FREQUENCY OF REFRACTIVE ERROR IN THE NON-AMBLYOPIC EYE IN AMBLYOPES.

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Abstract

Background: Amblyopia is visual impairment that typically results from abnormal visual development during critical development period. Mostly all attention is given to amblyopic eye while refractive status of non-amblyopic eye is not given much attention. The conventional therapies are usually monocular which ignore the fact that the non-amblyopic eye has also refractive error which should also be focused while treating the amblyopic eye.

Objective: Specifically, this research will seek to establish the frequency and incidence of refractive errors; myopia and hyperopia in the non-amblyopic in amblyopes.

Materials and methods: The sample comprised 55 participants aged 12-30 years; 18 of them male (32.7 percent) and 37 females (67.3 percent). The following equipment was used for the assessment of refractive errors among the sample population: Auto refractometer, retinoscopy, and a distance Log Mar chart, and trial box and pen torch. The findings show the significant refractive error in the non-amblyopic eye in amblyopes.

Results: Among the participants, 47.27 percent were hyperopic, 43.63 percent were myopic. From the total of 55 sample size only 9 percent were emmetropic in the non-amblyopic eye. The results show the high frequency of refractive error in the non-amblyopic eye in amblyopes.

Conclusion: The study shows high frequency of refractive error (90.9 percent) in the non-amblyopic eye in amblyopes. The results show the high frequency of myopia (43.6 percent) and hyperopia (47.3 percent). A small amount of emmetropia (9.1 percent) was also present. The results support and provide data base for the theory that amblyopia affects the both eyes and cause the binocular defects. The findings can help promoting the amblyopic treatment toward binocular therapies especially after the early age.

Keywords: Amblyopia, non-amblyopic eye, Refractive error.

IINTRODUCTION

The amblyopia is reduced visual acuity which usually occur in the early life period due to abnormal development in the critical period of visual development. The common risk factors of amblyopia are strabismus, refractive error and anatomical obstruction (1). During the critical period of visual development, the asymmetrical visual input from both eyes leads to reduced visual acuity and visually evoked spiking response in the affected eye while there are no physical pathologies are present in the eye, visual pathway or cortex. The severity of amblyopia depends on the age of initiation and type of asymmetrical response which can be caused by a number of ways. The asymmetrical input maybe due to misalignment (strabismus), unequal refractive error (anisometropia) or due to form deprivation (cataract). The critical period of visual development can extend up to 8 years of age (2).

Early treatment of amblyopia during critical period of visual development is very effective. Older amblyopes can still benefit from the treatment but it's not effective as in early age. The treatment of amblyopia involves the patching therapy, atropine and optical penalization. The improvement of amblyopia at the older ages is very slow often show minor or no improvement. Strict compliance of treatment therapy for long duration can help in the improvement (3).

The patching therapy is the conventional treatment of the amblyopia in which the fellow eye or the non-amblyopic eye is occluded. Occlusion forces the amblyopic eye to work improving its visual acuity. It is most widely used treatment option for the amblyopia (4). The treatment of amblyopia involves the spectacle correction followed by the patching therapy. Patching has been overprescribed in past but full-time patching is not supported by base evidence today. However, part time patching is still very effective and is most common treatment for the amblyopia. The duration of patching depends on the severity of tha amblyopia. Patching is extremely effective before the age 7 but show low improvement in older ages. This is due maturation of visual system at 7 years of age and bad compliance to some extent (5).

Optical treatment or simple spectacle refraction is the first step of the amblyopia treatment. The optical correction does not provide the normal vison to amblyopes but help restore the vison along with other therapies like patching and penalization over the long duration of time (6). Spectacle induced penalization is effective and good alternative to occlusion pathing therapy. Optical penalization is done by giving the appropriate spectacle correction forcing the amblyopic eye to be used. Optical penalization is good option especially if there is poor compliance with the occlusion therapy or in the cases of the regression of visual acuity after the cessation of the patching therapy. Contact lens optical penalization is also an option but not used widely due to poor compliance (7).

