SUMMARY. Altered dynamic control appears to be a significant contributing factor to shoulder dysfunction. The shoulder relies primarily on the rotator cuff for dynamic stability through mid-range. Hence, any impairment in the dynamic stabilizing system is likely to have profound effects on the shoulder complex. The rotator cuff appears to function as a deep stabilizer, similar to the transversus abdominus and vastus medialis obliquus, with some evidence of disruption to its stabilizing function in the presence of pain. Similarly, serratus anterior appears to function as a dynamic stabilizer, also demonstrating altered function in painful shoulders. Examination of dynamic control begins with a detailed examination of posture, evaluation of natural movement patterns and functional movements and assessment of the specific force couples relevant to shoulder function. One useful strategy in management of altered motor control related to these force couples is that of training isolated contraction of the rotator cuff prior to introduction of loaded activity, together with facilitation and training of appropriate scapular muscle force couples – serratus anterior and trapezius, in relation to arm elevation.

INTRODUCTION

The focus of this paper is assessment and management of dynamic control of the shoulder complex. The shoulder is a mobile joint that relies heavily for mid-range stability on muscle control (Schenkman & Rugo de Cartaya 1987, 1994; Lippitt & Matsen 1993; Lippitt et al. 1993; Souza 2000; Ciullo 1996; Kibler 1998a; David et al. 2000). Therefore, evaluation of such control and treatment directed at its improvement should form an integral part of management of all shoulder disorders. The programmes suggested are yet to be subjected to the rigours of scientific evaluation but follow principles demonstrated to be effective in other areas of the body (Richardson & Jull 1995; O’Sullivan et al. 1997a, b, 2000; Richardson et al. 1999). They are based on research on muscle function and control (Hodges & Richardson 1996; O’Sullivan et al. 1997a, b, 2000; Richardson et al. 1999; Cowan et al. 2000, 2001; Shumway-Cook & Woollacott 2001), reports from other experienced clinicians (for example, Wilk & Arrigo 1992; Kibler & Chandler 1994; Wilk 1994; Kibler 1998a, b; Chmielowski & Snyder-Mackler 2001; McConnell 2001) coupled with extensive clinical experience within a framework of sound reflective reasoning (Jones et al. 2000) and knowledge of patterns of presentation of shoulder disorders (Magarey 1999).

Panjabi’s (1992) now familiar concept of a “neutral zone” for the lumbar spine as a zone in which translatory movements are available can equally be applied to the glenohumeral joint (Hess 2000). The capsulolabral structures (passive restraints) are responsible for setting the limits of passive movement (Jobe 1990; O’Brien et al. 1990; O’Driscoll 1993; Pagnani & Warren 1994) with the muscles, influenced in their activity by their neural control, responsible for maintaining the humeral head centred in the
The balance of muscle activity within force couples is often more important to normal function than isolated strength of individual muscles (Kibler 1998a, b; Kibler & Chandler 1994). Such balance is determined by the length of muscle and associated fascial tissue and the pattern of recruitment. When tested in isolation in a classic isometric manual muscle test, a muscle may test strongly, but perform poorly during functional activity.

Kibler (1998a) used the term, the ‘length-dependent pattern’ of muscle activity to describe co-contraction force couples which operate locally around a joint, controlled by feedback from muscle spindle receptors and responding to perturbations of joint position. The primary function of such force couples is maintenance of joint stability.

One key force couple relevant to stability of the glenohumeral joint is that between the lower elements of the rotator cuff – subscapularis anteriorly and infraspinatus/teres minor posteriorly (Saha 1971; Poppen & Walker 1978; Kapandji 1982; Soderberg 1986; Schenkman & Rugo de Cartaya 1987, 1994; Norkin & Levangie 1988; Burkhart 1994, 1996; Wilk 1994) (Fig. 1). These muscles are ideally placed to draw the humeral head into the glenoid and maintain its axis of rotation, so that they can perform their role of concavity compression (Saha 1971; Lippitt & Matsen 1993; Lippitt et al. 1993; Sharkey & Marder 1995; Wuelker et al. 1995, 1998). Failure of function of these muscles in their stabilizing role will lead to creation of an abnormal axis of rotation (Poppen & Walker 1978; Howell & Galinat 1987; Schenkman & Rugo de Cartaya 1987, 1994; Howell et al. 1988; Souza 2000) and abnormal translation of the head of humerus (Burkhart 1994, 1996).

