Original Research Article

Evaluation of a relation of convergence insufficiency with error of refraction in a Rural Hospital set-up

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Abstract

Aim: The study was conducted to know a relation of convergence insufficiency with error of refraction in a Rural Hospital set-up

Methodology: A cross-sectional study and randomized selection of sample was conducted to determine the Convergence insufficiency using different subjective techniques in subjects of age (20-30years) in UPUMS saifai, Etawah. Subjects of age of 20-30 years of age were included in the initial screening for measuring visual acuity. The subjects emmetropes or ametropes with BCVA, Best Corrected Visual Acuity of 6/6 -6/9 in both eyes were only included while subjects having history of any ocular or systemic pathology affecting VA were excluded. Data collected was recorded and statistical calculations were done.

Results: Out of sample population (47% males and 53% females with mean age of 10.04 years), 16% were significantly affected with CI including emmetropes, myopes, hypermetropes & astigmats. In this study, the prevalence of Moderate CI & Severe CI was 10% & 6% respectively while the prevalence of REs was Myopic astigmatism=53%, Myopia =19%, Hypermetropic astigmatism =11%, emmetropic =10%, Hypermetropic =4% & Mixed astigmatism =3%. Significant amount of association was found between CI and Myopia.

Conclusion: Both CI and REs were shown to have very high prevalence (in particular CI and myopia). The results of this study are surely going to benefit the researchers in comprehending the relation of CI with REs. The study pointed on the necessity of visual screening for REs as well as CI of students at institution platform. It is essential to identify the subject prone to, referral for further investigation and management before the development of any symptom in order to prevent convergence insufficiency related anomalies.

Keywords: Refractive error, Convergence Insufficiency, Rural, Convergence Anomalies, Prevalence

1. Introduction

Vergence is defined as the movement of the both eyes in reverse directions simultaneously in order to achieve or maintain binocular single vision.

In case of anomalies related to vergence, the eyes cannot fixate or concentrate to form a clear image on the retina precisely, and the visual axes may point away (divergence) or point towards from one another (convergence) [1]. Convergence insufficiency (CI) is characterized as a non-strabismic anomaly of vergence due to the inability of eyes to converge or maintain convergence for optimum duration of time while performing near work [2].

Accommodative, Vergence and Refractive physiological mechanisms of human eye are integral components of the visual system, and refractive errors

(REs) play a vital role in the diagnosis and management of anomalies related to binocular vision which includes CI as well [3]. In adult subjects, CI of functional origin is a resultant of a breakdown of the Accommodation related vergence mechanism. These anomalies result from the task demanding long-duration visual performance at near like writing, reading or digital gadget-based works. CI can possibly occur due to factors such as uncorrected hypermetropia, under-corrected myopia and Spectacles having decentred Optical lenses. Learning cum reading disabilities along with social and emotional disorders could develop in children having accommodation based vergence and refractive anomalies [4,5]. 20-30 years adult-group was of prime focus in most of the studies and they have observed the statistically significant prevalence of CI in presence of REs, while rest studies found good relation of CI with REs. That's why, this present research study was aimed to determine the relation of convergence insufficiency with error of refraction and evaluate their demographic associations.

2. Materials and methods

Study Design

A cross-sectional study and randomized selection of sample was designed to determine the Convergence insufficiency using different subjective techniques in subjects of age (20-30years) in Uttar Pradesh University of Medical Sciences, Saifai, Etawah.

Study Population

In this cross -sectional study, 100 subjects of age group from 20-30 years were identified and then Convergence insufficiency is measured as per the protocol.

Inclusion criteria

Subjects of age of 20-30 years of age were included in the initial screening for measuring visual acuity. The subjects emmetropes or ametropes with BCVA, Best Corrected Visual Acuity of 6/6 -6/9 in both eyes were only included.

Exclusive criteria

On the basis of systemic and ocular history, subjects having any ocular or systemic pathologies affecting VA or on any related medication were excluded from the present study.

Data Collection

Data was collected from the routine OPD patients of the Eye department and was kept confidential. The data collection form comprises of demographic data, visual acuity, PGP, subjective refraction, objective refraction,

NPC (Near Point of Convergence) measurement, systemic and ocular history, etc.

Screening procedure

The subjects were screened by following the standard protocol in the Vision Therapy Lab of the Department of Optometry, UPUMS Saifai, Etawah. Firstly, complaints of the subject were recorded and after that medical history was taken (systemic, ocular medication/surgery, Optical, etc.). Then the torch light examination was performed to know the status of the external eye followed by visual acuity assessment with the Snellen's Visual Acuity chart at standard 6m distance as well as with Near Vision chart at 40 cm. If the unaided visual acuity was found to be less than 6/9, subjects were subjected to clinical objective refraction (performed by Retinoscope or Auto-refractometer). Cycloplegic refraction was also performed, whenever or wherever required. Subsequently, the subjective refraction (through duochrome test, Cross-cylinder test, etc) for the refinement of the refractive error was performed. Then subjective (NPC) near point of convergence was assessed with RAF ruler. Finally, anterior as well as posterior segment were evaluated along with the measurement of IOP (by Non-Contact tonometer).

