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Peripapillary Diffuse Chorioretinal Atrophy in Children as a Sign of Eventual Pathologic Myopia in Adults

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Purpose: To search for a morphologic biomarker to differentiate between pathologic myopia and simple childhood myopia.

Design: Retrospective case series.

Participants: The study included children (age ≤15 years) with high myopia (as defined by the Japanese Ministry of Health and Welfare) who attended the High Myopia Clinic between April 1982 and March 1994, had undergone fundus photography, and had a follow-up of 20 years or more.

Methods: Fundus photographs obtained in childhood and adulthood were examined for presence of pathologic myopia, defined by high myopia (myopic refractive error >8 diopters or axial length ≥26.5 mm) and the presence of stage 2 or higher myopic maculopathy.

Main Outcome Measures: Myopic maculopathy in childhood.

Results: The study included 56 eyes of 29 patients with a mean age of 10.2±3.6 years at the initial visit and an age of 36.0±7.6 years at the last visit. Mean axial length was 27.0±1.4 mm at baseline and 29.7±2.0 mm at the last visit. At the last visit, 19 eyes (34%) had tessellated fundus alone, 31 eyes (55%) had diffuse chorioretinal atrophy, 3 eyes (5%) showed patchy chorioretinal atrophy, and 1 eye (2%) had macular atrophy. Thus, 35 eyes (63%) had pathologic myopia in adulthood. Among the 35 eyes, 29 (83%) already had diffuse chorioretinal atrophy at the initial visit in childhood and the remaining 6 eyes (17%) showed tessellated fundus in childhood. The diffuse chorioretinal atrophy seen in childhood was restricted to the area temporal to the peripapillary region.

Conclusions: The presence of peripapillary diffuse chorioretinal atrophy in children with high axial myopia may be an indicator for the eventual development of advanced myopic chorioretinal atrophy in later life. These features in children may be helpful for differentiating simple childhood myopia from eventual pathologic myopia. *Ophthalmology 2016;■:1–5 © 2016 by the American Academy of Ophthalmology.*

Visual impairment resulting from pathologic myopia, which often is the result of the development of different types of myopic maculopathies, is a serious problem, especially in East Asian countries.[1–6] According to the Tajimi Study, myopic maculopathies are the leading cause of blindness in Japan,[4] and they are the second most common cause of irreversible blindness in China.[5] In addition, in East Asian countries, the prevalence of myopia has markedly increased in the past 50 years, with 80% of 18-year-old high school graduates now being myopic and 20% of 18-year-old high school graduates having a severe degree of myopia.[7,8] A recent epidemiologic study showed that in populations in which the prevalence of myopia was high, the prevalence of high myopia started to increase after 10 to 13 years of age.[9,10] It has remained unclear, however, whether this simple childhood myopia eventually will progress to pathologic myopia, as characterized by posterior staphyloma and severe myopic maculopathy, or whether pathologic myopia is a different disease than simple childhood myopia. Because it has not been clarified whether children with childhood myopia eventually will demonstrate pathologic myopia when they become adults, nor has it been determined which children will do so, we retrospectively examined the medical data of children with high myopia who were followed up for 20 years or more and searched for fundus features of their eyes when they were children or teenagers to identify indicators for the eventual development of advanced myopic maculopathy in later life.

Methods

This observational, longitudinal case series included children (age ≤15 years at the initial visit) who were examined consecutively at the High Myopia Clinic of the Tokyo Medical and Dental University between April 1982 and March 1994, who fulfilled the inclusion criterion of high myopia, and who had a follow-up of at least 20 years. The criterion of high myopia was myopic refractive error more than 4.0 diopters (D) for children 5 years of age or younger, myopic refractive error more than 6.0 D for children between 6 and 8 years of age, and myopic refractive error more than 8.0 D for children older than 9 years, according to Ministry of Health and Welfare in Japan.[11] All children were regularly

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followed up at least once yearly. Among them, those with a follow-up of 20 years or more were enrolled in the study. Approval was obtained from the Ethics Committee of the Tokyo Medical and Dental University. The procedures used during the examinations conformed to the tenets of the Declaration of Helsinki.

Fundus photographs obtained at baseline and at the last visit were assessed independently by 2 retina specialists (T.Y. and K.O.-M.). Myopic maculopathies were defined according to the myopic maculopathy international photographic classification system (META-analysis for Pathologic Myopia [META-PM] study classification).[12] This classification system included 5 categories: no myopic retinal lesions (category 0), tessellated fundus only (category 1), diffuse chorioretinal atrophy (category 2), patchy chorioretinal atrophy (category 3), and macular atrophy (category 4). Among the 5 categories, myopic maculopathy of stage 2 or more has been reported to be a cause of reduced best-corrected visual acuity.[13,14] Pathologic myopia was defined by high myopia (myopic refractive error >8 D or axial length ≥26.5 mm) and the presence of stage 2 or higher myopic maculopathy, according to the META-PM study.[6,12] Myopic maculopathy thus included features of diffuse chorioretinal atrophy, patchy chorioretinal atrophy, macular atrophy, or a combination thereof.[12] Exclusion criteria for entry into this study were a history of ocular disorders other than myopic maculopathy (e.g., retinitis pigmentosa, diabetic retinopathy, retinal vascular diseases, age-related macular degeneration), history of vitreoretinal surgery, and any glaucoma surgery. Patients with optic media opacities such as dense cataract preventing an ophthalmoscopic examination also were excluded.

