Rotator Cuff Surgical Repair

Return to Sport Protocol

Phase I: (Post-Op weeks 1-6)

Goals:

1- Protect surgically repaired tissues
2- Minimize pain and inflammation
3- Begin Scapular stabilization- rows, light PNF patterns in side-lying
4- Prevent muscular inhibition
5- Educate/ re-educate patient on all post-op instructions on precautions and progression of activities/movements, and teach patient a home exercise program
6- Patient to be independent with ADL's and modifications while continuing to protect the integrity of the repair

Interventions to Avoid/ Precautions:

1- No AROM of the shoulder (No pushing, pulling, leaning on elbow or hand)
2- No lifting of objects with the shoulder that was repaired
3- No excessive stretching or sudden movements
4- No supporting of bodyweight by the hand of the repaired shoulder
5- Do not push PROM to aggressively to the point of eliciting patient guarding or passed PROM staged ROM's
6- Excessive adduction or internal rotation should be avoided as the can place excessive stress on the repair
7- Avoid sleeping on the affected side

Specific Interventions:

Immobilization: This will be determined by the MD depending on; the size of the tear, concomitant injuries/ repairs, co-morbidities, etc. Patient must remain in the sling as directed only removing for bathing or to perform exercises. Patient should be educated that these restrictions need to be adhered to for protection of the repair, even with of lack of pain/symptoms. Typically sling is worn approximate 4-6 weeks post-op.

Treatment: Treatments should focus on achieving appropriate PROM goals; minimizing inflammation; normalizing scapular position, mobility and stability; and improving/normalizing ROM of uninvolved surrounding joints of the upper extremity, cervical and thoracic spine, and rib cage.

Patient Education:

1- Explain the nature of the surgery
2- Discuss the precautions specific to the nature of the patient's surgical repair, such as trying to meet the set goals for PROM, and not gaining motion too fast
3- The importance of tissue healing
4- Proper wearing time and positioning of the sling
5- Limited use of upper extremity for ADL's only at no higher than waist level

Therapeutic Exercises: Post-Op Days: 1-10:

1- Administer the Western Ontario Rotator Cuff Index (WORC), Shoulder Pain and Disability Index (SPADI), or the American Shoulder and Elbow Surgeon (ASES) Form outcome form(s) for a base line self-reported outcomes measurement of the patient. These are best for the Rotator Cuff and assessing shoulder instability.
2- Patient Education for posture and proper positioning of the shoulder for joint protection and to perform daily hygiene activities
3- Pendulum hangs, with no active movements of the shoulder
4- Cryotherapy for pain and inflammation
5- AROM, with no weights, for elbow, wrist, and hand (grip)
   a. Only PROM for elbow if they also underwent a biceps tenodesis/tenotomy
6- Deltoid reflexive isometrics- not if biceps involved ***see suggested exercise sheet**
7- Cervical A + PROM exercises, & manual mobilizations and soft tissue work
8- Scapular elevations and retraction exercises- perform in and out of the sling
   a. Scapular muscle isometrics/sets

Post-Op Weeks 1-3:

1- Continue above exercises
2- Moist hot packs pre-treatment to ↑blood proliferation, and tissue extensibility
3- Passive Forward Elevation (PFE) in plane of the scapula to tolerance to **60°-90°**
4- Passive External Rotation (PER) (with elbow no greater than 0°-20° of abduction- close to the body) for a ROM of **0°- 15°**: This direction of PROM may be delayed for up to 6 weeks **(per MD**) if tenuous tissue quality, poor repair integrity, and/or large tear.
5- Early PROM should only include activities with low rotator cuff activation, (no pulleys, cane therapeutic exercises, or self PROM at this time)
6- Begin manual scapula stabilization exercises- PNF in S/L, rib & thoracic jt. Mobs
7- Begin LE stationary bike, with sling on, to try to maintain some endurance level

Post-Op Weeks 4-6:

