Investigating the Relationship among Stability Indices with Severity of Pain, Disability and Duration of Disease in People with Cervicogenic Headache

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Abstract

Introduction: Cervicogenic headache is a secondary headache, whose cervicogenic disorders is known as its background factor. Considering the important role of cervical spine in providing deep-feeling entrances, a change in deep-feeling entrances can lead to disorder in these individuals. The aim of this study was to investigate the relationship between stability and severity of pain, disability and duration of headache in these patients. **Methodology:** In this cross-sectional study, 30 cervicogenic patients, headache index, duration of illness, disability inventory and visual acuity scale were recorded. To measure the stability, stability tests were performed in four standing positions on two extremities with open and closed eyes and with low and high stability level by Biodex stability device. The overall stability index, internal-external index and anterior-posterior index were measured. Pearson correlation test was used to examine the relationship between variables. **Results:** There was a significant relationship between the history of headache reporting and most of the stability indices (p=0.002, r=0.548). There was a significant relationship between the general stability index (p=0.001, r=0.563) and internal-external index and pain severity, and no significant correlation was found between the anterior-posterior index. There was no significant relationship between disability inventory (p=0.727) and headache index (p=0.186) with stability indices. **Conclusion:** With increasing duration of headache and increased pain intensity, stability indices increase, which can indicate a weaker stability in cervicogenic headache patients with longer illness history and more pain intensity.

Keywords: Biodex Stability Device, Cervicogenic Headache, Disability, Duration Of Illness, Pain, Stability

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Introduction

Cervicogenic headache is a kind of secondary headaches that in which the pain of cervicogenic vertebrae musculoskeletal injuries, especially in the upper three segments (1). Cervicogenic skeletal disorders are considered as the underlying cause of cervicogenic headache (2). These individuals are clearly affected by upper neck joints with neck movements, especially flexion-rotation (3). Another feature of this type of headache is muscle dysfunction (2).

Factors that affect state control and stability include sensory information from systems of somatic sensations, visual, and atrial and motor responses from muscle coordination and strength, and range of joint motion (4). Cervical spine plays an important role in providing deep-feeling entrances, which is due to the abundance of cervical mechanoreceptors and central and reflexive links with visual, atrial, and central nervous systems. Also, in the cervical region, especially the sub occipital region, there is high density of muscle spindles (5-7). Zoete in his review article has reviewed a number of articles that studied the instability disorder in patients with cervical pain (8). Other studies have also dealt with the stability in patients with cervical pain (9) and those with primary headaches (migraine, tension headaches), and the outcome of the instability disorder in patients with tensile headaches (10, 11), migraine (11) and cervical pain patients (7, 8). Also, in previous studies and researches, kinaesthetic sensitivity was investigated in headache with cervical cause and the rate of the person's trouble in

returning the head to the initial state of motion was measured (2, 12-14). But none of these studies investigated the relationship between pain, disability and duration of headache with the stability in cervicogenic headache patients. Therefore, the purpose of this study was to investigate the relationship between headache disability questionnaire, headache index, pain and duration of headache with stability indices measured by Biodex stability device.

Materials and Methods

This was a cross-sectional study and after obtaining the consent of the Ethics Committee of the University for confirmation of this study with code (IR.IUMS.REC.1395.9411340011), 30 persons with cervicogenic headache were selected voluntarily with easy sampling method and by the consideration of the inclusion and exclusion criteria, as follows.

Age range of 20-55, Body Mass Index 17-30, having a cervicogenic headache with a minimum history of 3 consecutive months, with recurrence of at least once a month or more (15), not having more than one type of headache, no cervical neurologic problems, or other parts, lack of rheumatoid problems, spondylosis and severe cervical degenerative changes (Grade 4), lack of brain injury, no history of trauma or history of cervical spine surgery, and instability of cervical vertebra, lacking dizziness, lack of uncorrected visual problems, lack of general health problems such as diabetes, pulmonary diseases, metabolic diseases and any history of cancer, non-pregnancy, absence of thoracic scoliosis, neonatal torticollis and lack of visible deformity in other parts of the body such as flatfoot, lack of caffeine consumption in less than 4 hours before the test, lack of alcohol or drug addiction, lack of known psychological disorder, lack of health care service reception in the upper chest region recently or in the past three months and not having acute injury such as ligament tension of the knee and wrist. Exclusion criterion: In the absence of a person's willingness to continue cooperation, he was excluded from the study.

