Original Article

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Effect of Sensorimotor Exercises on Cervicogenic Headaches among Dentists

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Abstract:

Objective: Dentists are prone to cervicogenic headaches due to repetitive trauma to the upper cervical region, primarily caused by prolonged neck bending and rotation during procedures. While the motor aspects of these headaches have been addressed, the sensory components require further investigation. This study aimed to explore the potential of sensorimotor exercises to alleviate pain and prevent recurrence, as well as to determine their effect on cervicogenic headaches among dentists.

Material and Methods: The study was conducted in the outpatient department of Saveetha College of Physiotherapy. A total of 30 participants were recruited for the study based on the inclusion-exclusion criteria and were randomly assigned to the control group, who received ultrasound therapy and motor exercises, and the experimental group, who received sensorimotor exercises along with ultrasound therapy for three days a week on alternate days for 3 weeks. Pressure pain threshold and neck disability were assessed before the commencement of the treatment and after the desired treatment protocol was delivered.

Results: The results of the study showed a mean difference of pressure pain threshold improvement: Experimental (+0.65) and Control (+0.10)=+0.55. Neck Disability Index improvement: Experimental (–4.5) and Control (–1.0)=–3.5 in NDI in the experimental group, which was statistically significant at p-vaue<0.005.

Conclusion: When the sensory issues of cervicogenic headache patients are addressed appropriately, pain and disability are reduced significantly. It can be inferred that any treatment program for cervicogenic headaches should include sensory and motor components in the rehabilitation.

Keywords: Cervical headache, pressure pain threshold, sensorimotor exercises

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Introduction

This emerging medical field has witnessed a rise in ergonomic insults among healthcare professionals, particularly dentists, who report an increasing prevalence of cervicogenic headaches (CGH). This condition is largely attributed to the prolonged bent position of the neck during procedures, especially when accessing the upper molar. Inadequate rest, poor ergonomics, and psychological factors are primary contributors to CGH among dentists[1]. The concentration and precision required in constricted work zones for extended periods have also been identified as key reasons for this increase in India[2,3], where a strong correlation between CGH prevalence and upper crossed syndrome in dentists working over three hours daily in bent postures at least five days a week was found. Consequently, alleviating the burden of CGH among dental professionals is imperative.

Cervicogenic headache is a secondary headache affecting men and women in middle age equally[4]. It is typically characterized by unilateral pain[5], often throbbing, that intensifies with prolonged neck bending or rotation[6]. Additional symptoms may include radiating pain in the shoulders and arms, nausea, and vomiting, although not always present. Pain is frequently localized in the temporal, occipital, frontal, and pre-orbital regions on one side and rarely manifests bilaterally, resembling a tension headache. Thus, distinguishing CGH from tension headaches and migraines is critical[7]. According to the Revised International Headache Society Classification (ICHD-II), CGH diagnosis involves a unilateral headache exacerbated by neck movements, specific head postures[8], or neck pressure[9]. Differential diagnoses must also rule out cranio-cervical trauma and greater occipital nerve block before confirming cervicogenic headache[10]. Globally, CGH affects approximately 0.4% to 2.5% of the population, with a higher prevalence in women during middle age. The estimated occurrence is 35% among the general population[11], particularly in professions involving prolonged forward neck postures. Among dentists, 40.7% were positive for the cervical flexion rotation test[12], and 50.3% reported pectoralis major contracture, unilaterally or bilaterally[13]. Clinical symptoms often include tenderness and pain in the suboccipital region, limited neck range of motion, and disability in the activities of daily living (ADL). Multifactorial manifestations like sensorimotor impairments may lead to altered cervical joint proprioception, reduced postural stability, light-headedness, and a spinning sensation akin to vertigo. Poor head-neck posture awareness and sensations of wobbling in low light, during travel, or in enclosed spaces are commonly reported. Visual disturbances such as photophobia, temporary blindness, blurry vision, and reduced visual fields are additional symptoms observed in many patients. These manifestations contribute to fatigue and difficulty concentrating. Given the significant impact of CGH on professional performance and overall well-being, understanding its management is crucial. Exercise interventions have shown promise in reducing CGH frequency and severity.

