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Clinical Assessment of the Shoulder

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Abstract: The shoulder joint is complex in structure and functionality. It is often difficult to assess clinically due to the great variety of associated pathology. This article presents an overview of the anatomy of the shoulder region and associated pathologies, whilst providing a summary of the clinical examination of the shoulder and associated 'special tests'.

A full history is vital when assessing shoulder pathology. No particular test is fully sensitive or specific alone and accuracy varies between both clinicians and patients alike. Assessment of the shoulder should be conducted systematically with a range of tests combined.

Keywords: Shoulder assessment, clinical examination, special test.

INTRODUCTION

The shoulder joint is one of the more mobile joints in the body and restriction can have a significant effect on functional ability [1, 2]. It is the role of primary care, orthopaedic and rheumatological clinicians to assess complaints relating to the shoulder in a systematic manner. To ascertain the origin of any pathology, an understanding of the anatomy of the shoulder girdle and related structures is recommended. The arrangement of the bony, muscular and ligamentous anatomy of the shoulder is relatively complex, providing a wide range of movement whilst maintaining stability.

The bony anatomy of the shoulder girdle consists of the scapula, clavicle and humerus, which articulates at the shoulder as theglenohumeral and acromioclavicular (AC) joints (Table **1**). Both are synovial joints consisting of a capsule, which is internally lined by a synovial membrane, and hyaline cartilage, which forms the articular surfaces. The clavicle articulates medially with the manubrium sterni *via* the sternoclavicular (SC) joint, an atypical synovial joint with a wedge of fibrocartilage between both articular surfaces. The scapulothoracic joint is a physiological joint, the movements of which are provided by the gliding of the acromion over the clavicle. The rotator cuff provides the main stabilising structure for the glenohumeral joint and is made up of supraspinatus, infraspinatus, subscapularis and teres minor muscles. Movements at the shoulder involve composite movements of these joints, either alone or in synchrony, and form an integral part of the functionality of the upper limb. They enable accurate positioning of the limb to carry out precise motor activities.

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Principle movements of the shoulder are flexion, extension, abduction, adduction, internal and external rotation. The range of these movements is dependent on a number of factors including age, sex, pathology and on which side is dominant [3, 4]. Table **2** below shows the average range of motion in the dominant and non-dominant arm in the healthy population [7]. Any movement of the humerus at the shoulder joint will almost always involve the glenohumeral joint but also the SC and AC joints. This, in particular, is true for elevation of the humerus. Classically authors have described the ratio of glenohumeral to scapulothoracic movement as 5:4, after 30 degrees of abduction, [3] however been the subject of some debate [5, 6]. Ludewig *et al.* in 2009 [6] used cortical bone pins and electronic sensors to record movements at each joint during humeral elevation in flexion, scapular plane abduction and coronal abduction. The AC joint demonstrated an increase in internal rotation, upward rotation and posterior tilting in all planes. Also, when examining the joint, there was increased clavicular retraction, elevation and axial rotation again in all three planes. The movement in these three planes at the glenohumeral joint showed an increase in humeral elevation of 85 degrees on average and the amount of glenohumeral elevation depended on the plane of motion.

Flexion involves the use of the anterior fibres of deltoid, as well as coracobrachialis, and occurs at all of the above joints. Extension is a much more limited movement and involves the posterior fibres of deltoid, triceps brachii (long head)latissimusdorsi and teres major. Abduction also involves every individual joint and is performed by the middle fibres of deltoid and supraspinatus. Adduction is performed by pectoralis major, teres major and latissimusdorsi. Internal rotation occurs at the glenohumeral joint and is performed by pectoralis major, teres major, latissimusdorsi and subscapularis. External rotation has a similar range of movement and is performed by infraspinatus and teres minor. These muscles work together and antagonistically to provide such a degree of movement as well as maintaining stability [8].

