

Association of Binocular Anomaly with Headache

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ABSTRACT

AIM: To study various binocular attributes associated with headache, in absence of refractive error and other ocular inflammatory diseases.

METHODS: Study comprised of 199 emmetropic patients of headache after all non-ocular causes of headache were ruled out and after getting the ethical clearance and proper consent. Detailed ocular evaluation was done including visual acuity, refraction, binocular assessment like convergence insufficiency and excess, accommodation excess and insufficiency and AC/A ratio, anterior and posterior segment examination. Data was collected and analysed

using SPSS software.

OBSERVATIONS: 45.22% patients were young adults of 21-30 years. The female: male ratio was 2:1. Frontal headache was the commonest presentation (34.7%). Precipitating factor for headache was inadequate or irregular sleep in young patients ($p < 0.07$) and smoking in older patients ($p < 0.0001$). An altered AC/A ratio was found in 74.9% patients. Direct proportion was seen between convergence insufficiency and low AC/A ratio and between convergence excess and high AC/A ratio ($p = 0.000$). Accommodation showed inverse relationship with AC/A ratio ($p = 0.0001$). Reduced negative fusional vergence was commonly associated with high AC/A ratio while, reduced positive fusional vergence was more common with low AC/A ratio ($p = 0.03$).

CONCLUSION: Ocular anomalies other than refractive error may coexist with headache complaints. Therefore thorough investigation should be done for refractive and binocular vision abnormalities in all patients suffering from headache.

Key words: Binocular anomalies; Headache; Accommodation insufficiency; Convergence insufficiency

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BINOCULAR ANOMALIES AS A CAUSE OF HEADACHE

Headache is quite prevalent in the general population and is among the most common disorders of the nervous system. Headache disorders are a global problem, affecting people of all ages, races, income levels and geographical areas.

Headache disorders impose a recognizable burden on sufferers including sometimes substantial personal suffering, impaired quality of life and financial cost.

Chronic headache disorders also result in depression which is three times more common in people with migraine or severe headaches than in healthy individuals^[1].

Prevalence of primary headache (headache without underlying disorders) varies with age, and is 9–11% in school children^[2]. In more than 80% patients, headache starts before the age of 40 with a lower prevalence rate at an advanced age (>50 years)^[3].

Even though the evidence in the literature for a strong association between oculo-visual problems and headache is weak^[4], the patients of headache are frequently referred to an ophthalmologist. Ophthalmological studies on headache have reported the role of different ocular diseases like acute glaucoma, uveitis, optic neuritis^[5] and visual anomalies like refractive errors and accommodative and vergence deficiencies^[6] in causing headache. The most frequently encountered condition after refractive error is binocular accommodative or oculomotor anomaly. The most widely accepted system for classifying binocular vision dysfunctions is Duane's classification^[7]. It is based on both the distance phoria and AC/A (accommodative- convergence by accommodative) ratio. The commonest anomalies are accommodative insufficiency and convergence insufficiency.

Binocular vision anomalies have been a major cause of headache which goes undetected due to neglect towards this aspect as a cause of headache. Therefore this study was conducted with the aim to study various binocular attributes associated with headache, in absence of refractive error and other ocular inflammatory diseases.

MATERIAL AND METHOD

It is a prospective cross-sectional study conducted in the department of Ophthalmology, after getting the approval from Institutional ethics committee and an informed written consent by the patient.

There were 199 patients with complaints of headache who either had come by their own or were referred from other departments to the department of Ophthalmology. Patients were also referred to other departments to rule out non-ocular cause of headache.

Patients who had non-ocular headache and other causes of ocular headache (hysteria, malingering, neurogenic causes such as intracranial space occupying lesion, benign intracranial hypertension, meningitis, giant cell arteritis; sinusitis, otitis, vascular headaches such as migraine; angle closure glaucoma, uveitis, optic neuropathy, etc; patients on NSAIDs/anticholinergic drugs – psychiatric medicines, cold, dysmenorrhoea etc; or patients using video display terminals for greater than 2 hr/day at a stretch) were excluded from the study.

Selected patients were interviewed according to a pre-designed and pre-tested performa. Detailed history of headache pattern, life style pattern and eating habits was taken. Ocular evaluation consisted of detailed refractive check-up, binocular vision assessment and anterior segment and posterior segment examination.

Visual acuity was tested at 6 meters by Snellen's chart and after refraction only the emmetropic patients were included in the study.

A slit lamp examination of the anterior segment was done and ocular tension was recorded by applanation tonometer. Fundus fluorescein angiography and OCT for retinal evaluation and Humphrey field charting for glaucoma patients was done if needed.

Detailed orthoptic examination was done and the diagnosis was made as defined below. Convergence insufficiency: (1) Near point of convergence^[8] (NPC) > 6 cm and; (2) Positive fusional convergence^[9,10] (PFC) <15 PD. Accommodative insufficiency^[11] (Cacho criteria): Near point of accommodation (NPA) <15-0.25 x Age.

