Effect of Scapular Position in Computer Professionals with Neck pain

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Abstract: Study design - case control study. Objectives are To study scapular position in computer professionals with neck pain and without neck pain. To compare scapular position in computer professionals with and without neck pain. Background Abnormal or altered scapular position is defined as an observable alteration in the position and motion of the scapula relative to the thoracic cage. Poor postural habits and neck pain are increasingly common among individuals who work predominately on computer. Methods and measures An case control study with convenience sampling was done with 100 subjects. Each subject Scapular protraction measurements were taken with the participant standing with normal, relaxed posture. The measurements were performed at 3 different positions (at rest, hands on hip, and 90° glenohumeral abduction). First the inferior angle of scapula was palpated and marked, then the lateral arm of the vernier caliper was then positioned at the corresponding spinous process, and the measurement was recorded. All measurements were taken bilaterally. Also scapular upward rotation was measured with the help of baseline digital inclinometer at rest, 60 and 90 degree glenohumeral abduction. Results The results showed that there is a significant difference in scapular position and in corresponding vertebra. Poor postural habits and neck pain are increasingly common among individuals who work predominately on computer. Conclusion In the present study it was concluded that scapular position is altered which includes altered scapular protraction and upward rotation in computer professionals who are suffering from neck pain in all three positions that is at rest, hands on hip, and 90 degree glenohumeral abduction and in scapular upward rotation.

Keywords: Neck pain, scapula position, altered scapular position, computer professionals.

1. Introduction

The position of scapula is the key contributor to normal and abnormal scapular motion and control. Normally scapula rests at a position on the posterior thorax approximately two inches from the midline, between the second and seventh ribs. The scapula also is internally rotated from vertical, and is upwardly rotated 10 to 20 degrees from vertical. Scapular position on the thorax and control during motion is a critical component of normal shoulder function. During elevation of the arm overhead, scapula should upwardly rotate and posteriorly tilt on the thorax. Upward rotation is the predominant scapulothoracic motion.

Protraction and retraction of the scapula on the thorax are often described as transitory motions of the scapula away from or toward the vertebral column, respectively. There is evidence for a causal relationship between highly repetitive work and neck and neck/shoulder musculoskeletal disorders. Most of the epidemiological studies reviewed have defined repetitive work for the neck as work activities which involve continuous arm and hand movements which affect the neck/shoulder musculature and generate loads on the neck/shoulder area resulting in altered scapular position.

Abnormal or altered scapular position is defined as an observable alteration in the position and motion of the scapula relative to the thoracic cage. Alterations that have been identified in computer professionals include increased protraction. Scapular protraction is an abnormal position which has been defined as an increased distance between the inferior angle of scapula and the spinous process of corresponding vertebra. Some authors reported that imbalanced force produce superior translation of the scapula with less efficient downward rotation and increased posterior tipping.

Work related musculoskeletal disorders (WRMSDs) are an important health problem in many industrialized countries. This term is not a diagnosis, but an umbrella term for disorders that develop as a result of repetitive movements, awkward postures, and impact of force. Many epidemiological studies have demonstrated that specific work-related risk factors may cause musculoskeletal complaints.

Poor postural habits and neck pain are increasingly common among individuals who work predominately on computer. Common poor postures include forward head position, protracted shoulder, and scapular winging and tipping. Changes in the alignment of either the scapulae or the cervical spine can potentially influence the biomechanics of the other by altering the tension at cervicoscapular muscles. Computer professionals who work for long hours used to adapt poor work posture most commonly altered scapular postures which cause various musculoskeletal disorders.

Computer professionals who work on computer for long hours continuously, he or she may notice increasing aches and pains in some parts of the body, usually musculoskeletal in nature. Pain in the neck has become one of the leading problems nowadays. Neck flexion, forward head posture, scapular retraction, forward stoop posture are some of the faulty postural alignment, resulting in neck pain due to increased cervical muscle activity to support head in forward position and results in increase in fatigue.

Overtime the muscles and other soft tissues tighten up due to the excessive workload required to hold the head in position. The anterior neck muscles become weak from being stretched and neural structures are kept in less than optimal positions. This chronic overload and tightening of soft tissues may eventually result in decreased blood flow and
heavy feeling, the person may maintain a slouched posture, which continues the vicious cycle. Increase of computer work coincided with a prevalence increase of work related musculoskeletal disorders of the upper extremities (WRMSDs), employees affected by WRMSDs often experience substantial pain and functional impairment. A review of epidemiological studies concluded that posture is an independent risk factor for development of work related musculoskeletal disorders among computer users. Constrained, prolonged or static postures lead to undesirable EMG muscle activity and discomfort. Infrequent postural changes and presence of discomfort while sitting are predictive of musculoskeletal problems. The number of hours spent performing keyboard operation appears to be a risk factor for work related musculoskeletal disorders.

