

Vertigo Is an Underestimated Symptom of Ocular Disorders: Dizzy Children Do Not Always Need MRI

Marie-José Anoh-Tanon, MD*, Dominique Bremond-Gignac, MD[†], and Sylvette R. Wiener-Vacher, MD*

Vertigo, instability, dizziness, or equilibrium disorders are not usually considered as consequences of ophthalmologic problems. We present data indicating that ocular disorders can be responsible for these symptoms in children. In a population of 523 pediatric patients with vertigo or disequilibrium and referred for vestibular testing in our otolaryngology department during a 5-year period, 27 children presented with normal vestibular and somatic neurologic examinations but with ophthalmologic disorders (vergence insufficiency or latent strabismus with binocular vision in 70% and anisometropia in 41%). These patients represented 24% of all vergence insufficiencies detected and 4% of all orthoptic examinations performed in the pediatric ophthalmology department. These ocular abnormalities were considered to be the initial cause of the problems. In two thirds of these patients the symptoms were completely resolved by simple ophthalmologic treatment. No other additional tests, such as magnetic resonance imaging, were required. Therefore we propose that every child complaining of vertigo or dizziness but with normal clinical somatic neurologic and vestibular examinations should have a complete ophthalmologic examination before additional, more costly, investigations. This should lead to better screening and more appropriate care of ocular disorders in children and avoid unnecessary magnetic resonance imaging. © 2000 by Elsevier Science Inc. All rights reserved.

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Introduction

Various ophthalmologic abnormalities can appear and become symptomatic in children during the first decade because of the continuing development of the visual system during that period [1,2]. Early diagnosis of visual disorders in children is essential to avoid serious consequences in learning abilities or visual development (such as amblyopia).

Although pediatricians routinely view headaches, reading difficulties, and ocular irritation as indications of a possible ocular disorder [3], vertigo, instability, dizziness, and equilibrium problems are rarely considered as indicators of ophthalmologic abnormalities.

The overall incidence and prevalence of visual disorders in the general population of children is difficult to determine, and the evaluations published to date are quite variable; for example, the incidence reported for convergence insufficiencies varies from 1% to 22% [4,5]. This variability is explained in part by the disparity in the selection of the populations studied and the screening techniques used in the studies [4,5].

At the Robert Debré Hospital, we formed a multidisciplinary team to perform a comprehensive battery of ocular and vestibular tests [6] on young vertiginous patients. We were surprised to discover that during a 5-year period, more than 5% of the 523 children referred for vestibular testing had no pathologic findings other than ocular disorders. The medical staff of the hospital was alerted to this finding, and now, an even greater number of dizzy young patients are diagnosed with ophthalmologic disorders. Our study presents the characteristics of these patients and the signs that allowed proper diagnosis and treatment of the ocular disorders.

From the Departments of *Otorhinolaryngology and [†]Ophthalmology; Robert Debré Hospital; Paris, France.

Communications should be addressed to:
Dr. Wiener-Vacher; Department of Otorhinolaryngology; Robert Debré Hospital; 48 Boulevard Sérurier; Paris 75019 France.
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Methods

Patients. We referred selected patients with mixed clinical symptoms, such as vertigo, dizziness, or equilibrium disturbances, associated with completely normal somatic and neurologic clinical examination findings and the absence of vestibular anomalies that could have produced the symptoms for ophthalmologic examination. Their otorhinolaryngologic examinations were normal.

The sensations of dizziness described by the patients did not correspond to any classic vestibular abnormality. A relation to ocular disorders was sometimes suspected because of associated headache, blurry vision during reading, or eye irritation after reading or watching television screens or computer monitors or occurring when fatigued. Another sign was observed during the clinical examination when obvious eye convergence insufficiency was demonstrated while maintaining the gaze at a target drawn closer to the eye along the midline.

Of 523 children referred for vestibular testing, 27 fulfilled these criteria and were suspected to have ocular disorders. The ophthalmologic examination was performed before any other additional investigations, such as magnetic resonance imaging (MRI), in 21 of 27 patients. MRI was not systematically requested, but six patients came to our clinics with MRI (normal findings) performed before vestibular testing. A complete somatic and neurologic examination was performed.

