When shoulder movements become restricted in all directions, the literature reports that contracture of the joint capsule is not present in every case. These findings suggest a different underlying pathology in some cases, which restricts shoulder movements in a manner resembling contracture.

In order to investigate the concept of another mechanism, fourteen patients were selected with a specific pattern of shoulder stiffness: a gross restriction of lateral rotation associated with only moderate restrictions of abduction and medial rotation. The patients were treated with mobilization of the lower cervical spine, which resulted in an improvement in the range of lateral rotation of the shoulder, the most restricted movement. These results suggest a correlation between the cervical spine and shoulders with this pattern of movement restrictions.

Shoulder movements may become painful and grossly restricted in all directions in the well recognized clinical syndrome of frozen shoulder. The condition is often accompanied by contracture and adhesions of the joint capsule and, when present, these changes are considered to be the cause of the restrictions of movement (Neviaser 1945, Lundberg 1969). Recently, arthrographic (Rizk et al 1984, Binder et al 1984) and arthroscopic (Haeri and Maitland 1981) studies have revealed that contracture and adhesions of the joint capsule are not present in every case of suspected frozen shoulder. These findings suggest that in some stiff shoulders a different underlying pathology causes the restricted movement, though in a manner resembling contracture.

In order to investigate another mechanism a group of patients were selected as case studies. Selection was based on a similar pattern of shoulder stiffness to that found typically with capsular involvement, but with identifiable differences. In this group the cause of the restricted movement was considered to be spasm of the shoulder muscles initiated in the cervical spine.

This paper initially reviews the information in the literature on shoulder stiffness caused by capsular contracture. It then describes the selection criteria for the case studies, and the method used to identify the cause of the restricted shoulder movement in these cases.

Capsular Contracture

Contracture and adhesions of the capsule of the shoulder joint have been observed during open exploration (Neviaser 1945, Lundberg 1969). Lundberg described thickening and fibrosis of the capsule from histological examination. These changes were considered to be the cause of the gross restriction of shoulder motion evident in all the cases investigated. Frozen shoulder, capsulitis and periarthritis are terms used to describe the condition.

When lesions involve the joint capsule, movement restrictions occur in characteristic proportions, with the limitation in one direction bearing a relationship to that in other directions (Cyriax 1969). The figures in Table 1 illustrate proportional restrictions of movement at the shoulder joint, and are given against normal values of 90° for each of glenohumeral abduction, medial rotation and lateral rotation.

It will be apparent from these figures that movement is most limited in the direction of lateral rotation, and that the proportional restriction of abduction is 1/4-1/2 range for lateral rotation ranges of 0-1/4 respectively.

Restricted Shoulder Movement

Table 1: Proportional restrictions of movement at the shoulder joint as against normal values of 90° (after Cyriax 1969)

<table>
<thead>
<tr>
<th>Restrictions</th>
<th>Lateral Rotation</th>
<th>Abduction</th>
<th>Medial Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross</td>
<td>0°</td>
<td>20°(1/4)</td>
<td>30°</td>
</tr>
<tr>
<td>Moderate</td>
<td>20°(1/4)</td>
<td>45°(1/2)</td>
<td>70°</td>
</tr>
</tbody>
</table>

Wright and Haq (1976a) and inactivity (Lundberg 1969, Rizk and Pinals 1982). None of these factors was of aetiological significance. The studies showed that frozen shoulder may exist as a separate clinical entity unaccompanied by other pathology or systemic illness.

The course is protracted with spontaneous recovery occurring within one to three years; no single method of treatment cures the condition in every case and the results are poor when treatment is directed solely to the capsule (Corrigan and Maitland 1983). Manipulation may produce some immediate improvement in mobility, but has no effect on the total duration of the syndrome (Lundberg 1969). Rizk et al (1983) demonstrated that pulley exercises were more effective if accompanied by Transcutaneous Electrical Nerve Stimulation. Using thermography, Middleditch and Jarman (1984) detected areas of increased temperature over the ipsilateral cervical spine in forty patients with limitation of all shoulder motions; ice and ultrasound applied to the hot spots produced a statistically significant improvement in shoulder movements within four weeks.

