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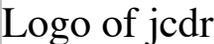
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Effect of Various Eye Exercise Techniques along with Pranayama on Visual Reaction Time: A Case Control Study

[Nitin B. Gosewade](#),¹ [Vinod S. Shende](#),² and [Shriniwas J. Kashalikar](#)³

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Abstract

Introduction: We depend on eyesight more than any other of our senses to maneuver through the space around us. In a fraction of a second, our eyes work with our brain to tell us the size, shape, colour, and texture of an object. Our eyes are body's most highly developed sensory organs. The use of computers and

television in the era of information technology has given new heights to the professional success rate and it saves time but on the other hand, it has led to an increase in the number of patients with ocular complaints.

Aims: The objective of the study was to study the effect of eye exercise techniques along with kapalbhati pranayama on Visual Reaction Time (VRT).

Material & Methods: Total 60 subjects in an age group of 18–30 were recruited in the study. All the subjects were divided into two equal groups (study group and control group) containing 30 subjects (18 male & 12 female) each. Both the male and female subjects were selected on the basis of their voluntary involvement. Visual reaction time for red and green light was recorded from all 60 subjects before the start of the study. Study group subjects were trained to practice various eye exercise techniques and kapalbhati pranayama for 8 weeks regularly whereas control group were busy with their routine activities. After 8 weeks, visual reaction time was measured for red and green light from all 60 subjects.

Statistical Analysis: Data expressed as Mean \pm S.D, Student t –test was applied for analysis of data, p value <0.05 is taken as statistically significant.

Results: Statistical analysis of data shows that there is a significant decrease in the visual reaction time for red and green light after intervention in study group (p value <0.05). Whereas there is no significant decrease in VRT in control group (p value >0.05).

Conclusion: The results of our study suggest that simple eye exercises along with pranayama helps in improvement of visual reaction time.

Keywords: Eye Exercise, Kapalbhati pranayama, Visual Reaction Time (VRT)

Introduction

The use of computers in the era of information technology has given new heights to the professional success rate and it saves time, but on the other hand, it has led to an increase in the number of patients with ocular complaints [1]. Common ocular complaints nowadays are itching, redness, burning, tearing of the eyes, headache, double vision, eye strain and blurred vision [2,3]. In India, the major symptoms related to the computer use reported by the ophthalmologists were eyestrain, headache, tiredness and burning sensation, watering and redness [4]. The eyes work together to perceive depth, enabling us to judge distance and the size of objects to help us move around them. Not only do the two eyes work together, they also work with the brain, muscles, and nerves to produce complicated visual images and messages. In our day to day life, each of us often has to respond almost instantaneously to different simple as well as complex situations. Right from the simple responses to the doorbell in home to the traffic signals on the road, it is very important. Our eyes need regular exercise in order to keep them healthy, just like any other muscle in the body. The thing is, we take it for granted that our eyes will eventually give up on us and we will eventually need glasses or contact lenses. This doesn't have to be the case if you regularly exercise your eyes.

Visual reaction time is the time interval between the application of the visual stimulus and the appearance of the motor response. It is a physical skill closely related to human performance. It represents the level of neuro-muscular coordination in which the body through different physical, chemical and mechanical processes decodes visual stimuli which travel via afferent pathways and reach the brain as sensory stimuli. Simple visual reaction time can be determined when an individual is asked to press a button as soon as a light appears [5]. Study done by Thompson et al., [6], has documented that the mean reaction time to detect the visual stimuli is approximately 180 to 200 milliseconds. There are various factors that affect the reaction time to a stimulus. Factors like intensity and duration of the stimulus, age and gender of the participant, effect of practice can affect the reaction time of an individual to a particular stimulus. Visual RT has been used to assess perceptual and cognitive abilities in individuals. It is known that regular

practice of breathing exercises (pranayama) increases para-sympathetic tone, decreases sympathetic activity, improves cardio-vascular and respiratory functions, decreases the effect of stress and strain on the body and improves physical and mental health [7]. The purpose of the study was to study effects of various eye exercise techniques along with pranayama on visual reaction time.

