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ORIGINAL ARTICLE

A COMPARATIVE STUDY TO FIND THE EFFECTS OF DEEP CERVICAL FLEXOR TRAINING AND CERVICO THORACIC MOBILIZATION (SNAGs) VERSUS KENDALL'S EXERCISES IN FORWARD HEAD POSTURE

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ABSTRACT

Background and purpose: Forward Head Posture is a common condition which physiotherapists have to deal in clinical practice. Various occupations require people to assume static postures for long periods, which cause continuous contractions of the head and neck muscles. Forward head posture (FHP) occurs when the head is anterior to a vertical line through the individual's center of gravity. If this aberrant development in the cervical region's muscles and joints persist, it may limit cervical mobility and reduce muscular function. The aim of this study was to evaluate the effectiveness of cervicothoracic mobilization (SNAGs) and deep cervical flexor strengthening with pressure biofeedback unit and Kendall's exercise on improving forward head posture. **Methods:** It is a comparative study with 40 subjects with Forward Head Posture who fulfilled the inclusion and exclusion criteria were selected for the study and 20 subjects were randomly assigned to each group. Group A received Cervicothoracic mobilization with deep neck flexors training and group B received Kendall's exercises. Treatment was given for a period of 8weeks. Pre-test and post-test evaluation was done with CVA, NPRS, NDI, CCFT and CROM. **Results:** CVA - When comparing between groups, the posttest mean of CVA for Group A showed increase in angle from 47.61to 52.61and Group B was4 7.95 to49.71 which was statistically significant (p<0.001).**Conclusion:** This study concludes that both cervicothoracic mobilization (SNAGs)with deep cervical flexor training and Kendall's exercise are effective in treating the patients with Forward head posture. However, cervicothoracic mobilization with deep cervical flexor training showed more improvement in CVA, pain and functions compared to Kendall's exercise.

Keywords: Cervicothoracic mobilization, deep cervical flexor training, Forward Head posture, Kendall's exercise.

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INTRODUCTION

Posture is one of the most frequently cited risk factors for musculoskeletal disorders. Proper posture is considered a state of musculoskeletal balance that involves a minimal amount of stress or strain to the body[1].

There has been the international interest in understanding human posture that a posture Committee of the American Academy of Orthopaedic Surgery was specially convened in 1947for the purpose of discussing it. This committee defined good posture as, “that state of muscular and skeletal balance that protects the supporting structures of the body against injury or progressive deformity irrespective of attitude (erect, lying, squatting, stooping) in which these structures are working or resting” [2].

Posture is defined as the attitude assumed by the body either with support during the course of muscular activity, or as a result of the coordinated action performed by a group of muscles working to maintain the stability[3].

Posture can be either static or dynamic. In static posture, the body and its segments are aligned and maintained in certain positions. Examples of static postures include standing, sitting, lying, and kneeling. Dynamic posture refers to postures in which the body or its segments are moving—walking, running, jumping, throwing, and lifting.

Postural control, which can be either static or dynamic, refers to a person’s ability to maintain stability of the body and body segments in response to forces that threaten to disturb the body’s equilibrium. The external forces that will be considered are inertia, gravity, and ground reaction forces. The internal forces are produced by muscle activity and passive tension in ligaments, tendons, joint capsules, and other soft tissue structures. The sum of all of the external and internal forces and torques acting on the body and its segments must be equal to zero for the body to be in equilibrium. Stability is maintained by keeping the body’s CoG over the BOS and the head in a position that permits gaze to be appropriately oriented.

The postural control system automatically activates the appropriate muscles to keep the body’s CoG over the base of support. Slight deviations from the optimal posture are to be expected in a Normal population because of the many individual variations found in body structure. However, deviations from an optimal standing posture that is large enough to cause excessive strain in passive structures and to require high levels of muscle activity need to be identified, and remedial action taken. If faulty postures are habitual and assumed continually on a daily basis, the body will not recognize these faulty postures as abnormal, and over time, structural adaptations such as ligamentous and muscle shortening or lengthening will occur.

