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Effect of Eye Exercise on Myopia in Children Aged Between 10-15 Years- A Randomized Clinical Trial

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ABSTRACT

Background- Myopia is the most common refractive error of eye in school going children. There are many treatment option are available to prevent or treat the myopia but not yet well documented in physiotherapy.

Objective- To find out the effect of eye exercise on myopia in children aged between 10-15 years.

Study Design- A Randomized Clinical Trial

Study setting- The setting were MMIMSR, Mullana-Ambala and Ashirwad Eye Hospital, Yamunanagar-Ambala.

Participants- 50 subjects of both genders mean age of 12.86 ± 1.48 years with diagnosed case of myopia were recruited through criteria based purposive sampling.

Method- Consent was taken, random allocation done in to two groups' Experimental (Exp) group and Control (Ctrl) group. Pre intervention optical power and CISS were taken by Nidek ARK 700A and CISS scale respectively. Exp group receive Palming exercise, Eye warmup exercise, Cross crawl and Tibetan Eye exercise for three weeks five days per week and 20 mins per day, Ctrl group was advised to use spectacles or contact lenses on regular basis for three weeks. After three weeks of intervention post optical power and CISS were taken and analyzed.

Result- CISS score significantly reduced within both the group after treatment, but there was no significant change observed for optical power in ctrl group. However from end-point to follow-up a significant reduction in CISS occurred ($P < 0.001$) in control group, and no significant change observed for optical power of RE and LE ($P = 0.13, 0.99$ respectively). In contrast, the Exp group showed reduction of optical power ($P < 0.001$), and CISS score ($P < 0.001$).

Conclusion- Eye exercises improvise the visual acuity and ocular health in children with myopia.

Key word: Pediatric Myopia; Visual Rehabilitation; Cross Crawl; Tibetan Eye Exercise.

INTRODUCTION

Myopia is derived from Greek word *muópiá* which means "trying to see like a blot", and also called as shortsightedness. Myopia is most common refractive error of eye in which the light that comes from infinity does not directly focus on the retina but in front of it, causing the image blur. Shiny et al¹ described the eye with myopia as "one for which the punctum remotum is a short distance off, sometimes only a little inches from the eye", and also says myopia is "one in which the images focus in front of the retina while eye at rest". Curtin explain shortsightedness that "the shortsightedness in which parallel rays of light entering the eye at rest are brought to a focus in front of the retina".² The preponderance of shortsightedness varies by country and by indigenous assortment, reaching as high as 70-90% in some Asian populations.² Near epidemic levels of myopia (up to 80%) have been reported in countries such as Hong Kong, Taiwan, Singapore & Japan.³⁻⁵ In Europe and America, its preponderance varies between 30-40%, while in Africa 10-20% of the population is affected. Shortsightedness affects 25% of the population in United States. The prevalence of myopia in India which is globally accepted that is 45%.⁶⁻⁸

Available treatment option for myopia are Optical correction, pharmaceutical treatment like cycloplegic promoters, vision therapy, orthokeratology, refractive surgeries like (radial keratotomy, excimer laser photorefractive keratectomy), osteopathy, yoga therapy and aerobic exercise therapy.⁹ These treatment choices have many problems like post-operative complication, cosmetic problem, eye infection, so to overcome from these problems eye exercises will be helpful. Exercise therapy for eye is not a new approach. In fact, vision workout and treatment approach have been around for years. The design of this treatment, or eye exercises, aids in conquer different visual disorders including binocular function. Not all the treatment methods have been proven effective by exercises, so in this study we included different eye exercises with Tibetan eye chart exercise to work effectively on eye for shortsightedness.

