Efficacy of chin tuck exercises in three different positions on neck pain and functional disability in patients with cervical spondylosis

[1]Dr. Joginder, [2]Dr. Abhinav Gupta, [3]Dr. Afaf Aqueel

Amity Institute of Physiotherapy, Amity University Noida,
Uttar Pradesh, and Jeewan hospital, New Delhi.

ABSTRACT

Background:

Cervical spondylosis, the age-related chronic disc degeneration, affecting the cervical vertebrae and facet joints is confirmed by the radiological investigation. It causes neck pain, upper extremity pain, and neurologic deficits. The chin tuck exercises are useful in keeping the cervical spine in its normal position though strengthening of the deep cervical flexors (DCF). They have been found a very effective exercise in improving neck pain and functional disability in cervical spondylosis.

Material and method:

60 participants with pre-diagnosed cervical spondylosis and neck pain aged 40-60 years were selected. They were divided into four groups, a control group (CG), and three experimental groups A, B, and C. The control group was treated with physiotherapeutic modality, trapezius stretching, ultrasound, and a hot pack. Group A, B, and C were given chin tuck exercises in standing, sitting, and supine respectively along with the same treatment given in the control group. NDI & NPRS were chosen as outcome variables.

Result:

There was a significant improvement in the neck pain and functional disability in all the four groups but Group C who were given the same physiotherapy treatment given in the control group & chin tuck exercises in the supine position showed the greatest improvement.

Conclusion:

This study revealed that chin tuck exercises performed in a supine position along with physiotherapy intervention are most effective in improving neck pain and functional disability in patients with cervical spondylosis.

Keywords: cervical spondylosis, chin tucks, deep cervical flexors

INTRODUCTION

Cervical spondylosis the common degenerative condition of the cervical spine observed in a section of the population develops in the fourth and fifth decades of life. It is found one of the most common reasons for neck pain that leads to reduced quality of life and causes socioeconomic damage [1]. Described as an age-related chronic disc degeneration, it affects the cervical vertebrae, facet joints, and associated soft tissue structures. Cervical spondylosis is classified according to three clinical syndromes. The first one is called axial neck pain, the second is called cervical radiculopathy and the third is cervical myelopathy. The patients can experience any of these three syndromes. Spondylotic changes are frequently found in many asymptomatic adults which can cause radiculopathy in some cases due to the narrowing of intervertebral foramina. Spinal canal narrowing can lead to spinal cord compression which ultimately gives rise to cervical spondylosis myelopathy. It can cause neurologic deficits of the sphincters, torso, the extremities if there is the involvement of the spinal cord [2].

The most common site of occurrence of cervical spondylosis is at C5-C6 and C6-C7 levels, insome cases, higher levels are also involved. Subjects having cervical spondylosis complain oftingling, pain, upper extremity weakness, reduced cervical ROM as compared to healthy subjects, and numbness. All these symptoms affect activities of daily living to a much greater extent. The radiological findings confirm cervical degeneration which comprises the degenerative changes in the intervertebral disc, hypertrophy of facet joints and laminalarches, osteophyte formation in the vertebral bodies, and all these changes ultimately lead to ligamentous and segmental instability. Sometimes in cervical spondylosis, there may be the presence of impaired mechanoreceptor feedback which might cause atrophy of cervicalmuscles and degenerative changes in the joints. The presence of impaired position sense can disturb both muscular and neuronal control of the normal cervical joint function which finally causes unbalanced muscle force and place the joint at risk of further trauma [3]. Cervical spondylosis has an incidence rate of 10% at the age of 25 and 75% by the age of 65 and above. The fastest-growing segment is the senior citizens in the United States and it is predicted that by the middle of this century they will represent approximately one-quarter of the population [4]. The highest prevalence is in the age group 45-60 years [5].