Poor postural habit is often seen in the person who stands or sits for long periods and begins to slouch. Maintenance of correct posture requires muscles that are strong, flexible, and easily adaptable to environmental change. These muscles must continually work against gravity and in harmony with one another to maintain an upright posture. A posture may appear to be very faulty, yet the individual may be flexible and the position of the body may change readily. Alternatively, a posture may appear to be good, but stiffness or muscle tightness may so limit mobility that the position of the body cannot change readily.

The lack of mobility, which is not apparent as an alignment fault but which is detected in tests for flexibility and muscle length, may be the more significant factor. Basic to an understanding of pain in relation to faulty posture is the concept that the cumulative effects of constant or repeated small stresses over a long period of time can give rise to the same kind of difficulties that occurs with a sudden, severe stress. Cases of postural pain are extremely variable in the manner of onset and in the severity of symptoms. In some cases, only acute symptoms appear, usually as a result of an unusual stressor injury. Other cases have an acute onset and develop chronically painful symptoms. Still others exhibit chronic symptoms that later become acute onset and develop chronically painful symptoms. Still others exhibit chronic symptoms that later become acute[4].

A standard for normal alignment as described by Kendall and McCreary is frequently used by physical therapists. The points of reference consisting of the lobe of the ear, the seventh cervical vertebra, the acromial process, the greater trochanter, just anterior to midline of the knee, and slightly anterior to the lateral malleolus form a theoretical line around which the body is balanced in perfect skeletal alignment, yielding equal weight distribution and maximum joint stability. An increased forward position of the head, a lordosis of the cervical spine, is a very common postural deformity. Usually it is accompanied by other postural displacements in the lower portions of the spine but usually the patient complains only of the neck[5].

Forward head posture (FHP) is one of the common types of poor head posture seen in patients with neck disorders.FHP also known as turtle neck is the most representative postural syndrome in modern times .Forward head posture was found to have an incidence of 66% in healthy adult between the ages of 20-50years. It is the most commonly reported postural anomaly in patient with either cranial or Craniomandibular dysfunction[6].

FHP is a posture in which individuals present a cervico encephalic hyperextension and cervicobrachial hyperflexion, leading to shortening of the posterior cervical extensor muscles. When a similar posture was extended for a long period, the pressure on the cervical vertebrae joint and the back of the cervical was vertebra increased, due to gravity; which can cause changes in the connective tissue and lead to chronic postural imbalance[7].

Anatomically, the upper cervical spine is in flexion and the lower cervical spine is in extension, but forward head posture causes extension of the head and the upper cervical spine (C1 -C3), accompanied by flexion of the lower cervical spine (C4-C7) so that the cervical curvature is increased, a condition called hyper-lordosis. This altered positioning magnifies the effect of gravity, thereby increasing the flexion moment of the head, which may cause changes in the curvature[8,9].

Objectives of the study: It was to evaluate the effectiveness of cervico-thoracic mobilization (SNAGs) and deep neck flexor strengthening with pressure biofeedback unit on improving forward head posture, and to evaluate the effectiveness of Kendall’s exercise on improving forward head posture., also to compare the effectiveness of cervico-thoracic mobilization (SNAGs) and deep neck flexor strengthening with pressure biofeedback unit versus Kendall’s exercise on improving forward head posture[10-14].

MATERIALS AND METHODS

Materials: Paper, Pen/Pencil/Market, Couch, Chair, Pressure biofeedback Universal Goniometer, Theraband.

Source of Data: For the purpose of data collection 40 subjects within the age group of18-50 years diagnosed with forward head posture in the Department of Physiotherapy or referred to the Department of Physiotherapy in Navodaya Medical College Hospital and Research Centre, Raichur were selected. Both male and female subjects were chosen.

Research design: Comparative study design.

Setting of the study: Navodaya Medical College, Hospital and Research Center, Raichur, which is 1200 Bedded Multispecialty Hospital with fully equipped Orthopaedic Physiotherapy Department.

