ORIGINAL ARTICLE

Frequency of amount and axis of astigmatism in subjects of Rawalpindi, Pakistan

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Abstract

Objective: To assess the frequency of amount and axis of astigmatism with respect to age and gender.

Methods: The prospective, observational study was carried out from September 2009 to January 2010 at Armed Forces Institute of Ophthalmology, Rawalpindi. Patients from 5-70 years of age were included from both genders with no previous history of eye abnormality, surgery or eye pathology. An auto refractor-keratometre was used for measurement. Descriptive statistics were used to analyse data on SPSS 15.

Results: Among the total 288 patients, with-the-rule astigmatism (n=21; 55%) had greater frequency in the 26-35 years sub-group. In terms of gender, 88 (48%); against-the-rule in 81 (44%); and oblique astigmatism in 14 (7.6%). In females, with-the-rule astigmatism was found in 52 (50%); against-the-rule in 36 (34.2%); and oblique in 17 (16%). The frequency of astigmatism ≥0.25 ranged from 0.8% (n=1) to 74% (n=28) across all age groups. The amount of astigmatism which was noted to be the most common and prominent in the sample was <1D.

Conclusion: The amount and axis of astigmatism varied within the age sub-groups and within the gender.

Keywords: Auto refractor, Keratometer, WTR, ATR, Oblique astigmatism, Prevalence. (JPMA 63: 1370; 2013)

Introduction

Astigmatism comes from Greek origin ("a" meaning absence and "stigma" meaning point). It is a refractive anomaly in which the parallel rays of light entering the eye through the refractive medium do not focus on a single point on the retina to give the sharp image of the object.

It may occur due to corneal and non-corneal factors or both (total astigmatism). Corneal factors include the difference in the radii of curvature of the principal meridians. The non-corneal factors include the lenticular errors, including the difference in the curvature, refractive index or position of the lens.[1]

Based on the focal point with reference to the retina, astigmatism is divided into simple astigmatism (simple myopic or simple hypermetropic), compound astigmatism (compound myopic or compound hypermetropic) and mixed astigmatism. Astigmatism is also classified on the relationship between the two principal meridians as regular (when two principal meridians are perpendicular to each other) and irregular (when the two principal meridians are not perpendicular to each other). Regular astigmatism can be with-the-rule (WTR) (≥0 to ≤30 or ≥150-≤180), against-the-rule (ATR) (≥60 to ≤120) or oblique (>30-60 or >120 to <150) astigmatism.[2]

It has various etiological factors. For example it is suggested to be inherited as an autosomal dominant trait having high concordance among the twins, with high risk in children whose parents have astigmatism.[3] Yet the evidence for the role of environmental factors in causing similar concordance is also suggested by Teikari.[4] Astigmatism varies with age,[5] gender[6] and ethnicity[7] leading to abnormal retinal electrophysiology,[8] meridonal amblyopia,[9] asthenopia, eye-strain, migraine, myopia and blindness.

According to global initiative 'Vision 2020: The Right To Sight', the World Health Organisation (WHO) has focussed on eliminating the preventable causes of visual impairment by year 2020 by avoiding and treating the likely factors causing decreased visual acuity, in which astigmatism and other refractive errors are the factors causing visual impairment up to 43% globally, including Pakistan.[10] The correction of these errors require the use of contact lenses, wearing glasses or going for the surgery which are very costly and uncomfortable means, causing discomfort to patients and exposing them to hazards like ulcerative keratitis from wearing eye lenses.[11] The costs of lost productivity and of rehabilitation and education of a visually impaired person constitute a significant economic burden for the individual, the family and society in a developing country like Pakistan. They may

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result in lost education and employment opportunities, lower productivity and impaired quality of life.[12]

The present study was conducted to determine the status of frequency of different types of regular astigmatism and the amount with relation to age sub-groups and gender.

