Comparison of Interpupillary distance in myopic and hyperopic individuals

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Abstract

Background:

Interpupillary distance is a basic parameter of oculofacial symmetry. This difference between the centers of two pupil has to be considered a vital measurement for the proper adjustment of eyeglasses. Different types of refractive errors have different interpupillary measurements. This difference evaluation can help manufacturer in making of spectacles.

Objective:

To find out the difference of interpupillary distance in myopes and hypermetropes.

Methods:

Study included 151 individuals with myopic and hypermetropic refractive error between the age of 20 and 50 years. Interpupillary distance was measured by centimeter ruler for near and with Autoreractometer (Topcon) for distance. Visual acuity measured by Standard Snellen test type then refractive error corrections were given by subjective and objective methods. Repetition was done for each test type for the purpose of accuracy.

Results:

There was significant difference between the mean (IPD) interpupillary distance of myopes (62.00 ± 3.6) and hypertmetropes (60.31 ± 3.12) by ($P < 0.01$). Out of 151 patients 88(58.3%) were females and 63(41.3 %) were males. Mean values of (IPD) are higher in myopic individuals than that of hypermetropic. Results are highly significant ($P< 0.01$) and positive correlation between myopic refractive error and measurement of (IPD) interpupillary distance. Whereas negative correlation between the myopic and hypermetropic (IPD) interpupillary distance with (-0.322). Out of total subjects 55 (39.0%) were aged 20 to 30 years and 55(36.4) between 31 to 40 years old and remaining 37(24.5%) between 41 to 50 years. From total 30 (19.9%) people were having myopic refractive error IPD (59-61mm), 50(33.1%) with IPD (62-64mm) and 71(47.0%) interpupillary distance in the range of (65-68mm). Results also showed that out of 151 patients 52 (34.4%) people having hyperopic refractive error IPD (59-61mm) and 68(45.0) have IPD (62-64mm) and 31(20.5) have interpupillary distance in the range of (65-68mm). Paired samples shows significant correlation.

Conclusions:

Study concluded that Measurement of (IPD) interpupillary distance increased in myopic refractive error as compared to hypermetropia. Study also revealed wide nasal bridge in myopes than hypermetropes.

Keywords:

Interpupillary distance, Myopia, Hypermetropia.

Introduction:

Interpupillary distance (IPD) is the distance between the centers of the two pupils. It is basically determined the stereo separation of two different images that combines in brain to form stereo separation. It is measured in millimeters (mm), taken appropriately between the centers of the two pupils. The value can vary from person to person and it may depends on if they are looking at near or far [1]. When we talk

about Monocular PD it refers to the gap between the eye and nasal bridge, this may be a little different for each eye because of anatomical variations. Mean interpupillary distance (IPD) is an important and more often use measure in stereoscopic task management. According to stereoscopic literature mean Interpupillary distance is referred as anything ranges from 58 (mm) to 70 (mm). The value may vary with age, gender and race[2]. Refractive errors arise when the ocular shape prevents rays of light rather focusing on the retina either in front or behind it. The main etiology is length of the eyeball (longer or shorter), changes in the shape of the cornea (corneal curvature), or aging of the lens can cause refractive errors. These eye disorders caused by irregularity in the shape of the eye. The resultant of this abnormality makes it difficult for the eyes to focus images clearly, and vision become hazy and impaired[3]. Any change in focusing the rays of light is described as ammentropia which is further categorized in three main types Myopia, Hypermetropia and Astigmatism, while an eye is said to be emmetropic if there is no error in refraction pattern. Which means that rays of light from an object are after refracting through surface of eye sharply focused on retina. The neural cells in the retina sent a message down the optic nerve to the vision centers in the brain [4]. Further brain processes the information it receives, in accordance to this we perceive things. Myopia (shortsightedness) is a common eye disorder which has become a public health delinquent and worldwide affecting 85%–90% of young individuals in Asia such as Singapore and Taiwan. The prevalence of myopia has increased speedily over the past few years, especially in East Asia. Additionally, about 10–20% myopic patients are known to have pathological myopia [5], in peripheral Chinese region. The pathological or high myopia defines as error of refraction with spherical equivalent at least (−6.00) D and axial length of at least 26.0mm 6. Retinal damage, Chorioretinal changes and stretch are common pathological features in high myopia, apparently causing damage to the innately photosensitive retinal ganglion cells layer [7]. Refractive errors are associated with interpupillary distance[8]. Myopia or short-sightedness is a condition in which near things appear clearly, while objects at far away appear blurry. In myopia, light comes to focus in front of the retina instead to be sharply focused on retina [9]. Hyperopia or farsightedness is a common type of refractive error in which far objects may be seen more clearly than objects at near. Conversely, people may experience hyperopia differently. Some individuals may not feel any problem in vision, especially in their adulthood. For people with a specific amount of hyperopia, vision can be hazy for objects at any distance, near or far[10]. As interpupillary distance (IPD) is a width between the centers of two eyes and is reliant on both distance and near prescription. IPD should properly measure to avoid any symptoms like headache, strain and image jump. For this purpose the center of eyeglass lenses keep align with the centre of eyes (pupil). If the centres of your eyeglass lenses are not adjusted properly, then you may experience eyestrain, headaches, distorted vision, double vision, blurred vision, and/or an inability to wear your eyeglasses[11]. IPD measurements are not usually taking in general ocular examination. Depending on protocol regulations, an IPD measurement may be a prerequisite part of a spectacle prescription, or this measurement may be of the concern in dispensing. Dispensing services include selection of a appropriate frame, commendation of a suitable lens type, width and coatings, fine-tuning of the frame, and proper allocation of the bifocal or progressive lens. IPD determines the degree of retinal image disparity in eyes which are combined in the brain to form stereo image perception. Knowledge of a given population's mean IPD is important in the design of stereoscopic displaying devices and the production of stereoscopic content. Understanding of normal IPD values in population subdivisions can help studies on orbitocranial development patterns, diagnosis of