Variables:

Independent variables: Cervico-thoracic mobilization (SNAGs), Deep neck flexor strengthening, Kendall's exercises,

Dependent variables: Cranio vertebral Angle, Neck disability index, Numeric pain rating scale, cervical range of motion Cranio cervical flexion test.

Sample and sampling Techniques:

Men and women (18-50 years) with clinical diagnosis of FHP attending the physiotherapy department will be selected for the study.

These subjects were allocated into two groups using simple random sampling technique.

Mean and SD of NPRS between groups were 4.61 ± 1.71 and 4.05 ± 0.87

Total sample consists of 40 subjects with FHP.

Group A: Cervico- thoracic mobilization+ deep cervical flexor training Group B: Kendall's exercises

Inclusion criteria: Subjects with Agebetween18-50years, both male and female, Subjects with forward head posture, having neck pain symptoms of atleast 3 months duration, CVA (cranio vertebralangle) less than 50° and Subjects willing to participate in the study.

Methods of data collection:

Study consists of 20 subjects within the age group of 18-50 years. The subjects were screened for inclusion and exclusion criteria and those who fulfilled the criteria were considered for the study.

Measurement Tools: Pain level was assessed by Numeric Pain Rating Scale (NPRS), Functional level was assessed by Neck disability index (NDI), Cervical ROM was assessed using universal Goniometer(UG), Strength of the deep neck flexors was assessed using Pressure biofeed back unit (PBU), FHP was assessed by Cranio vertebral Angle (CVA).

Duration of the study: The duration of the study was 8 weeks.

METHODOLOGY

40 subjects who fulfill the inclusion and exclusion criteria has been selected for the study and 20 subjects has been randomly assigned to each of the two groups.

Interventions conducting on the subjects have been explained to them and written consent had taken from all the subjects with forward head posture.

All the subjects were assessed for FHP by Cranio vertebral Angle.

After evaluation the 40 subjects were randomly divided into two groups i.e.,groupA (n=20), group B (n=20).

Pre-test was taken before the intervention in first week and post-test after 8 weeks of intervention.

Group A received cervico-thoracic mobilization (SNAGs) along with deep neck flexor strengthening with PBU. Group B received Kendall's exercises. Duration of program: 8 weeks.

Procedure:

Group A: Participants in the Cervico-thoracic mobilization group were subjected to three sets of SNAGS, with each set performed six times in both the cervical and thoracic areas along with deep neck flexors strengthening exercise using a PBU (Stabilizer™, Chattanooga Group Inc., USA).

1. Cervical mobilization: The participants were instructed to sit comfortably on a chair, with their feet touching the ground and their head and cervical spine in a neutral position. SNAGs were applied with the therapistst and standing behind the patient. The therapist placed their left and right thumbs on the respective sides of the spinous process on the cervical spine and applies the SNAG in a horizontal direction. This mobilization for the cervical region was continued from C3 to C7 segments. For continuous gliding, participants were guided to perform neck flexion and extension movements.

2. Thoracic mobilization Participants were instructed to sit on a chair, with their feet touching the ground and both hands placed behind the neck to protract the scapula. SNAGs were applied with the therapist standing to one side of the patient. The therapist placed one hand on the participant's chest and one leg behind the participant to support the lumbo sacral spine. For joint mobilization, the therapist placed the palm of the hand on the spinous process of the thoracic spine. While the participant performing thoracic flexion and extension movements, the therapist uses the palm of the hand placed on the spinous process to glide the facet joints of the thoracic spine in the cranial direction. Mobilization was given from T1 to T6 level (upper thoracic segments).

3. Deep cervical flexor strengthening was performed using an air-filled with the digital pressure biofeedback unit (Stabilizer TM, Chattanooga Group Inc., USA). After asking the subjects to lie down, the device was placed between the participant's nape and the occipital condyle, digital pressure biofeedback. The manometer of the device was set at 20 mmHg, and participants were asked to nod lightly as if their chin was touching the sternum. The final stage would finish at 30 mmHg, and the pressure was increased by 2 mmHg at each stage. When the final stage will be reached, it is considered as 1 complete set and the rest time was 5 seconds per training session, and 30 seconds per set.

a. Frequency: 5–10minutes once a day, three times a week for 8 weeks.