The association between restricted shoulder movements and capsular changes seen in some cases has led to the assumption by clinicians and most of the authors reviewed in this paper that the restriction of movement in all similarly stiff shoulders is due to capsular contracture and adhesions. However, arthrographic and arthroscopic studies reveal that not every shoulder with marked limitation of movements has contraction and adhesions of the joint capsule. Normal arthrograms were found in a number of clinically diagnosed frozen shoulders from several studies: Nevisser (1962) 20%, Lundberg (1969) 9%, Rizk et al (1984) 23%, Binder et al (1984) 50%. Rizk et al observed that the patients with normal arthrograms were clinically indistinguishable from other patients, and Binder et al recorded the same recovery time for their patients with normal arthrograms as for those patients with contracture. Haeri and Maitland (1981) found no intra-articular adhesions in any of the cases when 24 patients with a diagnosis of frozen shoulder were examined by arthroscopy; the authors concluded that these findings implicated an extra-articular cause for the restricted movement. These investigations imply that a mechanism other than contracture and adhesions of the capsule must also be capable of limiting shoulder movement, though in a manner resembling contracture. Case studies were conducted for the purpose of identifying a different mechanism.

Patient Selection and Treatment Response

Fourteen subjects were selected for this study from all the patients with stiff shoulders who attended the author’s clinic over a three year interval; the proportion of this sample was not analysed. Selection was based on a specific pattern of shoulder restrictions. The criteria were that movements be limited in all directions, but not in the proportional pattern detailed earlier which is characteristic of capsular involvement. Lateral rotation was still to be the most restricted movement, but against values of 0-1/4, the ranges of abduction were 3/4, instead of the proportional 1/4-1/2 ranges. Furthermore, the ranges of medial rotation for this group were only moderately restricted, even though there was gross limitation of lateral rotation. All the patients reported that their condition had been present for nine months and that shoulder mobility had not improved with routine shoulder exercises and mobilization.

All shoulder movements were assessed by carefully moving the joint passively through its available range of movement. Eyeball estimates only were made to determine the ranges of lateral rotation and abduction, which were assessed as quarter intervals of an arc of 90°. With the patient supine, abduction was estimated by moving the flexed elbow in an arc away from the side. Lateral rotation was tested with the flexed elbow held by the side; the humerus was then rotated laterally by moving the forearm through an arc from the vertical to a horizontal position. Medial rotation was measured by moving the arm into the hand-behind-back position with the patient standing.

In the sample of patients selected for this study it was considered that lateral rotation was being limited by abnormal muscle activity. This judgement was made on the rebound quality perceived at end range, and the gradual passive tension curve felt through range. These factors are described in the Discussion section of this paper.

Treatment of these patients was directed to the lower cervical spine. The rationale for treating the spine in these cases is also considered under Discussion. Palpation and test
movements of the ipsilateral C4/5 and C5/6 segments revealed thickening over the zygapophyseal joints and moderate restrictions of intervertebral accessory and physiological movements. These cervical segments were treated by repeated rhythmical oscillatory mobilizations (Maitland 1983 P93). No treatment was given to the shoulder. After each ten minute session of mobilization to the neck, the movements of the ipsilateral moves were made in the manner described for selection. After six treatments in a two week interval, the range of lateral rotation was estimated to have increased from 0-1/4 range to 1/2-3/4 range.

Only changes in the most restricted movement, lateral rotation, were recorded over the time of treatment, though there was an observable improvement in the lesser affected movements. Management of these patients extended beyond the two week study interval. Total recovery time was not recorded because the purpose of the study was not so much to evaluate the effectiveness of a treatment as to investigate mechanisms other than contracture which could limit shoulder movement. As shoulder mobility improved following treatment to the neck it was considered unlikely that contraction of the shoulder capsule could have been the primary factor limiting movement. For these long-standing cases, improvement of the most restricted shoulder movement in two weeks suggested a correlation between cervical structures and the limited shoulder movement. Possible mechanisms for this relationship are discussed in the following section.