While many studies focus on re-educating deep cervical flexors, addressing sensory issues remains underexplored and underutilized in clinical practice. Pulsed ultrasound therapy has been found effective in alleviating headaches, preserving muscle properties, and improving neck range of motion[14]. Suboccipital muscle release post-ultrasound therapy over 12 sessions notably reduces neck disability and enhances cervical rotation[15]. Chin-tuck exercises play a vital role in correcting forward head posture by altering the suboccipital muscles' elastic modulus[16]. Sensorimotor exercises target restoring joint position sense, a fundamental therapeutic approach[17]. These exercises aim to reduce cervical joint position error[18], improve smooth eye pursuit during head movements[19], and enhance gaze stability. Such interventions alleviate the sensory disturbances associated with CGH and improve postural stability and balance[20]. Task-oriented exercises on the cervical spine help integrate proprioceptive input, and the visual input initiates the neuroplasticity of the brain, which facilitates the sensorimotor functions. Dentists are at high risk for cervicogenic headaches due to prolonged neck flexion, awkward postures, and repetitive movements. Their limited ergonomic flexibility makes them more vulnerable compared to other professions, yet research on targeted interventions remains scarce. Studying sensorimotor exercises in this group can help improve their musculoskeletal health, work efficiency, and career longevity. This study aimed to evaluate the effectiveness of sensorimotor exercises in reducing pain and neck disability in dentists affected by CGH.

Material and Methods

Methods

Two postgraduate students and one clinical therapist working in the Outpatient Department of Physiotherapy were the assessors of the study. They were not told of the group allocation of the participants. Double blinding was maintained; neither the assessor nor the participant knew the group to which they had been allocated. The study is a randomized controlled trial with a control group and an experimental group, each consisting of 15 participants, with a 1:1 allocation ratio. All participants were briefed about the nature and purpose of the study, and informed consent was obtained. The flow chart of the study is shown in Figure 1. The study was conducted in the outpatient department of Saveetha College of Physiotherapy. Participants were dentists who visited the Outpatient Department with a history of headaches. A questionnaire survey was also conducted among dental professionals through their association.

Dental professionals aged 30 to 40 years, of both genders, with at least 5 years of clinical practice, were included in the study. Participants with a history of 2 to 3 headache episodes in the past 3 months, aggravated by prolonged bending activities like root canal treatments, were selected. Participants with a history of high or uncontrolled blood pressure, history of whiplash injuries or sinusitis, migraine headaches, obliteration of cervical lordosis, and those who had vision problems or hearing impairment were excluded from the study. Participants who were under any kind of antidepressant drug were excluded from the study. Double blinding was done, and either the assessor or the participants knew of the group they were allocated. The sample size of the current study was 30 participants and was estimated using G Power3.0 software.

Meterials

The outcomes of the study were pain and neck disability measured through the pressure pain threshold (PPT) and Neck Disability Index (NDI). PPT was measured in kilopascals using an algometer[21] over the suboccipital muscles on both sides, with the average taken as the final score. NDI is a subjective questionnaire involving various ADLs[22]. The driving question was excluded to maintain uniformity in scoring among participants.

The participants were from the OPD of various neuro-physicians' offices, and a survey questionnaire was circulated among dental professionals. Of the 42 enrolled, 12 were excluded based on the inclusion-exclusion criteria, and 30 participants were finalized for the study. The baseline characteristics, including age, gender, height, weight, BMI, and illness duration, were recorded, and pre-test assessments for pressure pain threshold (PPT) and neck disability were scored.

The participants were randomly assigned to either the control or experimental group. The control group received ultrasound therapy in pulsed form with a predetermined dosage for 9 days on alternate days for 3 weeks. In the second week, the protocol combined ultrasound therapy with motor exercises for the neck, including craniocervical flexion and deep cervical extensor exercises[23]. The exercises were performed in a supine-to-prone position, with each exercise repeated for 10 RM with 3 sets, based on the FIIT principle[24]. The experimental group received ultrasound therapy and sensorimotor exercises three times a week on alternate days for 3 weeks. These exercises were similar to those of the control group, but also included sensory rehab exercises based on the FIIT principle with 10 RM and 3 sets. The participants tracked a laser pointer on a screen while seated, returning the head to a neutral position. If symptoms like dizziness or nausea occurred, the session was stopped. Exercises for eye movement with head movement, tandem walking, and single-leg stance were also performed, progressing to foam after mastering the hard surface. After 3 weeks, the post-test scores were recorded; see Figure 3.