The most common method of determining the AC/A ratio is the gradient method in which the phoria at near is measured after

changing the accommodation with a spherical lens (usually +1.00 D or -1.00D) placed in front of the two eyes. It is expressed as $AC/A = (\alpha - \alpha') / F$ where α = near phoria and α' is distance phoria: F is power of lens used. (esodeviation is taken as positive and exodeviation as negative).

Data entry and statistical analysis was done using Statistical Package for Social Sciences (SPSS SOFTWARE VERSION 11.5) and inferences drawn. Mantel-Haenszel chi-square test (χ^2_{MH}) was used to control any possible confounding variable, wherever necessary. A 'P' value of less than 0.05 was taken as significant.

RESULT

Total of 199 emmetropic individuals having headache with no other systemic problem were included in the study.

Majority of patients were young adults in the age group of 21-30yrs (N = 90); Females outnumbered males in a ratio of 2:1 with 32.2% males and 67.8% females (Table 1).

Pain topography showed frontal headache (45.2%) to be the most common presentation followed by hemicranial type of headache (34.7%) (Table 2).

On orthoptic evaluation, an altered AC/A ratio was found in 74.9% of individuals complaining of headache, having either low (39.7%) or high (35.2%) AC/A ratio ($p < 0.0001$). Out of 199 patients, 39.9% pts were suffering from convergence insufficiency where as 33.66% had convergence excess and only 27.13% had normal convergence range. Direct proportion was seen between Convergence Insufficiency and low AC/A ratio and also between convergence excess and high AC/A ratio ($p = 0.000$) (Table 3).

Accommodation insufficiency was seen in 46.7% of patients while accommodation excess was present in 36.68% of patients. Contrary to convergence, accommodation was inversely proportional to AC/A ratio. Accommodation insufficiency being more common with high AC/A ratio (69.5%) whereas accommodation excess was seen more in patients having low AC/A ratio (84.9%) $p = 0.0001$ (Table 4).

Fusional vergence findings showed normal vergence in only 39(19.5%) patients. Reduced negative fusional vergence was seen in 39.69% patients and was more commonly associated with high AC/A

Table 1 Headache related with age and sex .

Age Group (N)	Sex	
	Male	Female
10-20 Yrs (N = 74)	23 (31.10%)	51 (68.90%)
21-30 Yrs (N = 90)	30 (33.30%)	60 (66.70%)
31-40 Yrs (N = 27)	8 (29.60%)	19 (70.40%)
41-50 Yrs (N = 6)	3 (50.00%)	3 (50.00%)
51-60 Yrs (N = 2)	0 (0.00%)	2 (100.00%)
TOTAL (N = 199)	64 (32.20%)	135 (67.80%)

Table 2 Distribution of patients according to pain topography in relation to working hours.

		Occipital	Frontal	Hemicranial	Generalised
WORKING HOURS	UPTO 4HRS (N = 76)	4 (5.30%)	41 (53.90%)	24 (31.60%)	7 (9.20%)
	5-8HRS (N = 61)	(-)	30 (49.20%)	19 (31.20%)	12 (19.70%)
	9-12HRS (N = 18)	(-)	11 (61.10%)	5 (27.80%)	2 (11.10%)
	13-16HRS (N = 44)	4 (9.10%)	8 (18.20%)	21 (47.70%)	11 (25.00%)
	TOTAL (N = 199)	8 (4.00%)	90 (45.20%)	69 (34.70%)	32 (16.10%)

ratio (39%), while reduced positive fusional vergence was present in 40.7% patients and was more common with low AC/A ratio (40.9%). ($p = 0.0300$) (Table 5).

On correlating the type of headache with AC/A ratio we observed that throbbing type of pain was associated more with low AC/A ratio while piercing type of headache was seen with high AC/A ratio ($p = 0.632$) (Table 6).

DISCUSSION

Headache is experienced by majority of population and has a major impact on public health. The condition has been ranked among the ten most disabling conditions by the world health organisation. Headache is common during childhood and it becomes even more common and more frequent during adolescence.

In our study, the commonest binocular anomaly was accommodative insufficiency (46.7%) followed by convergence insufficiency (39.19%), while according to Mocii F *et al*^[12] convergence insufficiency is the most frequent cause of muscular asthenopia. This prevalence of convergence insufficiency is less than that of Gupta *et al*^[13] (49%), Romania^[14] (60.4%) and Patwardhan and Sharma^[15] (71.4%), while it is more than that of Sanjay *et al*^[16] (16.25%). These discrepancies might be because of the different working environment of the patients.

In our study, accommodative insufficiency is associated with low AC/A ratio, which is normally overcome by positive fusional reserve but when this fusional reserve is also insufficient the patient develops the symptom of asthenopia and then actual headache. This fusional reserve become insufficient due to functional causes such as overwork or deficient physiology though there may be other non-functional causes. And this may be the reason for headache in younger age group as they stress their eyes by staying awake at night and watching television or computers and also skipping meals.

