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ORIGINAL RESEARCH

Study visual field abnormalities associated with different types of Amblyopia

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ABSTRACT

Introduction: The medical word for sluggish eye is amblyopia. Treatment for amblyopia, the medical word for lazy eye, have been documented since before 900 A.D. "Amblyopia is a condition in which a person's best-corrected visual acuity (BCVA) is reduced unilaterally or (rarely) bilaterally due to a lack of form vision and/or aberrant binocular interaction with no visible pathology of the eye or visual pathway."

Method: An evaluation of the current study was conducted on78 amblyopic patients who visited the Kalinga Institute of Medical Sciences and Hospital in Bhubaneswar's ophthalmology outpatient department. All patients were included for the current study who were diagnosed to have amblyopia and informed consent, going in age from 10 to 50 years and of both genders.

Result: During my two-year study period, 8600 new cases visited the Kalinga Institute of Medical Sciences and Hospital's Eye OPD. There was a sum of 78 amblyopia cases diagnosed. Due to such issues, the prevalence rate is 0.9 percent. Six of the 45 anisometropic individuals had a normal field, while the other 39 suffered from widespread depression. Three of the thirty participants had a normal field, 21 had global depression, 6 had a misplaced blind spot, and 15 had a central scotoma; some had several abnormalities.

Conclusion: The prevalence rate of amblyopia was 1.1 percent in population-based regional studies in India connected to childhood blindness and the common occurrence of refractory mistakes (V Kalikiyavi et al)14, whereas it was 4.4 percent in a study on urban population by GV Murthy et al15. According to a Chinese study by Andrey Chia et al16 and Jing Fu et al17, the prevalence ranged from 0.8 percent to 2.5 percent in different subsets of individuals in the south Asian region.

Keywords: Amblyopia, visual acuity, Anisometric amblyopia, Strabismic amblyopia, mixed amblyopia

INTRODUCTION

Amblyopia (from the Greek words amblyos, which means dull, and opia, which means vision, which means dull vision) is a most contentious area in ophthalmology. Though extensive clinical evaluations have been documented from time to time, only a few data relating to automated perimeter visual field examination in amblyopia are now accessible.

Amblyopia is defined as "a unilateral, or (rarely) bilateral, loss in best-corrected visual acuity (BCVA) due to form vision deprivation and/or improper binocular interaction where there is

no apparent pathology of the eye or visual pathway," according to Kanski (2020). Hugonnier et al described amblyopia as "low visual acuity not explained or insufficiently explained by an organic lesion of the fundus or the media" in 1969.

According to Schiefer et al, Von Graefe defined it as "the condition in which the spectator sees nothing and the sufferer perceives very little" (2005). "The field of vision is defined as a region of space within which the constantly fixating eye may sense light," wrote Traquair. St. Louis4 in 1957. It's a projection of all the locations in the retina that can cause visual sensations outward."

The spatial limit of visual discrimination is referred to as visual acuity, which is considered a measure of form sense. Visual acuity is the evaluation of the threshold of discrimination between two spatially distant targets in clinical practice. According to Dr A K Khurana, 4th edition of Theory and Practice of Optics and Refraction, it is a function of Fovea Centralis. "Visual acuity is sharpest at the top of the hill (the fovea) and then gradually falls towards the periphery, with the nasal slope being steeper than the temporal". According to Kanski 9th Edition, the blind spot is "located temporally between 10^0 and 20^0 on the site of fixation."

Binocular input to individual neurones, which is central to the partial decussation of optic nerve fibres, is possible at different points in the optic chiasma. However, just a few cells in LGN's first synaptic relay can be stimulated by visual inputs presented to either eye. In reality, there are laminae in the nucleus, each of which receives primary input from the eyes (Kaas, Guillery and Allman, 1972). The visual cortex's majority of neurons get excitatory input in both eyes, and each cell has a unique stimulus or trigger feature that causes it to respond. The response to orientations is different based on the classifications of cells, however, it is synonymous to both eyes. These binocular cortical cells appear to facilitate binocular depth discrimination.

