Treatment of Arm Pain Associated with Abnormal Brachial Plexus Tension

An outline is given of the possible effect passive movement has on pathological conditions involving cervical nerve roots in order to cause a resolution of the condition.

Techniques for the treatment of arm pain conditions such as Repetitive Strain Injury (RSI), which are accompanied by signs of abnormal brachial plexus tension, are described. The techniques are outlined in order to give the clinician further insight into an understanding of cervical nerve root conditions and an increased range of treatment choice.

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Manipulative therapy and physiotherapy techniques of examination are intended to test tissue structure and the dynamics of the musculoskeletal system. Following the examination, treatment is then aimed at restoring, to as normal as possible, the function and the anatomy of that system. This implies to a major extent that the emphasis is on the moving parts of the body both in examination and in treatment. It becomes apparent in the clinical setting that if relative movement of any tissue of the musculoskeletal system is impaired in any way, the dysfunction which results may take different forms but it will commonly result in pain. Tests for determining the presence of abnormal brachial plexus tension described by Elvey (1979, 1983) for use in the differential diagnosis of arm pain will also indicate whether or not the neural tissue is of normal extensibility (Kenneally 1985). Any limitation of extensibility present may be due to limited mobility of the cervical nerve root complex within the intervertebral canal (Elvey 1983).

Causes of Impaired Motion

One way in which relative movement is impaired occurs when inflammation involves the tissue concerned. This can be observed in many ways, for example, a first degree sprain of a ligament causes joint dysfunction because mobility of the joint produces relative movement of the ligament, and movement of an inflamed ligament stimulates a pain response. Another example is the impairment of movement and resultant dysfunction of an articulation anatomically related to a tendon, where there is an inflammatory process involving the tendon or its sheath such as may be seen in Achilles tendonitis.

Similarly, dysfunction in terms of pain and loss of mobility are possible where inflammation involves a nerve root complex. It has been demonstrated that relative mobility takes place between the nerve root and its surrounds (Brieg and Marions 1962) and more recently this has been demonstrated in the cervical spine (Elvey 1979) where certain movements of the arm produce movement of the roots and investing sheaths of the cervical nerves of the brachial plexus. Movement occurs maximally at C5 and C6 and to a lesser degree at C7 and to an even lesser degree at C8 and T1. It seems likely that any inflammatory process resulting from the pathology of trauma or disease affecting the nerve root or especially its investing sheath could result in dysfunction in terms of its relative mobility. This seems even more likely when consideration is given to the rich nociceptor system of the meningeal nerve root sheath (Bogduk 1983). While it is said that a nerve root can be handled without any pain response when it is normal, it becomes intensly sensitive and painful to the slightest movement when it is inflamed (Smyth and Wright 1958).

In addition to relative movement of the nerve root complex being affected by an inflammatory process, it appears that fibrous tissue formation can develop within the nerve root sheath causing adhesions between the sheath and the nerve root as a result of an

inflammatory process following trauma or disease (Murphy 1977). According to Murphy there is extremely poor lymphatic drainage within the nerve root sheath. This therefore implies that any injury or disease process resulting in inflammation and oedema of the nerve root complex would be relatively slow to resolve. Formation of fibrous adhesions could readily occur within the nerve root sheath.

From these observations of relative movement between the nerve root complex and its bone and fascial surrounds and of the sensory neurology and physiology of the nerve root complex, any resultant dysfunction due to inflammation involving a nerve root complex may result in a loss of normal relative mobility of the complex due to pain. Conditions such as this involving the cervical nerve root complex can be examined using tests for the presence of abnormal brachial plexus tension (Elvey 1983).

Where pathology involves the lumbosacral nerve roots there will be limitation of movement of the lumbosacral spine and also of the lower limb in directions such as hip flexion/adduction with knee extension ie straight leg raise test, which involves stretch or movement of the affected nerve root complex.

In the case of pathology affecting the cervical nerve roots of the brachial plexus there could be limitation of the cervical spine and also of the arm in directions which involve the affected nerve root complex. This could manifest itself as painful restriction of shoulder movement (Elvey 1979), and may also be associated with the condition commonly referred to as Repetitive Strain Injury (RSI) (Elvey *et al* 1986).

