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The effect of Sahrmann's approach on headache and stability indices in patients with chronic cervicogenic headache: a single-blind clinical trial

Fateme Ghiasi[1], Elahe Moshfeghi Rad2, Mohammad Hoseinifar*[3]

[1]Assistant Professor, Rehabilitation Sciences Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.

[2]MS.c. P. T., Zahedan University of Medical Sciences, Zahedan, Iran.

[3]Assistant Professor, Rehabilitation Sciences Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.

*Correspondence: Mohammad Hoseinifar

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ABSTRACT

Background and purpose: Cervicogenic headache is a type of secondary headache that is caused due to a disturbance in the structures of the cervical region. Most of the studies have investigated the effect of neck manipulation and mobilization for the treatment of cervicogenic headache, and the effects of adjusting the movement pattern have not been discussed. The purpose of this study was investigating the effect of Sahrmann's approach on headache and stability indices of patients with chronic cervicogenic headache.

Materials and methods: In this single blind clinical trial study, thirty-two subjects with cervicogenic headache were randomly divided into a Sahrmann exercise group and a physical therapy group. Exercises were conducted three times per week for four weeks. Overall, anterior-posterior and mediolateral stability indices were measured before, after and one month after the intervention with the Biodex stability system. Data were analyzed with multiple ANOVA Repeated measure and Bonferroni tests ($p<0.05$).

Results: Comparison within group showed a significant improvement in headache, disability and stability indices in both groups ($p<0.05$). In the comparison between the groups, a significant difference in headache and disability indices was observed in favor of the Sahrmann group ($p<0.05$).

Conclusion: The results of this study showed that Sahrmann exercises are an effective treatment for reducing headache intensity and improving disability. According to the results of the study, the positive effects of Sahrmann exercise on postural control reactions were shown, so we suggest that in addition to traditional physical therapy, Sahrmann exercise should also be considered in subjects with chronic cervicogenic headache.

Key words: Cervicogenic Headache, Biodex Stability System, Sahrmann Exercises.

INTRODUCTION

The World Health Organization has classified headache as one of the ten most debilitating diseases worldwide (1) . One of the most common types of headache is cervicogenic headache, which is associated with cervical dysfunction (2). Different factors are involved in the occurrence of cervicogenic headache syndrome(3).. For this reason, various researches have investigated different treatments. Among the treatments offered for cervicogenic headache, physical therapy treatments include the use of heat modalities, ultrasound, stretching exercises and therapeutic exercise. These treatments may provide temporary pain relief. In order to be more effective, the emphasis of rehabilitation methods should be on correcting the posture, and the upper cervical dysfunction and improving the muscle strength (4). In general, the change in the ideal alignment and as a result the change in the center of gravity causes more involvement of the pastural muscles and pressure on the joints(5). According to Sahrmann's approach, which is based on movement and posture correction, in people with cervicogenic headache, the extension of the upper neck area is more than usual, and these people also have muscle imbalance and distribution in alignment of head, neck and scapula. (6). In addition, considering that studies have shown that the deep flexor muscles are less active in people with cervicogenic headache(7). Also, the deviation from the normal alignment causes a defect in the sensitivity of the muscle spindle, followed by a defect in the sense of proprioception(8).. In addition, factors such as effusion, pain and muscle fatigue can also lead to changes in proprioception (9, 10). Change in proprioception has a negative effect on movement control feedbacks and muscle tone regulation mechanisms, resulting in postural instability and increased postural distribution (11).

Hass et al. (2010), Donning et al. (2016) showed that the neck and thoracic manipulation can improve the symptoms of patients with cervicogenic headache (15,16). Jull et al. (2002) founded that therapeutic exercise and manipulation can reduce the symptoms of neck headache and its effects will be continuous .(12) Few studies investigated the effects of resistance and endurance exercise therapy on these patients. The results of these studies showed that all exercises reduced intensity of headache (13). Salva et al. (2019) investigated the effect of deep neck flexor muscle strengthening exercises in patients with cervicogenic headache (19). Mc Donnell et al. (2005), in a case report study, treated a 46-year-old man based on Sahrmann's approach. Their interventions reduced the frequency of headache, intensity of headache, increased range of motion of the upper neck region, improved the alignment of the scapula, and increased the strength of the scapulothoracic muscles (14).

