reliability and responsiveness in patients with shoulder pain.[35,36] The modified ASES rating scale compared favorably to other shoulder rating scales and was found to be more sensitive to change than a generic questionnaire and was chosen for use in this investigation.[35]

RESULTS

The mean $\pm$ standard deviation (SD) age of the 39 patients (6 females and 41 males) studied was 43 $\pm$ 14.9 years. The mean time from initial injury to surgical repair of the superior labrum was 23 $\pm$ 26.83 weeks with a range of 4 weeks to 92 weeks. Patients were seen for their first visit of physical therapy and evaluated 2.6 $\pm$ 1.93 weeks post-surgery. Surgery was performed on the dominant arm in 27 of 39 cases.

Passive ROM measures for forward flexion and abduction taken in the supine position and active internal and external rotation measures also taken in the supine position 6 weeks following arthroscopic rotator cuff repair are presented in Table 1. In addition the active ROM values of the contralateral limb taken during the initial evaluation are listed for reference. Passive ROM values measured in the supine position at 6 weeks post surgery showed greater forward flexion than active anti-gravity measures from the uninjured extremity and less than 10 degree differences in movement for abduction and external rotation. The largest difference in ROM at 6 weeks post surgery was in the motion of internal rotation measured with 90 degrees of glenohumeral joint abduction.

Table 2 contains the active ROM measures taken at 12 weeks following superior labral repair as well as the number of degrees of difference relative to the uninjured extremity. Values obtained for forward flexion, abduction, and external rotation actually exceeded those measured on the uninjured extremity by 2-6 degrees at the 12 week post surgery. Mean deficits of 12 degrees in internal rotation were measured at 90 degrees abduction and compared to the uninjured extremity.

Table 3 contains the isokinetic single-repetition work values. In addition, Table 3 presents isokinetic bilateral strength comparisons, expressed as the percent deficit of the injured extremity relative to the uninjured extremity for shoulder internal and external rotation at the three testing speeds. Results show deficits of 7-11 % for external rotation compared to the uninvolved extremity. Internal rotation strength deficits of 8-9 % were measured at 90 and 210 degrees per second, with 4 % greater strength identified on the injured extremity at 300 degrees per second.

Table 1. Passive Range of Motion (PROM) of the Involved Extremity 6 Weeks following Arthroscopic Superior Labral Repair and Active Range of Motion (AROM) of the Uninvolved Extremity taken at Initial Examination (n = 39 patients).

	PROM Injured Extremity			AROM Uninjured Extremity		
Movement	Mean	SD	Range	Mean	SD	Range
Forward Flexion	164.54	7.9	(140-175)	157.81	9.2	(135-175)
Abduction	158.67	17.9	(115-180)	163.91	14.4	(110-180)
External Rotation @ 90 Abduction	84.83	16.4	(50-105)	92.83	11.0	(65-115)
Internal Rotation @ 90 Abduction	41.37	11.0	(10-62)	55.63	11.5	(30-70)

Note: All measures expressed in degrees

Table 2. Active Range of Motion of the Involved Extremity 12 Weeks following Arthroscopic Superior Labral Repair (n = 39 patients).

	Injured Extremity			Degrees Different from Uninjured Extremity	
Movement	Mean	SD	Range	Mean	SD
Forward Flexion	161.21	8.7	(130-175)	-3.40*	12.1
Abduction	169.62	9.7	(150-180)	-5.71*	15.4
External Rotation @ 90 Abduction	94.51	9.21	(75-115)	-1.68*	31.0
Internal Rotation @ 90 Abduction	45.41	9.43	(25-65)	10.22	23.6

Note: All measures in degrees.

(*) measures expressed as negative values indicate injured extremity exceeds value measured on uninjured extremity.

Table 4 contains the external/internal rotation work ratios for the injured and uninjured extremity. Mean external/internal rotation ratios ranged between 48 and 61% similar to that measured on the contralateral extremity. The self report section of the modified ASES rating scale administered 12 weeks post surgery produced mean values of 37 out of 45 possible points.

DISCUSSION

This study provides descriptive information on the short-term outcome following a common surgical procedure seen in orthopaedic and sports physical therapy clinics. The ROM findings reported in this patient series suggest the value of limited immobilization post-surgery and early physical therapy and ROM exercise. The use of this rehabilitation protocol produced ROM values in nearly all planes of motion within 5-10 degrees of the contralateral uninjured extremity as early as 6 weeks post-surgery. By 12 weeks post-surgery, the ROM values actually exceeded baseline contralateral ROM values in all planes except for internal rotation. One possible explanation for the decrease in internal rotation ROM measured at 90 degrees of glenohumeral joint abduction with scapular stabilization was the demographic that 19 of the 39 patients in this series were former or current competitive baseball, tennis, or softball players (athletes performing overhead activities). Since pre-operative measures were not performed on this series of patients, the assumtion for the purpose of this study was that subjects had bilaterally symmetric glenohumeral joint ROM values. However, research has consistently shown in athletes performing overhead activites, reductions in dominant arm internal rotation ROM from osseous adaptations such as humeral retroversion[37] and musculotendinous and capsular tightness[38,39,40] which may explain the larger internal rotation ROM mean difference in this series of patients following superior labral repair.