The shoulder is a highly mobile joint, with over 1600 degrees of movement, but its stability is very important to its function. Any disruption to this balance, for example through injury to the soft tissues, may lead to abnormal translation of the humeral head and loss of joint stability. The balance of muscle activity within force couples is often more important to normal function than isolated strength of individual muscles (Kibler 1998a, b; Kibler & Chandler 1994). Such balance is determined by the length of muscle and associated fascial tissue and the pattern of recruitment. When tested in isolation in a classic isometric manual muscle test, a muscle may test strongly, but perform poorly during functional activity.

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In the scapulothoracic area, the force couples associated with movement overhead alter through range, as the axis of rotation changes with increasing elevation and plane of movement (Inman et al. 1944; Poppen & Walker 1978; Dvir & Berme 1978; Schenkman & Rugo de Cartaya 1987, 1994; Bagg & Forrest 1988; Culham & Laprade 2000; Abelew 2001), but the primary contributors are serratus anterior and trapezius (Inman et al. 1944; Basmajian 1963; Kapandji 1982; Bagg & Forrest 1986, 1988; Schenkman & Rugo de Cartaya 1987, 1994; Norkin & Levangie 1988; Souza 2000). In the early part of range, when the axis of rotation is at the root of the scapular spine, the principal rotators are the upper fibres of both serratus anterior and trapezius (Basmajian 1963), whereas when the axis of rotation moves towards the acromioclavicular joint, the relative contribution of upper trapezius lessens while that of lower trapezius increases, together with the lower fibres of serratus anterior (Basmajian 1963; Schenkman & Rugo de Cartaya 1987, 1994) (Fig. 2A, B). Serratus anterior is, therefore, a significant component of the force couple throughout range (Bagg & Forrest 1986).

David et al. (2000) demonstrated consistent activation of the rotator cuff prior to the more superficial delto-pectoral muscles during isokinetic rotation in normal shoulders, confirming their role as dynamic stabilizers for the glenohumeral joint. Similarly, analysis of activation during rotation in the normal shoulder revealed that at least one component of the antagonist rotator cuff was always active (David et al. 2000), providing evidence of their stabilizing role.

Strong evidence is available that pain alters the timing of contraction in stabilizing muscles – transversus abdominis and multifidus in relation to the lumbar spine (Hides et al. 1994, 1996; Richardson & Jull 1994, 1995; Hodges & Richardson 1996, 1998; Hodges et al. 1996; O’Sullivan et al. 1997a, b, 2000), vastus medialis obliquus in relation to the knee (Cowan et al. 2001). Preliminary continuation of our shoulder stabilization research (David et al. 2000) with unstable shoulders has shown widely differing patterns of onset of muscle activity, with failure of the rotator cuff and biceps to be activated prior to the delto-pectoral group and, in some instances, failure to fire until after the onset of movement – thus demonstrating a similar disruption to stabilizing function as found in the knee and lumbar spine.

Kibler (1998b) considered that serratus anterior and lower trapezius are susceptible to inhibition in painful shoulders. This inhibition is seen early as a non-specific response to any painful condition in the shoulder, presenting as a disorganization of the
normal firing pattern and a decreased ability to produce torque and to stabilize the scapula, a phenomenon Kibler (1998b) described as ‘scapular dyskinesis’.

Alteration in activity of serratus anterior in the painful shoulders of swimmers and throwers has been found when compared to that of non-painful athletes (Glousman et al. 1988; Scovazzo et al. 1991; Pink