In our study the vestibular testing included a clinical vestibular and neurologic examination and vestibulo-ocular response recordings, with the electro-oculography technique [6] during canal function tests (caloric test, earth vertical axis rotation, and pendular rotation) and otolith function tests (off vertical axis rotation) [6]. Hearing tests were performed to assess the function of the inner ear in all patients (pure tone and speech audiometry).

The complete ocular examination included visual acuity, refraction with cycloplegia, intrinsic and extrinsic ocular motricity investigation, and vergence functional testing. The vergence was evaluated with a cover test, variable prisms, Maddox rod, and the synoptophore techniques.

Refractive disorders were corrected with prescription eyeglasses. Vergence anomalies were treated with 12 sessions of orthoptic therapy, which included training of convergence and fusion with prisms and synoptophore to assess the binocular vision. At the end of the orthoptic therapy, the quality of the convergence was measured by prisms testing.

Results

Characteristics of Vertigo Induced by Ocular Disorders

The symptoms usually appeared in children after 6 years of age, when activities involving prolonged attention become more frequent. Our group included 13 females and 14 males with an age range of 3 years, 6 months to 13 years (mean \pm S.D. = 8 years, 6 months \pm 7 years).

The clinical manifestations usually occurred at the end of the day or with fatigue. However, they could also appear on waking in the morning (particularly for hyperopia) or after long exposure to computer or television screens. The ever-increasing popularity of computer games among children seems to be an important factor in triggering previously latent ocular disorders because of the strain on ocular motility that they impose. The symptoms were not related to rapid or prolonged standing but were sometimes related to walking or rapid movements of the head. They were not associated with phosphenes, visual hallucinations, or subjective noise in the ears and were never associated with a loss of consciousness.

In the 27 young patients diagnosed with vertigo related

to ocular abnormalities the symptoms were reported as sensations of rotation, displacement of the environment, or rolling. Although it was often associated with headache (44%), vertigo could also be the only sign (15%). The vertigo was usually well tolerated, and nausea ($n = 4$) or vomiting ($n = 3$) occurred only when the vertigo was associated with headache. In younger children (younger than 4 years of age, $n = 3$), ocular disorders were responsible for unsteadiness, but the unsteadiness was not described as a real sensation of rotation, although it was initially described as vertigo by the patients and their parents.

Ocular Disorders Leading to Vertigo

In 19 patients the ophthalmologic examination revealed refractive errors (ametropia), such as hyperopia, myopia, or astigmatism. In one patient an amblyopia (unilateral loss of vision without an organic lesion) was observed. A latent strabismus with binocular vision was detected in six patients, and convergence insufficiency was evident in 13 patients (Fig 1).

In our series, vergence anomalies (convergence insufficiency and strabismus with binocular vision) were present in 19 (70%) of the 27 children. These vergence anomalies were the only ophthalmologic disorders in 30% of the patients and were associated with anomalies of refraction and visual acuity in 41% ($n = 11$) (Fig 1).

Of the 27 patients with vertigo and ocular disorders, 21 tested normally in the vestibular examinations (recordings of vestibulo-ocular responses). In the other six patients the vestibulo-ocular anomalies were subtle, at the limit of the normal values, and could not explain the vertigo.

The ophthalmologic examination was performed before any other additional investigations in 21 of the 27 patients, and MRI was not systematically requested. Six patients had undergone MRI before being referred for vestibular testing; the MRI findings were normal.