In summary, some of studies have examined the effects of passive maneuvers such as mobilization and especially manipulation (15-20). A number of these studies have investigated the effects of increasing the strength of deep neck flexor muscles (7, 21). Some studies have investigated the effects of strengthening the muscles of the upper limb, upper neck and cervicoscapula, and some have compared the effect of the therapeutic exercise group with manual therapy (12-15, 22). Overall, the results of the relevant studies suggested that exercises could be effective in cervicogenic headache. However, number of studies that have examined effects of Sahrmann's approach on specific cervicogenic headache are limited. In addition of few numbers of studies, it is difficult to make conclusion about effectiveness of Sahrmann's approach in the patients with cervicogenic headache due to low quality of studies and variations in methods. It indicates that the clinicians need to conduct more studies in this field. Thus, the aim of present study was the effect of Sahrmann's approach on headache and stability indices in patients with chronic cervicogenic headache.

Methods

This study was a single blind randomized controlled trial. Thirty-two patients with chronic cervicogenic headache were voluntarily participated in this study. The patients were divided into two groups by simple non-probability sampling method. The medical ethics committee at the Zahedan University of Medical Sciences (ZUMS) approved the study ethics and issued the ethics certification number as #IR.ZUMS.REC.1401.165. It was also registered with the region’s Clinical Trials Registry (IRCT20160531028186N6). All participants signed written informed consent form before starting trial.

Inclusion Criteria

Inclusion criteria were included men and women aged between 18 and 65 years, with extension rotation syndrome and extension syndrome according to sahrmann's approach(6) , at least 5 of the CHISG diagnostic criteria (23), Current headache of at least 3 months' duration in the past year, no history of fracture or structural abnormalities, no history of dizziness and head trauma. Also, the patients had no history of progressive rheumatic or neurological diseases, long-term use of corticosteroids, accident, whiplash injury, malignancy, and pregnancy (16).

Exclusion Criteria

Exclusion criteria were included inflammation in neck, receiving other treatment during the research, unwillingness to continue treatment, incomplete treatment, taking painkillers, using sedatives or alcohol 48 hours before the starting time, Intensification of symptoms during treatment (18, 24).

Sample Size

The sample size was determined based on a pilot study. Ten patients with the inclusion criteria were divided randomly into two equal groups, and the main part of study was conducted on them. The means and SDs for the parameters from this pilot study, with α= 0.05 and 90% power were applied to calculate the sample size.

$n= (Z_{1-\alpha/2} + Z_{1-\beta})^2 (S_1^2+S_2^2)/ (\mu_1-\mu_2)^2$

$Z_{1-\alpha/2}= 1.96$

$Z_{1-\beta}= 1.28$

According to the results of the pilot study and the formula stated, the sample size in each group was 16 patients.

The sampling method was the simple, non-probabilistic sampling method and from the available population. The participants will then be allocated randomly to two intervention groups, the traditional group and the sahrmann exercise group. Randomization would be performed using random number sequence.The physiotherapist who evaluated the patients, measured the outcomes, and analyzed the data was blinded about the groups.

Procedure

The initial clinical examinations were performed by demographic information, patient history and clinical tests including sahrmann test (6). and CHISG diagnostic criteria to differential diagnosis of cervicogenic Headache (23). Then, the patients were selected to enter the study by examining the inclusion and exclusion criteria.

Pain intensity

The VAS (Visual Analogue Scale) of McGill Short Questionnaire was used to evaluate the intensity of pain. The VAS is a 100-mm, non-graded horizontal line with fixed boundaries from no pain to worst possible pain, on which the patient marks his/her pain severity(25).

Disability index

NDI and HDI Questionnaires were used to obtain neck disability level of the patients. The score zero in this questionnaire indicates a lack of problem and as this score goes up, it indicates an increase in disability level(26, 27).

Stability indices

In this study, stability indices were measured using the Biodex SD stability system (Stability System SD 950-304, model SW45-30D-E6N, Biodex Medical System, Inc., New York, USA).