For final confirmation, subjects underwent a skilled physiotherapist under the diagnostic criteria of cervicogenic headache (15). After reviewing the criteria for selecting and removing individuals and obtaining informed consent, people were explained with the details of the project (duration and method of assessment). Firstly, people's demographic information and history of headache was recorded in three groups: less than one year, 1 to 5 years and more than 5 years. Then, the headache index questionnaire, including the sum of headache severity numbers (VAS), frequency (repeat of headache per month), and headache period (per hour) were asked by the researcher. The maximum value of this index is 100 and has been used in the study of Niere (16) and Hall (17) as a tool for measuring headache. Then Headache Disability Inventory (HDI), by Jacobson et al. (18) was completed by individuals. The validity of this questionnaire was reported to be 86% with the repetition of 83%. In the revised version, it has 23 emotional and functional questions to measure disability induced by headache, with three options for responding. In total, zero score was recorded for the lack of disability and score 92 for the highest disability (19).

To measure people's stability ability, balancing tests were performed by Biodex stability device (302-950 made in the US) in four standing positions on two limbs, open and closed eyes on a stable moving surface (changing the degree of stability from level 12 to 9) and low stability (change from level 4 to 1). The Biodex device used has 12 levels of stability, where level 12 provided the lowest instability and level 1 provided the highest instability. For this purpose, the person stood on the force platform without shoe and socks and with comfortable clothes. After recording the status of the subject's feet, the person was asked to keep his standing position for 20 seconds, so that the cursor is held in the middle of concentricity circles on the screen of the device. With the declaration of patient's readiness, each test was performed once for experimental purposes and for adaptation and training, and then the main test was performed in three replications. After performing the software test, the device presented its report in a complete table including the total index of stability, the anterior-posterior stability index, and the internal-external stability index. Higher score showed a weaker stability. In the analysis, the mean score of three replicates was calculated. To prevent fatigue, patients sat on a chair for one minute between each test and to prevent learning from repetition, tests were randomly chosen and performed.

All the stages of evaluation and testing were conducted in Faculty of Rehabilitation Sciences of Iran University of Medical Sciences from February to September 2017. The collected data were analyzed using SPSS 21 software. The normality distribution of data was measured using K-S statistical test. The Pearson correlation coefficient was used to determine the statistical relationship between stability indices and pain variables, headache index, disability questionnaire and duration of the disease. The significance level of the tests was less than 0.05.

Results

A number of 30 cervicogenic headache patients (25 female, 5 male) with an average age of 28.97±9.70 years, height of 164.00±8.73, weight 63.23±12.26 kg, and BMI of 23.29±3.47 participated in this study. 11 patients with a history of more than 5 years, 14 patients 1-5 years, and 5 reported a headache of less than one year. The Kolmogorov-Smirnov test was normal in this study. The mean pain severity of patients based on VAS was 6.33±1.53.

The Pearson correlation coefficient was used to determine the relationship between stability indices in the four stability tests with pain severity and headache history (Table 1).

Table 1. The relationship between stability indices with pain severity and history of headache

		Closed eyes (4-1)			Opened eyes (4-1)			Closed eyes (12-9)			Opened eyes (12-9)		
		MLSI	APSI	OSI	MLSI	APSI	OSI	MLSI	APSI	OSI	MLSI	APSI	OSI
Pain severity	**Correlation coefficient**	0.419	0.257	0.415	0.402	0.224	0.367	0.715	0.071	0.563	0.327	0.311	0.413
	Significance level	0.006	0.171	0.023	0.028	0.234	0.046	0.000	0.710	0.001	0.078	0.094	0.023
Headache history	**Correlation coefficient**	0.498	0.419	0.521	0.312	0.377	0.370	0.466	0.286	0.548	0.301	0.433	0.469
	Significance level	0.005	0.021	0.003	0.094	0.040	0.044	0.009	0.126	0.002	0.106	0.017	0.009

OSI: Overall Stability Index; APSI: Anterior-Posterior Stability Index; MLSI: Interior-exterior Stability Indes;

Table 2. Relationship between overall stability indices with headache disability questionnaire and headache index

		OSI Open (1-4)	OSI close (1-4)	OSI close (9-12)	OSI open (1-4)
Disability questionnaire	**Correlation coefficient**	0.040	0.148	0.127	-0.067
	Significance level	0.833	0.435	0.505	0.727
Headache index	**Correlation coefficient**	0.304	0.414	0.226	0.248
	Significance level	0.103	0.023	0.229	0.186

About the history of headache also, there was a significant relationship between the history of headache with all the stability indices excluding the anterior-posterior index with closed eyes test with stability level of 12 to 9 and open eyes tests with a stability level of (12 to 9) and (4 to 1).

