Original Article

Comparison Of Stereopsis And Contrast Sensitivity In Myopic And Hyperopic Anisometropia.

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BACKGROUND: Good vision has always been important for mankind; ancient activities like hunting and fishing require the same eye quality as driving a car or flying an airplane. A significant loss of vision occurs resulting in a poor quality of life. If there is difference of more than 2D in the total refractive power of both eyes considered as anisometropia. Anisometropia results in aniseikonia which causes disturbance in the fusion of slightly two different images seen by each eye. As fusion is disturbed, stereopsis (depth perception) is also disturbed. To asses functional vision contrast sensitivity function can be a helpful tool especially when careful evaluation is essential other than specified by visual acuity.

OBJECTIVE: To compare stereopsis and contrast sensitivity in myopic and hyperopic anisometropia and evaluate any difference in contrast sensitivity and stereopsis in different degrees of myopic and hyperopic anisometropic correction.

PATIENTS AND METHOD: A comparative cross sectional study was conducted on 31 patients having different degree of myopic and hyperopic anisometropia and its influence on contrast sensitivity and stereopsis. Distance (6m) and near (33 cm) visual acuity was measured by using Snellen distance and near visual acuity chart and contrast sensitivity was measured by using Pelli Robson contrast sensitivity chart. Stereopsis was measured by Lang1, Lang2 and Frisby. Results were obtained by asking the patient to fill a structured Performa.

RESULTS: Contrast sensitivity was affected more in hyperopic anisometropic patients than in myopic anisometropia patients. Mild and moderate myopic patients showed normal contrast sensitivity while severe myopes have reduced contrast sensitivity. Hyperopes have reduced contrast sensitivity as compared to myopes. Moreover binocular contrast was better than monocular contrast. By comparing pre and post examination results of anisometropic patients showed that there was significant improvement in stereopsis (depth perception) at Lang1 test, Lang2 test and at Frisby test in anisometropes.

CONCLUSION: It was concluded that myopic and hyperopic anisometropes show reduced contrast as compared with emmetropes. Mild and moderate anisometropes have significant contrast with and without optical correction. Severe anisometropes have insignificant contrast sensitivity visual function without optical correction which can be improved by wearing optical correction. Binocular contrast was better than monocular contrast sensitivity. Stereopsis in isoametropes was better than anisometropes. Stereopsis decreased as degree of anisometropia increased.

INTRODUCTION:

Anisometropia is the difference in refractive status of both eyes that is also linked with major visual problems including misalignment of eyes, aniseikonia and loss of depth perception.[1] Binocular single vision is a state when both eyes are stimulated at the same time to see the object of interest precisely. It includes 3 parts: first, simultaneous perception (both eyes receive the image at the same time), second, fusion (the ability of visual cortex to fuse the images from each eye acting as a glue to present them as a single image) and third, stereopsis (the ability of visual system to perceive depth of image).[2]

Contrast sensitivity: contrast sensitivity is the ability to detect, differentiate or identify objects that vary slightly in relative luminance, difference in contrast sensitivity is due to the differences in sensitivity of retinal ganglion cells.[3] Contrast sensitivity is basic part of visual performance and has ability to perform task such as driving, reading, navigation. Contrast sensitivity is used for the calculation of outcomes of refractive surgery. Measurement of contrast sensitivity gives the quality of vision. It can be checked on Pelli-Robson chart. It can also be measured by Mars contrast sensitivity chart which is hand held and used at a distance of 41 to 5 cm. Its range is from 0.04 to 1.92 log units. Letters are not arranged in triplet of equal contrast which decreases by 0.04 log unit. Test Chart 2000 is a contrast sensitivity chart which consists of letters on a computer screen. It is performed at a distance of 1 meter similar to Pelli-Robson chart. The patient has to wear add of +0.75DS.[4] The Pelli–Robson chart is performed at a distance of 1m and the patient has to wear glasses with addition of +0.75 DS. The letters used are of constant size. The chart is in the form of 16 triplets with 8 rows. It is performed binocularly.[5]

With different age groups the prevalence of anisometropia is about 2%. About 1.5% infants have anisometropia more than or equal to 1.5 diopters. Cycloplegic retinoscopy shows anisometropia of more than 1D is present about 14% in newborn infants. As the degree of anisometropia increases the binocular vision is deteriorated and it also finds out that which eye is amblyopic eye. About 1D of anisometropia is the threshold for developing amblyopia.[6] Spherical hyperopic anisometropia of greater than 1D or spherical myopic anisometropia of greater than 2D consequences greater increase in occurrence of amblyopia and reduction in binocularity. Cylindrical hypermetropic anisometropia and cylindrical myopic anisometropia of greater than 1.5D consequences greater increase in the occurrence of amblyopia and reduction in binocularity.[7]