Proposed Rationale of Treatment

It is widely accepted that treatment in the form of passive movement is suitable to treat joint dysfunction. It is equally accepted that movement, both active and passive, is an important part of the treatment of soft tissue pathology involving muscles, tendons and ligaments (Salter 1985). In these cases movement techniques are used to treat pathology involving tissues and structures that should display freedom of relative movement but do not, because of pain or other factors.

It therefore stands to reason that in certain circumstances where neural tissue is involved in relative movement dysfunction, it can be treated with passive movement techniques of manual therapy.

The effect movement has, as a form of treatment, on any pathological process involving a nerve root complex has not been explained except in terms of generalizations. However, at the same time, it is not always understood how movement, in the form of passive movement techniques of treatment, affects the pathological process causing joint or soft tissue dysfunction, yet this type of passive treatment is justified and accepted due to the clinical results obtained by passive movement or manual therapy techniques (Farrell *et al* 1982).

Techniques for the lumbosacral plexus involving the lower limb have been described by many authors including Maitland (1977) where a straight leg raising procedure is described, and by Stoddard (1962) where a lumbosacral rotation technique with straight leg raising is described. It is understood that reference has been made to some surgeons instructing their patients, who have undergone laminectomy for lumbosacral radiculitis, to do exercises in the form of passive straight raising of the affected leg using rope and pulleys. This is said to prevent the formation of adhesions around the nerve root. This argument could be extended to nerve roots which may have been involved in adhesion formation as a result of trauma or pathology unrelated to surgery.

Fitch (1982) states that movement and maintenance of function in acute ankle sprains achieves much better results in the early term than immobilization. These results include reduction of swelling, increased movement and decreased pain. A comparison could be drawn between management of acute ligamentous sprains and injured nerve root tissue whereby passive movement rather than immobilization would be a preferable form of treatment for these normally mobile structures.

Giovanelli *et al* (1985) stated that passive mobilization of lumbar zygapophyseal joints has a therapeutic effect on painful zygapophyseal joint conditions, based on evidence that pressure variations created by the passive movement cause an ingress and egress of joint fluid, which is a normal physiological response (Nade and Newbold 1983) required in the resolution of intracapsular joint conditions. An initial primitive study of intra-nerve root sheath pressure conducted by the author indicates that it will vary with passive movement of the sheath. If this is the case, it could be hypothesized that passive movement of the nerve root sheath may lead to a beneficial physiological response involving the pressure gradients described by Sunderland (1968), which exist between extra and intra funicular elements of nerve roots within the intervertebral foramen and which are essential for normal nerve root physiology. In other words, if for any reason the relative movement property of a nerve root complex is lost, then a passive movement technique could be very useful and acceptable as a form of treatment by causing physiological pressure variations. It could be argued that this form of treatment helps reduce the oedematous inflammatory nature of a nerve root condition similar to that of the acute ligamentous ankle condition, and also prevents the organisation of oedema into fibrous tissues or overcomes adhesive intra and extra funicular fibrous formations once they have formed.

Passive Movement Techniques for Mobilization of the Cervical Nerve Root Complex.

A literature search by the author revealed no descriptions of treatment techniques of passive movement for the cervical nerve roots. Consequently a series of techniques have been developed which are based on the results of cadaveric studies at autopsy and clinical observations and experimentation. It is considered that they have clinical merit in the treatment and management of certain cervical nerve root shoulder or arm pain conditions.

Careful assessment must be made at the initial objective examination in order to make a correct differential diagnosis so that the technique suits and is applicable to the condition and pathological state of the condition. Signs of adverse brachial plexus tension which can be determined by specific tests (Elvey 1983) will guide and indicate the use of the technique.

The techniques described (Figures 1-6) can be selected to move either the nerve root complex within the spinal intervertebral canal, or to move the spinal intervertebral canal in relation to the nerve root complex when it is held tense by means of fixation of the shoulder girdle and arm. The techniques also move the neural tissue in relation to the fascial planes of soft tissue from the cervical spine to the axilla. In certain circumstances relative movement also occurs between the peripheral nerves and their surrounding soft tissues in the arm itself.