Discussion

Three aspects relating to these cases of restricted shoulder motion are discussed:

• muscle spasm limiting shoulder movement

• somatic structures in the cervical spine provoking spasm of muscles around the shoulder, and

• the mechanism for decreasing this spasm by stimulating cervical segments.

Muscle Spasm

Muscle spasm is a contraction of the muscle fibres activated through the motor nerve (Travell and Simons 1984). The muscle activity is involuntary. The spasm may not be present at rest but may be initiated to limit movement, either to prevent pain or as a response to some other dysfunction. Varying the speed of test movements may help to distinguish whether muscle spasm or fibrous contracture is responsible for restricting joint movement (Maitland 1986 p358). Muscle spasm which is activated by attempts to lengthen the muscle has a quality of recoil which rebounds against the test movement; the strength of the rebound increases with the speed of the test movements. Resistance offered by tissue which is predominantly fibrous does not behave in this way. Gossman et al (1982) state that tissues shortened by contracture show much steeper passive tension curves when compared with controls. That is, contracted tissue is 'stiffer' than the muscle in spasm, where stiffness is defined as the ratio of force to displacement (Pope and Panjabi 1985). These considerations were used when determining the factor limiting lateral rotation of the shoulders in this group of patients.

Somatic Referred Pain Initiating Spasm

Bogduk (1988) has detailed the origin and mechanism of cervical somatic structures referring pain into the shoulder region. Several experimental and clinical studies are cited which demonstrate that the cervical zygapophyseal joints (Sluijter and Mehta 1981, Dory 1983) and the ligaments and muscles (Kellgren 1939, Campbell and Parsons 1944, Feinstein 1954) are potential sources of referred shoulder pain. In other experiments spasm of shoulder muscles has been observed with stimulation of the C5-8 ventral roots (Frykholm 1951), the paravertebral muscles (Feinstein 1954) and with stimulation of the cervical zygapophyseal joints (Wyke 1979). These experiments demonstrate the potential for cervical somatic structures not only to refer pain into shoulder territory, but also to initiate spasm in shoulder musculature which could limit movement. Such mechanisms could explain the restricted shoulder movement of the patients in this study, which, because of a perceived rebound quality and gradual tension curves, was attributed by the author to abnormal muscle activity.

Neurophysiological Mechanisms and Joint Stimulation

A rationale is also required for the decrease in muscle spasm, and consequent improvement in range of shoulder movements, which occurred following mobilization of cervical segments. In the light of two recent experimental works Zusman (1987) has proposed a neurological basis for relief from pain of spinal origin with therapeutic methods of passive joint movement. In these experiments, repetitive mechanical stimulation caused a decrease or failure of response in normal joint afferents of the knee (Schabile and Schmidt 1983), and conduction block of sensitised nociceptors supplying the inflamed ankle joint of the rat (Guilbaud et al 1985). The cervical zygapophyseal joints may refer pain and trigger muscle spasm around the shoulder. If repetitive passive movement of the zygapophyseal joints decreases or blocks discharges from the joint afferents, this conduction block could inhibit effects being initiated from these joints. Such a mechanism could explain the decrease in shoulder muscle spasm which resulted from mobilization of cervical segments of the patients in the present study. Ultrasound may reduce or block
nerve impulses along C fibres (Kramer 1987). Middelitch and Jarman (1984) reported improved ranges of shoulder movement following applications of ice and ultrasound to the cervical spine. The cause of movement restriction in these cases was not analysed but, if muscle spasm initiated in the cervical spine was a factor, a similar neurological mechanism as that outlined above for repetitive joint movement may account for this response.

Summary

Findings reported in the literature suggest that factors other than contracture may also restrict shoulder mobility in some cases, and in a manner resembling contracture. This introductory study suggests that the cervical spine may cause movement restrictions of the shoulder in an identifiable pattern. The distinguishing feature in these cases is that shoulder movements are not restricted in the exact proportions which are typical of a capsular pattern. The mechanism may involve somatic pain referral with secondary muscle spasm preventing movement. The improvement in shoulder movements resulting from cervical mobilization may have a neuroloogical basis.

References


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