Non-Operative Management of the Athletic Shoulder and Overhead Athlete Injuries

Rehabilitation Protocol *See more detailed descriptions on next pages

Evaluation:

- **Subjective History:**

- **Observation of Movement and Posture:**
  - Posture, shoulder, spinal, & scapular position assessments
  - **Scapular tests:**
    - Scapular Assistance Test (SAT)
    - Scapular Retraction Test (SRT)
      - Alternate test: Scapular Reposition Test
    - Flip Sign

  - **Glenohumeral ROM: AROM and PROM**
    - IR and ER at 30° and 90° of abduction (in side-lying)
    - Forward flexion, Scapular Plane Elevation, Abduction, Adduction across the body
    - Functional ROM: Apley Scratch Test (IR + Ext, Abd + ER)
    - Consideration of ROM differences with overhead athletes
    - Glenohumeral Internal Rotation Deficit (GIRD)

  - **Manual Muscle Testing (MMT):**
    - Forearm MMT and Grip Strength measurements
    - Supraspinatus: **Full Can Test, & Diagonal Horizontal Adduction Test**
    - Infraspinatus: Standard MMT testing
    - Teres Minor: **Patte Test**
    - Subscapularis: **Lift-off Test**
    - Serratus Anterior: **Modified Wall Push-up Test**
    - Rhomboids MMT: Standard MMT testing
    - Upper Trapezius: **Shoulder Shrug**
    - Middle Trapezius MMT: Standard MMT testing
    - Lower Trapezius MMT: Standard MMT testing
    - Pectoralis Major MMT: Standard MMT testing
    - Latissimus Dorsi MMT: Standard MMT testing
    - Deltoid (Anterior, Middle, & Posterior) MMT:
    -

- **Shoulder Special Test:**
  - Impingement Tests:
    - Neer Impingement Test: (passive)
    - Hawkins-Kennedy Impingement Sign: (passive)
    - Yocum Impingement Test: (active)
    - Coracoid Impingement Syndrome Tests:
      - Coracoid Impingement Test
      - Cross-Arm Adduction Impingement Test

- **Bony Instability Tests:**
  - Bony Apprehension Test
  - Inferior/Multidirectional Instability (MDI) Sulcus Test
  - Anterior and Posterior Translation (Drawer) Tests

- **Tendinopathy Tests:**
  - External Rotation Lag Sign
  - Belly-off Sign
  - Belly-Press Modified Test
  - Lateral Jobe Test
  - Bear Hug Test (Subscapularis)

- **Labral Tear Tests:**
  - Modified Dynamic Labral Shear Test

- **Superior Labrum Anterior Posterior (SLAP) Tests:**
  - Passive Compression Test
  - Passive Distraction Test
  - Jobe Relocation Test
  - Active Compression Test
  - The Dynamic Speed's Test
  - The Pronated Load Test
  - Resisted Supination External Rotation Test
- Long Head of the Biceps Tests:
  - Yergason's Test

- **Other Tests:**
  - Olecranon-Manubrium Percussion Test
  - Shrug Sign
  - Beighton Hypermobility Index: **(See Chart)**

- **Functional Movement Tests:**
  - Seated Rotational Test
  - Rolling Assessment: (4 directions- supine<->prone UE or LE only)
  - Selective Functional Movement Assessment (SFMA)
  - Functional Movement Screen (FMS)
  - Y-Balance Assessment

Rehabilitation:

- **Phase 1:** Acute Phase:
  - **Goals:**
    - 1- Decrease/eliminate pain and inflammation
    - 2- Improve flexibility/mobility throughout the shoulder, scapula, and spine (cervical, thoracic, and lumbar)
    - 3- Improve/Retrain strength of dynamic stabilizers (muscle balance)
    - 4- Control functional stressors, compensatory patterns, and poor posture

  - **Treatment:**
    - Followed expected passive ROM for individual athletes (compared to total arc of motion), and expected alterations in shoulder ROMs, by the sport the athlete plays. These should be restored prior to strengthening.
    - Abstain from sporting activities that could compensate recovery
    - Modalities, if warranted, including taping techniques
    - ROM:
      - Improve IR ROM at 90° of abduction to normal measurements, Sleeper stretch, cross-body stretch
      - Gradually improve horizontal adduction and ER (do not force in to painful ER), improve flexion
      - Elbow, wrist and forearm ROM
    - Strengthening:
      - Scapular Serratus Anterior and Lower Trapezius retraining/stabilization exercises
        - Rhythmic Stabilization, Isometrics, PNF, specific exercises
        - Side-lying, Quadruped, Prone, Standing
      - Rotator Cuff Strengthening (especially ER):
        - No weight/bands-> light weight/ bands-> moderate weight/bands
        - In prone, side-lying, quadruped, or standing
      - Elbow, wrist and forearm strengthening exercises
      - Maintain/retrain core and lower body exercises

- **Criteria for Progression to Phase 2:**
  - Minimal to no pain or inflammation
  - Normal ROM for IR and Horizontal Adduction
  - No visible signs of significant weakness, scapular winging, fatigue with minimal repetitions

- **Phase 2:** Intermediate Phase
  - **Goals:**
    - To continue to progress strengthening exercises
    - Restore muscular balance/symmetries: left-right, agonist/antagonist
    - Improve proximal and dynamic stability
    - Maintain/improve overall flexibility/mobility
    - Continue improving core and lower body strengthening and conditioning

- **Treatment:**
  - Pain at rest should be eliminated before beginning strengthening (hypertrophy) or plyometric exercises
  - ROM:
    - Continue to stretch and improve flexibility for shoulder and spine limitations, gradually restore full shoulder ER ROM
  - Strengthening:
    - Continue to progress scapular, rotator cuff and dynamic stabilizing muscles (can be at end range)
    - May begin wall stabilization and push-up exercises, and UE plyometric Phase 1 Protocol **(See Sheet)**

- **Criteria to Progress to Phase 3:**
  - Full, pain-free ROM
  - Full strength with no sign of extreme fatigue with strength evaluation tests or current exercises

- **Phase 3:** Advanced Strengthening Phase:
  - **Goals:**
    - Begin a more aggressive strengthening program
    - Progress neuromuscular and proprioceptive control
    - Begin exercises centered more around strength, power, endurance, agility

  - **Treatment:**
    - ROM:
      - Continue to maintain normal ROM/Mobility
      - Teach patient routine for active warm-up stretches pre-work/competition, and static cool-down/ post-workout stretches
    - Strengthening: Be sure to patient goes through stretching routine before beginning strengthening exercises
      - Continue any previous strengthening exercises that are appropriate
      - Thrower's Ten Program-> progressed to Advanced Thrower's Ten Program: (**see attached sheets**)
      - Begin Phase II->III of UE Plyometric Protocol (**See attached sheets**)
      - Patient may begin Phase I of interval sports programs (Throwing and Tennis)
    - Assess/Reassess Functional Mobility:
      - Functional Movement Screen (FMS)
      - Y- Balance UE and LE assessment
      - 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 O.H. Medicine Ball Throw Test
   iv. Sidearm Medicine Ball Throw Test
   v. Seated Shot-Put Throw Test

- **Criteria to Progress to Return to Specific Sport Protocols:**
  - Expected active ROM, with normal movement patterns, should be restored before beginning hypertrophy strengthening or plyometric exercises
  - Patient should be able to demonstrate pain-free normal movement patterns through multi-planar movements, with 45-60 repetitions (good endurance), before progression to eccentric, plyometric, and/or high load exercises
  - Patient must complete plyometric program (UE & LE if appropriate), Score ≥ 16 on the FMS™ (with no asymmetries, Y-Balance™ score should be equal to peers of the same age and sport along with no asymmetries, score ____ on the DASH/PSS (or low/no disability on chosen self evaluation assessment)
  - **Passing of the functional tests listed above: Test can be over multiple sessions**

- **See Sport Specific Protocols**

Clinical Evaluation: (More Descriptive Version)

- **Subjective History:**
  - General Information:
    - Age,
    - Gender,
    - Dominant-handedness,
    - Sport played & position,
    - Number of years playing,
    - Level of competition.
  - Injury Information:
    - Onset of symptoms & were they gradual or sudden in their onset,
    - History of previous shoulder injury,
    - Location of symptoms,
    - Description, severity, and duration of symptoms,
    - Activities that alleviate or worsen symptoms,
    - Phases of throw or swing that produce the symptoms,
    - Number of innings pitched/number of games played per season/year,
    - Changes in control/location of swings/throws.

