



Original Article

Comparison of Convergence Insufficiency Between Different Refractive States of the Eye

Authors

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Purpose: To determine the relationship between convergence insufficiency and different refractive errors, and to determine the magnitude of convergence insufficiency.

Materials and Methods: A hospital based descriptive cross sectional study was conducted at Haji Murad Eye Trust Hospital Gujranwala including 100 patients of age between 15 to 35 years. Visual acuity of all the patients was recorded and subjective refraction was performed. The convergence insufficiency was recorded on the basis of the near point of convergence (NPC). It was measured subjectively using cm ruler.

Results: A total of 100 patients aging 15-35 years including males and females in equal proportion were assessed for remote near point of convergence to find the magnitude of convergence insufficiency. 35 patients were myopic, 35 hypermetropic and 30 were astigmatic. Out of 35 myopic patients 16 (45.71%) were having 18 cm near point of convergence (NPC), 10 (25.57%) 17cm NPC and 9 (25.71%) 16cm NPC. The values for near point of convergence in hypermetropic patients were opposite to those of myopic. Out of 35 subjects 28 (80%) were having 10cm of NPC while other 9 (20%) 12 cm. In our study the astigmatism was showing variation from myopia and hypermetropia. 10 (33.3%) out of 30 astigmatic subjects were measured 10cm as their NPC, 2 patients (6.67%) 12cm, 1 patient (3.33%) 13cm, 2 patients (6.67%) 14cm, 4 patients (13.33%) 15cm, 4 patients (13.33%) 16cm, 4 patients (13.33%) 17cm and 3 patients (10%) 18cm.

Conclusions: There is a weak relationship between refractive errors and convergence insufficiency. Myopia is the only contribution to remote near point of convergence.

Keywords: Refractive errors, convergence insufficiency, near point of convergence.

Introduction

Convergence insufficiency is a binocular vision disorder.¹ It is a sensory and neuromuscular problem. It interferes with the ability to perform near work. It is a condition in which the eyes drift outward while performing near work.² The main cause of convergence insufficiency is unknown, but the intraocular muscles involved in the misalignment of the eyes.^{3,4} A person with convergence insufficiency has difficulty in reading, blurring of vision and headache.^{5,6} Patients having convergence insufficiency normally reveal an **exophoria or intermittent exotropia at near**, but can also exhibit orthophoria. This is typically due to accommodative convergence, the exophoria at near is greater and sometimes use +3.00 DS lens to relax the accommodation at near. There may be orthophoria at distance or very small angle exophoria.⁷ Unilateral exotropia can be excluded from intermittent exotropia as in intermittent exotropia the eyes turn outward in both near and distance but in convergence insufficiency the eyes turn out only in near.⁸ Refractive convergence insufficiency is associated with the refractive errors like myopia, hypermetropia and astigmatism (myopic simple and compound astigmatism).⁹ The characteristics of convergence insufficiency are: 1) the amount of exophoria is greater for near than for the distance target. 2) Remote near point of convergence, for example the convergence breaks at the distance more than 3 inches, and 3) positive fusional convergence is decreased for near.^{10,11} It is necessary to test the **near point of accommodation** (for both eyes), as a joint insufficiency of convergence and accommodation can happen sometimes. The rate of comorbidity increases with the severity of the convergence insufficiency.¹²

The common symptoms that occur with convergence insufficiency are: doubling of vision (diplopia), eyestrain during or after near work, blurring of the vision, deviating of the eyes especially outwards when patient try to concentrate, dizziness, closing of an eye to avoid diplopia, mild to severe headaches and the words appear to be moving while reading. The symptoms of convergence insufficiency become worse and worse by illness, in wakefulness, nervousness, despair and long duration of close work.^{12,5,14} Convergence insufficiency typically presents with venerable and persistent complaints of double vision at near, with a negative past medical history. Convergence insufficiency is the legitimate and troublesome binocular vision dysfunction.¹³

