

## ORIGINAL RESEARCH

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## EFFECT OF THE CERVICAL ENDURANCE TRAINING PROGRAMME IN MECHANICAL NECK PAIN

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## ABSTRACT

**Background:** Mechanical neck pain commonly arises insidiously and is generally multifactorial in origin. Regardless of the primary source of pain, the prognosis for individual experiencing chronic neck pain is poor. Exercise interventions are important for effective management of patients with neck pain. The objective of the study is to compare the efficacy of cervical endurance training programme with cervical isometric exercise in alleviating symptoms of mechanical neck pain.

**Methods:** 40 subjects were assessed and identified with Mechanical Neck Pain and recruited for the study and were randomly divided into two groups. In one group endurance training for cervical muscles and in another group resisted isometric had been given for 3 weeks. The post treatment scores regarding endurance, pain intensity, disability, Range of motion and muscle power were compared with the pre treatment scores.

**Results:** Paired 't' test was done to compare the pretreatment scores with the post treatment scores. Unpaired 't' test was done to compare the post treatment scores of both the groups. The pain intensity, disability were found to be significantly decreased in experimental group than the control group ( $p < 0.001$ ). While the endurance was found to be significantly increased in experimental group than the control group ( $p < 0.001$ ). The muscle power was found to be slightly increased in the control group than the experimental group. The post treatment cervical range of motion does not have significant difference in between the groups (Flexion-  $p = 0.35$  and Extension-  $p = 0.40$ ).

**Conclusion:** This study showed that the progressive endurance exercise is beneficial in alleviating mechanical neck pain and should be incorporated along with the conventional physiotherapy treatment for mechanical neck pain.

**Keywords:** Mechanical neck pain, endurance, Craniocervical flexion, Training, Deep neck flexors

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## INTRODUCTION

Mechanical neck pain commonly arises insidiously and is generally multifactorial in origin, including one or more of the following: poor posture, anxiety, depression, neck strain, and sporting or occupational activities.<sup>1,2,3</sup> Panjabi et al<sup>4</sup> estimated that the neck musculature contributes 80% to the mechanical stability of the cervical spine while the osseoligamentous system contributes the remaining 20%. Hallgren et al<sup>5</sup> and McPartland et al<sup>6</sup> determined that subjects with chronic head and neck pain showed atrophy and fatty infiltration of the sub occipital skeletal muscle tissues. Previous research investigating cervical impairment suggests that Deep Neck Flexor (longus capitus, longus colli [superior portion], and rectus capitis anterior) muscle weakness might be a causative or contributory factor in the pathogenesis of mechanical neck pain.<sup>7</sup> It is theorized that when muscle performance is impaired, the balance between the stabilizers on the posterior aspect of the neck and the Deep Neck Flexors will be disrupted, resulting in loss of proper alignment and posture, which is then likely to contribute to cervical impairment.<sup>8</sup> The results of one randomized controlled trial of patients with neck and headache complaints showed that a group of patients who received endurance exercises, attempting to target the Deep Neck Flexor musculature as part of a multimodal intervention, experienced a significant reduction in neck pain and headache frequency.<sup>9</sup> Gentle low load exercise may be a better approach to management in the initial stages of rehabilitation when pain is a key issue and also has the added benefit of permitting the patient to train in a manner that facilitates the coordinated action of the deep and superficial cervical muscles.<sup>10</sup> In the present study we have included only reliable and cost effective instruments or tests to identify the problem and to compare the baseline results with the post interventional results.

In view of the above fact an experimental study has been taken out with homogenous population with mechanical neck pain. This study will find out the effectiveness of cervical endurance training programme over the conventional physiotherapy in alleviating the symptoms of mechanical neck pain.

## METHODS

**Subjects:** 50 patients both male and females (Mean age = 27.45 years, SD =  $\pm$  3.64 years) with neck pain were recruited from the physiotherapy outpatient department of Saveetha medical college and hospital, Chennai.

First the patients were screened for mechanical neck pain by history taking and doing special test (upper limb tension test, distraction and spurling's test) to rule out the exclusion criteria. Out of 50 subjects 10 subjects were excluded from the study since they match the exclusion criteria.

### Treatment condition

The exercise regimens were conducted over a 3-weeks period and subjects in each group received personal instruction and supervision.

It consists of training of the deep lower cervical extensor muscles and progressive training of deep cervical flexor muscles.