- **Observation of Movement and Posture**
  - Postural assessment
    - Shoulder height bilateral comparison- (typically the dominate shoulder is lower than the non-dominate shoulder, at rest, particularly with unilaterally dominate athletes like baseball pitchers and tennis players)
    - Scapular position (rotation, position against the thoracic wall/ tilting, and movement: (scapulothoracic, and scapulohumeral)) right to left comparison
      - Kibler describes 3 primary types of scapular dysfunctions and tested in resting stance, hands on their hips, and during bilateral active movements in the sagittal, scapular and frontal planes (Below)
      - The use of an external load, such as holding a free weight may be necessary to elicit the scapular dysfunction in athletes where the scapular dysfunction/pathology may be subtle
      - * Scapular dissociation away from the ribs is typically seen with slow eccentric lowering of the extremities, so the clinician should carefully observe all directions of movement carefully.
      - Scapular Position Considerations for the Overhead Athlete: The Throwing side may have ↑'d protraction and anterior tilting, especially with fatigue.

	Characteristics at Rest	Characteristics with Movement	Axis of Motion
Name/Dysfunction			
Inferior Angle (Type I)	Inferior medial border of the scapular is prominent when viewed posteriorly	Inferior medial border of the scapula moves dorsally, superior anterior tilts and the acromion tilts downward and moves ventrally over the thorax	Sagittal plane
Medial Border (Type II)	The entire medial border of the scapula is prominent when viewed posteriorly	Entire medial border moves dorsally away from the thorax	Transverse plane
Superior Border (Type III)	Superior border of the scapula is prominent and often elevated compared to the contralateral side	A shrugging or superior motion is used to initiate movement of the shoulder along with prominence of the scapula compared to the contralateral side	Sagittal plane

*** The scapular dysfunction does not always present as clearly as listed above, and in many cases, because of the complexity of movement of the scapulothoracic joint, the patient can demonstrate more than one classification at a time***

- (In Standing) Observe shoulder and scapular muscles- particularly focusing on muscle development and areas of atrophy. Patient should be observed with hands comfortable by their side, as well as, with hands on their hips (places shoulders in 45°-50° of abduction and slight internal rotation. This allows the Patient to let arms relax and will show more apparent pockets of atrophy along the scapular border.
    - Visible atrophy in the Infraspinatus fossa could be a signs of Rotator Cuff Dysfunction or with severe atrophy there could be suprascapular nerve involvement- further diagnostic testing would be warranted.

- **Scapular Tests**:
  - Scapular Assistance Test (SAT): The clinician places one hand on the inferior medial aspect of the scapula and the other on the superior base of the scapula to provide an upward rotation (and posterior tilt), while the patient elevated their arm either in the scapular or sagittal plane. The test is positive if there is a greater ROM or decreased pain (elimination of the impingement type symptoms), with the clinician's assist with scapular movement.
  - Scapular Retraction Test (SRT): The clinician manually positions the scapula in retraction, (to improve supraspinatus strength, optimizing a weakened cuff and giving a truer idea of supraspinatus power), and has the patient perform an upper extremity movement that would typically elicit their symptoms.
    - The Scapular Reposition test: (alternative test): tested well in a study with 142 college overhead athletes. This test is performed with the patient in sitting or standing. The clinician grasps the scapula with the fingers contacting the acromioclavicular joint anteriorly and the palm of the hand and thenar eminence contacting the spine of the scapula posteriorly, with the forearm obliquely angled toward the inferior angle of the scapula for additional support on the medial border. The patient was then asked to repeat a movement/test position that previous reproduced their pain. A reduction of pain of >1 on a VAS pain scale, may be a way to identify suitable interventions for addressing the scapula, such as taping, strengthening specific muscles, or bracing.
  - Flip Sign: The clinician resists External rotation at the patient's elbow, while carefully monitoring for a positive test when the scapula for any signs of winging (scapula "flips" away from the ribs and becomes more prominent). A positive test indicates a loss of scapular stability, and should suggest further evaluation of the scapula muscles and nerve innervations and exercise integration should focus on serratus anterior and the trapezius initiation/strengthening. This test was originally described in testing for spinal accessory nerve lesions.

- **Glenohumeral ROM**:
  - Goniometric measurements are best with scapular stabilization using a "C" shape type grasp with four fingers on the scapula posteriorly and the thumb on the coracoid process anteriorly.
  - Measurements should be taken of AROM and PROM of IR and ER at 90° of abduction with the patient in side-lying [better inter and intrarater reliability]: (ER norm: 90°, IR norm: 30°-45°); *see OH Athlete Considerations below), scapular plane elevation: (norm: 160°-180°), forward flexion (norm: 160°-180°), abduction: (norm: 160°-180°) *document if patient exhibits a painful arc, adduction across the body: (norm: 90°), and Extension: (norm: 40°-60°).
    - Reliability of ROM measurements for Internal Rotation was found to be higher when taken with the patient in the side lying position. The patient is lying on their side, in a position in which the acromion processes were aligned perpendicular to the plinth. The

shoulder should be in 90° of flexion with 0° of rotation and the elbow is flexed to 90°. The olecranon process should be positioned off the edge of the table. The clinician passively rotates the humerus into internal rotation, while maintaining the shoulder and elbow flexion at 90°. Comparison of both sides was made.

- You should also check functional movement patterns of IR and extension (T7 for women, T9 for Men), and Abduction and ER (spine of contralateral scapula), like in the Apley Scratch Test, SFMA, or simultaneous movement in the FMS.
- Other motions that are recommended for athletes are Horizontal (cross-arm) Adduction- This can be done in different positions, however, the optimal position is patient supine with scapular stabilization provided by the clinician at the lateral border of the scapula to keep it in retraction, while the patient's arm is guided into horizontal adduction without overpressure.
- *** The use of a digital inclinometer has been shown to have high reliability.**

- Considerations of ROM measurements with overhead athletes:
  - It has been shown that in baseball players that they typically exhibit increased ER and decreased IR on the dominant arm shoulder when compared to the non-dominant side. ***However, the total arc of rotational motion should equal on both arms. (No greater than +/- 5°)**
    - Ex. If a patient is measured at 120° of ER and 30° of IR on their dominant shoulder and 90° of ER and 60° IR on their non-dominant arm, the total arc of motion both shoulders equals 150° and is considered normal for baseball pitchers.
  - With regards to tennis players, Ellenbecker et al. found they had significantly less internal rotation on their dominant arm, as well as significantly less total arc of rotational motion compared to their non-dominant arm in uninjured athletes.
    - They found approximately 10° less with IR ROM and of the total arc of rotational motion in the dominant arm of non-injured athletes compared to their non-dominant shoulder.
- Glenohumeral Internal Rotation Deficit (GIRD):
  - This condition has several definitions including, greater than 20°-25° loss in internal rotation on the dominant side when compared to the non-dominant side; or a loss of 10% or more of the total rotation ROM on the dominant side compared to the non-dominant side, which is more widely used.
    - So, if still using the numbers from the last example a loss of 15° or more on the dominant side would constitute a conclusion of GIRD.
    - Wilk et al. reported that a loss of total arc of motion of >5° was found to place athletes at a high risk of shoulder injury.
    - Wilk et al. Also expressed that there is an increased risk of shoulder injury when the total arc of motion was greater on the throwing/ dominant side in the overhead athlete.
    - The therapist should assess the dynamic stability of the glenohumeral joint in thee athletes and develop a program accordingly.
  - *** A caution with GIRD is that the mobility restriction may actually be a result of thoracic spine and/or ribs hypomobility/dysfunction, which could present as a false positive for GIRD/Posterior capsule tightness. The dysfunction should be treated out and motion reassessed. What appears to be posterior capsule tightness of the shoulder often resolves with mobilization of the rib cage to promote thoracic rotation to the opposite side. (See the mobilization section in Suggested Specific Exercises). If the IR ROM limitation is still present, than joint mobilization and posterior capsular stretching, and appropriate strengthening exercises should be initiated.**
- **Manual Muscle Testing (MMT)**:

- Forearm Strength Tests: Grip Strength and MMT
- Supraspinatus: The optimal testing position, found by Kelly et al., is seated with elevation of the arm to 90° in the scapular plane (45° horizontal adduction from the coronal plane) with ER of the humerus so their thumb is pointed toward the ceiling. This is also called the Full Can Testing Position. The clinician resists an upward motion exerted by the patient.
    - The Empty Can Position Test has also been frequently used, which is the same starting patient position with the exception of the humerus being in IR with the thumb pointing down to the floor. *These tests report great predictability with testing weakness (which is the capacity being used here), versus pain. Both tests are considered to have equivalent diagnostic accuracy, however considering the pain provocation is typically higher with the Empty Can Test, and this is test is being used to test weakness the Full Can position is preferred.
    - The Diagonal Horizontal Adduction Tests: Patient is seated with the elbow extended and their arm fully externally rotated, at 35° of shoulder flexion, and then adducted across the pectoral area of the body. The patient is then asked to lift their arm up (into horizontal abduction) and the clinician performs an isometric resistance. The patient is asked to maintain the contraction for approximately 5 seconds, to feel for any weakness. This test should be used in conjunction with the Full-Can Test to assess suprspinatus weakness
- Infraspinatus: The optimal test position, according to Kelly et al., is with the patient seated with 0° of Glenohumeral Joint elevation and in 45° of IR from neutral. Then the patient pushes into ER and the clinician resist the motion while monitoring the elbow. Test for weakness and compensation.
    - There is an alternative test position that was described by Jenp et al., in which the patient's arm is in 90° of elevation in the sagittal plane, with the elbow bent and positioned in the halfway point to maximal ER ROM. This was not tested with EMG like Kelly et al., however may be useful with some overhead athletes for a further evaluation of infraspinatus strength.
- Teres Minor: (Patte Test): the patent's shoulder is positioned in 90° of abduction in the scapular plane and 90° of ER. The patient pushes into ER while the clinician supports the elbow and resists the movement. The clinician should be monitoring for weakness as well as compensatory motions.
- Subscapularis: Kelly et al., found the optimal test is the Lift-off Test in which a patient is standing with the arm IR, extended behind the back, so the dorsum or their hand is resting in the middle of their low back. The clinician then lifts the dorsum of their hand away from their back and the patient is asked to maintain this position. The clinician can also add resistance, if the patient is able to initially able to hold the lift off position.
    - An alternative position, described by Stefko et al., is with the dorsum of the patient's hand placed up near the inferior border of the ipsilateral scapula, where they found the highest muscular activity.
- Serratus Anterior: Patient performs a modified push up against the wall. The clinician should be note if patient exhibits any scapular winging.
- Rhomboids: Patient is prone with arm extended and slightly adducted contracting the rhomboids. The patient resists/holds this position as you try to move the scapula from the

medial border laterally. Weakness is if patient is unable or has difficulty holding the scapula in that position with or without the resistance.

- Trapezius:
  - Upper Trapezius: Patient seated and performs a shoulder shrug. The clinician resists the motion and notes weakness or inability to even achieve shrug position.
  - Middle Trapezius: patient is prone with elbow extended and abducted to 90° in external rotation, so thumb is up towards the ceiling. Patient is asked to hold the position against resistance. Weakness is if patient is unable to achieve or hold position with or without resistance.
  - Lower Trapezius: Patient is prone with elbow extended and shoulder abducted to 120° in external rotation so the thumb is toward the ceiling. The patient is asked to hold the position against resistance. Weakness is if the patient is unable to achieve or maintain the position with or without resistance.
- Pectoralis Major: Patient is in supine or standing position. The patient adducts the arm in about 20° of flexion with the elbow slightly bent and resists the clinician's force pushing laterally. Weakness is when he patient cannot maintain position with resistance.
- Latissimus Dorsi: Patient is in prone with arm of the side being tested off the edge of the table. The patient is then asked to internally rotate, adduct slightly, and extend the shoulder the clinician then applies resistance. Weakness is if the patient cannot achieve of hold the position with or without resistance.
- Deltoid: Weakness is if patient cannot achieve or maintain the position.
  - Anterior Deltoid: The clinician resists patient in forward flexion of their shoulder.
  - Middle Deltoid: The clinician resists patient in abduction with their elbow flexed to 90°.
  - Posterior Deltoid: The clinician resists patient in shoulder extension with the elbow flexed at 90°.
- * These tests can also be performed in a more objective measurement using a hand held dynamometer (HHD). These have been shown to be reliable strength measurements and have high inter- and intra-rater reliability. They also give more objective numbers to the strength measurements. Statistical relationships have been shown between ER and supraspinatus strength measurements with a HHD, and shoulder injury. There was also a significant relationship between IR/ER muscular strength ratios and injury risk. See Separate sheet for HHD Instructions.
- Isokinetic Muscle Testing: This can be used to get objective measurements of dynamic muscular strength. Ellenbecker et al., compared isokinetic testing and MMT. They assessed 54 subjects to exhibit 5/5 strength using MMT, while isokinetic tests found 13%-15% bilateral difference in ER and 28% bilateral difference in IR, despite symmetrical MMT strength assessment.

- **Shoulder Special Tests:** (Rotator Cuff Impingement, AKA: RTC Tendinosis / Tendinopathy tests, Subacromial Impingement tests, Coracoid Impingement tests, AC Joint Impingement tests, Labral Tear tests, SLAP Lesions tests, Bony Instability tests):
  - Impingement Tests: (Passive): The primary goals is to attempt to re-create the subacromial compression and symptoms
    - **Neer Impingement Test:** The clinician monitors the humeral head stabilizes the scapula and prevents scapular rotation with one hand, as they passively move the patient's arm

into maximal forward flexion/elevation with the other hand, which causes the greater tuberosity to impinge against the acromion. Positive test is reproduction of the pain.
    - **Hawkins-Kennedy Impingement Sign:** The clinician monitors the humerus and brings the patient's shoulder into elevated in the scapular plane to 90°, with the elbow flexed, and then forcefully internally rotates the patient's arm rotating the shoulder, down, in the sagittal plane. The test is positive if the patient's pain is reproduced.
    - **Evidence shows that the Neer and Hawkins-Kennedy both have high sensitivity but low specificity, so they are suitable for screening but not for making a specific diagnosis. However they can be used in a cluster type diagnosis of multiple positive tests increase the likelihood of the diagnosis.**
  - **Coracoid Impingement Syndrome:** Patient presents with anterior shoulder pain, with increased pain with forward elevation, internal rotation, adduction, and positive findings with the next two tests. **(See Attached Algorithm)**
    - **Coracoid Impingement Test:** Patients shoulder is passively brought into forward elevation, adduction and internal rotation. A positive test is pain, directly over the coracoid process, and clicking with the movement.
    - **Cross-arm Adduction Impingement:** Patient's arm is brought passively into 90° of flexion and then forcefully brought into horizontal adduction across their chest, performed either by the patient or the clinician. Pain and location is documented. This test can show possible coracoid impingement or AC joint pathology.
  - Impingement Test (Active):
    - **Yocum Impingement Test:** The patient begins with the palm of the hand of the arm being tested resting on the top of the opposite shoulder. The patient then moves into elevation with IR, bringing their elbow up toward their face. This test is looking for provocation of symptoms, as well as, assesses the patient's ability to control the superior humeral head translation during active arm elevation, while in a position of impingement.