Vergence Tests RAF ruler was employed to assess the NPC, the point target was moved slowly close to the subject. The break points subjectively (when subject reports double vision) or objectively (when eye diverges) was determined and stored for data analysis. WFDT (Worth four dot test) was performed to rule out cases of suppression. Cover Test was used to determine the type and magnitude of heterophoria at Distance and Near.

Table 1 Criteria applied to define convergence insufficiency types

Signs	Convergence types	Criteria
Single clinical signs	Near point of convergence (break):	
	Mild	6 to < 9 (in cms)
	Moderate	9 to < 12 (in cms)
	Severe	≥ 12 (in cms)

Table 2: Distribution of subjects on the basis of types of REs & and severity of CI

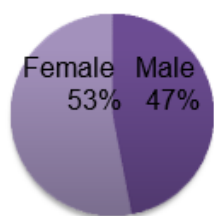| S. No	Refractive errors	Mild (6-<9 cm)	Moderate(9-<12cm)	Severe (≥ 12 cm)	Total
1	Emmetropic	6	1	3	10
2	Myopic	15	4	-	19
3	Hypermetropic	4	-	-	4
4	Astigmatism (sub divisions)				
A	*Myopic astigmatism*	48	2	3	53
B	*Hypermetropic astigmatism*	8	3	-	11
C	*Mixed astigmatism*	3	-	-	3
	Total	84	10	6	100

Fig- 1 Number of male and Female
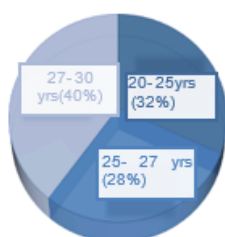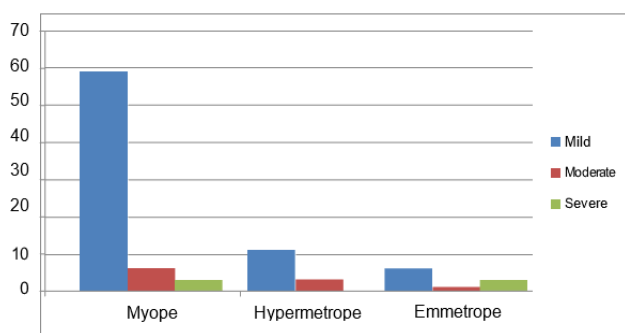

Fig- 2 Distribution according to age

Fig-3. Distribution of Subjects according to Refractive and Severity of C.I.

Table 3: Number of subjects affected through CI differentiated on the basis of age & sex.

Criteria of CI	20-<25Yrs		25-<27 Yrs		27-30 Yrs		
	M	**F**	**M**	**F**	**M**	**F**	**Total**
Mild	16	15	9	12	15	17	84
Moderate	-	1	3	1	-	5	10
Severe	-	-	2	1	2	1	6
Total	16	16	14	14	17	23	100

Normal values of NPC

The normal values of NPC vary considerably person to person and even in different examinations of the same person. In normal adult, its average value is 7cm with a range between 5cm & 10cm. A distance closer than 5cm is excessive, however, in children it may be as close as tip of the nose. Defective NPC, when diplopia occurs further away than 10 cm. Subjects having CI may have NPC of equal to or more than 25 cm.

Data analysis

Data collected was recorded in tabular forms and then represented on graphs with the help of MS Office and the calculations were done manually. Distributions of various variables were represented in tabular form. Grading of the CI as per CIRS criteria [6]. (Table-I). Refractive errors were classified based on the standard criteria while 0.25 D or less spherical equivalent as emmetropic.

3. Results and Discussion

Out of sample population (47% males and 53% females with mean age of 10.04 years), 16% were significantly affected with CI including emmetropes, myopes, hypermetropes & astigmats.

The prevalence and relation of CI and REs as well as their interrelations were determined and assessed. Moderate CI & Severe CI were having prevalence of 10% and 6% respectively while the prevalence of REs was as follows:

Myopic astigmatism=53%, Myopia =19%, Hypermetropic astigmatism =11%, emmetropic =10%, Hypermetropic =4% and Mixed astigmatism =3%. The variations in the prevalence of REs were considerable according to demographic, the major contributors. Myopic astigmatism and myopia in refractive errors as well as Convergence insufficiency in accommodative-vergence based anomaly were highly prevalent in institute going students.

Association between convergence insufficiency and refractive errors

There was a statistically significant relation of the CI with Myopia which was similar to the Gupta et al. [7]. Study Gupta et al. observed the prevalence of myopia as the REs in subjects having CI. As far as distribution of REs in CI is concerned, there was a good amount of diversity in findings. Passmore and MacLean [8] concluded that CI subjects (52%) were hypermetropes, (34%) myopes and (14%) emmetropes while Smith [9] observed that 38% were having myopia (low), 57% emmetropic & 5% were hypermetropes

Conclusion

Both CI and REs were shown to have very high prevalence (in particular CI and myopia). The results of this study are surely going to benefit the researchers in comprehending the relation of CI with REs.

The study pointed on the necessity of visual screening for REs as well as CI of students at institution platform. It is essential to identify the subject prone to, referral for further investigation and management before the development of any symptom in order to prevent convergence insufficiency related anomalies. Hence, timely identification of not only refractive but also related binocular problems among institution going students will be a boon or asset in their right management in turn resulting in academic excellence on account of enhancement in visual efficiency.

Acknowledgement

Compliance with ethical standards

There is no conflict of ethical and financial interest

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