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ORIGINAL ARTICLE

ASSESSMENT OF CAUSES OF EYESTRAIN IN EMMETROPES, 10-18 YEARS OF AGE

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ABSTRACT: AIM: Assessment of causes of eyestrain in emmetropic patients 10-18yrs of age. **SETTINGS AND DESIGN**: Cross sectional study. **MATERIALS AND METHODS**: We did an observational study of 100 patients, 10 to 18 years of age, coming to Ophthalmology O.P.D. of KIMS, Karad, who were emmetropes (post cycloplegic retinoscopy) but complained of eyestrain. After taking thorough history of these patients, they were subjected to anterior segment and posterior segment examination followed by squint and binocular vision synaptophoric assessment, the cause was diagnosed and they were treated accordingly. **RESULTS**: After assessing 100 such patients we found that, 24% of patients had Video Display Terminal Syndrome (VDTS), 23% had convergence insufficiency, 17% had squint, and 7 % had ocular surface disorder. The cause were not gender related (p value >0.005). Of these VDTS and convergence insufficiency were statistically significant (p value <0.005). **CONCLUSION**: These findings conclude that VDTS and convergence insufficiency are frequent among emmetropes with eyestrain in the age group of 10-18yrs.
KEYWORDS: Eyestrain, emmetropes, VDTS, convergence insufficiency

INTRODUCTION: Eyestrain (asthenopia) is a symptom complex that involves sensation of irritation to the eye itself, changes in vision (such as blurred or double vision) and associated symptom such as headache.[1, 2] It is seen and concluded in many studies that if a child has eyestrain he/ she cannot concentrate completely on his studies and his learning is affected.

The main cause of eyestrain is thought to be fatigue of ciliary and extraocular muscle due to prolonged accommodation and vergence required by near vision work.[1- 4]
With the increasing use of video display terminals in day to day life eyestrain is becoming the problem of many people.

Need for the Study: Almost every day an ophthalmologist comes across a patient who is an emmetrope but complains of eyestrain. In general practice we tend to ignore the symptom of eyestrain if the patient is an emmetrope; this study highlights that there are several other causes which should be investigated before labeling a patient as a malingerer.

A recent Romanian study revealed that roughly 3 in 5(60.4%) of young adult patients complaining of blurred vision at near work suffered from convergence insufficiency. Similar studies conducted by Southern California college of optometry found that approximately 1 in 8 i.e. 13% of fifth and sixth grade children examined during visual screening had the disorder of convergence insufficiency as did nearly 1 in 5(17.6%) of 8 to 12 year olds, receiving examinations at optometry clinics.

In the past many workers have studied the incidence of convergence insufficiency in causing eyestrain and recently there have been various studies regarding VDTS, but all the causes of eyestrain

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have not been taken into account. I would like to undertake this study where all the causes of eyestrain have been encompassed.

AIMS AND OBJECTIVES:

1) To find the prevalence of Video display terminal syndrome (VDTS).
2) To find the prevalence of convergence/ divergence anomalies.
3) To find the prevalence of latent squint.
4) To find prevalence of Binocular vision anomalies.

MATERIALS AND METHODS: This study was conducted among emmetropic patients presenting with eyestrain, 10 to 18 years old, in the eye O.P.D. of Krishna Hospital, Karad during the period of November 2011 to May 2013. All the patients were subjected to routine clinical examination, cycloplegic refraction; fundoscopy.100 patients with normal vision were taken up for this study. All the patients were enrolled for the study after explaining the purpose of the study to them. Tests for latent and manifest squint, binocularity and testing for near point of convergence as well as near point of accommodation were done and causes of eyestrain identified.

Study Design: Cross sectional study design.

Sample Size: 100 patients.

Inclusion Criteria:

- Age: 10-18 years.
- Emmetrope (Normal undilated and cycloplegic refraction).
- Using video display terminal for more than 3 hours/day.
- Symptoms of eyestrain.
- Symptoms of eyestrain while viewing computer/ microscope.

Exclusion Criteria:

- Age <10 years or >18 years.
- Ammetrope.
- H/o any refractive/ocular surgery.
- H/o any ocular trauma.
- H/o any ocular pathology.

