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Effect of Cervical Sensorimotor Control Training on Pain, Disability and Dynamic Balance in Patients with Cervicogenic Headache

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ABSTRACT

Background: Headache is one of the most prevalent conditions in the world, headaches can cause significant impairment in every day activity. Common headache conditions including migraine, tension-type headache (TTH), and cervicogenic headache (CGH) have a detrimental effect on one's quality of life (QOL), ability to function at work, and family life. As a result, they can directly or indirectly burden society financially.

Objective: This study aimed to investigate the effect of cervical sensorimotor control training on pain, disability and dynamic balance in patients with CGH.

Subjects and methods: 50 patients of both genders were suffering from CGH, randomized into 2 groups 25 patients each: Group A and B respectively. Group A was rehabilitated with cervical sensorimotor training program including gaze direction recognition exercise (GDRE), cervical joint Reposition Exercises (CJRE) and stabilizer pressure biofeedback (SPB) in addition to conventional physical therapy program. Group B received only conventional physical therapy program. The intervention consisted of three weekly therapy sessions for three weeks. The outcome measures included in this study were the Biodex Balance Index, Neck Disability Index, and Numerical Pain Scale. Measurements were made right before, during, and four weeks following treatment.

Results: There was a statistically significant ($p<0.05$) difference in the improvement of outcome measures between the two groups when comparing post-intervention averages at four weeks of treatment. Subjects in Group A had a higher percentage of improvement than those in Group B.

Conclusions: The cervical sensorimotor training program, when paired with standard cervical treatment, showed a considerable favorable effect on pain, disability, and dynamic balance.

Keywords: CGH, Cervical sensorimotor training, Pain, Neck disability, Dynamic balance.

INTRODUCTION

Headaches is one of the most prevalent conditions in the world, headaches can cause significant impairment in every day activity. Common headache conditions including migraine, tension type headache (TTH), and cervicogenic headache (CGH), Cervicogenic headache have a detrimental effect on daily life, employment, and family obligations. Also, they can directly or indirectly cost society money [1]. In adults, the 1-year prevalence of primary headache is 47% worldwide [2], but the incidence of particular headache disorders is lower but nonetheless significant. In adults, the 1-year prevalence of migraine, TTH, and CGH was reported to be 15%, 21%, and 4% respectively [3–4].

The general population's frequency of CH ranges from 2.2% to 4.1%, with females being four times more likely to have it than males. The confluence of the afferent branches of the trigeminal and superior cervical spinal nerves in the trigeminal-cervical caudalis nucleus may be the source of this headache. The fact that individuals with CH frequently exhibit headaches that correspond to the cervical and trigeminal dermatomes may be explained by this convergence. Therefore, CH may develop as a result of a concussion or whiplash injury that causes neck discomfort and mobility limitations [5].

Despite being adequately described in the third version of the International Center for Human Development ICHD 2018, headache diagnosis can be problematic due to symptom overlap with migraine, TTH, and CGH [6]. Furthermore, in clinical practice, different headache types might coexist in up to 55% of patients [7]. This might explain the confusion in the initial diagnosis and later shift in headache classification, which happens in 40% of patients at follow-up [8]. To provide the best possible patient care, it is critical to determine the most common form of headache [9].

Sensorimotor training is mostly used in fall prevention programs for the elderly and rehabilitation programs for athletes [10]. As a result, various studies have examined his effects, mostly on clinical populations and sportsmen who wish to enhance performance and avoid injuries [11]. In essence, the ability to manage and maintain balance serves as the major basis for movement, upper extremity usage, and preserving general functional independence throughout life. This ability is sometimes taken for granted. Lack of appropriate posture and balance control can have detrimental impacts on mental and physical health in people of all ages, including decreased physical performance, diminished independence, and disruption of social activities [12].

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Instead of increasing overall joint strength, sensorimotor training aims to improve muscle responsiveness and restore automatic reflexive stability for dynamic restraint. Although it is evident that it plays a major role in enhancing postural balance and stability, it is yet unknown if adding certain sensorimotor activities to a training regimen improves postural balance, stability, and coordination more broadly in a healthy population [13]. Therefore, this study aimed to investigate the relationship between sensorimotor control training and pain, disability and balance in patient with CGH. So that the hypothesis of this study is that there is no effect of cervical sensorimotor control training on pain, disability and dynamic balance in patients with CGH.

