Effect of Hamstring Active Release Technique in Cervicogenic Headache

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ABSTRACT

Objectives: To investigate the effect of Hamstring active release technique on pain intensity level, headache intensity, pressure pain threshold, cervical flexion rotation range of motion and Hamstring flexibility in patients with cervicogenic headache. **Methods**: Fifty-six patients with cervicogenic headache participated in the study, aged 25-45 years. Patients were randomized into two groups of 28 individuals each**. Group A** was given conventional physiotherapy only in the form of ultrasonic therapy, stretching as well as strengthening exercises. **Group B** was given conventional physiotherapy and active release technique for Hamstring. Each group was treated three times a week for one month. Pain intensity level, headache intensity, pressure pain threshold of Sub-occipital and Hamstring muscles trigger points, cervical flexion rotation range of motion and Hamstring flexibility were measured by visual analogue scale, the Arabic version of 6-item headache impact test, digital pressure algometry, **CROM** device and straight leg raising test respectively, pre and post-treatment. **Results:** Within group comparison showed significant difference in pain intensity level, headache intensity, pressure pain threshold of Sub-occipital and Hamstring muscles, cervical flexion rotation range of motion and Hamstring flexibility. Between groups comparison showed no significant difference in all variables, pre-study. Where a significant difference in all variables, post study, in favor of **group B** except right and left cervical flexion rotation range of motion. **Conclusion:** Hamstring active release technique improves pain intensity level, headache intensity, pressure pain threshold and Hamstring flexibility, in patients with cervicogenic headache.

1. Introduction

A secondary headache, defined as a cervicogenic headache (CGH), can radiate pain from the cervical spine to the temporal, frontal, as well as occipital regions of the skull (1). According to epidemiological studies, one in five individuals with chronic headaches have a CGH (2). Adults experiencing neck pain are more likely to suffer from headaches. Ipsilateral pain in the neck, shoulder, or arm, as well as limited neck mobility, are symptoms that patients with CGH may have. In most cases, the pain is moderate to severe in intensity, lasts for varying periods of time, and is neither throbbing nor lancinating (3). Day, week, or month-long CGH presentations are possible. The majority of patients additionally have other symptoms such as nausea, vertigo, tinnitus, phonophobia, photophobia, impaired vision, or sleep disorders with their condition (4).

The literature suggests that long-term poor posture might lead to hyperactivity of the Suboccipital muscles, which in turn can transmit the tension to the dura, which is sensitive to pain and ultimately produce chronic headaches (5). It has been proposed that the Suboccipital muscles contribute to both neck pain as well as CGH. Also, muscle atrophy is another potential complication of the pain condition (6). Suboccipital muscles are fascially connected to the dura mater and the C2 vertebra (7). As well as fascia runs throughout the body, it stands to reason that when one area has fascial constriction. It can generate abnormal stress in other areas due to fascial continuity. So, when there is fascial constraint in the suboccipital region, the muscles can't move as freely between the fascial plates in this area (8).

In addition to passing through the dura mater, the Sub-occipital muscles are linked to Hamstring via a neurological pathway called Superficial back line (SBL) (9), which consists of a wide variety of fascia and muscles such as the plantar fascia, Gastrocnemius muscle, Erector Spinae, Hamstring and epi-cranial fascia and so on (10). Curiously, Gerwin (2001) (11) showed that Hamstring tightness and shortening can lead to shoulder and neck pain. This is due to the SBL which extends from the neck all the way to the lower extremities, and the dura and Suboccipital muscle fascia are connected by the soft tissues in the cervical spine (12). Furthermore, whenever the muscles in the neck are stiff, the muscles in the limbs tense up as well (13).

One form of hand on manual therapy has shown to have an effect on the treatment of soft tissue injuries is called active release technique (ART) (14). It used for treating issues related to nerves, fascia, muscles, tendons, as well as ligaments. ART invented by Leahy (1985) entails shortening the muscle and the examiner applies tension by manual contact then the patient actively moves throughout the range of motion of the muscle. ART has an effect on treating soft tissue injuries (15).

There is a shortage of randomized clinical trials investigating the impact of this method on CGH patients, despite its prevalence, declines in quality of life, as well as even reduces physical functioning ratings. The goals of this study were to examine how ART for the Hamstring affected CGH patients' pain intensity level, headache intensity, pressure pain threshold, cervical flexion rotation range of motion (ROM), as well as Hamstring flexibility. It was hypothesized that patients with CGH who received Hamstring ART would have achieved better improvements than control patients who received traditional physical therapy alone.