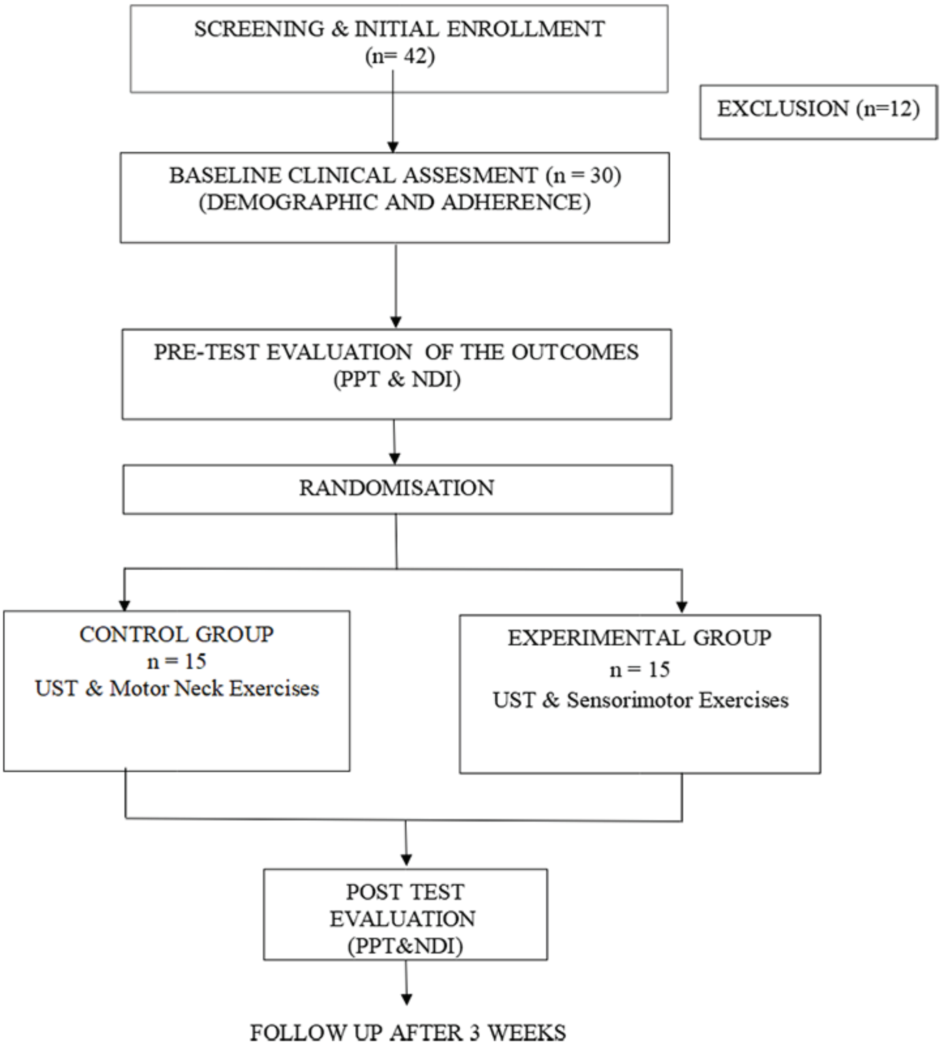

Figure 1 Consort of the study

Results

The statistical analysis was performed using SPSS software version 25. The sample size alone was estimated using G Power software. This was a typo error, which was corrected as suggested by the reviewer. The collected data were subjected to statistical analysis using G Power 3.0 software. The mean and standard deviation were calculated for the descriptive data. As the test involved both the parametric and non-parametric scores, corresponding tests of significance were applied. The within-group analysis of PPT was done by ANOVA, and NDI was done by Wilcoxon tests, and a post hoc test was done using Dunn's test. The between-group analysis of PPT was done through an independent t-test and NDI through the Mann-Whitney test, and a post hoc analysis was done through Dunn's test. The demographic data were subjected to normality using the chi-square analysis.

Results (flow of subjects in the study, dropouts): This randomized controlled trial was carried out for 3 weeks. A total of 42 participants were enrolled in the study. They were screened based on the inclusion and exclusion criteria. Out of these total subjects enrolled, 3 were excluded as they were on antidepressants due to the recurrence of headaches, 2 had whiplash injuries followed by an RTA, 3 had uncontrolled hypertension, and 4 could not give consent for participation in scheduled treatment due to personal reasons. Hence, 30 participants were finalized for the study. The control group and experimental group showed homogeneity in baseline characteristics, that is, age, gender distribution, height, weight, BMI, and duration of illness. No adverse reaction to treatment was reported during the three weeks of scheduled treatment. Also, all participants completed the prescribed treatment schedule, showing a high rate of completion in the study. The demographic data and clinical parameters are displayed in Figure 2 and Table 1.