MATERIAL AND METHOD

This double-blind randomized clinical trial was conducted at Faculty of Physical Therapy MTI University Outpatient Clinic. A total of 50 volunteer subjects were recruited from a convenience sample through the period from June 2024 to September 2025. Their ages ranged between 18 - 40 years.

Patients were divided equally (n=25) into two groups:

Group (A) was given a 4-week traditional rehabilitation program as well as sensorimotor control training, with each session lasting around 80 minutes.

Group (B) was given a 4-week standard cervical rehabilitation program, with each session lasting around 60 minutes.

50 young adults were selected with CGH.

Inclusion criteria: 1. Patients with episodic CGH, at least ten headache episodes that range anywhere from ten minutes to seven days and typically occur one to fourteen days each month for more than three months. 2. The ages of the chosen patients all fell between 18 and 40. 3. All patients were in stable medical condition and cooperative during treatment. 4. All the chosen patients had no history of cervical spine or upper limb surgery. 5. Patients who had not received any exercise therapy in the past six months.

Exclusion criteria: 1. Headache due to other cause rather than cervicogenic headache (e.g.,: miagrane and tension headache). 2. People who have been diagnosed with both cervical radiculopathy and cervical myelopathy. 3. Patients with thoracic outlet syndrome and insufficiency of the vertebrobasilar artery. 4. Cellebelar, vestibular, and whiplash patients. 5. Patients with hearing or sight impairments.

i. **Evaluation procedure: First, anthropometrics measurements including height, weight and body mass index was taken.**

Participants were assessed using the following instrumentations:

a. **Assessment of pain by numerical pain scale:** Pain intensity [NPRS is an 11-point (0–10) pain rating scale. Patients vocally pick a number from 0–10 based on the severity of their pain. (0) indicates no discomfort, while (10) indicates the highest level of pain felt at baseline. High test retest reliability has correlations range from (r=0.96 and 0.95 respectively) for construct validity, correlations range from 0.86 to 0.95 [14].

b. **Assessment of disability by neck disability index:** Neck disability [NDI is a questionnaire used to evaluate how neck discomfort has impacted a patient's capacity to function in daily life. The total potential score for each of its ten parts is five. If the first sentence is marked, the section score is zero; if the last statement is marked, the section score is five. The score is computed and transformed into percentages if all 10 sections are finished. The NDI has a maximum score of 50. Prior to intervention, it is assessed at baseline. Reliability intraclass correlations might vary between 0.5 and 0.98, and good construct validity [15].

c. **Assessment of postural stability (PS)) by BBS:** Dynamic bilateral postural stability on an unstable surface was assessed, providing quantitative evidence of neuromuscular control in antro-posterior, medio-laterl and overall index. The BBS has a display screen that can be elevated (from 51cm to 68 cm) or lowered (from 45° to vertical) relative to the platform. A control for locking the screen's height. The handle release pin is supported. A standing platform that could be tilted up to 20 degrees from the horizontal plane in all directions, measuring 8 cm in height and 21.5 cm in circumference. The number eight denotes the most stable platform surface, while the number one represents the most unstable. The platform included 0-45 degree angle marks. The screen proportions were 122 mm by 92 mm. The height of the platform-supporting railings was increased from 25 to 36.5 centimeters. Wheels, in addition to a printer. Following the end of each examination, the device would automatically calibrate and print the results [16].

Treatment procedures:

1. **Conventional physical therapy techniques:**

A. Continuous ultrasound (Primo US device):

- The Premier US device provides low-intensity continuous ultrasound at 1 MHz frequency and 0.5 W/cm^2. It has single transducer settings and is FDA authorized for home use for up to 4 hours per day, delivering 18,720 Joules per treatment with a dual transducer.
- The Primo US gadget was placed to the neck region and used for a 5-minute treatment. The device's two buttons—a clock button on the side and an on/off button in the center—make it simple to operate.