diseases, and operative management of craniofacial malformations, trauma, and manufacturing of spectacles[12]. Myopic refractive error may runs in genetic and commonly appears in early childhood. Sometimes the in some cases the amount of error drops significantly with age but most of the time it worsen[13,14]. In addition to change in IPD measurement either short or long myopic symptoms becomes worse[14]. Similarly individuals with hypermetropia complain of pain in ocular area, headache, eyestrain, deviation in eyes (squint) or tiredness when driving, playing sports, or looking at far. IPD measurements may cause disturbance and alleviate the symptoms[15].

Methods:

A comparative cross sectional study which included 151 patient age between (20 and 50 years) was done during January 2017 to October 2017. Interpupillary distance measured by ruler after correction of refractive error. Data collection was done through non probability sampling technique at Eye Wear & CO. Clinic Liberty Lahore Pakistan. Data was assembled through self-design Performa. Patients accomplishing the inclusion criteria and reporting to the Outdoor- patient department of Eye Wear & Co. Optometry clinic were enrolled. The data of the patients evaluated to diagnostic criteria of interpupillary distance was recorded on specially designed Performa. Patients with facial palsies, previous surgeries, strabismus and low vision were excluded from study. Those patients with facial palsies due to congenital malformation (microencaphly) were evaluated in exclusion criteria. All 151 individuals were underwent complete eye examination under same optometrist to avoid any practitioner error. Refractive errors were evaluated through complete subjection and objection refraction using standard Snellen test charts and Neitz Retinoscope (Ophthalmo Retinoscope BXα- 13A set). IPD interpupillary distance for near was measured with great care through centimeter rule, and distance IPD through Autoreractometer (Topcon). Each measurement was taken thrice for the purpose of accuracy. Data was analyzed using SPSS software version 21. Descriptive statistics was calculated to find out the proportion. Age distribution represented using SD and mean. Graphs were made for descriptive analysis. For the comparison of IPD interpupillary distance between myopic and hypermetropic individuals sample paired t- test was applied. A P value of <0.05 was taken statistically significant. All information and data collection was kept confidential.

Results:

Out of 151 patients 88(58.3%) were females and 63(41.3%) were males included in study,59 (39.0%) people were age between 20 to 30 years and 55(36.4) between 31 to 40 years old and remaining 37(24.5%) have age 41 to 50 years. The mean age of both myopic and hypermetropic individuals were 35.5 ± 16.00. The overall range of age was 20-50 years.

Gender	Frequency	Percentage	Cumulative Percentage
Female	88	58.3	58.3
Male	63	41.3	100.0
Total	151	100.0	

Table 1: Gender wise distribution

Age	Frequency	Percentage	Cumulative Percentage
20-30	59	39.0	39.0
31-40	55	36.4	75.6
41-50	37	24.5	100.0
Total	151	100.0	

Table 2: Age Distribution

Out of 151 individuals 30 (19.9%) with myopic refractive error were having IPD (59-61mm) and 50(33.1%) with IPD (62-64mm) and 71(47.0%) with IPD interpupillary distance in the range of (65-68mm). Above table no.4 showed that out of total 151 patients 52 (34.4%) with hyperopic refractive error were having IPD (59-61mm) and 68(45.0) with IPD (62-64mm) and 31(20.5mm) with intrapupillary distance in the range of (65-68mm).