Patients and Methods

The observational, prospective study assessed refractive statuses of 576 eyes of 288 patients. The amount and axis of astigmatism using Canon RK-1 ARK autorefractor-keratometre were assessed. Non-probability convenience sampling was done. Patients between the ages of 5 years and 70 years regardless of gender or ethnicity were included, who were then examined in the outpatient department of Armed Forces Institute of Ophthalmology (AFIO), Rawalpindi, from September 2009 to February 2010.

Informed written consent was taken prior to the procedure which was conducted in clean environment with the patient responding calmly to the instructions. Non-cycloplegic autorefraction was conducted and auto refractor-keratometre was used for recording the curvature of cornea and axis of astigmatism. The refractive error was recorded in minus cylinders and any error of ¼ diopters or more was considered significant for data analysis.

Those excluded were subjects with congenital anomalies or other diseases that affect visual acuity, pain, presence of marked facial asymmetry, pterygium, history of ocular surgery, ptosis, cataract, genetic predisposition, retinal detachment, discharge, any clinically significant retinal pathology, redness, glaucoma, optic neuropathy, watering of eyes, and optic disc pathology.

The subjects were divided into six age sub-groups by decades (5-15, 16-25, 26-35, 36-45, 46-55, >56). Astigmatism was classified on the basis of relationship between the two principal meridians as regular (when two principal meridians are perpendicular to each other) and irregular (when the two principal meridians are not perpendicular to each other). Regular astigmatism was further determined as With the Rules (WTR) ($\geq$0 to $\leq$30 or $\geq$150-$\leq$180), Against the Rules (ATR) ($\geq$60 to $\leq$120) or oblique (>30-60 or >120 to <150). The axis of the cylindrical component was regarded as being WTR if the minus-cylinder axis was at 180±30º, ATR if the minus-cylinder axis was at 90±30º or oblique (i.e., other than either WTR or ATR).

Statistical analysis was done on SPSS version 15. Variables were compared using chi-square test. A P value of <0.05 was considered statistically significant for the comparison of numerical variables between different axis of astigmatism classified as WTR, ATR and oblique astigmatism.

Results

Of the total, 183 (64%) were males and 105 (36%) were females. The data was further grouped in 6 sub-groups of age, and the frequency of amount and axis of astigmatism was then calculated for individual age sub-groups and gender.

Table-1: Type of regular astigmatism with relation to age (p<0.002).

Age	N	With the rule	%	Against the rule	%	Oblique	%
5-15	41	19	46	20	49	2	5
16-25	121	64	53	53	44	4	3.3
26-35	38	21	55	10	26	7	18
36-45	23	9	39	10	43	4	17.3
46-55	34	18	53	11	32	5	15
56 and above	31	9	29	13	42	9	29
Total	288	140	49	117	41	31	11

Table-2: Amount of astigmatism with relation to age (p<0.02).

Age	n	<1D	%	1-<2D	%	2-<3D	%	3-<4D	%	4-<5D	%	>5D	%
5-15	41	18	44	19	46	3	7	0	0	0	0	1	2
16-25	121	55	45	45	37	14	12	6	5	0	0	1	0.8
26-35	38	28	74	8	21	2	5	0	0	0	0	0	0
36-45	23	14	61	7	30	2	9	0	0	0	0	0	0
46-55	34	24	71	4	12	5	15	0	0	0	0	1	3
56 and above	31	17	55	5	16	7	23	2	6	0	0	0	0
Total	288	156	54	88	31	33	11	8	3	0	0	3	1

Table-3: Amount of astigmatism with relation to Gender (p<0.05).

Gender	n	<1D	%	1-<2D	%	2-<3D	%	3-<4D	%	4-<5D	%	>5D	%
Females	105	65	62	23	22	15	14	2	2	0	0	0	0
Males	183	91	50	65	36	18	10	6	3	0	0	3	2
Total	288	156	54	88	31	33	11	8	3	0	0	3	1

The age wise distribution of the type of astigmatism in which the type of astigmatism most frequently found in the sample irrespective of the gender was WTR astigmatism for younger age groups, being most frequent in 26-35 years sub-group of age (n=21; 55%), and as the age group increased, ATR and oblique astigmatism were seen in the subjects (Table-1). ATR astigmatism was most frequent in age group 5-15 years (n=20; 49%; p<0.002). WTR astigmatism (n=140; 49%) was more than ATR astigmatism (n=117; 41%). Oblique astigmatism was found to be the least (n=31; 11%).