The Biodex system consists of a circular moving desk with a diameter of 55 cm, which is placed at a height of 20 cm above the ground inside the body of the equipment. This desk can tilt in different directions up to 20 degrees relative to the horizon plane. The overall stability index shows the variance in plate deviation from the horizontal plane. The anteroposterior and mediolateral indices show the deviation of the plate from the horizontal position in the sagittal and frontal planes, respectively. The indices' scores show the deviation from the horizontal position, so the lower scores indicate better balance (28, 29). The difficulty level is also adjustable, meaning the system can change the stiffness from 1 (least stable) to 12 (most stable).

The subjects stood on the balance board without shoes or stockings. The right heel was placed at the intersection of lines E and 9. The left heel was placed on the intersection of lines F and 12. The feet were 20 degrees out of alignment. The hands were laid one across the other on the thorax. To measure dynamic stability indices in the two-leg position, subjects at a stability level of 8 and 5 were tested with open and closed eyes. Each test lasted 20 seconds and was repeated three times, and the rest time was selected to be 10 seconds. The parameters of the overall balance index, anteroposterior stability index, and mediolateral stability index were recorded.

Intervention

The patients were randomly divided into two groups: the traditional group and the sahrmann exercise group. The patients in both groups received traditional physical therapy treatment including TENS and hot pack (100 Hz and 50 microseconds , 25min) and ultrasound(5min) (28, 29).

In the Sahrmann exercise group, in addition to receiving TENS, hot packs and ultrasound, the patient was trained by functional exercises based on sahrmann approach. Extension-rotation syndrome exercises include, neck Sitting with back to wall performing cervical rotation, Supine active cervical rotation, facing wall arms supported-active cervical rotation and Quadruped active cervical rotation. Extension syndrome exercises include Sitting with back to the wall-capital flexion, Strengthening the intrinsic cervical spine flexors in supine, Strengthening the intrinsic cervical spine extensors in prone, sitting with back to wall-shoulder abduction, sitting with back to wall performing shoulder flexion and wall slides (facing the wall-shoulder flexion). Each exercise was repeated in 3 series and 10 times in each series. Exercises were performed for 35 minutes in each session. The number of treatment sessions was 12, three days a week for four weeks. All exercises were performed in each session under the supervision of a physiotherapist (6, 14, 24).

Data Analysis

The results were presented as mean values and standard deviations (SD). Criterion of significancy was set as $p<0.05$. Data analysis was performed with SPSS version 27. The assumption of a normal distribution was assessed using the Shapiro-Wilk test. The assumption of equality of variances was evaluated using Levene's test. The Mixed model repeated measure ANOVA and Bonferroni correction were used for within- and between-group comparisons.

Results

Sixty-seven people were nominated for this study and 37 of these patients were divided into two groups: Sahrmann exercise group and traditional physical therapy group (Figure 1). Figure 2 presents the recruitment strategy and experimental plan. Ultimately, 32 subjects finished the study procedure. Thirty of them were not eligible based upon the inclusion and exclusion criteria. Two subjects from the Sahrmann exercise group and three subjects from traditional physical therapy group left the study because of personal problems, unwillingness to continue treatment and incomplete treatment or reasons unrelated to the investigation. The flowchart of choosing participants in the study is shown in Figure 1.