B. Hot pack: The participant was in a prone position. A heat pack set at 45°C was placed to the neck for ten minutes, it was maintained at about 40–50 °C.

C. TENS (Gymna device): TENS used by placing an electrode to the posterior neck and paraspinal area. For Pain Control: (Mode: M-modulation, Pulse width: 60usec, Pulse Rate: 150Hz, Output: Adjust to most comfortable sensory intensity for 20 minutes per session) [17].

D. Neck ROM and isometric exercises:

- To strengthen the cervical muscles, the sitting posture proved to be an excellent choice.
- The patient was asked to do static exercise to all cervical groups including flexors, extensors, side bendors and rotators.
- All performed 10 repetition 3 sets with 7 sec hold.

2. Sensorimotor control training:

A. Gaze Direction Recognition Task Procedure (GDRTP):

- Experimental design of gaze direction recognition task. Each column represents the positional relationship between a subject and an experimenter with six numbered boxes. The patient is positioned behind the therapist and views neck rotation of the therapist who attempts to gaze randomly at one of six boxes placed on the table, and imagines which one of the boxes the experimenter directs his gaze upon. The patient was then asked to give a verbal response as to the box number of the experimenter's gaze direction [18].

B. Cervical joint Reposition Exercises (CJRE):

- In order to minimize the impact of balance issues or other postural compensations on the test results, the cervical JPE test should be conducted when the patient is seated in order to best isolate the head and neck.
- A target is positioned on a wall 90 cm from the patient, at head height, while the patient is seated.
- A lightweight headband with a laser pointer is then put on the patient's head.
- For a total of five minutes, the patient is then instructed to concentrate on achieving a natural resting head posture such that the laser pointer lines up with the target's center, or "bullseye".
- The patient will actively move their head in each direction on the map, while keeping their eyes open, then return to the neutral position and continue the process for five minutes [19].

C. Stabilizer Pressure Biofeedback (SPB):

- The individual is in crock lying position on a plinth during the test. The therapist put his left hand on the table slightly behind the subject's occiput, positioning the subject's head in a mild upper neck flexion.
- Putting the pressure sensor under the neck, and ask the patient to gently and slowly nod the head as though you're saying "yes". Start at twenty mm hg and then increase the pressure two mmHg over baseline, then four mmHg, then six mmHg, eight mmHg, and ten mmHg without breaks in between, at the end of the movement sequence, the pressure sensor should register thirty mmHg. After all five increments hold each one for two seconds, for a total of ten seconds. Continue doing this exercise for five minutes, repeating the greatest level attained with proper technique until ten repetitions with 10-second holds are completed [20].

Ethical approval:

The study was approved by Cairo University's Faculty of Physical Therapy's Institutional Ethics Committee (No.:P.T.REC/012/005684). Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

SPSS for Windows version 23.0 was used to statistically analyze and compare the measured variables, with an alpha level of 0.05. The assumption of normalcy, homogeneity of variance, and the existence of extreme scores were checked in the data. The measured variables have a normal distribution, according to the X^2-test and Shapiro-Wilks test for normality ($p > 0.5$). With the exception of gender (counts), all outcomes' data are presented as Mean ± SD. The cumulative effect of all outcomes was compared between the groups using a two-way mixed design MANOVA. To guard against type I error, follow-up univariate ANOVAs with Bonferroni correction were conducted for each outcome measure when the MANOVA revealed statistical significance. Statistical significance was definite as a two-tailed with P value ≤ 0.05.

RESULTS

1- General characteristics of the patients:

Age and BMI did not significantly differ between the groups, according to a comparison of the general characteristics of the patients in the two groups ($p > 0.05$). The distribution of sexes did not significantly change across two groups ($p = 0.71$) (Table 1).