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Table 1. Summary of Gross Anatomy of the Shoulder Girdle

Joint	Type of Joint	Articular Surfaces	Nerve Supply
Sternoclavicular	Saddle	Sternal end of clavicle Manubrium Sterni 1st costal cartilage	Median supraclavicular Nerve Subclavian Nerve
Acromioclavicular	Plane synovial	Acromial end of the clavicle Acromion of the scapula	Supraclavicular, lateral pectoral, Axillary nerves
Glenohumeral	ball-and-socket	Humeral head Glenoid cavity of scapula	Suprascapular Nerve Axillary Nerve Lateral pectoral Nerve

Table 2. The Range of Motion at the Shoulder Joint in the Healthy Adult Population [7]

Motion	Ranges of Motion (Degrees)	
	Dominant Side	Non-Dominant Side
Passive Abduction	165.7 ± 5.8	168.2 ± 18.9
Active Abduction	82.7 ± 12.0	92.2 ± 6.2
Adduction		
Active	48.8 ± 6.0	52.4 ± 4.7
Passive	52.5 ± 6.0	56.6 ± 7.0
Internal Rotation		
Active	95.5 ± 12.6	98.3 ± 9.4
Passive	102.2 ± 6.3	110.4 ± 5.8
External Rotation		
Active	65.9 ± 9.4	69.6 ± 6.3
Passive	71.5 ± 9.4	75.2 ± 9.4
Flexion		
Active	116.7 ± 8.6	122.9 ± 8.4
Passive	121.3 ± 5.5	125.1 ± 6.5
Extension		
Active	27.7 ± 11.0	30.7 ± 9.4

Shoulder pain is very common, in fact 1% of adults over the age of 45 present with this symptom to their G.P. each year [9, 10] and, due to the complexities of the anatomy and physiology, it is difficult to achieve a definite diagnosis using the patients history alone. This is especially true as a range of abdominal conditions such as appendicitis, cholecystitis and various gynaecological conditions can also present with shoulder pain [11-14]. The reason for this is that the shoulder, diaphragm and sub-diaphragmatic peritoneum receive their nerve supply from the cervical nerve roots C3-C5.

The musculoskeletal causes for shoulder pain can be acute, chronic or neuropathic. Acute causes can be from fracture, dislocation and muscular injury. Chronic causes can be due to osteoarthritis, rotator cuff tears, recurrent dislocations, biceps long head tendonitis [15], adhesive capsulitis [16], and neoplasia, either benign sarcoma [17] or malignant disease. Neuropathic causes can be from cervical spine pathology, herpes zoster infection [18], or brachial neuritis [19]. The causes for shoulder symptoms can be broadly classified as post-traumatic, inflammatory, neoplastic, congenital, degenerative or iatrogenic. Further assessment of symptoms should be focused on mode of onset, time of pain, precipitating or exacerbating factors, and associated symptoms.

Specific conditions present in a typical fashion and some of these are mentioned further below. For instance, osteoarthritis is a common disease among the elderly and is likely to increase due to our aging population [20, 21]. A pathological fracture must be considered in patients whose fractures havea minimal mechanism of injury. Pain resulting from rotator cuff injury and impingement is exacerbated with overhead activities. Weakness of the arm can be associated with cervical disc disorders or rotator cuff injuries. Instability is common in dislocations or subluxations. Locking of the shoulder can be due to glenoidlabrum tears, osteoarthritis of the joint or impingement syndromes in later stages. Many of these conditions mentioned are reviewed below, alongside their associated clinical tests.

ASSESSMENT OF THE SHOULDER

Prior to clinical assessment of the shoulder, a comprehensive and accurate clinical history is helpful. Common symptoms of shoulder pathology include pain, instability, stiffness or a range of restricted movements (active or passive) and deformity. Clinical examination follows the order of inspection, palpation, assessment of range of motion and special tests for the shoulder.

Clinical examination of the shoulder should begin with adequate exposure of the patient and follows a basic pattern. Most clinicians follow a stepwise approach summarised as Look, Feel, Move (active then passive), followed by special tests for specific pathology.

Inspection must be from all sides of both joints, with the clinician looking for bruises, swelling, deformity, erythema, asymmetry of shoulder contour and scars, either traumatic or from previous surgery. For example, in the area of the deltopectoral groove, which is a frequent approach to the shoulder [22]. The clinician must also look in the axilla, as disease here may present with shoulder symptoms, as well as non orthopaedic surgery particularly previous axillary lymph node clearance for breast cancer [23]. Disuse atrophy of the supraspinatus and/or infraspinatus muscles is shown to point towards a diagnosis of a rotator cuff tear, although little in the way of quantitative data is present at the time of writing [24].

If ‘sagging’ of the shoulder is seen, this can denote a lesion in the accessory nerve, which supplies trapezius and the sternocleidomastoid muscles. Winging of the scapula is seen in injury to the long thoracic nerve as well as the accessory nerve [25] and this can be elicited by asking the patient to press against a wall.