In the United States of America the prevalence of convergence insufficiency is approximately 2% of the whole population.^{6,8,14,15} Frequency of the problem increases

with near work. The convergence insufficiency is infrequently originated in the age set less than 9 years. However, the increased burden of near work and longer working hours can cause it to appear earlier.¹⁶ The etiology of convergence insufficiency may be associated with the wide nasal bridge (the eyes appear in divergent condition), endocrine disorders, debility or disease, toxemia, head injuries, encephalitis, hepatitis, malnutrition, mononucleosis, debility, and inadequate development of the neuromuscular function, tiredness and the prolonged near work or reading.¹⁷

Convergence insufficiency affects 2.15-8.6% of the population and is characterized by an inability to converge the eyes smoothly as the object of regard moves from distance to near.¹⁸ Hypermetropia, myopia and astigmatism are common refractive errors that cause decrease in visual acuity. Mostly these refractive errors are running in genetics but with the passage of time changes occur as per visual demands of the patients. The close near work can cause the change in refractive error. The binocular vision disorders like convergence insufficiency, divergence insufficiency and convergence excess are associated with the refractive errors. 60% of the binocular vision disorders fall into convergence insufficiency.¹⁹

Many myopic patients become deficient in accommodative convergence. The high hypermetropes usually greater than 5D has no effort to accommodation so they might have convergence insufficiency. As the myopic patients have greater power than normal they do not need to accommodate in near so they got convergence insufficiency. Even small degree of myopia can cause convergence insufficiency (0.5D and onward). Those Patients who are wearing the fully corrected plus glasses have become accommodative and convergence deficient.^{1,4}

Materials and Methods

A hospital-based descriptive cross sectional study was conducted from 20th April 2016 to 21st May 2016, through non-probability convenient sampling to include 100 subjects with convergence insufficiency between age of 15 to 35 years, at the Outdoor patient department of Haji Murad Eye Trust Hospital, Gujranwala, Pakistan.

Inclusion criteria were, patients having convergence insufficiency age between 15 to 35 years, patients having simple myopia, simple hyperopia, simple myopic astigmatism and those without any ocular disease. Uncooperative & Mentally retarded patients, patients having compound myopic, compound hyperopic or mixed

astigmatism, Squint patients, patients having binocular anomalies trauma or after surgery and patients with any other systemic disease that have associated with binocular anomalies, anisometropia & amblyopia were excluded.

A descriptive cross-sectional study was conducted, after the approval of supervisory and ethnical committee. Sample size of 100 patients were selected, Subjects between 15 and 35 years of age were recruited for the study. The ratio of male to female was 1:1. Written informed consent was taken from the patients about the symptoms of the convergence insufficiency and the visual disturbance. A Performa was filled for all the 100 patients containing the detailed description of the subject included in the study. The visual acuity was recorded using the Snellen visual acuity Chart. The average of the visual acuity of the both eyes was taken. The refraction was performed using retinoscope and auto refractor, Cycloplegic refraction was performed for latent hypermetropia in adult patients. For all the patients near point of convergence was measured. The procedures with good repeatability and reliability were taken to measure near point of convergence.

The convergence was measured subjectively. For the measurement of the near point of convergence a target was dot on the tip of a wide stick selected and the convergence was measured using centimeter (cm) ruler. The target was introduced to the patient and the cm ruler fixed to the nasal bridge. When the patient reported double dot (diplopia) the point on the scale was noted as the near point of convergence. Both breakup and recovery points were assessed. All subjects were fitted with their best corrected vision in the trial frame after both the subject and objective refraction.

