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COMPARATIVE EVALUATION OF OCULOMOTOR RESPONSES IN YOGA AND NON-YOGA

Speech & Hearing

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ABSTRACT

Objective: To evaluate whether yoga practice improves oculomotor function and assess its clinical relevance.**Method:** Sixty yoga practitioners and sixty non-practitioners participated. Oculomotor tests including saccade, smooth pursuit, and optokinetic tests were administered using videonystagmography.**Results:** Yoga practitioners showed significantly better performance, with higher saccadic peak velocity and accuracy, improved smooth pursuit gain, and increased optokinetic slow phase velocity at 40°/sec.**Conclusion:** Enhanced oculomotor responses in yoga practitioners may reflect plasticity within the oculomotor system. These findings support the potential use of yoga as a rehabilitative approach for individuals with vestibular dysfunction.

KEYWORDS

Vestibulo-Ocular Reflex, Eye Movement Measurements, yoga, saccade, velocity

INTRODUCTION

Balance is a composite mechanism involving a set of sensory-motor inputs from the visual, proprioceptive and vestibular system for postural maintenance [1]. Oculomotor examinations may serve as a means to clarify the perception of the brainstem dysfunction as a mutual denominator for the central nervous system (CNS) disturbance. The key role for the evaluation of the central and peripheral oculomotor disorders is determined through video-oculography and caloric stimulation [2]. The vestibulo-ocular reflexes help to keep the gaze steady on a stationary object while the body or head is in motion. Eye motor working relies on a complex CNS system consisting of the cerebellum, brainstem and centres in the cerebral cortex. The vestibular system, in conjunction with the ocular and proprioceptive systems, functions to maintain the equilibrium [3]. The vestibular system reports of exhibiting plasticity which is observed at the level of otolith organs and the vestibular pathways [4] . The plasticity is widely recorded using the evoked neuronal activation of an auditory system [5-6]. Better vestibular functioning is by means of the mediated vestibular plasticity as a consequence of participating in various physical health activities such as dancing, diving and sports. Literature reveals that certain amount of neural adaptation taking place in the sacculo-collic pathways, in turn, bringing changes in the vestibular system of professional divers [7]. There is also a reported improvement in the vestibular plasticity in professional dancers with early latencies and enhanced cVEMP amplitude [8]. Gauchard et al [9] enunciated that individuals who underwent low-energy sports activities had better postural control and good vestibular sensitivity compared to those who do not undergo any form of exercise which was measured through caloric, rotational and postural tests. Similarly, to perform dance and yoga often requires, joint mobility and strong flexibility in order to preserve the balance of the body.

Therapeutic yoga has been well established as a practice of incorporation of yoga asanas. Hatha yoga has combinations of postures, breathing, and meditation. It is theorized to be more therapeutic than the traditional exercise due to the coordination between components of the body and mind [10]. Yoga improves postural stability and balance and also prevents the risks of falls in older adults [11] . Similarly, a study reported that yoga can help in improving muscular strength and flexibility which is achieved through the help of asanas which constitute the static physical postures thereby providing benefits for conditions like musculoskeletal problems [12]. Videonystagmography (VNG) tests of oculomotor evaluations could be used as an objective tool to determine if there is any enhancement of oculomotor functioning of individuals whose practice yoga. So, the importance of this study is to find out whether practicing yoga can bring any difference in the oculomotor system. Thus the present study attempts to objectively evaluate to compare Saccades test, Smooth pursuit test and Optokinetic test responses between yoga practitioners and non yoga practitioners.

METHODS

A total of 120 individuals within the age range of 18–40 years were selected using convenient sampling for this study. They were divided into two groups; the yoga practitioner consists of 60 participant and non-yoga had 60 participants. Participants of both the groups had hearing sensitivity within normal limits. The inclusion criteria of the yoga practitioner included duration of yoga practice in the clinical group ranged from at least 1 year or more. The participants having history vestibular symptoms (such as sudden or severe vertigo, dizziness, balance difficulties, nausea, vomiting, etc.), otological symptoms, neurological issues, systemic illness, history of smoking and consumption of alcohol were excluded from both the groups.