The clinician should palpate theSC joint, clavicle, AC joint, coracoid process, acromion and the spine of scapula. The tendon of the biceps must also be palpated for tenderness. Tenderness along the joint indicates a joint pathology, most commonly osteoarthritis of the joint. In cases of fibromyalgia, there will be concomitant tenderness over the shoulder and neck regions, as well as in other parts of the body [26].

The range of motion of the shoulder should be assessed initially actively and then passively. If active motion is limited, passive movements will help determine if the restriction is due to pain, motor disease or an obstructive pathology. Painful active motion is seen in joint disease, while painless restriction is seen in motor nerve disease. An example of this is the scarf test for AC joint osteoarthritis. The patient experiences pain in the AC joint when bringing the forward flexed arm across the front of their body, as if to “toss a scarf” over the opposite shoulder. Flexion, extension, abduction and adduction can be tested, and the degree of motion can be noted compared to normal. Internal and external rotation should be tested with elbow at 90° of flexion. Adequacy of internal rotation can also be tested by asking the patient to touch the opposite shoulder, or the opposite scapula.

A range of special tests exists for common conditions of the shoulder. Although many have been described, relatively few have been evaluated and validated by quality studies. Furthermore, debate exists on the value of any single test being used alone [27]. These tests should be used together as part of a full clinical assessment.

Anterior Instability

The shoulder joint is the most mobile joint in the human body and, as such, sacrifices stability to achieve this degree of mobility. There are a large amount of factors that contribute to joint stability and a deficit in any one of these can lead to recurrent instability [28]. These stabilising factors can be classified as dynamic or static. Dynamic factors include the rotator cuff, biceps tendons, negative intra-articular pressure as well as scapulothoracic and scapulohumeral motion. Static factors include the bony architecture of the joint itself as well as the glenoidlabrum and intrinsic ligaments of the glenohumeraljoint [28]. The incidence of traumatic anterior shoulder injury is reported to be 1.7% in the general populationand it is by far the most common form of shoulder instability [29]. Dislocation of any form is most common in young and male patients [30]. The most common injury mechanism resulting in an anterior dislocation is a fall with the humerus abducted and externally rotated. In this position, the inferiorglenohumeral ligament is the primary defence against anterior translation of the humeral head on the glenoid. This can become injured with a related Bankart lesion in up to 90% of anterior dislocations [31, 32]. A number of clinical tests have been designed to evoke the instability and allow the symptoms to present themselves, these are outlined below.

The main tests for anterior instability include the apprehension test, relocation test and surprise test. The apprehension test is carried out by flexing the patients elbow to 90°, then abducting the shoulder to 90° and applying an anterior force to the posterior surface of the shoulder, while externally rotating the shoulder. If these actions cause pain, the test is positive. A Relocation test is performed if the apprehension test is positive. It involves continuation of the external rotation force, but this time applying a posterior force to the anterior surface of the shoulder. The relocation test is positive if theseactions relieve the pain. The surprise test involves subsequently letting go of the anterior pressure, which recreates the anxiety feeling or dislocation. A positive apprehension test with a positive relocation test indicates anterior instability. A positive apprehension with a negative relocation indicates a possible AC joint pathology. The cross over arm test can also indicate AC joint pathology. The surprise test has the highest sensitivity (90.9) and negative likelihood ratio (0.78), compared to the apprehension (81.8, 025) and relocation (69.1, 0.08) tests. The apprehension test has the highest positive likelihood ratio for anterior instability [27].

Posterior Instability

Posterior instability is rare when compared to its anterior counterpart and accounts for up to 10% of cases of shoulder instability [33, 34]. Initially, posterior instability was thought to be mostly due to capsular laxity however, recent research has showed the importance of the glenoidlabrum and the glenoid depth [35]. Again, as with most shoulder complaints, the most common presentation is pain and can be diffuse across the shoulder or localised deeply within the posterior area of the shoulder. Athletes may present with pain particularly towards the end of their activities when muscle fatigue is high [35, 36].

The posterior apprehension test has a sensitivity of 99%, but a specificity of only 19% to detect posterior instability [37]. It is performed by applying posterior force on the anterior surface of an adducted and flexed shoulder. Apprehension by the patient for this movement signifies a positive test [33].