Another treatment option for amblyopia is atropine penalization which consist of using 1% atropine drops in the non-amblyopic eye forcing the amblyopic eye to be used. Atropine penalization is good choice especially when children are resistant to the slandered patching therapy (8). Another treatment option for the amblyopes with eccentric fixation is the pleoptics. It's a reliable treatment for the suppression amblyopia. Treatment involves the session of 30 minutes once or twice a week. In this technique the peripheral retina including the eccentric fixation area is dazzled and the fovea is protected by shadow of 3-to-5-degree black disc. The light source is turned off after 15 to 30 seconds and fovea functions better as surrounding retina is in state of hypo action. The complexity of the treatment technique, the high cost and the required absolute cooperation of patient makes the treatment less acceptable and it seldom used these days (9).

The patching therapy is very effective in the critical period of time but it has some limitation like it is very slow especially after the 7 years of age and it's a monocular approach which limits the patient visual perception during therapy. Therefore, the modern treatments include the dichoptic treatment or the dichoptic training. In the dichoptic training the stimuli presented to both eyes are different. The amblyopic eye receives the full stimulus while other eye receives reduced stimuli forcing the use of amblyopic eye. They are available as videos or the action video games played via headset. It increases the child interest and cooperation thus the compliance of treatment greatly improves as compared to conventional patching therapy. Dichoptic video games combine number of features or mechanics that help improving the visual cortex plasticity and learning. The level of difficulty increases with the visual improvement and perceptual learning (10).

Normally amblyopia is defined as reduced visual acuity in affected eye only however, studies show that anatomical changes in LGN and visual cortex affects the both eyes. Studies show the abnormalities of visual acuity, color vision, contrast sensitivity and perceptual motion affect both the amblyopic and non-amblyopic eyes depending with age of onset. In the early onset amblyopia both amblyopic and non-amblyopic eye show delayed response to stimulus than the normal eyes. Visual responses from both amblyopic and non-amblyopic eyes are abnormal and these abnormalities depend on the age of the onset (11).

Amblyopia is typically associated with the cortical dysfunction at both monocular and binocular sites. The patching is good only for the younger children. As binocular vision is compromised in the amblyopia. So, the binocular strategies have been developed to treat the binocular disorder. These therapies are provided as the dichoptic videos or games in which the different stimulus is provided to both eyes with reduced stimulus to the non-amblyopic eye forcing amblyopic eye to be used. These binocular treatment methods are vast improvement over the pathing therapies as they are

not only better accepted by patients and show good compliance but also help in obtaining the binocular improvement. Results show the significance improvement of visual acuity after the dichoptic training (12).

OBJECTIVE OF THE STUDY

• To find the frequency of refractive error in the non-amblyopic eye in amblyopes.

METERIALS AND METHODS

STUDY DESIGN

Descriptive study design was used.

SETTINGS

Data was collected from Ghurki Trust Teaching Hospital.

DURATION OF STUDY

Four months following the approval of the synopsis, the study was finished.

SAMPLING TECHNIQUE

Stratified random sampling was used.

SAMPLE SIZE

The sample size was 55 amblyopic patients.

The sample size was calculated by Rao soft calculator.

TARGET POPULATION

Amblyopic patient aged 12 - 30

SAMPLE SELECTION

Inclusion criteria:

- Age group of 12 to 30
- Amblyopic patient
- Both males and females

Exclusion criteria:

- Refractive error patient other than amblyopia
- People with any ocular disease
- People with any systemic condition
- Children and old people
- People with history of recent ocular medication
- People with any recent ocular surgery

DATA COLLECTION PROCEDURE

Data was collected at Gurki Trust Teaching Hospital Lahore. The 55 amblyopic patients that falls in our inclusion criteria was taken. The written as well as informed consent of patients was taken. The anterior ocular structure of patients was examined using the pen torch. The objective visual acuity was assessed by using auto refractometer. The patient was seated and chin rest was adjusted. The three visual acuity readings were taken of both eyes. Then visual acuity of patient was recorded using the retinoscope. The patient was seated in dim illumination and asked to focus on distant target while corneal reflex was observed using retinoscope. The visual was recorded using trial lenses to neutralize the corneal reflex. The final visual acuity of all patients was assessed using the log MAR chart. The patient was instructed to sit at 4 m from the log MAR chart. The subjective refraction was performed using the trail lenses. The best corrected visual acuity of amblyopic and non-amblyopic eye was recorded.

