Academy of PHYSICAL MEDICINE

Research Paper Review

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SCAPULAR DYSKINESIS: PRACTICAL APPLICATION & RESEARCH UPDATES

1. **Clinical Implications of Scapular Dyskinesis in Shoulder Injury: The 2013 Consensus Statement from the "Scapular Summit"**
   British Journal of Sports Medicine 2013; 47: 877-885
   Kibler BW, Ludewig PM, McClure PW, et al.

2. **Scapular Dyskinesis: Practical Applications**
   British Journal of Sports Medicine 2013; 47: 875-876
   Pluim BM

3. **Diagnostic Accuracy of Scapular Physical Examination Tests for Shoulder Disorders: A Systematic Review**
   British Journal of Sports Medicine 2013; 47: 886-892
   Wright AA, Wassinger CA, Frank M, et al.

4. **A User's Guide to Performance of the Best Shoulder Physical Examination Tests**
   British Journal of Sports Medicine 2013; 47: 903-907
   Myer CA, Hegedus EJ, Tarara DT & Myer DM.

Reviewed by Dr. Demetry Assimakopoulos DC (Research Review Service)

BACKGROUND INFORMATION

The report on the 'Scapular Summit' by Kibler et al. (Study #1, above) describes the anatomy and basic movement patterns of the shoulder complex. In conjunction with Pluim's paper (Study #2), they describe what is known (and what is not known) about scapular dyskinesis and its associated injuries.

Another study from the British Journal of Sports Medicine included in this review by Wright et al. (Study #3, above) attempted to systematically review the evidence surrounding scapular physical examination tests and their ability to diagnose specific pathologies. Their data provide clinicians with pertinent information regarding whether scapular tests are useful in clinical practice. Building on this information, this review concludes with a fourth study by Myer et al. (Study #4), which introduces the reader to the best new clinical shoulder orthopaedic tests for the diagnosis of specific tissue pathology.

SUMMARY

Scapular Anatomy

- The scapula makes up part of the glenohumeral (GH) and acromioclavicular (AC) joints.
- Physiologically, the scapula acts as a stable point, or 'punctum fixum' for the numerous muscles which contribute to dynamic GH stability and function.
- The coordinated coupled motion of the humerus and scapula (referred to as scapulohumeral rhythm or SHR) is required for efficient arm movement, and to maximize GH joint congruency.

Definition and Cause of Scapular Dyskinesis

- Altered SHR and scapular resting position have been termed 'scapular dyskinesis', hypothesized to result from alterations in GH angulation, AC joint strain and changes in subacromial space (normally reductions), muscular activation and humeral position/motion.
- *Bony causes:* thoracic hyperkyphosis or poor thoracic mobility with arm movement, clavicular fractures (non-union or shortened mal-union), high grade AC instability or AC arthrosis, GH instability, GH joint derangement.
- *Neurological causes:* cervical radiculopathy, long thoracic nerve or spinal accessory nerve palsy.
- *Soft tissue causes:* stiffness/inflexibility of the pectoralis minor and/or short head of biceps, creating protraction and anterior tilt due to their pull on the coracoid; posterior muscular inflexibility can lead to GH internal rotation deficit (GIRD); alterations in periscapular muscle activation (namely serratus anterior [SA]) causing a loss of posterior scapular tilt and upward rotation; a change in the force couple of the upper/lower traps, with latency for the activation of the lower traps, causing alteration in the upward rotation of the scapula and loss in posterior scapular tilting.

Specifically, clinicians should observe for winging of the medial and inferior borders of the scapula and a lack of smooth scapular movement (i.e. early scapular elevation, shrugging, rapid downward rotation during lowering). If present, no description is needed, just a simple "yes" indicating that scapular dyskinesis is present is recommended, as this "yes" or "no" method has been proven to be reliable more reliable than an exact description of scapular kinematics. While these observations are associated with many shoulder pathologies, the exact pathophysiological relationship is not clear.