1- Progress pendulum hangs to pendulum mobility
2- Progress scapula strengthening- rows, scapular depression, progress PNF
3- Progress PFE in plane of the scapula to **90°-120°**, and PER at 0°-20° of abduction to **20°-30°**, as patients tolerates, by week 6 patient can be progressed to **20°-45°** for ER in 20°of Abduction, as well as begin ER at 90° of abduction with ROM between **40°-60°**
4- Begin Passive ROM in other planes, -> AAROM (Pulleys, Cane, & UE Ranger)
   a. ER PROM can be advanced to 45°, 75°, and 90° of abduction as motion and patient's tolerance will allow
   b. Begin Horizontal Adduction
5- May begin grad I->II joint mobilizations for pain relief/ relaxation, for all joints of the shoulder (GH, SC, ST, AC)
6- If a pool/aqua therapy is available, patient may begin AAROM in the pool, no swimming strokes
7- Progress elbow, wrist and finger AROM to light strengthening (delayed to 6 weeks post-op for biceps tenodesis/ tenotomy)
8- Light scar mobilization as soon as the scar is fully healed, and modalities PRN

Staged ROM Goals:

Post-Op Week	Range Of Motion (ROM)
POW 1-3:	**PROM:** - PFE: (scapular plane): 60°- 90°, - PER: (@0°-20° Abd): 0°- 15°- may be delayed per MD, **AROM:** - Elbow, Wrist and Hand (grip): Only PROM for the elbow if the patent underwent a biceps tenotomy/ tenodesis ***No Horizontal Add or IR behind the back**
POW 4-6:	**PROM:** - PFE: (scapular plane): 90°- 125°, - PER (@0°-20° Abd): 20°- 45°, - PER (@45°, 75°, & 90° Abd): 40°- 60° - IR (scapular plane): slowly progress to 45°, - Abd: 45°- 100°: progress as tolerated, - May begin Horizontal Adduction to tolerance **AAROM:** - Begin in all planes, within staged ROM Goals **AROM:** - Continue to progress any ROM deficits in the elbow, wrist and hand- May be with biceps tenotomy/ tenodesis patients
POW 7-12:	**PROM:** - PFE: 135°- 155°, - PER: (@20°-30° Abd): 30°-60°, - PER (@90° Abd): 50°- 75°, - IR (scapular plane): 60°, - Abd: slowly progress as tolerated, **AROM: Progress AAROM to AROM** - AFE: 80° - 120°, - Abd: slowly progress as tolerated, - AIR + AER: slowly progress as tolerated
POW 13-18:	**ROM:** - PER +AER (@20°-30° Abd): 80°-90° (by week 18), - PER + AER (@90° Abd): 75°-90° (by week 18, 110°-115° if patient is a throwing athlete), - P + A IR (@90° Abd): 30°-65° (by week 18), - AFE: must be 180°/WNL (by week 18), - P + A Abd: must be 180°/WNL (by week 18)
Key:	POW = Post-Operative Week, PFE = Passive Forward Elevation, PER = Passive External Rotation, AFE = Active Forward Elevation, AIR+ AER = Active Internal and External Rotation

Phase II: Post-Op Weeks 7-12

Criteria for entering Phase II:

1- Appropriate healing of the surgical repair by adherence to the precautions and immobilization guidelines
2- Achievement of the PROM goals, as stated in the previous section: Passive Forward Elevation (in the plane of the scapula) of 90°-125°, Passive External Rotation (with 20°of abduction) of 20°-45°, Passive External Rotation (with 90° of Abduction in the plane of the scapula) to 40°-60°, Passive Internal Rotation $\geq$ 45°
3- Reduction in pain to 0-2/10 (on a VAS scale) with PROM
4- Minimal Detectable Change (MDC) on outcome form of 9.4 for ASES, between 8-13 for the SPADI, and 7.1 points for the WORC

Goals:

1- Continue to allow for soft tissue healing
2- Do not overstress healing tissue
3- Restore full PROM (by week 12)
4- Normalize AROM movements and ranges
5- Minimize pain and inflammation
6- Patient is independent with functional ADLs and light work activities (Week 12)
7- Begin to increase strength and endurance
8- To continually change the scores on the WORC, SPADI or the ASES outcomes forms with MDC

Interventions to avoid/ Precautions:

1- No lifting or activities that require ROM beyond what is stated for acceptable/desired ROM goals
2- No supporting the bodyweight by the surgically repaired hand and arm
3- No excessive behind the back motions
4- No sudden jerking motions
5- Do not perform ROM/ stretching beyond stated acceptable ROM goals
6- Do not perform long lever arm strengthening exercise for the rotator cuff that will place too much load on the repaired tissue
7- Do not perform scaption with internal rotation (empty can) at any stage of rehabilitation due to impingement and stress on the rotator cuff repair

Specific Interventions:

Patient Education:

1- Continue patient education for all areas of therapy and recovery
2- Typically the sling is discontinued by weeks 4-6 Post-Op, based on the demonstration and expression little to no pain and appropriate control of the upper extremity with waist level ADLs and is aware of the limitations allowed (no sudden reaching, lifting, etc.), however, consult with MD for D/C timeframe
3- Continue educating patient on using the upper extremity in a pain-free ROM for ADLS, beginning and waist level, then progressing to shoulder level activities, and finally overhead activities

Therapeutic Exercises: (See Suggested Exercise Sheet)

1- Continue previous phase I exercises/activities as needed
2- Progress PFE and PER ROM as needed to achieve goals
3- Progress PROM and begin Active Forward Elevation (AFE) in the scapular plane in week 9
   a. ROM limitations are: PRE: 130°-155°, PER (@ 20° Abduction): 30°-60°+, PER (@90° abduction): 50°-75°, and AFE: 80°-120°
4- Progress AAROM progressing to AROM, for Forward Elevation, Flexion Abduction in the scapular plane, External Rotation, as tolerated, with emphasis on proper shoulder mechanics
5- Progress Joint mobilizations to Grade III->IV to address capsular restrictions and regain full passive ROM, if indicated, for all shoulder joints (GH, SC, AC, ST)
6- Progressing to AROM, for Forward Elevation, Flexion Abduction (scapular plane), External Rotation, and functional Internal rotation with behind the back motions
7- Initiate posterior capsule stretching cross body adduction stretching as indicated
8- Establish basic rotator cuff and scapula neuromuscular control within allowed ROM
9- Introduce light waist level functional activities, then progress to light resistance exercises within allowable AROM without creating significant force on the shoulder girdle musculature
10- Sub-maximal isometric external and internal rotation exercises
11- Address all scapulothoracic and trunk mobility limitations, to facilitate normal movement of the shoulder. Focusing especially on thoracic extension and achieving normal cervical ROM
12- When pain-free AROM with good shoulder mechanics is demonstrated, begin a strengthening program for the Deltoid, non-repaired segments of the rotator cuff, and scapula musculature
13- Light resistance band strengthening is appropriate within the patients pain-free ROM
14- Begin low-level closed chain strengthening (quadruped, physioball, suspension training system (ex. TRX™ system)) and Stage I UE Plyometric Protocol, once scapular strength and stabilization is achieved **(*see attached protocol)**

*** Do not initiate a beginning strengthening program progression until patient's pain is at an appropriately low level and the chosen exercises do not increase symptoms**

Phase III: Post-Op 3-6 Months

Criteria for entering Phase III:

1- PROM and AROM of: >155° for PFE, >120° AFE, >60° PER @20°abduction, >75° PER @ 90° abduction, with 0-2/10 pain and no substitution patterns with the movements
2- Pain of <2/10 with all current strengthening exercises
3- Demonstrate appropriate position, statically and dynamically, of the scapula during ROM and exercise activities
4- Scores of >/= 70% on the WORC, </= 0-20 on the SPADI or </= 0-12 on the ASES outcome forms

Goals:

1- Achieve full P+AROM
2- Improve dynamic shoulder and scapular stability
3- Gradually fully restore shoulder strength to be able to progress power and endurance
4- Improve neuromuscular scapular, shoulder, and trunk control
5- Return to normal functional ADLs, full work, and modified recreational activities
6- Evaluate functional movements with the patient, as soon as AROM is achieved, with the Selective Functional Movement Assessment (SFMA), or total body movement screening, such as cervical mobility, forward and backward bending, total body rotation, single-leg stance, squat, etc. **Make sure you tease out if dysfunctions are caused by a mobility or a stability/motor control issue!**

Interventions to Avoid/ Precautions:

1- **No lifting objects heavier than 10 lbs**
2- **No sudden lifting or pushing activities**
3- **No sudden jerking motions**
4- **No uncontrolled movements**

