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Original Article

Ophthalmology Section

Decoding Visual Symptoms in Migraine: The Role of Binocular Vision Abnormalities: A Cross-sectional Study

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ABSTRACT

Introduction: Migraine is a chronic, neurovascular disorder characterised by recurrent attacks of headaches. Migraine is also associated with a variety of symptoms, including sensitivity to light, sound, and smell, as well as nausea, dizziness, difficulty concentrating, and fatigue. Accommodative issues can manifest as blurred vision at distance and/or near, headaches, poor concentration, and reading difficulties. There is a relationship between binocular vision impairments and migraine headaches, as both conditions can produce visual symptoms that diminish a patient's overall quality of life.

Aim: To quantify visual symptoms and their correlation with specific binocular vision dysfunctions in a cohort of migraine patients.

Materials and Methods: This cross-sectional study was conducted at Yenepoya Medical College, Mangaluru, Karnataka, India, from June 2024 to January 2025. The study included 72 migraine patients (with or without aura), diagnosed with specific binocular vision anomalies such as Accommodation Insufficiency (AI), Convergence Insufficiency (CI), Accommodation Excess (AE), or Convergence Excess (CE). Visual symptoms of all 72 patients were assessed using the 14-item Symptom Questionnaire for Visual Dysfunctions (SQVD). Scores were categorised into mild, moderate, and severe using a predefined percentage-based cut-off derived from principles often applied in knowledge/attitude/practice assessments. Statistical analyses included one-way Analysis of Variance (ANOVA) and regression analysis to examine relationships between visual symptom scores and binocular vision anomalies, age, and gender.

Results: The cohort comprised predominantly females 64 (89%) with a mean age of 22.29±2.67 years. The average SQVD score was 10.08±4.14. The severity distribution indicated that 52 (72.2%) experienced mild, 16 (22.2%) moderate, and 4 (5.6%) severe visual symptoms. A one-way ANOVA revealed no statistically significant difference in visual symptom scores among the four binocular anomaly groups (p-value=0.454). Regression analysis identified age as a significant negative predictor of visual symptom scores (β=-0.4, p-value=0.035), indicating that scores decreased with increasing age. Binocular anomaly types and gender were not statistically significant predictors.

Conclusion: Visual symptoms are prevalent among young adult migraine patients, with photophobia often being a major contributor. While binocular vision anomalies frequently co-exist with migraine, this study found no statistically significant correlation between specific binocular vision dysfunction types and overall visual symptom severity as measured by the SQVD. Further research is warranted to explore the complex interplay of various visual disturbances in migraine and their impact on quality of life, particularly considering age-related trends and the distinct pathophysiology of photophobia.

Keywords: Photophobia, Quality of life, Visual symptoms

INTRODUCTION

Migraine is a chronic, complex neurovascular disorder characterised by recurrent attacks of headaches, often described as pulsating and throbbing. Migraine is also associated with a variety of symptoms, including sensitivity to light (photophobia), sound, and smell, as well as nausea, dizziness, and fatigue [1]. Globally, migraine is recognised as a significant public health concern, ranking as the third most prevalent disorder and the seventh highest specific cause of disability according to the Global Burden of Disease Survey 2010, with an estimated prevalence of 10% [2,3]. Diagnosis typically differentiates between migraine with aura and migraine without aura, based on criteria from the International Classification of Headache Disorders [4,5].

Visual symptoms are common and can lead to a debilitating state in patients with migraine. These include asthenopia symptoms, which are frequently reported in patients manifesting non-strabismic accommodative and vergence disorders. Specifically, accommodative issues can manifest as blurred vision at distance and/or near, headaches, poor concentration, and reading difficulties. Vergence issues can lead to blurred vision, diplopia, ocular discomfort during or immediately following near work, frontal headaches, nausea, sleepiness, loss of concentration, a heavy lid sensation, and general fatigue, sometimes described as a "pulling" sensation of the eyes. The impact of these symptoms on daily life is substantial, with individuals often resorting to "task avoidance" to prevent symptom exacerbation, thereby negatively affecting their overall quality of life, particularly in academic and professional settings [6,7]. Photophobia is another characteristic symptom of migraine. Migraine patients often report a reduced visual quality of life, with dry eye symptoms appearing to be a significant contributing factor. Sensitivity to visual patterns, influenced by colour and spatial frequency, has also been noted in migraine sufferers [8-11].

