An analysis of high myopia in a pediatric population less than 10 years of age

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Purpose: The purpose of this article is to document a comprehensive clinical profile—including the prevalence of amblyopia, strabismus, and anisometropia—of a pediatric population less than 10 years of age who manifested 6.00 diopters or more of myopia.

Method: A retrospective record review was performed on all pediatric patients less than 10 years of age, examined at the State University of New York (SUNY) State College of Optometry between 1998 and 2001, and with a spherical equivalent of 6.00 diopters or more of myopia.

Results: One hundred seventy-eight patients met the criteria. Amblyopia or reduced corrected visual acuity was present in 75.8% of the patients. Strabismus was present in 31.5% of the patients, with essentially equal numbers of esotropes and exotropes. Anisometropia was present in 35.4% of the patients. One hundred forty-five patients had high myopia in the absence of significant ocular or systemic compromising conditions. In this sample of 145, strabismus or anisometropia was an etiology for amblyopia. There was a greater prevalence of bilateral high myopia (64.8%) than unilateral high myopia. Anisometropia was present in 10.6% of the bilateral high myopes, and 78.4% of the unilateral high myopes.

Conclusion: Children less than 10 years of age with high myopia have a high risk of having amblyopia, strabismus, and anisometropia.

Key Words: Amblyopia, anisometropia, high myopia, pediatric population, refractive status, strabismus

In general, high myopia is categorized as myopia of 6.00 or more diopters (D).[1-6] Low myopia has a refractive range of 0.25 to 3.00 D, and intermediate myopia is from 3.00 to 5.00 D, and frequently manifests a scleral crescent formation.[7] Congenital high myopia manifests some increase in axial length and can be essentially nonprogressive. It can also manifest retinopathy of prematurity, abnormal ocular refractive components (i.e., keratoconus, lenticonus, and spherophakia), systemic conditions, and syndromes.[1,7] Prematurity and associated low birth weight are major contributors to increased incidences of high myopia and myopia in general.[1] Pathologic myopia is high myopia, with the presentation of progressive myopic changes in childhood that include increased axial length and fundus changes. Close to 50% of these children become legally blind as a result of retinal detachments or maculopathy.[8] Deller et al.[9] believed that at 5.50 D of myopia, the eye starts to depart from its normal spherical shape. Grosvenor and Goss[10] and Curtin[1] suggested that high myopia of 6.00 D is the borderline for pathologic myopia, with accompanying ocular complications, especially posterior segment changes.

The genetic basis of myopia has been well documented.[11,12] The mode of transmission can be either autosomal dominant or recessive.[1,13-15] However, environmental and cultural aspects also influence the development of myopia.[1]

The prevalence, progression, and age at onset of high myopia varies with ethnicity and gender.[16-18] Curtin[1] noted that approximately 2.1% of Americans at 17 years of age present with more than 5.00 diopters of myopia. Fuchs[16] found high myopia in 9.6% of his Spanish sample and 8.4% of his

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Japanese sample, but only 0.2% of his Egyptian sample. Goldschmidt[18] noted the rate of myopic progression was similar between Chinese and Scandinavian children, but the Chinese had a four-year earlier age at onset and a greater amount of final myopia.[18] Though there are conflicting studies regarding gender bias, it appears there is a higher prevalence of high myopia in females.[1]

Marr et al.[19] investigated the inter-relationship of high myopia with ocular and/or systemic conditions in a hospital-based sample. Their study's inclusion criteria were 6.00 D spherical equivalent (SE) or more of myopia and age of less than 10 years. There were no additional exclusion criteria. In their sample of 112 children, only 8% had high myopia in the absence of any other ocular or systemic condition, 54% had an underlying systemic condition, and 38% had ocular conditions alone. The particularly high incidence of systemic conditions was of interest and served as an impetus for this study.

The purpose of the present study is to document the clinical profile of a similar population in an outpatient teaching clinic. This article focuses on the ocular conditions amblyopia, strabismus, and anisometropia, which prove to be far more prevalent than the systemic issues identified by Marr et al.[19]

Method

The Quality Assessment and Improvement Committee of the University Optometric Center (UOC)—the patient care facility of the State University of New York, State College of Optometry—conducted a retrospective study of all patients, under 10 years of age and having the diagnosis of myopia, who were examined in the clinics within the College in the four-year period between 1998 and 2001. Pediatric clinical faculty performed the examinations of patients under the age of 5 years, while the examinations of patients older than 5 years were performed by either interns or residents supervised by a member of the pediatric clinical faculty, to ensure reliability of findings. In order to capture possible miscoded records, the review included all patients with a diagnostic code (ICD-9-CM) of myopia (367.1) or progressive/degenerative myopia (360.21). Inclusion criteria were the same as used by Marr et al,[19] (i.e. spherical equivalent [SE] of 6.00 or more diopters of myopia in one or both eyes, and the patient being less than 10 years of age). For the purpose of this study, the following criteria were used:

- *myopia* (a refractive condition of -0.25 D or more)
- *amblyopia* (20/40 or worse visual acuity [VA] in at least one eye)
- *anisometropia* (3.00 or more diopters difference between the spherical equivalents of the two eyes)

For the younger patients, in whom visual acuity was measured using preferential looking tests, the criterion for amblyopia was a deviation from age-expected. Ocular findings included all physical and/or functional eye conditions. Systemic findings included all reported associated general health conditions. Since temporal crescents are well-documented elements of high myopia, these data were excluded from the study.

The data retrieved from each record were the patient's age, gender, ocular, medical and developmental histories, refractive status, best-corrected visual acuity, binocular alignment, and ocular conditions. If a patient had more than one examination within the qualifying time period, the earliest visit findings were used for data collection. A patient questionnaire (*see* Appendix), which included birth and developmental milestones, was used to collect personal and family ocular and medical histories. Ethnicity was not included in the questionnaire. Though all patients received an anterior and posterior ocular evaluation through dilated pupils, a cycloplegic agent was not universally used on the first qualifying visit. However, at least one cycloplegic refraction was performed on each subject either before the study's onset or some time during the study period. This was an important part of the analysis, as it confirmed the patient's true refractive status. Thus, the refractive status data in this study were a combination of cycloplegic and non-cycloplegic retinoscopies.

The data collected were analyzed to determine the relationship between high myopia and amblyopia, strabismus, and anisometropia. The chi-square test was chosen due to the categorical nature of the data (e.g., presence or absence of a certain condition). Other statistical analysis, such as *t*-test and multivariate analysis, was used to look at trends between subgroups.

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