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Critical review

Management

Scapular dyskinesis: Diagnosis and treatment

R Postacchini[1]*, S Carbone[2]

Abstract

Introduction

Scapular dyskinesis is a condition responsible for alteration of the normal position and kinematics of the scapula rather than a disease. It can thus be found in healthy individuals or be responsible for a syndrome characterised by several symptoms and objective findings, called SICK, which indicates the main features of the disease. Our purpose is to describe the anatomical, pathogenetic and clinical characteristics of the condition, and to highlight the appropriate management.

Discussion

The vast majority of patients with scapular dyskinesis were overhead athletes, particularly baseball, rugby, tennis and volleyball players. Treatment is based on rehabilitation, using numerous exercises for activating scapulothoracic muscles. However, few studies report the results of the rehabilitative therapy.

Conclusion

Scapular dyskinesis is a well-recognised condition that needs early diagnosis with appropriate clinical examination, including specific tests, and adequate treatment to avoid the instauration of a SICK syndrome. The latter requires aggressive and prolonged treatment to be effectively cured. However, the results of rehabilitation are poorly known.

Introduction

Scapulothoracic kinematics plays a key role in the normal function of the upper extremity since it affects shoulder stability, the integrity of the superior labrum, the dimension of the acromiohumeral space and the function of the rotator cuff, as well as the motion of the acromioclavicular (AC) and sternoclavicular (SC) joints. In overhead movements, the function of the scapulothoracic joint and the motion and strength of the glenohumeral joint are significantly influenced by the kinematics and forces transmitted by the lower limbs and trunk to the upper extremity.

When the arm is raised overhead, the scapulothoracic motion involves upward rotation, first internal and then, to a greater extent, external rotation, and posterior tilt of the scapula, as well as elevation and retraction of the clavicle. Of the numerous muscles inserted on the scapula, those playing the most important role in the scapulothoracic kinematics are the upper and lower trapezius (LT) and the serratus anterior (SA). Their activation and coupling are the most responsible for upward rotation, external rotation and posterior tilt of the scapula. The SA is also important as a stabiliser of the scapula medial border and inferior angle, thus preventing scapular winging[1]. When the scapulothoracic rhythm is altered, there are changes in glenohumeral angulation, AC joint strain, size of the subacromial space and activation of the rotator cuff muscles, with loss of normal arm position and motion.

The condition of altered scapular mechanics and motion is called 'scapular dyskinesis', where 'dys' indicates alteration and 'kinesis' motion[2]. Scapular dyskinesis is not necessarily a pathologic term. In fact, it may be found either in asymptomatic subjects or in patients with pain in the shoulder girdle[3–6], and, in both cases, in subjects playing no overhead sports or in athletes involved in several types of overhead sports, such as baseball, rugby, waterpolo, tennis, volleyball, swimming and badminton, as reported in the literature,[5,7–12] and in patients with sequelae of clavicle fractures or AC joint injuries[13,14].

Burkhart et al.[1] who recognised the importance of scapular dyskinesis in overhead athletes complaining of shoulder pain introduced the acronym SICK (**S**capular malposition, **I**nferior medial border prominence, **C**oracoid pain and malposition and dys**K**ynesis of scapular motion) to indicate the clinical findings that are present in the dyskinetic syndrome. Thus, this acronym should be used only when scapular dyskinesis is obviously symptomatic. The aim of this review was to discuss the diagnosis and treatment of scapular dyskinesis.

Clinical features

The symptomatic patient with scapular dyskinesis may complain of pain in the anterior and/or the posterosuperior aspect of the shoulder or in the upper part of the lateral arm below the acromion. Occasionally, pain radiates into the lateral aspect of the neck along the upper trapezius (UT) or shows a radicular-like distribution along the upper extremity. In most cases, the presenting symptom is pain in the coracoid region due to tightening of the pectoralis minor as a result of downward tilt and lateral displacement of the coracoid and the second most frequent is posterosuperior scapular pain[1].