Comparison of this series to others with respect to specific objective measurement of glenohumeral joint ROM is limited. Most studies following arthroscopic superior labral repair use composite functional outcome ratings and return to specific activity statistics with limited objective data on range of motion or muscular strength.[10,11,12] Kim et al[12] evaluated 34 patients at a mean 33 months following superior labral repair using a UCLA rating score. Repair of the superior labrum resulted in satisfactory UCLA scores in 94% of the patients with 91% reporting a full return to pre-injury shoulder function. Despite the long-term follow-up, no objective data on ROM or strength was reported. Ide et al[11] reported on 40 patients 41 months following superior labral repair using suture anchors. A modified Rowe score was used showing improvement from 27.5/100 preoperatively to 92.1 points. Seventy five percent of the patients were rated as excellent on the modified Rowe score with 75% reporting a return to pre-injury level athletic activity. While long-term outcomes research such as these studies do provide valuable information that can be disseminated to patients regarding their overall recovery following surgery, little can be gained regarding the objective parameters directly affected during post-operative rehabilitation while the physical therapist has direct contact with the patient.

Table 3. Isokinetic Internal (IR) and External Rotation (ER) Strength Single Repetition Work Values and Injured/Uninjured Comparisons Measured at 12 Weeks Status Post Arthroscopic Superior Labral Repair (n = 39 subjects).

Motion / Speed	Injured		Uninjured		% Deficit *		
	Mean	SD	Mean	SD	Mean	SD	Range
ER 90°/s	23.44	8.6	26.47	8.7	11.18	15	(-36-40)
ER 210°/s	16.28	7.5	18.18	7.1	10.34	20	(-33-45)
ER 300°/s	11.60	6.6	12.60	6.3	7.71	29	(-55-67)
IR 90°/s	38.44	13.0	43.15	14.1	9.60	18	(-44-42)
IR 210°/s	29.68	12.0	32.94	12.4	8.50	23	(-82-40)
IR 300°/s	23.97	12.0	24.55	12.5	-4.15	48	(-237-48)

Note: All measures expressed in foot pounds (1 foot pound = 2.98 newton meters)
* negative value indicates involved extremity is stronger than uninvolved
°/s = degree per second

Table 4. External/Internal Rotation Ratios Measured at 12 Weeks following Arthroscopic Superior Labral Repair (n = 39 subjects)

Speed	Injured			Uninjured		
	Mean	SD	Range	Mean	SD	Range
90°/s	61.92%	15.3	(36-105)	62.28%	13.6	(42-100)
210°/s	55.63%	15.1	(31-100)	55.76%	13.2	(32-83)
300°/s	48.15%	15.9	(22-93)	54.36%	22.0	(21-125)

°/s- degree per second

Cadaveric research[13] has highlighted the importance of dynamic musculotendonous stabilization in the glenohumeral joint following simulated SLAP lesion and subsequent repair. A complete restoration of glenohumeral joint stability requires the addition of muscular stabilization, which is a key component of shoulder rehabilitation programs in physical therapy.[41,42,43,44] Long term outcome studies have shown a high rate of return to overhead sports[11,12] following SLAP repair which indirectly infer the return of dynamic stabilization to the shoulder. However, studies using objective documentation of muscular strength during long-term follow-up are lacking.

The present study shows a return of internal and external rotation strength documented isokinetically within 10% of the contralateral extremity during dynamic testing. External/internal rotation ratios which are used to quantify muscle balance between opposing muscle groups, were also calculated and measured in this study. Normal values for the external/internal rotation ratio in healthy uninjured shoulders have been reported to be 66% in descriptive studies.[26,45,46] Ratios measured in the patients 12 weeks following superior labral repair ranged between 48 to 61%, well below the normal range targeted in post-operative rehabilitation. Continued emphasis on posterior rotator cuff strengthening to improve external/internal rotation muscular balance is recommended for these patients both during continued rehabilitation and in home programming following discharge. Further research, including long term follow-up, with documentation of specific muscular strength relationships beyond the 12 week post-operative time interval is presently needed.

Another important component measured in this study was the patient's perception of their function captured using the modified ASES rating scale. The self-report section totaled 37/45 possible points 12 weeks following surgery. The compares closely to patients following mini-open rotator cuff repair 12 weeks post-surgery who measured 38.7/45 points.

A limitation of this study is that the study was performed retrospectively, and followed patients for a limited time interval post-operatively while they were undergoing outpatient physical therapy. An additional limitation is that the study design included only a single surgeon and physical therapist. Therefore, the ability to generalize this information beyond this surgical technique and rehabilitation protocol used in this study is cautioned. One strength of the use of a single physical therapist in this study was that this therapist performed all goniometric measures increasing reliability of recording over other studies using multiple examiners. An additional strength was the use of an objective reliable measurement instrument for internal and external rotation strength.