Cortical neurones have typical orientation selectivity in a monocularly deprived kitten, but there exists only one way to control every cell is through the visually experiencing eye when seen practically. The visual image that deteriorates in one eye is a particularly potent cause of amblyopia in humans newborns. Anisometropia, aniseikonia, and squint can virtually likely cause losses of binocularity in the visual brain of humans newborns due to inconsistencies in both retinal pictures. Keeping in mind the visual field abnormalities in amblyopia, it is now clear that various categories of ganglion cells tend to have different receptive fields in the retinal area, and that they manifest distinctive forms of visual field abnormalities as their number and cell shrinkage to varying degrees in various forms of amblyopia.

METHODS

Average normal visual field isopters (Visual field in degrees)

Size	Distance	Isopter notation	Visual angle	Temporally	Inferiorly	Nasally	Superiorly
White:							
1 mm	330	1/330	10.32[1]	80	60	55	50
2 mm	330	2/330	20.70[1]	85	65	60	50
3 mm	330	3/330	31.08[1]	90	70	60	60
5 mm	330	5/330	51.60[1]	100	80	60	60
40mm	330	40/330	60.56[1]	110	80	60	60
Green:							
3 mm	330	3/330	31.08[1]	18	12	18	10
5mm	330	5/330	51.60[1]	`30	24	18	18
Red:							
3mm	330	3/330	31.08[1]	39	15	15	15
5mm	330	5/330	51.60[1]	45	29	23	26

Blue:							
3 mm	330	3/330	31.08[1]	63	30	30	25
5 mm	330	5/330	51.60[1]	75	46	38	38

Perimetry can be defined as an investigation of the visual field. It is categorised into two forms:

1. Kinetic perimetry is an estimate of the vision hill's boundaries in two dimensions. A line is traced to represent the perception point after a moving stimulus of known brightness or intensity is presented at a consistent speed from a not-seeing region to a seeing (visualised) region along the different meridian (hours of the clock). By connecting these dots along distinct meridian lines, the construction of an isopter takes place due to the intensity of the stimulus. The visual field can be mapped as a contour map with a variety of different isopters based on stimuli of varying strengths. Simple confrontation, the tangent screen, the Lister perimeter, and the Goldman perimeter could all be utilized.
2. Static perimetry: This test measures the height (differential sensitivity levels of light) of a predetermined area of a visual hill in three dimensions. To determine a vertical border of the visual field, static perimetry requires presenting non-moving stimuli of varied luminance in the same spot.

The N-methyl-D-aspartate (NMDA) receptors may have a role in neural plasticity in the developing visual cortex; the number of NMDA receptors in these tissues has a temporal relationship with plasticity, peaking at the critical period. Experimental investigations in monkeys have shown that disruption of binocular vision early in life has a long-term effect. A child who develops continuous esotropia shortly after birth, normal stereo acuity is hard to regain.

STATISTICS

The acuity profile perimetry by Johnson perimeter shows a higher overall loss in sensitivity, with a significant loss at and around fixation. As a result, the acuity profile shows a significant central scotoma, although the static profile is quite flat over the central visual field. At no point in the visual field could the acuity profiles be measured. Acuity sensitivity was shown to be much lower in people with strabismic amblyopia than static threshold sensitivity. Within the middle 2° or 3° from fixation, the acuity profile loss was the most significant.

Peripheral field anomalies in amblyopic eyes have been discovered using stimuli other than light foci. Studies conducted upon the contrast grating resolution, for instance, by Sireteanu and Fronius, had found nasal field abnormalities with strabismic amblyopia in individuals. Along with this, paracentral and central abnormalities have also been witnessed among anisometropic amblyopia patients.

The current study was based on the evaluation of 78 amblyopic patients who went to the Kalinga Institute of Medical Sciences and Hospital in Bhubaneswar's ophthalmology outpatient department.