Scapular dyskinesis is detected by observing the subject from behind. Dyskinesis is generally considered to be present when the subject shows one or more asymmetric positions of

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the scapula. Kibler et al.[15] identified three dyskinetic patterns. Type I is characterised by the prominence of the inferomedial border of the scapula due to abnormal posterior tilt around a horizontal axis in the plane of the scapula; when this type is isolated, the scapula may be lower than that of the opposite side (Figure 1). Type II consists in the prominence of its entire medial border due to excessive external rotation around a vertical axis through the plane of the scapula (Figure 2). These types would be often associated with superior labrum injuries (SLAPs). Type III displays upward rotation of the superomedial border of the scapula around a horizontal axis perpendicular to the plane, resulting in abnormal superior migration of the scapula (Figure 3); this pattern would be associated with decrease in the size of the acromiohumeral space and potential rotator cuff injuries. The author also included Type IV, indicating normal scapular position and motion.

The assessment is first performed with the patient's arm at rest. Only one or two or all three patterns of dyskinesis can be found. With pattern III, as a result of superior migration of the superomedial border, the latter displays a higher position compared to the contralateral scapula. In the resting position, the stability of the SC and AC joints should be assessed and the clavicle examined to detect any shortening, angulation, malrotation or hypermobility. The coracoid should be palpated to determine its position compared to the opposite side and the presence of possible tenderness on its medial border where the pectoralis minor is inserted. Next, the evaluation is done while asking the subject to elevate and then lower the arm in the sagittal and/or scapular plane. The third stage is to observe the scapular motion while elevating and lowering the arm with some 3 to 5 lb weight in one hand and then in the other[16]. In the presence of dyskinesis, there can be associated conditions, such as impingement syndrome, rotator cuff tear, SLAP lesion or shoulder instability. It is unclear, however, whether some of these conditions are the result of the dyskinesis or the latter depends

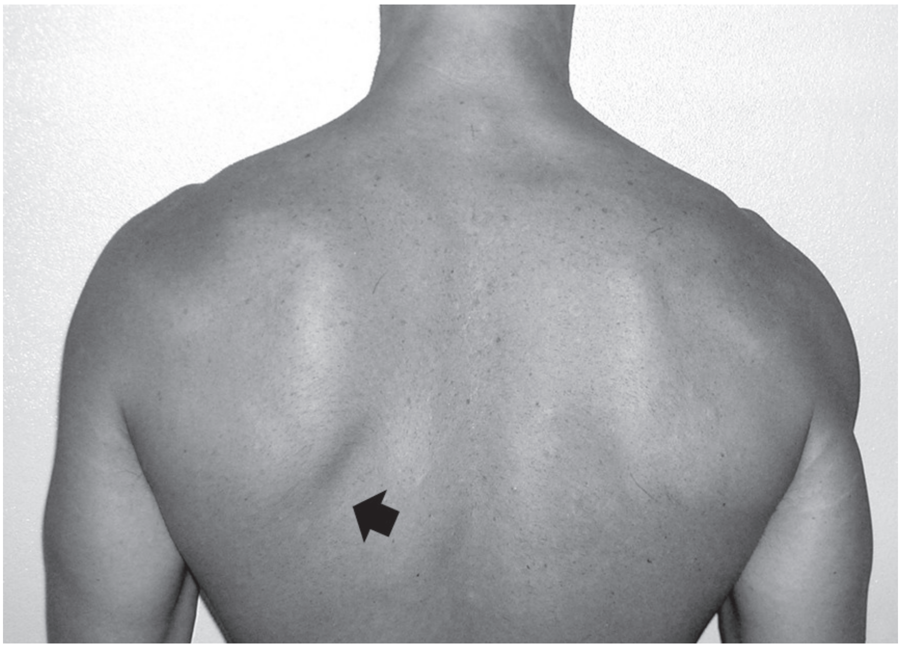

Figure 1:Type I dyskinesis in a water polo player, showing posterior prominence of the inferomedial angle of the left scapula (*arrow*).