Materials and Methods

Study design

A randomized, controlled, pre-post measurement single-blinded trial.

Setting

This study was carried-out in the physical therapy outpatient clinic of Miniat El-Nasr Central Hospital in Dakahlia, Egypt from December 2022 to August 2023.

Sample size estimation

G*Power (version 3.0.10) was used for calculating the sample size. The F-test **MANOVA** was chosen for the analysis of variance, both within and between interactions. With a power of 0.80, an α level of 0.05 (2-tailed), as well as an effect size of 0.39, along with two groups as well as two measurements, a minimum of 54 people was needed for the sample, with an additional 6 subjects (10%) dropped out, resulting in a total of 60 subjects. Each group needed 30 participants.

Participants

Sixty patients aged 25-45 years (16), body mass index between 18 and 35 kg/m^2 were diagnosed as CGH, referred from a neurologist and reassessed by the investigator, met the inclusion criteria defined by Sjaastad and Fredriksen (2000) criteria (17): a) one-sided pain that starts in the neck and radiates to the frontotemporal area. b) Pain that gets worse when you move your neck. c) Limited mobility of the cervical vertebrae. d) Tenderness within one or more of the upper cervical spine joints (C1-C3). Positive bilateral straight leg raising test (SLR) for Hamstring muscle below 80°. The following conditions were considered exclusion criteria for the study: a) other forms of headaches. b) Previous history of head or neck trauma or operation. c) Pregnancy. d) Physiotherapy for the head or neck within the last three months. Utilizing computer-generated block randomization, individuals were divided into equal numbers, then they were secretly assigned to groups based on the information on a card inside an envelope that had been numbered and sealed. Four patients refused to participate in the study. So the final sample size was 56. (Figure 1).

Instrumentation

All the variables were measured pre- and post-intervention. The pain intensity level was measured using the Visual Analog Scale (VAS), a brief and very reliable tool with a correlation coefficient of 0.99 (18). Standard VAS components included a 100 mm horizontal line with two opposing labels indicating "no pain" on one end and "worst potential pain" on the other. A vertical line representing the patient's pain level was used to assign a score on the scale (19).

The Arabic version of the 6-item headache impact test (HIT-6) (20) was utilized to measure the severity of headaches and their negative effects on social as well as psychological functioning (21). On a scale from 36 (the lowest possible score) to 78 (the greatest) for six items, it often indicates that the patient's daily life is seriously disrupted by the headache when the score exceeds 59. This test was designed to measure the impact of CGH and it is highly reliable (22).

In order to measure pressure pain threshold (PPT) for Suboccipital as well as Hamstring muscles trigger points, digital pressure algometry was used. While participant lying prone, the examiner administered a pressure of 1 kgf to her/his trigger points of Suboccipital as well as Hamstring muscles. The individual was asked to speak up when the pressure began to cause pain. The measurement was recorded based on the immediate value. After three separate measurements, the mean value was calculated from the experiment's execution on each side. A lower PPT was indicated by an increased average value. With a reliability of 0.89, the digital pressure algometry proved to be a valid as well as reliable approach for measurement of PPT of trigger-point sensitivity (23).

The degree of rotation in C1-C2 was measured using the cervical flexion rotation test (CFRT), which involves gently flexing the patient's head and then passively rotating it in both directions. A CROM device was used for measuring the rotation (24). At 30-second intervals, each measurement was performed three times. Data analysis was conducted using the mean value calculated from the three trials. As far as the CFRT is concerned, a typical range of rotation is 44◦ to each side. Individuals were considered to have a positive test result if their range of motion is less than the normal range of motion by 10◦ (<34◦) (25). For CGH originating in the C1/C2 region, the CFRT is valid (26), and has a discriminative accuracy (27), intra-rater reliability (ICC=0.84-0.89), as well as inter-rater reliability (ICC=0.93) (28).

The Hamstring flexibility was measured using the straight leg raising test SLR. The participant was placed in a supine position, the examiner held her/his calcaneus using one hand and lifting one leg and the other hand fixed the knee in order to ensure that the individual's knee doesn't bent. Universal goniometer (29) was used for measuring to record the passive SLR test three times for each limb. This test is valid and highly reliable (0.94) (30).