The techniques are used as a very careful and gentle oscillation procedure, and should be varied to suit the circumstances in respect to pain, restriction of shoulder or cervical spine mobility and above all, *any pathology or reason that may indicate caution.* With regard to this the principles in administering such treatment, for example, grade related to pain response, apply in exactly the same manner as those applying to joint mobilization. Static hold techniques may be used in chronic conditions. Reference should

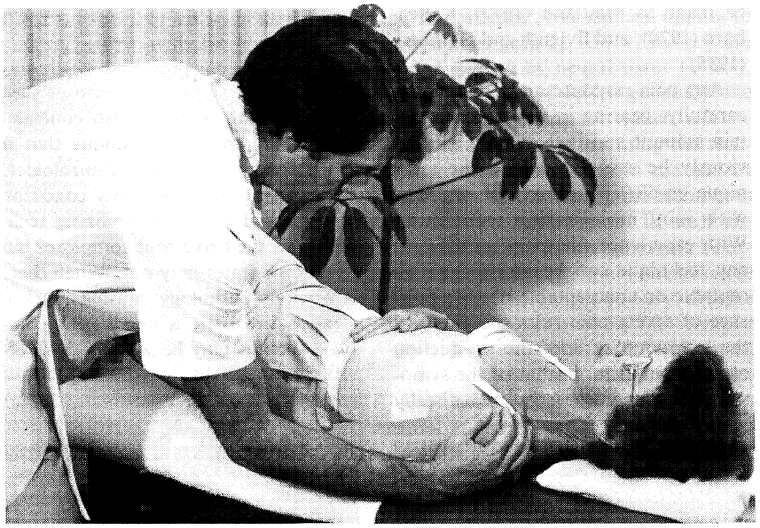

Figure 1: Shoulder girdle depression (oscillation) with traction exerted through the arm.

Patient's forearm is fixed between operator's upper arm and chest. The technique can be applied with the patient's glenohumeral joint in any position and an abduction movement of the joint can be performed as the shoulder girdle is depressed.

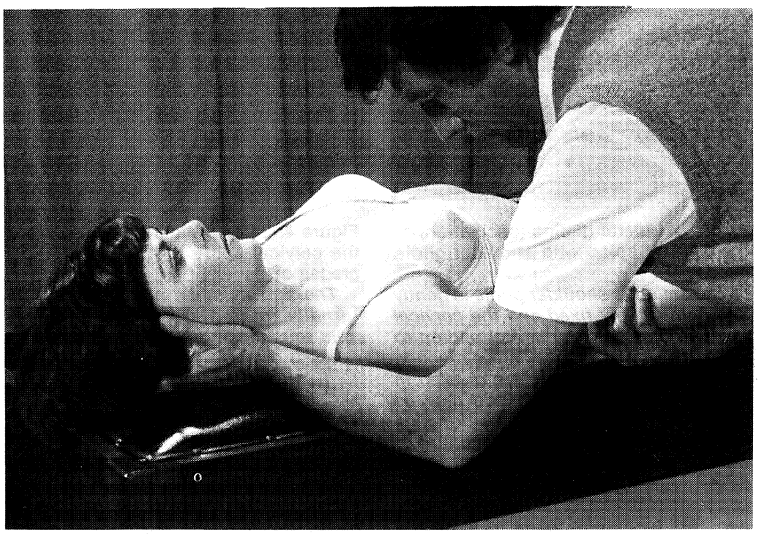

Figure 2: Shoulder girdle depression (oscillation) with fixation of the cervical spine to achieve stronger grades of oscillation.

Oscillation is performed by fixation of the patient's forearm between the operator's upper arm and chest and a firm but comfortable grip around the patient's elbow. The operator's body performs the necessary oscillatory movement.

be made to Maitland (1977), Kaltenborn (1970), and Evjenth and Hamberg (1985).

Any pain response must be assessed carefully, bearing in mind that a certain amount and type of pain will obviously be associated with the technique employed, as may be expected with joint mobilization techniques. With experience, the pain response of any technique can be assessed as acceptable or unacceptable but the presence of severe pain rules the grade of the technique as does the production of any pain distal to that of the symptoms. Both pain severity and distally produced pain contraindicate the grade of the technique being used.