What we know and what we don't know

Shoulder Impingement:

- It is apparent that 2D and 3D models of acromiohumeral distance are not capable of fully describing the complexity of shoulder kinematics and the risk of rotator cuff impingement.
- Scapular dyskinesis might be due to dynamic alteration of the humeral head, RC and acromion, rather than a static alteration, such as a bony spur, that alters the shape/size of the subacromial space.
- Compression of the subacromial bursa is likely the origin of painful symptoms, as opposed to the RC, especially if pain is experienced with humeral elevation greater than 90 degrees.
- Decreased upward rotation and protraction of the scapula increase the area of contact between the humerus and posterior-superior glenoid, creating the internal impingement. This is now being recognized in many populations outside of overhead athletes.
- Because of the large number of clinical findings that could be present in any case of impingement, the authors label impingement as a physical condition (like a syndrome), rather than a clearly identifiable diagnostic entity.
- The label of "subacromial impingement" is not effective at directing treatment.
- Shrugging the shoulder and winging of the scapula with GH movement are known to be clear signs of dyskinesis – be sure to watch for them!

Rotator Cuff Tears:

- Studies of patients with RC tears have shown increased scapular upward rotation to some magnitude. Dyskinesis has also been shown to be a major factor and is associated with lower functional scores.
- It is unclear as to whether or not scapular dyskinesis is a cause or a result (via some sort of compensation) of rotator cuff pathology.
- It is proposed that scapular anterior tilt and protraction will create glenoid ante-tilting while moving the arm, predisposing the RC to internal impingement.
- In addition, increased upward rotation and posterior tilt can alter the size of the subacromial space and create abrasion and wear of the RC.
- If dyskinesis is an effect of a pre-existing injury, it might be due to the inhibitory effect of pain on individual muscular activation and its disruption of normal muscle activation patterns.

Superior Labral Tears:

- There is a large association between scapular dyskinesis and labral injuries in general.
- Altered internal rotation and anterior scapular tilt changes GH alignment, placing increased tensile strain on the anterior ligaments. This creates a peel back of the labral/biceps complex on the glenoid, creating internal impingement and weakness of the RC.
- These are magnified by the presence of GIRD (glenohumeral internal rotation deficit), which creates more protraction due to the windup of the tight posterior structures.
- Correction of painful symptoms while performing the dynamic labral shear test can be frequently demonstrated using the Scapular Repositioning Test (SRT – see below), indicating the need for scapular rehabilitation.

Acromioclavicular Separations:

- Separation of the AC joint may disrupt the synchronous motion in multiple scapular planes, which can manifest as scapular dyskinesis and shoulder symptoms.
- Demonstration of scapular dyskinesis during examination can aid treatment. The role of the AC joint in scapuloclavicular motion is especially important.
- Patients with AC joint disruption who show scapulothoracic joint dysfunction may be counselled that surgical treatment can help in restoring biomechanics and function.
- It is assumed that individuals who demonstrate normal scapular mechanics can be treated with non-operative rehabilitation.

Multidirectional Glenohumeral Instability:

- Scapular static position and its dynamic ability to move are integral to functional GH stability.
- Symptoms generally occur in mid-ranges of GH motion, where concavity/compression of GH bony alignment and muscle activation are important.
- These patients typically feature increased scapular protraction, and in some cases decreased upward rotation with poor GH joint centration. These functionally allow the humeral head to translate inferiorly, creating instability.
- A protracted scapular position is created by increased activation of the pec minor and lats. The subscapularis, lower traps and serratus anterior are usually inhibited/underactive.
- Capsular laxity, altered scapular kinematics and muscle activity during arm elevation cause the glenoid to be positioned inferiorly, which predisposes the humerus to be displaced inferiorly.
- A positive Scapular Retraction Test (see below) alters the position of the glenoid and decreases lat activation, which may decrease instability symptoms. In this case, strengthening the lower trapezius and serratus anterior and lengthening of the pecs minor and lats are indicated.

