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Effectiveness Of Respiratory Exercises, Chest Expansion Exercises And Thoracic Flexibility Exercises On Pulmonary Functions And Neck Disability Index In Chronic Neck Pain -A Pilot Study

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Abstract

Objective: The aim of the study was to analyze the effects of addition of respiratory exercises ,chest expansion exercises and thoracic flexibility exercises to conventional physiotherapy on pulmonary functions and neck disability index in chronic neck pain patients.

Method: 30 patients with chronic neck pain were randomly divided into experimental (n=15) and control (n=15) group. Experimental group received respiratory exercises, chest expansion exercises and thoracic flexibility exercises along with the conventional physiotherapy for 5 days a week for 2 weeks, whereas the control group received only conventional physiotherapy. At the beginning and at the end of the treatment pain intensity ,chest expansion ,craniovertebral angle, neck disability index and respiratory functions were assessed .

Results: There were significant improvement in the PEF (peak expiratory flow),FEV1(forced expiratory volume in 1 second),VAS(visual analog scale),NDI(neck disability index) in the experimental group .

Conclusion: The addition of breathing exercises, chest expansion exercises, thoracic flexibility exercises to conventional physiotherapy are effective intervention for improving pulmonary functions and reduces the pain and disability level in patients with chronic neck pain.

Keywords : Chronic neck pain ,Breathing exercises, Chest expansion exercises, Thoracic flexibility exercises, Pulmonary Functions.

Introduction

Chronic neck pain (CNP) is an important health problem in the modern world (1). Neck pain is the fourth leading cause of disability, with an annual prevalence rate of >30% (2). Although patients with neck pain are managed predominantly as musculoskeletal patients, weakness and fatigue of cervical muscles, reduced cervical mobility, impaired proprioception, postural abnormalities, and psychological compromise have been argued to be factors that are associated with poor pulmonary functions (3).The close anatomical, musculoskeletal, and neural connections of the cervical region with the thoracic spine made some researchers hypothesize that CNP may lead to biomechanical changes in the thoracic spine and rib cage and consequential changes in respiratory function.(4).

Respiratory exercises given in the treatment of patients with chronic neck pain are reported to decrease pulmonary capacity and disability level (5). Physiotherapy methods applied to the patients with chronic neck pain were found to increase respiratory functions and functional capacity by decreasing pain severity and disability level (6).

Leelarungrayub et al studied that chronic obstructive pulmonary disease patients conducted chest expansion exercises, there was significant improvement in pulmonary function, dyspnea, and the degree of chest expansion(7). In the previous studies have sought to determine the effects of thoracic mobility exercises on cervicothoracic function, posture and pain in mechanical neck pain but in the previous studies have not addressed their effects on pulmonary functions. Hence the current study was conducted to investigate the effectiveness of addition of deep breathing exercises, chest expansion exercises ,thoracic mobility exercises along with conventional physiotherapy treatment on the pulmonary functions and neck disability index in patients with chronic neck pain.

Methodology

The study was done at OPD, Department of Rehabilitation sciences, HAHC Hospital ,Jamia Hamdard, New Delhi, India. Thirty subjects with chronic neck pain were recruited , if they had pain at least 6 months and aged between 20-50 years old .Neck disability index score between 15-24 were taken.

Exclusion criteria of the study were those who reported pregnancy ,smokers ,traumatic neck pain ,obese patients(BMI>40) , spinal fracture or surgery patient , vertigo ,presence of severe co-morbidity (musculoskeletal, neurological ,cardiorespiratory) diabetes mellitus, malignancy. The whole procedure of the treatment program was explained to the subjects and asked to sign an informed consent before participating in the study .The subjects who fulfilled the inclusion criteria were divided into two groups by simple random sampling method . Group A included 15 subjects who received the conventional physiotherapy treatment and group B included 15 subjects who received the respiratory exercises, chest expansion exercises, thoracic flexibility exercises along with the conventional physiotherapy treatment.

Protocol

Group A

Subjects in Group A received only conventional physiotherapy treatment which included -Transcutaneous Electrical Nerve Stimulation (TENS) for 20 minutes ,ultrasonic therapy , active ROM exercises of neck for 10 repetitions , stretching and strengthening exercises of sternocleidomastoid , levator scapulae , upper trapezius

muscles for 10 repetitions .Cervical isometric exercises for 10 repetitions, soft tissue release technique for any trigger points.

