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Upper Trapezius Activation during Upper Limb Neural Tension Test-1 in Karate Players

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Abstract

Background: Manual examinations and subsequent manual therapy became the mainstream options for treatment of mechanical musculoskeletal disorders. Neurodynamics deals with the mechanics and pathomechanics of the nervous system as it moves relative to its adjacent tissues.

Objectives: We determined upper trapezius activity during upper limb neural tension test-1 (ULTT-1) in asymptomatic National level Karate players of Madhya Pradesh State of India and correlated its activity with sensory responses during neural test. **Subjects and Methods:** Fifty national-level karate players (26 males) aged 20 to 25 years (mean age 22.0±1.4 SD) with no history of musculoskeletal or neurological injury were studied. Sensory response intensity was recorded on visual analogue scale (VAS). Electromyography (EMG) activity of upper trapezius muscle was recorded from the muscle belly. **Results:** All subjects showed 'positive' sensory responses on VAS with the mean value of 6.5±1.1 and EMG activity in upper trapezius muscle

with mean of 93±19 microvolts. They all had "positive" sensory responses during upper limb tension test-1. They were described mainly as stretch, pain, pull and, tightness. Majority of the sensory responses was reported during the stages of wrist and elbow extension and all subjects showed increased EMG activity in upper trapezius muscle during ULTT-1, which correlated directly with the perceived sensory response. **Conclusion:** Upper trapezius muscle activity is evident during ULTT-1 which is directly correlated with the perceived intensity of sensory responses during the test. Sensory responses to ULTT 1 can be elicited in a large proportion of asymptomatic active young players.

Key words: Upper Limb Neural Tension Test-1 (ULTT-1), Electromyography (EMG), Trapezius muscle.

Introduction

There are several different sources of neck and upper extremity pain. One major cause of this is nerve tissue com-

pression and its abnormal dynamics (1-3). However, the nerve can produce pain and abnormal sensations if there is reduced mobility or irritation to the nerve. To assess the contribution of the cervical nerve roots and peripheral nerves to upper extremity pain, “brachio-plexus tension test” was developed by Elvey (4). Later, the test became more commonly known as “Upper Limb Tension Test (ULTT) or less often “Upper Limb Neural Tension Test”. The test was designed to place tensile stress on the cervical nerve roots and their associated peripheral nerves by using longitudinal traction force (4). Neurodynamic tests (e.g. slump test, straight leg raise and upper limb neurodynamic tests) challenge the physical capabilities of the nervous system by using multi-joint movements of the limbs and trunk to alter the length and dimensions of the surrounding nerve bed and corresponding neural structures (2,3,5-11). Neural tissues are well adapted to tolerate mechanical forces generated during the positions or movements associated with daily and sport activities (12-16). Neural tension is often an overlooked problem in overhead athletes (1). It is associated with disorders like carpal tunnel syndrome; Guyons canal syndrome, double crush syndrome and piriformis syndrome which are common in athletes of all streams. Different varieties of neural tension tests have been used for diagnostic and therapeutic goals in a wide range of patients. Upper limb neural tension test-1, a well established neural tension test was originally designed for diagnostic purposes when moving and tensing nervous system of the upper limb (especially the median nerve) (17). Initially this test was used

as diagnostic aid but judicious use and variations of the test can also implicate mechanical disorders of nervous system as a component of many common neuro-musculoskeletal disorders and can act as a treatment method for these disorders. The ULTTT-1 involves performance of an ordered sequence of passive arm movements, which imparts tensile forces to cervical nerve roots and their peripheral nerves (1). The sequence involves six stages which include stabilization of the subject’s shoulder girdle, abducting the shoulder to 110 degrees, wrist and finger extension, forearm supination followed by lateral rotation of the shoulder and finally elbow extension. The aim of upper limb neural tension test is to determine the source of pain and other sensory symptoms in upper extremities associated with adverse neurodynamics. However, the examiner can also note any associated stiffness contributed by the musculature during these tests. It is documented that protective muscle activity from the upper trapezius, brachialis, and biceps contributes to resistance encountered by the examiner during a median biased upper limb neurodynamic test (18).