Fig. 2—Force couples around the scapula relevant in arm elevation (Adapted from Bagg and Forrest 1986; Kapandji 1982). Depicted is the most common pattern of muscle recruitment reported by Bagg and Forrest (1986). (A) In the first 60°, the axis of rotation of the scapula is situated at the root of the spine of the scapula. Primary muscles involved in upward rotation of the scapula are lower fibres of serratus anterior and upper trapezius, working via the clavicle, with lower and middle trapezius functioning eccentrically to control the movement. In this range, muscle function is highly variable. (B) In the next 60°, the axis of rotation begins to move along the spine of the scapula towards the acromioclavicular joint. This means that the emphasis of contribution of the muscles changes, with the fibres of lower trapezius now becoming more actively involved in upward rotation, along with those of lower serratus anterior and upper trapezius. (C) By the time the arm reaches 120° of elevation, the axis of rotation is at the acromioclavicular joint. Upper trapezius is no longer positioned to be able to function to upwardly rotate the scapula, whereas lower trapezius is now ideally situated to perform this function, in conjunction with lower serratus anterior. (D) In the final stages of elevation, lower trapezius and lower serratus anterior are the primary rotators of the scapula, with upper trapezius functioning to rotate the clavicle and middle trapezius working eccentrically to control the degree of upward rotation.
et al. 1993). Wadsworth and Bullock-Saxton (1997) found significant delay in activation of serratus anterior in the painful shoulders of swimmers compared with non-painful shoulders, with little change in timing of activation of trapezius. All these studies highlight serratus anterior as the primary stabilizer of the scapulothoracic region, functioning in a manner similar to other deep stabilizers.

The movement of elevation has been used as an example of the need to consider force couples. Clearly, different considerations must be made if the disorder involves other movements and loads. Adduction against resistance needs to be considered in conjunction with elevation in the throwing or swimming athlete, for example. This function is well described in Schenkman and Rugo de Cartaya (1994) and Souza (2000).

PRINCIPLES OF A DYNAMIC ASSESSMENT

Patients move in a variety of ways, with a wide range of what can be called ‘normal’ (Shumway-Cook & Woollacott 2001). Influences on movement patterns include avoidance of pain, general health and mood, relative length of tissues, strength and level of activity of muscles and timing of contraction of those muscles. Functional demands and habitual activities also contribute to development of particular movement patterns (Shumway-Cook & Woollacott 2001). All these factors must be considered during examination of muscle function around the shoulder.

Antalgic movement patterns are familiar features of physical examination – a classic example is the arm that drifts towards the plane of the scapula during frontal plane abduction, with prevention of this movement causing pain. A patient who is unwell or depressed often demonstrates a hunched posture with slow, heavy movements. Such a posture, if habitual, could lead to learned poor scapular rotation during arm elevation, with the potential for development of specific muscle length (Sahrmann 2001). Movement occurs in the path offering the least resistance, such that compensation for a tightened tissue or restricted joint occurs with movement in a different plane or of a different body part. A weakened muscle will also disrupt a normal movement pattern as its weakness must be compensated for by an altered pattern of activity in a substitute muscle capable of achieving similar action.

Altered timing of contraction, as discussed above, influences movement patterns, such that either the torque producing muscles tend to be activated without pre-setting by the stabilizers (Hodges & Richardson 1996, 1998; David et al. 1997; Cowan et al. 2001) or the nature of activity of the stabilizers is converted from one which is direction-independent to one which becomes direction-specific (Hodges & Richardson 1997).

To achieve a successful outcome from any dynamic stabilization programme, rehabilitation must be centred on the patient’s abilities rather than impairments. The starting point for progression must be correct movement patterns and muscle recruitment. Training in an incorrect pattern will only reinforce the pattern. Therefore, the assessment of muscle function must reveal the patient’s abilities in addition to impairments. As a simple example, if lower trapezius is tested in a standard manual muscle test position (Kendall et al. 1993) and found to be weak, the position in which the muscle is tested, or the load placed on the muscle during testing, must be incrementally reduced to a stage where the contraction can be initiated and maintained successfully. The point from which to start re-training of lower trapezius, if appropriate, is that where the contraction can be successfully achieved. Each of the tests described below is based on this principle.

Gentile (1992) advocated that goal-directed functional behaviour should be analysed at three different levels: the action itself, the movements that are incorporated in that action and the neuromotor processes that drive the movements – for example, the integrity of the motor and sensory systems.

DYNAMIC EXAMINATION

Knowledge of, and the indications for, inclusion of specific muscle length (Evjenth & Hamberg 1980) and isolated strength tests (Kendall et al. 1993) is assumed by the reader. In this paper, those components and techniques that we have found particularly useful during dynamic examination will be discussed.