Table (1): General characteristic of patients (N=50)*

	Study group	**Control group**	**t- value**	**p-value**	**Sign**
	Mean ±SD (n=25)	**Mean ±SD (n=25)**			
Age (years)	22.44±0.87	22.56±1.19	-0.41	0.69	**NS**
Weight (kg)	63.32±9.31	68.16±10	-1.77	0.08	**NS**
Height (cm)	163.4 ±6.93	164.28 ±4.67	-0.53	0.6	**NS**
BMI (kg/m²)	23.8±2.47	24.08±2.66	-0.39	0.7	**NS**
Gender, n (%): Male Female	4(16%) 21(84%)	5(20%) 20(80%)	$\chi 2$= 0.14	0.71	NS

2-Effect of treatment on NPRS, ANDI, anteroposterior stability, mediolateral stability and overall stability: Multivariate analysis using a mixed design was used to examine how treatment affected every variable that was assessed. There was statistical significant difference between groups as Wilk's A = 0.13, $F_{(5, 44)}$ =61.09, P-value < 0.001, Partial Eta Squared ($\eta^{2)}$ = 0.87. Also there was statistical significant effect on time (pre- & post-treatment) as Wilk's A = 0.02, $F_{(10, 39)}$ =247.27, p-value < 0.001, η^2 = 0.98, as well as for the interaction between groups and time as Wilk's A= 0.12, $F_{(10, 39)}$ = 28.08, p-value < 0.001, η^2 = 0.88 (Table 2).

Table (2): Results of Mixed design multivariate analysis of Variance

	Mixed MANOVA			
	Wilks' Lambda	**F-value**	**p-value**	**Partial Eta Squared**
Effect of treatment (group effect)	**0.13**	**61.09**	**<0.001**	**0.87**
Effect of time	**0.02**	**247.27**	**<0.001**	**0.98**
Interaction effect (treatment * time	**0.12**	**28.08**	**<0.001**	**0.88**

3- Effect of treatment on NPRS:

Within group comparison:

Study group: The study group's NPRS decreased significantly post-treatment (p<0.001) compared to pre-treatment. NPRS decreased significantly throughout study group follow-up compared to post-treatment (p < 0.001) **(Table 3).**

Control group: The control group's NPRS decreased significantly post-treatment compared to pre-treatment (p < 0.001). When comparing the control group follow-up to post-treatment, there was no discernible drop in NPRS (p=0.09) **(Table 3).**

Comparison between groups:

Pre-treatment: Pre-treatment, there was no discernible change in NPRS between the study and control groups (p = 0.49) **(Table 3).**

Post-treatment and follow-up:

Post-treatment, the study group and control group differed significantly (p=0.002), with the mean difference in NPRS between the groups being -1.2. At follow-up, the mean difference in NPRS across groups was -2. The follow-up between the study group and the control group differed significantly (p<0.001) **(Table 3).**

Table (3): Effect of treatment on NPRS (N=50) *

NPRS (cm)						
Study group			**Control group**			
Pre-treatment	**Post-treatment**	**Follow-up**	**Pre-treatment**	**Post-treatment**	**Follow -up**	
$\overline{X}$ **± SD**	$\overline{X}$ **± SD**	$\overline{X}$ **± SD**	$\overline{X}$ **± SD**	$\overline{X}$ **± SD**	$\overline{X}$ **± SD**	
6.64±0.99	**3.56±0.86**	**2.28±0.79**	**6.84±1.03**	**4.76±0.97**	**4.28±0.74**	
Within group comparison (time effect)						
		MD	**% of change**	**p-value**	**Sig**	
Pre vs post	**Study group**	**3.08**	**46.39**	**<0.001**	**S**	
	Control group	**2.08**	**30.41**	**<0.001**	**S**	
Post vs follow-up	**Study group**	**1.28**	**35.96**	**<0.001**	**S**	
	Control group	**0.48**	**10.08**	**=0.09**	**NS**	
Between group comparison (group effect)						
			MD	**p- value**	**Sig**	
Study vs control	**Pre-treatment**		**-0.2**	**=0.49**	**NS**	
	Post-treatment		**-1.2**	**0.002**	**S**	
	Follow-up		**-2**	**<0.001**	**S**	

4- Effect of treatment on ANDI:

Within group comparison:

Study group: The study group's ANDI significantly decreased post-treatment as compared to pre-treatment ($p < 0.001$). The ANDI of the study group follow-up was significantly lower than that of the post-treatment period ($p<0.001$) **(Table 4).**

Control group: The control group's ANDI significantly decreased post-treatment as compared to pre-treatment ($p<0.001$). When comparing the control group follow-up to post-treatment, there was no discernible drop in ANDI ($p=0.99$) **(Table 4).**

Comparison between groups:

Pre-treatment: pre-treatment showed no discernible change in ANDI between the study group and control group ($p = 0.74$) **(Table 4).**

Post-treatment and follow-up: post-treatment, the groups' mean ANDI differences were -8.84. After treatment. The study group and control group differed significantly ($p<0.001$). At follow-up, the mean ANDI difference between groups was -11.36. The follow-up between the study group and the control group differed significantly ($p<0.001$) **(Table 4).**

Table (4): Effect of treatment on ANDI (N=50) *

ANDI (score)						
Study group			Control group			
Pre-treatment	Post-treatment	Follow-up	Pre-treatment	Post-treatment	Follow -up	
$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	
26.4±2.92	7.72±1.72	4.88±0.75	26.68±2.93	16.56±2.86	16.24±2.49	
Within group comparison (time effect)						
			MD	% of change	p-value	Sig
Pre vs post		Study group	18.68	70.76	<0.001	S
		Control group	10.12	37.93	<0.001	S
Post vs follow-up		Study group	2.84	36.79	<0.001	S
		Control group	0.32	1.9	=0.99	NS
Between group comparison (group effect)						
				MD	p- value	Sig
Study vs control		Pre-treatment		-0.28	=0.74	NS
		Post-treatment		-8.84	<0.001	S
		Follow-up		-11.36	<0.001	S

N: number.MD: Mean difference.CI: Confidence interval. P: Probability value. * Data are mean± SD. P-Value ≤0.05 indicate statistical significance difference. ANDI: Arabic neck disability index.

5- Effect of treatment on anteroposterior stability:

Within group comparison:

Study group: The study group's anteroposterior stability significantly decreased post-treatment as compared to pre-treatment ($p<0.001$). Anteroposterior stability of study group follow-up was significantly lower than that of post-treatment ($p<0.001$) **(Table 5).**

Control group: The control group's anteroposterior stability significantly decreased post-treatment as compared to pre-treatment ($p<0.001$). When compared to post-treatment, the control group's anteroposterior stability did not significantly decline ($p=0.99$) **(Table 5).**

Comparison between groups:

Pre-treatment: Anteroposterior stability did not significantly differ between the study and control groups pre-treatment ($p = 0.52$) **(Table 5).**

Post-treatment and follow-up: Post-treatment, there was a substantial difference ($p<0.001$) between the study and control groups. The study group and control group follow-up differed significantly ($p<0.001$) **(Table 5).**

Table (5): Effect of treatment on anteroposterior stability (N=50) *

Anteroposterior stability (score)						
Study group			Control group			
Pre-treatment	Post-treatment	Follow-up	Pre-treatment	Post-treatment	Follow -up	
$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	
2.6±0.26	1.29±0.18	0.96±0.2	2.54±0.4	1.86±0.44	1.8±0.25	
Within group comparison (time effect)						
		MD	% of change	p-value	Sig	
Pre vs post	Study group	1.31	50.38	<0.001	S	
	Control group	0.68	26.77	<0.001	S	
Post vs follow-up	Study group	0.34	26.36	<0.001	S	
	Control group	0.06	3.23	=0.99	NS	
Between group comparison (group effect)						
			MD	p- value	Sig	
Study vs control	Pre-treatment		0.06	=0.52	NS	
	Post-treatment		-0.57	<0.001	S	
	Follow-up		-0.85	<0.001	S	

N: number.MD: Mean difference.CI: Confidence interval. P: Probability value. * Data are mean± SD. P-Value ≤0.05 indicate statistical significance difference.

