Effect of Neck Stabilisation Exercise on Cranio-Vertebral Angle in Patients with Non-Specific Neck Pain

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ABSTRACT

Background: Nonspecific neck pain refer to neck pain whose underlying cause cannot be traced and problem associated with the population spent more time on smart phones and computers tends to develop forward head posture. Objective: This experimental study was aimed to find out the effect of neck stabilisation exercise on cranio-vertebral angle in patients with non-specific neck pain. Methods: 30 patients with non-specific neck pain (NSNP) satisfying the selection criteria were randomly allotted into two groups. Group A (15) was given neck stabilization exercise (NSE) along with conventional physical therapy for three sessions per week for the period of 3 weeks and Group B (15) was given conventional physiotherapy alone. Outcome measures: Evaluation of pain intensity using Numerical Pain Rating Scale (NPRS), Cranio-Vertebral angle (CV) angle by Electronic Head Posture Instrument (EHPI) and Cervical range of motion using goniometer was done at two stages-pre-treatment and at the end of 3rd week. The two periodical readings i.e. the pre and post intervention evaluation of outcome measures were taken for statistical analysis. Results: The mean age of study participants in both groups were same (A = 34.8± 5.2; B = 34.8± 5.7). Group A shows highly significant changes in all the outcome measures (p=0.001). Group B shows significant reduction in NPRS score (t =6.48; p =0.001) and improvement in cervical...
rotations ($t = 4.79, 3.50; p=0.001, 0.004$) cervical extension ($t= 6.08; p= 0.001$), and CV angle ($t=10; p=0.001$) whereas the cervical flexion remains the same. On comparing the post outcome measures of group A with B, NPRS scores, cervical flexion & extension and CV angle shows significant difference ($p<0.05$), there exists no significant difference in the movement of cervical extension & lateral rotation ($p=0.6; 0.4$ respectively) Conclusion: The study findings concluded that, three weeks of Neck Stabilisation exercises proves good in reducing pain, improves cervical ROM and helps in normalizing the decreased CV angle.

**Key words:** Non-Specific Neck Pain (NSNP), Cranio-Vertebral angle (CV angle), Electronic Head Posture Instrument (EHPI), Neck stabilisation Exercise, Numerical pain rating scale.

**INTRODUCTION**

The neck pain whose underlying cause cannot be traced to any Specific systemic disease are called Non Specific Neck Pain (NSNP) [1-2]. Non-Specific Neck Pain may due to excess time people spend on electronic devices like laptops, personal computers which alters the alignment of cervical spine & line of gravity. It causes an overload on muscle and connective tissue and results Forward Head Posture (FHP) [3].

Forward head posture is described as carrying the head forward to the centre of the shoulder [4]. FHP is a postural distortion, regarded as typical musculoskeletal disorder and it is commonly seen in patients with cervical disease in which occiput and upper cervical spine lean forward excessively and the lower cervical spine and the upper vertebrae lean backward excessively [5].

Abnormal alignment of the vertebrae is continuously maintained due to inappropriate posture. The vertebrae and surroundings soft tissues are easily exposed to a sudden impact or chronic stress, and this could lead to possible changes in the blood vessels, spinal disease, organ dysfunction, degenerative diseases, and autonomic dysfunctions, such as headache chronic fatigue if left undetected [7].

Head posture can be assessed by measuring CV angle. The measurement of CV angle is one of the common objective method is assessing FHP [8-9]. The standard normal value of CV angle in pain free population is about 50 degree. Any value below 50 degree leads to a form of cervical disorder [10]. This necessitates the assessment of head posture in evaluating and monitoring the outcome of treatment regimens for patients with NSNP [11].

There are many treatment strategies are available for the management of Non Specific Neck Pain. Among them, recent literatures enlighten the role of neck stabilization exercises (NSE). The neck stabilization exercises can increase flexibility in the neck and increasing the strength of muscles that support the neck dysfunction [12]. Neck stabilization exercises are performed to improve function and prevent reoccurrence of neck pain. They require co-
contraction and recruitment of the anterior and posterior cervical and shoulder girdle musculature [13].

A progression of neck stabilization exercises can increase flexibility in the neck, ease pain, and can also reduce the chance of re-injury. The present study aims to find out the effect of Neck stabilization exercises on Cranio Vertebral angle in patients with Non-Specific Neck Pain. Stabilization training as a series of strengthening exercise for the neck is a great way to get better balance in the muscles around the neck, chest and upper back which are helpful in supporting the neck in safe position while we are working or when we are doing other daily activities.