### Training of the deep lower cervical extensor muscles:

The exercise is performed in prone on elbows or in sitting position as comfortable to the patients. The patient was instructed to let the head and neck move into flexion, then return to the starting position

to train the eccentric /concentric function of the cervical extensors. During the exercise, the patient is encouraged to maintain a neutral Craniocervical position, and instead the flexion /extension motion is encouraged at the lower cervical spine facilitated by the therapist's fingers. This maneuver encourages training of the deep lower cervical extensors while minimizing activity of the more superficial extensors such as the semispinalis capitis muscles that attach to the occiput [Fig 1(a & b)]. The exercise was performed at 10 repetition 3 times daily.

**Figure 1:** Training the deep lower cervical extensor muscles



Figure 1 (a)

Figure 1 (b)

### Training of the deep cervical flexor muscle:

Specific training of the cervical flexor muscle group had been gradually progressed.

(A) Figure 2- Craniocervical flexion training with an emphasis on the coordinated action and low load endurance of the deep and superficial cervical flexor muscles. Correct performance and progression of the exercise was enhanced with modified sphygmomanometer as a stabilizer Pressure Biofeedback device. This was done for 10 repetitions 3 times daily for 3 weeks.

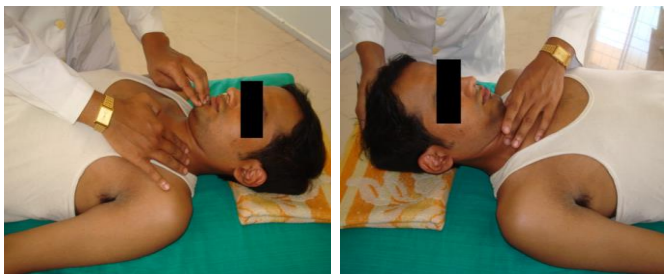
(B) Figure 3 - A progression of flexor muscle training. The head was gently lifted off, then lowered down to the supporting surface, while maintaining the Craniocervical region in mild flexion to train the inner range concentric and eccentric performance of all cervical flexor muscles. The exercise had been commenced carefully and within the capabilities of the patient, instructed first to only partially lift the weight of the head, progressed to lift the full weight of the head off the supporting surface. This was done for 10 repetitions 3 times daily for 3 weeks.

(C) Figure 4 - Training is progressed to an upright position to train the outer range eccentric and concentric performance of the flexors, progressed to the extreme of range within the patient's capability. This was done for 10 repetitions 3 times daily.

**Figure 2:** Using modified sphygmomanometer as a biofeedback. Craniocervical Flexion Training



**Figure 3:** flexor muscle training (inner range)



**Figure 4:** Trains outer range eccentric and concentric performance of the flexors



Control group was given the conventional physiotherapy i.e. Resisted neck isometric exercise. Subject is instructed to sit in a chair with his back straight. Patient is asked to hold the resistance for 10 seconds and relaxed. This was done for 10 repetitions and 3 times daily for 3 weeks. After giving intervention to 2 groups for 3 weeks the

subjects were assessed to compare with the baseline data.

### Outcome Measure

Pain was assessed using a visual analog scale consisting of a 10-cm horizontal line with endpoints labeled "no pain" and "worst pain ever." Gravitational goniometer for cervical range of motion in degree. The pendular-type gravity goniometer has been reported to have good test-retest and interexaminer reliability, with intraclass correlation coefficients reported to be generally greater than 0.80.28. Modified pressure Sphygmomanometer for measuring cervical muscle power and endurance of deep cervical muscles. Cervical muscle power was assessed by the modified sphygmomanometer<sup>[11]</sup> for cervical flexors and extensors. Craniocervical flexion test was used to find the endurance of the Craniocervical flexor muscle. In Oswestry Neck disability index questionnaire, Subjects were assessed for baseline values i.e. neck disability index (NDI) questionnaire designed to measure disability in activities of daily living due to neck pain.