Scapula and Sports Participation

What we know and what we don't know:

- The scapula is the pivotal link between the larger proximal bodily segments that produce stability and force, which allow the arm to be mobile enough to throw a ball or move a racquet with tremendous precision and force.
- For example, a tennis serve requires adequate knee flexion, trunk rotation and core stability. Additionally, athletes must control the trunk over the back leg, have the forearm pronated during cocking, front hip and leg directed toward the target, and be able to rotate towards the target. This allows maximal scapular retraction to occur, which permits appropriate horizontal abduction and external rotation of the shoulder, generating maximum velocity.
- Alteration of one segment in the chain can negatively affect the more distal segments. The exact nature of these relationships requires further study in most instances.

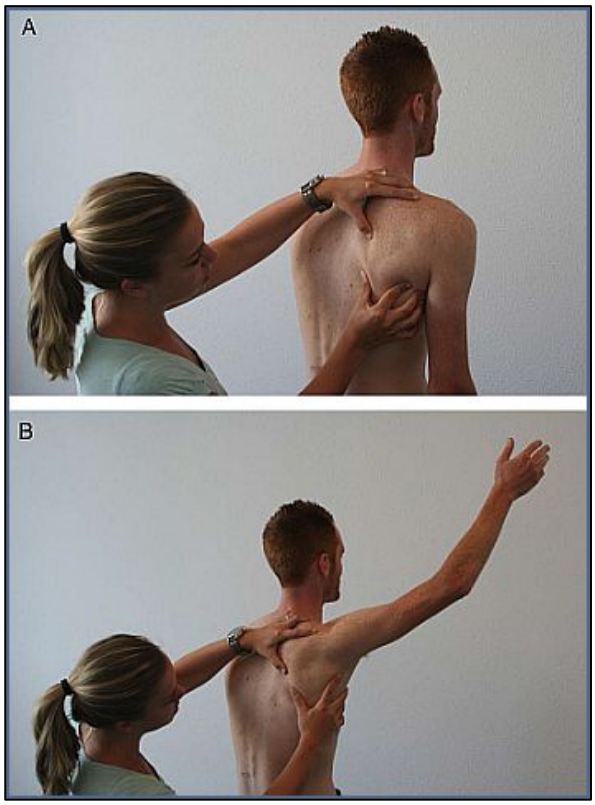
Clinical Implications:

- Athletes may feature side-to-side differences and altered scapular resting position.
- Clinicians must evaluate athletes bilaterally to check for abnormal asymmetries. Alterations found with injury should be addressed, since they have the ability to decrease muscle function and have implication in injury.
- The key scapular muscles for scapular stability and mobility are the low/upper trapezius and the serratus anterior.

Clinical Evaluation:

- Statically measuring side-to-side difference of the distance from the inferior pole of the scapula to the adjacent spinous processes (Lateral Scapular Slide Test – LST) might not be a valid method of assessing dyskinesis, as its static, 2D nature fails to fully assess the shoulder girdle dynamically in three dimensions.
- During examination, the clinician must observe the patient from behind as they perform a functional task. Here, the patient can hold a 2lb weight in each hand, flexes and then abducts the arm. Here, the clinician can observe for dyskinesis and record "yes" if dyskinesis is present, and a "no" if it not.
- Additionally, clinicians must ask why dyskinesis is present in the first place: is it present as a compensation to avoid stress on a pain-sensitive tissue? This is why tests which manually attempt to correct scapular movement, are theoretically valid. Two such tests will be described below.

Scapular Assistance Test (SAT):
The practitioner manually assists scapular upward rotation as the patient abducts or forward flexes the arm. A positive SAT demonstrates that altered scapular motion in upward rotation and/or anterior and posterior tilting of the scapula might be part of the reason for impingement symptoms. If positive, treatment should include: increased flexibility of the pectoralis minor and short head of the biceps, and strengthening of the serratus anterior and lower trapezius.



Scapular Retraction (or Reposition) Test (SRT):
The practitioner anchors the scapula in external rotation, posterior tilt and/or retraction (normally along the medial border). A positive test or improved strength during loaded arm elevation might indicate a lack of scapular stability.