Observation of posture

Altered joint position such that some muscles appear tight or overactive and others lengthened or underactive provides early hypotheses in relation to muscle function. Observation of the posture of the whole body is an integral component of postural assessment of the upper quarter. This should occur in the context of the patient’s functional demands, so that it includes evaluation of routine postures used by the patient. Lower quarter muscle development and spinal posture can indicate whether whole body integrated movement patterns are adequate for normal upper quarter muscle function.

Cervicothoracic posture has considerable influence on scapular position and mobility and therefore, also glenohumeral mobility (Crawford & Jull 1991; Culham & Peat 1993; Solem-Bertoff et al. 1993). Specific analysis of scapular and arm position will
then provide initial clues to the comparative load carried by the glenohumeral and scapulothoracic joints. Finally, specific analysis of contour and tone of all relevant muscle groups should be made.

**Analysis of movement patterns**

Particular emphasis is placed on detailed visual analysis of spontaneous movement patterns. Specific attention is given to recruitment of particular muscle groups related to each movement, visual assessment of the timing of that recruitment and the relative contribution of all body parts to the movement.

An important part of normal function is the ability to dissociate different body parts during movement. Our clinical experience has shown us that the inability to dissociate trunk from scapular movement, for example, is often a significant contributor to shoulder dysfunction. In the same way, poor trunk and pelvic stability place considerable stress on the upper quarter during loaded or rapid functional activities (Kibler 1998a, b).

Control of the movement, both concentric and eccentric, is also evaluated, at speeds relevant to the patient’s presentation. Similarly, if symptoms are only provoked after repetition or under load, these components are included. Repetition of arm elevation while holding a small weight may demonstrate altered movement patterns not detected with a single unloaded movement.

Careful attention is placed on detection of substitution strategies and provocation of symptoms. Any asymmetries found are corrected actively, if possible, and passively to evaluate their effect on symptom production and performance of the movement. Active correction provides some insight to the patient’s awareness of postural or movement impairment and the appropriate motor strategy to correct it. Postural correction or facilitation of a more normal muscle activation that alters pain on movement provides a positive indication of a relationship between pain and movement and of the potential benefit of a dynamic rehabilitation programme.

**Specific evaluation of relevant force couples**

In an initial examination, more importance is placed by the authors on evaluating the force couples relevant to stabilization of the shoulder complex than on isolated manual muscle testing as knowledge of the more subtle stabilizing capability of the shoulder complex allows better interpretation of the results of the more superficial muscle strength assessments. Testing of more global muscle function – termed the ‘force–dependent’ patterns by Kibler (1998a) – tends to be addressed at later sessions.

**Rotator cuff**

The two tests that we have developed and used over a number of years to determine dynamic control of the head of humerus in the glenoid are the dynamic rotary stability test and the dynamic relocation test.

1. **The Dynamic Rotary Stability Test (DRST)**. The DRST is used to evaluate the ability of the rotator cuff to maintain the normal centring of the humeral head in the glenoid when loaded through rotation (Howell & Galinat 1987; Howell et al. 1988). In a frankly unstable shoulder or one in which rotator cuff dynamic control is lacking, the humeral head can be felt to translate when the rotator cuff is loaded. In more subtle situations, or where the instability is more functional than structural, provocation of symptoms, alteration in the quality of contraction, clicking/clunking and compensation by other muscle groups are often noted, without the sensation of humeral head translation.

The DRST is undertaken in different parts of the range of glenohumeral flexion and abduction from neutral towards the functional position(s) in which the patient has symptoms, whether pain, weakness, apprehension or instability (Fig. 3). The aim is to find the position(s) in range where the patient has control of the head of humerus as close as possible to the position in which control is lost. The test is performed isometrically, isotonically, concentrically and eccentrically at different speeds and under different loads. The amount of resistance added is usually light to moderate, as the assessment is one of the ability to stabilize, rather than one of strength of rotation.