All patients underwent a detailed ophthalmologic examination, including measurement of refractive error, biometry with measurement of axial length using A-scan ultrasonography (Ultrascan; Alcon, Fort Worth, TX), fundus examination under medical mydriasis using indirect ophthalmoscopy and slit-lamp–based posterior fundus examination, and color fundus photography (Topcon TRC 50DX fundus camera [Topcon, Tokyo, Japan] or Kowa Pro 1 or VX-10 fundus cameras [Kowa, Tokyo, Japan]).

Statistical analysis was performed using a commercially available statistical software program (SPSS version 22.0; IBM/SPSS, Chicago, IL). The normal distribution of refractive measurements was tested with the Kolmogorov-Smirnov test. The Wilcoxon signed-rank test was used to compare refractive error, axial length, or the best-corrected visual acuity between the initial visit and the final visit.

Results

The medical records of 1244 eyes of 622 patients who attended the High Myopia Clinic at Tokyo Medical and Dental University from April 1, 1982, through March 31, 1994, were reviewed retrospectively. The inclusion criterion of age 15 years or younger was fulfilled by 118 eyes (59 patients), and 96 of these eyes (50 patients) met the criterion of high myopia according to the definition given by the Ministry of Health and Welfare in Japan. Among the 96 eyes (50 patients), 66 eyes (34 patients) had a follow-up of 20 years or more. From among those 66 eyes (34 patients), 6 eyes were removed because there were no fundus photographs available at the initial visit; 2 more eyes were removed because there were no axial length data measured at the initial visit, and 2 more eyes were removed because they had no pathologic features.

Eventually, 56 eyes of 29 patients met all inclusion criteria and were enrolled in the study. There were 19 men (37 eyes) and 10 women (19 eyes). Among them, 27 patients had bilateral high myopia and 2 patients had unilateral high myopia. The mean follow-up was 25.8±4.9 years (range, 20−30 years). The mean age was 10.2±3.6 years (range, 5−15 years) at the initial visit and 36.0 ± 7.6 years (range, 33−42 years) at the last visit. Mean refractive error was significantly ($P<0.001$) less myopic at the initial examination (−9.6±4.8 D; range, −21.0 to −4.8 D) than at the final examination (−16.6±4.5 D; range, −30.0 to −9.1 D). As a corollary, mean axial length was significantly ($P<0.001$) shorter at the first visit (27.0±1.4 mm; range, 24.0−29.7 mm) than at the initial visit (29.7±2.0 mm; range, 26.4−33.6 mm).

At the last visit, among the 56 enrolled eyes, 19 eyes (34%) had tessellated fundus alone, 31 eyes (55%) had diffuse chorioretinal atrophy, 3 eyes (5%) had patchy chorioretinal atrophy, and 1 eye (2%) had macular atrophy. Thus, based on the META-PM study definition, 35 of the 56 eyes (63%) met the definition of pathologic myopia in adulthood and were analyzed further. The mean age of this subgroup was 10.5±2.6 years (range, 5−15 years) at the initial visit and 37.0±5.1 years (range, 33−42 years) at the last visit. The mean refractive error was −11.5±4.4 D (range, −21.0 to −6.5 D) at the initial visit and −18.5±4.0 D (range, −30.0 to −13.0 D) at the last visit, with a significant ($P<0.001$) difference between both measurements. Mean axial length was 27.8±1.2 mm (range, 25.5−29.7 mm) at the initial visit and 30.8±1.5 mm (range, 28.7−33.6 mm) at the last visit, again with a significant ($P<0.001$) difference between both examinations. The best-corrected visual acuity was 0.13±0.36 logarithm of minimum angle of resolution (logMAR; range, −0.08 to 2.0 logMAR) at the initial visit, which was not significantly ($P = 0.53$) different from the value at the last visit: 0.19±0.40 logMAR (range, −0.18 to 2.0 logMAR).

Although myopic chorioretinal atrophy has been reported to be uncommon during childhood,[15] 29 of 35 eyes (83%) had diffuse chorioretinal atrophy at the initial visit (Figs 1 and 2), and the remaining 6 eyes (17%) had tessellated fundus only. We then analyzed the presence and types of myopic maculopathy at the initial visit, according to the myopic maculopathy at the last visit. Of 31 eyes with diffuse chorioretinal atrophy in adulthood, 25 (81%) already had diffuse chorioretinal atrophy at the initial visit. The remaining 6 eyes (19%) with diffuse chorioretinal atrophy in adulthood had only tessellated fundus at the initial visit. All 3 eyes with patchy chorioretinal atrophy and the eye with macular atrophy in adulthood had diffuse chorioretinal atrophy at baseline.

In the 31 eyes with diffuse chorioretinal atrophy in adulthood, diffuse atrophy was observed in the entire posterior fundus beyond the macular area in 20 of 31 eyes (65%) at the final visit, whereas in the other 11 eyes (35%), diffuse atrophy was limited to the region temporal to the optic disc. However, in the 29 eyes with diffuse chorioretinal atrophy at the initial visit, the diffuse atrophy was limited to the temporal peripapillary region in 19 of 29 eyes (65%), and in the remaining 10 eyes (35%), it was observed in the entire posterior fundus beyond the macular area. During the follow-up, 8 eyes showed a transition from diffuse chorioretinal atrophy located only in the temporal peripapillary region at baseline to a diffuse chorioretinal atrophy covering the entire posterior fundus at the last visit (Figs 1 and 2).