Results

One hundred patients were included in our study. Fifty (50%) subjects were male and fifty (50%) were female. Majority of subjects were in age group 15-20 years (43%) followed by 21-25 years (35%), 26-30 years (14%) and 31-35 years (8%). Out of hundred patients 35 were myopic, 35 hypermetropic and 30 were astigmatic. The convergence insufficiency compared on the basis of near point of convergence (NPC). Out of 35 myopic subjects 16 (45.71%) were having 18cm near point of convergence (NPC), 10 (25.57%) 17cm NPC and 9 (25.71%) 16cm NPC. The values for near point of convergence in hypermetropic patients were opposite to those of myopes. Out of 35 hypermetropic subjects 28 (80%) were having 10 cm of NPC while other 9 (20%) 12 cm. In our study the

astigmatism was showing variation from myopia and hypermetropia. 10 (33.3%) out of 30 astigmatic subjects were measured 10cm as their NPC, 2 patients (6.67%) 12cm, 1 patient (3.33%) 13cm, 2 patients (6.67%) 14cm, 4 patients (13.33%) 15cm, 4 patients (13.33%) 16cm, 4 patients (13.33%) 17cm and 3 patients (10%) 18cm.

Table1: Gender wise distribution of convergence insufficiency in myopia.

Gender	Convergence			Total
	16.00	17.00	18.00	
Male	4	6	8	18
Female	5	4	8	17
Total	9	10	16	35

Table2: Gender wise distribution of convergence in hypermetropia:

Gender	Convergence		Total
	10	12	
Male	15	3	18
Female	13	4	17
Total	28	7	35

Table3: Distribution of near point of convergence (NPC) in myopia, hypermetropia and astigmatism.

Near point of convergence (NPC)	Myopia n=35	Hypermetropia n=35	Astigmatism n=30
10cm	0	28 (80%)	10 (33.3%)
11cm	0	0	0
12cm	0	7 (20%)	2 (6.67%)
13cm	0	0	1 (3.33%)
14cm	0	0	2 (6.67%)
15cm	0	0	4 (13.33%)
16cm	9 (25.71%)	0	4 (13.33%)
17cm	10 (28.57%)	0	4 (13.33%)
18cm	16 (45.71%)	0	3 (10%)

The highest values of NPC showed that those patients were having remote near point of convergence and thus convergence insufficiency existed in them.

Discussion

The diversity in the reported values of the convergence insufficiency in literature may be due to difference in target populations, age groups, facilities for visual assessment, interpupillary distances and geographical factors that affecting the results. Scheiman and colleagues suggested that refractive errors are not the only reason for causing abnormal near point of convergence.¹⁹ There are many other causes like phoria, tropias, injuries, trauma and psychological implications. Looking for the relationship between refractive errors and convergence insufficiency Amy Davis conducted a comparative study.^{20,21} The study was to determine that moderate/high astigmatism had an increased rate of convergence insufficiency compared to children with no/low astigmatism. The sample included 485 Tohono students ages 9 to 16 years. Prevalence of convergence insufficiency was 6.2% (30/484). Astigmatism <1.00D was present in 43.8% (212/484), >1D to <3D was present in 26.0% (126/484) and ≥3D was present in 30.2% (146/484). There was no significant relation between presence of convergence insufficiency and magnitude of astigmatism. Hirsch found 61% of CI patients had ametropia of 0.75 D or less. The mean spherical equivalent refractive error was less than 0.50 D. These findings are similar to those in the normal population, suggesting that there is no relationship between refractive error and convergence insufficiency.^{22,23} Passmore and MacLean found that 52% of their convergence insufficiency sample was hyperopic, 34% myopic, and 14% emmetropic.^{24,25} They showed slight association with convergence insufficiency. In this study only myopia showed association with convergence insufficiency. As in myopic eyes there remains a slight need to converge at near. The variation in our study from other studies is may be due to some factors like wide nasal bridge of the patients, wide interpupillary distances, data collection techniques, gender distribution, age distribution and others.

Conclusion

Hypermetropia showed weak association with convergence insufficiency. Out of 35, 80% patients have normal near point of convergence 10cm only 20% have a little remote near point of convergence 12cm. Astigmatic patients showed variation in the measurements of the near

point of convergence. Only 10% patients were having highest value of remote near point of convergence 18cm. 33% have normal near point of convergence. It is concluded that only myopia affected the near point of convergence values.

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