Despite the widespread use of upper limb neural tension test, the neurophysiological basis for sensory and motor responses produced during the test remain controversial (19,20). It has been suggested that increased muscle activity evoked during the upper limb neural tension test may be a withdrawal response to pain that acts to indirectly protect the nerve by preventing further tensioning, but this concept has recently been challenged (20,21). It is not certain



Figure 1. Placement of EMG electrodes at the upper trapezius

whether pain triggers the motor responses and increase resistance to movements or the resistance to passive movements during ULTT-1 should be explained by a different mechanism. We have therefore undertaken this study to ascertain the upper trapezius activity during upper limb neural tension test-1 and to explore its correlation with sensory responses during the test.

Subjects and Methods

Subjects

Fifty asymptomatic national-level karate players who were in sports for more than two years volunteered for this study. They were 26 males and 24 females and their age ranged from 20 to 25 years (mean age $22.0 \pm 1.4SD$). No one had any history of musculoskeletal or neurological injury.

Procedures

All subjects gave a written informed consent before the study. Three examiners conducted the three tests separately and being blinded to other examiners. The skin was prepared for a standard EMG procedure. Subject was asked to lie in supine position and relax completely (Figure 1 and 2). A pair of self-adhesive surface electrode is placed over the belly of upper trapezius muscle with an inter-electrode space of 2 cm. ULTT-1 was performed by one examiner and subjects were instructed to report as soon as they felt any sensation like stretch, pain, tightness, tingling or numbness. Sensory response intensity was recorded on VAS by second

examiner and EMG activity of upper trapezius muscle was recorded in microvolts from the muscle belly by third examiner using Myo 200 (Gymna Uniphy, Bilzen, Belgium).

Statistical Analysis

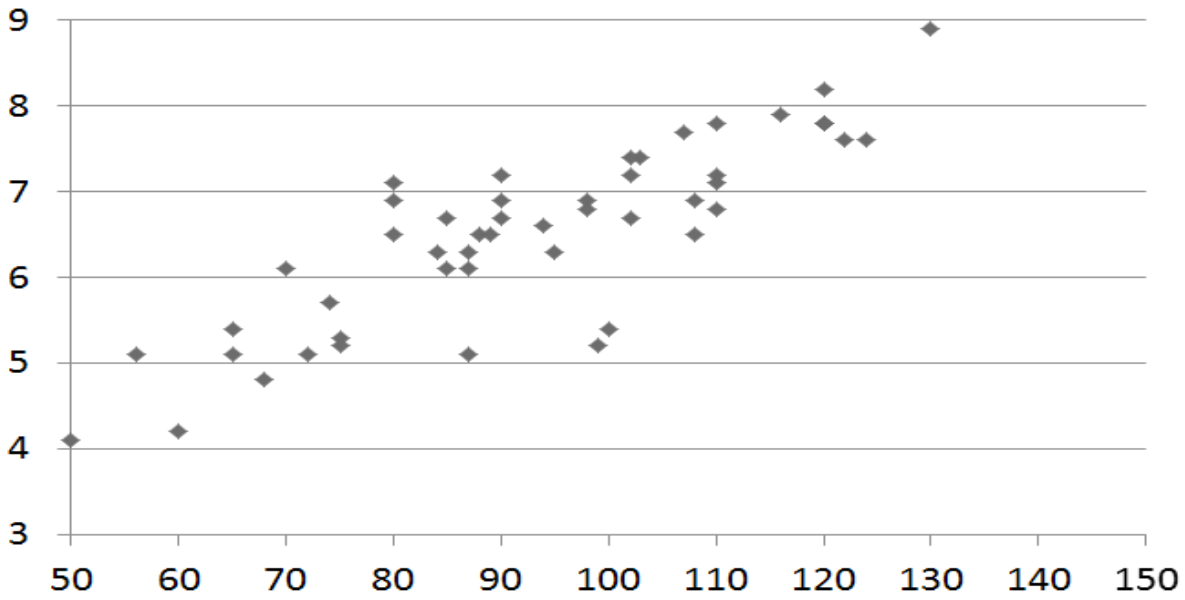
Descriptive statistics was used to summarize the demographic and research data. Pearson co-relation coefficient was used to explore the relationship between sensory responses to ULTT-1 and EMG activity of upper trapezius muscle.