INCLUSION CRITERIA

For this investigation, all subjects with diagnosed amblyopia and informed consent between the ages of 10 and 50 years, of both sexes, were chosen. Two out of every three cases in the stimulus deprivation group were removed from the current investigation due to poor visual acuity, as measured by counting fingers close to the face and visual acuity which was lower than 6/36. Thus, there was just a single patient in the stimulus deprivation amblyopia group, and no statistical analysis could be possible on them.

Based on types of amblyopia, patients were placed into three groups in this investigation. Patients diagnosed with strabismic amblyopia had either a background marked by manifest

strabismus or by eye muscle surgery, also as no anisometropia that could cause amblyopia. Patients having anisometropia were delegated having anisometropic amblyopia on assumption that they had a distinction in round likeness more than 1.0D, a differentiation in the meridional cylinder of 1.5D, or a slanted cylinder of 1.0D, or a mix of any of these filed either during evaluation or as of now by cycloplegic refraction. Finally, individuals were classed as having deprivation amblyopia in the event found having blockage to the section of light covering the visual axis, for example, monocular congenital cataract serving as stimulus deprivation under the age of five, and the obstruction was absent at the hour of assessment.

The Humphrey Visual Field Analyzer in the eye department of Kalinga Institute of Medical Sciences and Hospital, Bhubaneswar, was utilised to test the visual field in this investigation. Model: HFA // 720-4289-A12.3/A12.3

The following strategy was employed: Full-threshold strategy 30-2 SITA Standard was the programme utilised.

Analyses were conducted as two-tailed scenarios, with a statistically significant p-value of 0.05. The level of a link between different parameters where the same group of eyes was assessed using Spearman's rank correlation, with (Rho) values of 0.7 and above deemed high correlation and 0.4 and above considered fair correlation. Microsoft Excel 97 and Statistics 6 were adopted for conducting the analysis.

RESULT

Two-tailed scenarios were used in the analyses, with a statistically significant p-value of 0.05. Spearman's rank correlation was adopted to determine the degree of the link between different metrics among the same group of eyes, with (Rho) values of 0.7 and above deemed strong correlation and 0.4 and above rated fair correlation. The analysis was undertaken using Microsoft Excel 97 and Statistics 6.

Table: 1 The different types of Amblyopia prevalent among the sample:

Types	Groups	Number (n=78)	Percentage (%)
Anisometropic	I	45	57.69
Strabismic	II	30	38.46
Stimulus Deprived	III	3	3.84