By performing the Pearson correlation test, it became clear that there was no significant relationship between headache disability questionnaire and stability indices using. Also, there was no significant relationship between headache indexes with most stability scores (Table 2).

Findings showed that there is a significant relationship between the overall stability index and pain severity (Figure 2). Also, there is a significant relationship between the internal-external stability index in all tests except for open eye condition with variable stability level from 12 to 9 with pain severity. There was no relationship between the anterior-posterior indices.

Discussion

The results of this study showed that there is direct correlation between duration of headache and increase of overall stability index, anterior-posterior index and internal-external index. In a way that, this correlation in open eyes tests is higher than close eyes tests. Given that the stability is affected by the sensory information obtained from the three sensory, visual and atrial systems, when one of these three (somatic sensations) systems is interrupted, the other two systems act compensatory. But when the eyes are closed, only one system remains for stability control (20). Therefore, a stronger relationship between increased duration of headaches and increased stability indices in close eye tests is not unexpected. Also, the greater relationship between closed eyes tests than open eyes can be attributed to increased visual dependence in these patients. This increase in visual dependence was also reported in the Giacomini study in people with tension-type headache (10). There was no significant relationship between the duration of headache and the internal-external index in open eye tests with the stability level of (12-9) and (4-1); this lack of correlation could also be attributed to the compensatory role of the visual system. There was no relationship between the duration of the disease with the anterior-posterior index of closed eyes test and the stability level of 12 to 9, where this lack of relationship could be due to insufficiency of disturbance conditions due to the high stability level of the device's screen (12-9), so that the disturbance created has not been sufficient so as to disturb the stability of individuals, which indicates a significant relationship with the duration of headache.

Stability can be defined by the ability of the musculoskeletal system to maintain a stable position. Head and neck are the basic systems in maintaining the position and stability (21). Studies in cervicogenic patients, have shown reduction of strength and endurance in the neck muscles and increased activity of surface flexors and decreased deep flexor muscle activity, as well as decreased cross-sectional of semispinalis capitis in the involved side (2, 13, 22) and rectus capitis posterior major muscle and multifidus, as well as increased fat filtration in rectus capitis posterior major and minor muscle, splenius capitis in these individuals (23). On the other hand, in the study of Partland, the relationship between fat filtration in rectus capitis posterior major muscle and weakness of stability control was seen (24). Therefore, it seems that with an increase in the history of headache and subsequently increase in musculoskeletal problems in cervicogenic headache patients, due to the important role of cervical spine in providing deep-feeling entrances, the relationship between duration of onset and reduced functional ability of afferents related to deep-feeling and stability disorder is expected.

Figure 1. Biodex stability device

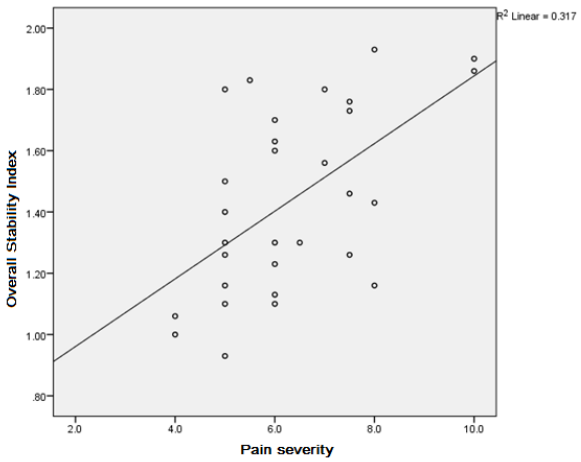

Figure 2. Relationship between pain severity and Overall Stability Index with closed eyes with a change in the level of stability from 12 to 9

Among other findings, is a direct correlation between the overall stability index and external-internal indices with severity of pain in cervicogenic headache patients. Increasing pain messages from pain terminals due to metabolic changes and accumulation of inflammatory substances such as bradykinin and arachidonic acid, and atrophy and lipid filtration in muscles, lead to a decrease or change in deep-feeling afferents to higher centers, which affects the local deep-feeling and also affects the central control mechanism and causes stability disorder (25). Pain can lead to a change in the function of cervical mechanoreceptors, especially muscular spikes, and thus leads to disorder in the cervical deep-feeling function (26).