The cervical muscles have abundant high-density muscle spindles which are present in the suboccipital and deep cervical flexors (DCF). Whenever cervical muscle performance is degraded, the balance between stabilizers on the posterior aspect of the neck and DCF gets disrupted which leads to loss of alignment and loss of appropriate posture which ultimately causes cervical impairment and forward head posture in the majority of neck pain patients. DCF training has been vital to enhance the activation of DCFs for restoring coordination and maintaining proper alignment of posture [1]. The deep cervical flexor (DCF) has an importantpostural function in supporting and straightening cervical lordosis. The main action is to support the craniocervical flexion (CCF) which can be very well achieved by performing chintuck exercises also known as deep flexor muscle (DCF)

training. CCF helps to improve the isometric function of the neck muscles, which counteracts the forces to maintain and has been significantly shown to improve pain intensity and disability in patients suffering from chronic neck pain [6]. Active chin tucking exercises have been shown to decrease pain and improve neck function [7]. Forward head posture has been observed to be a common postural abnormality in cervical spondylosis. It is described as the anterior position of the head in relation to the vertical line of the body's center of gravity. It causes lengthening and weakness of the anterior cervical muscles and shortening of posterior cervical muscles which causes an imbalance in cervical muscles due to prolonged postural misalignment [8]. The chin tuck exercise is fruitful in correctingforward head posture by expanding the craniovertebral angle and recruiting deep cervical flexor muscles [9,14]. The chin tuck exercise in the supine position is more effective than the sitting position for the neck muscles and improves posture [14]. Physical therapy in cervical spondylosis plays a vital role in decreasing pain and alleviating the symptoms of spondylosis. Physiotherapy treatment is very beneficial in restoring the flexibility, mobility, and strengthening of muscles through various exercises like the chin tuck exercises, strengthening, and physiotherapeutic modalities. Besides helping in relieving pain, it also prevents the reoccurrence of pain, so physical therapy is advisable for people who suffer fromrestricted mobility, and pain as experienced in cervical spondylosis patients [10].

METHODOLOGY

This study is a randomized controlled comparison of pre and post scores of the four groups taken. A convenient sampling method was used for selecting the participants and randomly into the groups.

The objective of the study

The aim was to find the effectiveness of physiotherapeutic modalities and trapezius stretching versusphysiotherapy combined with chin tuck exercises on neck pain and functional disability in patients with cervical spondylosis

Need of the study

There has been only very little works done with appropriate evidences supporting cervical chin tuck exercises and their roles in treating neck pain and functional disability in patients having cervical spondylosis.

Experimental setup

This randomized experimental trial was carried out at Jeewan hospital. The protocol was properly explained in detail to each patient before the initial assessment and their enrolmentin the study. All the patients were made to sign an institutionally approved informed consent which got its ethical clearance from the Amity Institute of Physiotherapy, Amity University, Noida, and after completing the clinical trial registry of India (CTRI) registration process. The general initial assessment was done for all the individuals who were allocated into four different groups. They were asked to fill out the Neck Disability Index (NDI), and Numeric Pain Rating Scale (NPRS) as both of these were chosen as the outcome variables for this study (17,18). All the members of the groups were given treatment for forty minutes daily, five times per week for 6 weeks. The instruments required to carry out this research were a couch, a chair, a towel roll (approximately 5 mm thickness), transcutaneous electrical nerve stimulation, an ultrasound machine, gel, and hydrocollateral.

Participants

The study had a total of 60 subjects both male and female who fulfilled the inclusion criteria were recruited for the study. The participants were pre-diagnosed cervical spondylosis patients having chronic neck pain. The participants were from the age group 40-60 years. Theexclusion criteria included sensory or cognitive aphasic deficit, pregnancy, H/O spinal surgery, recent fracture, malignancy, auditory impairment, and mental retardation. All the participants have divided into four groups out of which one was the control group (CG), while the other three were the experimental groups i.e., experimental group A,experimental group B, and experimental group C. The participant flow, Consolidated Standards of Reporting Trials (CONSORT) is given below in Figure 1.