Statistical test used: Pearson's chi square test and unpaired t test were used.

METHODOLOGY:

Procedure: For each patient one information sheet was completed.
This included following data:

- Age.
- Sex.
- Standard/College.
- H/O systemic illness.

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- H/O watching Video Display terminal.
- Hours of viewing video display terminal.
- Any other systemic disease/drugs/cosmetics/face pimple/scar treatment: drugs used/Laser.
- H/o similar complains in the family.
- Visual acuity (distant and near).
- Cycloplegic retinoscopy.
- Anterior segment examination on slit lamp.
- Posterior segment examination with direct and indirect ophthalmoscopy.

Following investigations were undertaken:

1) Hirschberg corneal reflex test (degree):
2) Cover tests: Direct cover test
   Cover Uncover test
   Alternate cover test
3) Ocular movements:
4) RAF ruler: Near point of convergence.
   Near point of accommodation.
5) Prism bar reflex test: Range of fusion: with base out -with base in.
6) Worth's four dot test:
7) Maddox rod test:
8) Two pencil test:
9) Synaptophore: Simultaneous macular perception.
   Fusion.
   Stereopsis.
   Heterotropia.
   Convergence Range.

Blinking rate/Schirmer's test (if more than 3hrs use of video display terminal):

The final diagnosis of each patient was determined.

RESULTS:

Age	Male	Female	Total
10 to 12	12	14	26
13 to 15	14	20	34
16 to 18	12	24	40
	42	58	100

Table 1: Age and sex distribution of the subjects

Total number of subjects in 10 to 12 years of age group is 26,
In 13 to 15 years of age group is 34 and 16 to 18 years of age group is 40.

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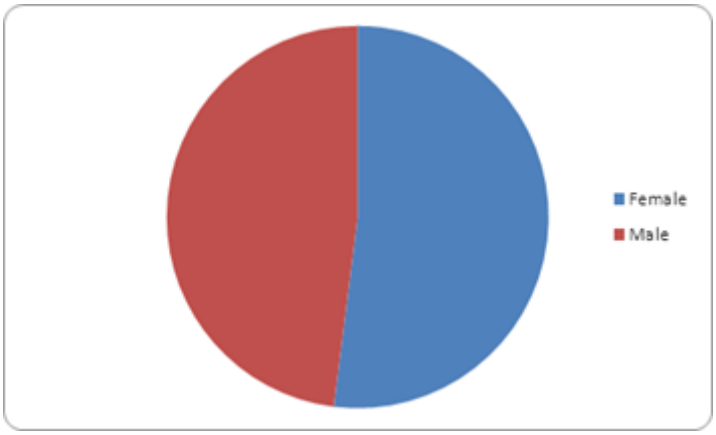

Chart 1: Pie chart showing Sex distribution of the subjects

42% of the subjects were males
58% of the subjects were females

Age Distribution			
	10 to 12	**13 to 15**	**16 to 18**
Mean	**14.02**	**14.53**	**14.32**
S.D.	**2.4**	**2.47**	**2.44**
p value	**>0.05**		

Table 2: Age wise Mean and standard deviation of the subjects

The p value of age distribution is more than 0.05
So the age distribution is not statistically significant.

Age Group	**10 to 12**
Convergence Insufficiency	2
Phorias	3
Tropias	2
VDTS	8
OSD	3
Normal	7
Miscellaneous	1
Total	**26**

Table 3: Causes of eyestrain in the age group: 10 to 12 years

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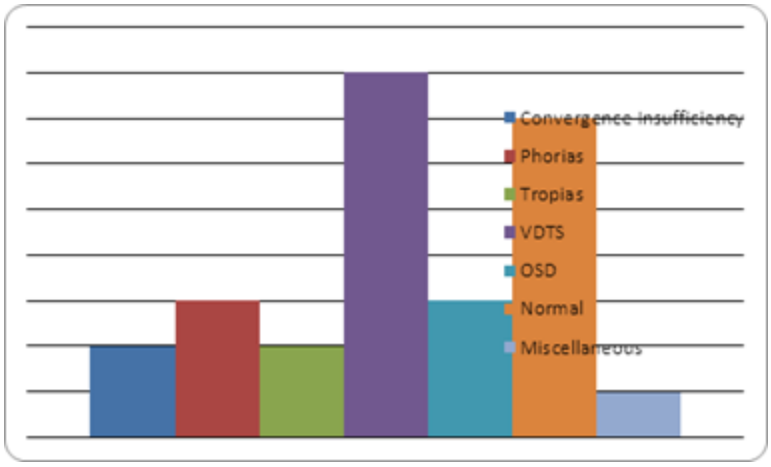