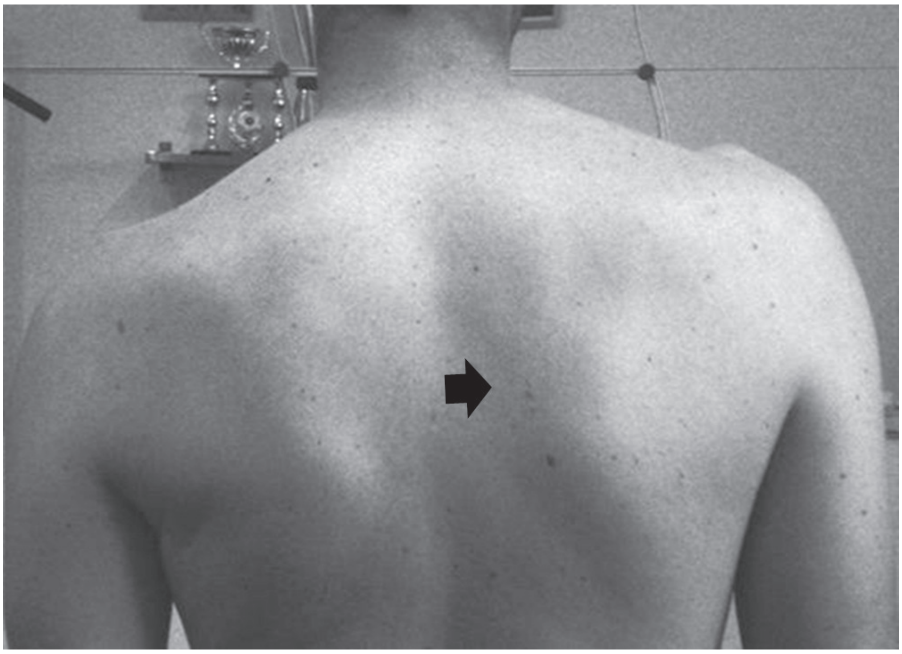

Figure 2: A volleyball player with Type II dyskinesis characterised by the prominence of the entire medial border of the right scapula (*arrow*).

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Figure 3: Type III dyskinesis with posterior prominence of the inferomedial angle, medial prominence of the medial border and upward migration of the superomedial border of the right scapula (*arrows*).

on those pathologies due to altered shoulder motion or defective muscle activation.

To determine the reliability of the clinical assessment, a study was carried out in asymptomatic subjects and in patients with shoulder pain[6]. The medial and superior scapular borders were assessed while the subjects performed three to five trials of arm elevation in the sagittal and scapular plane. The two evaluators categorised the scapular motion either using the 'four-type' method described above or a two-type method (yes/no)—yes, indicating the presence of one or more dyskinetic patterns, and no, indicating a normal motion. A three-dimensional kinematic analysis using an electromagnetic tracking was also performed to determine the presence of dyskinesia and to establish criterion validity of the two methods. The yes/no method produced a higher inter-rater agreement (79%) than the four-type method (61%). The former method had a higher sensitivity (76%) and positive predictive value (74%). In symptomatic subjects, multiple-plane asymmetries were found in a significantly higher percentage (54%) than in asymptomatic subjects (14%). The conclusion was that the yes/no method is a good screening tool for the presence of scapular dyskinesis. However, in contrast with these findings, Ellenbecker et al.[8] found a low reliability of the Kibler et al.[15] method of evaluation, using either the four-type or the two-type systems in baseball players videotaped while doing five repetition of scapular plane elevation holding a 2-pound weight.

The group of McClure et al.[12,16] described a different method than that of Kibler et al.[15] to identify scapular dyskinesis and determine its severity, which they termed scapular dyskinesis test. The task was to ask overhead athletes to perform five repetitions of bilateral weighted shoulder flexion and abduction. Scapular dyskinesis would be characterised by dysrhtythmia (premature or excessive scapular elevation or protraction, nonsmooth or stuttering motion on elevation or lowering or rapid downward rotation during lowering) and/or winging (medial border or inferior scapular angle posteriorly displaced from the thorax). Each STD was rated as normal motion, subtle abnormality or obvious abnormality. The agreement between raters in identifying normal or dyskinetic subjects was 75% to 82%. However, the presence of dyskinesis was not related to shoulder symptoms.