Results

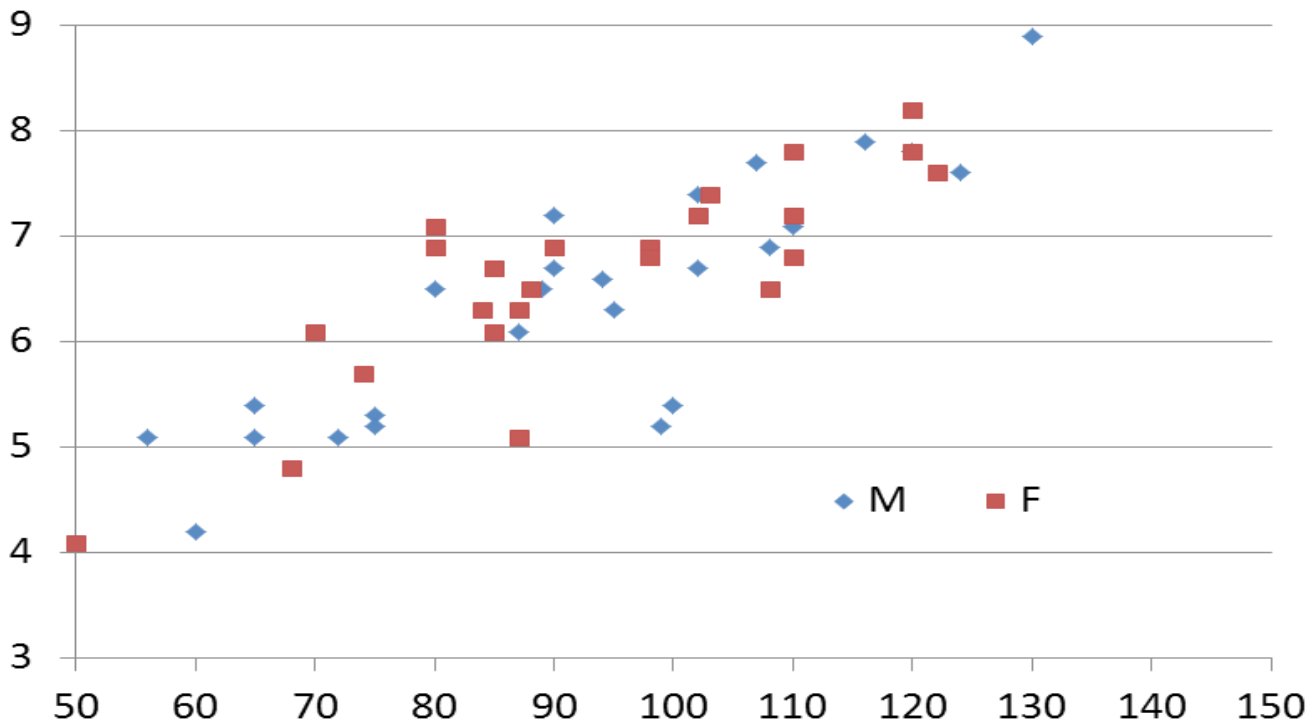
All subjects showed 'positive' sensory responses on VAS with a mean value 6.5 ± 1.1 points [median (range) was 6.7 (4.1-8.9) points] and EMG activity in upper trapezius muscle with mean of 93 ± 19 microvolt [median (range) was 92 (50-130) microvolt]. Results of VAS for men and women separately were [median (range) 6.6 (4.2-8.9) and 6.8(4.1-8.2) respectively] and EMG activity in upper trapezius muscle for men and women separately were [median (range) 95 (56-130) and 89(50-122) respectively]. All the subjects had "positive" sensory responses during ULTT-1. The sensory responses were described mainly as stretch, pain, pull and, tightness. Majority of the sensory responses were reported during the stages of wrist and elbow extension. All subjects showed increased EMG activity in upper trapezius muscle during ULTT-1. There was positive correlation with the EMG activity and the intensity of perceived