A similar trend of dominant WTR astigmatism was seen in the female gender (n=52; 50%). ATR was seen in 36 (34.2%) and oblique astigmatism in 17 (16%).

WTR astigmatism was found in 88 (48%) males while ATR was found in 81 (44%) and oblique in 14 (7.6%). Astigmatism was noted more among female subjects in the sample than males (p<0.04).

With the increase in age, there was no difference noticed in the amount of astigmatism in the sample (Table-2). It remained between 1-2D with very little fluctuation.

Females were found to be more astigmatic than males in all the powers from <1 to >5 (p<0.05) (Table-3). Irrespective of their ages, the two genders showed more frequency of 1-2 D. Females had more frequency of showing variation in the amount of astigmatism in the sample than the males.

Discussion

In the present study the relation of age and gender with the amount and axis of astigmatism was noted. In the children from age 5-15 years, WTR astigmatism was found to be more frequent i.e. the axis varied ± 15-30^{o} from 180 principal meridian, which is in agreement with other studies conducted on the refractive errors of children. The frequency of astigmatism ≥1D was found less in children below the age of 15 years as also explained by a study[13] of different age-related functions of astigmatism in Chinese pre-school children and in other related studies like in Singapore, in which children showed more of <1D of astigmatism, with WTR type dominanting.[14]

There was no prominent trend of continuous decrease or increase in the frequency of amount and axis of astigmatism with the increasing age seen in the current study. The amount and axis differed for each age group separately. Two peaks were observed in the frequency of amount as well in the type of astigmatism in the young adults 16-25 years and elderly 45 years and above which was also demonstrated by a study in Hong Kong.[15]

With the increasing age, the trend of WTR astigmatism shifted towards ATR astigmatism and oblique astigmatism.[16] This can be due to age-related changes in the vertical/horizontal meridians of eye and may also be because of the age-related changes in the corneal curvature, lens and axial length which are known to promote astigmatism. The shift of astigmatism towards ATR is a byproduct of all age-related changes. Age group 60 and above showed more inclination towards ATR and oblique astigmatism, as rightly said by Elinborg Gudmundsdottir that WTR astigmatism is not the rule for elderly, while the amount of astigmatism predominated in the range from 0.25 to 2D, in agreement with other studies describing the amount of astigmatism in the elderly.[17,18]

Male acuity is considered to be better than the female, which was consistent with the current study, showing a greater number of astigmatic females in the sample and with greater variability in the amounts of astigmatism than males. Elinborg Gudmundsdottir and other researches who tried to find the influence of gender on astigmatism also found the relevant findings that astigmatism has gender-related distribution in the subjects.[19-21] In a study conducted in Peshawar on children reflected that males were better than females with respect to the refractive errors such as astigmatism, myopia etc.[22] It was contrary to the study conducted in Iran where the males were found more astigmatic than females in the sample.[23]

Conclusion

The amount and axis of astigmatism varies with the age sub-groups and within gender.