Group B

Subjects in Group B received the conventional physiotherapy treatment along with respiratory exercises, chest expansion exercises and thoracic flexibility exercises.

Diaphragmatic breathing, and pursed lip breathing exercises have been taught as breathing exercises (6).

- Diaphragmatic breathing exercises was taught by placing the subject comfortably positioned with either therapist or the patient's hand directed over the abdominal area and instructing the subjects to focus on an outward movement of the abdominal area throughout inspiration and an inward movement of the abdominal area during expiration. Inspiration is aimed through the nose and expiration through the mouth(8,9).

- Pursed lip breathing exercises were performed by necessitating the subjects to inhale through their nose and then exhaling slowly for a period of 4–6 s by pursing the lips (10,11).

Respiratory exercisers was repeated for 10 repetitions.

Chest expansion exercises ;-

- Chest expansion exercises was taught in a seated position ,subject should hold his arms to reach both arms overhead (bilateral shoulder flexion and slight abduction) during inspiration .And then should bend forward at the hips and reach the floor during expiration.

- The patient in a seated position instructed to clasped his hands behind the head and patient were instructed to horizontally abduct the arms during inspiration. And then instruct the patient to bring the elbows together and bend forward during expiration.

Chest expansion exercises were repeated for 10 repetitions.

Thoracic flexibility exercises:

- Cat Stretch: The cat stretch is a gentle way to practice pelvic rotation. It provides a non-weight-bearing flexion/ extension stretch to the lumbar and thoracic areas. The cat stretch begins in a quadruped position with the pelvis in a neutral position. Next, the individual slowly alternates between an arched and a depressed back position with the pelvis rotating backward and forward (12).

- Quadruped thoracic rotation:

This exercise begins in a quadruped position with knees under the hips and hands under the shoulder with spine in a neutral position. Next the individual places one hand on the back of the head. Then rotate the upper back downward and bring the elbow of the elevated arm down towards the bracing arm and slowly reverse the movement.

Thoracic flexibility exercises were maintained for10 seconds and repeat 10 times after 10 seconds of rest . Sessions were applied in both the groups were 8 sessions for 5 days per week for 2 weeks .The duration of the treatment was 40-45 minutes. Home exercise program and ergonomics were advised for both the groups. In weekends all the patients were monitored via phone calls .

All the patients were asked to repeat the exercises at home for 3 times a day for 10 repetitions.

Outcome Measurements

Age, body mass index (BMI), duration of pain, severity, and frequency of pain were recorded in all patients before the treatment.(6).
At the beginning and at the end of the treatment , pain intensity was assessed by visual analog scale ,chest expansion by a measuring tape, pulmonary function test was assessed by spirometer (MIR , Spirolab, Italy), disability level with a neck disability index ,and craniovertebral angle by UTHSCSA image tool software.

Visual Analog Scale (VAS): The VAS pain score was measured to determine the pain level of the patients. The 0-10 cm chart was presented to the patient, with 0 no pain, 0 the most severe pain felt in life 10, 18 and was asked to mark the pain severity. Then the point marked with the millimetric ruler was measured and recorded (13).

Chest expansion: To measure chest expansion when breathing, the subjects chest wall was measured with a tapeline in an upright sitting position. Chest expansion was calculated using the difference in chest wall circumference during the state of maximal expiration and maximal inspiration (14,15).

Neck disability index (NDI) :The measure of activity limitation for neck pain was measured using an English version of neck disability index (NDI) which consists of 10 sections of questions. The scoring was categorized into five stages ranging from minimal disability to cripple and it was carried out by a physiotherapist. The method of scoring demonstrated a high degree of reliability and internal consistency (16).

Data Analysis
All the statistical analysis was done by using the software package SPSS version 16 for window version. Mean and standard deviation of all the variables were calculated. Paired t-test was for used to analyze the within the group comparison. Independent t test was used to analyze the between the groups. p value <0.05 was accepted as meaningful for all statistical levels.