Specific Interventions:

Patient Education:

a. Continue to express the importance of gradually increasing the stress to the shoulder while returning to normal ADLs, work and limited recreational activities

Therapeutic Exercises: (See Suggested Exercise Sheet)

1- Continue stretching and passive ROM as needed
2- Patient may still desire/need Moist hot pack prior to stretching and cryotherapy post treatment
3- Nearly full elevation in the scapular plane should be achieved before elevation in the other planes
4- All exercises/activities should be perform pain-free without and compensatory/substitution/ altered movement patterns
5- Exercises intensity should be with higher repetitions (30-50 repetitions) and lower resistance
6- Treat dysfunctions found through SFMA/Functional Movement testing
7- Progress Neuromuscular Re-education with dynamic stabilization exercises; light PNF training for the rotator cuff, deltoid and scapula; closed-chain activity progression
8- By the end of this Phase, evaluate patient with the Functional Movement Screen (FMS) & Y-Balance/ CKCUTEST Assessments at least one time for baseline scores
9- Strength exercises that target the surgically repaired rotator cuff can be initiated, with lightweight or bands in and pain-free, low stress range. Exercises should be progressed in terms of muscle demand and intensity to patient's tolerance. They should also be progressed in terms of shoulder elevation/level the exercises are performed (waist level -> shoulder height-> overhead activities)
   a. ER side-lying with a towel roll under the humerus
   b. Perform ER/IR exercises at various degrees of abduction
   c. Full can in the scapular plane (avoid empty can exercise at all time 2° to possible impingement)
   d. Prone scapular and rotator cuff exercises (rowing, extension, horizontal abduction, etc.)

Criteria for Progressing to Advanced Strengthening Program:

1- MMT of a grade of 4/5 or greater
2- Pain-free with all basic ADLs and previous strengthening exercises
3- Full AROM with Elevation
4- Patient has a desire to return to pre-injury level of sport/activity

Exercise Advancement: (See Suggested Exercise Sheet):

1- Integrate functional patterns that will be part of the activities/sport patient will be returning
2- Increase speed of movements
3- Decrease rest time between exercises to improve endurance
4- Begin LE plyometric and Phase II UE plyometric Protocols (**see attached sheets/protocol**)
5- PNF patterns with resistance bands in standing
6- Resistance band exercises @ 90°/90° for IR and ER with and without arm support
7- Simulated sport movements with resistance bands, such as; golf, batting, and tennis swings
8- Begin Throwers Ten Program (***see attached sheets**) -> Advanced Thrower's Ten Program (***also see attached sheets**)

Phase IV (Advanced Training Phase): To prepare for Return to Sport Phase. No set time frame as patients may progress to this stage at slightly different rates

Criteria for entering Phase IV:

1- Demonstrate adequate strength and dynamic stabilization for progression to higher demand sport specific activities
2- Appropriate scapular positioning/control statically and dynamically with ROM and all strengthening exercises
3- Score a 14 or > on the FMS, and minimal asymmetries on the Y-Balance/CKCUTEST Assessments
4- WORC, SPADI or ASES is replaced by DASH- Sport/performing Arts Module for a patient self-evaluation outcome measurement

Goals:

1- Maintain full and non-painful active ROM
2- Improve muscular strength, power, and endurance
3- Return to functional activities
4- >14 on the FMS, No statistical asymmetries with Y-Balance/ CKCUTEST assessments
5- Be able to begin the Return to Sport Specific Protocol after Phase IV completion

Interventions to Avoid

1- No heavy lifting greater the 15-20 lbs, no Sudden lifting or pushing activities
2- No sudden jerking motions or uncontrolled movements
3- No progression to activity specific exercises unless patient has full pain-free ROM & strength with the surgically repaired shoulder

Specific Interventions:

Therapeutic Exercises: (See Suggested Exercise Sheet):