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References

1. Bennet AG, Francis JL. Ametropia and its correction. In: Davson H (ed.). The Eye: Visual Optics and the Optical Space Sense. Vol 4. New York: Academic Press; 1962; pp 145-9.
2. Harvey EM, Dobson V, Miller JM. Prevalence of high astigmatism, eyeglass wear, and poor visual acuity among the Native American grade school children. Optom Vis Sci 2006; 83: 206-12.
3. Hashemi H, Hatef E, Fotouhi A, Mohammad K. Astigmatism and its determinants in the Tehran population: the Tehran eye study. Ophthalmic Epidemiol 2005; 12: 373-81.
4. Grosvenor T. Etiology of astigmatism. Am J Optom Physiol Opt 1978; 55: 214-8.
5. Sorsby A, Sheridan M, Leary GA. Refractions and its components during growth of the eye after the age three. Med Res Council Special Rep Ser 1962; 301: 1-18.
6. Czepita D, Goslawski W, Mojsa A. Astigmatism among students ranging from 6 to 18 years of age. Klin Oczna 2004; 106: 61-3.
7. Kleinstein RN, Jones LA, Hullett S, Kwon S, Lee RJ, Friedman NE, et al. Refractive error and ethnicity in children. Arch Ophthalmol 2003; 121.
8. Gwiazda J, Grice K, Held R, McLellan J, Thorn F. Astigmatism and the development of myopia in children. Vision Res 2000; 40: 1019-26.
9. Somer D, Budak K, Demirci S, Duman S. Against-the-rule (ATR) astigmatism as a predicting factor for the outcome of amblyopia treatment. Am J Ophthalmol 2002; 133: 741-5.
10. World Health Organization. Global Data on Visual Impairment 2010. Geneva, Switzerland: WHO Press; 2012. [Online] Last updated on 5-1-2013. (Online) (Cited 2013 January 6). Available from URL: http://www.who.int/blindness/GLOBALDATAFINALforweb.pdf.
11. Schein OD, Glynn RJ, Poggio EC, Seddon JM, Kenyon KR. The microbial keratitis study group. The relative risk of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses: a case-control study. N Engl J Med 1989; 321:773-8.
12. Haroon A, Sadia MM, Niaz UK. The economic burden of blindness in Pakistan: a socio-economic and policy imperative for poverty reduction strategies. Indian J Ophthalmol 2012; 60: 358-64.
13. DS Fan, SK Rao, EY Cheung, M Islam, S Chew. Astigmatism in Chinese preschool children: prevalence, change, and effect on refractive development. Br J Ophthalmol 2004; 88: 938-41.
14. Tong L, Saw SM, Carkeet A, Chan WY, Wu HM, Tan D. Prevalence rates and epidemiological risk factors for astigmatism in Singapore school children. Optom Vis Sci 2002; 79: 606-13.
15. Leung TW, Lam AK, Deng L, Kee CS. Characteristics of astigmatism as a function of age in a Hong Kong clinical population.Optom Vis Sci 2012; 89: 984-92.
16. Hirsch MJ. Changes in astigmatism after the age of forty. Am J Optom Arch Am Acad Optom 1959; 36: 395-405.
17. Gudmundsdottir E, Jonasson F, Jonsson V, Stefansson E, Sasaki H, Sasaki K. 'With the rule' astigmatism is not the rule in the elderly. Reykjavik Eye Study: a population based study of refraction and visual acuity in citizens of Reykjavik 50 years and older. Iceland-Japan Co-Working Study Groups. Acta Ophthalmol Scand 2000; 78: 642-6.
18. Leighton DA, Tomlinson A. Changes in axial length and other dimensions of the eyeball with increasing age. Acta Ophthalmol 2012; 50: 815-26.
19. Attebo K, Mitchell P, Smith W. Visual acuity and the causes of visual loss in Australia. The Blue Mountains Eye Study. Ophthalmology 1996; 103: 357-64.
20. Satterfield DS. Prevalence and variation of astigmatism in a military population. J Am Optom Assoc 1989; 60: 14-8.
21. Katz J, Tielsch JM, Sommer A. Prevalence and risk factors for refractive errors in an adult inner city population. Invest Ophthal Vis Sci 1997; 38: 334-40.
22. Malik R, Rahil N, Khan O. Prevalence of refractive errors in school going children in age group of 11-15 years. Ophthalmology Update 2011; 9: 26-9.
23. Hashemi H, Khabazkhoob M, Yekta AA, Jafarzadehpur E, Emamian MH, Shariati M, et al. High prevalence of astigmatism in the 40- to 64-year-old population of Shahroud, Iran. Clin Experiment Ophthal 2011; 40: 247-54.