2. **The Dynamic Relocation Test (DRT)**. The DRT is a test of the ability of the transverse force couple of the rotator cuff to stabilize the head of humerus in the glenoid against a de-stabilizing load. It is predicated on the knowledge that, in normal situations, the rotator cuff functions in some degree of co-contraction to stabilize the glenohumeral joint during dynamic function and this activation precedes that of the more superficial torque producing muscles (David et al. 1997, 2000). Co-contraction stiffens a joint and is an important feature of early stages of skill acquisition (Shumway-Cook & Woollacott 2001). In patients with shoulder pain, the co-contraction and pre-setting appears to be lost. Once the ability to isolate the co-contraction has been determined in the optimal position (Fig. 4), maintenance of this isolated contraction can be evaluated in different positions and during different tasks.

Patients with a dysfunctional shoulder may find isolation of this contraction to the rotator cuff difficult without considerable facilitation and practice. Once the patient can master the relocation contraction, the ability to maintain it during arm movement is evaluated, using any relevant functional movement, with progressively increasing difficulty. If
abnormality were detected in the DRST, the test position in which loss of control was found can be re-evaluated with facilitation of dynamic relocation. If control is improved, dynamic rehabilitation has a good chance of success. The specific techniques for these tests are outlined elsewhere (Magarey & Jones, 2003). To date, research on the reliability and validity and on establishing normative values for these tests is incomplete.

**Scapular stabilization and movement**

Scapular stabilizing and movement function is evaluated with two methods, using weightbearing assessment of scapular control and with modified PNF diagonal patterns in isolation from and in conjunction with arm movements.

1. **Weightbearing assessment of scapular control.**

Weightbearing assessment allows evaluation of a number of factors. In particular, it is a useful position for testing dissociation of spinal movement from scapular movement and lumbar from thoracic movement, in addition to scapular control. Although dissociation can be evaluated in many different
positions, the steps to evaluate this ability are integral to the scapular assessment and are therefore included.

The standard starting position for weightbearing assessment is four point kneeling, although assessment should be undertaken in multiple different positions, as a wide variation appears to exist in people’s ability to function in weightbearing. The positions used include leaning against a wall or table, four point kneeling, prone on elbows and weightbearing in the frontal and scapular plane. In the frontal plane, the contribution of the trapezius components of the force couple may be stressed more than serratus anterior as a result of the lesser protraction component (Inman et al. 1944; Schenkman & Rugo de Cartaya 1994).

In four point kneeling, the patient’s ability to dissociate pelvic from lumbar, lumbar from thoracic movement and thoracic from cervical movement is evaluated first. Spinal dissociation and awareness of natural posture will facilitate success in scapular control re-training. The next step is to determine whether the patient can protract and retract the scapulae without concurrent spinal movement (Fig. 5). If this can be achieved, the scapula’s holding ability in neutral (mid-range) protraction is then assessed through different stages and types of loading. If loading in this position fails to demonstrate any impairment, the assessment can be progressed to more challenging positions or demands. Equally, if scapular control is not adequate, positions which require less weightbearing or cognitive load should be evaluated.

2. Scapular diagonal patterns. One method in which to assess functional muscle performance is through the use of the PNF patterns from glenohumeral extension/abduction/medial rotation to elevation/adduction/lateral rotation (D1) and from extension/adduction/medial rotation to elevation/abduction/lateral rotation (D2) (Voss et al. 1953; Knott & Voss 1968; Engle 1994). During these movements, the scapula moves from retraction/depression/downward rotation to protraction/elevation/upward rotation and from protraction/depression/downward rotation to retraction/elevation/upward rotation, respectively. Having first determined that the relevant range is available passively, an initial assessment of the patient’s ability to perform these scapular patterns independent of arm movement is undertaken. Without inclusion of the arm, the rotation component of the scapular movement is minimal, but the resultant diagonal movements are regularly dysfunctional with a painful shoulder. This may simply relate to lack of familiarity with the movement, so inclusion of stimulation with passive, active assisted and resisted movement through the patterns is used to determine whether this is the case (Fig. 6A,B). If so, repeat assessment of unassisted active scapular diagonal movement is significantly improved, whereas in the impaired shoulder, such improvement is not immediately evident (Fig. 7).