Samia¹⁰ have done a randomized clinical trial on myopia with 15 female aged between 12 to 15 years in Saudi Arabia and the results of the study showed that there is improvement in visual acuity in subjects with myopia. These results suggest that clinicians should consider the use of eye exercises as a way of improving visual acuity for adolescents suffering from myopia. Rathod et al¹¹ have done research work in both gender age ranging between 18-25 year on 30 subjects with myopia. Subjects were

randomly assigned in to two group that is Group A (Experimental Group) and Group B (Control group). Group A receive Eye focusing exercises 10 repetition 3 sets daily for 4 weeks with standard care and control group did not receive any exercises except standard care for myopia for 4 weeks. The results of this study showed that eye exercises are effective in improving Near point convergence (NPC) in myopia but not as statistical improvement in visual acuity.

Gopinathan et al¹² have performed a research and the aim of the study was to evaluate the role of eye exercises and Trataka Yoga Kriya on Ammetropia and Presbyopia. Total of 66 patients were registered under two main groups with four sub groups of refractive error like shortsightedness, hyperopia, astigmatism, and presbyopia, respectively, (Group A – 32 patients, Group B – 34 patients) by random sampling method. Group A subjects were asked to perform eye exercises once daily for 3 weeks. Group B total of 34 patients were registered in this group here subjects were asked to perform Trataka Yoga Kriya once daily (either in morning or in evening) for 3 weeks. They were prescribed with the following eye exercise such as: Sunning, Eye wash, Palming, Candle light reading, Shifting and Swinging, Playing with ball, Vaporization, Cold pad. After taking full therapy session, subjects were investigating for 1 month in order to see any adverse effects of the therapy. The conclusion of the study suggests there is Snellen's chart reading one line rectification was noted. It is a promising conclusion that a non-medicinal, inexpensive, relaxation approaches can rectify the quality of vision, by which it discursively review the betterment of the disease status. Jones-Jordan et al¹³ in his study and they found that the persons diagnosed with myopia spent less time engaged in sports and physical activities in childhood prior and following the occurrence of myopia in relation to emmetropes. Donovan et al¹⁴ determined that myopia progression is slower during summer than winter, because people spend more time outside during the summer and they are more engaged in sport activities.

Myopia is a most common refractive error which is highly significant problem, it's not only because of high preponderance, but also by cause of it can come through visual morbidity and increase the risk for visual-threatening conditions (example, retinal breaks and retinal detachment, glaucoma etc). Due to any problem in vergence there Diplopia (double vision), can result if one of the eye's external muscles are weaker than the other which is the main problem in myopia. The available research of exercises for myopia is on aerobic exercises which are not directly work on eye, in our study the eye exercises work on external as well internal muscle of eye that may be retard the development of myopia or can reduce the optical power of myopia in children.

Methods

The study was a prospective, multicenter, randomized clinical trial with blinded outcome assessment. Based on sample size calculation with a two-sided α of 0.05 and a power of 0.90, 85 patients of both genders had to be included in the study by means of criteria based purposive sampling based on inclusion and exclusion criteria to detect the effect of eye exercises on myopia. Diagnosed case of simple myopia, aged between 10-15 years and both genders was the inclusion criteria. The children who have other types of myopia, Refractive power more than 3D, myopia with glaucoma, eye muscles pathology, musculoskeletal problems, visual vertigo, neurological problems and who underwent any surgical interventions in eyes and skull were excluded from the study. Before assessment and treatment the children and parents were explained the whole procedure and asked to parents to sign a declaration of consent and ascent was taken from the child. Randomization was done and pretreatment optical power and CISS score was measured by means of Autorefractometer and CISS scale respectively. Then the case history was documented. In the physiotherapy examination and treatment those structure[s] were focused which is relevant for the eye. The children under the study were recruited by an ophthalmologist. The patients were listed in the randomization list, which divided the patients into two groups – depending on the date of registration: group 1 Experimental group and group 2 as Control group.

The experimental group received holistic physiotherapy treatment in the first, second and third week. Control group received standard care for myopia. The primary parameter was changed in optical power which was measure by autorefractometer by an optometrist. The secondary parameter was CI of the patients and measured by CISS. The procedures followed were in accordance with the ethical standards of the Indian Council Medical Research (ICMR) responsible committees on human experimentation.