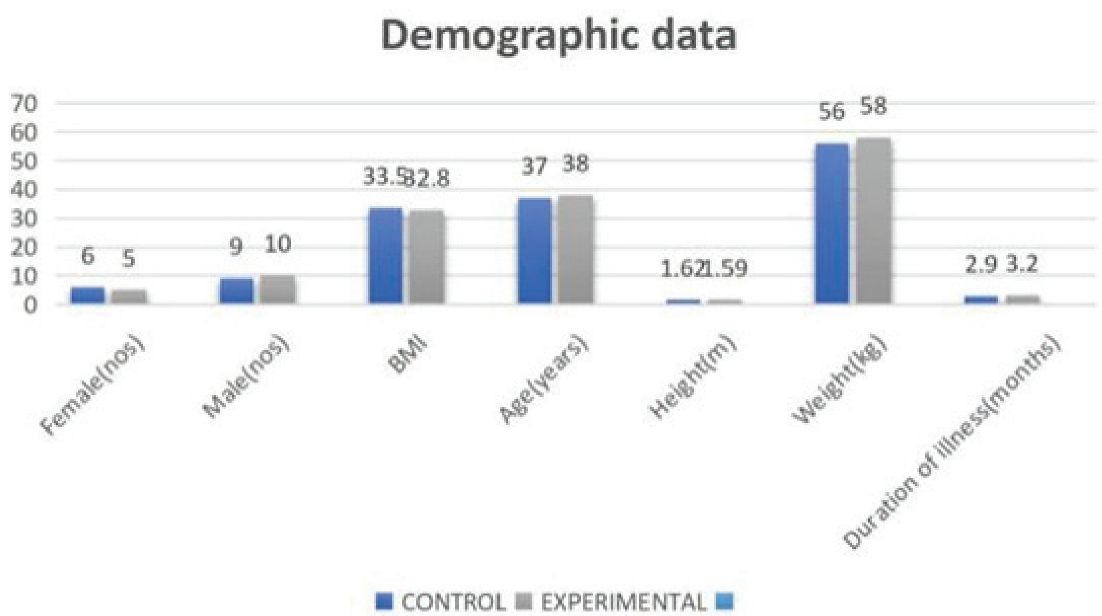

Figure 2 Demographic data of the variables

Chi-square test was done to find the correlation between the variables, which was intended for further expansion of the study. The line is deleted as it is irrelevant to the data analysis of the current study. The distribution normality used in the current study was the Shapiro-Wilk test.

The selection of statistical analysis was undertaken purely by the statistician. And the variable PPT is a parametric score with definite values that were unique for each participant. Hence, it was subjected to ANOVA for within-group and t-test for between-group analysis.

The variable NDI is a non-parametric score, hence it follows the related statistical analysis of the Wilcoxon and Mann-Whitney test for the within-group and between-group analysis, respectively.

Table 1 Demographic data of the participants

Characteristics	Control group	Experimental group
Female	6	5
Male	9	10
Age (years)	37	38
Height (m)	1.62	1.59
Weight (kgs)	56	58
BMI	33.5	32.8
Duration of illness (months)	2.9	3.2

In the tables, though given cumulatively, only the related contents are filled, while the unrelated columns are left vacant. Further, the tabular values highlight the p-value achieved for each test with comparisons to the related significance level rather than the mean and standard deviation. Hence, it is justified.

The primary outcomes of the study were analyzed for both within-group differences and between-group differences. The within-group analysis of PPT showed a significant difference in F-value with p 0.001, which is significant at p-value<0.05. The mean difference of the pre- and post-test of the experimental group revealed a mean difference of 6.27 (1.151), while the control group revealed a mean difference of 1.2 (0.050).

The within-group analysis of NDI yielded Z-values of -2.725 and -3.407 in the control and experimental groups, respectively. The mean difference within the experimental group was higher at 1.967 compared to the control group's mean difference of 0.734. Hence, it is assumed that although both groups performed well, the experimental group was superior to the control group in terms of mean difference. The results of within-group analysis are displayed in Table 2. However, from Table 3 (between-group analysis), it is evident that the experimental group performed well at the end of the intervention in terms of both PPT and NDI. PPT showed a t-test value of 13.679 with a p-value of 0.001, which is significant at p-value<0.05, and NDI had a U value of 77.5 with a Z-score of 1.430 with a p-value of 0.001, which is significant at p-value<0.05.