Chart 2: Bar diagram depicting the causes of eyestrain in 10-12 years of age

As seen in the bar diagram, convergence insufficiency seems to be the major cause eyestrain in 10-12 years of age

Age Group	13 to 15
Convergence Insufficiency	13
Phorias	4
Tropias	1
VDTS	2
OSD	2
Normal	11
Miscellaneous	1
Total	**34**

Table 4: Causes of eyestrain in the age group: 13 to 15 years

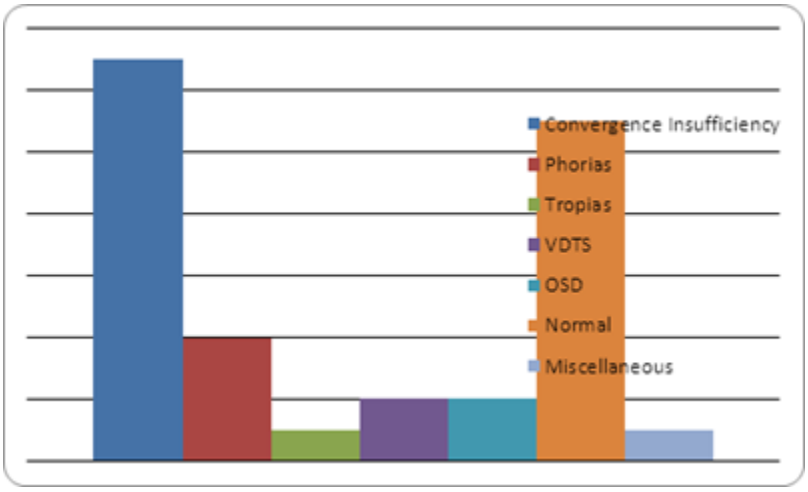

Chart 3: Bar diagram depicting the causes of eyestrain in 13 to 15 years of age

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As seen in the bar diagram, convergence insufficiency seems is the major cause eyestrain in 13 to 15 years of age

Age Group	16 to 18
Convergence Insufficiency	8
Phorias	5
Tropias	2
VDTS	14
OSD	2
Normal	6
Miscellaneous	3
Total	**40**

Table 5: Causes of eyestrain in the age group: 16 to 18 years

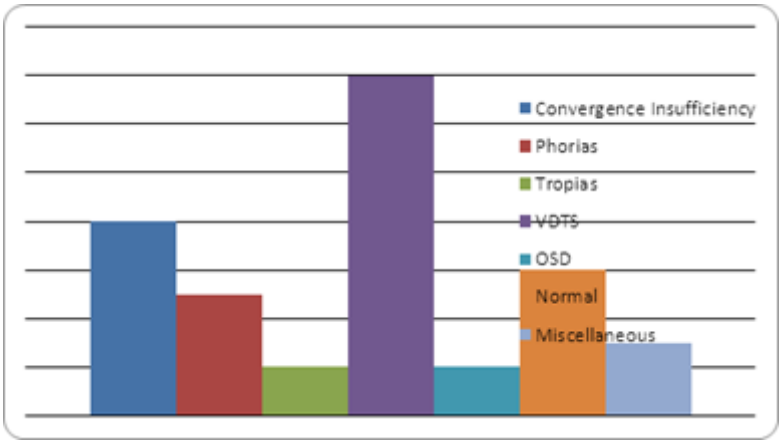

Chart 4: Bar diagram depicting the causes of eyestrain in 16 to 18 years of age

As seen in the bar diagram, video display terminal syndrome seems to be the major cause eyestrain in 16 to 18 years of age.