CONCLUSION

The data collected 12 weeks following superior labral repair show deficits of 10 degrees in internal rotation Active ROM and a full return of flexion, abduction, and external rotation relative to the contralateral extremity. Deficits in muscular strength of 7-11 % were found in the internal and external rotators 12 weeks following surgery. Self reported data from the modified ASES Rating Scale showed patients to score 37/45 points. These results show a nearly complete return on active ROM and strength following repair of the superior labrum and post-operative rehabilitation.

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Appendix

ARTHROSCOPIC SUPERIOR LABRAL (SLAP) REPAIR POST-OPERATIVE PROTOCOL

- Note: Specific alterations in post-operative protocol if SLAP repair is combined with thermal capsulorrhaphy, capsular plication, rotator interval closure or repair of full thickness rotator cuff repair.

- Sling use as needed for precarious activities and to minimize bicep muscle activation during initial post-operative phase. Duration and degree of sling use determined by physician at post-op recheck.

- Early use of stomach rubs, sawing, and wax-on/wax-off exercise to stimulate home based motion between therapy visits recommended.

PHASE I - EARLY MOTION (Weeks 1 - 3):

1. Passive range of motion of the glenohumeral joint in movements of flexion, scapular and coronal plane abduction, cross arm adduction, internal rotation in multiple positions of elevation. External rotation performed primarily in the lower ranges of abduction (<60 degrees) to decrease the stress on the repair from peel-back mechanism. Cautious use of glenohumeral joint accessory mobilization unless specific joint hypomobility identified on initial post-operative examination. Use of pulleys and supine active assistive elevation using a cane applied based on patient tolerance to initial passive range of motion post-op.

2. Patient to wear sling for comfort as needed.

3. Range of motion of elbow, forearm, and wrist.

4. Manual resistive exercise for scapular protraction and retraction minimizing stress to glenohumeral joint.

5. Initiation of submaximal internal and external rotation resistive exercise progressing from manual resistance to very light isotonic and elastic resistance based on patient tolerance using a position with 10-20 degrees of abduction in the scapular plane.

6. Manual resistance for elbow extension, forearm pronation/supination, and wrist flexion/extension as well as the use of theraputty or ball squeezes for grip strengthening. ** NOTE: No elbow flexion resistance or bicep activity for the first 6 weeks post-op to protect the superior labral repair.

7. Modalities to control pain in shoulder as indicated.

PHASE II – PROGRESSION OF STRENGTH AND ROM (Weeks 4-6):

1. Continue with previous exercise guidelines.

2. Begin to progress gentle passive range of motion of the glenohumeral joint with 90 degrees of abduction to terminal ranges with full external rotation with 90 degrees of abduction expected between 6 and 8 weeks post-op. All other motions continue from in Phase I, with continued use of both physiological and accessory mobilization as indicated by the patient's underlying mobility status.

3. Advance rotator cuff progression using movement patterns of sidelying external rotation, prone extension, prone horizontal abduction using a light weight or elastic resistance.

4. Initiate upper body ergometer for scapular and general upper body strengthening

5. Rhythmic stabilization performed in 90 degrees of shoulder elevation with limited flexion pressure application to protect SLAP repair.

PHASE III TOTAL ARM STRENGTH: (Weeks 6 - Week 10):

1. Initiation of elbow flexion (biceps) resistive exercise.

2. Initiate seated rowing variations for scapular strengthening.

3. Advance rotator cuff and scapular progressive resistive exercise using oscillation based exercise to increase local muscular endurance. Initiation of 90 degree abducted exercise in scapular plane for internal and external rotation if patient requires extensive overhead function at work or in sport.

4. Progression to closed chain exercises by week 8 including step-ups, quadruped rhythmic stabilization, and progressive weightbearing on unstable surface.
5.
6. Initiate upper extremity (two arms) plyometric program progressing from Swiss ball to weighted medicine balls as tolerated.

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PHASE IV: ADVANCED STRENGTHENING (Weeks 10 – 12/16):

1. Begin isokinetic exercise in the modified neutral position at intermediate and fast contractile velocities.

    Criterion for progression to isokinetics:

    a. completion of isotonic exercise with a minimum of a 3# weight or medium resistance with elastic tubing.

    b. pain-free range of motion in the isokinetic training movement pattern

2. Isokinetic test performed after 2-3 successful sessions of isokinetic exercise. Modified neutral test position.

3. Progression to 90 degree abducted isokinetic and functional plyometric strengthening exercises for the rotator cuff (shoulder internal and external rotation) based on patient tolerance.

4. Continue with scapular strengthening and range of motion exercises listed in earlier stages.

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PHASE V - RETURN TO FULL ACTIVITY:

1. Return to full activity is predicated on physician's evaluation, isokinetic strength parameters, functional range of motion, and tolerance to interval sport return programs.

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