GROUP B

Subjects in this group were performing the Kendall's exercises to correct FHP. The Kendall's exercise methods as follows:

1. Chin tucks was performed while lying supine with the head in touch with the floor, which will be progressed to lifting the head off the floor in a tucked posture and holding it for varied periods of time (progress by two-second

holds starting at two seconds, i.e., 2, 4, 6, and 8 s).

2. Chin drop while sitting to stretch cervical extensors (the progression of this exercise is to drop the chin with hand assistance). The patients were instructed to flex the neck until a good stretch is felt at the base of the head and top of the neck. The patient should hold the final position for 5s.

3. Pulling the shoulders back using a theraband while standing to strengthen the shoulder retractors. The patient was instructed to squeeze their scapulae together tightly for at least 6s without elevating or extending their shoulder.

4. Every two weeks, participants alternated between unilateral and bilateral pectoralis stretches. The patient was seated comfortably with their hand behind their head for bilateral pectoralis stretching. From this posture, the patient's elbow was pushed up and out to the limit of its possible range. The arm at the affected location will be shifted into abduction and external rotation for unilateral stretching. The end position was maintained for 20–30 s and repeated 3–5 times. For unilateral stretching, the patients had been directed to bring their hands up such that their forearms and elbows rested on the side of the doorway. The elbow and shoulder should be at a 90-degree angle. The patient was encouraged to move his or her body toward the opposite side away from the door way until a stretch was felt anteriorly between the chest and shoulder. The same process was repeated on the opposite side. This posture was maintained for 20–30 s and repeated 3–5 times. Frequency: three times a week for 8weeks.

RESULTS

A comparative study was done consisting of 40 subjects randomized into two groups with 20 subjects in group A and 20 subjects in group B to study the effects of deep cervical flexor training and cervico thoracic mobilization(snags)versus Kendall's exercises in forward head posture.

GROUP		N	Mean	Std. Deviation	Std. Error Mean	"t"test	P Value
AGE	GROUPA	20	29.8	6.135	1.372	0.761	0.456
	GROUPB	20	32.5	5.596	1.251		

Table1: Age distribution between 2 groups

The above table shows mean and standard deviation of age in SNAG+DCF group as 29.8±6.13 Mean and standard deviation of age in Kendall's Exercises group as 32.5±5.596

		GROUP				Chi-square	P Value
		Group A		Group B			
		No.	%	No.	%		
Sex	Female	8	40.0	9	45.0	0.266	<0.001
	Male	12	60.0	11	55.0		
Total		20	100	20	100		

Table2: Gender Distribution between Group A and Group B.

The above table shows majority are females in the Kendall's exercise group i.e. (45%) and majority are males in SNAG+DCF group i.e.(60%).

GROUPA		Mean	N	Std. Deviation	Std. Error Mean	t-test	P-value
CVA	PRE-TEST	48	20	1.7455	0.3903	-10.931	<0.001
	POST-TEST	53	20	1.4177	0.3170		
NPRS	PRE-TEST	6	20	0.826	0.185	26.250	<0.001
	POST-TEST	3	20	0.688	0.154		
NDI	PRE-TEST	25	20	6.030	1.348	13.870	<0.001
	POST-TEST	14	20	6.017	1.345		
CCFT	PRE-TEST	23	20	1.765	0.395	-15.983	<0.001
	POST-TEST	28	20	1.667	0.373		
FLEXION ROM	PRE-TEST	51	20	3.485	0.779	-12.889	<0.001
	POST-TEST	58	20	3.426	0.766		
EXTENSION ROM	PRE-TEST	68	20	4.028	0.901	-13.860	<0.001
	POST-TEST	77	20	2.360	0.528		
ROTATION ROM	PRE-TEST	69	20	3.364	0.752	-14.000	<0.001
	POST-TEST	77	20	1.785	0.399		
LATERAL FLEXION ROM	PRE-TEST	37	20	2.936	0.657	-20.396	0.022
	POST-TEST	43	20	1.877	0.420		