Labral Tear

Tears in the labrum are either restricted to the anterior labrum (as with a Bankart lesion in anterior instability) or extend posteriorly along the superior aspect (superior labral anterior posterior - SLAP lesion). These lesions most commonly present after other injuries and conditions, such as instability and rotator cuff tears, but they can present alone and can become a significant source of shoulder problems [38]. Nevertheless, effective treatment of these lesions can provide an improvement in the patient’s symptoms [38]. These are, however, difficult to diagnose without radiological investigations or direct vision with arthroscopy, although there have been some clinical tests that have been described in current literature [39]. Tests for detecting such lesions include active compression, Speeds test, anterior slide test, Crank test, Yergason's test, relocation test, biceps load test and the modified dynamic labral shear test. The description of each test, as well as the accuracy, is shown in Table **3**. Despite these specific tests, there are doubts regarding their efficacy including a systematic review of 260 articles in 2010 [40] which concluded that the likelihood ratios of Speeds and Yergason's tests did not rule in or out the presence of a SLAP lesion.

Shoulder Impingement

Shoulder impingement syndrome is a common cause of shoulder pain accounting for between 44 and 65% of shoulder pain complaints in general practice [41]. Shoulder impingement is caused by a narrowing of the subacromial space, resulting in an intrusion of the tissues within. This can be caused by a number of pathological conditions such as a bursitis, tendonitis or a partial or full thickness tendon tear [42]. The main presentation of this is pain anterolateral to the acromion, which may radiate to the lateral aspect of the humerus as far as the mid shaft area. This pain is frequently present at night and exacerbated by positioning of the affected limb overhead. Functional difficulties may also be present, such as difficulty when combing ones hair or any form of work with the arms over head [43].

The Neer's test, Hawkins Kennedy test and the shoulder arc test can be used to assist in the diagnosis of subacromial impingement. Of the three, the Hawkin's Kennedy test has the highest sensitivity. The Neer's test is performed by stabilizing the patient's scapula with one hand, while passively flexing the arm when it is internally rotated. If the patient reports pain in this position, then the result of the test is considered to be positive [44]. This has a sensitivity of

Table 3. Clinical Tests for Labral Tears

Test	Description	Accuracy [27]	
		Sensitivity	Specificity
Active Compression	In the standing patient the arm is forward flexed to 90° with the elbow in full extension and then adducted 10 - 15° medial to the sagittal plane of the body and internally rotated it so that the thumb pointed downward. The examiner, standing behind the patient, applies a uniform downward force to the arm. With the arm in the same position, the palm is then fully supinated and the manoeuvre is repeated. The test was considered positive if pain is elicited during the first manoeuvre, and is reduced or eliminated with the second. Pain localized to the acromioclavicular joint or "on top" is due to acromioclavicular joint abnormality, whereas pain or painful clicking described as "inside" the shoulder is considered indicative of labral abnormality[1].	67%	37%
Speeds test	The patient is seated. With the patient's elbow extended and the forearm in full supination, the clinician resists active forward flexion from 0°to 60°. A positive test is where pain is increased in the shoulder, and the patient localizes the pain to the bicepital groove [39].	20%	78%
Anterior Slide test	Patient sitting with hands on hips and thumbs pointing posteriorly. Examiner places on hand on top of affected shoulder and other hand on point of elbow. Examiner then applies a forward and superior force on the elbow. Patient asked to resist this force. Pain over the front of the shoulder or a click is positive[2].	17%	86%
Crank test (Compression rotation test/ O'Brian's test)	The patient is instructed to stand with his or her involved shoulder at 90° of flexion, 10° of horizontal adduction, and maximum internal rotation with the elbow in full extension. The examiner applies a downward force at the wrist of the involved arm. The patient is instructed to resist the force. The patient resists the downward force and reports any pain as "on top of the shoulder" (acromioclavicular joint) or "inside the shoulder" (SLAP lesion). The patient's shoulder is then moved to a position of maximum external rotation, and the downward force is repeated. A positive test is indicated by pain or painful clicking in shoulder internal rotation and less or no pain in external rotation [39].	34%	75%
Yergason's test	The patient's elbow is flexed and their forearm pronated. The examiner holds their arm at the wrist. Patient actively supinates against resistance. A positive test indicates a labral tear or a biceps tendinopathy[3].	12.4%	95.3%
Biceps load test	The patient is supine and the examiner sits at the side of the patient's involved extremity. The examiner places the patient's shoulder in 120° of abduction, the elbow in 90° of flexion, and the forearm in supination. The examiner moves the patient's shoulder to end-range external rotation (apprehension position) and examiner asks the patient to flex his or her elbow while the examiner resists this movement. A positive test is indicated as a reproduction of concordant pain during resisted elbow flexion [39].	38.6%	66.7%
Modified dynamic labral shear test	With the patient standing, the involved arm is flexed to 90° at the elbow, abducted in the scapular plane to above 120° and maximally externally rotated to tightness. It is then guided into maximal horizontal abduction. A shear load is then applied to the joint maintaining the external rotation and horizontal abduction while lowering the arm to 60°. A positive test is indicated by reproduction of pain and/or click in the joint[4].	72%	98%