Data Collection Tools (Performa/Questionnaire)

- Trial box
- Pin Hole

	N	Minimum Age	Maximum Age	Std. Deviation
Patient Age	55	12.00	21.00	2.628

- Auto refractometer
- Torch light
- Log mar chart
- Retinoscope

DATA ANALYSIS

The statistical program SPSS 26.0 was used to examine the data.

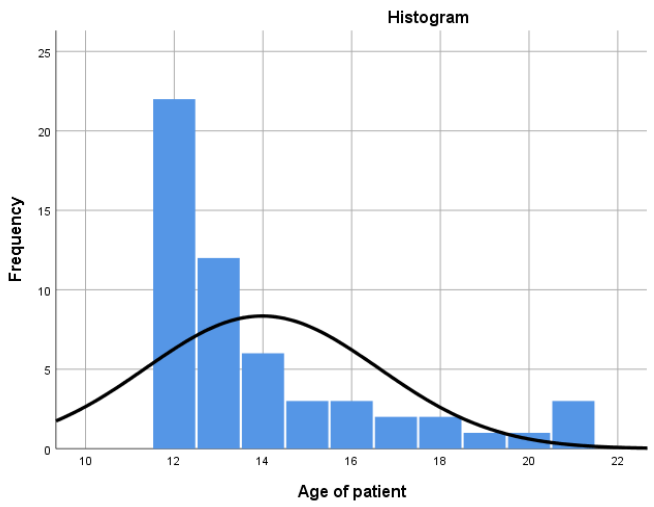
RESULTS

Age of the patients:

Table 5.1: Shows the descriptive statistic in which mean deviation and standard deviation of the age group are presented.

Table 5.1: Age-related descriptive statistics

Graph 5.1: Shows the histogram of the age of the patients with the normal curve.



Graph 5.1: shows the histogram of the age of the patient

Gender of the patients

Table 5.2: Shows the frequency of the patients in which there were total of 55 patients among which there were 18 male patients and the numbers of females were 37. Total of 18 males made up the 32.7 percent of the total value and females made up the remaining 67.3 percent.

Gender	Frequency	Percentage
M	18	32.7
F	37	67.3
T	55	100

Table 5.2: Frequency of the gender of patients

Figure 5.2 shows the pie chart of the total gender of the patients which include 32.7 percent of the males and 67.3 percent of the females.

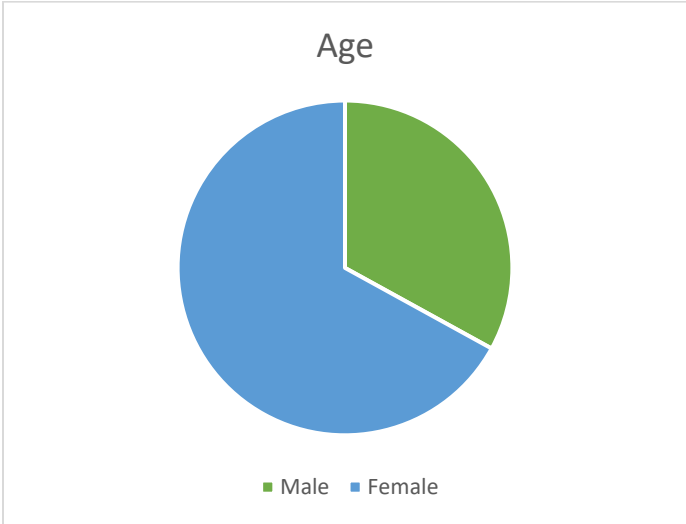


Figure 5.2: Pie Chart of the gender of the patients

Refractive Errors

Table 5.4 shows the frequency and percentage of the refractive errors in non-amblyopic eye of 55 amblyopic patients. Out of 55 total amblyopic patients 24 (43.63%) have myopia, 26 (47.27%) have hyperopia and 5 (9.09%) have emmetropia in the non-amblyopic eye.

Table 5.3: Percentage and frequency of the refractive errors type

Figure 5.3 shows the frequency of the refractive errors in non-amblyopic eye in amblyopes. Total patients were 55 out of which 5 (9.09%) have emmetropia, 24 (43.63%) have myopia and 26 (47.27%) have hypermetropia in the non-amblyopic eye.