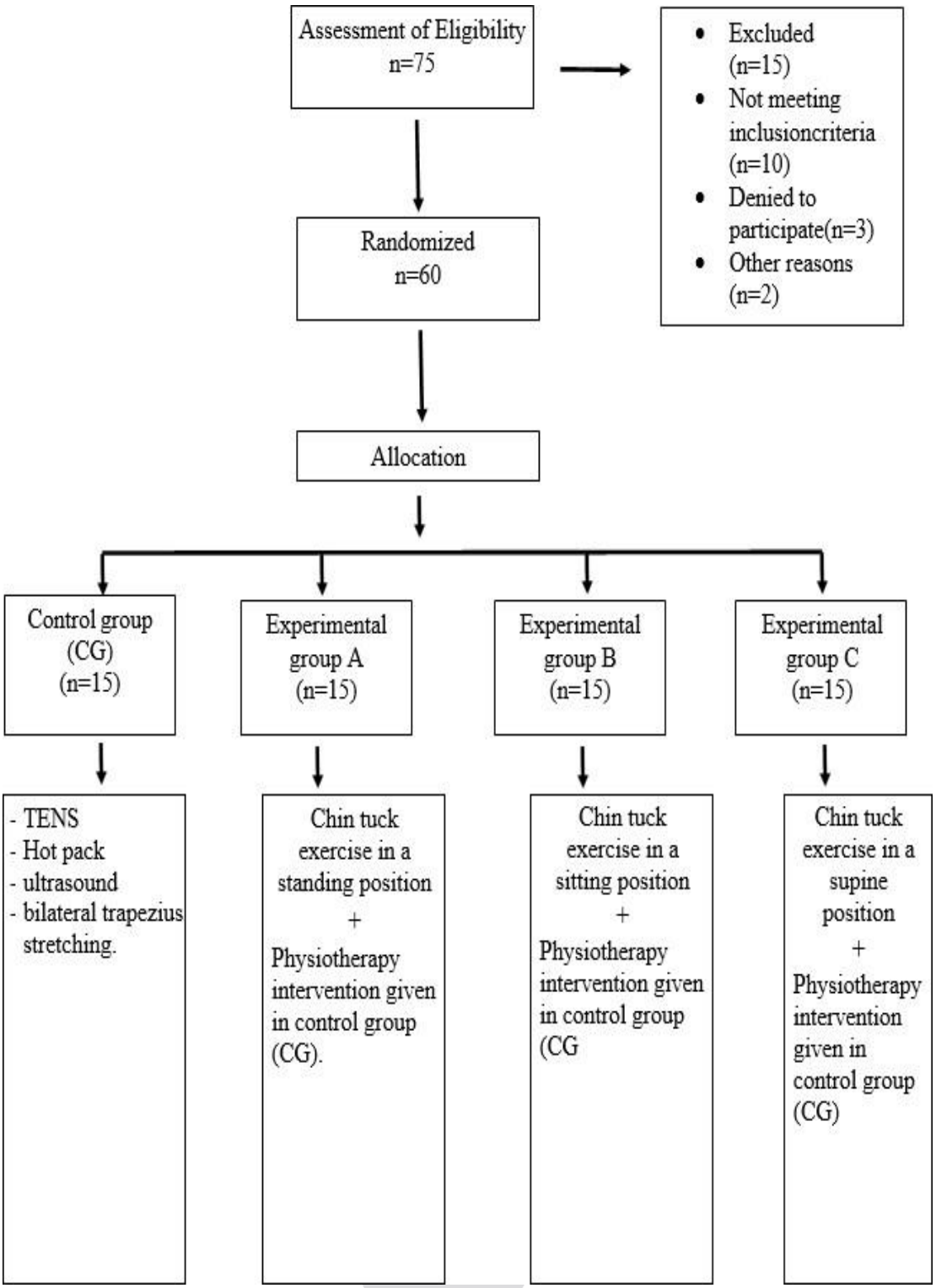

Figure 1. Study and participation flow (CONSORT), n= number of patients

Intervention and procedure

1. Treatment for the control group (CG) – transcutaneous electrical nerve stimulation in a continuous mode for twenty minutes and a hot pack for ten minutes was given in the cervical region [1,10,15]. Ultrasonic therapy: 1 MHz at 0.8 watt/cm square in right and left trapezius was given for three minutes was given on each side [10,11]. Bilateral trapezius stretching wasalso administered to the patients [12].