- **Bony Instability tests:**
  - Bony Apprehension test: Patient is either positioned in sitting or standing with the elbow flexed to 90°. The clinician stands behind the patient holding their lateral forearm with one hand and placing the other hand on the posterior aspect of the humeral head. The clinician brings the patient's arm into 45° of abduction and 45° of external rotation. A positive test is when the patient demonstrates apprehension with or without pain.
    - Test Rationale: The author chose the positioning of the glenohumeral joint to provoke instability from a bony Bankart lesion and/or a Hill-Sachs bony lesion. This test may be used for both ruling in or out a diagnosis of bony instability.
  - Inferior/ Multidirectional Instability (MDI) Sulcus test: Patient is seated with arms in neutral adduction/abduction with their hands resting on their lap. The clinician grasps the distal aspect of the humerus using a firm but not painful grip with one hand, while the other hand monitors the AC Joint. The clinician then performs several brief and rapid downward pulls on the humerus in an inferior direction. The clinician is watching for a visible sulcus sign, or tethering of the skin between the acromion and the head of the humerus, widening the subacromial space. A >2cm sulcus is considered a positive test and may be indicative of MDI.

        - Test Rationale: This test, when performed in neutral, assesses the integrity of the superior Glenohumeral ligament and the coracohumeral ligament, which are the primary stabilizing ligaments against inferior humeral head translation. It I also believed that excessive translation in the inferior direction is an indication that there may be a pattern of forthcoming increases in translation in the anterior and posterior positions, hence the term Multidirectional Instability.
    - Anterior and Posterior Translation (Drawer) tests: Patient is the supine position, because of greater inherent relaxation of the patient.
        - The test position for Anterior Translation is performed between 0° and 30° of abduction, in 30°-60° of abduction, and at 90° of abduction to test the integrity of the superior, middle, and inferior glenohumeral ligaments, respectively. The translation is performed with a downward pressure on the head of the humerus along the plane of the joint line (approximately 30° in a medial to lateral direction).
        - The test position for the Posterior Translation is at 90° of abduction, because there is no distinct thickening of the capsule, except with the posterior band of the inferior Glenohumeral ligament. The clinician directed force is anteriorly along the plane of the joint (approximately 30° in a lateral to medial direction).
        - Positive tests are if unilateral increases in translation are present in one or more directions, in the presence of shoulder pain. Increased translation without shoulder pain merely suggests laxity.

- **Tendinopathy tests:**
    - External Rotation Lag Sign: (supraspinatus and infraspinatus muscles): The patient is sitting or standing with their elbow flexed to 90° and shoulder abducted 20° with the forearm supinated so the palm is up. The clinician supports and monitors the elbow as they passively rotates the patient's arm into full external rotation. A positive test is when the patient is unable to maintain position of full external rotation of the affected shoulder.
        - Test Rationale: Sensitivity= 45%-70%, Specificity= 91%-100%
    - Belly off sign: The patient is in either sitting or standing, with the clinician standing in front of the patient, while passively moving the affected arm in flexion, supporting the elbow in 90° flexion, while the other hand brings the patient's arm into maximal internal rotation, so their palm is on there belly. The patient is then asked to keep their wrist straight and actively maintain this position of internal rotation as the clinician releases the wrist (maintaining the elbow support). A positive test occurs when the patient is unable to maintain the position, the wrist flexes or lag occurs and the hand is lifted off the abdomen.
        - Test Rationale: The subscapularis muscle is the primary internal rotator and this test evaluates the integrity of the musculotendinous unit.
    - Belly Press test Modified: The patient is positioned in sitting or standing with the hand on the affected side flat on their abdomen and the elbow close to the body. The clinician stands on the affected side of the patient and instructs the patient to bring the elbow forward straightening the wrist. The clinician measures the final angle of the wrist and compares it to the non-affected side. A positive test is a greater than a 10° difference between sides.
        - Test Rationale: Same as the non-modified version, with the modified version giving an objective number of dysfunction.

- Lateral Jobe Test: The patient is positioned in sitting or standing, and the clinician instructs the patient to abduct their shoulder to 90° in the coronal plane with the elbow flexed to 90° and the shoulder internally rotated so that the fingers point toward the floor and the thumb is medial. The clinician then applies an inferior force to the distal arm. A positive test finding is pain or weakness or inability to perform the test.
    - Test Rationale: Sensitivity= 81%, Specificity = 89%
    - **The evidence suggests that for the last three tests (Belly press, Belly press modified, and Lateral Jobe) can all be used for both ruling in and out subscapularis and rotator cuff tendinopathy, respectively.**
- The Bear-Hug test: (subscapularis tear): The patient is in standing with the palm of the involved side placed on the opposite shoulder with fingers extended (so the patient does not resist by grabbing their shoulder), with their elbow in front of the body. The clinician asks the patient to hold the position as they try to bring the forearm into external rotation (resisted internal rotation), with a perpendicular force to the forearm. The test is considered positive if the patient is unable to maintain the hand against the shoulder or f they show weakness of greater than 20% when compared to the unaffected side. If the patient experienced pain without weakness it should be noted, because their was some correlation with pain and small upper subscapularis tears, although it can't be quantified, the surgeon may want to be notified of the finding.
    - Test Rationale: The subscapularis superolateral corner and the sling of the biceps share the same general insertion point, so that if the sling is disrupted, the biceps may sublux medially causing tearing of the upper subscapularis. Activation of the subluxated biceps during the bear-hug test may cause excessive shear stresses on an already-damaged upper subscapularis, explaining the pain and weakness observed in a positive test.
    - **This test has a specificity of 92% and sensitivity of 60%, showing this test is good for ruling a subscapularis tear in, and had been shown to detect tear sizes as low as 30%. Most sensitive test for subscapularis pathology.**

- **Labral Tear Tests:**
    - Modified Dynamic Labral Shear Test: Patient is standing with elbow flexed 90°, abducted in the scapular plane >120° and externally rotated to tightness. The clinician stands behind the patient, guiding the involved upper extremity into maximal horizontal abduction and provide a shear load to the joint by maintaining external rotation and horizontal abduction as the arm is lowered from 120°-60° of abduction. A positive test is reproduction or pain and/or painful click or catch in the posterior joint line between 120° and 90°.
        - Test Rationale: The arm position and load application for this test was to try to mimic the peel-back phenomenon and the biceps movement that create the shearing mechanism of posterior cuff on the posterosuperior labrum.
- **Superior Labrum Anterior Posterior lesion (SLAP) tests:**
    - Diagnosing a SLAP lesion:
        - When taking the subjective history patient may report a history of trauma such as a fall onto an outstretched arm, direct blow to the shoulder, falling onto the point of the shoulder, or a forceful traction on the arm. In these cases there would be a sudden onset of symptoms. However, patients, especially overhead athletes, may report a more gradual onset of symptoms, such as popping, clicking, or catching, along with pain during

throwing (usually late cocking phase), and a decrease in power and accuracy with there throws