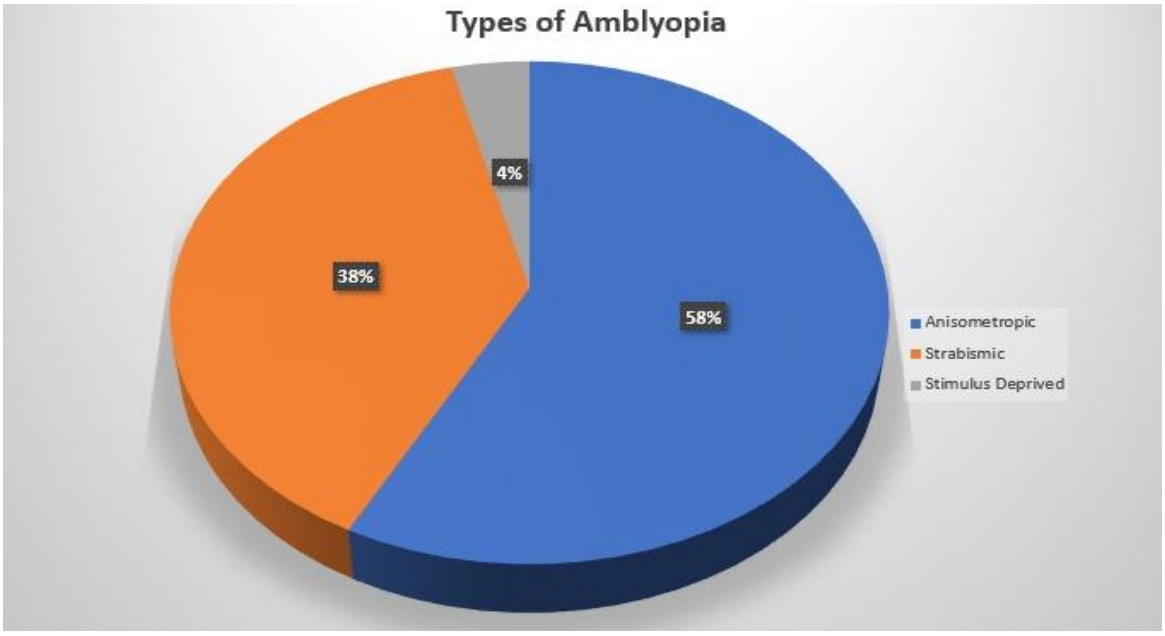

Figure 1: Prevalence levels of the types of Amblyopia

Table: 2 Distribution of age groups according to the kinds of amblyopia

Age Group (years)	Anisometropic	Strabismic	Stimulus Deprived	Total	Percentage (%)
10-20	18	6	0	24	30.76
21-30	15	15	3	33	42.30
31-40	9	6	0	15	19.23
>40	3	3	0	6	7.69
Total	45	30	3	78	

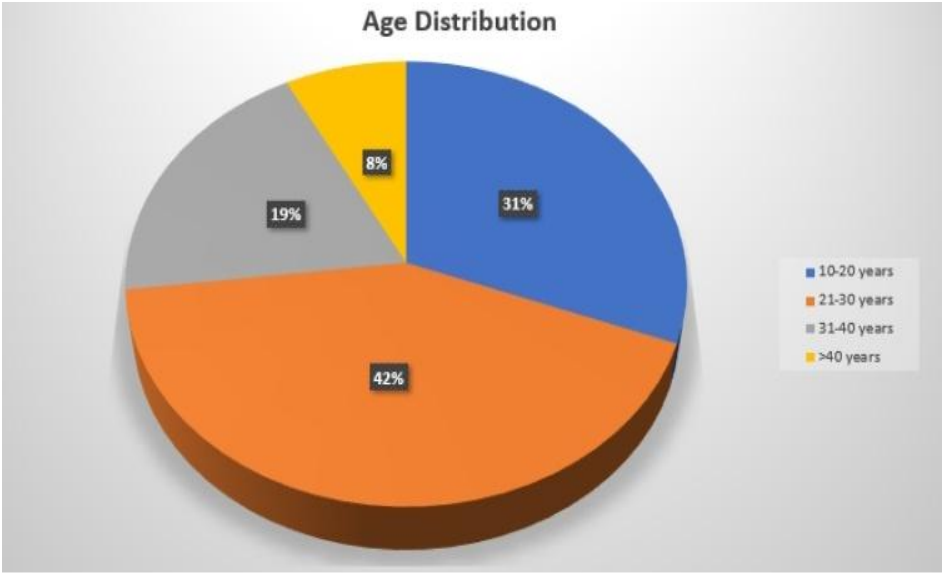

Figure 2

Table: 3 Distribution of sex according to the kinds of amblyopia

Sex	Anisometropic	Strabismic	Stimulus Deprived	Total	Percentage (%)
Male	30	27	3	60	76.92
Female	15	3	0	18	23.08
Total	45	30	3	78	