Intervention

For experimental group we have gave simple palming, eye muscles warmup exercise, cross crawl and Tibetan eye chart exercise. For the simple palming the patient was asked to place the centre of their palms over closed eyes (not fingers) very gently. Ideally rest elbows on a pillow or soft surface and was maintained it for about 20 -30 sec. it was repeated for 2-3 times.



(Figure1). Simple Palming

Eye muscle warmup exercise-this exercise goal was to warm up and stretch out the extra ocular muscles. In this way, we prepare them for work. The eyelids were closed and relaxed. Look in front; every muscle is relaxed. This is primary position. The patients were asked on the count of one, move the eyes to the left they were feeling tension in the left corners of the eyes. Then return them to the primary position and move them left again, slowly. The eyelids were closed and relaxed as before.

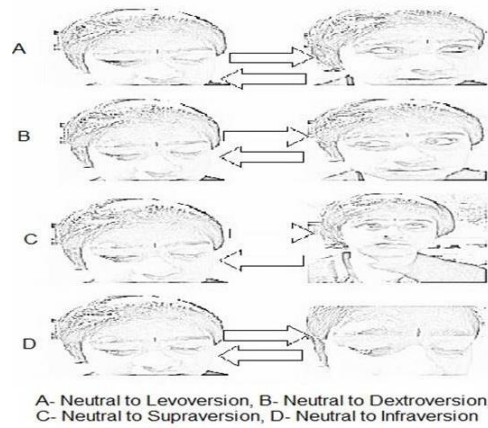


Figure 2.A, B, C, D- Gaze Exercise

On the count of two, moved the eyes up so that visual axes are parallel, as like looking at the sky. Then move the eyes to the primary position (Figure 2.C). On the count of three, moved the eyes right and they were feeling tension in the right corners of the eyes. Then move the eyes to the primary position (Figure 2.B). On the count of four, moved the eyes down so that the visual axes are parallel. Imagine that the child looking at feet. Then move the eyes to the primary position (Figure 2.D).

For cross crawl (Figure 3) the patient was asked to stand with the feet comfortably apart, and then asked to lift the left knee up and touch it with the right in that manner that the knee and hand should touch in front of the center of the body. Then asked to release the knee and hand and return the foot to the ground. The same procedure was asked to perform at the right side also. Then repeat the exercise continually switching back and forth.



Figure 3- Cross Crawl

During this cross crawling the patient was asked to draw the figure of eight in the air with eyes on the visual field and imaginary nose feather.

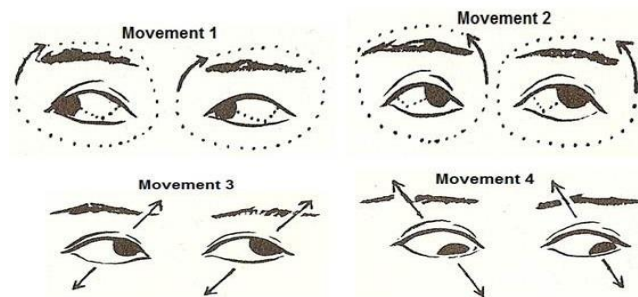


Figure 4- Tibetan Eye Exercise



Figure 5- Tibetan eye chart

Tibetan eye chart¹⁸ was about one inch directly in front of the face with the centre dot at nose level. During exercise moved only the eyes do not move the head, and then each movement done for 30 seconds. In movement one moved the eyes in a circle manner follow the dots in eye chart, begin with 12 o'clock, moving clockwise around the outer circle of dots. In movement two repeated that pattern, moving counter clockwise, beginning with 12 o'clock. In movement three moved eyes in and out between dots at 2 o'clock and 8 o'clock. In movement four moved eyes in and out between dots at 4 o'clock and 10 o'clock. End

by relaxing eyes, again, by cupping them with the hands. For control group we advised to wear their spectacles on regular basis and to avoid rich carb diet.