Clinical tests

Two corrective manoeuvres can be helpful to confirm the kinematic alterations, and to determine whether their correction normalises the arm motion and improves the patient's symptoms[4,17,18]. With the scapular assistance test (SAT), the examiner passively assists the scapula into upward rotation and posterior tilt during humeral elevation. The test is performed by pushing upward and laterally on the inferior angle of the scapula and by pulling the superior aspect of the scapula posteriorly while the patient elevates the arm. The test is positive if there is relief of symptoms and increased motion. The SAT increases the acromiohumeral space and is helpful in detecting the scapular contribution to impingement and rotator cuff dysfunction. With the scapular retraction test, the examiner first assesses the supraspinatus muscle strength by contrasting the arm elevation using the Jobe[19] 'empty can' and then repeats the test while stabilising the medial scapular border. The test is positive when the supraspinatus strength increases and pain decreases. This test would detect labral injuries related to scapular dyskinesis.

Measuring tools

Hong et al.[20] measured the distance from the ribs to the medial border

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of the scapula with an inclinometer either at rest and when placing the stabiliser muscles under load using the press-up test, which involves the subjects pressing down on a chair from the sitting position to raise their body up for 5 s while measuring the scapular medial border posterior displacement. The measurement may assist in the documentation of the scapula posterior prominence and its correction after treatment.

In a study[11], a digital inclinometer was used to measure the forward scapular posture in baseball players. The instrument consists of two 12-in combination squares in which one of the squares was attached in an inverted position to the ruler of the second square. The authors found that football players had more forward scapular posture in the dominant, than the nondominant, arm, probably related to posterior shoulder tightness.

Prevention

A 'shoulder at risk' in the throwing athletes, particularly baseball players, is the asymptomatic shoulder with a deficit of varying degree of glenohumeral internal rotation, scapular dyskinesis or both[1]. Early recognition of this condition and its treatment by internal rotation stretching and strengthening of scapular stabilisers was found to be effective to avoid the risk of glenohumeral internal derangement with potential injuries to superior labrum and cuff tendons, leading to a SICK syndrome.

Our group[13] first showed that 70.6% of patients with chronic Type III AC dislocation[21] treated conservatively had scapular dyskinesis and 58.3% of these had a SICK syndrome. These findings are consistent with a study showing that section of AC and coracoclavicular ligaments in cadavers could cause dyskinesis of the scapula and clavicle[22]. Furthermore, a study on patients with Type III AC dislocation treated surgically found that only 11.7% of cases had scapular dyskinesis and one patient (2.9%) was affected by SICK syndrome[14]. Surgical treatment of Type III AC dislocation would, thus, be highly effective in preventing scapular dyskinesis and SICK syndrome.

Treatment

Management of scapular dyskinesis is focused on rehabilitation. However, the asymptomatic subjects who occasionally play overhead sports may not need treatment if dyskinesis is mild, while those with clear-cut alterations deserve rehabilitation. The athletes 'at risk' must be treated before becoming symptomatic. The symptomatic overhead athletes should initially avoid activities involving the affected shoulder and start rehabilitation[1]. Return to sport at low level may be allowed when significant improvement in tissue stretching is obtained. Full return to competitive sport can be permitted after complete resolution of the scapulothoracic alterations, but rehabilitation should be pursued at least for 4 to 6 months. However, the results of the training program may not be correlated only to number and duration of sessions. It was shown, in fact, that the subject's psychomotor skills, evaluated by the ability to perform selected tasks with both hands, may play a role in obtaining good or poor outcomes[23].

Rehabilitation programs

The aim of the rehabilitation is to restore scapular muscular control and balance[24]. Since scapular dyskinesis implies a higher activation of the UT and a decreased control of the LT, middle trapezius (MT) and SA, the objective is to balance the ratio between the three parts of the trapezius, that is, UT/LT and UT/MT, and activate SA. Cools et al.[25] conceived a set of four exercises (prone extension, sidelying external rotation, sidelying forward flexion and prone horizontal abduction with external rotation) which would induce high activation of MT and LT and low contraction of UT. Studies have shown that the push-up plus, wall slide exercises and shoulder elevation in the scapular plane increase the activation of SA, with the push-up plus inducing minimal activation of the UT[26,27].