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Table 4. Clinical Tests for Tendinopathy/ Rotator Cuff Tear

Test	Description
Jobes test	The patient holds the arm done at 30 degrees of abduction in the plane of scapula with the elbows flexed at 90° and the hands pointing inferiorly with the thumbs directed medially. A positive test consists of pain or weakness on resisting downward pressure on the arms or an inability to perform the tests[5].
Resisted External rotation test	Passively flex the elbow to 90° holding the wrist and ask to patient to resist rotating the shoulder to near maximum external rotation. Compare to other side [47].
Gerber's test (belly lift off test)	This test can only be carried out when the patient is able to develop an internal rotation sufficient to place the hand in the back. Normally, the patient can move the hand away from the back; in the case of a tear, the hand will remain "stuck" to the lumbar region. Sensitivity and specificity are said to be 100% in the case of full tears, but this test does not enable detection of a partial tear[6].
Modified belly press test	The patient presses the abdomen with the hand flat and attempts to keep the arm in maximum internal rotation. The test is considered positive when the elbow drops in a posterior direction, internal rotation is lost, and pressure is exerted by extension of the shoulder and flexion of the wrist[7].
External rotation lag sign	Passively flex the elbow to 90° holding the wrist to rotate shoulder to near maximum external rotation. Tell the patient to maintain the position and release wrist looking for a lag or angular drop. Compare to other side [27][8].

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72% and specificity of 60% [27]. The Hawkins Kennedy test is performed by examining the patient in sitting position with their arm at 90° and their elbow flexed to 90°, supported by the examiner to ensure maximal relaxation. The arm is then quickly moved into internal rotation. Pain in the subacromial space denotes a positive sign [45]. This has a sensitivity of 80% and specificity of 56 % [27]. The painful arc test involves observing the patient actively and slowly abducting their humerus through its entire range of movement. Pain in the acromion area, starting at 70° of abduction and easing after 130°, denotes a positive test. This has a sensitivity of 53% and a specificity of 76 % [27].

Rotator Cuff Pathology

Rotator cuff pathology can be in the form of a tendonopathy *via* a partial or a complete tear and these can present as an impingement syndrome with pain on overhead activity [16]. The causes of rotator cuff tendonopathy are normally theorised into intrinsic factors, extrinsic factors or a combination of both. The intrinsic factors are as a result of chronic damage from inflammation to the tendons or the bursa by over-use or trauma to the shoulder [46]. The alternative theory is that mechanical compression of the tendons by external structures causes the chronic inflammation and subsequent degradation of the structures in the subacromial space [44]. Tests for individual muscles include the Jobe's test (sensitivity 81%, specificity 89%) [27] for supraspinatus muscle, the resisted external rotation test for infraspinatus muscle (sensitivity 76%, specificity 57%) [47], the belly off and modified belly tests for subscapularis muscle (sensitivity 86%, specificity 91%) [27], and the external rotation lag sign for teresminor (sensitivity 97%, specificity 93%) [27]. Table **4** outlines these specific tests and how they are performed.

Assessment of the shoulder by way of accurate history and clinical examination is vital for the diagnosis of shoulder pathology. Many tests exist for the assessment of the shoulder. The accuracy varies with clinician as well as patient group. The clinician must be aware of the limitations of each test and tailor the routine of clinical exam in order to assess the shoulder appropriately. Assessment of the shoulder should be performed in the context of a detailed history and comprehensive examination, which should include a range of tests used in conjunction with each other.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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