The SAT and SRT:

- The SAT and SRT are positive if they are helpful in alleviating painful arc/impingement issues.
- If either of these tests are positive, the clinician should aim to improve scapular stability rather than focusing only on the RC as a first step.
- Following these, clinicians must examine the surrounding shoulder girdle joints (AC, SC, GH joints and labrum) and soft tissue. Specifically, using palpation, muscle length testing (pectoralis minor, upper trapezius) and manual muscle strength testing techniques (SA, lower traps, middle traps etc) to identify possible fault with tissues that can alter scapular motion.
- Assessing GH internal rotation is also quite valuable, because when ROM is limited in this direction, scapular movement can be impaired.

STUDY #3: SCAPULAR TESTS & SHOULDER PAIN

- The following tests demonstrated low sensitivity and variable specificity (28-86%) for shoulder pain: the scapular dyskinesis test, winging scapula, tilting scapula and kinetic medial rotation test.
- These results suggest very poor positive/negative likelihood ratios (LRs), suggesting a poor ability to confirm or reject the possibility of shoulder pain.

Scapular Tests & Shoulder Dysfunction:

- The lateral scapular slide test demonstrated poor diagnostic accuracy (2), with high sensitivity (80-100%) and low specificity (4-26%) (3).
- Another study reported that when clinicians manually retract the scapula using the SRT, it results in increased muscle force with resisted scapular plane abduction.

Scapular Tests & Shoulder Impingement:

- When a positive test is defined as increased shoulder strength with manual muscle testing, the SRT demonstrated a 26% sensitivity and 70% specificity.
- However, when a positive test was defined as a decrease in pain, sensitivity increased to 47%. These results suggest that the use of this test to *specifically diagnose* shoulder impingement is not better than chance. Remember, the SRT and SAT should be used to guide rehabilitation and treatment strategy, and should not be used to render a specific diagnosis.

Scapular Tests & AC Dislocation:

- The scapular dyskinesis and SICK scapula tests were used to find scapular dysfunction in the presence of AC dislocation.
- The sensitivity for these tests were 71% and 41%, respectively. Specificity values were not reported.
- Because the individuals included in these analyses were already diagnosed with type III AC dislocation, the authors conclude that signs of scapular dyskinesis may be the result of the direct shoulder pathology, versus the cause.

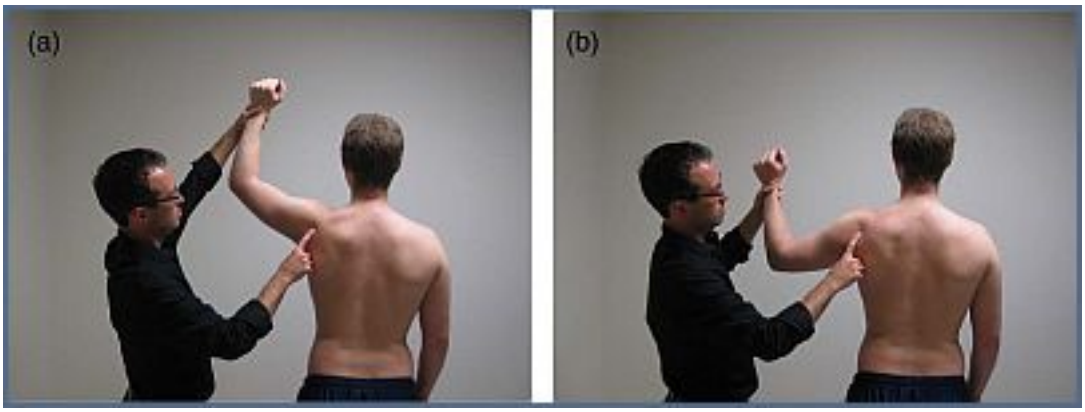
Trapezius Myalgia:

- The winging scapula at rest and winging scapula during arm elevation with and without a dumbbell were included to identify scapular winging in subjects with and without trapezius myalgia.
- They all showed low sensitivity (13%) with high specificity (78-91%), with likelihood ratios near zero.