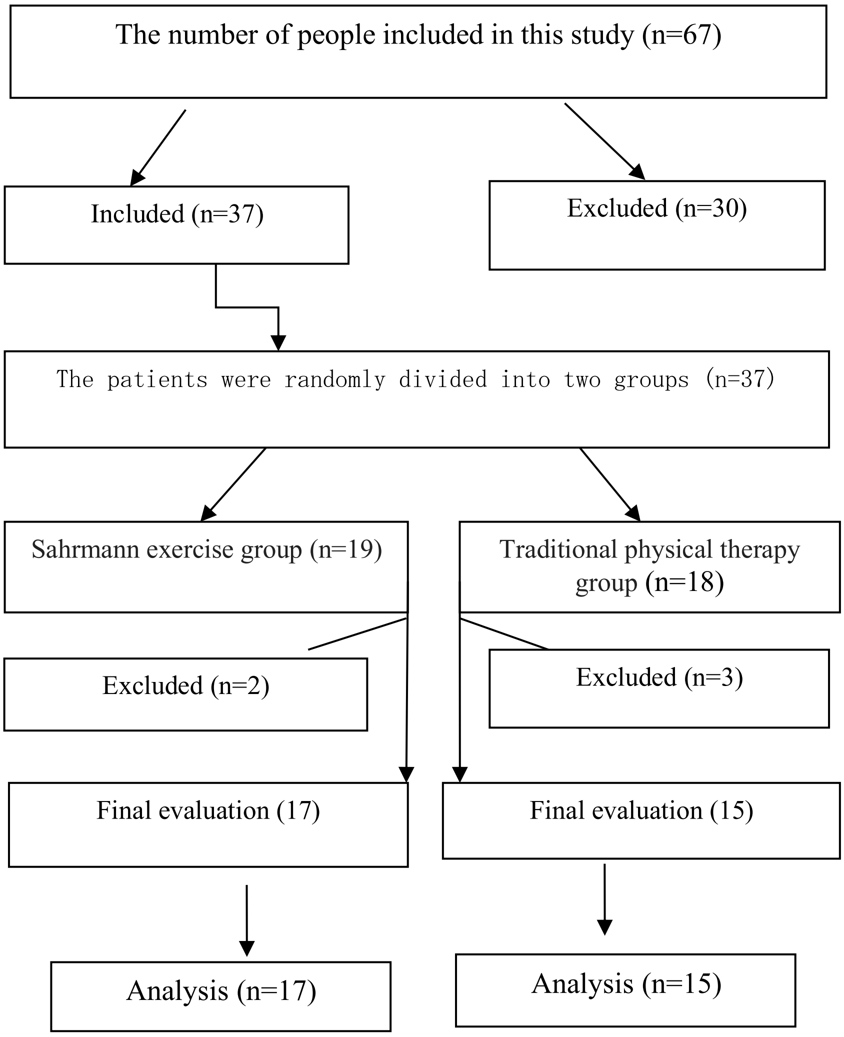

Figure 1_ The clinical trial flow chart

Data were analyzed by SPSS 27 software. The normality of data distribution was examined by the Shapiro-Wilk test. The p-value was considered as less than 0.05. Thus, the statistical tests did not reject the hypothesis of normality and the data was normal (p>0.05).

Table 1 presents the demographic characteristics of patients including age, height, weight, and body mass index. The demographic characteristics of the patients, which were recorded before intervention, were compared between two groups of study. There was no significant difference between two groups (Table 1).

Table 1. Comparison of demographic characteristics between two groups.

Variable	SEG*	TPG*	Sig**
Age (Years)	33.1±8.5	36.8±8.1	0.345
Weight (Kg)	70.09±28.5	64.8±9.4	0.499
Height (Cm)	155.54±30.3	159.47±10.6	0.627
Body Mass Index (BMI) (m2/Kg)	24.65±3.9	24.93±3.4	0.829

*mean ± standard deviation. ** A significance level of less than 0.05. Sahrmann exercise group: SEG

Traditional physical therapy group: TPG

To examine the homogeneous of the samples in two groups before intervention, a t-test was used. The results showed that the samples in two groups were equal and homogeneous (p>0.05).

Within group and between group comparison

Table 2. Within and between groups comparison of the cross-sectional areas of the pain and disability.

Variables	**SEG***				**PTG***				
	Before intervention	After intervention	One month later	Sig **	Before intervention	After intervention	One month later	Sig**	Between group sig**
Headach intensity	7.71 ± 1.5	2.24 ± 1.1	3.88 ± 1.6	0.001	6.67 ± 1.04	4.53 ± 2.0	5.91 ± 2.7	0.001	0.001
Duration of headache	8.06 ± 8.9	2.18 ± 2.7	3.94 ± 3.4	0.001	5.60 ± 2.9	3.13 ± 1.9	4.33 ± 3.3	0.001	0.10
frequency of headache	4.18 ± 2.2	1.35 ± 0.7	1.65 ± 0.9	0.001	4.00 ± 2.0	2.47 ± 1.3	2.80 ± 1.89	0.001	0.01
NDI	23.65 ± 8.3	8.94 ± 4.7	10.65 ± 4.9	0.001	23.27 ± 6.8	14.87 ± 6.8	18.73 ± 7.9	0.001	0.03
HDI	59.18 ± 22.1	22.47 ± 14.5	27.00 ± 15.3	0.001	66.13 ±18.0	45.27 ± 25.8	47.93 ± 20.1	0.001	0.008

*mean ± standard deviation. ** A significance level of less than 0.05 .Sahrmann exercise group: SEG
Traditional physical therapy group: TPG

Table 2 shows the results of between groups and within groups comparisons in general. The changes in all of variables in the both groups during three measurements is significant (p<0.005). Also, the results of the between group comparison showed that all of variables were significant difference between variables (p<0.005), except duration of headache (p>0.005).