1- Continue passive and active stretching of the shoulder and capsule to maintain ROM
2- Address any remaining strength/ motor control/ stability deficits for the rotator cuff, scapula, and trunk- with emphasis on engaging tonic stabilizing trunk and hip muscles while performing dynamic upper and lower extremity exercises
3- Advance proprioceptive and neuromuscular exercises/activities
4- Continue progression of strength with the Advanced Thrower's Ten Program (**see attached**)
5- Gradually progress return to weight-lifting program focusing on larger, primary upper extremity muscles- start with light weight and high repetitions (15-25 per set) and gradually decrease repetitions down to 8-10) as you increase to higher weights over the course or 6-8 weeks
6- Begin 8 week UE advanced plyometric protocol (**see attached protocol**)
7- Begin Interval Sport Program (Throwing, Tennis, Golf) (**see attached programs**)

Criteria for entering Return to Specific Sport Protocols:

1- Clearance from the surgeon to begin the Return to Sport Specific Protocol
2- No signs of any lingering shoulder instability with activities
3- Restoration or all ROM needed to participate in desired sport
4- Adequate strength and muscle endurance of the shoulder, rotator cuff, trunk, hip, and scapular musculature needed to perform sport specific drills/ activities with minimal to no pain or difficulty

5- Patient scores an appropriate score on the DASH-Sports/Performing Arts Module Self-assessment outcome form: ("no" – "mild" difficulty on all questions) and the Kerlan-Jobe Orthopaedic Clinic Shoulder & Elbow Score (KJOC Score): (≥ 80)
6- >16 on FMS and score on the Y-Balance of equal to peers for sport and age through the Y-Balance data base, or CKCUTEST equal to normative
7- No pain with any of the previous exercises/ activities performed
8- Completing the Throwers Ten Program (if an overhead athlete) and the upper extremity plyometrics protocols
9- Passing of the functional tests listed below: Test can be over multiple sessions
   a. Trunk Testing: **(See attached sheets)**
      i. Deep Neck Flexor Test
      ii. Segmental Multifidus Test
      iii. Trunk Curl-up Test
      iv. Double-Leg Lowering Test
      v. Prone Bridge Test
      vi. Endurance of Lateral Flexors (Side Bridge)
      vii. Extensor Dynamic Endurance Test
   b. Upper Extremity Testing: **(See attached sheets)**
      i. Alternative Pull-up Test
      ii. Push-up Test
      iii. Backward Overhead Medicine Ball Throw Test
      iv. Sidearm Medicine Ball Throw Test
      v. Seated Shot-Put Throw Test
      vi. *<u>If patient is a baseball or soft-ball pitcher/player</u>
         1. Functional Throwing Performance Index (FTPI) Test- best assessed with video analysis
         2. **Baseball pitchers only**- PT/ATC fills out Upper Extremity Throwing Analysis Form- to determine areas of the throwing motion that need to be addressed in the sport specific/return to baseball pitching protocol

*See Return to Specific Sport Protocol

References

Aleen, A, & Brophy, R. Outcomes of Rotator Cuff Surgery: What Does it Tell Us?. The Journal of Clinical Sports Medicine 2012; 31: 665-674

Brumitt, J. Scapular Stabilization Exercises: Early-Intervention Prescription. Athletic Therapy Today. September 2006; 11(5): 15-18

Carter et al. Effects of High volume Upper Extremity Plyometric Training on Throwing Velocity and functional Strength Ratios of the Shoulder Rotators in Collegiate Baseball Players. The Journal of Strength and Conditioning Research. 2007 21(1): 208-215

Chorba et al. Use of a Functional Movement Screening Tool to Determine Injury Risk in Female Collegiate Athletes. North American Journal of Sports Physical Therapy. 2010; 5(2): 47-54

Cook, Gray. Movement: Functional Movement Systems: Screening, Assessment, and Corrective strategies. Aptos, CA: On Target Publications, 2010

Cools et al. Rehabilitation of Scapular Muscle Balance: Which Exercises to Prescribe?. The American Journal of Sport Medicine. 2007; 35(10): 1774-1751

Coughlan et al. A Comparison Between Performance on Selected Directions of the Star Excursion Balance Test and the Y Balance Test. The Journal of Athletic Training. 2012; 47(4): 366-371

Davies, GJ, Ellenbecker, TS, Bridell, D. Powering up: Plyometrics Redefine Rehab for Overhead Athletes. BioMechanics. September 2002

Decker et al. Serratus Anterior Muscle Activity During Selected Rehabilitation Exercises. The American Journal of Sports Medicine 1999; 27(6): 784-791