2. Treatment for the three experimental groups are

Experimental group A (chin tuck in standing) – the patient was asked to stand against the wall while keeping their back against the wall. The patient was instructed to maintaina relaxed and erect posture while keeping the spine straight as much as possible and a towel roll was placed behind the head of the patient to provide them with feedback. The instructions given to the patient were "bring your head straight back, tuck your chin in (asif you are creating a double chin), and continue to stretch up". The patients were

instructed to hold this position for 10 seconds. A total of three sets were performed with twenty repetitions in each set [1,14]. The physiotherapy intervention as explained in the control group above was also administered to the patients of this group.
Experimental group B (chin tuck in sitting)- the patient was made to sit by leaning against the back of the chair and was instructed to maintain a relaxed and erect posture keeping the spine straight as much as possible. Both feet were evenly placed on the ground with the hip and knee flexed to 90 degrees. A towel roll was kept behind the patient's head to provide feedback. The instructions given to the patients were "bringyour head straight back, tuck your chin in (as if you are creating a double chin), and continue to stretch up". The patients were instructed to hold this position for 10 seconds. A total of three sets were performed with twenty repetitions in each set [1,14]. The physiotherapy intervention as explained in the control group above was also administered to the patients of this group.
Experimental group C (chin tuck in supine)- the patient is instructed to lie down in a crook lying position with the hip and knee flexed to 90 degrees. A thin layer of towel is placed behind the patient's head. The instructions given to the patient were" try to draw the head straight down by trying to flatten the curve of the spine (avoid nodding yes or no), hold this position for 10 seconds, and then relax. A total of three sets were performedwith twenty repetitions in each set [1,13,14]. The physiotherapy intervention as explained in the control group above was also administered to the patients of this group.

Data Analysis

The statistical analysis was performed using the statistical package for social studies (SPSS) version of Windows 19. The significance level was set to 5% for all statistical analysis, and p-values below 0.05 were considered significant. One-way ANOVA was used for all the pre-test groups i.e., the control group (CG) and all the three experimental groups to know the p-value [WHY THIS DONE?]. The 'p' value came out to be 2.025 which was above 0.05 which shows that there was no significant difference between the groups "I FIND A MISTAKE – CHECK". Paired t-test was applied for comparing the pre-test and post-test values in all the groups. The 'p' values got from the test were less than 0.01 in all the 4 groups indicating significant differences between the pre and post values. To know which group was better among all the four groups, one-way ANOVA was used to compare the significant difference in the post-test data among all the four groups [**THIS IS WRONG. YOU MUST COMPARE % CHANGE IN THE POST-VALUES FROM THE PRE-VALUES**]. The p-values came out to be 0.00* stating that there exists a significant difference between the post-test data of all the four groups which consist of one control group and three experimental groups respectively.

RESULTS

Table 1. Pre-test and post-test data of control group andexperimental groups A(standing), B (sitting), C(supine)

NECK DISABILITY INDEX (NDI)

Domain	Pre-Test		Post-Test		Pre-test "F" value	Post -test "F" value	NS	S
	Mean	SD	Mean	SD				
Control group (CG)	33.9	4.1	31.13	4.2	2.025	16.23	0.120	0.00*
Experimental Group A(STANDING)	30.5	5.8	27.13	5.8				
Experimental Group B(SITTING)	34	4.3	23.06	4.6				
Experimental Group C(SUPINE)	30.6	6	18.6	5.1				

THE CONTENTS OF THE TABLE TO BE CHECKED. WHAT IS THE PURPOSE OF "F" TEST

*p<0.05 is statistically significant. NS-non-significant, S-significant, single-factor ANOVA

Table 1 shows one way ANOVA has been used to see the difference between the pre-test and post-test values of all the four groups i.e., control group (CG) where Tens, bilateral trapezius stretching, ultrasound, and hot pack were given, experimental group A where the same physiotherapy was given as in control group along with chin tuck exercise performed in standing position, experimental group B where chin exercise was performed in sitting position along with same treatment given in control group and, experimental group C where chin tuck exercise was made to perform in supine position along with the same treatment given in the control group. The pre-test data of the groups show a p-value of more than 0.05 which states that there is no significant difference between the groups but the post-test data shows a p-value of less than 0.05 which clearly states that there exists a significant difference between all the groups.

Table 2. Pre-test and Post-test data of control group (NDI)

Domain	Pre-Test		Post-Test		**Paired t-test value**	Critical value	S/NS
	Mean	SD	Mean	SD			
Control Group (CG)	33.9	4.3	31.13	4.2	**0.00***	1.761	S

"t" given is wrong

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired-test.