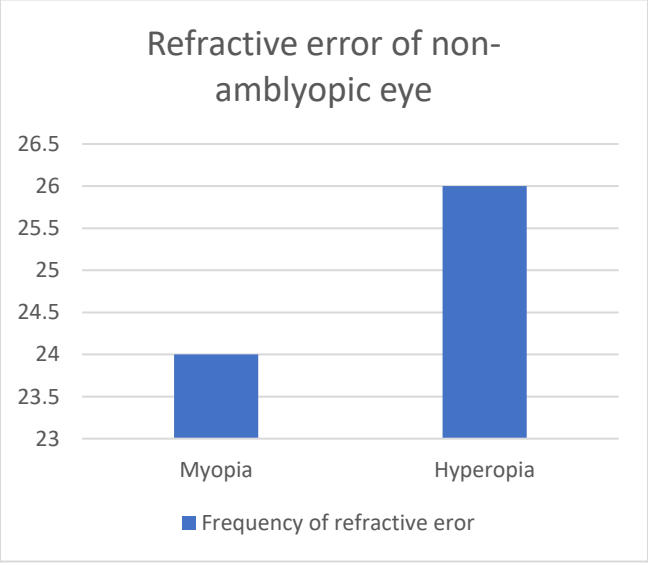


Figure 5.3: Bar chart of the refractive errors

Table 5.4 shows the frequency of the range of refractive errors above and below 3DS in which the total patients were 55 out of which there were 5 emmetropic patients, 24 were myopic patients and 26 were hypermetropic patient.

Table 5.4: Types of the refractive errors

Refractive errors type		
Types	**Frequency**	**Percentage**
Myopic	22	43.63
Hypermetropic	26	47.27

Types	**Range of error**	**Frequency**
Myopia	Myopia < 3 DS	15
	Myopia >3 DS	9
Hyperopia	Hyperopia<3 DS	18
	Hyperopia>3 DS	8

Figure 5.4: shows the bar chart of the frequency of range of refractive errors in the non-amblyopic eye in the amblyopes.

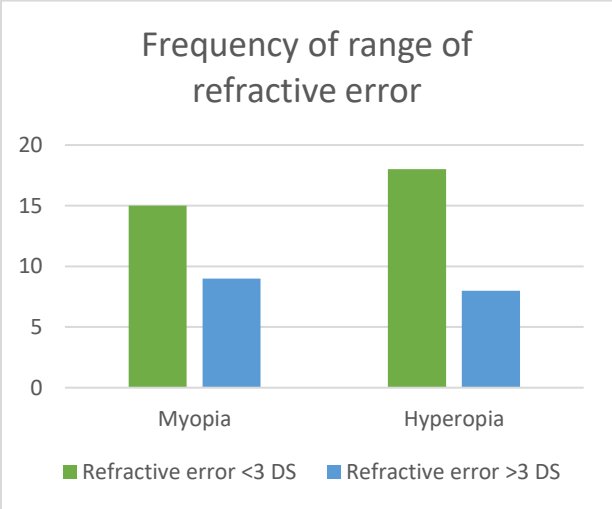


Figure 5.5: Bar chart of the frequency of range of the refractive errors.

DICUSSION

The amblyopia is serious eye condition that affects the vision. The amblyopia is treatable especially in early age with the patching therapy but if left untreated can lead to permanent visual impairment. Amblyopia is most common cause of the unilateral vision loss that affects about 2% to 4% children. The adequate and immediate treatment of amblyopia is required to prevent the vision loss (13).