Binocular vision refers to the capacity of both eyes to maintain visual focus on an object simultaneously, resulting in a single, clear visual image. Abnormalities in binocular vision can manifest as headaches, eye pain, diplopia, periodic blurred vision, and the sensation of print letters moving during reading. Prior studies have indicated a relationship between binocular vision impairments and migraine headaches, as both conditions can produce visual symptoms that diminish a patient's overall quality of life. Individuals with migraine have also been observed to exhibit lower convergence and divergence fusional reserves [12-14].

While the prevalence of visual symptoms in migraine and their association with binocular vision anomalies are well established.

The specific quantitative relationship between these binocular dysfunctions such as accommodation and convergence anomalies and the subjective visual symptom burden reported by patients has not been thoroughly investigated. This study aimed to address this gap by systematically and quantitatively assessing the correlation between binocular vision anomalies and the intensity of visual symptoms in individuals with migraine, presenting to a tertiary care hospital. The primary objective of this study was to assess the visual symptoms among patients with migraine and secondary objective was to determine any underlying binocular vision dysfunctions among this population. This may be important for developing targeted diagnostic and management strategies to improve the quality of life for migraine patients.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Ophthalmology, Yenepoya Medical College, Mangaluru, Karnataka, India from June 2024 to January 2025. Prior to commencement, the study received approval from the Institutional Ethics Committee (YEC-1/2023/016). Informed consent was obtained from all participants.

Sample size calculation: Based on Smuglova E and Bleything WB, with a Quality of Life change from 34.8±19.1 to 20.8±13.7, an effect size of 0.82 was derived [15]. Using G*Power, a minimum of 72 participants was calculated for 95% confidence, 5% significance, and 99% power. A total of 72 individuals aged 18-30 years diagnosed with migraine were included (with or without aura) and referred to the ophthalmology department.

Inclusion criteria: Migraine patients with presence of any one of binocular dysfunction {Convergence Insufficiency (CI), Convergence Excess (CE), Accommodation Insufficiency (AI) and Accommodation Excess (AE)} diagnosed after a full battery of binocular vision screening by an optometrist were included in the study.

Exclusion criteria: Patients with any ocular pathology such as amblyopia, extraocular muscle and cranial nerve palsies that affect normal binocular vision functions were excluded from the study.

Diagnostic Criteria for Binocular Vision Anomalies

Binocular vision anomaly: The diagnosis of specific binocular vision anomalies by an optometrist adhered to standard clinical criteria for each condition [16]. All the participants underwent a comprehensive ocular examination, refraction and binocular vision assessment for accommodation and convergence anomalies. They were then administered a questionnaire to assess the visual symptoms using the SQVD, a 14-item instrument [17]. This questionnaire addresses various aspects of visual discomfort, including blurred vision, binocular visual problems, ocular irritation, headache, concentration difficulties, reading problems, and postural aspects. Each item utilised a Likert scale with three response options indicating symptom frequency, with scores assigned between 0 and 2 points. The total SQVD score, obtained by summing the 14 individual item scores, ranged from 0 to 28. For the quantification of visual symptom scores, the SQVD scores were categorised into mild, moderate, and Severe using a percentage-based cut-off approach. The maximum SQVD score was of 28, the following ranges were applied: severe symptoms were defined as scores ≥ 80% of the maximum (i.e., ≥ 22.4 points); moderate symptoms as scores between 60% and 79% of the maximum (i.e., 16.8 to 22.3 points); and mild symptoms as scores < 60% of the maximum (i.e., < 16.8 points) [17].