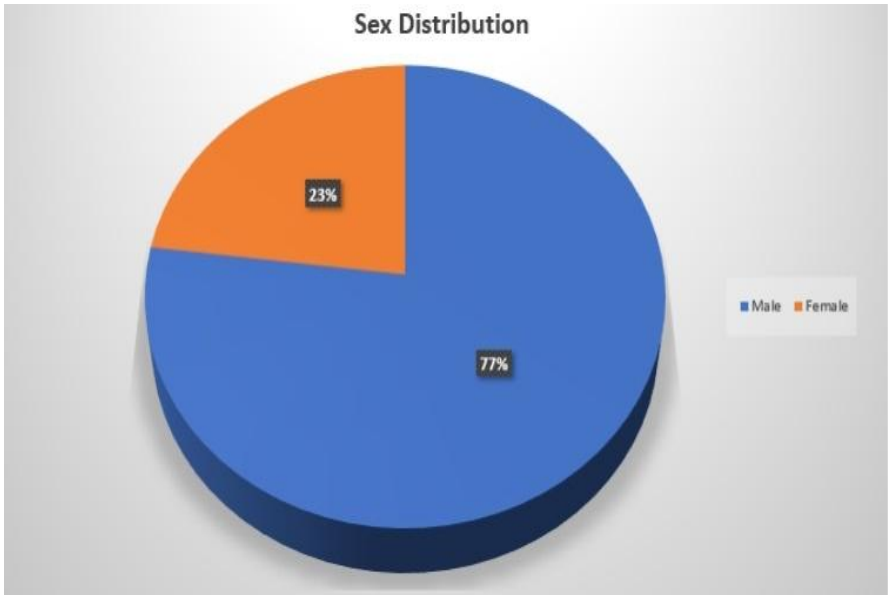

Figure: 3

Table: 4 A summary of automated field abnormalities

Type of abnormality	Normal	Central scotoma	Displaced blind spot	Generalized depression
Anisometropic n =45	6 13.33%	-	-	39 86.67%
Strabismic n =30	3 10%	15 50%	6 20%	21 70%
Stimulus deprivation n = 1	-	-	-	1 100%

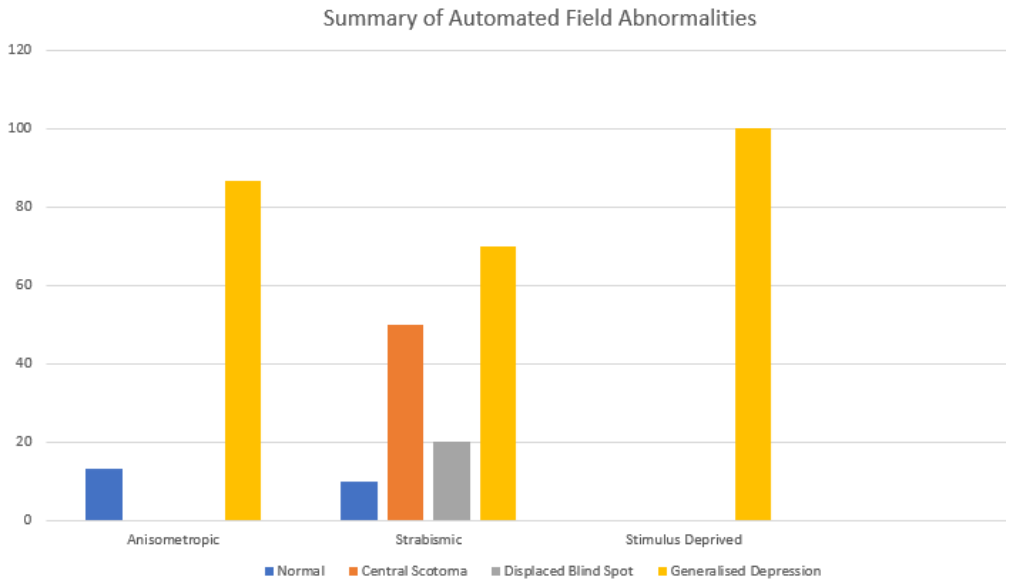

Figure: 4

Table-5A &5B Comparison of Snellen's acuity/visual acuity in the amblyopic eyes between the two groups of amblyopia: Group-I is the Anisometropic amblyopia & Group-II is the Strabismic amblyopia.