STUDY #4: ORTHOPEDIC TESTS FOR THE SHOULDER

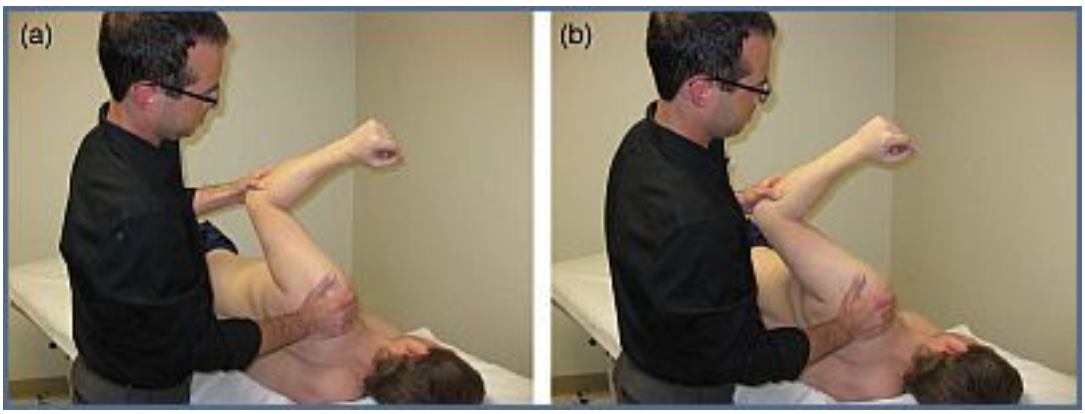
Modified Dynamic Labral Shear Test:

- Patient flexes the elbow to 90°, with the shoulder abducted in the scapular plane to > 120° and externally rotated to tightness (panel a in picture below).
- The therapist guides the upper extremity into maximal horizontal abduction and applies a shear load to the joint by maintaining maximal ER. The therapist then lowers the arm from 120° of abduction to 60° (panel b in picture below).
- A positive test is reported when the motion reproduces the painful click or catch in the posterior joint line between 90-120° of abduction.
- This test reproduces the motion of the biceps long head and the peel-back mechanism. It also reproduces the shear mechanism of the posterior RC against the posterior-superior labrum.
- This test shows both high sensitivity and specificity.



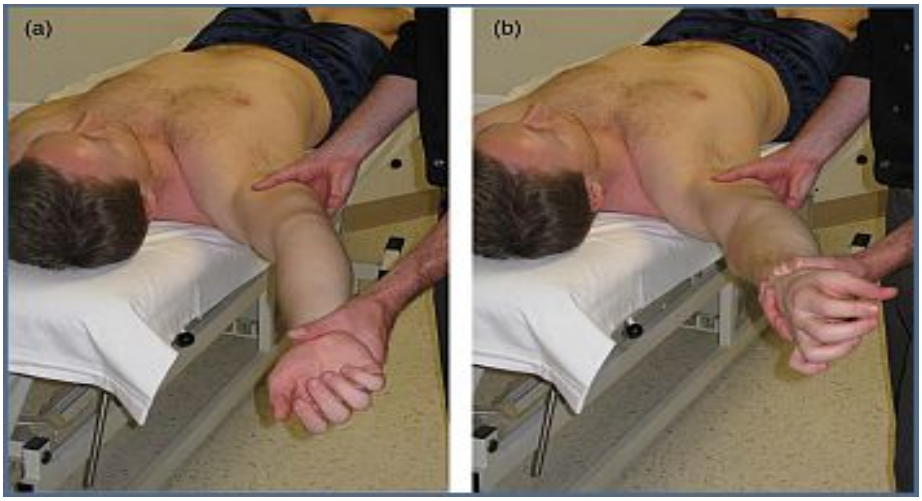
Passive Compression Test – Superior Labrum Anterior-to-Posterior (SLAP) Lesions

- Patient is side-lying with the affected arm up.
- The clinician stands behind the patient and holds the AC joint with one hand and the elbow with the other to stabilize the shoulder.
- The clinician then externally rotates the shoulder in 30° of abduction, and then pushes the arm proximally while extending the shoulder (see picture below).
- A positive test is the reproduction of a painful click in the GH joint.
- This test simulates the late cocking phase, where the long head of the biceps is placed under extreme tensile force while wrapping around the lesser tuberosity, leading to a shift of the superior labrum from the superior glenoid. This aggravates the unstable labrum.