De Mey et al. Trapezius Muscle Timing During Selected Shoulder Rehabilitation Exercises. Journal of Orthopaedic & Sports Physical Therapy. 2009; 39(10): 743-752

Economopoulos, K, Brockmeier, S. Rotator Cuff Tears in Overhead Athletes. The Journal of Clinical Sports Medicine. 2012; 675-692

Ekstrom et al. Surface Electromyographic Analysis of Exercises for the Trapezius and Serratus Anterior Muscles. Journal of Orthopaedic & Sports Physical Therapy. 2003; 33(5): 247-258

Eisner et al. Partial Rotator Cuff Tears in Adolescents: Factors Affecting Outcomes. The Journal of Pediatric Orthopaedics. 2013; 33(1): 2-7

Ekeberg et al. Agreement, Reliability and Validity in 3 Shoulder Questionnaires in Patients with Rotator Cuff Disease. BMC Musculoskeletal Disorders. 2008; 9(68)

Ellenbecker et al. Glenohumeral Joint Total Rotation Range of Motion in Elite Tennis Players and Baseball Pitchers. Medicine & Science in Sports & Exercise. 2002: 2052-2056

Filipa et al. Neuromuscular Training Improves Performance on the Star Excursion Balance Test in Young Female Athletes. Journal of Orthopaedic & Sports Physical Therapy. 2010; 40(9): 551-558

Fortun, CM, Davies, GJ, Kernozek, TW. The Effects of Plyometric Training on the Shoulder Internal Rotators. Physical Therapy Journal. 1998; 78(51): 63-75

Gelen, E et al. Acute Effects of Static Stretching, Dynamic Exercises, and High Volume Upper Extremity Plyometric Activity on Tennis Serve Performance. Journal of Sports Science & Medicine. 2012; 11: 600-605

Gorman et al. Upper Quarter Y Balance Test: Reliability and Performance Comparison Between Genders in Active Adults. The Journal of Strength and Conditioning Research. 2012: 26(11): 3043-3048

Jung et al. Effects of Scapular Stabilizing Exercises in Patients with Partial-Thickness Rotator Cuff Tear. Journal of Physical Therapy Science. 2012; 24: 1173-1175

Liebler et al. The effect of Thoracic Spine Mobilization on Lower Trapezius Strength Testing. The Journal of Manual & Manipulative Therapy. 2001; 9(4): 207-212

Maenhout et al. Quantifying Acromiohumeral Distance in Overhead Athletes with Glenohumeral Internal Rotation Loss and the Influence of a Stretching Program. The American Journal of Sports Medicine. 2012; 40(9): 2105-2112

Michener et al. American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, Patient Self-Report Section: Reliability, Validity, and Responsiveness. Journal of Shoulder and Elbow Surgery. Nov/Dec. 2002; 587-594.

McCarron et al. Failure with Continuity in Rotator Cuff Repair ”Healing”. The American Journal of Sports Medicine. 2013; 41(1): 134-141

McClure et al. A Randomized Controlled Comparison of Stretching Procedures for Posterior Shoulder Tightness. Journal of Orthopaedic & Sports Physical Therapy. 2007; 37(3): 108-114

Minick et al. Interrater Reliability of the Functional Movement Screen. The Journal of Strength and Conditioning Research. 2010; 24(2): 479-486

Moore, L et al. Kinematic Analysis of Four Plyometric Push-up Variations. International Journal of Exercise Science. 2012; 5(4): 334-343

Moore et al. The Immediate Effects of Muscle Energy Technique on Posterior Shoulder Tightness: A Randomized Controlled Trial. Journal of Orthopaedic & Sports Physical Therapy. 2011; 41(6): 400-407

Myers, J, Lephart, S. The role of the Sensorimotor System in the Athletic Shoulder. The Journal of Athletic Training. 2000; 35(3): 351-363

Negrete et al, Can Upper Extremity Functional Tests Predict the Softball Throw for Distance: A predictive Validity Investigation. The International Journal of Sports Physical Therapy. 2011; 6(2): 104-111

Onate et al. real-Time Intersession and Interrater Reliability of the Functional Movement Screen. The Journal of Strength and Conditioning Research. 2012; 26(2): 408-415