Result
The demographic characterstics of the subjects are given in the [Table 1]
The Comparison within the control group from pretreatment to post treatment score showed that there were significant improvement in VAS(visual analog scale),NDI(neck disability index).chest expansion, craniovertebral angle and FEV1 (forced expiratory volume in 1 second) [Table .2]

Table-1 Demographic characteristics of chronic neck pain patients

	MEAN±SD		t	p
	CONTROL	EXPERIMENTAL		
AGE	32 ± 9.411	33.8± 9.770	-.514	.611
BMI	24.767± 3.869	24.813± 3.304	-.036	.972

BMI :Body mass index ,SD: Standard deviation

Table- 2 Comparison within pre and post score of control group

	MEAN±SD		t	P
	pre	Post		
NDI	18.667±2.554	13.267±4.096	9.662	.000
VAS	7.2±1.320	4.8±1.373	18.330	.000
Chest Expansion	1.3±0.455	1.733±0.651	-4.026	.001
CVA	132.9±12.821	131.77±6.052	3.329	.005
FVC	79.33±12.821	87.33±10.097	-2.141	.050
FEV1	81±15.766	90±11.692	-2.275	.039
FEV1/FVC	107.13±28.126	108.07±7.732	-.282	.782
PEF	67.067±28.126	61.4±19.309	.991	.339
FEF25-75	72.8±32.571	76.133±25.821	-.576	.574

NDI: Neck disability index, VAS :Visual snalog scale, FVC :Forced vital capacity, FEV1: Forced expiratory volume, PEF :Peak expiratory flow, FEF25-75 :Forced expiratory flow at 25-75 %,L/second ,CVA : Craniovertebral angle.

Within the experimental group comparison there were significant improvement observed in VAS(visual analog scale),NDI (neck disability index), chest expansion, craniovertebral angle, FVC (forced vital capacity),FEV1(forced expiratory volume in 1 second),FEV1/FVC,PEF(peak expiratory flow),FEF25-75(forced expiratory flow at 25-75). [Table 3]

Table -3 Comparison within pre and post score of experimental group

	MEAN±SD		t-value	p-value
	Pre- score	Post-score		
NDI	17.933 ± 2.434	1.3333 ±0.617	26.963	.000
VAS	7.6 ± 0.910	0.5333 ±0.640	24.886	.000
Chest expansion	1.4 ± 0.471	2 ± 0.627	-6.874	.000
CVA	135.77 ± 4.437	134.36 ± 3.932	6.717	.000
FVC	82.4 ± 3.019	93.067 ± 10.138	-3.581	.003
FEV1	81 ± 4.000	100.6 ± 10.183	-6.420	.000
FEV1/FVC	84.6 ± 2.165	111.13 ± 7.120	-16.00	.000
PEF	84.333 ± 16.439	74.8 ± 15.553	2.184	.000
FEF25-75	69.6 ± 18.055	90.533 ± 19.342	-4.286	.000

NDI; Neck disability index, VAS :Visual snalog scale, FVC :Forced vital capacity, FEV1: Forced expiratory volume, PEF :Peak expiratory flow, FEF25-75 :Forced expiratory flow at 25-75 %,L/second ,CVA : Craniovertebral angle

When comparison between the groups there were improvement in the VAS(visual analog scale), NDI(neck disability index),FEV1(forced expiratory volume in 1 second) ,PEF (peak expiratory flow]) in experimental group as compared to control group. [Table 4]
Chest expansion, craniovertebral angle, FVC (forced expiratory capacity), FEF25-75 (forced expiratory flow at 25-75),FEV1/FVC showed no changes as compared to control group.

Table -4 Comparison between the pre and post score of control and experimental group