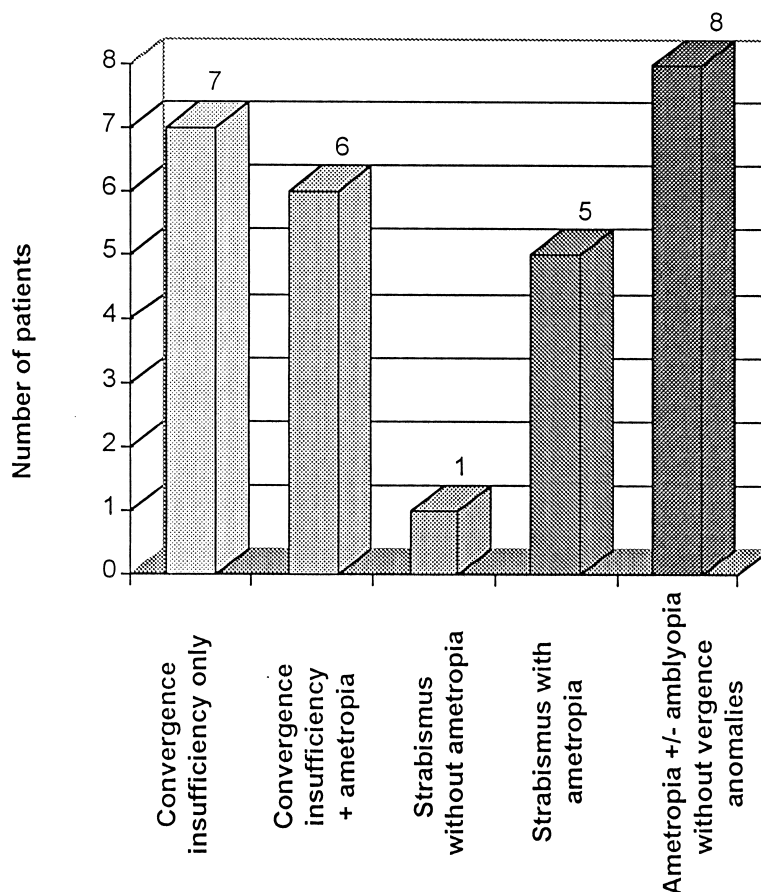
The correction of refraction anomalies and the orthoptic therapy effectively treated the symptoms. Twenty-five percent of the patients underwent orthoptic therapy, 55% optical correction with eyeglasses, and 20% both orthoptic therapy and optical correction with eyeglasses.

Two thirds of the children (21 of 27) had satisfactory or excellent results after ophthalmologic treatments (Fig 2), that is, their vertigo or imbalance disappeared. This improvement always correlated with measurable improvement of the quality of convergence at orthoptic testing after treatment. In the four other patients, follow-up examination was not possible.

Discussion

The results of the present study have demonstrated that dizziness and vertigo can be caused by simple ocular disorders in children with normal clinical neurologic and vestibular examinations. The selection of these patients

Figure 1. Results of refraction, visual acuity, and orthoptic examinations in the 27 patients.



requires a detailed description of the signs, including the actual sensations perceived (which are rarely intense sensations of rotation), triggering factors (reading, television, and computer games), time of the day that the signs occur, and associated problems (headache, visual difficulties, and double vision).

It is also essential that a complete clinical somatic neurologic examination and complete vestibular testing (including a caloric test) are performed before considering an ophthalmologic disorder as the principal cause. Even if the complaints do not seem to correspond to any classic vestibular abnormality, a complete vestibular examination, including the caloric test, is required to exclude a completely compensated unilateral impairment of the canal vestibular system.

These symptoms are never associated with a loss of consciousness, black vision, or visual hallucinations. They are not associated with obvious signs of orthostatic or postural hypotension, and, in particular, they are not noticeably related to rapidly standing up or prolonged standing. Vertigo related to ocular disorders is often associated with headache (44% in the present series), particularly in patients with a familial or personal history of migraine, and may be related to vertiginous migraine equivalent. However, in these patients the ocular disorder acts as a trigger for the migraine and requires treatment.

Patients fitting the aforementioned profile should first

be referred for a complete clinical ocular examination before any other costly investigations, such as MRI, are performed. The failure to detect and identify the responsible ocular abnormality can lead to unnecessary MRI and inappropriate therapy.

Relationship Between Ocular Disorders and Vertigo

Postural-motor control of the body during a wide variety of activities is constantly readjusted on the basis of visual, proprioceptive, and vestibular information related to self-movement [7-9]. For example, gaze stabilization (which requires good vision) is one of the fundamental factors necessary for equilibrium [8,9]. Abnormal refraction or a vergence insufficiency could lead to poorly adjusted visual control.