Plisky et al. The Reliability of an Instrumented Device for measuring Components of the Star Excursion Balance Test. North American Journal of Sports Physical Therapy. 2009; 4(2): 92-99

Pretz, R. Plyometric Exercises for the Overhead- Throwing Athletes. The Strength and Conditioning Journal. 2006; 28(1): 36-42

Reiman, M, & Manske, R. Functional Testing in Human Performance. Campaign, IL: Human Kinetics, 2009

Reinhold et al. Current Concepts in the Evaluation and Treatment of the shoulder in Overhead Throwing Athletes, Part 2: Injury Prevention and Treatment. Sports Health. 2010; 2(2): 101-115

Reinhold et al. Electromyographic Analysis of the Rotator Cuff and Deltoid Musculature During Common Shoulder External Rotation Exercises. The Journal of Orthopaedic & Sports Physical Therapy. 2004; 34(7): 385-394

Schneiders et al. Functional Movement Screen Normative Values in a Young Active Population. The International Journal of Sports Physical Therapy. 2011; 6(2): 75-82

Shah, S. Plyometric Exercises. International Journal of Health Sciences and Research. 2012; 2(1): 115-126

Strunce et al. The immediate Effects of Thoracic Spine and Rib Manipulation on Subjects with Primary Complaints of Shoulder Pain. The Journal of Manual & Manipulative Therapy. 2009; 17(4): 230-236

Swanik et al. The Effects of Shoulder Plyometric Training on Proprioception and Selected Muscle Performance Characteristics. Journal of Shoulder and Elbow Surgery. 2002; 11(6): 579-586

Tashjian, R. Epidemiology, Natural History, and Indications for Treatment of Rotator Cuff Tears. The Journal of Clinical Sports Medicine. 2012; 589-604

Teyhen et at. The Functional Movement Screen: A Reliability Study. Journal of Orthopaedic & Sports Physical Therapy. 2012; 42(6): 530-540

Vo et al. Physical Therapy and Rehabilitation after Rotator Cuff Repair: A Review of Current Concepts. International Journal of Physical Medicine & Rehabilitation. 2013; 1(5): 1-11

Wessel et al. Validation of the Western Ontario Rotator Cuff Index in Patients with Arthroscopic Rotator Cuff Repair: A Study Protocol. BMC Musculoskeletal Disorders. 2011; 12(64)

Westrick et al. Exploration of the Y-Balance Test for Assessment of the Upper Quarter Closed Kinetic Chain Performance. The International Journal of Sports Physical Therapy. 2012; 7(2): 139-147

Wilcox et al. Rehabilitation of the Athlete's Shoulder following Arthroscopic Rotator Cuff Repair (APTA Sports Physical Therapy Section: home study course; chapter 5), 2013.

Wilk et al. Rehabilitation Following Thermal-Assisted Capsular Shrinkage of the Glenohumeral Joint: Current Concepts. Journal of Orthopaedic & Sports Physical Therapy. 2002; 32(6): 268-292

Wilk et al. Shoulder Injuries in the Overhead Athlete. Journal of Orthopaedic & Sport Physical Therapy. 2009; 39(2): 38-54

Wilk, K, Arrigos, C. Current Concepts in the Rehabilitation of the Athletic Shoulder. Journal of Orthopaedic & Sports Physical Therapy. 1993; 18(1): 365-378

Wilk, K, Hooks, T, Macrina, L. The Modified Sleeper Stretch and Modified Cross-body Stretch to Increase Shoulder Internal Rotation Range of Motion in the Overhead Throwing Athlete. Journal of Orthopaedic & Sports Physical Therapy. 2013; 43 (12): 891-894

Wilk, KE, Meister, K, Andrews, JR. Current Concepts in the Rehabilitation of the Overhead Throwing Athlete. The American Journal of Sports Medicine. 2002; 30(1): 136-151

Wilk, KE, Meister, K, Andrews, JR. Current Concepts in the Rehabilitation of the Overhead Throwing Athlete. The American Journal of Sports Medicine. 2002; 30(1): 136-151

Vo et al. Physical Therapy and Rehabilitation after Rotator Cuff Repair: A review of Current Concepts. International Journal of Physical Medicine & Rehabilitation. 201; 1(5): 1-11