- SLAP Classifications: (basic 4, however, recently additional classifications have been added):
  - Type I: Isolated Fraying of the superior labrum, with a firm attachment of the labrum to the glenoid (typically degenerative in nature)
  - Type II: A detachment of the superior labrum and the origin of the long head of the biceps brachii tendon from the glenoid creating instability of the biceps-labral anchor
  - Type III: A bucket-handle tear of the labrum with an intact biceps insertion
  - Type IV: A bucket-handle tear of the labrum that extends into the biceps tendon. This type will also have instability at the bicep-labrum anchor
  - Type V: SLAP lesions with the presence of a Bankart lesion of the anterior capsule extending into the anterior superior labrum
  - Type VI: A disruption of the biceps anchor with an anterior posterior superior labral flap tear
  - Type VII: Lesions that extended anteriorly to involve the area inferior to the middle glenoid ligament
  - Type VIII: A type II SLAP tear with a posterior labral extension to the 6 o'clock position.
  - Type IX: Is a circumferential lesion involving the full 360° of labral attachment to the glenoid rim
  - Type X: In involves a superior labral tear combined with a posteroinferior labral tear (a reverse Bankart lesion)
  - * It is common to have concomitant injuries with SLAP lesions, so these classifications can be beneficial for creating the mot appropriate treatment plan*

- Special Tests:
  - Passive Compression test: Patient is in side lying with the affected side up. The clinician is standing behind the patient, stabilizing the shoulder by holding the AC joint with one hand and the patient's elbow with the other. The clinician externally rotates the shoulder in 30° of abduction and then pushes the arm proximally while extending the shoulder. A positive test occurs when there is pain or a painful click in the glenohumeral joint.
    - Test Rationale: When the glenohumeral joint is externally rotated and extended (late cocking phase), the long head of the biceps tendon is placed under tensile forces while wrapping around the lesser tuberosity and ultimately shifting the superior labrum from the superior glenoid rim. Proximal migration of the humerus aggravates he displacement of the unstable labrum and passively displaces the superior labrum. **Evidence shows this test can be used for ruling a SLAP lesion in.**
  - Passive Distraction test: Patient is supine, with the clinician standing on the affected side of the patient. The patient's arm is positioned off the edge of table into 150° abduction in the coronal plane, with the elbow extended, the forearm supinated, and the upper arm stabilized to prevent proximal humerus rotation. The clinician then pronates the forearm, while maintaining the head of the humerus position. A positive finding is when the patient reports pain deep in the glenohueral joint either anteriorly or posteriorly.
    - Test Rationale: Mimics the peel-back phenomenon of the superior labrum. **Evidence shows that this test can be used for both ruling a SLAP lesion in or out.**
  - Jobe Relocation test: The patient is positioned supine, with their elbow flexed to 90° and shoulder abducted to 90°. The clinician applies an external rotation force, and any apprehension is noted. The clinician then applies a posteriorly directed force to the shoulder. If the patient's

pain or apprehension is reduced in this position than, the test is considered positive. * It is important that the patient releases the relocation force before bringing the patient back to neutral positioning, to decrease risk of dislocation.

- Test Rationale: This test was found to have a higher sensitivity (85%) for posterior lesions than for anterior lesions. Throwers have been found to have a 3 times greater likelihood for developing Type II posterior lesions. Morgan et al.

- Active Compression test: The patient is in sitting or standing, with their shoulder placed in 90° or flexion and 10°-20° of horizontal adduction. The patient then completely internally rotates their shoulder and pronates their forearm. The clinician then applies a stabilizing force distally on the extremity, as the patient is instructed to perform an upward force into the clinician's pressure. The procedure is then repeated with the shoulder and forearm in neutral position. A positive test occurs with pain reproduction or clicking in the shoulder with the first position and reduction/absence in the second position. This test is also negative when a report of pain is located over the AC joint or the posterior shoulder, as it is not specific enough to suggest a labral (SLAP) lesion.
  - Test Rationale: This test has been reported as having a higher sensitivity (88%) for anterior lesions. The trauma patients have been found to be 3X more likely to present with anterior lesions. Morgan et al.
- Pain Provocation Test: The patient is supine with their shoulder abducted to 90°-100°. Their shoulder is then passively externally rotated with the forearm fully pronated and then repeated with the forearm fully supinated. This test is considered positive if the symptoms were present or more severe in the externally rotated pronated position versus the supinated position, secondary to the additional stress placed on the biceps tendon with the shoulder externally rotated and forearm pronated.
  - Test Rationale: This test has demonstrated a sensitivity of 100%, and a Specificity of 90% for diagnosis a SLAP lesion.
- The Biceps Load II Test: The patient is in supine with their shoulder placed in 120° of abduction and maximally externally rotated. When the shoulder is in maximal external rotation the patient is asked to perform a resisted isometric biceps contraction. Deep shoulder pain is indicative of a SLAP lesion.
  - Test Rationale: This test has a sensitivity of 90%, specificity of 97%, Positive Predictive Value of 92%, and Negative Predictive Value of 96%. This test was found to have a higher sensitivity than the Biceps I Test, which is performed in 90° of shoulder abduction.
- The Resisted Supination External Rotation Test: The patient is in supine with their shoulder abducted to 90°, elbow flexed to 65°-70°, and forearm in neutral rotation. The patient is asked to try to forcefully supinate their forearm while the clinician resists and passively rotates their shoulder into external rotation. The patient is then asked to describe their symptoms at end range external rotation. A positive test I if the patient describes anterior or deep shoulder pain, clicking or catching in the shoulder, or a reproduction of the symptoms they experience during throwing. It is a negative test if the patient describes posterior pain, apprehension, or if no pain was elicited with the maneuver
  - Test Rationale: It is believed that this test simulates the peel-back mechanism of a SLAP lesion. This test has been reported to have 82.8% sensitivity, 81.8% specificity, 92.3% positive predictive value, and 64.3% negative predictive value, with a diagnostic value of 82.5% when compared to other Provocative tests for SLAP lesions.

- The Pronated Load Test: The patient is in supine with their shoulder abducted to 90°- 110° and passively externally rotated, with the patient's forearm fully pronated to increase tension on the biceps and labral attachment. Once the arm is at maximal passive external rotation, the patient is asked to perform a resisted isometric biceps contraction, in an attempt to create the peel-back mechanism.
    - Test Rationale: This test is a combination of the active bicipital contraction of the biceps load test and the passive external rotation in the pronated position of the pain provocation test. A positive test is a description of pain/discomfort within the shoulder.

- **Other Tests:**
  - Olecranon-Manubrium Percussion test: The patient is positioned in sitting or standing with the elbows flexed to 90°. The clinician places the stethoscope over the manubrium and percusses each olecranon process. The clinician is listening for a decrease in pitch or intensity on the affected side, which would indicate a positive test.
    - Test Rationale: If there are any bony abnormalities, the affected side should have a duller sound than the normal side.
    - **This test may be used to rule in or out bony abnormalities.**
  - Shrug Sign: Patient is in standing and the clinician instructs the patient to abduct both their arms in the coronal plane, with elbows flexed to 90°. A positive test is when the patient elevates the scapula or shoulder girdle in order to achieve 90° of abduction. The clinician should measure with a goniometer, the angle between the arm and the horizontal point at which the shrug moment began (or from 90° of abduction to the angle of the humerus when the shrug began).
    - Test Rationale: The shrug sign can detect shoulder abnormalities, especially those associated with loss of range of motion or weakness on manual muscle testing.
    - **This test may be used to rule out stiffness-related disorders as well as rotator cuff tendinopathy.**

  - Beighton Hypermobility Index: **(See Chart)**: A simple score to quantify joint laxity and hypermobility. It is a 9 point system, with the higher the score the higher the laxity. Cameron et al. found that a total Beighton Scale score of 2 or greater were nearly 2 1/2 times more likely to have reported a history of glenohumeral joint instability.