The smaller degree of anisometropia does not affect the binocular single vision but in case of greater degree of anisometropia fusion is not possible and this cause foveal suppression, abnormal retinal correspondence, amblyopia and strabismus. Spherical anisometropia about 1D can have major adverse effects on higher level of binocular interaction.[8]

Anisometropia causes one eye to receive blurred visual input which cause decrease in binocularity as well as in optotype acuity, vernier acuity and contrast sensitivity.

Stereopsis function is present in only 8.33%. By varying the level of anisometropia the suppression and stereopsis function changes. The magnitude of anisometropia is associated with the severity of amblyopia and causing lower contrast sensitivity, fusion and stereopsis.[9]

In anisometropic children the stereoacuity is considerably not as good as in isometropic children and high degree of anisometropia is linked with worse stereoacuity. When the spherical equivalent anisometropia is greater than 0.5D, myopic anisometropia is greater than 0.25D, hyperopic anisometropia is greater than 0.5D or cylindrical anisometropia is greater than 0.5D then stereoacuity is significantly reduced.[10]

Stereopsis is critically impaired if its magnitude greater than 3.0D and especially those anisometropes whose magnitude greater than 6.0D. The greater degree of anisometropia is notably linked with, poorer contrast sensitivity, fusion and stereopsis functions in those patients with previously uncorrected anisometropia amblyopia.[11]

The isometropic patients have better stereopsis as compared to anisometropic patient. In spherical hyperopic form of anisometropia the stereopsis was not as good as in spherical myopic form of anisometropia. By wearing of anisometropic glasses the stereopsis level was clinically close to normal and the glasses did not have effect on the binocular vision in spite of the severity of the anisometropia.[12]

Stereopsis is mainly affected by spherical hypermetropia. The total loss of stereopsis in all types of refractive errors was more than 3D. The spherical anisometropia cause more loss of stereopsis as compared to cylinder.[13]

With increasing anisometropia Binocular vision affected and deteriorated. While prescribing glasses in young children probable effect of anisometropia on binocular vision should be measured in the sensitive period.[14]

Three diopters of anisometropia produced reduction of stereo acuity in all patients. Foveal suppression associated with the degree of anisometropia and responsible for the loss of stereopsis.[15]

Stereoacuity assessment provides a definite assessment of binocular function in very young children. To determine the gross stereopsis in young children with either the Lang or the Frisby stereo test showed normal binocularity. So the clinical measures of stereopsis in infants and very young children results in stereo thresholds not so good than the criteria suggested distinguishing normal and abnormal binocularity.[16]

Binocularity is the process in which it responds to binocular stimulus instead of monocular stimulus. Sensitivity of binocular process is reduced against high spatial frequency and insensitive to the stimulus close to the detection threshold for the whole visual system. The binocularity can be affected by the blur image in one eye. All these properties of binocular system have the same characteristics of stereopsis and this process of binocularity is essential stage in stereopsis.[17]

The correction of anisometropia causes some symptoms which are intolerable but effectively adapted within a few days resulting noticeable improvement in binocular single vision.[18] Fine stereopsis can be obtained by the fusion of small retinal disparities but coarse stereopsis is obtained through larger retinal disparities. Under some circumstances when stereopsis of small disparities is affected by early visual deprivation then stereopsis of larger disparities may be safe.[19] The Frisby and TNO test for stereopsis are more accurate test for the assessment of stereoacuity. Individuals recorded considerably better stereoscopic vision with Frisby test as compared to the TNO test. The values of Frisby test are insignificantly correlated with TNO test.[20]

Low and medium myopes of normal contrast sensitivity have normal retinal function. In high myopes, contact lens correction improve contrast sensitivity, in retinal dysfunction it cannot improve contrast sensitivity. In severe myopes before retinal pathology contrast sensitivity may be lost.[21]

Contrast sensitivity function and visual acuity are independent variable same visual acuity measurement of two persons does not have same measurement of contrast sensitivity. It is evident from several studies that visual acuity and contrast sensitivity cannot be assessed at a time, but contrast sensitivity can represent the visual acuity dysfunction.[22]

