Original Article

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Efficacy of Motor Control and Endurance Exercises in Neck Pain: A Pilot Study

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Abstract

Background of the Study: A neck pain complaint was found to be one of the most emerging musculoskeletal complaints and requires attention of the health professionals. Our objective was to determine the efficacy of the motor control and endurance exercise over conventional exercise in subjects with non-specific neck pain.

Methodology: A Prospective cohort study, with Pre-post test series compared the outcomes among two intervention groups and a conventional group conducted in the Outpatient Physiotherapy department of ACS Medical College for the duration of 12 weeks. 18 Patients with non-specific neck pain were recruited and randomized into three groups. VAS, endurance, CCFT score were measured at baseline, 4th, 8th and 12th week follow up. NDI and SF-12 scores were obtained at baseline and 12th week follow up.

Result: Comparison of VAS, NDI, SF-12, endurance, CCFT score within the group at the baseline, 4th, 8th, and 12 week follow up, the subjects in the MCT group demonstrated a significant progressive change from baseline throughout the 12th week than the endurance and conventional training group in all the outcomes. The endurance training group also showed significance difference from the baseline to 12th week follow up, however not significant than the MCT group when compared between the group

Conclusion: Motor control exercise has high impact on neck pain and led to marked relief in pain intensity, disability and in improving the endurance of the neck muscle. Endurance training has also showed a statistically significant improvement, however lesser the significant than the motor control exercise group. In contrast, the conventional exercise has found to reduce the pain and disability, although there was no significant improvement in the endurance of the muscle.

Keywords: Motor Control Exercise; Non-Specific Neck Pain; Activation Pressure Score; Highest Pressure Score; Jull's Technique.

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Introduction

Neck pain is one of the major public health problems which have a greater effect on both the individual and the society in terms of pain and suffering, lost work day and health care cost [1]. Within the general and work population, the annual prevalence is 30-50 percent [2], while the lifetime prevalence of neck pain is about 70% [1]. In a relatively recent report on the global burden of disease, where 291 conditions were studied, neck pain was ranked 21st in terms of overall burden and fourth when measured by years lived with disability [3]. Neck pain can be very disabling and the individual may have difficulty with a wide range of activities such as driving, turning the head and working at a desk [4]. Neck pain is often characterized by exacerbations, and more than one third of patients will develop chronic symptoms lasting more than six months [5]. Integration of evidence-based practice with clinical expertise and patients' preferences, that aim to reduce pain and improve function, is of paramount importance for

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increasing the quality of life and maintain the work capacity of individuals with neck pain [6]. Exercise is one of the most common treatment choices for non-specific neck pain, but evidence regarding its effectiveness innon-specific recurrent patient group is scarce, especially for those with neck pain [7]. Conservative management of neck disorders includes both passive and active therapies, neither of which has been shown to be effective [8]. While several studies have demonstrated that pain can to some extent be reduced by endurance training [9,10]. But some studies have found no effect on non-specific neck pain [9]. A recent review showed limited evidence for the efficacy of exercise in the treatment of symptoms of the neck and shoulder due to the lack of high quality research [11]. Prospective studies have suggested that patients with chronic neck pain have weak neck muscles, and loss of motor control [12,13]. The motor control exercises are the therapeutic approach which mainly focuses on motor control, activation of deep cervical muscles, and aims to retrain the optimal control and co-ordination of the cervical muscles [14,15]. The MCE are usually established under supervision and it has been shown to increase the motor control and reduce the pain and disability in patients with neck pain [16]. The exercise targets the deep flexor muscles of the upper cervical region, the longus capitis and longus colli muscles, rather than the superficial flexor muscles, the sternocleidomastoid and anterior scalene, which flex the neck but not the head [17,18]. During the endurance training program of the cervical flexor group, flexion movement is performed at the lower cervical segment in supine and prone with proper head support to the train the flexor group of muscles in the neck [19]. The primary aim of the study was to compare the effectiveness of motor control exercise and endurance exercise over conventional exercise on pain, disability and endurance in patients with non-specific neck pain.

Materials and Method

Design: A Prospective cohort study, experimental design with Pre-post test series compared the outcomes among two intervention groups and a conventional group conducted in the Outpatient Physiotherapy department of ACS Medical College for the duration of 12 weeks.