6- Effect of treatment on mediolateral stability:

Within group comparison:

Study group: Pre-treatment, the study group's mediolateral stability significantly decreased (p<0.001) in comparison with post-treatments. Mediolateral stability of study group follow-up was significantly lower than post-treatment (p<0.001) **(Table 6).**

Control group: The control group's mediolateral stability significantly decreased post-treatment as compared to pre-treatment (p<0.001). The control group follow-up showed no discernible decline in mediolateral stability as compared to post-treatment (p=0.07) **(Table 6).**

Comparison between groups:

Pre-treatment: pretreatment, the study and control groups' mediolateral stability did not differ significantly (p = 0.41) **(Table 6).**

Post-treatment and follow-up: Post-treatment, the study group and control group differed significantly (p<0.001). The follow-up between the study group and the control group differed significantly (p<0.001) **(Table 6).**

Table (6): Effect of treatment on mediolateral stability (N=50) *

Mediolateral stability (score)						
Study group			Control group			
Pre-treatment	Post-treatment	Follow-up	Pre-treatment	Post-treatment	Follow -up	
$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	
2.37±0.28	1.17±0.18	0.87±0.16	2.44±0.26	1.78±0.39	1.67±0.47	
Within group comparison (time effect)						
		MD	% of change	p-value	Sig	
Pre vs post	Study group	1.2	50.63	<0.001	S	
	Control group	0.65	26.77	<0.001	S	
Post vs follow-up	Study group	0.31	26.64	<0.001	S	
	Control group	0.11	6.18	=0.07	NS	
Between group comparison (group effect)						
			MD	p- value	Sig	
Study vs control	Pre-treatment		-0.06	=0.41	NS	
	Post-treatment		-0.61	<0.001	S	
	Follow-up		-0.81	<0.001	S	

N: number.MD: Mean difference.CI: Confidence interval. P: Probability value. * Data are mean± SD. P-Value ≤0.05 indicate statistical significance difference.

7- Effect of treatment on overall stability:

Within group comparison:

Study group: When compared to pre-treatment, the study group's overall stability significantly decreased post-treatment ($p<0.001$). When compared to post-treatment, the general stability of the study group follow-up significantly decreased ($p<0.001$) **(Table 7).**

Control group: The control group's overall stability decreased significantly post-treatment compared to pre-treatment ($p < 0.001$). There was no significant decline in overall stability of the control group follow-up compared to the post-treatment ($p=0.99$) **(Table 7).**

Comparison between groups:

Pretreatment: There was no significant difference in overall stability between study and control groups pre-treatment ($p = 0.79$) **(Table 7).**

Post-treatment and follow-up: Post-treatment, the study group and control group differed significantly ($p<0.001$). The follow-up between the study group and the control group differed significantly ($p<0.001$) **(Table 7).**

Table (7): Effect of treatment on overall stability (N=50) *

Overall stability (score)					
Study group			Control group		
Pre-treatment	Post-treatment	Follow-up	Pre-treatment	Post-treatment	Follow -up
$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD
3.18±0.49	1.73±0.47	1.35±0.29	3.14±0.53	2.36±0.5	2.34±0.43

Within group comparison (time effect)					
		MD	% of change	p-value	Sig
Pre vs post	Study group	1.45	45.6	<0.001	S
	Control group	0.78	24.84	<0.001	S
Post vs follow-up	Study group	0.38	21.96	<0.001	S
	Control group	0.02	0.85	=0.99	NS

Between group comparison (group effect)				
		MD	p- value	Sig
Study vs control	Pre-treatment	0.04	=0.79	NS
	Post-treatment	-0.63	<0.001	S
	Follow-up	-1	<0.001	S

DISCUSSION

Fifty both sex patients suffering from CGH represented the sample of the study. The patients were divided into 2 equal groups at random manner. Study group (GA) treated by sensorimotor training in addition to conventional physical therapy techniques. Sensorimotor training consists of Gaze Direction Recognition Task Procedure (GDRTP), Cervical joint Reposition Exercises (CJRE) and Stabilizer Pressure Biofeedback (SPB) and conventional physical therapy consisted of hot pack, ultrasound (US), TENS and exercise. Control group (GB) treated by only conventional physical therapy.