Any sensations produced which may indicate adverse neural responses such as tingling in the hand also contraindicate the grade of technique that is being used at the time. Neurological deficit in any acute or early condition also contraindicates mobilizing techniques of the nerve root complexes but in chronic states may not. When there is obvious pathology causing marked stenosis involving a nerve root complex, such as may be seen on computerized tomography or myelography, the techniques may be contraindicated as movement may cause further irritation between the nerve root complex and the obstructing pathology.

As a general rule treatment technique should be of *a grade that does not go to the end of range* and, as far as duration is concerned, *it should be much less than that used in joint mobilization.* A great deal of care and attention is needed at all times. Above all, assessment of the technique during, after and on subsequent evaluations of the patient, is all important and reference should be made to Maitland (1977, chapter 8).

In addition to signs of adverse tension or limited extensibility evident on testing the brachial plexus, a useful objective assessment sign in any limb condition due to cervical nerve root pathology is active shoulder abduction/elevation. If this is not restricted to some degree on careful examination it usually will be if the cervical spine is laterally flexed to the opposite side with the shoulder girdle gently fixed by the therapist while the patient performs the movement. Such a test adds tension to the neural tissue and together with the tests of adverse brachial plexus tension it can be used as a ready guide in the assessment of the condition before, during and after treatment.

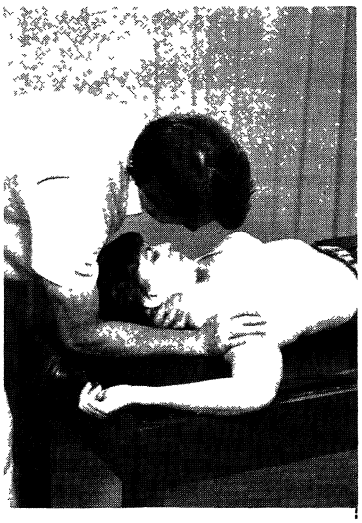

Figure 3: Lateral gliding (oscillation) of the cervical spine with shoulder girdle fixed.

The patient's shoulder girdle is gently and comfortably fixed and the cervical spine is displaced by lateral gliding to opposite side in an oscillating manner. The patient's head/neck are cradled in the operator's hand. The arm may be placed by the side or in a position similar to that shown. A certain amount of traction can be applied and movement of the spine is localized to the involved segment with the operator's index finger. This technique tends to move the intervertebral canal rather than the neural tissue and therefore, along with the techniques shown in Figures 4 and 5 is a suitable technique for'RSI' conditions.

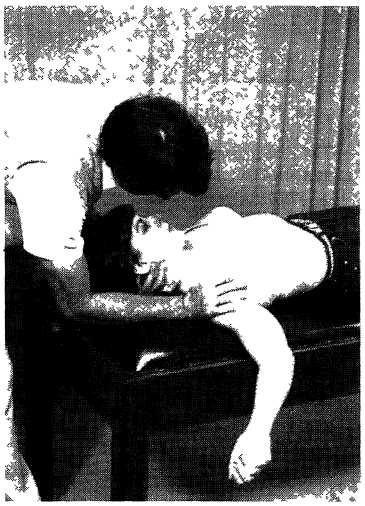

Figure 4: Lateral gliding (oscillation) of the cervical spine to achieve stronger grades of oscillation.

The arm must be abducted and externally rotated at the glenohumeral joint thus tensing the neural tissue distally. The range of abduction and external rotation can be varied according to the sensitivity of the condition and also according to the pain response at the time of oscillation. The greater the range of abduction/external rotation the greater the likely pain response due to the degree of neural tension imparted to the system. The range of shoulder abduction is therefore reduced according to the irritability or sensitivity of the condition.

Discussion

Treatment techniques of passive movement of cervical nerve roots for conditions accompanied by signs of abnormal brachial plexus tension can be varied and modified according to the condition. In all instances, it is essential to regard neural tissue with great caution as to its response to passive (and active) movement. At no time should either testing procedures used during examination or treatment techniques be of such a strength that symptoms are exacerbated. This is not only of importance to the patient and to the therapist but also to the physiotherapy profession in relation to its reputation in the treatment of radiculopathies and related conditions.

Figure 5: Lateral gliding (oscillation) of the cervical spine for use in the acute stage.