Data analysis

The data were analyzed using statistical package for social science (SPSS) version 16 with 95% confidence interval. Descriptive statistics were used for subject’s demographic characteristic. The level of significance was set at 0.05. Two samples Kolomogorov-Smirnov test was used to check the normality of the data. The data does not follow normal distribution hence non-parametric test of significance was used. Within group variable Wilcoxon matched paired test was used to compare pre and post mean values of optical power and CISS within group that is Experimental group and Control group. Between group variable Mann Whitney U test was used to compare the pre and post treatment change score between Experimental group and Control group for optical power and CISS. Study flow chart Figure 6 must be inserted here

Results

The sample size was calculate and after that there should be 13 subjects in each group to participate in the RCT, 40 % assuming non- participating rate so the total sample size changed to 20 in each group. Of the 85 participants who entered the trial group, 44 in the experimental group and 41 in the control group, received treatment; 20% were lost follow-up and 20% discontinued the intervention.

Randomization started in March 2014, recruitment was completed in October 2014 with follow-up scheduled to continue through April 2015.

Variable		Values
Sample size		50
Gender	M	22 (44)
	F	28 (56)
Age in year		12.86±1.48

Figure 7- Base line characteristics of total sample size, gender, and Age

Variables		Experimental group	Control group	P value
Sample size		27	23	NA
Gender N (%)	M	12 (44)	10 (43)	0.48
	F	15 (56)	13 (57)	0.48
Age in years		12.59±1.55	12.97±1.18	0.97

Figure 8- Base line characteristics of sample size, age, gender in Exp. Froup and ctrl group

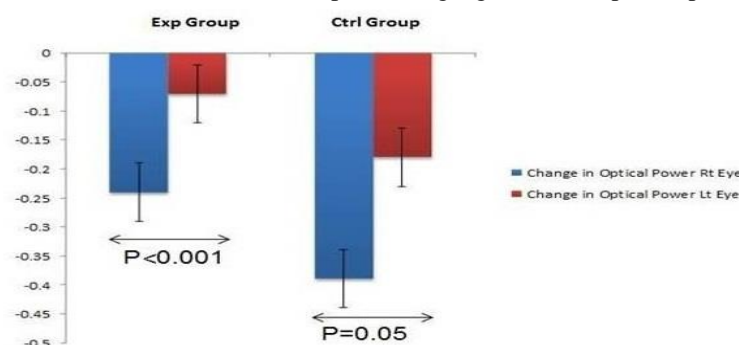


Figure 9- Comparison of change score of optical power of eye between Experimental group and Ctrl group

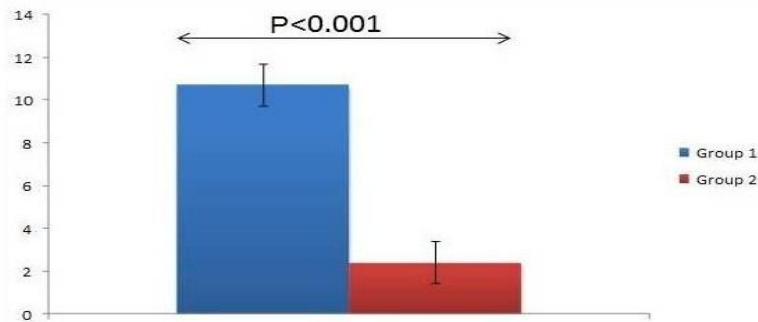


Figure 10- Comparison of change score of CISS between Experimental group and Ctrl group.

Discussion

The primary objective of this study was to determine the effect of eye exercises on myopia in children age between 10-15 years. The results obtained after the data analysis did not support the null hypothesis. The conclusion of our study showed that there was a significant reduction in mean change of scores of optical power and CISS after treatment of 3 weeks in the experimental group. In the present study, the average within group change scores of optical power and CISS for participants in both the groups showed significant reduction, but it was more in experimental group. Since the MCID values are not available in the literature, it cannot be compared for the clinical significance levels.