In this study, headache was more common in females ($p > 0.001$) similar to the observations of Hendricks *et al*^[17] and sanjay *et al*^[16], with females having more than two fold prevalence over males especially in young adults in the age group of 21-30 years. Headache prevalence in this particular age group might be because of the psychological stress caused by educational pressures for career development and emotional factors. Female preponderance could be because of the culturally set factors and the effects of male dominated society which may lead to psychological stress^[18]. In our study, patients in the school age comprised of 37%. Headache in this age group could be because of peer pressure for better performance in the studies and extracurricular activities.

Regarding the site of headache, our study revealed that the frontal (45.2%) followed by unilateral location (34.7%) were the commonest sites. According to Unp *et al* (2005)^[23] most of the patients who suffered from headache defined more than one location. More than half of the studied sample (70.35%) had throbbing type of headache followed by piercing type in 16.08%. Throbbing headache was commonly associated with low AC/A ratio (40%) while piercing type was commonly associated with high AC/A ratio (43.8%). These findings were similar to the studies of Unp *et al.* 2005^[23] and Ayatollahi & khosravi (2006)^[24].

Various studies have stated different precipitating factors for headache such as skipping meals, and inadequate or irregular sleep, and stress to be majorly responsible for headache. Isik *et al* (2006)^[19] and El tallawy *et al* (2006)^[20] reported them to be the most common precipitating factors for headache in 69%, 83.6% and 72.6% cases respectively. Hunger or missed meal is shown to be a precipitating factor in 60.06% of children by Blau *et al* (2004)^[21].

Table 3 AC/A ratio as related with convergence.

AC/A ratio	Convergence	High	Low	Normal
	Insufficiency; N = 78 (39.19)	2 (2.6%)	72 (92.3%)	4 (15.1%)
	Excess; N = 67 (33.66)	63 (94.00%)	2 (3.00%)	2 (3.00%)
	Normal; N = 54 (27.13)	5 (9.30%)	5 (9.30%)	44 (81.50%)
Total; N = 199		70(35.2%)	79(39.7%)	50(25.1%)

$p = 0.0001$

Table 4 Accommodation as related with AC/A ratio

AC/A ratio	Accommodation	High	Low	Normal
	Insufficiency; N = 93 (46.7%)	60 (64.5%)	9 (9.6%)	24 (25.8%)
	Excess; N = 73 (36.68%)	3 (4.1%)	62 (84.9%)	8 (10.9%)
	Normal; N = 35 (17.58%)	7 (20%)	8 (22.8%)	18 (51.4%)
Total; N = 199		70 (35.2%)	79 (39.7%)	50 (25.1%)

Table 5 Fusional vergence as related with AC/A ratio.

Fusional Vergence	AC/A ratio			
		High	Low	Normal
	Reduced Negative; N = 79 (39.69%)	62 (39%)	5 (3.10%)	12 (7.50%)
	Reduced Positive; N = 81 (40.7%)	2 (1.20%)	65 (40.90%)	14 (8.80%)
	Normal; N = 39 (19.5%)	6 (15%)	9 (22.50%)	24 (60%)
Total; N = 199(100%)		70 (35.10%)	79 (39.60%)	50 (25.10%)

$p = 0.030$

Table 6 Type of headache as related with AC/A ratio.

Type of Headache	AC/A ratio			
		High	Low	Normal
	Throbbing N = 140 (70.35%)	46 (32.9%)	56 (40%)	38 (27.1%)
	Piercing; N = 32 (16.08%)	14 (43.8%)	10 (31.3%)	8 (25%)
	Dull Aching; N = 14 (7.03%)	6 (42.9%)	7 (50%)	1 (7.1%)
	Gnawing; N = 13 (6.53%)	4 (30.8%)	6 (46.2%)	3 (23.1%)
Total; N = 199(100%)		70 (35.2%)	79 (39.7%)	50 (25.1%)

$p = 0.632$

Other precipitating factors were staying for long in front of TV or computer, ingestion of cold drink or ice cream and eating chocolate or cheese in a study carried out by Stovner *et al* (2007)^[22]. These environmental triggers, light, sound and smell are transmitted directly to the central nervous system(CNS) by the special senses and thus cause direct excitation of the neural pathways which then causes headache attack. We could not include them in our study due to limited resources.

CONCLUSION

Emmetropic females above the age of 21 years without any systemic association suffer from headache more than males.

Younger age group (10-20 years) patients suffer more from convergence insufficiency, accommodation insufficiency and poor fusional vergence.

Inappropriate lifestyle pattern could be the major precipitating factor triggering headache in them. Thus we found that ocular anomalies other than refractive error may co-exist with headache complaints for which thorough investigation should be done as proper treatment of refractive anomalies and binocular vision usually results in improvement of headache.

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