Table3: Intra group comparison of pre-test and post-test values of CVA, NPRS, NDI, CCFT and CROM in GROUP A

GROUP B		Mean	N	Std. Deviation	Std. Error Mean	t-test	P-value
CVA	PRE-TEST	47.955	20	1.1651	0.2605	-7.621	<0.001
	POST-TEST	49.710	20	0.9119	0.2039		
NPRS	PRE-TEST	5.60	20	1.046	0.234	21.708	<0.001
	POST-TEST	2.75	20	0.851	0.190		
NDI	PRE-TEST	22.95	20	4.915	1.099	12.499	<0.001
	POST-TEST	16.05	20	4.904	1.097		
CCFT	PRE-TEST	23.50	20	1.821	0.407	-9.200	0.001
	POST-TEST	26.30	20	1.342	0.300		
FLEXION ROM	PRE-TEST	51.20	20	3.397	0.760	-17.085	0.005
	POST-TEST	55.10	20	2.954	0.661		
EXTENSION ROM	PRE-TEST	67.65	20	4.069	0.910	-9.602	0.001
	POST-TEST	73.20	20	3.518	0.787		
ROTATION ROM	PRE-TEST	67.65	20	3.167	0.708	-14.451	0.105
	POST-TEST	72.85	20	2.720	0.608		
LATERAL FLEXION ROM	PRE-TEST	35.60	20	2.741	0.613	-13.402	0.003
	POST-TEST	39.35	20	2.346	0.525		

Table4: Intra group comparison of pre-test and post-test values of CVA, NPRS, NDI, CCFT and CROM in GROUP B

CVA	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	df	P Value
PRE-TEST	GROUPA	47.615	20	1.7455	0.3903	-0.655	19	0.052
	GROUPB	47.955	20	1.1651	0.2605			
POST-TEST	GROUPA	52.615	20	1.4177	0.3170	7.116	19	<0.001
	GROUPB	49.710	20	0.9119	0.2039			

Table5: Inter group comparison of pre-test and post-test values of CVA

NPRS	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	Df	P Value
PRE-TEST	GROUP A	6.05	20	0.826	0.185	1.577	19	0.131
	GROUP B	5.60	20	1.046	0.234			
POST-TEST	GROUP A	2.50	20	0.688	0.154	-0.960	19	<0.001
	GROUP B	2.75	20	0.851	0.190			

Table6: Inter group comparison of pre-test and post-test values of NPRS

NDI	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	Df	P Value
PRE-TEST	GROUPA	24.95	20	6.030	1.348	1.176	19	0.254
	GROUPB	22.95	20	4.915	1.099			
POST-TEST	GROUPA	14.10	20	6.017	1.345	-1.506	19	<0.001
	GROUPB	16.05	20	4.904	1.097			

Table7: Inter group comparison of pre-test and post-test values of NDI

CCFT	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	Df	P Value
PRE-TEST	GROUPA	23.20	20	1.765	0.395	-0.590	19	0.562
	GROUPB	23.50	20	1.821	0.407			
POST-TEST	GROUPA	27.60	20	1.667	0.373	3.115	19	0.006
	GROUPB	26.30	20	1.342	0.300			

Table8: Intergroup comparison of pre-test and post-test values of CCFT

ROM	**GROUPS**	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**	**t" test**	**df**	**P Value**
PRE-TEST	GROUPA	50.60	20	3.485	0.779	-0.590	19	0.562
	GROUPB	51.20	20	3.397	0.760			
POST-TEST	GROUPA	58.05	20	3.426	0.766	2.678	19	<0.001
	GROUPB	55.10	20	2.954	0.661			

Table 9: Inter group comparison of pre-test and post-test values of flexion ROM.

ROM	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	df	P Value
PRE-TEST	GROUPA	67.70	20	4.028	0.901	-4.359	19	0.062
	GROUPB	73.20	20	3.518	0.787			
POST-TEST	GROUPA	77.10	20	2.360	0.528	3.986	19	0.001
	GROUP B	73.20	20	3.518	0.787			

Table10: Inter group comparison of pre-test and post-test values of extension ROM.