Passive Distraction Test for SLAP Lesions:

- Patient lays supine. The examiner places the arm off the edge of the table and abducts the patient's shoulder to 150° and places the forearm in supination.
- The clinician then pronates the forearm while maintaining the position of the humerus.
- A positive test is reported when pain is felt deep inside the GH joint either anteriorly or posteriorly.
- This, much like the other labral tests, reproduces the peel-back phenomenon of the superior labrum.



Bony Apprehension Test:

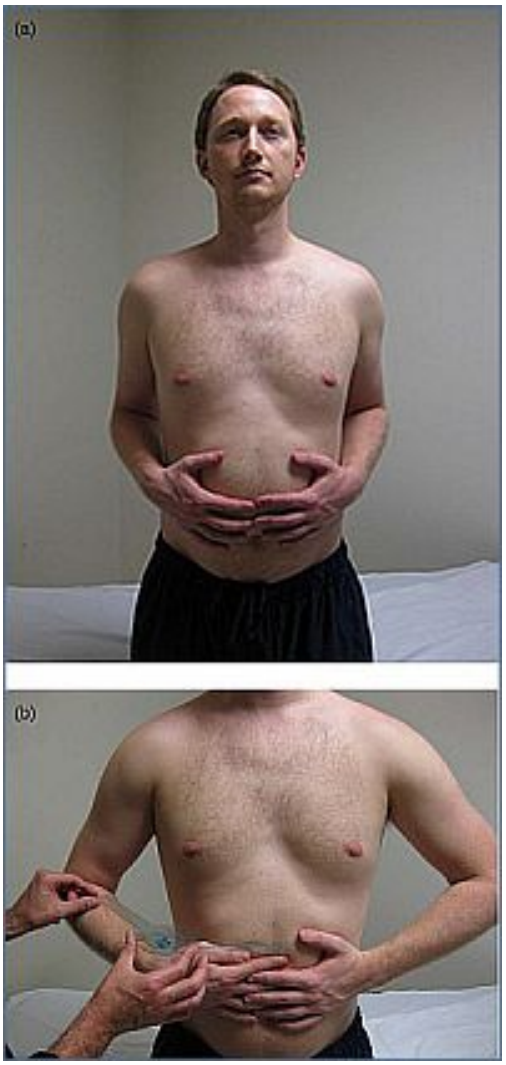
- The patient flexes the elbow to 90°.
- The clinician stands behind the patient and holds the lateral forearm with one hand, and places the other hand on the proximal humerus. The clinician then abducts the affected arm to 45° and externally rotates the arm to 45°.
- A positive test is reported with apprehension with or without pain.
- This test provokes instability of the GH joint from a Bankart Lesion and/or engages a Hill-Sach's lesion.

Belly Off Sign for Subscapularis Tendinopathy:

- The examiner passively moves the affected upper extremity in to flexion and maximal internal rotation with the elbow flexed to 90°, and places the patient's hand on their own abdomen. The patient is asked to keep the wrist straight and maintain the position of their palm on the abdomen while the therapist lets go of the patient's wrist. At this point, the patient is asked to maintain this position.
- A positive test is recorded when the patient is unable to maintain this position, the wrist flexes or a lag occurs and the hand is lifted off the abdomen.
- The subscapularis is a strong internal rotator. This test evaluates the musculotendinous integrity of this structure.

Modified Belly Press Test:

- The patient sits or stands with the affected hand flat on the abdomen with the elbow close to the body (panel a in picture below).
- The clinician asks the patient to bring the elbow forward and straighten the wrist. The clinician measures the belly-press angle of the wrist with a goniometer (panel b in picture below).
- A positive test is reported when a belly-press angle is different side-to-side by 10°. The image below shows a positive test.