**MATERIALS AND METHODS**

This experimental study was carried out in the Department of Physical Medicine Rehabilitation, RMMCH at Annamalai University, Chidambaram. The samples were recruited through simple random sampling method and their informed written consent was obtained. **Inclusion:** apparently healthy subjects with non specific neck pain and their CV angle less than 50 degree, both genders were included. **Exclusion:** dizziness of neck movement, severe migraine complaints of radicular pain, cervical spine injury.

**Procedure:** 30 patients with Non specific neck pain (NSNP) satisfying the selection criteria were randomly allotted into two groups of 15 each. Group A (n=15) was given Neck stabilization exercise (NSE) along with conventional physical therapy for 3 sessions per week for the period of 3 weeks and group B (n=15) was given conventional physiotherapy alone (IFT/TENS) for 3 weeks. Evaluation of pain intensity using Numerical pain rating scale (NPRS), Cranio vertebral angel (CV Angle) by Electronic head posture instrument (EHPI) and Cervical ROM using Goniometer were done at two stages – pre treatment and end of 3rd week. The two periodical readings of pre and post intervention evaluation of outcome measures of group A&B were taken for statistical analysis.

**Procedure of measuring CV angle using EHPI**

Cranio-Vertebral Angle is an angle formed by intersection of horizontal line drawn to the spinous process of 7th cervical vertebra and the line joining spinous process of C7 vertebra with the tragus of ear. CV angle was measured by the electronic head posture instrument, an electronic angle finder mounted on a transparent plastic base and a tripod camera stand.

The C7 spinous process was palpated and identified and an adhesive pin marker was attached over its midpoint of the most prominent part. The participant was them asked with his/her left shoulder in front of the EHPI. Another pin marker was fixed at the tragus of the ear. Participants were instructed to stand/sit comfortably with his/her weight distribution evenly on both feet and keep the eyes looking straight forward. A virtual line was drawn between the two pin markers from midpoint of the tragus to C7.
The present study evaluates the effectiveness of Neck Stabilization Exercise (NSE) on Cranio-vertebral Angle (CVA) in patients with non specific neck pain (NSNP). Thirty participants (N=30) having NSNP were randomly assigned into 2 equal groups. Group A (n₁=15) receives Neck Stabilization Exercises along with conventional physiotherapy whereas group B (n₂=15) receives conventional physiotherapy alone.

Both groups receive therapy for the period of 3 consecutive weeks. The Numerical pain rating scale (NPRS) score of NSNP, cervical range of motion - cervical flexion, extension, right lateral rotation, left lateral rotation and CVA was measured before and after the treatment as outcome measures.

The pre and post data of the outcome measures were taken for statistical analysis using SPSS version.16 to draw the results.

STASTICALS ANALYSIS
The mean age of the participants in group A was 34.8 ± 5.2 years and group B was 34.8 ± 5.7 years. The above graph shows that, participants of both groups share the common mean age.

From the above graph 2, it was inferred that 1/3rd of the participants in group A were males and 2/3rd were females whereas in group B, males and females were similarly distributed.
Graph 3 categorizes the participants based on their duration of NSNP. In group A, 73% of the participants (n=11) falls within the duration of 3 months. In group B, 60% of the participants (n=9) comes under the category of 1 month & 3 months duration of illness. In group A, none of the participants (n=0) have illness beyond 6 months whereas 13% of the participants (n=2) of group B have illness beyond 6 months.

The pre and post treatment mean values of outcome measures of both groups were statistically compared and analysed using “paired ‘t’ test”.

Table 1: Descriptive Statistics & Pre-Post Comparison of Group A.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre values</th>
<th></th>
<th></th>
<th>t – value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>6.0</td>
<td>0.92</td>
<td>3.4</td>
<td>0.95</td>
<td>11.76</td>
</tr>
<tr>
<td>Cervical Flexion</td>
<td>34.3</td>
<td>5.30</td>
<td>38.6</td>
<td>2.28</td>
<td>6.51</td>
</tr>
<tr>
<td>Extension</td>
<td>31.0</td>
<td>3.38</td>
<td>38.0</td>
<td>2.53</td>
<td>10.69</td>
</tr>
<tr>
<td>Right lateral rotation</td>
<td>39.6</td>
<td>3.99</td>
<td>43.6</td>
<td>2.28</td>
<td>5.52</td>
</tr>
<tr>
<td>Left lateral rotation</td>
<td>37.3</td>
<td>4.95</td>
<td>42.0</td>
<td>4.55</td>
<td>7.897</td>
</tr>
<tr>
<td>CV angle</td>
<td>32.6</td>
<td>1.96</td>
<td>41.76</td>
<td>2.88</td>
<td>25.61</td>
</tr>
</tbody>
</table>

(p = <0.05 is Significant).
Table 1 indicates the mean values of experimental group - A on NPRS score, cervical range of motion and CV angle. The pre-treatment and post treatment mean of outcome measures were compared using paired t-test and it was found that all the parameters were significantly improved (p=0.001).