Interventions

The participants of the study were assigned into two groups randomly: **Group A** (n= 28) was treated with conventional physiotherapy that included Ultrasound therapy for 5 minutes for each muscle, 1MHz at 1.0 watts/ cm^2 intensity for Rectus capitis posterior minor as it was a deep muscle and 3MHz at 1.0 watts/cm^2 intensity for upper Trapezius and Sternocleidomastoid as they were a superficial muscles (31), Stretching exercises for Sternocleidomastoid , upper fibers of Trapezius, Levator Scapulae, Scalenes, Suboccipitals in addition to Pectoralis minor and major (32) (Hold for 15 seconds, repeat 3 times) and Strengthening exercises for deep neck flexors (Longus capitus and Longus colli muscles) Isometric exercise-(Self resistance) (33). Group B (n= 28) was treated with conventional physiotherapy in addition to ART for Hamstring muscle. This technique was applied while the patient lay in prone position on the treatment table, feet dangling off the edge, knee bent to shorten the Hamstring. Next, the examiner manually palpated the Hamstring muscles to feel their texture and determine where the tightness could be felt. After applying longitudinal stress to the individual's Hamstring bellies, the examiner next had the participant extend his knee in accordance with the ART technique. Repetitions are five times side by side (34). Each subject received 45 minutes' treatment on three separate occasions weekly for four weeks (35).

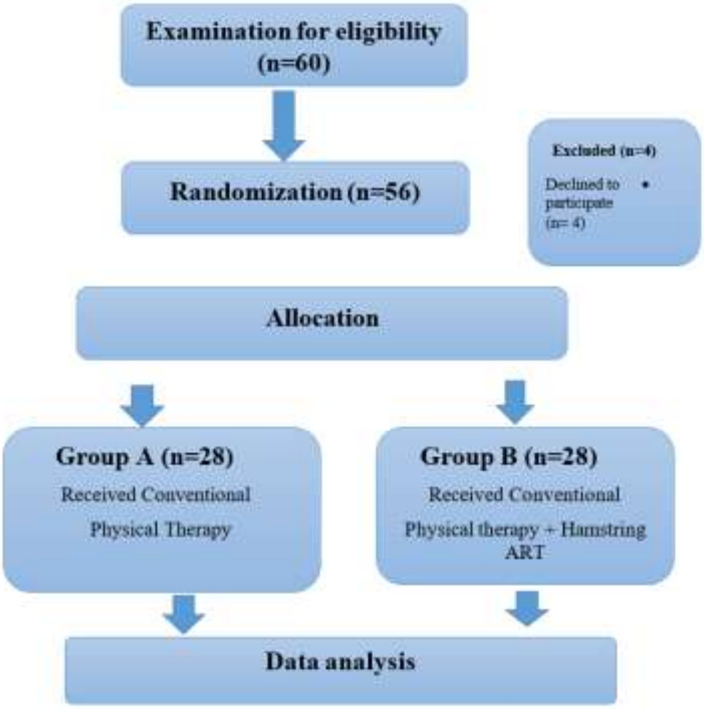

Figure (1). Flow chart of experimental procedure

Data analysis

Descriptive statistics was used to determine mean and **SD** in each group. Descriptive statistics and independent t-test were done to calculate the mean age (years), weight **(Kg)**, height **(cm)**, and **(BMI) (kg/m^2)** of the two groups. Test of Chi squared was performed for evaluation of allocation of sex among groups. In advance of analysis, test of Shapiro-Wilk was employed to check the data normality. Variance's homogeneity test of Leaven was performed to evaluate among groups homogeneity which revealed normally distributed data with variance homogeneity. Boxplot showed no data outliers. **MANOVA** of mixed 2 x 2 design was carried out to examine the impact of treatment (between groups), time (pre versus post) besides the interaction impact on mean values of pain intensity, headache intensity, **PPT**, cervical flexion rotation **ROM** and Hamstring flexibility. All statistical tests were set at a significance threshold of $p < 0.05$. All statistical tests were conducted using version 20 of the statistical program for social studies **(SPSS)** for windows **(IBM SPSS, Chicago, IL, USA).**

Results

Participants Characteristics

Between groups comparison, there was No significant difference in mean values of age, sex height, weight and **BMI (p>0.05, Table 1)**.

Within group comparison

Post study, there was a statistically significant difference in pain intensity level, headache intensity, **PPT** of Suboccipital and Hamstring muscles trigger points, flexion rotation **ROM** and Hamstring flexibility favoring **group B (Table 2,3,4)**.

Between groups comparison

Post study, there was a statistically significant difference in pain intensity level, headache intensity, **PPT** of suboccipital and Hamstring muscles trigger points and Hamstring flexibility post study in favor of **group B**. Also, no statistically significant difference has been detected of flexion rotation **ROM** post study **(Table 5)**.

Table (1): Descriptive statistics and ANOVA, chi square for subject characteristics of the two groups.