Table 3. Pre-test and Post-test data of Experimental Group A (Standing) (NDI)

Domain	Pre-Test		Post-Test		**Paired t-test value**	Critical Value	S/NS
	Mean	SD	Mean	SD			
Group A (Standing	33.53	5.8	27.13	5.8	**0.00***	1.761	S

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test.

"t" given is wrong

Table 4. Pre-test and Post-test data of Experimental Group B (NDI)

Domain	Pre-Test		Post-Test		Pairedt-test value	Critical Value	S/NS
	Mean	SD	Mean	SD			
GroupB(Sitting)	34	4.3	23.06	4.6	**0.00***	1.761	S

"t" given is wrong

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test

Table 5. Pre-test and post-test data of Experimental Group C (Supine) (NDI)

Domain	Pre-Test		Post-Test		Paired t-test value	Critical Value	S/NS
	Mean	SD	Mean	SD			
Experimental Group C(Supine)	30.6	6	18.66	5.1	0.00*	1.761	S

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test

Table 2,3,4, and 5 shows the comparison of the pre-test and post-test data of the controlgroup (CG), experimental group A, experimental group B, and experimental group C. To compare the pre-test and post-test values within the same group, paired t-test was applied. Looking at the calculated paired t-test value for all groups which is less than0.05 clearly shows the significant difference between the pre-test and post-test values within all the groups mentioned above in the tables.When comparing the pre-test and post-test mean difference values of the groups, the control group (2.8), experimental group A (3.4), experimental group B (10.9), and experimental group C (11.9) confirm that the experimental groups (A, B, C) show significant improvement over the control group.

Table 6. Pre-test and post-test data of control group and experimental groupsA(standing), B (sitting), C(supine) NPRS (NUMERIC PAIN RATING SCALE)

Domain	Pre-Test		Post-Test		**Pre-test "F" value**	**Post-Test "F" value**	NS	S
	Mean	SD	Mean	SD				
Control group	6.53	2.1	5.2	2	**1.81**	**21.07**	0.154	0.00*
Experimental Group A(STANDING)	5.2	2.9	2.33	1.5				
Experimental Group B(SITTING)	6.4	1.8	3.6	1.2				
Experimental Group C(SUPINE)	4.93	2.1	1.13	0.6				

THIS "F" TEST IS WRONG

*p<0.05 is statistically significant. NS-non-significant, S-significant, single-factor ANOVA

Table 1 shows one way ANOVA has been used to see the difference between the pre-test and post-test values of all the four groups i.e., control group (CG) where Tens, bilateral trapezius stretching, ultrasound, and hot pack were given, experimental group A where thesame physiotherapy was given as in control group along with chin tuck exercise performedin standing position, experimental group B where chin exercise was performed in sitting position along with same treatment given in control group and, experimental group C where chin tuck exercise was made to perform in supine position along with the same treatment given in the control group. The pre-test data of the groups show a p-value of more than 0.05 which states that there is no significant difference between the groups but the post-test data shows a p-value of less than 0.05 which clearly states that there exists a significant difference between all the groups.

Table 7. Pre-test and Post-test data of the control group (NPRS)

Domain	Pre-Test		Post-Test		Paired t-test value	Critical value	NS/S
	Mean	SD	Mean	SD			
Control group (CG)	6.53	2.1	5.2	2	0.00*	1.761	S

p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test

Table 8. Pre-test and Post-test data of experimental group A (Standing) (NPRS)

Domain	Pre-Test		Post-Test		Paired t-test value	Critical value	NS/S
	Mean	SD	Mean	SD			
GroupA(Standing)	5.2	2.9	2.33	1.5	0.00*	1.761	S

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test

Table9. Pre-test and Post-test data of experimental group B (Sitting) (NPRS)

Domain	Pre-Test		Post-Test		Paired t-test value	Critical value	NS/S
	Mean	SD	Mean	SD			
GroupB(Sitting)	6.4	1.8	3.6	1.2	0.00*	1.761	S

*p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-test

Table 10. Pre-test and Post-test data of experimental group C (Supine) (NPRS)

Domain	Pre-Test		Post-Test		Paired t-test value	Critical value	NS/S
	Mean	SD	Mean	SD			
Group C(Supine)	4.93	2.1	1.13	0.6	0.00*	1.761	S