Table-5A

Visual acuity	Group-I	Group-II	Row totals
6|12	21 87.50%	3 12.50%	24
6|18	15 100%	0 0%	15
6|24	3 33.33%	6 66.67%	9
6|36	6 22.22%	21 77.78%	27
Totals	45	30	75

Chi-square test *p* value= 0.007

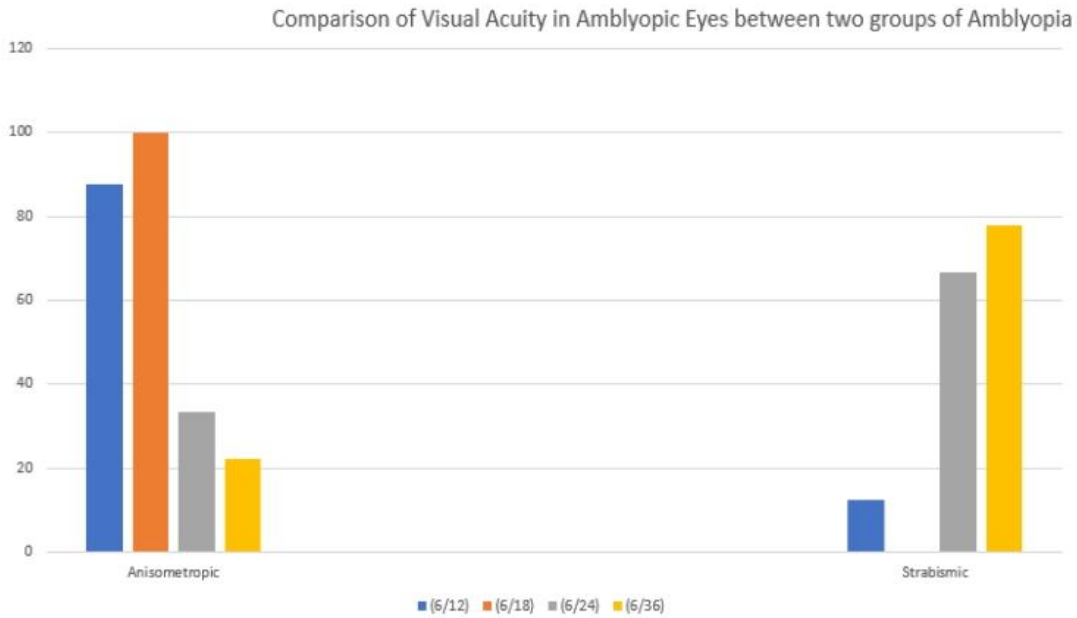

Figure 5A: Visual Acuity in types of amblyopia in the sample

Table-5B Range of visual acuity according to the kinds of amblyopia

Visual acuity	Group-I	Group-II	Row totals
6|12-6|18	36 (80%)	3 (10%)	39
6|24-6|36	9 (20%)	27 (90%)	36
Totals	45	30	75

Fishers exact test *p* value=0.001

In the fellow eyes, VA was 6/6 in all the 78 patients under study.