	Group A	Group B	t-value	p-value
Age (years)	35.82±6.15	34.82±5.57	0.638	0.526
Height (cm)	161.39±5.36	161.36±6.76	0.022	0.983
Weight (kg)	78.57±11.78	79.39±9.10	-0.292	0.771
BMI (kg/m^2)	30.01±4.03	30.24±3.03	-0.244	0.808
Sex Males **Females**	1 (3.6%) 27 (96.4%)	1 (3.6%) 27 (96.4%)	$\chi^2 = 0$	1

Data represented as mean ±SD or number (percentage), $\chi^{2:}$ Chi squared value

Table (2): Descriptive statistics and 2×2mixed MANOVA design for pain intensity between groups at various periods of measuring.

Pain intensity (cm)	Group A	Group B	F value	p-value	η^2
Pre-study	6.76±0.96	7.19± 0.88	3.04	0.087	0.053
Post study	5.06±0.98	2.53±0.97	94.33	0.001*	0.636
MD (95%CI)	1.7(1.3,2.1)	4.66 (4.2, 5.1)			
% of change	25.1%	64.8%			
Multiple comparisons pair wisely between pre and post study values for pain intensity of both groups					
	Group A	**Group B**			
F-value	45.01	338.3			
p-value	0.001*	0.001*			

*Significant at alpha level <0.05; p-value: Probability value; F-value: F- statistics; CI, Confidence interval; η2, eta squared

Table (3): Descriptive statistics and 2×2mixed MANOVA design for headache intensity between groups at various periods of measuring.

Headache intensity	Group A	Group B	F value	p-value	η^2
Pre-study	61.3±6.2	63.4± 5.3	1.91	0.172	0.034

Post study	55.6±6.7	42.9±7.7	34	0.001*	0.443
MD (95%CI)	5.7 (3.5, 7.9)	20.5 (18.3, 22.7)			
% of change	9.3%	32.3%			
Multiple comparisons pair wisely between pre and post study values for headache intensity of both groups					
	Group A	**Group B**			
F-value	10.5	137			
p-value	0.002*	0.001*			

*****Significant at alpha level <0.05; p-value: Probability value; F-value: F- statistics; CI, Confidence interval; η2, eta squared

Table (4): Descriptive statistics and 2×2mixed MANOVA design for Hamstring flexibility between groups at various periods of measuring.

Hamstring flexibility (degrees)	**Right**					**Left**				
	Group A	**Group B**	**f-value**	**p-value**	η^2	**Group A**	**Group B**	**f-value**	**p-value**	η^2
Pre-study	55.6±10.96	57.24±9.12	0.367	0.547	0.007	59.68±11.89	57.1±11.85	0.66	0.420	0.012
Post study	58.5±11.86	78.97±11.56	42.6	0.001*	0.441	61.2±11.42	82.17±15	34.65	0.001*	0.391
MD (95% CI)	-2.9 (-4.9, -1)	-21.73 (-23.7, -19)				-1.52 (- 3.9, 0.9)	-25.07 (-27.5, -22.6)			
% of change	5.2%	38%				2.5%	43.9%			

Multiple comparisons pair wisely between pre and post study values for Hamstring flexibility for both groups

	Right		**Left**	
	Group A	**Group B**	**Group A**	**Group B**
F-value	1	55.3	0.20	55.2
p-value	0.319	0.001*	0.654	0.001*

*Significant at alpha level <0.05; p-value: Probability value; F-value: F- statistics; CI, Confidence interval; η2, eta squared

Table (5): Descriptive statistics and 2×2mixed MANOVA design for flexion rotation ROM between **groups at various periods of measuring.**

flexion rotation ROM (degrees)	**Right**					**Left**				
	Group A	**Group B**	**f-value**	**p-value**	η^2	**Group A**	**Group B**	**f-value**	**p-value**	η^2
Pre-study	25.4±4.29	24.55± 4	0.612	0.437	0.011	25.58±4.27	24.37±3.2	1.43	0.236	0.026
Post study	27.3±4.37	26.95±4.23	0.097	0.757	0.002	27.26±4.56	26.59±3.65	0.370	0.545	0.007
MD (95%CI)	-1.9 (-2.4, -1.3)	-2.4 (-2.9, -1.9)				-1.68 (-2.4, -1)	-2.22 (-2.9, -1.5)			
% of change	7.5%	9.8%				6.6%	9.1%			

Multiple comparisons pair wisely between pre and post study values for flexion rotation ROM for both groups

	Right		***Left***	
	Group A	**Group B**	**Group A**	**Group B**
F-value	*2.8*	*4.52*	*2.54*	*4.42*
p-value	0.001*	0.001*	0.001*	0.001*

*Significant at alpha level <0.05; p-value: Probability value; F-value: F- statistics; CI, Confidence interval; η^2, eta squared

Discussion

The purpose of the study was to identify the effect of Hamstring active release technique on pain intensity level, headache intensity, PPT, cervical flexion rotation ROM and Hamstring flexibility in cervicogenic headache patients. In our study participants were assigned into two groups randomly, group A had traditional physiotherapy and group B had traditional physiotherapy in addition to Hamstring ART, 3 sessions a week for one month.