		MEAN±SD		t-value	p-value
		Control group	Experimental group		
NDI	Pre	18.667 ± 2.554	17.933 ±2.434	.805	.428
	Post	13.267 ± 4.096	1.3333 ± 0.617	11.156	.000
VAS	Pre	7.2 ± 1.320	7.6 ± 0.910	-.966	.343
	Post	4.8 ± 1.373	0.5333 ± 0.640	10.907	.000
chest expansion	Pre	1.3 ± 0.455	1.4 ± 0.471	-.592	.559
	Post	1.7333 ± 0.651	2 ± 0.627	-1.143	.263
CVA	Pre	132.9 ± 6.269	135.77 ± 4.437	-1.449	.160
	Post	131.77 ± 6.052	134.36 ± 3.932	-1.392	.175
FVC	Pre	79.333 ± 12.821	82.4 ± 3.019	-.902	.375
	Post	87.333 ± 10.097	93.067 ± 10.138	-1.552	.132
FEV1	Pre	81 ± 15.766	81 ± 4.000	.000	1.000
	Post	90 ± 11.692	100.6 ± 10.183	-2.648	.013
FEV1/FVC	Pre	107.13 ± 12.426	84.6 ± 2.165	6.919	.000
	Post	108.07 ± 7.732	111.13 ± 7.120	-1.130	.268
PEF	Pre	67.067 ± 28.126	84.333 ± 16.439	-2.053	.052
	Post	61.4 ± 19.309	74.8 ± 15.553	-2.093	.046
FEF25-75	Pre	72.8 ± 32.571	69.6 ± 18.055	.333	.742
	Post	76.133 ± 25.812	90.533 ± 19.342	-1.729	.095

NDI; Neck disability index, VAS :Visual snalog scale, FVC :Forced vital capacity, FEV1: Forced expiratory volume, PEF :Peak expiratory flow, FEF25-75 :Forced expiratory flow at 25-75 %,L/second ,CVA : Craniovertebral angle

Discussion

This is the first study intended to find the beneficial effects of respiratory exercises, chest expansion exercises, thoracic flexibility exercises along with conventional physiotherapy treatment on neck disability index (NDI) and pulmonary functions in patients with chronic neck pain. Recent studies have emphasized the effect of neck pain and neck mechanical disturbances on respiratory functions. It has been reported that patients with neck pain may have impaired disability and respiratory functions in clinically significant (17).

In the current study the comparison within the group showed that FEV1, FVC, FEVI/FVC, PEF, FEF 25-75 had increased significantly in post values in patients treated in the experimental group as compared to control group(Table 3). When compared between the groups results showed that in pulmonary functions, FEV1,PEF was significantly higher in post values in patients treated with deep breathing exercises ,chest expansion exercises and thoracic mobility exercises along with conventional physiotherapy treatment group (Table 4).

Pain severity and disability level correlated with maximal expiratory pressure in chronic neck pain, it has been reported that patients with high levels of pain and disability have a particularly reduced performance of their expiration due to sternocleidomastoid, scaleni and trapezius muscle weakness and cervical movement limitation(18). In the previous study it was determined that the pain intensity of the patients was decreased by 89.05% and the disability levels by 93.21% after the patients treated with physiotherapy method in chronic neck pain(6) . In the current study, the pain intensity and disability level was improved significantly in the post treatment experimental group .(Table 4)

In the previous study , it has been reported that pain intensity level was detected to be diluted, also established respiratory exercises were proved to be an effective tool in chronic neck pain. . This reveals that the function of sternocleidosmastoid, scalene and trapezius would have improved and provided postural stability followed by training and this has been reported to be weak in chronic neck pain patients (19).

The chest expansion exercise used in the present study is an intervention method used to help chest movement and contraction of the diaphragm (20). It is considered that an increase in chest mediolateral and anterioposterior diameters, inspiratory muscle contraction (21) .Burianova s opinion that chest expansion exercises achieve appropriate contraction of the respiratory muscles and enhance ventilation by promoting muscle activity(22). Thoracic flexibility exercises reduces the compensatory action of the lumbar spine and improves the mechanical stability of the lumbar spine, which affects pain reduction increased flexibility of the thoracic spine and balance ability (23,24,25).

It has been reported that the thoracic flexibility exercises may have facilitated thoracic mobility and improved the thoracic curve by reducing tension in the intervertebral disc and surrounding tissues (26,27).

Hence ,the experimental group shows a better results in chronic neck pain patients. These exercises are simple to execute and do not require any costly equipment . Moreover, the addition of these exercises reduces the extended rehabilitation sessions in chronic neck pain .

The limitations of the study include the low number of patients, the limited age group being assessed, and the lack of assessment of cervical isometric muscle strength[6]

Conclusion

The study concluded that the additions of respiratory exercises, chest expansion exercises, thoracic flexibility exercises along with conventional physiotherapy treatment is more effective than conventional physiotherapy treatment in improving the pain, disability level and pulmonary functions in patients with chronic neck pain.

Conflict of Interest: None

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