The visual system is not mature at birth, and refraction continues to develop during infancy [1,2]. During this developmental period, various abnormalities can appear and become symptomatic [3]. In normal eyes (emmetropia), binocular visual fixation of a target presupposes a stable convergence of the eyes (to obtain a projection of the target onto the corresponding points of the retina). The capacity for adjustment of the focus from distant to near vision (which requires lens accommodation) is also necessary. The accommodation-convergence reflex is executed with the conjugate action of internal ocular muscles

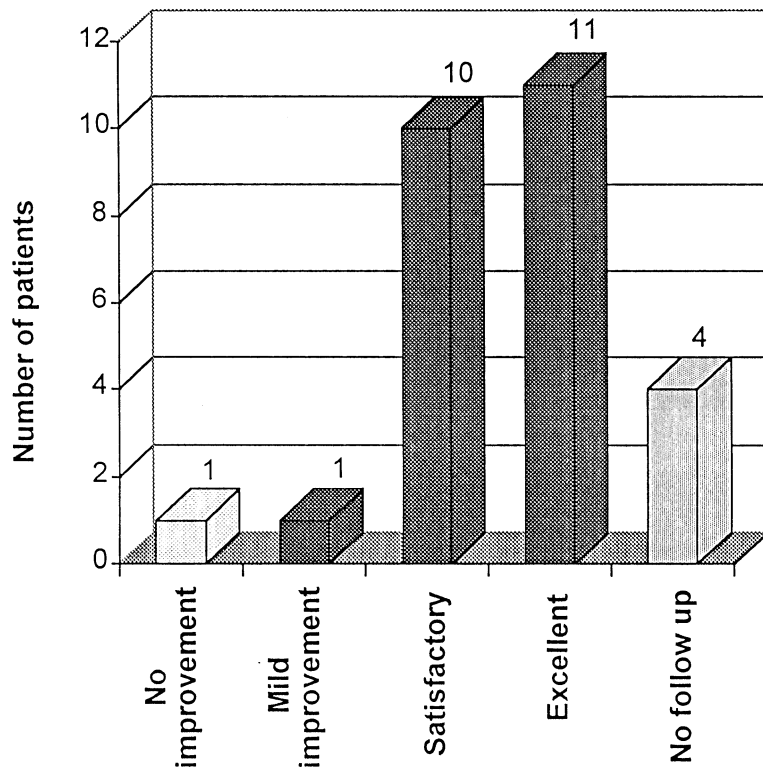


Figure 2. Results of treatment; 25% of the patients had undergone orthoptic re-education, 55% optical correction, and 20% both.

and extraocular muscles. Different ocular disorders can disturb this process and lead to an increase in strain of the ocular muscles. Failures in binocular vision or in convergence can be responsible for inadequate gaze stabilization during movement and double or blurry vision during fixation, which could generate a sensation of imbalance and dizziness. The correlation frequently observed between long exposure to computer or television screens and the occurrence of manifestations, such as headache or vertigo, supports this hypothesis.

In children the changes in anatomic and physiologic properties of the visual system and the age-related changes occurring in their ocular activities (e.g., increased efforts at visual fusion when learning to read or increasing use of computer) may explain why in some patients adaptive mechanisms [10] become insufficient to compensate for the ocular disorders. Our preliminary findings indicate that patients with migraine or with predisposing factors for migraine and motion sickness have a greater tendency to suffer vertigo when ocular disorders occur. Such observations should be verified in a larger scale study.

The ophthalmologic screening of these ocular anomalies should include visual acuity testing, refraction with cycloplegia, intrinsic and extrinsic ocular motility studies, and especially orthoptic testing. Unfortunately, particularly in children, convergence insufficiency is not systematically investigated during standard ophthalmologic examinations, and hence vergence anomalies pass undetected. Although headache is a common indicator of

refraction or vergence anomalies, only rarely do specialists or pediatricians recognize dizziness and vertigo as indicators. Our study has demonstrated not only that vergence anomalies and refraction anomalies can be the cause of vertigo but also that their specific treatment alleviates the problem.

In conclusion, children with vertigo and dizziness but with normal neurologic findings and no obvious vestibular disorders after vestibular testing should undergo complete ocular testing for detection of an ocular abnormality as a possible cause of the vertigo and dizziness. For reasons of economy and risk control, ocular testing should be performed before MRI. This examination should include visual acuity, refraction with cycloplegia, intrinsic and extrinsic ocular motility studies, and orthoptic testing. Good optical correction or comprehensive orthoptic re-education can solve the problem and terminate the symptomatology.

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