Often, patients and non-symptomatic individuals will be biased in their un-loaded scapular diagonal patterns, possibly reflecting learned movements. For example, physiotherapists and keyboard operators frequently present with an exaggerated protraction component at the expense of shoulder elevation in the D1 pattern.

Finally, the scapula’s ability to rotate upwardly during arm elevation is evaluated, using similar principles to those described for the scapular patterns. With this assessment, the emphasis is on the retraction/downward rotation to protraction/elevation/forward rotation component with less emphasis on depression/elevation (Fig. 8).

In most instances, the authors have found that, at initial dynamic assessment, these tests, coupled with appropriate muscle length assessment, are all that need to be included for the upper quarter. Specific evaluation of isolated muscle strength may be appropriate, particularly for the athletic population, but frequently, because of impairment in the stabilizing force couples, such evaluation is withheld until stabilization is improved. However, evaluation of
trunk control, either the ability to isolate the deep stabilizers, as described by Richardson et al. (1999) and control of pelvic and hip muscle function, or through control of neutral and later out-of-neutral postures and movements should be included, as upper quarter stability requires a strong stable base on which to work (Fleig et al. 1994; Kibler 1998a,b).

MANAGEMENT OF MUSCLE CONTROL DYSFUNCTION OF THE SHOULDER COMPLEX

From the examination findings, a management plan can be made, addressing those aspects of each part of the examination found to be impaired and ensuring maintenance of an appropriate balance between function of the scapulothoracic and scapulohumeral muscles. Training for control of one region must not occur at the expense of the other. Similarly, training for either the glenohumeral joint or scapulothoracic region must be implemented in positions of total body control and stability. In this paper, the dominant features associated with the early stages of rehabilitation are addressed.

Our approach to management of muscle control impairment of the shoulder complex follows similar principles to those outlined in other dynamic stabilization programmes (for example, O’Sullivan et al. 1997a, b, 2000; Richardson et al. 1999; Comerford & Mottram 2001; Sahrmann 2001). Progression through the programmes is considered...
in terms of attainment of specific skills and control – a criteria-based protocol (Chmielewski & Snyder-Mackler 2001) – rather than length of time, as in many shoulder rehabilitation programmes (for example, Kunkel & Hawkins 1994; Loeb et al. 1994; Souza 2000; O’Brien et al. 1994; Scarpinato & Andrews 1994; Timmerman et al. 1994; Ciullo 1996). Our approach also works on the principle of specificity of muscle function and the importance of functional relevance for transfer of training (Kibler & Chandler 1994; Kibler 1998a; Shumway-Cook & Woollacott 2001) so that, as soon as possible, any re-training occurs in positions relevant to the patient’s habitual activities.

The authors use the concept of re-training by breaking function into interim steps (Schmidt 1991; Weinstein 1991). One goal of any motor control rehabilitation is to gain awareness of, and the ability to, activate the deep stabilizers of the region prior to activation of the, usually, more superficial torque producing muscles and to maintain that activation during activity. Another is retraining of optimal movement patterns. Both involve motor programme retraining and therefore, refined, controlled activation of the deep stabilizing force couples, using either strategies of isolation or controlled posture or movement facilitated by imagery. Activation of isolated muscles is often difficult to conceptualize. Therefore, patient explanation of the reasons for the programme and the processes required become important aspects of the management. Similarly, imagery can facilitate understanding of the action required. Without the patient’s understanding and collaboration in the process, it is doomed to failure, as perseverance, even when there is little obvious initial change, is essential to success.

Pain inhibition appears to have a powerful influence on the motor system (Richardson 1987; Hodges & Richardson 1996, 1998; Cowan et al 2001), so palliative treatment may be necessary to decrease pain in the early stages. However, there is no need to wait for pain to settle before starting a motor control programme within a pain-free range at a load that does not provoke symptoms, as often, restoration of control acts as a potent pain inhibitor.

Retraining motor programming, or the neural control in Panjabi’s (1992) model, is dependent on motor learning. Motor learning involves learning new strategies for sensing as well as moving, arising from a complex of perception—cognition—action processes (Shumway-Cook & Woollacott 2001). Motor learning can be enhanced by the use of mental imagery, tactile, verbal, visual, tapping, weightbearing and movement oriented cues – different cues are effective with different people. Initially, facilitation is undertaken in an optimal position for the relevant muscles, usually mid-range.