Participants: 18 Patients with non-specific neck pain were recruited from physiotherapy outpatient department in ACS Medical College and Hospital, and randomized into three groups. The inclusion criteria were both male and female, aged 20 to 45 years, Idiopathic neck pain with duration > 2 weeks, Pain Numeric Rating Scale [VAS] 3 and above will be selected, NDI score < 15 and should be an Outpatient from ACS Medical college and hospital.Patients were excluded if undergone a Neck or upper extremity surgery, medical red flags suggesting a non-musculoskeletal origin (spine fracture, cervical myelopathy), Neurological disease of genetic, infectious, or neoplastic origin, Patients who are under anticonvulsants, antidepressants, psychotropic medication, Intellectual disability i.e severe mental illness, intoxication, severe sleep deprivation, Alzheimer's disease, Systemic or diagnosed chronic disease, including diabetes, stroke and neurological diseases, that may influence motor control and neck pain or ability to perform tests, Positive spurling test for neurological radiating arm pain, VBI symptoms, Pregnancy and whiplash injury.

Randomization: Patients were randomly allocated into three groups with 6 patients in each group by using a computer generated minimization method taking into account age, gender, and degree of disability result from the neck pain. A computerised program for randomization was used and the program automatically allocated the grouping of the patient. As these computers based randomization helps to establish allocation concealment. Informed consent was obtained from all subjects before inclusion. All the participants received an explanation about the procedures corresponding to their group.

Outcome: Before the exercise session, participants rated their level of neck pain intensity at rest on VAS, a 10cm scale, extremes were 'no pain' and 'worst pain', NDI- self reported Neck Disability Index, using Pressure Bio-feedback [chattanooga], endurance were measured by Jull's technique, neck control by cranio-cervical flexion test (CCFT), SF-12 to measure the impact of neck pain on their quality of life. An independent investigator assigned to each group and the researcher taking the measurement was blinded to subject group for the outcome assessment and statistical analyses. The patients were assessed at baseline 4th, 8th and 12th week follow up by an independent assessor who was blinded to the grouping.

Exercise Regimen: The exercise regimens were conducted over a 12-week period and subjects in each group receive exercises for 1 session per day for 3 days a week for 6 weeks. Subjects were asked not to receive any other specific intervention for the neck pain. Patients were randomized into motor control training, endurance training and a Conventional exercises group. Group A received the Motor control exercises, group B received the Endurance exercises, and group C received the Conventional exercises. The exercise program began with one set of activation of the deep neck muscles to enhance its ability for active stabilization of the cervical spine. Then the patient was asked to perform flexion and extension of the neck for 15 repetitions as a warm up exercise for the superficial torque producing muscles.

Motor control exercise

Training of the craniocervical flexor muscles followed the protocol described by Jull et al20. The exercise is a low-load exercise, specifically train the deep cervical flexors, which occurs in a head lift exercise. The exercise used an air-filled pressure sensor (Stablizer), which was placed sub-occipitally and the subject was guided by the feedback from the pressure sensor to reach the five pressure targets in 2–mmHg increments from 20 mm Hg - 30 mm Hg. The subjects were instructed to "gently nod their head as though they were saying 'yes'." Then the therapist identifies the target level that the subject could hold for 10 seconds. Training was commenced at the target level that the subject could achieve with a slow and controlled craniocervical flexion movement. For each target level, the contraction duration was increased to 10 seconds, and trained to perform 10 repetitions [using Pressure Bio-feedback, chattanooga]. Isometric hold with chin tucks in supine position with head and neck of the table. Quadruped track with book on the back of head and neck added with arm and leg movements.

Endurance exercises

The endurance training regimen consisted of progressive resistance exercise for the neck flexors in two separate stages. Stage 1 was of 2 weeks duration, patients performed supine head lift exercises in upper cervical neutral (12–15 repetitions) with weight (12 repetition maximum determined on first visits). In Stage 2 was of 4 weeks - three sets of 15 repetitions starting at 12 repetitions maximum (Falla et al.). Ball squeeze - The patient can hold a small ball (or his/her fist) between the chin and the chest and squeeze. Sets of isometric contractions can build deep flexor endurance for 6 sec hold and 6 repetitions. Forehead Ball roll - The deep flexors can be activated and endurance can be built by having the patient use his/her forehead to roll a small ball up and down against a wall, using short nodding movements. Once a patient has good active range of motion, diagonals can be added to this exercise [8-10 repetitions].

Conventional exercises: The conventional training regimen consisted of Supervised Isometric exercises for neck muscles and supervised stretching and active exercises at the cervical region.