IPD Measurements	Frequency	Percentage	Cumulative Percentage
59-61	30	19.9	19.9
62-64	50	33.1	53.0
65-68	71	47.0	100.0
Total	151	100.0	

Table 3: IPD Intrapupillary distance measurements in myopes

IPD Measurements	Frequency	Percentage	Cumulative Percentage
59-61	52	34.4	34.4
62-64	68	45.0	79.5
65-68	31	20.5	100.0
Total	151	100.0	

Table 4: IPD Interpupillary distance measurements in hypermetropes

Table 5 Revealed distribution of (IPD) interpupillary distance measurements in myopic and hypermetropic refractive error as their Mean ± SD. (IPD) interpupillary distance Mean ± SD for Myopic subjects was 62.00 ± 3.6 and 60.31± 3.12 for hypermetropic. Results showed that Mean values of Myopic refractive error was greater than that of hypermetropia. The mean values of interpupillary distance for myopes were greater for each age group than that of hypermetropia. Paired samples shows significant correlation between myopic and hypermetropic subjects with P < 0.01 value.

	Myopia Mean ± SD (IPD)	Hypermetropia Mean ± SD (IPD)
Overall =	62.00 ± 3.6	60.31 ± 3.12
Age		
20-30	60.00 ± 3.8	59.80 ± 3.10
31-40	63.00 ± 3.3	61.20 ± 3.2
41-45	66.50 ± 4.00	59.95 ± 3.00
Total = 151		

Table 5: Comparison of IPD in myopia and hypermetropia (Mean, Standard deviation)

Variables		IPD in Myopia	IPD in Hyperopia
IPD in Myopia	**Pearson correlation**	1	-0.322**
	P- Value		0.000
	Total number	151	151
IPD in Hyperopia	**Pearson correlation**	-0.322**	1
	P- Value	0.000	
	Total number	151	151

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion:

A study showed same results as achieved from this study. The results showed normal values and standard deviations for pupil span and IPD interpupillary distance in subject's age between one to nine months. Optimum values of pupil diameter and interpupillary distance (IPDs) were calculated in a population of 1322 subjects (in 4395 visits). Pupil diameter were measured by photographic readings, when the corneas brightened by 15.8 +/- 0.4 lux ambient illumination (i.e. under mesopic situations). IPD Interpupillary distance was measured with a centimeter distance rule while the individual fixated an object at 0.65m for distance[16]. The interpupillary distance is significant greater in myopes as compared to hyperopes it may be due to elongation of the eyeballi.e elongation of the eyeball[17]. A study was conducted in Turkey that based on the comparison of IPD between different Refractive errors. Total 1200 individuals were included in study, further underwent for IPD interpupillary distance measurement for both myopia and hypermetropia. Out of total 1200, 600 myopic and 600 hypermetropic subjects were analyzed further for IPD values. The mean age for myopic subjects were 42±15.00 and for hypermetropia 43.50±15.50. The mean IPD interpupillary distance for myopia was 64mm that was greater than 62.00mm in hypermetropia. The results were statistically significant with P<0.05[18]. A similar study showed that shortsightedness has high IPD interpupillary distance as compared to farsightedness or hypermetropia. .The mean age was 47.42±21.55 years, between 19 to 89 years. The mean IPD interpupillary distance was calculated as 61.5±4.0 mm (range 50-75). The mean IPD value was perceived to be suggestively greater among male subjects compared to females (P<0.05). The significant results attained in the comparison of IPD interpupillary distance in myopia and

hyperopia[19]. The myope had greater IPD interpupillary distance as compared to hyperopes[20]. The average corrected IPDs as a function of age were found to estimate another second-order regression equation: (males IPD = 42.36 + 1.653*age in year - 0.035*age in year 2, r2 = 0.976; females IPD = 42.76 + 1.881 *age in years - 0.042*age in years2, r^2 = 0.976). Male IPD interpupillary distance was wider than female IPD by an average of 1.57 mm ($p < 0.0002$). IPD Interpupillary distance is higher in myopia as compared to hyperopia. It was determined that pupil diameter and IPD raised more progressively than ocular axial length in the first few years. The normal values and standard deviation SD for both pupil size and pupil diameter measurement determined which decided that the study has important clinical insinuations as well as applications in the optical industry. This study proposed that myopia have more IPD interpupillary distance as compared to hyperopia and in squint/ Strabismus it was seen that in esodeviation IPD interpupillary distance was higher than exotropia[21].

Conclusion:

When mean values of myopic and hypermetropic individuals were compared for their (IPD) interpupillary distance values, statistically significant difference found. (IPD) interpupillary distance mean values was higher in myopic refractive error as compared to the hyperopia. Myopes bear wider range of interpupillary distance and nasal bridge measurements as compared to hypermetropes.

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