The results of the Bonferroni test indicated that the headache intensity variable in the traditional treatment group was significant only immediately after the treatment (p=0.01). In the Sahrmann exercise group, the average changes in headache intensity were significant in all three comparisons (p<0.05). The average headache duration in the traditional treatment group was significant only immediately after the treatment (p=0.03). In the Sahrmann group, immediately after the treatment and one month after the start of the treatment, the changes in headache duration were significant (p<0.05). The frequency of headache in the traditional treatment group was significant immediately after the treatment (p<0.05). In the Sahrmann group, the changes in headache frequency immediately after treatment and one month after treatment were significant (p=0.001). Neck disability index and headache disability index were significant in both treatment groups immediately after intervention and also after one month after treatment (p<0.05).

Table 3. Within and between group comparison of static stability index.

Variables	SEG*				PTG*				
	Before intervention	After intervention	One month later	Sig **	Before intervention	After intervention	One month later	Sig**	Between group sig**
overall stability index - open eyes	0.45± 0.1	0.34± 0.1	0.36± 0.1	0.008	0.50± 0.2	0.40± 0.1	0.45± 0.1	0.008	0.182
A-P stability index – open eyes	0.27± 0.08	0.24± 0.07	0.24± 0.06	0.06	0.34± 0.2	0.26± 0.1	0.28± 0.1	0.06	0.207
M-L stability index – open eyes	0.28± 0.2	0.19± 0.1	0.20± 0.08	0.01	0.27± 0.1	0.22± 0.09	0.22± 0.07	0.01	0.687
overall stability index - close eyes	1.69± 0.5	1.19± 0.5	1.34± 0.6	0.001	1.24± 0.4	1.10± 0.3	1.37± 0.4	0.001	0.279
A-P stability index – close eyes	1.17± 0.5	0.91± 0.5	1.03± 0.5	0.04	0.90± 0.4	0.84± 0.3	1.10± 0.4	0.04	0.525
M-L stability index –close eyes	1.07± 0.6	0.60± 0.4	0.70± 0.4	0.001	0.62± 0.2	0.52± 0.2	0.66± 0.2	0.001	0.137

*mean ± standard deviation. ** A significance level of less than 0.05.
Sahrmann exercise group: SEG Traditional physical therapy group: TPG.
A-P: anterior-posterior M-L: Medial-lateral

Table 3 shows the results of within group and between group comparison for static stability indices in general. In the traditional physiotherapy group, all the static stability indices, except for the anterior-posterior stability index with eyes open, are significant (p<0.05). In the Sahrmann exercise group, all the stability indices except for the overall and anterior-posterior stability index are significant with eyes open (p<0.05). The difference between groups is not significant in any of the static stability indices (p>0.05).

The results of the Bonferroni test show that in the traditional physiotherapy group, the overall stability index with eyes open and the anterior-posterior stability index with eyes open were significant in comparison before and immediately after treatment (p<0.05). Also, in this group, the overall and anterior-posterior stability index with eyes closed are significant in comparison after treatment and one month after treatment (p<0.05). In the Sahrmann exercise group, the changes of all stability indices except anterior-posterior and medial-lateral stability index with open eyes, it was significant in comparison before and immediately after treatment (p<0.05). The changes of general and medial lateral stability indices with closed eyes were significant in comparing before treatment and one month after (p<0.05).

Table 4. Within and between group comparison of dynamic stability index (level8).