- Functional Mobility Tests:
  - Seated Rotational Test: (To Identify thoracolumbar rotational mobility/dysfunctional movement). Patient is seated with knees and feet together, supported on the floor, with their body erect, arms crossed across their chest, and looking straight ahead. The patient is asked to rotate the trunk to the right and then to the left, as far as possible. The clinician should evaluate the ease and fluidity of the movement, as well as, measure the amount of movement with a goniometer. The clinician is looking for symmetry/asymmetry comparing right to left rotation. Normal seated thoracolumbar rotation is 30° bilaterally.
  - Rolling Assessment: These movements are evaluated for controlled mobility, core stability, and properly sequenced loading of the segments of the body required to perform the rolling exercise correctly.
    - Rolling occurs around diagonal axes- the axis for each rolling exercises does not involve the extremity that initiates the movement, (ex. Right axis- Left UE or LE is initiating the movement).

1- Supine to Prone leading with the Upper Body: This movement isolates shoulder flexion/horizontal adduction, which leads to trunk flexion/rotation, finally to pelvic rotation/hip flexion to be able to sementally and sequential complete the roll. Patient is lying supine with legs extended and slightly abducted and arms flexed overhead and slightly abducted. The patient starts to roll by lifting their head into flexion and reaching their right arm across the body, with face going toward their axilla. The lower body should remain quiet and not contribute to the roll. Watch the legs for assistance. The therapist should be monitoring the segmental quality of the movement, ability to complete the movement, substitution of from other areas of the body, and respiration (or lack of). Have the patient repeat to the opposite side. It may also show joint mobility issues (shoulder, thoracic, cervical, lumbar, hip) that need to be addressed before continuing.
    a. Some verbal cues are: "Look with your eyes and head", "Reach your arm across your body and turn your head into your shoulder", "Reach through your non-moving arm and leg to elongate the axis".
2- Prone to Supine leading with the Upper Body: This movement begins with isolated shoulder flexion, initiating trunk extension/rotation, ending with pelvic rotation posteriorly to be able to complete the roll correctly. Patient is lying prone with both arms and legs straight and slightly abducted and head is in neutral position. Ask the patient to roll over onto their back using the right arm only, by extending their arm back and across into adduction with the head following. The lower body should not contribute to the roll. The therapist should be monitoring the segmental quality of the movement, ability to complete the movement, substitution of from other areas of the body, and respiration (or lack of). Have the patient repeat to the opposite side. It may also show joint mobility issues (shoulder, thoracic, cervical, lumbar, hip) that need to be addressed before continuing.
    a. Verbal cues: "Lift your arm and look up and over your opposite shoulder", "Reach through your non-moving arm and leg to elongate the axis"
3- Supine to Prone leading with Lower Body: This movement begins with isolated hip flexion, then pelvic rotation/lumbar flexion, and finally with trunk flexion/ rotation to correctly complete the roll. Patient is lying supine with arms separated overhead and legs apart. Ask the patient to roll to the prone position starting with their right leg only. The patient should lead with the right hip flexion followed by adduction of the extended leg. The upper body should not contribute. The therapist should be monitoring the segmental quality of the movement, ability to complete the movement, substitution of from other areas of the body, and respiration (or lack of). Repeat to the opposite side. Work within the dysfunction patterns to improve movement. It may also show joint mobility issues (shoulder, thoracic, cervical, lumbar, hip) that need to be addressed before continuing.
    a. Verbal cues: to reach long through the axis with the non-moving arm and leg."
4- Prone to Supine leading with the Lower body: This movement begins with isolated hip extension then pelvic rotation/ lumbar extension, and finally with trunk extension/ rotation to correctly complete the roll. Patient is prone with arms and legs slightly abducted and head in neutral position. Ask the patient to roll over onto their back using the right leg only, by extending and adducting back across. The upper body should not contribute to the roll. The therapist should be monitoring the segmental quality of the movement, ability to complete the movement, substitution of from other areas of the body, and respiration (or lack of). Have the patient repeat to the opposite side. It may also show joint mobility issues (shoulder, thoracic, cervical, lumbar, hip) that need to be addressed before continuing.

a. Verbal cues: "Elongate through the axis of the non-moving arm and leg."

- Selective Functional Movement Assessment (SFMA) &,
- Functional Movement Screen (FMS):
  - To evaluate for global and contributory dysfunctions and asymmetries. **(See attached work sheets)**

Rehabilitation: Non-Operative Shoulder Injuries, Athletic Shoulders:

- **Subjective Evaluations:** Disabilities of the Arm Shoulder and Hand (DASH) with the sport module, or Pennsylvania Shoulder Score (PSS)
  - Minimal Detectable Change (MDC) for the DASH is 13, however there is no MDC currently for the sport module alone.
  - The MDC for the aggregate total for the PSS is 12 points; or by section: ±5.2 points for the pain section, ±1.8 points for the satisfaction section, and ±8.6 points for the function section
- **Treatment-Based Classification**: Treating in the context of pathology:

High Irritability *3/5 to categorize*	**Moderate Irritability** *3/5 to categorize*	**Low Irritability** *3/5 to categorize*
• High pain (≥ 7/10) • Constant night or rest pain • Pain before end ROM • AROM < PROM • High disability- ≥ DASH/PSS 50%	• Moderate pain (4-6/10) • Intermittent night or rest pain • Pin at end ROM • AROM ≠ PROM • Moderate disability- DASH/PSS 26-49%	• Low pain (</= 3/10) • No night pain or rest pain • Minimal pain at end ROM • AROM = PROM • Low disability- DASH/PSS </= 25%

Treatment Focus	Treatment Focus	Treatment Focus
• Pain reduction • Restoration of PROM • Neutral stability exercises: isometrics and AAROM	• Pain reduction • Equalization of AROM and PROM • Stabilization (scapular rotator cuff program): AROM, limited resistance	• Restore end terminal ROM, • Improve shoulder girdle endurance, then power, • Initiate return to play, • Respectively
Taken from: Non-operative Management of the Athletic Shoulder: Thigpen C & Jenk, D. Home Study Course 2013		

- * The Athletic shoulder girdle is highly reliant on the muscles of the rotator cuff and scapular stabilizers, as well as scapulothoracic, thoracic spine, acromioclavicular and sternoclavicular motions/mobility.
- Rotator Cuff Disease: (biceps, subacromial bursitis, rotator cuff tendinits/tendinosis, and partial rotator cuff tears)
  - Proposed mechanisms of injury are; Shoulder impingement, hooked acromion, weak rotator cuff muscles, altered scapulothoracic positioning and scapulohumeral kinematics, bone spurs, chronic bursal thickening, rotator cuff thickening due to calcium deposits, tightness in the posterior joint capsule. This leads to a believe sequence of events starting with repetitive microtrauma to the rotator cuff, followed by tendonitis, bursitis, osteophyte formation, and then finally rotator cuff tear.
    - Impingement can be from intrinsic factors: those related to the human body or extrinsic factors: such as occupation or activity
      - Common relevant extrinsic factors for athletes are rotator cuff weakness and scapular dysfunction.
- Instability: All capsulolabral pathologies; Superior Labral Anterior Posterior (SLAP) lesions, Multi-directional Instability (MDI), or anterior-inferior capsulolabral lesions.
  - Typical order of prevalence is Anterior/Inferior ligament with and with labral involvement (Bankart), SLAP tears, MDI, and posterior instability.
  - Each diagnosis has a distinct recovery, however, they all have a similar basic imbalance of static and dynamic stability, creating symptomatic increased glenohumeral joint laxity.
    - MDI- may demonstrate increased side-to-side glenohumeral instability in more than one quadrant, creating a secondary involvement of dynamic instability from overactivity or substitution patterns from the rotator cuff, biceps, and scapular stabilizing muscles.
      - Patient typically presents with posterior shoulder pain, especially with sagittal loading, and subluxations.