Material and Methods

Study Design

This study was carried out in Department of Physiology, Seth G.S Medical College & KEM Hospital, Mumbai, India. It involved 60 young healthy subjects (both male and female) who were in the first year MBBS at Seth GSMC Mumbai, in the age group of 18–30 years and who belonged to similar socio-economic status. All the study participants were residing in college hostel having similar eating and sleeping patterns. The subjects who suffered from medical conditions which were known to impact the cognitive functioning, which included neurological disorders, head injuries; cardiovascular diseases and diabetes were excluded from the study. Also subjects with red green color blindness, organic disorders of eye e.g. Glaucoma, Eye injury, Eye infections, Malignancy, Post surgery for refractive errors; Squint, etc. were excluded from the study. Absence of these disorders was confirmed by history and clinical examination of every subject. The subjects were briefed about the study protocol and written informed consent was taken from each study participants. Study was approved by the Institutional ethical committee.

Study participants were divided randomly into two groups; study group and control group. Each group contains 30 subjects (18 male and 12 female). Baseline visual reaction time (VRT) was recorded from each study participant irrespective of their group before starting the study. Study group participants were taught eye exercises and kapalbhati pranayama. They practiced eye exercises and pranayama twice a day for (total one hour) the period of 8 weeks regularly under supervision. Control group participants were busy with their routine activities and were not given any exercise. After 8 weeks VRT was recorded from all subjects to see the effect of eye exercises along with kapalbhati pranayama on VRT.

Baseline Recordings of VRT

All the readings of visual reaction time were measured during morning hours between 10 am to 11 am at the same place and at same room temperature [Table/Fig-1].

[Table/Fig-1]:

Baseline VRT in study and control group

VRT	Study group	Control group	p value
Red light	304.1 ± 71.74	295.1 ± 62.04	>0.05 (Non significant)
Green light	304.4 ± 67.13	296.0 ± 62.55	>0.05 (Non significant)

Values are expressed as Mean ± S.D, * p value < 0.05

Mean VRT in millisecon for red light before intervention in study and control group was 304.1 ± 71.74 and 304.4 ± 67.13 respectively. Whereas mean VRT for green light in study and control group before intervention was 295.1 ± 62.04 and 296.0 ± 62.55 respectively. The values were compared using student t-test. It was statistically non significant indicating study and control group were comparable.

Study Procedure

Study group participants practiced the following exercise techniques regularly as per protocol for a period of 8 weeks.

1. Palming and Visualization with Kapalbhathi: In this exercise, subject has to rub his/her palms over each other to make them warm. Close the eyes and cover them with the palms, allowing the fingers to cross on the forehead. The hands have to be cupped so that no pressure is put on the eyeballs. After that open the eyes and see if any light is getting in. If so, the hands should be moved so that no light enters and then close the eyes again. The warmth of the hands, combined with blocking out all light, relaxes the pair of tense eyeballs.

Kapalbhathi: While palming, subject has to exercise the diaphragm by exhaling suddenly and quickly through both nostrils, producing a hissing sound. Inhaling is automotive and passive. The air should be exhaled from the lungs with a sudden, vigorous inward stroke of the front abdominal muscles. The abdominal stroke should be complete and the breath should be expelled fully. While inhaling, no willful expansion is necessary and the abdominal muscles should be relaxed. This exercise should be done in three phases, each consisting of 20 to 30 strokes a minute. A little rest can be taken in between. Throughout, the thoracic muscles should be kept contracted [8]. Subject has to practice it as a 5–10 minute sessions, at least twice a day. If this is found unpleasant, one can try mini–sessions, palming for a period of 15 breaths, up to 20 times a day. Palming may also help when the eyes become tired and bleary.

2. Blinking: Subjects are instructed to make a habit of blinking regularly, once or twice every 10 seconds. It cleans and lubricates the eyes especially in glass and contact lens wearers.

3. Near and far focusing with Kapalbhathi: Subject has to hold two pencils or index fingers, in front of the face—one about 7.5 cm away, the other at arms length. Then he/she has to focus on one with eyes, then blink and focus on other. One has to repeat several times whenever an opportunity arises. Subjects have to practice kapabhati pranayama while doing focusing exercise.