In the study by Stubbs, the relationship between pain severity and lower stability reliability in elderly patients with musculoskeletal pain was shown (27). In the study of Sterling et al., patients with greater pain severity and disability, mostly caused by whiplash, showed a defect in kinaesthetic sensitivity, while in patients with less pain and disability this disorder was not observed (28). The results of these two studies are consistent with the findings of the present study on the relationship between pain severity and stability.

The results of this study showed that there is no significant relationship between the anterior-posterior stability indices and pain severity. The reason for this can be attributed to stability strategies on sagittal and frontal planes. Two strategies that play a role in controlling the position of the body are the wrist strategy and hip strategies. In standing position, posterior-anterior stability is controlled by the ankle strategy and hip strategy, while the internal-external stability is under the control of hip. The existence of two strategies in the sagittal plane and only the hip strategy in the frontal plane leads to a larger fluctuation in the external direction. Therefore, increased displacement in the external-internal direction in performed tests has led to increase of internal-external stability indices, while in sagittal plane, the two hip and ankle strategies prevent the increase of posterior-anterior fluctuation.

No significant correlation was found between headache disability questionnaire and stability. The lack relationship can be due to the type of questionnaire questions that are more emotional and less effective on stability. On the other hand, this questionnaire is a questionnaire for the assessment of headache disability in all types of headaches and is not specific to cervicogenic headache. But, considering that this questionnaire was only a localized questionnaire of headache disability, it was used in this study. A study with similar to or different results from the present study was not found in available resources.

There was no significant relationship between headache index and stability indices. The target index in the study by Hall and Niere was used to study the effect of interested treatment on parameters of severity, duration and frequency of headache (16, 17). The maximum index number is 100, where the sum of the maximum share of pain severity is 25, frequency 30 and headache period 45. Considering the relationship between pain severity and stability indices and the lack of relationship between headache index and stability indices in this study, the cause can be known as less share of pain severity in this questionnaire.

Due to the lack of studies in this field, further studies are needed. It is suggested that the relationship between pain, disability and duration of the disease be investigated with greater number of samples, more age of most samples, given the mean age of cervicogenic headache involvement (42.9 years), as well as patients with longer duration of cervicogenic headache.

Conclusion

The increase in the duration of headache as well as the increase in pain severity is directly correlated with the increase of stability indices, which can indicate a greater stability of disorder in cervicogenic headache patients with longer history of involvement and more pain severity. Therefore, therapists may be recommended to consider the disability disorder in cervicogenic

headache patients, especially those with higher pain severity and longer history of infection. So that stability exercises are used along with other physiotherapy for their treatment.