Aberrant activity within the three portions of the trapezius muscles and associated changes in scapular posture have been identified as potential contributing factors. Recent study suggest that poor placement of the keyboard is a predictor for neck pain, it has been found that supporting the forearms on the tabletop in front of the operator reduced significantly the load on both right and left trapezius. Also location of screen showed a tendency for being a risk factor. It has been shown that visual discomfort and musculoskeletal strain, particularly in the neck and shoulders, are associated with computer screen height.

Aberrant scapular posture and any associated changes in axioascapular muscle activity may contribute to, or exacerbate painful neck disorders by adversely affecting mechanical stresses on pain sensitive cervicobrachial structures. Computer professionals were most likely to report musculoskeletal symptoms, they experience such symptoms which were more likely to rate their workstation ergonomics as poor. Office work is often associated with prolonged sitting, particularly with poor workstation ergonomics, may cause prolonged static contraction of muscles, increased pressure on the intervertebral discs and tension on ligaments and muscles, decreased tissue flexibility, altered spinal curvature and weakened paravertebral muscles, and such changes may lead to, or increase the risk of musculoskeletal injury in the spine and finally cause altered and abnormal scapular posture which lead to neck pain.

There is positive association between neck pain and neck flexion at work, although not significant, suggesting that there is an increased risk of neck pain for people who are working with the neck flexed more than 20° for major part of their working day.

Individuals with neck pain may display altered postural behavior when performing prolonged sitting tasks such as during computer use abnormal scapular posture and any associated changes in axioascapular muscle activity may contribute to, or exacerbate painful neck disorders by adversely affecting mechanical stresses on pain sensitive cervicobrachial structures.

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2. Method and Material

Study design

This is a case control study. An ethical clearance was obtained from the ethical committee of Banarsidas Chandiwala Institute of Physiotherapy before the commencement of this study.

Participants

Both males and females working in IBM were screened by the researcher for their eligibility in this study. Inclusion criteria for study group were 1. Computer operator with neck pain. 2. Computer operator working more than 8 hours. 3. Age group 30-45. Inclusion criteria for control group were 1. Computer operator without neck pain. 2. Computer operator working more than 8 hour 3. Age group 30-45. Exclusion criteria for both study and control group: 1. Any recent surgery of the back and neck. 2. Any neurological dysfunction. 3. Subjects who were undergoing any physiotherapy treatment for their current neck pain. 4. Any pathology preventing scapular position testing. 5. Language/cognitive deficits that might limit the informed consent. 6. Current or past (within 4 weeks) use of oral corticosteroids.

Study protocol and allocation

If the subject fulfilled the inclusion and exclusion criteria, a patient information sheet providing details about the study was given to them. For subjects willing to take part in this study, an informed consent was obtained. A brief assessment of the subject was taken prior to the commencement of the study. Subjects were allocated using convenience sampling method for study and control group as required by the study.

Outcome measures

The primary outcomes for the study were baseline digital inclinometer for assessment of scapular upward rotation at rest, 60 and 90 degree glenohumeral abduction and keibler’s method of assessment of scapular protraction at three different positions of glenohumeral abduction. Initially before measuring the scapular position, a brief physical assessment was taken which included demographic data and assessment of neck pain by using VAS. The number of hours each individual works in a day were also taken into consideration. Two groups were included in the study Study group- with neck pain. Control group- without neck pain.

Technique

Scapular position was assessed with the help of digital inclinometer for upward rotation and keibler’s method of
assessment of scapular position with the help of vernier caliper. Scapular protraction measurements were taken with the participant standing with normal, relaxed posture. The measurements were performed at 3 different positions: 1. At rest., 2. Hands on hip, 3. 90° glenohumeral abduction with internal rotation. First, the inferior angle of the scapula was palpated and marked. The subject was asked to stand relaxed with arms by the side of the body. This was considered as position of rest. The distance from the inferior angle of the corresponding spinous process was taken right and left side measurement was recorded. The measurement was done three times. The average of the three readings was considered as final reading. The same procedure was repeated for second position hands on hip and for third position 90° abduction.

We measured scapular upward rotation using the protocol developed by Johnson et al. which demonstrated good to excellent intraexaminer reliability and good to excellent criterion-related validity when measuring scapular upward rotation in the scapular plane. The investigators assessed scapular upward rotation in a resting position and in the scapular plane at humeral elevation. Scapular position in the resting position was measured with the subject’s arm relaxed at the side of the body. Subjects then elevated the arm as much as they could at 60 degree. At this angle, the subject was instructed to hold that position while the digital inclinometer was positioned over the scapula and the amount of the scapular upward rotation was measured. The difference from beginning to the last position was taken as a scapular upward-rotation score similarly for 90 degree abduction readings were taken.