- **Patient Education:** From day 1 their needs to be ongoing education and communication with the athlete, (parents if under 18 or requested by patient), MD, athletic trainers, coaches, and any other involved parties, on precautions, recommendations for activity, short- and long-term prognosis, home exercises, and later on criteria for return to play.

- **Specific Interventions:**
  - ROM: this with be based on the treatment classification in the chart above, however, initially ROM is a priority, whether you are restoring ROM or maintaining full ROM.
  - Make sure you take into consideration the specific sport typical ROM changes. (**See Considerations of ROM measurements with Overhead Athletes Section in the Clinical Evaluation part of the protocol**)
  - In addition to stretching, athletes typically respond to a variety of techniques for improving mobility, tissue extensibility, joint mobility, and ROM. Before implementing techniques, clinician should be aware of which tissue(s) restriction is creating the loss of ROM. In many instances a combination of techniques is most effective. Results from functional assessments can be used as well to guide treatments and progressions as well as other evaluative findings.
    - Joint Mobilizations (if capsule restrictions present) Grades I-**V**
      - **Grades I-II:** typically for decreasing pain
      - **Grades III-V:** typically for decreasing capsular restrictions. Grade V mobilizations, thrust type manipulation, will mostly be used on the cervical, thoracic, lumbar spines, pelvis, and lower extremities to maintain/achieve alignment for proper posture and joint positioning.
    - Soft Tissue Mobilization: Myofascial Release (MFR), Friction Massage (DFM or TFM), Soft Tissue Massage (STM), Muscle Energy technique (MET), Dry Needling Technique, Graston™or other instrumentation soft tissue release techniques, Active Release™, etc.
    - Stretching: These should not just be centered on the shoulder. Cervical, thoracic, lumbar, hips, and lower extremities should be evaluated for tissue restrictions and treated accordingly. (**See Specific Exercise Sheets)** for some examples of exercises/stretches

  - Muscle Stretching/Retraining: Any alterations in timing, recruitment, and endurance of muscles can cause weakness and dysfunctions, as well as decrease athlete maximal force output for performing at their sport.
    - Use the findings from the evaluation and the irritability classification to determine when strengthening/retraining is begun, which movements/muscles are treated, and progression.
    - Painful unstable shoulders typically demonstrate increased activity in the prime movers of the shoulder; pectoralis major/minor, long head of the biceps, deltoids, latisimuss dorsi and upper trapezius. These are compensatory and protective in nature.
    - Overhead athletes also have a tendency to present with weakness and decreased timing/activation of serratus anterior, middle & lower trapezius, and rotator cuff musculature. Alterations with the timing/activation usually reflect an imbalance between the shoulder girdle muscles responsible for stabilizing the scapulothoracic and glenohumeral joint, and the prime movers of the shoulder. This could also be from joint dysfunction of the thoracic and/or cervical spine, as well as rib rotations or scapular altered position.
    - Shoulder stabilizer should be facilitated first, rotator cuff, serratus anterior, and middle & lower trapezius. Once the athlete is able to demonstrate good stabilization, the exercises can switch to focusing on improving timing and endurance.
      - Low resistance (if any) with high repetitions allows for re-integration of motor patterns, as well as, building up muscle endurance. Emphasis is on good form/motor control and appropriate muscle firing.

- Once the patient demonstrates good motor control (absence of; compensatory patterns, scapular winging, and decreased ER with elevation), and is able to perform 45-60 repetitions, then the difficulty of the exercise can be progressed with resistance, more advanced movements/exercises, or to exercises to mimic sport-specific functional movements.
    - Positional Progressions:
        - Supine/side-lying/prone -> quadruped -> standing -> balance/unstable surface
        - Planar movements -> diagonals -> overhead -> combined movements -> sport specific positions
        - Targeting individual muscles -> combined muscle activation -> movement patterns -> sport-specific movement patterns
        - No resistance -> light resistance (weights, bands, medicine balls, etc.) -> heavier resistance

- Kinetic Chain Restoration: This is paramount to being able to perform a sequential, multi-segmental, total body movement, along with a production of torque and force to be able to propel a ball or a body forward. The legs, trunk and core develop the power and it is ultimately transferred from the legs and trunk of the athlete-> through the scapulohumeral structures-> to the arm, directing the force output, -> to the ball, racquet, bat, club, etc.
    - Restoration of these patterns is where the use of the functional assessment tests have the most value**: SFMA™, FMS™, Y-balance™/CKCUEST, or any other tools/tests that asses functional movement patterns throughout the body**
    - The patient should also be assessed for core activation and breathing technique. This needs to be addressed initially because they can affect ability to improve ROM/ tissue extensibility, UE and LE movements, strengthening, stability, force production, etc.
        - Breathing and core activation should be assessed in all positions, with and without performance of exercises
    - Based on the results of the assessments, hips and pelvis and all the associated structures should be the secondary focus as they directly support core stability
    - Gluteal muscles (major power generators as well as stabilizers), Hip abductors, adductor, flexors, extensors, and rotators
    - Balance and single-leg stability is also key for restoration of the entire kinetic chain
    - Lower extremities functioning at an optimal level is a key to proper mechanics all the way up the kinetic chain in the overhead athlete.

- Keys to Successful Rehabilitation Criteria-Based Progression to be able to progress patient to Return to Specific Sport Protocols

- Followed expected passive ROM for individual athletes (compared to total arc of motion on the non-involved side of the body), and expected alterations in shoulder ROMs, by the sport the athlete plays. These should be restored prior to strengthening.
- Pain at rest should be eliminated before beginning strengthening (hypertrophy) or plyometric exercises
- Expected active ROM, with normal movement patterns, should be restored before beginning hypertrophy strengthening or plyometric exercises

- Patient should be able to demonstrate pain-free normal movement patterns through multi-planar movements, with 45-60 repetitions (good endurance), before progression to eccentric, plyometric, and/or high load exercises
- Patient must complete plyometric program (UE & LE if appropriate), Score ≥ 16 on the FMS™ (with no asymmetries, Y-Balance™ score should be equal to peers of the same age and sport along with no asymmetries, score _"no"-"mild" difficulty on all questions on the DASH (sports/ Arts module), (or low/no disability on chosen self evaluation assessment)
- Passing of the functional tests listed below: Test can be over multiple sessions
    ii. Trunk Testing: **(See attached sheets)**
        1. Deep Neck Flexor Test
        2. Segmental Multifidus Test
        3. Trunk Curl-up Test
        4. Double-Leg Lowering Test
        5. Prone Bridge Test
        6. Endurance of Lateral Flexors (Side Bridge)
        7. Extensor Dynamic Endurance Test
    iii. Upper Extremity Testing: **(See attached sheets)**
        1. Alternative Pull-up Test
        2. Push-up Test
        3. Backward Overhead Medicine Ball Throw Test
        4. Sidearm Medicine Ball Throw Test
        5. Seated Shot-Put Throw Test
    iv. Functional Lower Extremity (Strength/Power, Agility/Quickness, if needed)
    v. *<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

- **<u>See Return to Specific Sport Protocols</u>**

References

Bahk, M et al. Laxity Testing of the Shoulder. The American Journal of Sports Medicine. 2007; 35(1): 131-144

Barth et al. Diagnosis of Subscapularis Tendon Tear: Are Available Diagnostic Tests Pertinent for a Positive Diagnosis?. Orthopaedics & Traumatology: Surgery & Research. 2012; 98S: S178-S185

Barth et al. The Bear-Hug Test: A New and Sensitive Test for Diagnosing a Subscapular Tear. The Journal of Arthroscopic and Related Surgery. 2006; 22(10): 1076-1084

Bookhout, M, Chase, L. Exercise Prescription as a complement to Manual Medicine (course manual). Michigan State University College of Osteopathic Medicine. 2013