To best of our knowledge our study is first randomized clinical trial to check the effect of eye exercise on myopia in children aged between 10-15 years. When experimental group compared with control group, experimental group showed more reduction in optical power and CISS score on autorefractometer reading and on CISS scale respectively. The mean reduction of optical power for both the eye was -0.24 with an effect size of (0.59), (0.51) for RE and LE respectively. The mean reduction of CISS was 10.70 with an effect size of (2.00). But in the ctrl group the mean reduction of optical power for RE was -0.06, for LE it was -0.04 with an effect size of (0.28) and (0.00) respectively. The CISS mean reduction was 2.78 with an effect size of 0.76. In a previous study by Samia 2013¹⁰ the mean reduction of optical power for RE was -0.66 with an effect size of (0.15) and for LE the mean reduction was -0.68 with an effect size of (0.46). The mean reduction in CISS score was 5.5 with an effect size of (4.18) by Scheiman et al 2005.¹⁵ From the above finding we prove that our study support the evidence and shows statistical and clinical significance as well.

The study also shows the improvement in other ocular symptoms such as (visual acuity, near point convergence, accommodation lag etc). We used Simple palming exercise, swinging exercise, cross crawling and Tibetan eye chart exercise in our study. Palming exercise relaxes the ocular muscles, pencil push-ups and swinging exercise strengthen the rectii muscles and ciliary muscles by which they alter the shape of the lens result in change in optical power and relieve from problems associated with myopia, this was well supported by the study done by Lin et al¹⁶ and Gilmartin et al.¹⁷

Tibetan eye chart exercise help in improving vision by strengthen the ocular muscles that are intra and extra ocular muscles.¹⁸ The cross crawl gets the body moving, improves balance and coordination and activates and integrates the left and right brain hemispheres. Activating and integrating the left and right brain hemispheres activates equally clear eyesight in the left and right eyes at all distances close and far and improves all brain hemisphere functions; moving the left side of the body activates the right brain hemisphere. The right hemisphere activates clear distant vision and relaxation. Moving the right side of the body activates the left brain hemisphere, the left brain hemisphere activates energy and clear close vision. Both left and right hemispheres have an effect on close and far vision. The right dominates distant vision; the left dominates close vision.¹⁹ So in this study all the eye exercises directly work on eye muscles that are extra and intraocular muscles. Hence prevent the progression of myopia and even helpful in curing the myopia when the exercises will use for long time.

The potential benefits to be gained by the persons participating in this study is to increase overall activity at a physical, social and psychological and to contribute to body of knowledge aimed at developing the most efficacious, valuable and successful design to improve visual power in children with myopia. This study assist myopic survivors in regaining their loosed visual power and other myopic manifestation as well, these children increase their exercise, refine the ocular health and thus decrease the severe consequences of myopia. Approximately children who sustained myopia have visual problem which can lead to difficulties in daily living and engage in social life. This programme will help the myopic individuals to enhance the functional and sensory recovery of visual problems. This programme can be used clinically as it will be more encouraging, motivating, competitive, interesting and safer to perform by the patients and results good recovery.

Physical activity level did not check during the eye examination and simple myopic children with optical power less than 3 D only included in the study these are the limitation of our study. Future recommendations of our study are other than simple myopia can be included in the study, different age group can be taken, and traditional exercise can be included in the study.

Conclusion

The study provides an evidence to support there is effect of eye exercises which improvised the visual acuity and ocular health in children with myopia.

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Figure Legends-

Figure 1- Simple Palming

Figure 2 – 2 A, 2B, 2C, 2D- Eye muscles warm up Exercise

Figure 3 – Cross crawl

Figure 4 – Tibetan eye exercise

Figure 5 – Tibetan eye chart

Figure 6 – Study flow chart

Figure 7 - Overall Demographic Characteristics of Study Participants

Figure 8 – Between group comparisons of demographic characteristics

Figure 9 - Comparison of change score of optical power of eye between Exp group and Ctrl group

Figure 10 - Comparison of change score of CISS between Exp group & Ctrl group