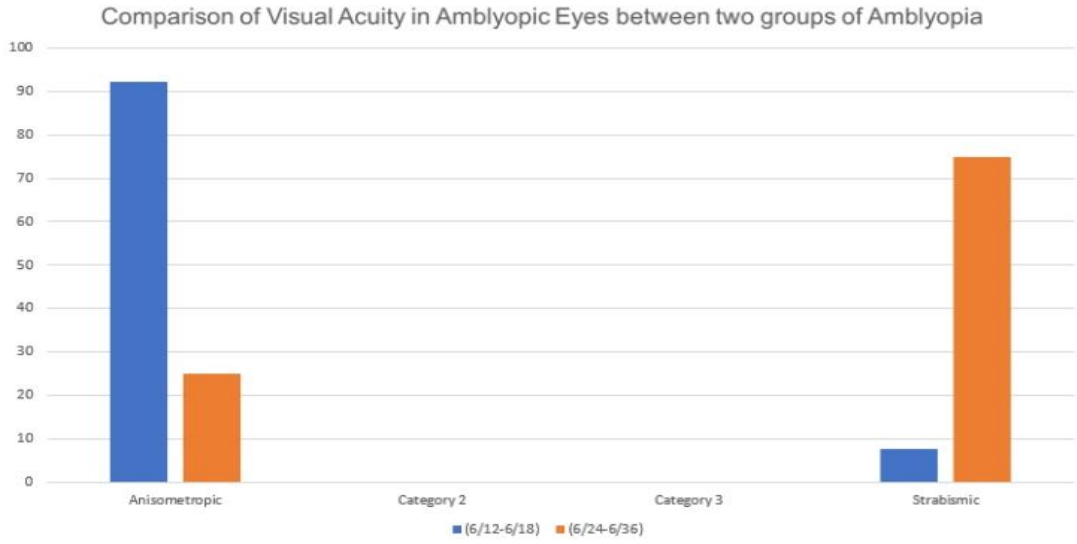

Figure 5B: Shows range of Visual Acuity in different types of Amblyopia

DISCUSSION

In a two-year study on amblyopia undertaken at the Kalinga Institute of Medical Sciences and Hospital in Bhubaneswar, a total of 78 cases were detected (September 2018- September 2020). Amblyopia affects 0.9 percent of the population, with 76.92 percent of males and

23.08 percent of females affected. Almost three-quarters of the patients were under the age of 30.

Anisometropic Amblyopia was shown to be much common in people under the age of 20. Anisometropic Amblyopia (45 instances; 57.6%), Strabismic Amblyopia (30 cases; 38.46 percent), and Stimulus Deprivation were the three forms of Amblyopia identified by automated perimetry (3 cases; 3.84 percent).

Anisometropic Amblyopia-Generalized Depression (39 cases; 86.67 percent) was identified, with Normal results in 6 cases (13.33 percent). Generalised Depression, Central Scotoma, and Displaced Blind Spot were detected in 21 (70%) cases, 15 (50%) cases, and 6 (20%) cases, respectively, with Normal results in three cases (10 percent). When compared to several forms of visual field defects in the Strabismic Amblyopia group, Generalised Depression is the prominent type of visual field defect (86.67 percent) (46.67 percent of Generalised Depression, 33.33 percent of Central Scotoma, 13.33 percent of Displaced Blind Spot).

In 36 out of 45 instances (80%), individuals with anisometropic amblyopia had the best visual acuity of 6/12 to 6/18, compared to 3 out of 30 cases (10%) in the Strabismic Amblyopia group. In 83.78 percent of people with strabismic amblyopia, their visual acuity was between 6/24 and 6/36.

CONCLUSION

Amblyopia is a condition that affects individuals of all ages. The prevalence of a visual field imperfection isn't restricted to the centre visual field; it can likewise be located on the periphery visual field.

Visual acuity loss is less in Anisometropic Amblyopia, which is essentially connected with generalised depression, than in Strabismic Amblyopia, which is related to a variety of visual field defects like Generalized Depression, Central Scotoma, and Displaced Blind Spot.

In a wide range of amblyopia, all visual indices (Foveal Threshold, Mean Deviation, and Average Threshold) are lower than in healthy eyes. In Amblyopia circumstances, central vision is a dependable indicator of fringe field irregularities.

REFERENCES

1. Kanski JJ: Clinical Ophthalmology. 9th Ed. John F. Salmon. Elsevier, 2020, p.707.
2. Hugonnier, R. and clayette-hugonnier S. Strabismus, heterophoria, ocular motor paralysis-clinical ocular muscle imbalance, II Fresh Edition translated and edited by S, Veronneau-Troutman. St. Louis, Mosby Year book, 1969, Inc. p.155.
3. Schiefer U, Patzold J, Dannheim F. Konventionalle Perimetrie Teil I: Einfuhrung Gruntbegriffe. Derma Ophthalmology. 2005; 102(6): 627-646.
4. Scott GI. Traquair's Clinical Perimetry. 7th Ed. St. Louis, C.V. Mosby, 1957.
5. Kanski JJ. Clinical Ophthalmology. 9th Edition. John F Salmon. Elsevier 2020.
6. Khurana A.K. Theory and Practice of Optics and Refraction. 4th Edition, Elsevier, 2018.
7. Mehdorn E. Nasal field defects in strabismic amblyopia. Doc Ophthalmology. 1986; 45: 318-329.
8. Philipp W, Mayer W. Investigation of visual field defects in strabismic and anisometropic amblyopes with the Octopus Program G1. Graefes Arch Clin Exp Ophthalmology. 1989; 227: 448-454.
9. Sireteanu R, Fronius M. Human amblyopia: structure of the visual field. Exp Brain Res. 1990; 79: 603-614.
10. Duke-Edler ST, Wybar K. Ocular motility and strabismus. In: Duke-Elder ST, editor. System of ophthalmology. Volume 6. St Louis: Mosby, 1973; 3-851.
11. Donahue SP, Wall M, Kutzko KE and Kardon RH. Automated perimetry in amblyopia: a generalized depression. Am J Ophthalmology. 1999; 127: 312-321.