**Statistical Analysis**

The statistical software namely SPSS 15.0 was used for analysis of the data and Microsoft Excel has been used to generate graphs and tables. Descriptive statistical analysis has been carried out in the present study. Measurement of scapular position which includes measurement of scapular protraction according to Kirshner at three different positions that is at rest, hands on hip, and 90 degree glenohumeral abduction with maximum internal rotation were taken along with measurement of scapular upward rotation at 60 and 90 degree glenohumeral abduction. Mean of right and left side were compared with in the study and control group, and after that mean difference of study and control group was compared. After using descriptive statistics mean value, standard deviation, confidence interval, t value and p value was obtained. **Statistical test: Independent t test was used to compare the mean in terms of distance of right and left side in study and control group, also test was used to compare the mean difference of scapular position at three different positions and for scapular upward rotation at rest, at 60 and 90 degree abduction between study and control group.**

### 3. Results

The total no of subjects who were included in the study were 100 of which 50 subjects in study group and 50 in control group.

Table 1 gives details of the sample size, working hours per day, and work experience of study group (with neck pain), which shows minimum age was 30 and maximum was 36 with mean of 31.71(1.87). Also minimum working hours was 8 and maximum was 12 with mean of 9.48(0.76) and mean of working experience was 6.14(0.98).

![Table 1: Demographic characteristics of study group (with neck pain)](attachment:table1.png)

<table>
<thead>
<tr>
<th>Position</th>
<th>Right</th>
<th>Left</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands on hip(cm)</td>
<td>13.32(1.61)</td>
<td>13.35(1.47)</td>
<td>1.98</td>
<td>0.995</td>
</tr>
<tr>
<td>90° abduction(cm)</td>
<td>13.32(1.61)</td>
<td>13.35(1.47)</td>
<td>1.98</td>
<td>0.93</td>
</tr>
<tr>
<td>Upward rotation at rest</td>
<td>32.5(1.87)</td>
<td>32.7(1.81)</td>
<td>1.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Upward rotation (in degrees) 60 degree abduction</td>
<td>29.96(1.69)</td>
<td>29.93(1.73)</td>
<td>1.98</td>
<td>0.89</td>
</tr>
<tr>
<td>Upward rotation (in degrees) 90 degree abduction</td>
<td>10.5(1.2)</td>
<td>10.0(1.17)</td>
<td>1.98</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Table 6: gives details of scapular position in individuals with neck pain at three different positions that is at rest, hands on hip, and 90° abduction.
hip and 90 degree abduction including the scapular upward rotation at rest, 60 degree abduction and 90 degree abduction. Results shows there is significant difference between right and left side in all three positions and in upward rotation.

<table>
<thead>
<tr>
<th>Position</th>
<th>Right Mean(SD)</th>
<th>Left Mean(SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest(cm)</td>
<td>12.04(1.57)</td>
<td>11.07(1.22)</td>
<td>1.98</td>
<td>0.0004</td>
</tr>
<tr>
<td>Mean difference</td>
<td>1.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hands on hip(cm)</td>
<td>12.67(1.56)</td>
<td>11.74(1.24)</td>
<td>1.98</td>
<td>0.0007</td>
</tr>
<tr>
<td>Mean difference</td>
<td>1.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90° abduction(cm)</td>
<td>13.51(1.63)</td>
<td>12.52(1.24)</td>
<td>1.98</td>
<td>0.0005</td>
</tr>
<tr>
<td>Mean difference</td>
<td>1.37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The result shows there is a significant difference between the right and left side in all three positions and in upward rotation of scapula.

The result shows there is significant difference of scapular position among study and control group in all three positions and in upward rotation.

Table 7: Comparison between study and control group

<table>
<thead>
<tr>
<th>Position</th>
<th>Cases Mean (SD)</th>
<th>Control Mean (SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest(cm)</td>
<td>1.36</td>
<td>0.49</td>
<td>1.99</td>
<td>0.0007</td>
</tr>
<tr>
<td>Hands on hip(cm)</td>
<td>1.3</td>
<td>0.43</td>
<td>1.99</td>
<td>0.0009</td>
</tr>
<tr>
<td>90° abduction(cm)</td>
<td>1.37</td>
<td>0.43</td>
<td>1.99</td>
<td>0.0006</td>
</tr>
<tr>
<td>Upward rotation at rest</td>
<td>3.2</td>
<td>0.2</td>
<td>1.99</td>
<td>0.0000</td>
</tr>
<tr>
<td>Upward rotation 60 degree abduction</td>
<td>3.7</td>
<td>0.03</td>
<td>1.99</td>
<td>0.0000</td>
</tr>
<tr>
<td>Upward rotation 90 degree abduction</td>
<td>2.1</td>
<td>0.5</td>
<td>1.99</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The result shows there is significant difference of scapular position among study and control group in all three positions and in upward rotation.