Experience has shown that this technique is the most effective for use in 'RSI' conditions, particularly in the acute stage or in more acute radiculopathies. The arm is abducted and internally rotated at the shoulder, allowing the hand to rest on the thorax. The shoulder girdle is lightly fixed. The cervical spine is glided laterally to the opposite side in a slow and controlled oscillating manner according to resistance and reproduction of symptoms. This technique allows movement to occur within the intervertebral foramen without undue tension being applied to the neural tissue.

This is also a test position for reproduction of lateral and posterolateral upper arm and forearm symptoms.

Figure 6: Shoulder girdle oscillation with fixation of the cervical spine.

A useful technique to improve the dysfunction of the hand behind back movement, where there are signs of abnormal brachial plexus tension. The patient's arm is varied, with the hand behind the back position being increased as allowed during the treatment and at later treatment sessions. As a general rule except in acute/sensitive conditions the hand behind back position must be as maximum as the condition will allow.

In particular, this caution applies to conditions such as RSI when they are accompanied by neural tissue tension. The condition of RSI is generally one of an irritable nature which can be readily exacerbated by using the techniques described either to the end of range or by continuing the techniques for too long a duration. In such circumstances the technique should be extremely gentle and should not be taken to the end of range. A very delicate feel must be achieved by the therapist for the correct excursion of movement, the right feel of resistance and the appropriate duration of the treatment session. If there is doubt about this personal capability, the technique should not be used.

In using passive movement techniques for radiculopathies and some RSI conditions the therapist, in assessment, must consider the possibility that a physiological response is being affected rather than a pure mechanical one as occurs in some passive movement techniques which are used mechanically to increase the range of joint movement. With regard to this physiological effect, improvement of the condition may not be apparent at the time as may be seen when attempting to improve joint range. Likewise, any worsening may not be apparent at the time. This is a highly important aspect in reassessment and treatment particularly so with respect to the possibilities of either using too strong a passive technique or in administering the technique for too long.

Conclusion

This article has been written in its present form because of the use by many physiotherapists of the techniques described to treat arm symptoms and in particular RSI conditions. The use of the techniques has been due to the fact that many clinicians and referring medical practitioners have found the techniques suitable. This suitability has applied even though clinical trials have not been conducted.

At the same time it should be considered that specific passive movement techniques in manual therapy have been advocated by numerous authors and teachers without factual evidence as to their effectiveness. It has been clinical assessment in individual cases that has governed the support of such techniques.

It is the intention of the author to investigate the techniques described further in an attempt to demonstrate their physiological and clinical efficacy. However, it seemed appropriate at present to outline their use and in particular to stress the careful application and assessment needed in using passive movement techniques on neural tissue.

By no means has it been the intention of the author to advocate the techniques described as the only means of treating the conditions mentioned and, in fact, it appears that in many instances additional associated measures are necessary for a resolution of the condition. In particular, this applies to correction of prolonged or sustained poor postural positions related to the cervical/thoracic spines.

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Addendum

As the use of brachial plexus tension tests have become more widespread, both in clinical practice and in research protocols, it has become apparent that there is a need for uniform nomenclature. The use of the term 'upper limb tension test' does not really convey the overall concept of the term 'brachial plexus tension test'.

It is of utmost importance that the clinician is aware of the fact that these orthopaedic tests evaluate the integrity of the neural tissue from the cervical spine to the periphery of the upper limb and also the integrity of tissues and structures anatomically related by attachment or by proximity to the neural tissue. With regard to this, of prime importance is the thoracic region where there is a direct relationship between neural tissue, a major artery and vein and tissues which may harbour an abnormal space occupying mass.

Brachial plexus tension tests can therefore be used in the assessment of conditions in this region which may be responsible for upper limb symptoms eg Pancoast tumour. Stressing the neural tissue in the upper limb to its maximum normal extensibility will involve the brachial plexus. Also stressing the appropriate cervical nerve roots will involve the brachial plexus. In fact the brachial plexus portion of the neural tissue is the key to whether or not tension is applied. In using the tests the plexus must be 'controlled' via the shoulder girdle.

Bearing these facts in mind and also accepting that such tests in themselves are not 'positive' or 'negative' but are complementary to all other features of an examination, the term 'Brachial plexus tension test' should be used.