Variables	SEG*				PTG*				
	Before intervention	After intervention	One month later	Sig **	Before intervention	After intervention	One month later	Sig **	Between group p sig**
overall stability index - open eyes(level:8)	1.45± 0.5	1.04± 0.4	1.08± 0.5	0.001	1.60± 0.7	1.28± 0.5	1.11± 0.4	0.001	0.44
A-P stability index – open eyes (level:8)	0.95± 0.4	0.74± 0.3	0.76± 0.3	0.001	1.22± 0.6	0.85± 0.3	0.78± 0.4	0.001	0.34
M-L stability index – open eyes (level:8)	0.88± 0.4	0.62± 0.2	0.63± 0.3	0.001	0.86± 0.3	0.68± 0.2	0.74± 0.2	0.001	0.65
overall stability index - close eyes (level:8)	4.04±1.5	3.07±1.0	3.16±1.3	0.000	3.72±1.2	3.48±1.3	3.22±1.3	0.000	0.90
A-P stability index – close eyes (level:8)	2.76± 1.0	2.06± 0.7	2.25± 0.9	0.001	2.66± 0.9	2.36± 0.9	2.28± 0.9	0.001	0.79
M-L stability index –close eyes (level:8)	2.37±1.0	1.87± 0.6	1.82± 0.8	0.001	2.02±0.6	1.94±0.7	1.81± 0.6	0.001	0.72

*mean ± standard deviation. ** A significance level of less than 0.05

Sahrmann exercise group: SEG Traditional physical therapy group: TPG

A-P : anterior-posterior M-L : Medial-lateral

Table 4 show that the average changes of all dynamic stability indices of level 8 in both the physical therapy and Sahrmann exercises groups have become significant during three measurements($p<0.05$). The difference between groups is not significant in any of the dynamic stability indices of this level ($p>0.05$).

The results of the Bonferroni test show that the changes in overall and anterior-posterior stability index with eyes open in the traditional physical therapy group in the period before and after the treatment and also before and one month after the treatment are significant ($p<0.05$). All stability indicators in the Sahrmann exercise group were significant in the period before and after the treatment, as well as before and one month after the treatment ($p<0.05$).

Table 5. Within and between group comparison of dynamic stability index (level 5).

Variables	SEG*				PTG*				
	Before intervention	After intervention	One month later	Sig **	Before intervention	After intervention	One month later	Sig **	Between group p sig**
overall stability	1.83±0.6	1.37±0.6	1.38±0.7	0.001	1.61±0.5	1.40±0.5	1.42±0.5	0.001	0.79

index - open eyes(level:5)									
A-P stability index – open eyes (level:5)	1.28±0.5	0.88±0.4	1.00±0.4	0.0 01	1.20±0.3	0.92±0.3	0.99±0.3	0.00 1	0.88
M-L stability index – open eyes (level:5)	1.04±0.4	0.85±0.3	0.82±0.4	0.0 1	0.94±0.3	0.84±0.4	0.93±0.4	0.01	0.99
overall stability index - close eyes (level:5)	6.51±1.7	4.93±1.9	4.75±2.0 2	0.0 01	6.26±1.8	5.34±2.2	6.68±1.7	0.00 1	0.33
A-P stability index – close eyes (level:5)	4.81±1.3	3.59±1.5	3.71±1.7	0.0 01	4.68±1.5	3.87±1.7	4.80±1.3	0.00 1	0.64
M-L stability index –close eyes (level:5)	3.42±1.0	2.65±1.0	2.42±1.0	0.0 01	3.28±1.0	3.04±1.1	3.29±1.0	0.00 1	0.25

*mean ± standard deviation. ** A significance level of less than 0.05

.Sahrmann exercise group: SEG Traditional physical therapy group: TPG

A-P: anterior-posterior . M-L: Medial-lateral

Table 5 show that the average changes of all stability indices in this level in the both groups are significant during three measurements ($p<0.05$). The difference between groups is not significant in any one ($p>0.05$).

The results of the Bonferroni test show that, in the traditional physiotherapy group, the average changes of the overall stability index with open eyes are significant in the comparison before and immediately after the treatment ($p<0.05$). Also, in this group, the anterior-posterior stability index with open eyes is compared before and immediately after the treatment, as well as the comparison before and One month after the treatment, it is significant ($p<0.05$). In this group, the overall and anterior-posterior stability indices with eyes closed are significant in the comparison before and immediately after the treatment, as well as in the comparison immediately after the treatment and one month later ($p<0.05$). In the Sahrmann exercise group, the average changes of all stability indices were significant in the comparison before and immediately after the treatment, as well as in the comparison before and one month after the treatment, except for the medail lateral stability index with eyes open, which was only in the comparison before and immediately after The treatment is significant ($p<0.05$).