ROM	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	df	P Value
PRE-TEST	GROUPA	68.95	20	3.364	0.752	1.181	19	0.252
	GROUPB	67.65	20	3.167	0.708			
POST-TEST	GROUPA	77.35	20	1.785	0.399	5.290	19	<0.001
	GROUPB	72.85	20	2.720	0.608			

Table11: Inter group comparison of pre-test and post-test values of ROTATION ROM

ROM	GROUPS	Mean	N	Std. Deviation	Std. Error Mean	"t"test	df	P Value
PRE-TEST	GROUPA	36.90	20	2.936	0.657	1.559	19	0.135
	GROUPB	35.60	20	2.741	0.613			
POST-TEST	GROUPA	43.05	20	1.877	0.420	6.135	19	<0.001
	GROUPB	39.35	20	2.346	0.525			

Table12: Inter group comparison of pre-test and post-test values of lateral flexion rom.

DISCUSSION

Forward head posture refers to the posture that accompanies forward bending of the lower cervical vertebrae and excessive extension of the upper cervical vertebrae. Factors causing this posture in modern people include occupations and habits and most cases except the occupational factor are largely influenced by the habit of using electronic devices such as computers and smart phones. It usually accompanies a reduced range of motion (ROM) of the neck and muscle endurance. Basic to an understanding of pain in relation to faulty posture is the concept that the cumulative effects of constant or repeated small stresses over a long period of time can give rise to the same kind of difficulties that occurs with a sudden, severe stress. Cases of postural pain are extremely variable in the manner of onset and in the severity of symptoms. To manage this condition effectively, it is important to improve its symptoms, but it may be more important to prevent the recurrence of the symptoms.

The principal aim of this study was to compare the effects of deep cervical flexor training and cervico thoracic mobilization (snags) versus Kendall's exercises in forward head posture. This study was conducted on 40 subjects having FHP which were randomly divided into 2 groups with 20 subjects in each group. Group A received cervicothoracic mobilization (SNAGs) with deep cervical flexors training and group B received Kendall's exercises[15-19].

CVA measured a degree of the Forward head posture (FHP), NDI for evaluating neck discomfort, CCFT to assess function of deep neck flexor muscles, CROM to measure cervical range and NPRS scale was used to assess level of pain. Treatment was given 3 times a week for 8 weeks. The collected data was analyzed by means of various statistical tool via mean, standards deviation and paired't' test.

Eight weeks of Cervicothoracic Mobilization (SNAGs) With Deep cervical flexors training and Kendall's Exercis Eled to a significant improvement in CVA, NPRS, NDI, CCFT, CROM ($p<0.001$).

Subjects in Group A who received cervico-thoracic mobilization (SNAGs) with DCF training showed increase in CVA angle from 47.61 to 52.61,adecrementinNPRSfrom6.05 to2.50, a decrement in NDI from24.95 to 14.10, improvement in CCFT from23.20 to 27.60, increase in CROM of flexion, extension, rotation and lateral flexion from 50.60 to 58.05, 67.70to 77.10, 68.95to 77.35 and 36.90 to 43.05 respectively. All the results are found to be statistically significant ($p<0.001$).

The result of this study correlates with a randomized control trial done by Won-Jae Choi, Si-Nae Kang et al (2022) to compare the effects of Cervical and Thoracic Mobilization technique on range of motion in the sagittal plane and pain in patients with FHP. Patients were randomly divided into three groups: the mobilization group (CM; n = 15), the cervical and thoracic mobilization group (CTM;n=15), and the thoracic mobilization group (TM;n= 15). Each intervention was performed in sets of three and repeated six times. Outcome measures used were cervical ROM using goniometer and pain was evaluated using a visual analogue scale. As a result, all groups showed an increase in range of motion and decrease in pain post- intervention, but the increase in the CTM group was significantly greater than in the CM and TM groups. The study concluded that CTM may be more effective than CM or TM for improving cervical range of motion in the sagittal plane and pain in patients with FHP[20-23].