12. Lachenmayr B. Ophthalmologe. May 2006. 103(5): 373-381.
13. Grzybowski A. Acta Ophthalmologica. 86 (s243). 4th September, 2008.
14. Kalikiyavi V, Naduvilath TJ, Bansal AK, Dandona L. Visual Impairment in school children in South India. Indian Journal of Ophthalmology. 1997; 45: 129-134. PubMed.
15. Murthy GV, Gupta SK, Ellwein LB, Munoz SR, Pokharel GP, Sanga L et al. Refractive Errors in an urban population in New Delhi. Invest Visual Science. 2002; 43: 623-631. PubMed.
16. Chia A, Lin XY, Dirani M, Gazzard G. Risk factors for Strabismus and Amblyopia in young Singapore Chinese children. Ophthalmic Epidemiology. 2013; 20(3): 138-147. PubMed.
17. Fu J, Li SM, Liu LR, Li JL. Prevalence of Amblyopia and Strabismus in a population of 7th grade junior high school students in central china. The Anyang Childhood Eye Study (ACES), Ophthalmic Epidemiology. 2014; 21(3): 197-203. PubMed.
18. Donahue SP, Wall M, Stanek KE. Motion perimetry in anisometropic amblyopia: elevated size thresholds extend into the mid periphery. J Am Assoc Paediatric Ophthalmology. Strabismus. 1998; 2: 94-101.
19. Donahue SP, Kardon RH, Moore P. Automated pupil perimetry in amblyopia: generalized depression in the involved eye. Ophthalmology. 1997; 104: 2161-2167.
20. Donahue SP, Arthur B, Nelly DE, Arnold RW, Silbert D, Ruben JB. Guidelines for automated preschool vision screening: A 10-year, evidence-based update. Journal of AAPOS. 2013; 17: 4-8.
21. Simmers AJ, Grey IS, McGraw PV, Winn B. Functional visual loss in Amblyopia and the effect of Occlusion Therapy. Invest Ophthalmology Vis Sci. 1999; 40: 2859-2871.
22. Mueller I, Mast H, Sabel BA. Recovery of visual field defects: A large clinical observational study using vision restoration therapy. Restorative Neurology and Neuroscience. 2007; 25: 563-572.
23. Rahi JS, Logan S, Timms C, Eggitt IR, Taylor D. Risk, causes and outcomes of visual impairment after loss of vision in the non-amblyopic eye: A population-based study. THE LANCET. 2002 August 24; 360. www.thelancet.com.
24. Statistica version 6.0 by Stat Soft, Inc., Tulsa, Oklahoma. 2001(www.statsoft.com).
25. Faghihi M, Hashemi H, Nabovati P, Saatchi M, Yekta A, Rafali S. The prevalence of Amblyopia and its determinants in a population-based study. Journal Strabismus. 2017; 25(4): 176-183.
26. Fayi KA, Alahmari D, Al-Falki YH. Prevalence of Amblyopia and its impact on academic performance of male medical students in southern Saudi Arabia. Saudi Journal of Ophthalmology. Elsevier. Oct-Dec, 2018; 32(4): 290-294.
27. Levi D.M. Klein, S.A. (1985). Vernier acuity, crowding and amblyopia. Vision Research, 25, 979-991. PubMed.
28. Birch, E. E. Swanson, W.H. (2000). Hyperacuity deficits in anisometropic and strabismic amblyopes with known ages of onset. Vision Research, 40, 1035-1040. PubMed.