Data Analysis

Analysis was performed using SPSS for windows, version 16.0. Nominal background variables (age, height, weight, BMI) at baseline were collected in all the groups and generated a descriptive statistics represented in the Table 1. For the ordinal and non-normally distributed variables (VAS, NDI, SF-12), the comparison between the intervention group were performed by Mann-Whitney U-test, whereas the changes within the group were analyzed by Wilcoxon test. As the endurance, CCFT Score was assessed and data were normally distributed, paired t-test was to analyze the change within groups and difference in between the groups were analyzed by one way analysis of variance (ANOVA). Post hoc multiple comparison test with Tukey was used to identify the difference among the group.

Table: 1: Demographic Details

Baseline Characteristics	Motor Control Exercise	Endurance Training	Conventional Exercise
Age	32.0±7.26	43.6±1.75	40.8±4.87
Height	163±7.27	157±4.57	159±4.76
Weight	57.1±8.70	67.5±11.3	54.3±3.26
Bmi	21.39±2.11	27.2±6.01	21.35±1.83
Gender (Female/Male)	(1/5)	(2/4)	(1/5)

Table 2: Pre and Post test values with the follow up for VAS for all three groups

Variable	Motor Group	Control	Endurance Group		Conventional Group		Significance Between Group
Vas (0-10Cm)	Mean±Sd	Significance Within Group	Mean±Sd	Significance Within Group	Mean±Sd	Significance Within Group	
Baseline	5.66±1.03		5.83±0.75		6.16±1.16		0.725
4Th Week	5.16±0.98	0.083	5.0±0.89	0.09	5.60±1.03	0.08	0.461
8Th Week	4.16±1.16	0.06	4.1±0.75	0.02*	5.50±1.37	0.04*	0.149
12Th Week	2.16±0.75	0.02*	3.1±0.98	0.02*	5.1±1.16	0.03*	0.003*

*-p-value is significant < 0.05 level

Table 3: Pre and Post test values with the follow up for NDI and SF12for all three groups

Variables		MCTG	EG	CG	Significance Between The Group
NDI					
	Pre	29.16±6.85	26.5±9.18	28.5±7.14	0.582
	Post	15.6±4.22	17.0±5.93	20.0±2.52	0.216
	Significance Within Group	0.02*	0.02*	0.04*	
SF-12					
PCS	Pre	32.57±5.49	31.89±3.27	31.02±3.29	0.930
	Post	49.30±4.35	43.07±2.57	38.65±9.06	0.02*
Significance Within Group		0.02*	0.02*	0.116	
MCS	Pre	31.29±3.24	28.24±7.26	29.77±7.40	0.657
	Post	48.90±6.81	53.83±2.24	37.41±10.7	0.01*
Significance Within Group		0.02*	0.02*	0.46	

*p-value is significant < 0.05 level

Table 4: Pre and Post test values with the follow up for Jull's and CCFT for all three groups

Variable	Motor Group Control		Endurance Group		Conventional Group		(Anovo) Between Group	
	Mean±Sd	Significance Within Group	Mean±Sd	Significance Within Group	Mean±Sd	Significance Within Group	F	Signifi -Cance
Endurance (Sec)	14.0±1.41		13.83±2.13		13.6±1.50		0.057	0.945
Baseline								
4Th Week	17.16±1.47	0.001**	16.6±1.75	0.001**	14.16±1.32	0.203	6.64	0.009*
8Th Week	23.5±1.76	0.000**	21.0±2.75	0.003*	18.83±3.37	0.023*	4.44	0.03*
12Th Week	25.5±1.64	0.000**	23.3±2.73	0.001**	18.5±3.27	0.028*	11.07	0.001*
CCFT Score								
Activation Pressure Score	3.0±1.09		2.66±1.09		2.6±1.03		0.405	0.674
Baseline								
4Th Week	4.3±1.5	0.001**	3.3±1.50	0.02*	3.0±1.09	0.363	6.04	0.012
8Th Week	6.3±1.26	0.001**	4.66±1.03	0.001**	3.3±1.78	0.02*	10.26	0.002*
12Th Week	8.3±1.5	0.000**	6.6±1.02	0.000**	4.6±1.09	0.001**	26.98	0.000**
Highest Pressure Score	23.0±2.09		24.3±2.33		24.0±2.82		0.485	0.625
Baseline								
4Th Week	23.6±1.50	0.175	24.3±1.50	1.000	23.5±2.07	0.296	0.396	0.680
8Th Week	25.0±1.09	0.04*	25.5±1.76	0.287	24.0±2.60	1.000	0.946	0.410
12Th Week	26.6±1.03	0.01*	25.3±1.03	0.415	24.3±2.42	0.175	3.083	0.07*