Age	VDTS	CI	Phoria	Tropia	OSD	N	Misc	Total
10 to 12	8	2	3	2	3	7	1	26
13 to 15	2	13	4	1	2	11	1	34
16 to 18	14	8	5	2	2	6	3	40
Total	24	23	12	5	7	24	5	100
p value	<0.05	<0.05	>0.05	>0.05	>0.05	>0.05	>0.05	

Table 6: All age groups and causes of eyestrain with p values

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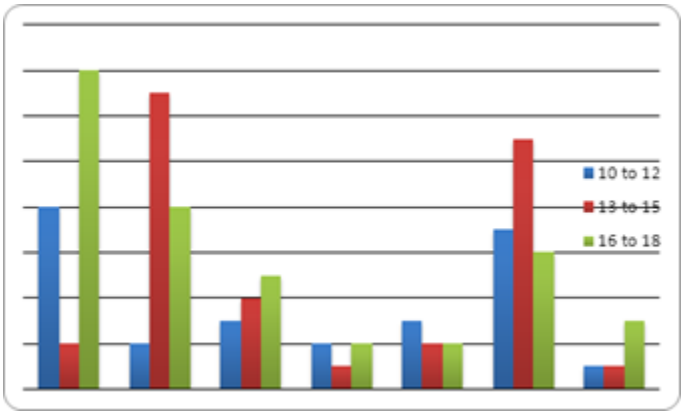

Chart 5: Multiple Bar diagram depicting all age group wise causes of eyestrain

As depicted by the bar diagrams VDTS and Convergence Insufficiency are the major causes of eyestrain in 10 to 18 years of age patients.

No. of subjects assessed	100
Percentage with Impaired Binocular vision	03
Percentage with Normal Binocular vision	97

Table 7: Binocular vision impairment in subjects with eyestrain

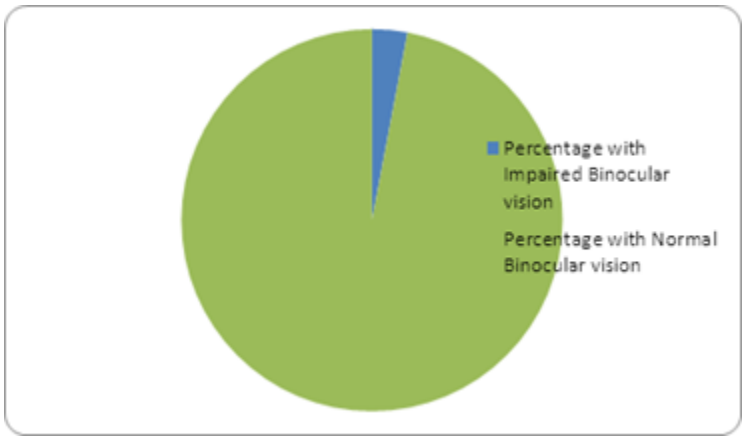

Chart 6: Pie diagram depicting the distribution of binocular vision anomalies in subjects

Pie chart shows that 3 % of subjects had impaired one or more grades of binocular vision.

DISCUSSION:

VDTS: The use of computers and digital electronic devices for both vocational and non-vocational activities including e-mail, internet access and entertainment is almost universal in modern society. A recent estimate of internet usage by continent ranged from 77.4% of the population of North America to 10.9% of Africa, with an estimated 1 966 514 816 users worldwide (or 28.7% of the world's population).[5]

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Today's visual requirements may include viewing laptop and tablet computers, electronic book readers, smart phones and other electronic devices either in the workplace, at home or in the case of portable equipment, in any location. Furthermore, computer use is not restricted to adults. A recent investigation of over 2000 American children between 8 and 18 years of age reported that in an average day they spend approximately 7.5 h using entertainment media, 4.5 h watching TV, 1.5 h on a computer and over an hour playing video games.[6]

These increased visual demands may give rise to a variety of symptoms which have been termed computer vision syndrome (CVS).