The rehabilitation program also includes exercises aimed at stretching both the posteroinferior glenohumeral capsule and the pectoralis minor, which are often retracted, particularly in overhead athletes. The posterior capsule is stretched in a sidelying position by forced internal rotation of the abducted arm with elbow at 90° and the pectoralis in the supine position by pushing posteriorly the shoulders. The cuff muscles should be maximally activated after adequate stabilisation of the scapular base on which they insert. In the literature[26,28], numerous other exercises are reported with the aim of activating not only the trapezius and SA, but also the rhomboids, the supraspinatus, infraspinatus, subscapularis and deltoid without or with weight-bearing upper extremity under the physiotherapist's supervision.

Mottram et al.[29] showed that normal subjects are able to learn exercises to move the scapula into posterior tilt and upward rotation after a short period of instruction and to repeat them without guidance of the physiotherapist. Using a motion analysis system and surface electromyography, they found that all parts of the trapezius demonstrated significant activity. In a similar study[7] on asymptomatic overhead athletes, it was found that conscious patient's control of the scapula orientation significantly increases the activation of the three parts of the trapezius without changing the UT/MT and UT/LT ratios in two of the four exercises described by Cools et al.[25], namely the prone extension and sidelying external rotation of the arm.

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Discussion

The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964), and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

The subjects enrolled in the studies analysed for this review played seven types of sports. While a part of the subjects were found to be normal, the vast majority had varying degrees of dyskinesis[6,15], their total number being approximately 500 (Table 1). Considering the enormous number of individuals practising these sports, the prevalence of scapular dyskinesis would appear quite low and less than generally thought. Furthermore, more than half of the subjects with dyskinesis enrolled in those studies were asymptomatic or had only a 'subtle' dyskinesis[16]. This highlights that scapular dyskinesis is an anatomical condition not necessarily symptomatic and often probably needing no treatment.

In numerous studies, the diagnosis of scapular dyskinesis was based on Kibler's classification system[6,15]. However, since recent investigations questioned the validity of that system[8,16], many results in the literature may not be reliable in terms of identification either of scapular dyskinesis and of its severity.

Most of the exercises suggested for scapular dyskinesis are based on EMG studies demonstrating the activation of the specific muscles investigated. However, for many other exercises, although largely employed for dyskinesis, there is little proof of their effectiveness in this condition.

In most studies reporting on the rehabilitation of patients with SICK syndrome, the results of treatment are not reported or, when assessed, the evaluation was done at short term[30], the longest follow-up being 1 year[1]. It is, thus, unknown whether the rehabilitation represents an effective cure also at long term.

These observations indicate that the various aspects of scapular dyskinesis and SICK syndrome are still scarcely known and that extensive research is needed to better understand and manage this condition.

Table 1 Subjects with proven or possible dyskinesis evaluated in the articles analysed in this study

Sport played	Number of players
Baseball[1,8,11,16,20]	219
Rugby[10]	120
Water polo[16]	89
Tennis[1,5,30]	81
Volleyball[1,30]	33
Swimming[16]	19
Badminton[7]	NR

NR, not reported.

Conclusion

Scapular dyskinesis is an alteration of the scapulothoracic rhythm characterised by dysfunction of the UT and LT and SA. Kibler et al. identified three patterns of dyskinesis to determine the presence and severity of alterations, but their reliability was not confirmed. Dyskinesis can affect asymptomatic subject, but it is typically observed in overhead athletes in whom it may cause a SICK syndrome, responsible for shoulder pain and functional deficit. When unrecognised and untreated, scapular dyskinesis may cause SLAP lesions, subacromial impingement and injuries to cuff tendons. . Treatment is based on rehabilitation, but not all exercises have sound proofs of efficacy. Little is known on the results of treatment, and only at short term.

Abbreviations list

AC, acromioclavicular; LT, lower trapezius; MT, middle trapezius; SA, serratus anterior; SAT, scapular assistance test; SC, sternoclavicular; UT, upper trapezius

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