Another comparative study by Kim Tae Ho et al (2022) was conducted to investigate the effects of cervical mobilization and deep cervical flexor training on muscle tone and pain in adults with non-specific neck pain. Using the Neck Disorder Index (NDI),30 patients in the normal group and 30 patients in the neck pain group were classified. Interventions used were Maitland's PA mobilization and deep cervical flexor training with the digital pressure biofeed back unit. For30adultswithnon-specific neck pain, each was classified in to the joint mobilization group, the deep cervical flexor training group, or the mixed group .Training was conducted twice a week for 10 minutes each for 4 weeks. As a result of comparing the tone between groups, there was a significant difference in all muscles ($p<0.05$), and there was no significant difference in all three groups in the comparison of pain between groups ($p>0.05$). The study concluded that mobilization applied to the neck had an advantageous effect on neck pain, static and dynamic balance, and range of motion. Deep cervical flexor training was effective in reducing neck pain and increasing muscle strength and muscle activity[24-27].

Sustained natural apophyseal glides (SNAGs) as a form of joint mobilization is used for the treatment of spinal pain. The SNAGs were described one of mobilization with movement techniques, and to apply passive glide simultaneously while performing active movement .The SNAGs may enhance treatment effects by eliminating pain originating from the lesion. The application of SNAG influences correcting irregular position of articular elements and achieving correct biomechanics of the spine[28].

Subjects in group B who received Kendall's exercise showed increase in CVA angle from 47.95 to 49.71, decrease in NPRS from 5.60 to 2.75, a decrement in NDI from 22.95 to 16.05, improvement in CCFT from 23.20 to 26.30, increase in CROM of flexion, extension, rotation and lateral flexion from 51.20 to 55.10,67.65 to 73.20,67.95 to 72.85,35.60to 39.35respectively.The results showed significant difference of mean value in pre-test and post-test.

The results of this study correlate with a study done by Ki-Hyun Kim et al (2015) to examine the effects of horse-riding simulator exercise and Kendall exercise on forward head posture. Thirty elderly college students with a forward head posture were randomly divided into two groups for 15 persons each, a horse-riding simulator group and Kendall exercise group, and performed exercise for eight weeks. The study showed appositive effect of horse-riding exercise and Kendall exercise groups on FHP. The results of this study indicate that horseriding simulator exercise is more effective on forward head posture than Kendall.[42]

Kendall's exercise is generally used as physical therapy for FHP and induces proper neck alignment generally using strengthening methods for two muscles (deep cervical flexors and retractors of the scapula) and stretching methods for two muscles (neck extensor muscles and pectoralis) to help with FHP, which is a state of imbalance of muscles, correcting unstable FHP and helping to correct the alignment of the neck [29].

In this study the intra group comparison of pre-test and post-test values of all outcome measures showed statistical significance.

The table 3 shows pre-test mean of CVA is 48±1.47 and post-test is 53±1.417 ; pre-test mean of NPRS is 6±0.826 and post-test is 3±0.688 ; pre-test mean of NDI is 25±6.03 and post-test is 14±6.017 ; pre-test mean of CCFT is 23±1.76 and post-test is 28±1.66 ; pre-test mean of CROM of flexion, extension, rotation and lateral flexion are 51±3.48, 68±4.02, 69±3.36,37±2.93 respectively and post-test are 58±3.42, 77± 2.36, 77±1.78, 43±1.87 in SNAG +DCF Group, Which is statistically significant i.e., p<0.001.

The table4 shows pre-test mean of CVA is 47.95±1.16 and post-test is 53±1.417; pre-test mean of NPRS is 5.60±1.046 and post-test is 2.75±0.851;pre-test mean of NDI is 22.95±4.91 and post-test is 16.05±4.904 ; pre-test mean of CCFT is 23.50±1.82 and post-test is 26.30±1.34 ; pre-test mean of CROM of flexion, extension ,rotation and lateral flexion are 51.20±3.39, 67.65±4.06, 67.65±3.16, 35.6±2.74 respectively and post-test are 55.1±2.95,73.2±3.51, 72.85±2.72,39.35±2.34 in group B which is statistically significant i.e., p<0.001.