Working at a computer terminal is invariably associated with ocular disorders that may affect visual acuity. Initially research was focused on the ocular effects of radiation hazards, but subsequently came to include symptoms due to exposure of the eyes to video display terminals (VDT), known as the Video Display Terminal/Computer Vision Syndrome.

The American Optometric Association defines CVS as the combination of eye and vision problems associated with the use of computers. These symptoms result from the individual having insufficient visual capabilities to perform the computer task comfortably.[7]

In a review of CVS, Thomson[8] indicated that up to 90% of computer users may experience visual symptoms including eyestrain, headaches, ocular discomfort, dry eye, diplopia and blurred vision either at near or when looking into the distance after prolonged computer use. It is unclear whether this number has increased, given the increased use of electronic displays today. Further, Rossignol et al.[9] reported that the prevalence of visual symptoms increased significantly in individuals who spent more than 4 h daily working on video display terminals (VDTs).

Convergence Insufficiency (CI): Definition: Convergence Insufficiency (CI) is a binocular vision disorder; first described by von Graefe[1] in 1855 and later elaborated by Duane[2] and is typically characterized by the following signs:

1. Exophoria that is greater at near than distance,
2. A remote near point of convergence (NPC), i.e., a breakdown in convergence greater than 3 inches, or
3. Decreased positive fusional convergence (PFC) at near.[2,10]

It often is associated with symptoms such as double vision, eyestrain, headaches, blurred vision, and loss of place while reading or performing near work; however, not all patients present with symptoms.

Convergence insufficiency (CI) is a common and distinct binocular vision disorder with a reported prevalence among children and adults in the United States of 2.25% to 8.30%.[3, 4, 11-13] Common symptoms include diplopia, asthenopia, headaches, and blurred vision usually associated with activities requiring close vision (eg: reading, computer viewing, or deskwork).[13-20] The exact impact of symptomatic CI on an individual's performance in school, at work, and on quality of life is unknown. Clinical signs of CI typically include exophoria that is greater at near than at distance, a receded near point of convergence measurement, and reduced positive fusional vergence at near measurement.[13, 20, 21]

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EPIDEMIOLOGY: The prevalence of CI is not truly known because no population-based studies are available. There is great variability in the reported prevalence of CI ranging from 1.75 to 33%.[14, 18, 20, 22-27]

SQUINT: Virtually everyone has a heterophoria, but comparatively few people experience symptoms. The appearance of symptoms depends on the state of the sensorimotor system, the use made of the eyes, and the general well-being of a person. The absolute amount of the heterophoric deviation is not the most important factor; what matters is the presence or absence of a discrepancy between the deviation and amplitudes of motor fusion.

If the amplitudes are inadequate to cope comfortably with the deviation, asthenopic symptoms may arise. Persons can overcome a heterophoria, provided there is no interference with fusion, by maintaining a tonus distribution in the extraocular muscles so that their visual axes are parallel for distance and are properly directed in near vision. Under certain circumstances, this task may be too difficult and may cause subjective symptoms consisting of discomfort of varying degree and location, so-called asthenopic symptoms, or diplopia.

Patients always relate the symptoms to use of their eyes and to so-called eyestrain. Complaints range from redness and a feeling of heaviness, dryness, and soreness of the eyes, to pain in and around the eyes, frontal and occipital headaches, and even gastric symptoms and nervous exhaustion. The eyes are easily fatigued, and such patients often have an aversion to reading and studying.

Typically, these complaints tend to be less severe or to disappear altogether when patients do not use their eyes in close work.[28]

Binocular Vision Anomalies:

BOAD syndrome: Binocular, Oculomotor, Accommodative Dysfunction.

It affects a significantly high percentage of children and adults.

It impacts reading and learning performance.

It is often associated with behavioral/emotional problems.

It has little or no impact on distant visual acuity leading to false negatives on acuity- based vision screenings.[29]

CONCLUSION: Hence from this study we conclude that every patient with coming to ophthalmic O.P.D. with ocular strain and 6/6, N6 vision, needs to be worked up thoroughly regarding his/her binocular visual functions, Video Display Terminal use and tests for convergence, apart from routine slit lamp and fundus examination, rather than dispensing the patient as normal, malingerer or referring to other disciplines of medicine.

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