The following anomalies were assessed in the present study:

Accommodation Insufficiency (AI)- Accommodation is the process by which the eye changes its refractive power by altering the shape of the lens in order to focus objects at various distances. AI means the inability of the eyes to perform accommodation for the expected age [15].

Accommodation Excess (AE)- Accommodation is the process by which the eye changes its refractive power by altering the shape of the lens in order to focus objects at various distances. AE means the ability of the eyes to exert more accommodation than the normal expected age [15].

Convergence Excess (CE)- Convergence is the inward movement of the eyes so that the line of sight intersects in front of eyes. CE means more inward turning of the eyes than the normal expected [15].

Convergence Insufficiency (CI)- Convergence is the inward movement of the eyes so that the line of sight intersects in front of eyes. CI means less inward turning of the eyes than the normal expected [15].

STATISTICAL ANALYSIS

Descriptive statistics, including mean, standard deviation, and percentages, were calculated for demographic and clinical variables. A one-way ANOVA was conducted to compare visual symptom scores among the four binocular anomaly groups. Regression analysis was performed to examine the relationship between anomaly types, age, gender, and the visual symptom score as the dependent variable. Statistical significance was considered as a p-value of <0.05.

RESULTS

The study included 72 participants, predominantly female, comprising 64 females (89%) and eight males (11%). The average age of participants was 22.29±2.67 years, with ages ranging from 18 to 30 years. The most common binocular anomaly was AI, seen in 37.5% of cases [Table/Fig-1].

Characteristic	n (%)/M±SD
Gender	
Female	64 (89)
Male	8 (11)
Age	
Mean±SD (years)	22.29±2.67
Binocular anomaly type	
Accommodation Insufficiency (AI)	27 (37.5)
Convergence Insufficiency (CI)	20 (27.8)
Accommodation Excess (AE)	17 (23.6)
Convergence Excess (CE)	8 (11.1)

[Table/Fig-1]: Demographic characteristics of study participants.

Visual symptom scores and severity distribution: The average visual symptom score, as measured by the SQVD, was 10.08±4.14. The distribution of visual symptom severity indicated that the majority of participants experienced mild visual symptoms. Specifically, 52 (72.2%) of the patients reported mild visual symptoms, 16 (22.2%) reported moderate symptoms, and 4 (5.6%) reported severe visual symptoms.

Comparison of visual symptom scores across anomaly groups: A one-way ANOVA was conducted to compare the visual symptom scores among the four distinct binocular anomaly groups. The analysis revealed no statistically significant difference in visual symptom scores across these groups (p-value=0.454) [Table/Fig-2].

Predictors of visual symptom scores: A regression analysis was conducted to explore how different types of binocular vision anomalies, along with age and gender, influence visual symptom scores (the dependent variable). The key findings are summarised below and the results are presented in [Table/Fig-3].

AI vs AE: The regression coefficient indicates a trend toward fewer visual symptoms in individuals with AI compared to AE, although this was not statistically significant (p-value<0.05). This suggests a potential negative association that may warrant further investigation with a larger sample size.

Anomaly	n	Mean±SD	Test statistics	p-value
AE	17	11.41±4.2	0.9	0.454
AI	27	9.33±3.81		
CE	8	10.38±3.66		
CI	20	9.85±4.68		

[Table/Fig-2]: Comparison of visual symptom scores across anomaly groups.
*AI: Accommodation insufficiency; AE: Accommodation excess; CE: Convergence excess; CI: Convergence insufficiency. Dependent Variable: Visual Symptom score.

Predictors		Regression coefficient	p-value
Intercept		20.78	<0.001
Anomaly			
AI-AE		-2.47	0.063
CE-AE		-1.92	0.286
CI-AE		-1.92	0.159
Age		-0.4	0.035
Gender	M - F	-0.65	0.682

[Table/Fig-3]: Results of regression analysis.
*AI: Accommodation insufficiency; AE: Accommodation excess; CE: Convergence excess; CI: Convergence insufficiency.
Dependent variable: Visual symptom score.