PATIENTS AND METHODS:

It was an institution based comparative cross sectional study, conducted on 31 patients having different degree of myopic and hyperopic anisometropia and its influence on contrast sensitivity and stereopsis. This study includes the effect of contrast sensitivity and stereopsis in myopic and hyperopic anisometropic patients with no associated ocular pathology. Distance (6m) and near (33 cm) visual acuity was measured by using Snellen distance and near visual acuity chart and contrast sensitivity was measured by using Pelli Robson contrast sensitivity chart. Stereopsis was measured by Lang1, Lang2 and Frisby.
These entire tests were performed with spectacles. Results were obtained by asking the patient to fill a structured Performa.

RESULTS:

TYPE OF ANISOMETROPIA

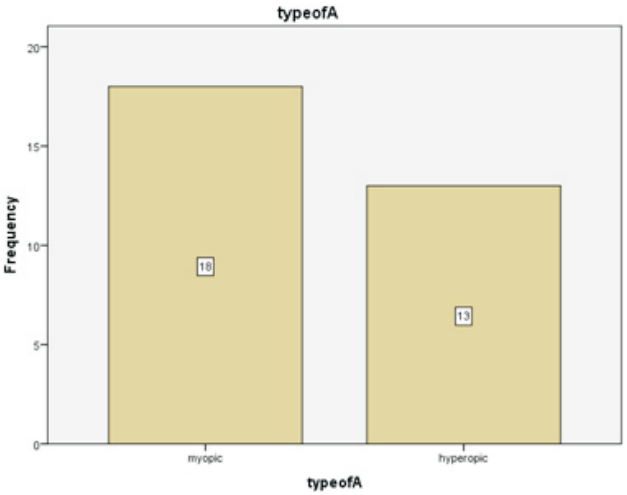

Table no: 1
Type of anisometropia vs. contrast sensitivity with spectacles in right eye

		CSRE						Total
		0.15	1.05	1.2	1.3	1.5	1.65	
Type	Myopic	0	3	2	0	7	6	18
	Hyperopic	2	0	2	3	6	0	13
Total		2	3	4	3	13	6	31

Table no: 2:
Type of Anisometropia * contrast sensitivity with spectacles in left eye

		CSLE					Total
		1.2	1.4	1.5	1.7	1.8	
Type of Anisometropia	Myopic	2	3	7	3	3	18
	Hyperopic	0	0	4	9	0	13
Total		2	3	11	12	3	31

Contrast sensitivity in hyperopic anisometropia is worse than myopic anisometropia.

Table no: 3:
Type of Anisometropia * Contrast sensitivity with correction binocular

		CSBN			Total
		1.5	1.7	1.95	
Type of Anisometropia	myopic	7	8	3	18
	hyperopic	2	11	0	13
Total		9	19	3	31

Binocular contrast sensitivity is better as compare to monocular but still myopic anisometropes show better

contrast sensitivity as compare to hyperopic anisometropes.

Table no: 4:

Type of Anisometropia vs. Lang1test Cross tabulation

		L1test			Total
		0	550	600	
type of Anisometropia	myopic	12	3	3	18
	hyperopic	4	9	0	13
Total		16	12	3	31

Table no: 5:

Type of Anisometropia * Lang2test Cross tabulation

		L2test		Total
		0	200	
type of Anisometropia	myopic	2	16	18
	hyperopic	2	11	13
Total		4	27	31

Stereopsis improves by using refractive correction. Greater the degree of anisometropia worse is the stereopsis.

Table no: 6:

Type of Anisometropia * Frisby test Cross tabulation

		Frisby test				Total
		0	85	170	340	
type of Anisometropia	myopic	8	5	2	3	18
	hyperopic	0	3	10	0	13
Total		8	8	12	3	31

Stereoacuity depends on the degree of anisometropia, Greater the degree of anisometropia worsen the stereopsis. Frisby is more precise test of stereopsis as compare to Lang.

CONCLUSION:

The result revealed that myopic and hyperopic anisometropes show reduced contrast as compared with emmetropes. Mild and moderate anisometropes have significant contrast with and without optical correction. Severe anisometropes have insignificant contrast sensitivity visual function without optical correction which can be improved by wearing optical correction. Binocular contrast was better than monocular contrast sensitivity. Stereopsis in isoametropes was better than anisometropes. Stereopsis decreased as degree of anisometropia increased.

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