Table 2: Descriptive Statistics & Pre-Post Comparison of Group B

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre</th>
<th>Post</th>
<th>t- value</th>
<th>p -value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>NPRS score</td>
<td>5.73</td>
<td>.883</td>
<td>4.20</td>
<td>.941</td>
</tr>
<tr>
<td>Cervical Flexion</td>
<td>38.6</td>
<td>2.28</td>
<td>38.6</td>
<td>2.28</td>
</tr>
<tr>
<td>Extension</td>
<td>41.3</td>
<td>4.41</td>
<td>46.0</td>
<td>2.80</td>
</tr>
<tr>
<td>Right lateral rotation</td>
<td>38.6</td>
<td>5.81</td>
<td>44.3</td>
<td>4.57</td>
</tr>
<tr>
<td>Left lateral rotation</td>
<td>38.3</td>
<td>5.23</td>
<td>40.6</td>
<td>4.16</td>
</tr>
<tr>
<td>CV angle</td>
<td>32.9</td>
<td>2.64</td>
<td>36.3</td>
<td>2.45</td>
</tr>
</tbody>
</table>

(p = <0.05 is Significant).

Table 2 compares the pre and post mean values of outcome measures of group B using “paired t-test”. The statistical analysis shows significant improvements in NSNP and CV angle (p=0.001). On considering the cervical range of motion, cervical extension, right lateral rotation and left lateral rotation shows improvement of high significance (p<0.05) whereas Cervical flexion was not significantly improved with the t value of 0.000 and corresponding P value of 1.00.

The difference in the outcome measures of group A & B were statistically analyzed using “Independent t test”. The mean values of pre-treatment outcome measures were tabulated below.

Table 3: Comparison of Pre Treatment Values of Group A & B

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>t- value</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS score</td>
<td>A</td>
<td>6.00</td>
<td>0.92</td>
<td>0.80</td>
<td>0.427</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>5.73</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical Flexion</td>
<td>A</td>
<td>34.3</td>
<td>5.30</td>
<td>2.90</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>38.6</td>
<td>2.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From the above table, it was inferred that, the pre values of Cervical flexion ($t = 2.9; p=0.009$) and extension ($t= 7.1;p=0.001$) movement of both groups were found to be significant. Meanwhile the pre-mean values of NSNP, CV angle and rotation movements were not significant.

**Table 4: Comparison of Post Treatment Values of Group A & B**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>t- value</th>
<th>p- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS score</td>
<td>A</td>
<td>3.46</td>
<td>0.91</td>
<td>2.16</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>4.20</td>
<td>0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical Flexion</td>
<td>A</td>
<td>38.6</td>
<td>2.28</td>
<td>7.84</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>46.0</td>
<td>2.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension</td>
<td>A</td>
<td>38.0</td>
<td>2.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>46.0</td>
<td>2.80</td>
<td>8.19</td>
<td>0.001</td>
</tr>
<tr>
<td>Right lateral rotation</td>
<td>A</td>
<td>43.6</td>
<td>2.28</td>
<td>0.50</td>
<td>0.619</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>44.3</td>
<td>4.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left lateral rotation</td>
<td>A</td>
<td>42.0</td>
<td>4.55</td>
<td>0.83</td>
<td>0.410</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>40.6</td>
<td>4.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV angle</td>
<td>A</td>
<td>41.7</td>
<td>2.88</td>
<td>5.51</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>36.3</td>
<td>2.45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

($p = <0.05$ is Significant).

Table 4 compares the mean difference in the post treatment outcome measures using “Independent samples t test”. There exists significant difference in the NPRS score ($p=0.039$), CV angle ($p=0.001$) and cervical flexion & extension ($p==0.001$) movement between group A and B. The difference in cervical rotation movements were not significant ($p=0.6; p=0.4$) between the groups.
DISCUSSION

Non specific neck pain (NSNP) appears to be a common ailment expected out of the tendency to stay seated for long periods of time. It is a problem associated with significant disability increasing to the percentage of the population that uses technology like personal computer, laptops or smart phones. **Edrish Saifee contractor, et al (2018)** recognizes that, patients with NSNP generally have poor CV angle due to the Forward head posture. **Dae-Hyun kim, Chan-ju kim and sung min (2018)** reported that the forward head posture (FHP) is known as an internal factor that causes dysfunction with shoulder and neck pain.