CE vs AE and CI vs AE: Both comparisons showed no statistically significant relationship with visual symptom scores. These findings suggest that, in this cohort, CE and CI were not strongly associated with changes in symptom burden compared to AE.

Age was found to be the only statistically significant negative predictor, indicating that visual symptom scores decreased with increasing age. This may imply that younger individuals experience greater symptom burden.

Gender (Male vs. Female) was not a statistically significant predictor (β=-0.65, p-value=0.682), suggesting that reported visual symptoms did not differ meaningfully between male and female participants.

DISCUSSION

Previous studies have suggested that migraine patients' visual quality of life is severely impacted and suggested for further studies in this field [18]. Several studies have already described a variety of visual symptoms accompanying migraine, including "visual blurring," "retinal migraine," "ophthalmoplegic migraine," photophobia, palinopsia, "visual snow," and prolonged or otherwise unusual auras [19]. This cross-sectional study provides insights into the prevalence and nature of visual symptoms in young adult migraine patients with co-existing binocular vision anomalies.

Photophobia appeared to be a major contributor to the visual symptom burden in the present study, which is consistent with previous studies that highlight the distinct pathophysiology of photophobia in migraine [20]. Mechanisms such as hyperexcitability of the visual cortex and complex interactions between visual and pain pathways may explain this heightened sensitivity [20]. These findings suggest that photophobia may influence symptom severity more than binocular dysfunctions in this cohort.

There are limited studies that have assessed the presence of binocular vision dysfunctions in patients with migraine. The lack of statistically significant associations between specific binocular anomalies and visual symptom scores, both in ANOVA and regression analyses in the present study results, may reflect the multifactorial origin of symptoms captured by the SQVD. The questionnaire's broad scope, including symptoms of glare, ocular discomfort, and concentration difficulty, may dilute specific associations with asthenopia due to binocular dysfunctions.

Notably, a significant negative correlation between age and visual symptom scores was observed. Younger participants reported higher symptom burdens, which may be attributed to increased visual demands such as prolonged screen time and academic stress factors that can intensify visual discomfort in this age group.

Previous literature has demonstrated that migraineurs experience reduced visual quality of life and more frequent photophobia compared to individuals without migraine or with other headache types [18,21]. The present study adds to this understanding by highlighting the high prevalence of visual symptoms, particularly in younger migraine patients, but it does not establish a causal link between binocular anomalies and symptom severity. Hanson LL et al., stated chronic migraineurs may really have visual quality of life effects that are just as severe as those linked to other prevalent neuro-ophthalmic conditions hence an assessment of the impact on visual performance should be part of future research on the overall disease burden in migraine sufferers [18]. Ozudogru S et al., stated that visual quality of life is affected in migraine individuals and dry eye seems to be the most important symptom [12]. In the future, the authors hope to investigate dry eye in this population and correlate it with symptoms related to vision.

Limitation(s)

Some limitations of the study also need to be noted. As the study had a cross-sectional design, causal inferences cannot be drawn. The sample size of 72 participants may have been insufficient to detect subtle correlations or differences, particularly for binocular anomaly groups with smaller participant numbers. The absence of a control group limits the ability to compare symptom prevalence and severity directly. The study cohort was predominantly young and female, which may limit the generalisability of the findings to older or male migraine populations. Future research should address these limitations.

CONCLUSION(S)

Visual symptoms are common among young adults with migraine, with photophobia contributing significantly to overall symptoms. Although binocular vision anomalies were frequently observed, no statistically significant correlation was found between specific anomaly types and visual symptom severity. The observed age-related trend suggests that younger migraine patients may be more symptomatic, potentially due to higher visual demands. These findings underscore the importance of comprehensive visual assessments in migraine management. Future research should explore whether targeted interventions, including management of photophobia and binocular vision anomalies, could help alleviate visual discomfort and improve quality of life in this population.

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