Braun, S, Kokmeyer, D, and Millett, J. Shoulder injuries in the Throwing Athlete. The Journal of Bone & Joint Surgery. 2009; 91(4): 966-978

Brumitt, J. Scapular-Stabilization Exercises: Early-Intervention Prescription. Athletic Therapy Today. 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

Chang, W. Shoulder Impingement Syndrome. Physical Medicine and Rehabilitation Clinics of North America. 2004; 15: 493-510

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

Curtis, T, Roush, J. The Lateral Scapular Slide Test: A reliability Study of Males with and Without Shoulder Pathology. North American Journal of Sports Physical Therapy. 2006; 1(3): 140-146

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

Dessaur, W, Magarey, M. Diagnostic Accuracy of Clinical Tests for Superior Labral Anterior Posterior Lesions: A Systematic Review. Journal of Orthopaedic and Sports Physical Therapy. 2008; 38(6): 341-352

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

Dodson, C, Altchek, D. SLAP Lesions: An Update on Recognition and Treatment. The Journal of Orthopaedic & Sports Physical Therapy. 2009; 39(2): 71-80

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

Ellenbecker, T, & Bailey, L. Evaluation of the Throwing Athlete's Shoulder (APTA Sports Physical Therapy Section: home study course; chapter 1) 2013

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

Escamilla et al. Shoulder Muscle Activity and function in common shoulder Rehabilitation Exercises. Sports Medicine. 2009; 39(8): 663-685

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

Forbush, S, White, D, Smith, W. The Comparison of the Empty Can and the Full Can Techniques and a New Diagonal Horizontal Adduction Test for Supraspinatus Muscle Testing Using Cross-Sectional Analysis Through Ultrasonography. The International Journal of Sports Physical Therapy. 2013; 8(3): 237-247

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

Gillooly, J, Chidambaram, R, Mok, D. The Lateral Jobe Test: A More Reliable Method of Diagnosing Rotator Cuff Tears. International Journal of Shoulder Surgery. 2010; 4(2): 41-43

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

Goulbourne, S. Sports-Related Injuries in the Young Athlete (course manual). Cross County Education. 2011.

Greis, P et al. Validation of the Lift-Off Test and Analysis of the Subscapularis Activity During Maximal Internal Rotation. 1996; 24(5): 589-593

Hegedus et al. Physical Examination Tests of the Shoulder: A Systematic Review with Meta-Analysis of Individual Tests. British Journal of Sports Medicine. 2008; 42: 80-92

Hegedus et al. Which Physical Examination Tests Provide Clinicians with the Most Value When Examining the Shoulder? Update of a Systematic Review with Meta-Analysis of Individual Tests. British Journal of Sports Medicine. 2012; 46: 964-978

Hoogenboom, B et al. Using Rolling to Develop Neuromuscular Control and Coordination of the Core and Extremities of Athletes. North American Journal of Sports Physical Therapy. 2009; 4(2): 70-82

Itoi, E et al. Which is More Useful, the “Full Can Test” or the “Empty Can Test”, in Detecting the Torn Supraspinatus Tendon?. The American Journal of Sports Medicine. 1999; 27(1): 65-68

Jain et al. Clinical Examination of the Rotator Cuff. The American Academy of Physical Medicine and Rehabilitation. 2013; 5: 45-56

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

Kuhn, J. Exercise in the Treatment of Rotator Cuff Impingement: A Systematic Review and a Synthesized Evidenced-Based Rehabilitation Protocol. Journal of Shoulder and Elbow Surgery. 2009; 18: 138-160

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

Lunden, J et al. Reliability of Shoulder Internal Rotation Passive Range of Motion Measurements in the Supine Versus Sidelying Position. Journal of Orthopaedic & Sports Physical Therapy. 2010; 40(9): 589-594

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

Maffet, M, Gartsman, G, Moseley, B. Superior Labrum-Biceps Tendon Complex Lesions of the Shoulder. The American Journal of Sports Medicine. 1995; 23(1): 93-98.

McClure et al. A Clinical Method for Identifying Scapular Dyskinesis, Part 1: Reliability. Journal of Athletic Training. 2009; 44(2): 160-164

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

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

Myer et al. A User’s Guide to Performance of the Best Shoulder Physical Examination Tests. British Journal of Sports Medicine. 2013; 47: 903-907

Myers, J, Lephart, S. The role of the Sensorimotor System in the Athletic Shoulder. The Journal of Athletic Training. 2000; 35(3): 351-363
Myers, T, Zemanovic, J, Andrews, J. The Resisted Supination External Rotation Test: A New Test for the Diagnosis of Superior Labral Anterior Posterior Lesions. The American Journal of Sports Medicine. 2005; 33(9): 1315-1320

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

Okoro, T, Reddy, V, Pimpelnarkar. Coracoid Impingement Syndrome: A literature Review. Current Review of Musculoskeletal Medicine. 2009; 2: 51-55

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

Papadonikolakis, A et al. Published Evidence Relevant to the Diagnosis of Impingement Syndrome of the Shoulder. The Journal of Bone and Joint Surgery. 2011; 93: 1-6

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

Powell, S, Nord, K, Ryu, R. The Diagnosis, Classification, and Treatment of SLAP Lesions. Operative Techniques in Sports Medicine. 2004; 12(2): 99-110

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, M, Gill, T. Current Concepts in the Evaluation and Treatment of the Shoulder in Overhead Throwing Athletes, Part 1: Physical Characteristics and Clinical Examination. Sport Health. 2010; 2(1): 39-50

Reinhold et al. Current Concepts in the Evaluation and Treatment of the Shoulder in Overhead Throwing Athletes, Part 2: Injury Prevention and Treatment. Sport 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

Rigsby, R, Sitler, M, Kelly, J. Subscapularis Tendon Integrity: An Examination of Shoulder Index Tests. Journal of Athletic Training. 2010; 45(4): 404- 406

Scheibel et al. The Belly-Off Sign: A New Clinical Diagnostic Sign for Subscapularis Lesions. The Journal of Arthroscopic and Related Surgery. 2005; 21(10): 1229-1235

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

Snyder et al. SLAP Lesions of the Shoulder. Arthroscopy. 1990; 4: 243-279

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

Tashijan, R. Epidemiology, Natural History, and Indications for Treatment of Rotator Cuff Tears. Clinical Sports Medicine. 2012; 31: 589-604

Tate et al. Effect of the Scapular Reposition Test on Shoulder Impingement Symptoms and Elevation Strength in Overhead Athletes. The Journal or Orthopaedic & Sports Physical Therapy. 2008; 38(1): 4-11

Tate et al. A Clinical Method for Identifying Scapular Dyskinesis, Part 2: Validity. Journal of Athletic Training. 2009; 44(2): 165-173

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

Thigpen, C, Jenk, D. Non-Operative Management of the Athletic Shoulder. (APTA Sports Physical Therapy Section: home study course; chapter 2) 2013

Uhl et al. Evaluation of Clinical Assessment Methods for Scapular Dyskinesis. The Journal of Arthroscopic and Related Surgery. 2009; 25(11): 1240-1248

Voight, M, Hoogenboom, H, Cook, G. The Chop and Lift Reconsidered: Integrating Neuromuscular Principles into Orthopedic and Sports Rehabilitation. North American Journal of Sports Physical Therapy. 2008; 3(3): 151-159

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

Wilk et al. Glenohumeral Internal Rotation Measurements Differ Depending on Stabilization Techniques. Sports Health. 2009; 1(2): 131-136

Wilk et al. Current Concepts in the Recognition and Treatment of Superior Labral (SLAP) Lesions. The Journal of Orthopaedic & Sports Physical Therapy. 2005; 35(5): 273-291

Wilk et al. The Recognition and Treatment of Superior Labral (SLAP) Lesions in the Overhead Athlete. The International Journal of Sports Physical Therapy. 2013; 8(5): 579-600

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