The results of study show that out of 55 amblyopic patients under study about 50 (90,9%) has refractive error in the non-amblyopic eye with 24 (43.63%) myopic and 26 (47.27%) hyperopic. These results are similar to George C Woo and Elizabeth Irving study in 1991 to assess the contrast sensitivity, eye movements and visual acuity differences between the non-amblyopic eye of the amblyopes and normal eye. Woo explain that there is significant refractive error present in both the amblyopic and non-amblyopic eye of amblyopes in relation to normal eyes. To evaluate the refractive error the mean spherical equivalent of spectacle refraction was used. The total of 161 amblyopic patients were studied along with the 161 normal control eyes. The frequency graph of sample extends from -10.00 to +7.75 but extreme values was very small. The amblyopic and non-amblyopic eyes show high frequency in the range of myopia and hyperopia. The 50 out of 161 patients fall in the range of -0.25 to +0.25 spherical equivalent. The frequency graph shows the higher refractive error in the non-amblyopic and amblyopic eye. A second study compares the refractive error among the normal, amblyopic and non-amblyopic eyes from the previous study. The 100 amblyopes samples and 161 samples of normal eyes from non-amblyopic persons were taken from the previous records of vison clinic of University of Waterloo. The age limit was from 5 to 55 years. The same analysis methods were used in this study as in the previous studies. The study shows a significant amount of refractive error in the non-amblyopic and amblyopic eye as compared to control normal eyes. The results of both studies show a significant amount of hyperopia and astigmatism in the non-amblyopic eye as compared to normal eyes and even higher amounts of the refractive error in the amblyopic eye. These results relate with result of our study showing the refractive error in the non-amblyopic eye of amblyopes.

A similar research study was conducted by the Sapkota et al. in 2013 to find the frequency of refractive error in amblyopic children of Nepal. The study was completed over time period of five years and results show that out of total of 565 astigmatic patients 59.2% (335) has astigmatism, 33.5% (189) has hyperopia and 7.3% (43) has myopia. Out of all the amblyopic patient 40 percent has severe amblyopia and 40 percent has moderate amblyopia. Anisometropia was the most common cause of the amblyopia (14).

The study shows that almost all the amblyopic patients (90.9%) under study have refractive error in the non-amblyopic eye along with amblyopic eye. The most of the patients have hyperopia (47.27%) have myopia and some have myopia (43.63%). The age analysis show that the majority of the patients are 12 and 13 years of age comprising 40% and 21.8% of total sample size. The 67.3% of the sample population was female and 33.7% were male. Overall result shows the high amount of refractive error in the non-amblyopic eye. Similarly, Noureen Malik et al. in 2019 conducted a study on frequency of refractive error in amblyopes in the pediatric age group. Out of the total 250 patients 150 were amblyopic patients. Result show that the 89% of amblyopes have unilateral amblyopia and rest have bilateral amblyopia. The total of 83 (55.3%) amblyopic patients have astigmatism and 54 (36%) have hyperopia (15).

As the study show high frequency of refractive error in the non-amblyopic eye using the binocular treatment therapy can help treating binocular interaction. S L Li et al. in 2014 conduct a study to prove effectiveness of binocular iPad treatment for amblyopia. As amblyopia is due to abnormal binocular interaction they test the effectiveness of binocular treatment therapy. 50 children were assigned to binocular games along with 25 controls. After 4 weeks binocular children show significant improvement in visual acuity (16).

CONCLUSION

The study's findings showed that participants had a high frequency (90.9%) of refractive error in the non-amblyopic eye in amblyopes. The result show that majority of amblyopes have hyperopia (47.27%) and myopia (43.63%) in the non-amblyopic eye. These findings indicate that the non-amblyopic eye of amblyopes is not normal and has visual deficits along with the amblyopic eye.

RECOMMENDATION

- The strict compliance to treatment therapy is required for amblyopia treatment.
- Educating the public especially the parents about the importance of early treatment of amblyopia can help in lowering the rate of amblyopia in population.
- Research ought to be done to determine the benefits of dichoptic treatment and their effectiveness on the amblyopia treatment.
- Study on causing factors of amblyopia and their root of action is needed to control the increasing amblyopic patients.
- A detailed study on the effectiveness of binocular therapies rather than conventional monocular therapy is needed.
- A prolonged study must be carried out to deeply understand the frequency of different refractive errors in the amblyopic and non-amblyopic eye in amblyopes.
- A study on the effectiveness of different amblyopic therapies should be conducted to find out best solution especially after critical period of development.

LIMITATIONS

- Given that this study was done over a four-month period, longer-term results may be more encouraging.
- This study only included age group of 12 to 30 years as the younger patients are in critical period of development.
- The data was self-collected based on eye camps held by undergraduates so the data reported might have some errors.
- This study excludes the amblyopic patients with any systematic condition and also diabetic patients were excluded.

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