A forward head posture results in a posture in which the extended head and upper cervical and lower cervical vertebrae flexes. The exposure to this constant load in the cranio-vertebral extension muscles and the non-contractile structures causes a change in the biomechanical movement and this increased can cause musculoskeletal damage or pain.

There are so many physiotherapeutic strategies are available for managing and preventing NSNP like electrotherapy modalities, exercises, manual therapy, etc. Among them **Yesim Dusunceli etal, (2009)** states that Neck stabilization exercises is the simplest form of exercise which the patient can do themselves by appropriate training and supervision. The stabilization exercises are exercises that are meant to maximize function, and prevent injury progression or re-injury. They require co-contraction and recruitment of the anterior and posterior cervical and shoulder girdle musculature.

**Emily Nichol (2012)** states that study reveals the efficacy of neck stabilization exercises when compared to physical therapy modalities for the treatment of non specific neck pain. There are many modalities used to the Non specific neck pain like, TENS, Ultrasound etc. **Chiu et al and Dusunceli et al (2012)**. There is strong evidence to support the use of neck stabilization exercises to reduce the report of NSNP patients. They performed 10 hours of neck stabilization exercises over 3 weeks and a home exercise program for the rest of the year produced statistically and clinically significant improvements in neck pain over 6 months. As per **Ashiyat Kehinde, et al (2018)** Neck Stabilization exercise is improving NSNP and CV angle too. Apart from pain management, Cranio-vertebral angle (CV angle) correction is gaining importance which in its optimal range will prevent many cervical dysfunctions. The present study evaluates the role of NSE over conventional physiotherapy in normalizing the reduced CV angle and improving cervical ROM thereby reducing pain.

Thirty participants with NSNP were randomly assigned in two equal groups. Group A receives Neck Stabilization Exercises along with conventional physiotherapy and group B receives conventional physiotherapy for the period of 3 weeks. The evaluation of NSNP, cervical ROM and CV angle were done initially before the commencement of treatment and post treatment using NPRS, goniometry and Electronic head posture instrument (EHPI) respectively. In the present study, the mean age of the both group was same and it was 34.8 years. This may reduce the impact of ageing over the result. The mean age of the participants of present study is consistent with the age range of patients affected by NSNP. The Graph 2
shows the gender distribution of participants. In this graph group A, 10 females and 5 males and group B, 8 females and 7 males were participated. Confined to the present study, majority of the participants having NSNP were females.

The Graph 3 shows the frequency distribution of pain duration. In group A, 73% (n=11) of the participants had NSNP for the duration of within 3 months. In group B (n=9) 60% of participants comes under the category of 1 month and 3 months duration of illness. In group A, none of the participants has illness beyond 6 months were as 13% of participants in group B have illness beyond 6 months.

On comparing the mean values of pre and post outcome measures of experimental group there was a significant difference in all the parameters. Control group also exhibits significant improvement in all outcomes except the cervical flexion as the mean difference was nil. Catherin Griffiths etal (2016) studied the effect of NSE in chronic NSNP individuals and found that neck stabilization exercise improves the cervical flexion thereby improving the CV angle. The mean difference in the pre –post values of group A with group B was statistically tested by Independent sample t test. There exists significant difference between the groups, where group A shows better improvements in NPRS score, cervical flexion and extension and cranio-vertebral angle.

The cervical rotation movement was not improved significantly and coincides with the study results of Dae-Hyun kim, Chan-ju kim and sung min (2018) stating that “no significant changes were observed in the right/left cervical rotation in individuals with Forward head posture. Ashiya Kehinde Akodu et.al (2018) also studied the effect of NSE in chronic NSNP and found significant improvement in the cranio- vertebral angle (p=0.001). From the present study it was concluded that pain reduction can be achieved by conventional physiotherapy but improvement in cervical flexion & extension and CV angle will be better achieved by Neck Stabilisation Exercises. NSE has no role in cervical rotation movements.

The sample size of the current was small and study duration also limited. The long term effect of neck stabilization exercises may be studied in and a follow up assessment can be done to study the long lasting effect of 3 weeks exercise regimen. For the extensive benefits, NSE can be incorporated into the management of NSNP patients.

CONCLUSION

The findings of the present study reveals that, 3 weeks of neck stabilization exercise proves good in reducing NSNP, improves cervical ROM and helps in normalizing the decreased CV angle. The cervical flexion was greatly improved by NSE which helps in improving the CV angle and reducing Forward head posture. Therefore the study results recommend the implementation of Neck Stabilization Exercises in the treatment of NSNP.

Ethical Approval

The study protocol got ethical clearance from the Institutional Human Ethics Committee, Rajah Muthiah Medical Collage, Annamalai University.
Source of support – Self

Conflict of interest – None

ACKNOWLEDGEMENT

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