Procedure. The pre assessment for the selection of the participants, included detailed case history to rule out any prior history of vestibular dysfunction or any ear-related pathology and any other neurological issues. The air conduction and bone conduction audiometry testing procedure was carried out using diagnostic audiometer. A calibrated middle ear analyzer was used for tympanometry and reflexometry. A 226 Hz probe tone used for immittance test, using for which tympanogram was obtained, ensured by acoustic reflexes, to identify the middle ear status Videonystagmography (VNG) test was carried out with a video eye-tracking system using Binoculars spectacles, which was placed on the patient's eyes and the participants were instructed to maintain an upright posture comfortably during the test to minimize the body and head movement. The distances from the patient to the midpoint of the light bar was maintained to be 4 feet to minimize the convergence. Participant's information was entered in the software and video adjustment was done for each subject for better eye visualization. Calibration was done for each participant on both horizontal and vertical plane. Here, the participants were asked to keep the head in a fixed position and track the red dot visible on the light bar which is placed in front of the participant. The oculomotor test battery included Saccade test, Smooth pursuit test, and Optokinetic test and each test recording was for 60 seconds. Throughout the testing the participants were instructed to be focused and concentrate on the target. In Saccade test, the subjects were asked to fixate on the laser target that moves random on a horizontal plane, during the testing the examiner ensured that the participant's head was maintained steady. Analyses was done based average latency, accuracy and velocity of the saccadic eye movement to the target. In Smooth pursuit test the participants were instructed to track the target which moves sinusoidally on a horizontal plane. The pattern varied in frequency over time from 0.2 to 0.7 Hz. The participant's tracking was measured in relation to the time and precision of the target and analysed based on the average rightward and leftward gain. For the optokinetic test the target was moving at the rate of 20°/sec and 40°/sec from right to left and in reverse direction. The participants were instructed to focus and track the target, the average slow phase velocity at 20°/sec and 40°/sec were analysed.

RESULT

Statistical analysis was performed using SPSS. Data were expressed as mean (± standard deviation), and since normal distribution was confirmed, independent t-tests were applied for group comparisons.

Yoga practitioners demonstrated higher peak velocity (410.52 ± 41.85°/s) compared to non-yoga practitioners (391.72 ± 38.94°/s), with a significant difference ($t = 2.285$, $p = 0.024$). Accuracy was also significantly better in the yoga group (91.27 ± 4.33%) than in the non-yoga group (86.61 ± 5.38%) ($t = 4.962$, $p < 0.001$). However, latency did not differ significantly between groups ($t = 1.704$, $p = 0.091$).

Velocity gain was significantly higher in yoga practitioners (0.883 ± 0.073) compared to non-yoga practitioners (0.779 ± 0.069) ($t = 7.573$, $p < 0.001$), indicating improved tracking performance. At 20°/s, no significant difference in slow phase velocity was observed between yoga (23.56 ± 2.16°/s) and non-yoga groups (23.29 ± 3.41°/s) ($t = -0.471$, $p = 0.639$). However, at 40°/s, yoga practitioners showed significantly higher slow phase velocity (41.98 ± 3.52°/s) compared to non-yoga practitioners (38.29 ± 5.57°/s) ($t = 4.105$, $p < 0.001$).

Overall, yoga practitioners exhibited superior oculomotor performance, particularly in saccadic accuracy, peak velocity, smooth pursuit gain, and high-speed optokinetic responses.

DISCUSSION

Yoga practitioners showed significantly better saccadic peak velocity and accuracy, higher smooth pursuit gain, and increased optokinetic slow phase velocity at 40°/sec, indicating enhanced oculomotor function and possible vestibular plasticity. Similarly, a literature reported an improvement in the latencies, amplitude, and asymmetric ratios of cVEMP for yoga practitioners in comparison to non-yoga practitioners [4]. A report of positive correlation observed between one of the types of Isha hatha yoga practice and the core stability balance measured using a single stroke and plank test [13]. Literature defined that practicing yoga improves body muscle flexibility and strength, also encourages and enhances cardiovascular and respiratory function [15]. A similar study states that, yoga will enhance the body balance which was assessed using static posturography and field procedure among individuals who practice hatha yoga [10]. yoga has also showed an improved gain for executive function on different aged populations such as healthy adults, infants, adolescents, and healthy older adults [16].

Better vestibular functioning mediates vestibular plasticity as a consequence of participating in various physical health activities such as dancing, diving, yoga, and sports. A study postulated that a certain amount of neural adaptation taking place in the sacculo-collic pathways in turn, brings changes in the vestibular system of professional divers [7]. Similarly, an improvement in vestibular plasticity was observed in professional dancers with early latencies and enhanced cVEMP amplitude [8]. Research reported 12 weeks of yoga practice showed a reduction of reaction processing time of the auditory and visual system and a relationship between eye exercises along with the kapalbhati prayanyam, showed a positive correlation between yoga and visual reaction time [15,17].

CONCLUSION

Improved balance with yoga suggests enhanced vestibular function, a key component of sensory-motor integration. This study provides evidence that yoga positively influences oculomotor responses and supports its use as a therapeutic approach to improve balance and postural stability in individuals with vestibular dysfunction.

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