Table 2 Within-group analysis of the variables

Variable	Test	F	P	Z
PPT	Control Pre& Post	3.310	0.078	-
	Exp Pre & Post	5.022	0.0001*	-
NDI	Control Pre& Post	-	0.0006*	-2.7255
	Exp Pre & Post	-	0.0006*	-3.4078

PPT=Pressure Pain Threshold, NDI=Neck Disability Index, F value- t-test score, z value –Kruskal Wallis score, *p-value<0.05

Table 3 Between-group analysis of the variables

Variables	Group	U	Z	P	t-test
PPT	Control & Exp Pre			0.0001*	-7.222
	Control & Exp Post			0.0001*	-13.679
NDI	Control & Exp Pre	100	0.497	0.617	
	Control & Exp Post	77.5	1.430	0.001*	

PPT=Pressure Pain Threshold, NDI=Neck Disability Index, U value Mann Whitney score, *p-value<0.05

Figure 3 Sensorimotor exercises

Discussion

Cervicogenic headaches have remained a subject of interest in recent years. The attribution of the disease to the healthcare professional is increasing because the medicos are more prone to ergonomic insults despite their knowledge and expertise in the field. While concentrating on their patients' health, they forsake their own health, thus risking their overall well-being. In long-term practice, self-injuries and improper ergonomics result in a poor quality of practice. Hence, this study sheds light on how certain postures affect dental professionals and how cervicogenic headaches are common among them. The study also spots the specific management in reducing the episodes of headaches and lowering the neck disability among dentists who often work in a forward-bent position. The key findings of the study can be summarized in two points: The control group showed significant improvement in neck disability alone, while the improvement in pressure threshold was not appreciable. This can be attributed to the study[25], which highlights the usage of ultrasound therapy in reducing the inflammation of the suboccipital muscles. Due to this, there is a reduction in pain and neck disability in patients with myofascial pain syndrome. The usage of ultrasound therapy in the field of physiotherapy is so common that sometimes the pathomechanics it plays in reducing inflammation and pain are overlooked[26]. While so much evidence is focused on the motor exercises performed for CGH, the sensory component remains unexplored and often neglected. Hence, the study has shed light on both the motor component and the sensory management of CGH for effective reduction in pain and disability of the neck. The motor exercises, especially the cervicoflexion exercise, play a primary role in stabilizing the upper cervical segment and in reducing the nociceptive stimulus, conveyed through the convergence in the upper cervical segment[27]. This is the case in the current study, in which the control group receiving both ultrasound therapy and motor exercises for the neck showed significant improvement in the neck disability index. Research also suggests that the exercises, when performed over a longer duration with the incorporation of static and dynamic exercises, reduce the recurrence of pain in most cases[28]. Not only is the reduction of pain important, but also the recurrence of pain. Hence, any treatment that aims for such a result will have a greater clinical application. Here is where the role of sensorimotor exercises plays a consequential role. The current study shows that the experimental group receiving sensorimotor exercises as an adjunct to ultrasound therapy had a significant difference in improvement in both pressure pain threshold and neck disability. The balance issues in CGH are often neglected and need to be addressed for effective intervention[29]. The study found that 50% of healthy individuals (ages 20-35) showed forward neck posture, regardless of gender, with an angle less than 50 degrees. Future research should explore the impact of occupation, workload, and musculoskeletal issues on cervical angle changes and quality of life[30]. The results of the study are on par with the already existing studies in addressing the sensory issues faced by patients. Realigning head position during random movements is significant for overcoming any light-headedness in CGH. The novelty of the current study lies in the incorporation of sensory exercises along with motor exercises, which aim at reducing pain and improving the range of motion at the neck. These sensory exercises encourage the patient to overcome the avoidance of sports participation or recreational activities, which are usually on a movable platform. Incorporating sensory exercises and addressing the balance issues helps dentists who move around their workspace in chairs with wheels, which is an unstable platform.

It is observed that the sensorimotor exercises play a vital role in regulating the proprioception received from the cervical spine. It is notable that the vestibular receptors, which are located in the base of the skull, are mostly dependent on the movable parts of the cervical spine, especially the upper cervical spine. Hence, any changes in this structure directly influence balance and pain components. Integration of the vestibular components and the visual components enhances the proprioception of the cervical spine.

The major limitations of the study are that the sample size was small and the population was from a specific region. Also, the neck disability index is a subjective tool that scores the outcome measure from the patient's perspective. However, the pressure pain threshold is a measurable and reproducible outcome measure of pain that cannot be overlayed.

Conclusion

The incorporation of sensorimotor exercises along with ultrasound therapy brings about a change in pain and disability among dentists with cervicogenic headaches. As the sensory issues need to be specifically addressed for a better quality of life, these exercises should be embraced in the first-line treatment of cervicogenic headaches.

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Conflict of interest

There was no conflict of interest in the current study.

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