Figure 2. Positioning for ULTT 1



(a)



(b)

Figure 3. (a) Relation between upper limb tension test - 1 sensory responses (VAS) and EMG activity in upper trapezius muscle. Pearson Product moment correlation reveals significant correlation between EMG activity in upper trapezius muscle and VAS scores ($r=0.73$, $p=0.000$). (b) Upper panel for the group as a whole and lower for males (M) and females (F) separately.

sensory responses (Figure 3.a). The trend was present in men and women when analyzed separately (Figure 3.b).

Discussion

There is sufficient biomechanical evidence that the peripheral nerve under tension undergoes strain and glides within its interfacing tissues. Evidence supports that Upper Limb Neural Tension Test causes strain within peripheral nervous system, however; it is also evident that it places strain on other multi-segmental tissues (22). Butler described a strong but sensitive connection between the surrounding somatic tissue and the neural tissue (4). Neural tissues may be hypersensitive (pathophysiologic problem) or have a tension problem (mechanical) or a combination of both. Alternately the primary mechanical fault may be one of reduced sliding, which is not directly a tension problem. It could also be a compression problem that relates to the tissues that form a mechanical interface to the nervous system (23). The currently hypothesized mechanisms linking the muscle activity with neural tension are mechanical sensitivity of ganglion cell bodies (24), existence of mechanoreceptors in thoraco-lumbar spinal cord (5) and mechanoreceptors of peripheral nervous system (25).

The above hypotheses infer that the somatic nervous system has natural mechanisms, which may protect the peripheral nervous system against tensile stresses. These findings in normal subjects suggest that mechanosensitivity of peripheral nerve to stretch may be a physiologic protective mechanism rather than a pathologic phenomenon following peripheral nerve insult. The finding that all the subjects reported sensory responses to ULTT 1 correlate with another study which showed positive sensory responses to SLUMP test in asymptomatic hockey players (26). The finding of positive responses to ULTT1 in all subjects again underlines that caution should be exercised before concluding a neurodynamic test as clinically positive. The present study provides a clear evidence that perception of sensory response and EMG activity of upper trapezius muscle is positively correlated. These findings support the assumption that increased muscle activity during ULTT or neural tension may be a withdrawal response to pain that acts to indirectly protect the nerve by preventing further tensioning. The results of the study demonstrate increased electrical activity in upper trapezius muscle during wrist and elbow extension component of the ULTT 1. This evoked electrical activity which suggests muscle contraction may be one of the mechanisms which further reduce neural tissue mobility in subjects, causing neural tension. This could

also be responsible for antalgic posturing of the shoulder, neck or arm in the presence of abnormal pathomechanics of the nervous system.

There are several clinical implications for this study. Caution should be exercised before concluding a neurodynamic test as clinically positive. In sport population, along with general stretching exercises, neural biased stretching may be administered by competent clinicians in an attempt to increase neural tissue mobility with respect to the interfaces and also to increase the strength of the connective tissue components of the peripheral nerves. As it is evident in this study, increased neural tension can result in sustained muscle activity which may lead to muscle pain syndromes. Reducing muscle spasm and therapeutic inhibition of muscles will increase the mobility of the neural tissues. Complete recovery of any neurodynamic problems cannot be accomplished without neural mobilization and addressing the adjacent contractile and non contractile elements of the kinetic chain. Abnormal muscle activation can be a contributing factor to reduced neural mobility and also may be a complication of abnormal neurodynamics. Some limitations that are noteworthy includes a small sample size and the recruitment was limited to young asymptomatic players. Future studies with larger population and analysis of the outcomes of neural stretching as an intervention to prevent injuries in sports are warranted.

In conclusion, findings of this study suggest that there is upper trapezius muscle activity during ULTT 1. Sensory responses to ULTT1 can be elicited in a large proportion of asymptomatic active individuals. There is a positive correlation between intensity of sensory response to ULTT 1 and EMG activity of upper trapezius.

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