4. Discussion

The present study assessed the scapular position in computer professionals with and without neck pain in three different positions and scapular upward rotation. The vernier caliper and base line digital inclinometer was used to assess the scapular position in computer professionals.

The result of the study showed that there is significant difference of scapular position in computer professionals in all three positions that is at rest, hands on hip and 90° glenohumeral abduction with internal rotation and in scapular upward rotation in computer professionals with neck pain. Which infers that the scapular kinematics is altered in all three positions in computer professionals who works in abnormal posture for long hours which cause neck pain.

The possible reason for this change can be explained by the fact that Neck pain from poor posture can be explained as in an upright position the head is supported by the spinal vertebrae. Once the head is flexed forward, For instance while working on computer, the vertebrae do not support the weight of the head as much. Muscles, tendons, and ligaments work harder to hold up the head. Overtime the muscles and other soft tissues tighten up due to the excessive workload required to hold the head in position. The anterior neck muscles become weak from being in shortened position and neural structures are kept in less than optimal positions. This chronic overload and tightening of soft tissues may eventually result in decreased blood flow and oxygen to the soft tissues, ultimately causing pain.

The altered scapular position could have probably occurred due to working posture of computer professionals, as they used to work for long hours in poor postures which include, forward head posture, and protracted shoulder. Poor working posture will further lead to imbalance of scapular muscle activity especially excessive loading of scapular muscles. This will then causes neck pain in computer professionals who works in poor posture. This can be supported by a systematic review done by Green B.N et al, who observed that neck pain is associated with prolonged computer use in poor working posture.

Impaired alignment of scapula may be classified as scapular downward rotation, depressed, elevated, adducted, abducted, tilted, or winged scapula. Scapular downward rotation is defined as a downwardly rotated scapula with the inferior border being more medial than superior border; the shoulder is lower and slopes downward at the acromion end. Scapular downward rotation can contribute to prolonged compressive loading of neck as a result of the transfer of the weight of the upper extremities to the cervical region through the attachments of the cervicoscapular muscles (upper trapezius and levator scapulae). Increased upper trapezius muscle length in scapular downward rotation does not effectively transfer the weight of an upper extremity load to the sternocleidomastoid joint, and increased levator scapulae muscle stiffness may contribute increased compressive load and shear force on the cervical spine during active neck movement. Repetitive and excessive stress in the neck structures has the potential to cause cumulative micro trauma to tissue in the cervical region which will lead to neck pain, and limited neck rotation range of motion. Also it has been found that prolonged exposure to stress can impair proprioception related muscle function, which can further damage muscle spindles. In this way, cervical compressive stress might inhibit the proprioceptive muscular feedback system. This increased joint position error has been in patients with neck pain.

Our results showed a significant difference that is more than 1.5 cm indicating change in scapular position in computer professionals with neck pain this is similar to observation made by Alexopoulos E.C, Tanagra D et al who observed that altered scapular alignment is proposed to be related to neck dysfunction and pain. Also Ludewig P.M found that


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extensive computer use amongst office workers has lead to an increase in work related neck pain. Aberrant activity within the three portions of the trapezius muscles and associated changes in scapular posture have been identified as potential contributing factor.

To further support the study Morten Wrested, Therese N Hanvold et al did a systematic review on computer work and musculoskeletal disorders of the neck and upper extremity, the review examines the evidence for an association between computer work and neck and upper extremity disorders. They observed that the work related load of the neck muscles especially trapezius in computer work is influenced by the computer workstation layout and individual working techniques which includes altered neck and shoulder posture which will lead to altered scapular position.

However the limitation of the study is that hand dominance was not included in the study. On the basis of these findings it is shown that the scapular position is altered in computer professionals with neck pain as compared to those who are not having neck pain. However it has not been established that whether neck pain lead to altered scapular position or its altered scapular position which is responsible for neck pain in computer professionals.

5. Conclusion

In the present study, it was seen that scapular position is altered in computer professionals who are suffering from neck pain in all three positions that is at rest, hands on hip, and 90 degree abduction including scapular upward rotation.

6. Declaration of Interest

The authors report no declarations of interest.

References