Lateral Jobe Test:

- The patient abducts their affected shoulder to 90° in the coronal plane with the elbow flexed to 90° with the shoulder internally rotated so that the fingers point inferiorly and the thumb medially (panel a in picture below).
- The therapist then applies an inferior force to the distal arm (panel b in picture below).
- A positive test is reported if pain, weakness or if the patient is unable to perform the test.

Olecranon-Manubrium Percussion Test for Bony Abnormality:

- The patient flexes the elbow to 90°.
- The therapist places the bell of their stethoscope over the manubrium and percusses the olecranon process.
- A positive test is recorded if there is a decrease in pitch or intensity of the affected side.
- Should bony abnormalities be present, the affected side might have a duller sound than the normal side.
- This test might be useful in acute cases where fracture might be suspected.

Shrug Sign for Shoulder Abnormality:

- The patient abducts both arms in the coronal plane.
- A positive test is recorded if elevation of the scapula or shoulder girdle to achieve 90° of abduction is performed. The magnitude of the shoulder shrug is defined as the angle between the arm and the horizontal point at which the shrug movement began.
- This test is especially suitable for abnormalities resulting in a decrease in shoulder ROM or weakness upon manual muscle testing.

CLINICAL APPLICATION & CONCLUSIONS

In order to diagnose specific shoulder pathology, one must keep abreast of the most current literature, as new and (hopefully) improved tests are added into the litany of orthopaedic diagnostic procedures. The final paper reviewed above provides a user friendly guide on how to perform some new tests from a recent systematic review (4). These, however, should be used in the context of a comprehensive physical examination.

Scapular dyskinesis is found in almost all types of shoulder pathology and is viewed to be a potential impairment to optimal shoulder function. Dyskinesis can be assessed by using simple observation methods to identify its presence, then attempting to reduce symptoms using scapular motion alteration tests (SRT, SAT). However, these tests cannot be used to infer specific shoulder pathology, and should be used to guide a comprehensive treatment program that addresses mobility deficits, coordination and activation of dysfunctional points along the kinetic chain.

STUDY METHODS

Study 1:
No methods section was included. This was a general consensus piece that was written subsequent to a meeting by the top professionals in the orthopaedic field.

Study 3:
The authors conducted a systematic search of a number of databases, including PUBMED, EMBASE, CONAHL and the Cochrane Library Databases. The search was performed to find research papers on diagnostic accuracy. They inquired into the scapula and associated shoulder diagnoses/pathologies, and physical examination procedures.

Each article had to meet the following criteria for inclusion:

- A report of criterion standard of diagnosed shoulder pathology
- A statistical association of at least one physical examination test with a reported outcome of interest
- A report of sensitivity or specificity calculation
- Full text
- English language

The articles were excluded if:

- Equipment not available to most clinicians were used during physical examination
- They used anaesthesia or cadavers
- A group of physical examination tests were generalized as a 'composite physical examination'
- Asymptomatic study population
- Review article

The quality of each article was assessed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) (5, 6). This is a scoring tool containing 14 components, with each component having a "yes" (1 point) or "no/unclear" (0 points) answer option. The maximum score is 14 points. A high quality diagnostic accuracy is anything above a 7/14, while < 7/14 is indicative of low quality.

Intra-observer reliability was first assessed using kappa-statistics. True positive, false positives, true negatives and false negatives from each clinical test assessed were extracted from the selected studies. Sensitivity (SN), specificity (SP), positive likelihood ratio (+LR) and negative likelihood ratio (-LR) were also calculated.

STUDY STRENGTHS / WEAKNESSES

Strengths:

- Study 1 identified where pertinent information is lacking, in addition to disseminating important research which guides examination and treatment.

Weaknesses:

- Study 1 touched on the notion of the kinetic chain involvement creating scapular dyskinesia in athletes, but did not comment extensively on this topic.
- In Study 3, many of the articles included in the review did not report on any diagnostic accuracy statistics.
- Study 3 also limited their search to articles written in English, making the review more prone to dissemination bias.

Additional References:

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