4. Shifting with Kapalbhathi: Shifting is necessary to avoid eye strain. Staring is harmful for eyes. One should not stare fixedly at an object. Subject has to pretend that he/she is looking at the center of a giant clock with face straight ahead. Keeping the head still all the while, subject has to look up as far as possible towards the 12 O'clock position, hold for 2 seconds, then move the gaze clockwise at 3' O'clock, then 6' O'clock, then 9' O'clock and return to 12' O'clock position. At every position he/she has to hold for two seconds and expire in three bouts with abdominal muscles contractions i.e., Kapalbhathi. Then repeat the cycle anticlockwise. Subject has to practice this three times clockwise and three times anticlockwise, alternately.

5. Splashing: Every morning subject has to splash closed eyes 20 times with warm water and then 20 times with cold water. Repeat the process in the night by splashing the closed eyes 20 times with cold water and then 20 times with warm water. This stimulates the circulation.

Outcome Measures [Table/Fig-2]

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[Table/Fig-2]:

Digital display response time apparatus

Visual reaction time was measured by digital display response time apparatus, Anand Agencies, Pune, India. The apparatus consists of inbuilt electronic circuits. It has two parts, one operational side for examiner and other for the subject to be tested. There is a partition in the middle so that the activities of the examiner will not interrupt the subject and be useful for avoiding faulty readings. On the examiner side there are various switches (opening switches) to set the instrument ready for visual or auditory responses. On the other side there are closing switches for right hand and left hand separately and red and

green bulb to see the light when they glow after switching on by the examiner.

Method of Operation [[Table/Fig-3](#)]

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[\[Table/Fig-3\]](#):

Picture depicting the procedure of VRT recording

Subject is asked to sit comfortably on the stool or chair with an appropriate height so that the examiner side of the instrument will not be visible to the subject. Examiner set the instrument to glow red or green light on the instrument. As soon as the examiner switch on the button for particular light, light glows on the subjects side of the instrument after a particular interval as set by the examiner of which subject is not aware. The subject is instructed to press the closing button on his side of the instrument when sees the red or green light. The reading is recorded in milliseconds on the digital screen by the examiner on opposite side separately for red and green light.

Statistical Analysis

The statistical calculations were done using Data Analysis tool of Microsoft Excel and Systat 12 (Systat Software, Inc. Chicago). The statistical significance was considered at probability value less than 0.05.

Results

Thirty subjects each were enrolled in the study and control group with age group of 18–30 years. Both male and female participants were included in the study. Visual reaction time (VRT) in msec for red light in study group before and after intervention was 304.1 ± 71.74 and 291.0 ± 70.0 respectively. Whereas in control group it was 295.1 ± 62.04 and 288.0 ± 55.27 . Student t-test was applied for statistical analysis, it shows significant improvement in VRT in study group practicing various eye exercises and kapalbhati whereas control group does not show any significant change [[Table/Fig-4](#)].

[Table/Fig-4]:

Visual reaction time for red light

Visual Reaction Time	Before exercise	After exercise	p value
Study group	304.1 ± 71.74	291.0 ± 70.0	$<0.05^*$ (Significant)
Control group	295.1 ± 62.04	288.0 ± 55.27	> 0.05 (No significant)

Values are expressed as Mean \pm S.D, * p value < 0.05

VRT in msec for green light in study group before and after intervention was 304.4 ± 67.13 and 279.7 ± 59.91 respectively. Whereas in control group it was 296.0 ± 62.55 and 291.0 ± 56.24 . Statistical analysis shows significant improvement in VRT in study group practicing various eye exercises whereas control group does not show any significant change [[Table/Fig-5](#)].