### Procedure:

Subjects were assessed for baseline values i.e. neck disability index (NDI) questionnaire designed to measure disability in activities of daily living. The CCFT was performed with the subject supine and required performing a gentle head-nodding action of Craniocervical flexion (an action indicating yes) for 5 incremental stages of increasing range, each stage being held for 10 seconds. Performance was guided by feedback from a pressure biofeedback unit placed suboccipitally to monitor the flattening of the cervical lordosis those results from the contraction of the deep neck flexors. The pressure biofeedback unit was placed between the plinth and the posterior aspect of the neck just below the occiput and inflated to a baseline of 20 mmHg (Fig 5). The examiner closely monitored the subjects during the CCFT and superficial neck flexor muscle recruitment was discouraged by verbal feedback. Each subject was reminded to relax the neck musculature and to concentrate on performing a gentle, nodding head movement. Each subject was instructed to perform the neck Craniocervical flexion movement at 5 different pressure levels (22, 24, 26, 28, and 30 mmHg) and to hold each level for 10 seconds. A 30-second rest period was provided between each level. The testing procedure ended when the subject could not hold a specific pressure level for 10 seconds or the maximum level of 30 mmHg was achieved. The highest level each subject achieved was recorded. Each subject was tested only once by 1 of the

researchers, who was blinded to the group assignment of the subjects.

**Figure 5:** Pressure biofeedback unit



Then the subjects were randomly divided into 2 groups' i.e. experimental group and control group each with 20 subjects. The allocation sequence was generated by an independent body and an independent investigator assigned participants to their group.

Experimental group received the progressive cervical endurance training programme and the control group received the cervical isometric exercise.

**Statistical analysis:**

Statistical analysis was performed with computerized software programme SPSS 12.0 and Excel 2007 (Microsoft). Paired't' test were conducted to determine if VAS , NDI, Range of motion, Muscle Power and Endurance

measurements were significantly different before and after the intervention for both exercise groups. Student's independent't' test was conducted in between the groups. This was done to find the post treatment effect of the endurance training and conventional physiotherapy treatment in both the treatment groups. For the pre intervention to post intervention analysis, a repeated measures general linear model was applied. A value of P < 0.05 was used as an indicator of statistical significance.

**RESULTS**

Initially 50 subjects were recruited for the study. 10 dropouts were there .Out of 10 subjects 8 of them were removed from the study since they met the exclusion criteria. 2 subjects were absent during mid of the study. The total population of this study was 40 subjects. Mean age for control group and experimental group are  $27.05 \pm 4.66$  and  $27.45 \pm 3.64$  respectively. Mean height (cms) for control and experimental group are  $162.55 \pm 7.87$  and  $161.90 \pm 9.29$  respectively. Mean weight for control and experimental group are  $60.95 \pm 5.33$  and  $61.85 \pm 7.72$  respectively. Comparison of the post treatment scores within the groups for endurance, pain intensity, disability index, cervical range of motion and cervical muscle power had been done by means of unpaired student's t-test in the table 1

**Table 1:** Comparison of the post treatment scores with in the groups

	Mean (performance Index in mm Hg)	Standard deviation ( $\pm$ SD)	p-value
<b>Endurance</b>			
Control (n = 20)	14.50	$\pm 9.57$	P < 0.0001
Experimental (n = 20)	68.50	$\pm 14.66$	
<b>Pain intensity</b>			
Control (n = 20)	4.80	$\pm 1.15$	P < 0.001
Experimental(n = 20)	1.50	$\pm 0.82$	
<b>Disability index</b>			
Control (n = 20)	5.30	$\pm 3.45$	P = 0.005
Experimental (n = 20)	2.45	$\pm 2.44$	
<b>Cervical muscle power</b>			
<b>Flexor</b> Control	76.2	$\pm 9.5$	p = 0.002
Experimental	66.3	$\pm 9.5$	
<b>Extensor</b>			
Control	$79.6 \pm 7.34$		p = 0.001
Experimental	$67.5 \pm 9.8$		
<b>Cervical range</b>			
<b>Flexion</b> Control	73.2	$\pm 11.25$	p = 0.35
Experimental	70.25	$\pm 8.46$	
<b>Extension</b>			
Control	62.2	$\pm 9.04$	p = 0.40
Experimental	64.3	$\pm 6.6$	

The two groups were compared within the group for pre and post treatment endurance scores by means of paired student's t-test.

**Table 2:** Comparison of pre and post treatment endurance scores within the groups

	Mean( ± SD) in mm Hg		p-value
	Pre treatment	Post treatment	
<b>Control</b>	13.0(±9.93)	14.50(±9.57)	P =0.08
<b>Experimental</b>	13.80(±9.88)	68.50(±14.66)	P < 0.001

Table 2 showed the significant difference between pretreatment and post treatment scores in experimental group. The mean value of pre treatment and post treatment scores in the control group does not vary much. This shows that the progressive endurance exercise has significant affect on increasing the endurance of the cervical deep muscles.