Discussion

The main result of the study showed the positive effects of Sahrmann approach on the pain, disability and dynamic stability indices in patients with chronic cervicogenic headache.

The belief is that correction of factors altering the precision of movement reduces the tissue irritation and thus the painful condition. Sahrmann approach through active movements of the neck and upper limbs and as a result of improving alignment and reducing compensatory movements, can lead to reduce the pressure and load on sensitive structures. Sahrmann exercise will lead to the correction of movement disorders and as a result balance between forces and reduce the pressure on the tissues and will give the damaged tissues a chance to repair. In addition, Sahrmann approach will create appropriate muscle performance, correct muscle imbalance and improve the neuromuscular function. The decrease in load reduces microtrauma to the damaged tissue, and as a result, the tissue will have a chance to recover (30).

It seems that the mentioned mechanisms improve the sense of proprioception by improving postural alignment, and as a result, the patients' balance will improve. Overall, studies have shown that therapeutic exercise can reduce the intensity of pain by reducing systemic inflammation(31) (6, 32, 33). Also, regular therapeutic exercise can lead to an increase in the presence of anti-inflammatory cytokines, in order to reduce pain nerve signals in the central nervous system (31, 34). This process can prevent or even reverse the process of increasing pain(31). In addition, improvement of body alignment and movements leads to improvement of range of motion and as a result, reduces disability in patients (35).

Consistent with our study, in a review study (2022) showed that manual therapy in short term and therapeutic exercises in long term lead to the improvement of symptoms such as pain and disability in patients with cervicogenic headache (36). Also, a review study by Gross et al. showed that the combination of dynamic and static neck exercises and scapulothoracic strength and endurance exercises can significantly improve headache in patients with cervicogenic headache. These exercises can reduce the pressure on the tissues under pressure and improve the pain and disability by correcting the alignment and as a result removing movement impairments (37). By improving the function of neck muscles, reducing fatigue, pain and creating normal posture and proper alignment of joints, Sahrmann exercises can lead to improvement of proprioception and thus stability in patients with cervicogenic headache(11, 38).

The muscles of the neck region, especially in the suboccipital region, have a very high density of muscle spindles, which have a significant impact on the vestibular, visual and proprioceptive systems(39-41). In general, therapeutic exercises can generally affect sense of proprioception (42-45). Rahnama etal. (2023) compared the effects of specific neck muscle training and general neck-shoulder exercises on neck proprioception, pain, and disability in patients with chronic non-specific neck pain. They found specific neck exercise and a general neck-shoulder range of motion exercise could be effective in improving neck proprioception. Therefore, exercises could be recommended based on patient comfort and patients' specific limitations (48). Reddy etal. (2021) showed that subjects who received kinesthetic rehabilitation showed more significant improvements in terms of improved proprioception, decreased pain intensity and disability (49). Lee et al. (2016) suggested that cervical stabilization exercise leads to improvement in accuracy of the joint position sense (50). In particular, treatment strategies in Sahrmann`s approach include obtaining optimal alignment cervical spine; optimal movement patterns of the cervical spine, ensuring no compensatory movements of the cervical spine and optimal length and recruitment of the intrinsic muscles of the cervical spine like suboccipital mucles (6). The result of all these changes is the improvement of muscle spindle activity and neuromuscular function. So, improvement of neuromuscular function is explained to improved cervical proprioception and postural stability (46, 47). Therefore, it can be expected that Sahrmann exercises will improve the postural reaction by improving the movement pattern and proprioception. The results of the study clearly show the better effects of exercise to facilitate the improving pain and function in patients with chronic cervicogenic headache.

Conclusion

The results of this study showed that Sahrmann exercises are an effective treatment for reducing headache intensity, headache frequency and improving disability. Also, this research showed that Sahrmannn exercises are effective in improving most stability indices, especially dynamic stability indices. The present study indicated the importance of intrinsic muscles in controlling posture fluctuations in individuals with functional ankle instability. Therefore, we suggest that Sahrmannn exercises should also be considered in rehabilitation programs for subjects with chronic cervicogenic headache in addition to routine exercises.

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Authors' contributions

All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

Conflict of interest

The authors declared no conflict of interest.

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