[Table/Fig-5]:

Visual reaction time for green light

Visual Reaction Time	Before exercise	After exercise	p value

Study group	304.4 ± 67.13	279.7 ± 59.91	<0.05* (Significant)
Control group	296.0 ± 62.55	291.0 ± 56.24	>0.05 (Non significant)

Values are expressed as Mean ± S.D, * p value < 0.05

Discussion

As human beings, we learn about the world around us through our five physical senses. The most dominant and highly developed is vision. In fact, 80% to 90% of the information that we gather comes to us through our eyes. The vision is our primary means of relationship with the world around us. Developmentally the eye is an extension of the brain, and it's the mind that sees. As a result of this body-mind connection the eyes only relax fully when the mind is relaxed. The mind relaxes when it is focused on just one thing at a time.

Although the beneficial effect of yoga on visual reaction time is very well documented, this is the first time that an effort has been made to study the effect of various eye exercises along with pranayama on visual reaction time.

In the present study the visual reaction time for both red and green colour was significantly reduced ($p < 0.05$) in study group as compared to control group participants. The results were statistically significant suggesting that the various eye exercises along with pranayama help in improving the visual reaction time.

A study carried out in 10 male participants to examine whether cerebral oxygenation affects an individual's ability to respond to peripheral visual stimuli during exercise suggest that decrease in cerebral oxygenation, has a potential to compromise visual perceptual performance [9].

A systematic review of 43 studies to examine the current scientific evidence base regarding the efficacy of eye exercises as used in optometric vision therapy conclude that eye exercises have been purported to improve a wide range of conditions including vergence problems, ocular motility disorders, accommodative dysfunction, amblyopia, learning disabilities, dyslexia, asthenopia, myopia, motion sickness, sports performance, stereopsis, visual field defects, visual acuity, and general well-being [10].

Bhavnani et al., reported significant decrease in VRT ($p < 0.0001$) from 296.15ms +/- 13.49 to 263.59ms +/- 12.53 and ART ($p < 0.0001$) from 247.88 ms +/- 14.33 to 217.35 ms +/- 11.36 following mukha bhastrika [11], the results are compared to our study; significant decrease in VRT for red light from 304.1 ± 71.74ms to 291.0 ± 70.0ms and VRT for green light from 304.4 ± 67.13ms to 279.7 ± 59.91ms following eye exercises and pranayama.

Madanmohan et al., reported that after 3 weeks intervention of Savitri and Bhastrika pranayama in 30 healthy subjects there was reduction in VRT as well as ART. Although the decrease was appreciable, it was statistically insignificant and this may be due small sample size and shorter duration of intervention [12].

Our study results were comparable with Madanmohan et al., [13]. They reported a significant ($p < 0.001$) decrease in visual RT (from 270.0 +/- 6.20 (SE) to 224.81 +/- 5.76 ms) in 27 student volunteers after yoga training for 12 weeks. Malathi & V Parulkar [14] studied visual and auditory reaction time in 83 subjects and found significant reduction in Visual R.T and Auditory R.T after 6 weeks practice of yogasanas.

The possible hypothesis for improvement in visual reaction time may be that, on exposure to darkness for long time, the retinal and opsins are converted back into light sensitive pigments. Also, vitamin A, retinol, is reconverted back into retinal which helps in additional formation of light sensitive pigments. Thus, uncapping the eyes, objects in the field of vision can be seen much clear and brighter. Improvement in reaction time indicates improved sensory motor performance and could be due to an enhanced processing

ability of the central nervous system [15].

Kapalbhati improves the oxygenation of blood in the body which helps in better nourishment of all the structures of eyeball along with nerves. Its effect on the central nervous system could be due to: greater arousal and faster rate of information processing and improved concentration power and ability to ignore extraneous stimuli. It has been reported that yoga practice results in a decrease in mental fatigability and an increase in performance quotient and makes a person psychologically more stable and mentally more competent [16].

Our study results suggest that short term interventions like eye exercises and pranayama relieve strain on the eyes and also refresh the mind reflected by improvement in the VRT.

Limitations of Study

The present study had some limitations. The low proportion of female volunteers meant that we could not make exact comparisons between males and females. The condition was not ideal for VRT recording; the exact glycemic status of study participants and the phase of respiration were not recorded which may influence the results.

Notes

Financial or Other Competing Interests

None.

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