The two groups were compared within the group for pre and post treatment pain intensity scores by Paired student's t-test.

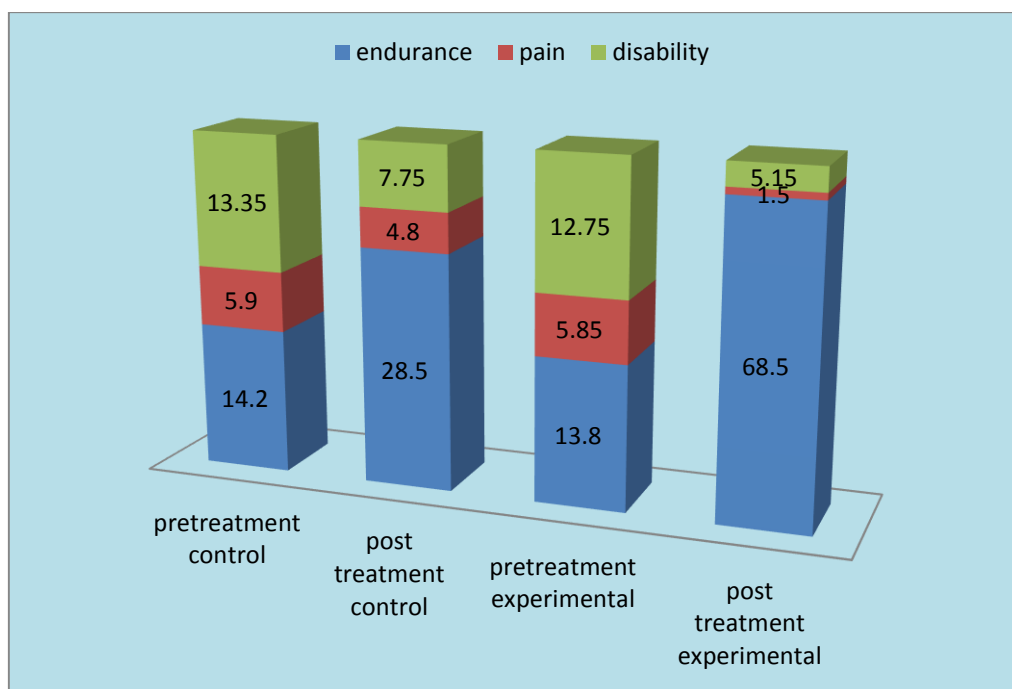
**Table 3:** Comparison of pre and post treatment pain intensity scores within the groups

	Mean( ± SD)		p-value
	Pre treatment	Post treatment	
<b>Control (n = 20)</b>	5.90(±1.37)	4.80(±1.15)	p =0.04
<b>Experimental (n = 20)</b>	5.85(±1.37)	1.50(±0.82)	P < 0.0001

The results in the above table showed that there is significant difference of the post treatment Numeric Rating Scale scores in between the two groups. The Low intensity Progressive endurance training decrease the pain intensity with immediate hypolgesic effect compared to the cervical isometric exercise.

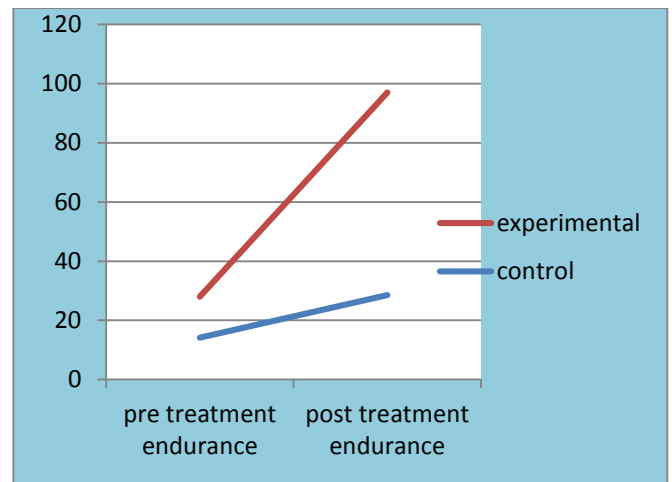
Subjects in the experimental group receiving progressive endurance training had a significant

**Graph 2:** This graph shows the Mean values of pre treatment and post treatment scores of the



improvement in alleviating the symptoms of neck pain. However the neck muscle power in the experimental group does not improved. As compared to the experimental group the control group receiving cervical isometric exercise has greater improvement in neck muscle power .The neck range of motion doesn't have much alteration as compared between the two groups. Pain intensity in the experimental group measured after 3 weeks had significant improvement from baseline score. Post treatment scores for endurance of the experimental group have significant difference from the control group (P < 0 .01) .Along with the pain intensity the disability of the subjects in the endurance group also has significant difference in the post treatment scores.