VALUES IN TABLE WRONGLY GIVEN

p<0.05 is statistically significant. NS-non-significant, S-significant, using paired t-Table 7,8,9, and 10 shows the comparison of

the pre-test and post-test data of the control group (CG), experimental group A, experimental group B, and experimental group C. To compare the pre-test and post-test values within the same group, paired t-test was applied. looking at the calculated paired t-test value for all groups which is less than 0.05 clearly shows the significant difference between the pre-test and post-test values within all thegroups mentioned above in the table.When comparing the pre-test- post-test values of the groups, the control group, the (1.33), experimental group A (2.8), experimental group B (3), and experimental group C (3.8), whichconfirms that experimental groups (A, B, & C) show a significant improvement over the control group.

DISCUSSION

Physiotherapy treatment to resolve neck pain and disability in patients who get diagnosedwith cervical spondylosis is a complex and difficult procedure. Various physiotherapy strategies evolved over the years for the rehabilitation of the same. Chin tuck exercises are a therapeutic program that aims at the optimization of function by training Deep neckflexor muscles. This study is to find out the effectiveness of chin tuck exercises in different positions in improving neck pain and disability in patients with having cervical spondylosis as evidenced by the outcome measure of the neck disability index and NPRS (Numeric pain rating scale). The values of the pretest post-test mean difference in all groups were negative showing a significant reduction in the values of the outcome measures between the groups which concisely represents that experimental group C i.e., physiotherapeutic modalities and trapezius exercises along with chin tuck exercises in supine shows the greatest improvement when compared to the other groups following which experimental group B shows quite promising results than the other two. Further, it shall be cogent to mention that experimental group A shows better outcomes than the control group. Results obtained from the statistical analysis between pretest and post-test mean difference values of experimental groups and control group at a 5% level of significance showed significant improvement in neck disability index of the patients and NPRS scoring by chin tuck exercises following 6 weeks of exercise program.
Analysis of results shows that there is a significant decrease in outcome measure of neck disability index scoring and NPRS from the control group towards experimental group C following experimental group B somewhat more promising than experimental group A. So, the interpretation of the result suggests that the chin tuck exercises in the supine position along with physiotherapeutic modalities and trapezius stretching show significant improvement as compared to other positions and the control group in reducingneck pain and functional disability in patients with cervical spondylosis. The neck pain and functional disability of the patients with cervical spondylosis are measured by the neck disability index. it is an impairment-based scale test item organized by the severity of impact on activities of daily life. Thus, chin tuck exercises in different positions (standing, sitting, and supine) may provide a valuable tool to access and improve functional disability and neck pain in patients who are diagnosed with cervical spondylosis. Hence, this form of exercise can prove useful for patients with cervical spondylosis who suffer from neck pain and disability. Therefore, when combing Chin tuck exercises in supine position with physiotherapeutic modalities and trapezius stretching improves the intensity of neck pain and functional disability which is revealed in this present research work.

CONCLUSION

The study concluded that the chin tuck exercises performed in a supine position along with the physiotherapy treatment which included stretching, electrotherapeutic modalities, hot pack, and ultrasonic therapy were most effective in improving neck pain and functional disability in patients having cervical spondylosis. The study was short-term and has been done with a smaller number of subjects so there is a scope for further studies with a large population and a longer duration

REFERENCES

1. Saleh MS, Rehab NI, Sharaf MA. Effect of deep cervical flexors training on neck proprioception, pain, muscle strength and dizziness in patients with cervical spondylosis: A randomized controlled trial. Phys Ther Rehabil. 2018 Jan 5;5(1):14.

2. Kelly JC, Groarke PJ, Butler JS, Poynton AR, O'Byrne JM. The natural history and clinical syndromes of degenerative cervical spondylosis. Advances in orthopedics. 2012 Jan 1;2012.

3. Reddy RS, Tedla JS, Dixit S, Abohashrh M. Cervical proprioception and its relationship with neck pain intensity in subjects with cervical spondylosis. BMC musculoskeletal disorders. 2019 Dec;20(1):1-7.
4. Holly, L. T., Wang, C., Woodworth, D. C., Salamon, N., & Ellingson, B. M. (2019). Neck disability in patients with cervical spondylosis is associated with altered brain functional connectivity. *Journal of Clinical Neuroscience*, *69*, 149-154.