In this study the inter group comparison of pre-test and post-test values of all outcome measures showed statistical significance.

The table 5 shows pre-test mean of group Ais47.61 ±1.74 with standard error of 0.39 and group Bis 47.95±1.16 with standard error of 0.317 ; post-test mean of group A is 52.61±1.41 with a standard error of 0.31 and group B is 49.71±0.91 with a standard error of 0.20 which is found to be statistically significant i.e., p<0.001 for CVA between group A and group B.

The table 6 shows pre-test mean of group A is6.05±0.82 with standard error of 0.18 and group B is 5.60±0.23 with standard error of 0.23; post-test mean of group A is 2.50±0.68 with a standard error of 0.15and group B is 2.75±0.81with a standard error of 0.19which is found to be statistically significant i.e., p<0.001 for NPRS between group A and group B.

The table7 shows pre-test mean of group A is 24.95±6.03 with standard error of 1.34and group B is 22.95±4.91with standard error of 1.09; post-testmean of group A is 14.10±6.01 with a standard error of 1.34 and group B is 16.05±4.90 with a standard error of 1.09 which is found to be statistically significant i.e., p<0.001 for NDI between group A and group B.

The table8 shows pre-test mean of group A is 23.20±1.76 with standard error of 0.39 and group B is 23.50±1.82with standard error of 0.40; post-test mean of group A is27.60±1.66 with a standard error of 0.37 and group B is 26.30±1.34with a standard error of0.30 which is found to be statistically significant i.e., p<0.001 for CCFT between group A and group B.

The table 9 shows pre-test mean of group Ais50.60±3.48 with standard error of 0.77 and group B is 51.20±3.39 with standard error of 0.76;post-test mean of group A is58.05±3.42 with a standard errorof0.766andgroup Bis55.10±2.95 with a standard errorof0.66 which is found to be statistically significant i.e., p<0.001 for flexion ROM between group A and group B.

The table 10 shows pre-test mean of group A is 67.70±4.02 with standard error of 0.90 and group B is 67.65±4.06 with standard error of 0.91; post-test mean of group A is 77.10±2.36with a standard errorof0.52 and group B is 73.20±3.51 with a standard errorof0.78 which is found to be statistically significant i.e., p=0.001 for extension ROM between group A and group B.

The table 11 shows pre-test mean of group A is 68.95±3.36 with standard error of 0.75 and group B is 67.65±3.16 with standard error of 0.70; post-test mean of group A is 77.35±1.78 with a standard error of0.399and group B is 72.85±2.72witha standard errorof0.60 which is found to be statistically significant i.e., p<0.001 for rotation ROM group A and group B.

The table 12 shows pre-test mean of group A is 36.90±2.93 with standard error of 0.65 and group Bis 35.60±2.74 with standard error of 0.61; post-test mean of group A is 43.05±1.87 with a standard error of 0.42 and group B is 39.35±2.34 with a standard error of 0.52 which is found to be statistically significant i.e., p<0.001 for lateral flexion ROM between group A and group B.

However, when mean of both the groups are compared, Group A was found to be more effective. These results indicate between group differences for Kendall’s exercise group and cervico-thoracic mobilization with deep cervical training favoring the SNAG+DCF over Kendall’s for subjects with FHP.

The result of this study showed that interventions given to both groups showed improvement in CVA, NPRS, NDI, CCFT and CROM. Based on the post-test comparison between two groups it can be said that GROUP A showed significant differences in CVA, NPRS, NDI, CCFT and CROM than GROUP B in subjects with Forward Head Posture.

CONCLUSION

This study concludes that both cervicothoracic mobilization (SNAGs) with deep neck flexor training and Kendall's exercise showed significant improvement in CVA, NPRS, CCFT, NDI and CROM. Thus, both the interventions are equally effective in treating patients with Forward head posture. However cervicothoracic mobilization (SNAGs) with deep neck flexor training group showed better improvement in increasing CVA, reducing pain, increasing strength and mobility in patients with Forward head posture.

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