**Graph 1:** This graphical representation shows the endurance improvement in both the groups



two groups regarding Endurance, Pain and Disability.

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## DISCUSSION

Despite the prevalence of mechanical neck pain, a large gap exists in the literature, which has failed to provide sufficient, conclusive evidence favoring one specific intervention over another in the conservative treatment of this pathology. The inconsistencies currently exist among Physical therapists regarding treatment techniques for mechanical neck pain. Although there is a role for therapeutic exercises in the treatment of chronic mechanical neck disorder, the relative benefit of individual exercises has not been clearly established.<sup>12</sup> The literature has established a strong association between deep neck flexor weakness and neck pain, warranting strengthening of these muscles for those with neck pain and poor posture.<sup>11</sup> In our study, we compared the effect of 2 different exercise methods in training the cervical musculature. The results of our study indicate that by giving the progressive cervical endurance training programme the pain intensity, disability and the endurance had changed in the subjects there by alleviating the symptoms of the neck pain. Subjects in the experimental group receiving progressive endurance training had a significant improvement in alleviating the symptoms of neck pain. However the neck muscle power in the experimental group does not improve. As compared to the experimental group the control group receiving cervical isometric exercise has greater improvement in neck muscle power. The neck range of motion doesn't have much alteration as compared between the two groups. Pain intensity in the experimental group measured after 3 weeks had significant improvement from baseline score. Post treatment scores for endurance of the experimental group have significant difference from the control group ( $P < 0.01$ ). Along with the pain intensity the disability of the subjects in the endurance group also has significant difference in the post treatment scores. O'Leary et al (2008)<sup>13</sup> that gentle low load exercise produces a superior immediate hypalgic effect than higher load exercise. Low load exercise may be a better approach to management in the initial stages of rehabilitation when pain is a key issue. Progressive endurance exercise had been done with low load and gentle slow motion. In a previous study by D. Falla (2004)<sup>14</sup> it was shown that an endurance-strength exercise regime for the cervical flexor muscles is effective in reducing myoelectric manifestations of superficial cervical flexor muscle fatigue as well as increasing cervical flexion strength in a group of patients with chronic non-severe neck pain. Provision of load to challenge the neck flexor muscles is required to

reduce the fatigability of the Sternocleidomastoid and Anterior Scalene muscles in people with neck pain. Improvements in cervical muscle strength and reduced fatigability were responsible for the reported efficacy with this type of exercise program. They reported a reduced average intensity of neck pain and reduced neck disability index score ( $P < 0.05$ ).

The finding of the study implies that the Mechanical Neck Pain is multifactorial in origin but the root cause of sudden pain is due to the lack of endurance in the cervical deep muscles. In our daily activities we used the neck movements which were largely controlled by neck superficial muscles. The endurance of the cervical deep muscles is not used mostly and due to which those muscles become weak and very easily fatigued. The progressive endurance training programme increases the endurance of the deep cervical muscles thereby reducing the pain and disability. Although the results of the study offer substantial information, there are limitations that cannot be overlooked. The study has been taken out within a very small time frame. The follow up has not been done and treatment duration is not enough. Craniocervical flexion test is only for evaluation of Craniocervical flexor muscles and is not for deep extensors. In our study we did not measure the endurance of the deep extensors.

## Conclusion

The endurance training programme for cervical muscle had significantly increased the endurance of the deep cervical muscle apart from which pain and disability also decrease in the subjects. The subjects getting cervical isometric exercise do not have any significant difference in endurance, pain and disability though the cervical muscle power increases in the subjects getting resistive isometric exercises. So our study concluded that in our daily clinical practice along with the conventional physiotherapy we may also concentrate on prescription of the progressive endurance training programme for better outcome of patients with Mechanical neck pain.

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