The present study's findings showed notable decrement in pain, disability and dynamic balance in both groups (GA & GB) post-treatment with more reduction in favor to study group (GA) ($P<0.05$). It also revealed significant reductions of pain, disability and dynamic balance in follow up in study group (GA). Postural stability and dynamic balance were evaluated using BBS. The neck disability index was employed to measure physical handicap in patients with CGH, and a numerical pain scale was utilized to measure the intensity of pain. Cervicogenic headache is strongly linked to muscular weakness, discomfort, and loss of proprioception. Sensorimotor function is impacted by these reductions in cervical joint sensory output, which might lead to impaired balance. In the current study, the study group's improved balance might be related to afferent acquisition and transmission to central integration centers, where an efferent neural signal can be propagated to the muscle.

Standing balance has been demonstrated to be impacted by proprioception in the cervical muscles, presumably as a result of supporting the neck, which hinders the vestibular system's correct alignment, cervical muscular movements, and the effectiveness of the involved proprioceptors [21-22]. The nociceptive input of pain may interfere with the proprioceptive information from the deep neck muscles, resulting in a less accurate central slow adjustment of balance and maybe worse postural shifts [19].

The first explanation suggested that because vestibular receptors are located in the skull base, away from the antigravity muscles in the lower body, movable joints in the cervical spine may have a greater effect on postural stability in patients with cervicogenic headaches after cervical proprioceptive training combined with traditional training. Central processing of afferent information from the biomechanical environment is required for the successful use of vestibular and visual information in posture control. As a result, the integration of vestibular and visual consequences on postural control is strongly dependent on proprioceptive information from the neck and other body segments [22].

It is widely established that the balance performance may be affected by manipulating the cervical spine's somatosensory system. For example, it has been demonstrated that neck muscular tiredness or vibration may affect one's ability to balance [23, 24]. On the flip side, studies have shown that neck coordination exercises may increase balance performance [25]. As a result, the somatosensory system of the cervical spine has been shown to have a strong connection to postural regulation. Previous treatments have focused on the cervical spine, but the current investigation may have altered not just the intention during task execution but also the brain control and, therefore, the muscle activation.

RECOMMENDATION

It would be useful to undertake a comparable research on patient with neurological disorders such as cervical radiculopathy. Patients with CGH should have an evaluation of their strategies for head stabilization in space because of the potential for a profound influence on postural stability. Patients with CGH might benefit from more research into the impacts of a cervical sensorimotor training program on limits of stability and risk of falling in geriatrics. It is important to discuss how cervical proprioceptive training influences gait evaluation metrics in patient with CGH. Patients with CGH should have their gender included in future investigations that analyses postural stability and electro-physiological alterations. Age's impact on double crush patients' postural stability and electro-physiological alterations should be explored in future research. Proprioceptive training for cervical spine diseases should be the subject of more research. Additional research is required to characterize the sensorimotor function in individuals with neck problems, including active cervical ROM, eye movement control, and symptoms of dizziness and unsteadiness. More research are needed to determine whether or not CGH patients benefit from postural stability, neck proprioception, and electro-physiological changes after receiving cervical proprioceptive training. In order to generalize the results of this research, it would be helpful to repeat it with a larger sample size.

LIMITATIONS

Initially, the study encompassed a restricted group of patients, with just a small number of participants being enlisted, and no individuals withdrew from the study. Second, there was a psychophysiological component experienced by both patient groups during testing and training that was consistent throughout the study but may have continued to the end of the study.

CONCLUSION

Patients with CGH showed a substantial improvement in their pain after participating in a sensorimotor training in conjunction with conventional physical therapy for four weeks. Neck disability showed a great improvement in patients with cervicogenic after a four-week program of

sensorimotor training in conjunction with conventional physical. Dynamic balance and sensorimotor control of the neck improved significantly in individuals with CGH after a four-week program of sensorimotor training in conjunction with conventional physical. A greater improvement in pain, neck disability and dynamic balance was detected in experimental group than in control group. This will add favor for the effect of sensorimotor training in treatment of patient with CGH.

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