5. Lv Y, Tian W, Chen D, Liu Y, Wang L, Duan F. The prevalence and associated factors of symptomatic cervical Spondylosis in Chinese adults: a community-based cross-sectional study. BMC Musculoskeletal Disorders. 2018 Dec;19(1):1-2.

6. Gupta BD, Aggarwal S, Gupta B, Gupta M, Gupta N. Effect of deep cervical flexor training vs. conventional isometric training on forward head posture, pain, neck disability index in dentists suffering from chronic neck pain. Journal of clinical and diagnostic research: JCDR. 2013 Oct;7(10):2261.

7. David Arun Kumar J. *A Comparative Study Between Combinations of Ultrasound Therapy with Active Chin Tucking Exercise and Ultrasound Therapy with Sub Occipital Muscle Release in the Management of Non-Specific Neck Pain Due to Sub Occipital Muscle Tightness among Computer Professionals* (Doctoral dissertation, RVS College of Physiotherapy, Coimbatore).
8. Lee, K. J., Han, H. Y., Cheon, S. H., Park, S. H., & Yong, M. S. (2015). The effect offorward head posture on muscle activity during neck protraction and retraction. *Journal of physical therapy science*, *27*(3), 977-979.
9. Nishanth H, Aishwarya A. Immediate Effect of Chin Tuck Exercises on Craniovertebral Angle and Shoulder Angle Among Collegiates with Forward Head Posture. Biomedical and Pharmacology Journal. 2021 Dec 30;14(4):2295-8.
10. Zain I, Daniel J, Hakim A. A cross sectional retrospective study: The pain outcome of Physiotherapy Rehabilitation for cervical spondylosis at Private Healthcare Institute In Negeri Sembilan. www. ijmaes. org. 2021 Jun 19.
11. Abdel-aziem AA, Draz AH, Battecha KH, Mosaad DM. Effect of ultrasound combined with conventional therapy on neck pain, function, and disability in patients with cervical spondylosis: a randomized placebo-controlled trial. Journal of Musculoskeletal pain. 2014 Jun 1;22(2):199-205.
12. Shady MA, Elnaggar IM, Sayed NI, Ali S. Comparative study between the effect of passive stretching exercises and post isometric relaxation technique in chronic mechanical neck pain patients. European Journal of Molecular & Clinical Medicine. 2021 Apr 8;8(3):2271-8.
13. Jeon J, Ju S, Jeong H. The effect of cervical stabilizing exercises in the standing position and the supine position on deep neck muscle strength and endurance. Journal of Physical Therapy Science. 2012;24(5):423-5.
14. Ahn SH, Yang JH, Lee SK, Park JS, Jo JS. Effect of chin tuck exercises on various postures and muscle activity of the neck and shoulder. PNF and Movement. 2020;18(3):403-14.
15. Miao Q, Qiang JH, Jin YL. Effectiveness of percutaneous neuromuscular electrical stimulation for neck pain relief in patients with cervical spondylosis. Medicine. 2018 Jun;97(26).
16. Gallego Izquierdo T, Pecos-Martin D, Lluch Girbes E, Plaza-Manzano G, Rodriguez Caldentey R, Mayor Melus R, Blanco Mariscal D, Falla D. Comparison of cranio-cervical flexion training versus cervical proprioception training in patients with chronic neck pain: a randomized controlled clinical trial. J Rehabil Med. 2016 Jan 1;48(1):48-55.
17. Young IA, Cleland JA, Michener LA, Brown C. Reliability, construct validity, and responsiveness of the neck disability index, patient-specific functional scale, and numeric pain rating scale in patients with cervical radiculopathy. American journal of physical medicine & rehabilitation. 2010 Oct 1;89(10):831-9.
18. Young IA, Dunning J, Butts R, Mourad F, Cleland JA. Reliability, construct validity, and responsiveness of the neck disability index and numeric pain rating scale in patients with mechanical neck pain without upper extremity symptoms. Physiotherapy theory and practice. 2019 Dec 2;35(12):1328-35.