Frequent stimulation and repetition improve awareness and the ability to activate far more than an isolated exercise session once a day (Catalano & Kleiner 1984; Shumway-Cook & Woollacott 2001). Therefore, while learning the activation technique, we encourage patients to practise it for a few minutes several times a day. Initially, each region is trained in isolation – that is, the rotator cuff is worked with the scapula in an unchallenged position and vice versa. The muscles are worked in co-contraction in their relevant force couples, with the contractions initially isometric and isotonic with low load, with a gradual build up and release.

Once dynamic stability is established, the positions in which control is emphasized are determined by the examination findings and functional needs of the patient. During the DRST, for example, the patient may have demonstrated good control up to 60° of abduction in isotonic external rotation, while isometric control may have been satisfactory to 120°. If these positions are re-tested with pre-setting of the rotator cuff via the DST manoeuvre, better control may be found. Training should then be started in those positions in which the patient has control, but as close to the position where that control is lost as possible. Isometric and isotonic training can be undertaken concurrently, as long as the patient is aware of the different sensations associated with control and lack of control. Teaching this difference in feel may be time consuming initially, but is essential to success of the programme, as training in a position in which control is lacking may reinforce poor movement patterns.

As control is mastered, the load can be increased cognitively by asking the patient to maintain control in one area and work on the other. Once activation can be achieved in an isometric, stable situation, we encourage the patient to incorporate the activation into simple tasks of daily living. Deliberate activation of the rotator cuff in the DRT manoeuvre while waiting at traffic lights in a car, or prior to reaching to answer the telephone; setting of the scapulae in an optimal position while at a computer or before reaching into a cupboard are examples of cognitive challenge. When such tasks are mastered, physical load, speed and more complicated, integrated tasks can be progressively added. Progression is made with any particular exercise only when the step before is mastered. The more times the technique is repeated and the more different situations in which it is repeated, the quicker the patient is likely to master it.

While this intensive training is underway for the upper quarter, any more general impairment in motor control should also be addressed. Issues such as poor dissociation may need to be improved before scapular work can be initiated and transversus abdominis and gluteal control can be incorporated and progressed from the first day of treatment. If
control is good, but general strengthening is indicated, this can be undertaken in conjunction with the upper quarter control programme. Progression in each region may be at different rates, depending on the degree of impairment, so each component must be regularly checked and progressed individually. Once this level is mastered, function is re-evaluated to determine the need for further progression. For many non-athletic patients, we have found that addressing the motor control issues and teaching the patient appropriate strategies to continue monitoring and stimulating the control are sufficient for a return to normal function. However, in the manual labourer or overhead athlete, further progression is needed. Whether rehabilitation is ceased at this point or continued, the authors have found that the patient who has had pain in the shoulder needs to continually monitor their dynamic control and practise it regularly, or the control tends to be lost. A brief self-directed activation session once or twice a week or deliberate pre-activation during normal function is sufficient to maintain the control once mastered to this level.

CONCLUSION

In this paper, we have presented an approach to dynamic evaluation and management of the shoulder complex that we use in conjunction with detailed passive examination and management as indicated for each patient. The ideas presented here represent one set of strategies that we have found to improve shoulder function. A deliberate setting in neutral rather than specific pre-activation can also be effective with different patients. Interestingly, a number of researchers have demonstrated that stable movement patterns become more unstable just prior to a transition to a new movement pattern in both adults and children (Kelso & Tuller 1984; Gordon 1987; Woollacott & Shumway-Cook 1990). Therapists should be aware of this possibility when reassessing patients undergoing a dynamic rehabilitation programme such as the one suggested. It is important that patients be made aware of this possibility so that they do not become discouraged through this phase of their training.

While the dynamic component of our management approach has not been challenged through clinical trial, it is based on similar principles to those demonstrated as effective in the cervical and lumbar spine regions (O’Sullivan et al. 1997a,b, 2000; Jull 2000; Jull et al. 2002). If the whole process is linked by sound reflective clinical reasoning (Jones et al. 2000), the optimal balance of passive and dynamic management will be included.

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