Result

Comparison of VAS, NDI, SF-12, endurance, CCFT score within the group at the baseline, 4th, 8th, and 12 week follow up, the subjects in the MCT group demonstrated a significant progressive change from baseline throughout the 12th week than the endurance and conventional training group in all the outcomes. The endurance training group also showed significance difference from the baseline to 12th week follow up, however not significant than the MCT group when compared between the group. Within the group comparison, all the groups demonstrated a change from the baseline, but the motor control and endurance training showed a statistically significant difference from the baseline to the 4th, 8th, 12th week measurements. The VAS score at the baseline to the 12th week follow up represented in the Table 2, the NDI, SF-12 were represented in the Table 3, endurance and CCFT score in the Table 4.

Discussion

This study was designed to determine the efficacy of motor control and endurance exercises over conventional exercises in non-specific neck pain. This study provides an evidence of the effect of motor control, endurance and conventional exercises on the variables measured in the neck in subjects with neck pain. An intervention of Motor control exercise effective in improving the neck control shown in CCFT score, and the endurance measured using Jull's technique, reduction in neck pain intensity, while the endurance training group and conventional group also showed a proportion of changes in the CCFT score, pain and disability, but not as effective as the MCT (Motor control training) group. There was a greater increase in the endurance of the neck muscle (MCT {pre: 14.0±1.41- 12th wk-25.5±1.64}, ET {pre-13.83±2.13- 12th wk-23.3±2.73}), in association with the improvement in the activation pressure (MCT {pre: 3.0±1.09- 12th wk-8.3±1.5}, ET {pre-2.6±1.09- 12th wk-6.6±1.02}) and in the highest pressure score(pre: 23.0±2.09 - 12th wk-26.6±1.03}, ET {pre-24.3±2.33- 12th wk-25.3±1.03}). This may reflect that the greater proportion of showed characteristics of the activation of deep cervical flexors following Motor control exercises than the endurance exercises. In contrast, the conventional group showed a significant change in the neck pain intensity and disability, and only a lesser proportion of change in the CCFT score, endurance of the cervical muscles followed by the intervention. Statistically difference were found for 12th week follow up CCFT score revealing difference for a group interaction (AP:F=26.98; Sig 0.000**), (HP:F=3.083; Sig 0.07*). Pre and post intervention differences were also observed in activation and highest pressure score in all the three groups. Both the MCT and endurance exercise training group showed an improvement in the endurance, CCFT score due to the enhanced pattern in activation of deep and superficial muscles of the cranio-cervical region. Although, both the subjects in the intervention group and the conventional group with neck pain demonstrated a progressive change in the VAS throughout the duration of 12 weeks. In subjects with neck pain, a single exercise may affect both the structural and functional change that present in the neck muscles [21]. The mode of exercise protocol applied determines the exercise induced changes in the motor performance [22]. The deep neck flexor training using the CCF exercise has been shown to produce improvement in the deep and superficial neck flexor neuromuscular co-ordination, though negligible effect on flexor muscle strength [23,22]. In accordance, the current study showed that the improvements in all the variables of motor performance (CCFT score, endurance), other than those in the endurance and conventional exercise training group. However, the improvements in the performance of CCFT following the intervention, both the MCT and endurance training group showed a greater proportion of activation of the deep cervical flexor muscle performance. Levoska et al. found that there is a significant reduction in the pain intensity and occurrence following the intervention, but the effect was transitory and in most of the cases, the pain had already returned by the 3rd and 12th month follow ups [24]. Waling et al, showed that the neck pain intensity decreased immediately following the endurance training duration of 10 weeks, but there is no significant difference were seen between the training group and the control group at the 8th month and 3 year follow up [9,25]. The conclusion that can be drawn from the previous studies is that effect followed by the short term intervention for a few weeks or months does not produce effects long lasting on chronic neck pain.

Conclusion

The results of the current study shows that motor control exercises produced statistically significant changes in all the variables of the neck region in the post-intervention measurement than the endurance and conventional training group. Although the endurance training group also showed a statistically significant improvement from the baseline to the 12-week follow up than the conventional group. However, the changes in the endurance training are statistically less significant than the motor control training group.

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