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Conflict of interest:
None

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

References

1. Rubio-Ochoa J, Benítez-Martínez J, Lluch E, Santacruz-Zaragozá S, Gómez-Contreras P, Cook C. Physical examination tests for screening and diagnosis of cervicogenic headache: A systematic review. Manual therapy. 2016;21:35-40.
2. Jull G, Amiri M, Bullock-Saxton J, Darnell R, Lander C. Cervical musculoskeletal impairment in frequent intermittent headache. Part 1: Subjects with single headaches. Cephalalgia. 2007;27(7):793-802.
3. Ogince M, Hall T, Robinson K, Blackmore A. The diagnostic validity of the cervical flexion–rotation test in C1/2-related cervicogenic headache. Manual therapy. 2007;12(3):256-62.
4. Palmieri RM, Ingersoll CD, Stone MB, Krause BA. Center-of-pressure parameters used in the assessment of postural control. Journal of Sport Rehabilitation. 2002;11(1):51-66.
5. Boyd-Clark L, Briggs C, Galea M. Muscle spindle distribution, morphology, and density in longus colli and multifidus muscles of the cervical spine. Spine. 2002;27(7):694-701.
6. Kulkarni V, Chandy M, Babu K. Quantitative study of muscle spindles in suboccipital muscles of human foetuses. Neurology India. 2001;49(4):355.
7. Liu J-X, Thornell L-E, Pedrosa-Domellöf F. Muscle spindles in the deep muscles of the human neck: a morphological and immunocytochemical study. Journal of Histochemistry & Cytochemistry. 2003;51(2):175-86.
8. de Zoete RM, Osmotherly PG, Rivett DA, Farrell SF, Snodgrass SJ. Sensorimotor control in individuals with idiopathic neck pain and healthy individuals: a systematic review and meta-analysis. Archives of physical medicine and rehabilitation. 2017;98(6):1257-71.
9. Poole E, Treleaven J, Jull G. The influence of neck pain on balance and gait parameters in community-dwelling elders. Manual therapy. 2008;13(4):317-24.
10. Giacomini P, Alessandrini M, Evangelista M, Napolitano B, Lanciani R, Camaioni D. Impaired postural control in patients affected by tension-type headache. European Journal of Pain. 2004;8(6):579-83.
11. Rossi C, Alberti A, Sarchielli P, Mazzotta G, Capocchi G, Faralli M, et al. Balance disorders in headache patients: evaluation by computerized static stabilometry. Acta neurologica scandinavica. 2005;111(6):407-13.
12. De Hertogh W, Vaes P, Beckwee D, Van Suijlekom H, Duquet W, Van Roy P. Lack of impairment of kinaesthetic sensibility in cervicogenic headache patients. Cephalalgia. 2008;28(4):323-8.
13. Dumas J, Arsenault A, Boudreau G, Magnoux E, Lepage Y, Bellavance A, et al. Physical impairments in cervicogenic headache: traumatic vs. nontraumatic onset. Cephalalgia. 2001;21(9):884-93.
14. Zito G, Jull G, Story I. Clinical tests of musculoskeletal dysfunction in the diagnosis of cervicogenic headache. Manual therapy. 2006;11(2):118-29.
15. Sjaastad O, Fredriksen T, Pfaffenrath V. Cervicogenic headache: diagnostic criteria. Headache: The Journal of Head and Face Pain. 1998;38(6):442-5.
16. Niere K, Robinson P. Determination of manipulative physiotherapy treatment outcome in headache patients. Manual therapy. 1997;2(4):199-205.
17. Hall T, Chan HT, Christensen L, Odenthal B, Wells C, Robinson K. Efficacy of a C1-C2 self-sustained natural apophyseal glide (SNAG) in the management of cervicogenic headache. journal of orthopaedic & sports physical therapy. 2007;37(3):100-7.
18. Jacobson GP, Ramadan NM, Aggarwal SK, Newman CW. The Henry Ford hospital headache disability inventory (HDI). Neurology. 1994;44(5):837-.
19. Sajadinezhad M, Mohammadi N, Ashjazadeh N. The evaluation of psychometric properties of headache disability inventory in the headache patients. 2007.
20. Akbari M, Karimi H, Farahini H, Faghihzadeh S. Balance problems after unilateral lateral ankle sprains. Journal of rehabilitation research and development. 2006;43(7):819.
21. Humphreys BK. Cervical outcome measures: testing for postural stability and balance. Journal of manipulative and physiological therapeutics. 2008;31(7):540-6.
22. Jull GA, O'leary SP, Falla DL. Clinical assessment of the deep cervical flexor muscles: the craniocervical flexion test. Journal of manipulative and physiological therapeutics. 2008;31(7):525-33.
23. Uthaikhup S, Assapun J, Kothan S, Watcharasaksilp K, Elliott JM. Structural changes of the cervical muscles in elder women with cervicogenic headache. Musculoskeletal Science and Practice. 2017;29:1-6.
24. McPartland JM, Brodeur RR, Hallgren RC. Chronic neck pain, standing balance, and suboccipital muscle atrophy--a pilot study. Journal of manipulative and physiological therapeutics. 1997;20(1):24-9.
25. Teng C-C, Chai H, Lai D-M, Wang S-F. Cervicocephalic kinesthetic sensibility in young and middle-aged adults with or without a history of mild neck pain. Manual therapy. 2007;12(1):22-8.
26. Thunberg J, Ljubisavljevic M, Djupsjöbacka M, Johansson H. Effects on the fusimotor-muscle spindle system induced by intramuscular injections of hypertonic saline. Experimental brain research. 2002;142(3):319-26.
27. Stubbs B, Schofield P, Patchay S, Leveille S. Musculoskeletal pain characteristics associated with lower balance confidence in community-dwelling older adults. Physiotherapy. 2016;102(2):152-8.
28. Sterling M, Jull G, Vicenzino B, Kenardy J. Characterization of acute whiplash-associated disorders. Spine. 2004;29(2):182-8.