The findings of this study revealed that treatment with ART, for the Hamstring, has clinical importance for pain intensity level, headache intensity, PPT, and Hamstring flexibility. This could be attributed to the known effect of ART on improving soft tissue and fascial flexibility. In our study ART conducted directly on Hamstring muscle and not on cervical region, so it is suggested that if ART is done on cervical region, there may be an improvement in cervical flexion rotation ROM.

Consistent with our findings, Kwon et al. (36) published their findings. Kwon investigated whether or not Hamstring relaxation program might alleviate tension headache symptoms. The average headache effect test score and the VAS score both reduced worthy. Both the mean PPT as well as the SLR test results showed a notable improvement following the Hamstring relaxation program. In the present study, results showed that PPT of the Sub-occipital as well as Hamstring muscles trigger points significantly increased. Also pain intensity and headache severity considerably decreased. Tissue adhesions as well as fibrosis are contributors to the formation of tissue restriction. Similar to other types of soft tissue techniques, the purpose of ART is to eliminate adhesions, which in turn reduces tissue tension and ultimately ends the accumulated injury cycle. This is achieved by stretching the tissue from its shortened to its fully extended position whereas the contact hand applies tension longitudinally across the fibers of the soft tissue (32).

Surprisingly a prior study found that Hamstring hypertonicity and tightness can lead to pain in the neck and shoulders (11). So our treatment program focusses on releasing tension in the Hamstring and posterior fascia which helped to alleviate headache-related neck muscles tension.

Consistent with previous research, Khan et al. (37) found that just one session of ART was more effective than muscle energy technique in improving Hamstring flexibility as well as ROM in individuals with Hamstring tightness.

We found similar results to those of Lee and Nam (38), who compared the impact of ART versus myofascial release technique on pain, dysfunction, Oswestry Disability Index scores, as well as pelvic asymmetry among individuals suffering from chronic low back pain. The authors found that ART effectively reduced pain and dysfunction and improved pelvic tilt as well as rotation greater than myofascial release did.

There was a great improvement in the SLR test scores between pre- and post-intervention periods. This happens because the SBL that links the cervical region to the lower extremities relaxes. The soft tissue of cervical region connects the dura mater along with Suboccipital muscle fascia, so it's likely that reducing the tone of the Suboccipital muscles (passively, through fascial treatment, or through active movements) reduces the tone of the knee flexors (Hamstring muscle), improve the amplitude of hip flexion, and raise the SLR test score (39).

The findings are supported by Cho et al. who found that myofascial release of the Suboccipital muscles could enhance Hamstring flexibility. This could be due to the fact that the SBL was relaxed when the Suboccipital muscles were relaxed. The Suboccipital muscles are important proprioceptor monitors that play a significant role in regulating head posture (9).

In addition, research by Cruz-montecinos et al. (40) supports the idea of fascial connection in the lower extremities and the cervical area. Finally, the study showed historic improvement of deep fascia utilizing the automated tracking method. These findings point to the possibility of myofascial connections between the lower extremities and the cervical area.

Mistry et al. (41) found no difference in Hamstring flexibility between ART and (PNF) (modified hold-relax) in 30 individuals with chronic low back pain, which contradicts our findings. After comparing ART and PNF (modified hold relax), they found that PNF improved Hamstring flexibility more significantly.

The opposite was shown by Kmiecik et al. (41) who over a period of four weeks, contrasted the impact of Graston Technique and ART on Hamstring flexibility. Graston Technique outperforms ART in terms of efficiency and consistency in improving scar tissue.

Future studies are necessary for the application of ART on cervical region that may improve cervical flexion rotation ROM. Further studies also are needed to determine what other muscles could be affected in the course of superficial back line in relation to the upper limb or lower limb or to the back muscles.

Study limitations

No limitations.

Conclusion

Based on results of this study, it was concluded that Hamstring **ART** has improved and has clinical importance on pain intensity level, headache intensity, pressure pain threshold and Hamstring flexibility in patients with cervicogenic headache.

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