

Comparison of anisometropes with and without amblyopia

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Background: To compare binocular functions in amblyopic and non-amblyopic anisometropes and to investigate the possible associated factors for amblyopia development such as type of refractive error and initial age of refractive error correction. **Materials and Methods:** Prospectively anisometropic subjects with ($n=42$) and without amblyopia ($n=33$) were included in the study. Full ophthalmological examination including binocularity and motility was performed. **Results:** There was no statistically significant difference between the ages at the time of initial refractive error correction ($P=0.946$). All of the anisometropes (100%) had fusion with Worth 4-dot test and Bagolini glasses. However 81% of amblyopic subjects had fusion with Worth 4 dot test and 88.1% had normal response with Bagolini glasses. Median stereopsis was 60 sec of arc in anisometropic subjects and 400 sec of arc in amblyopes. **Conclusion:** Our data support that, binocular functions are well developed in anisometropes without amblyopia and initial age at correction of refractive error has no primary effect on development of amblyopia.

Key words: Anisometropia, anisometropic amblyopia, fusion, stereopsis

Anisometropia is an important risk factor for amblyopia that develops when unequal refractive error causes the image to be blurred in the critical developmental period.^[1,2] In spite of extensive research, the importance of age at the correction of refractive error and degree of anisometropia is still uncertain.^[3,4] Due to the close relationship among anisometropia, amblyopia, and binocular functions, we conducted this prospective study to evaluate the factors such as age at correction of refractive error, type of refractive error, and the sensory status.

Materials and Methods

Anisometropic subjects who were detected during routine outpatient examinations in a period of 8 months were included. Anisometropia was defined as 2.0 diopter (D) spherical and/or 1.0D cylindrical refractive error difference. Patients who had latent or manifest deviation greater than 10 prism diopter (PD) were excluded. Subjects were prescribed glasses and seen 4 weeks later. Worth 4 dot, Titmus Fly, and Bagolini tests were performed under the same conditions with correction of refractive error. Subjects who had spectacles were questioned for the initial age prescription. Patients with any congenital or acquired organic pathology of the eye or with previous eye at surgery were excluded.

Patients were divided into two groups according to their best corrected visual acuities (BCVA); in the first group, cases having at least 2 Snellen lines difference between the eyes were accepted as anisometropic amblyopia. The second group consisted of anisometropic subjects who had 20/20 BCVA in both eyes in spite of anisometropia. For statistical analysis,

independent group *t*-test and Chi-square tests were used and statistical significance was defined as $P < 0.05$.

Results

Twenty-three male and nineteen female subjects with anisometropic amblyopia and 33 subjects (16 male, 17 female) with anisometropia were recruited. All anisometropes had 20/20 BCVA in both eyes and the mean age at the time of initial examination was 17.0 ± 5.8 years (range: 9–24). The mean age for anisometropic amblyopes was 17.5 ± 10.1 years (range: 9–54). There was no statistically significant difference between the groups for age and sex.

Mean spherical refractive error was -1.0 ± 3.7 D for the anisometropes and $+2.9 \pm 3.5$ D for the anisometropic amblyopes. Hypermetropia was significantly higher in the amblyopic group (independent group *t*-test, $P < 0.001$). However, when the absolute spherical refractive errors were compared, the difference was insignificant ($P = 0.616$) (3.4 ± 1.9 D for the anisometropes versus 3.9 ± 2.1 D for the amblyopes). Myopia was detected in 60.6% ($n = 20$) of the anisometropes and in 19% ($n = 8$) of the amblyopes, and the difference in the incidence of myopia was statistically significant (Chi-square test, $P = 0.0024$). No statistically significant difference was present between the groups regarding the age at correction of refractive error (13.1 ± 4.3 years for anisometropes versus 12.9 ± 5.5 years for amblyopes) (student *t*-test, $P = 0.946$).

Mean astigmatic refractive error for the anisometropes was 2.0 ± 1.5 D with a mean axis of 74.2 ± 39.1 and 1.7 ± 1.6 D for the anisometropic amblyopes with a mean axis of $84.1 \pm 42.3^\circ$ degrees (Mann–Whitney *U*-test, $P = 0.0689$). Statistically significant difference was not detected on comparing the groups for astigmatism and its axis (Chi-square, $P = 0.3025$).

When we evaluated the results of sensory tests, all anisometropes (100%) had fusion with Worth 4 dot test and Bagolini glasses. However 81% of amblyopes had fusion and 88.1% had normal response with Bagolini glasses. The

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anisometropes had 60 s arc of median stereopsis whereas anisometric amblyopes had 400 s arc of median stereopsis. The ratio of fusion (Fisher's exact Chi-square test, $P = 0.008$) and stereopsis (Mann-Whitney U -test, $P < 0.001$) was found to be lower in the amblyopes. However, there was no significant difference for Bagolini test (Fisher's exact Chi-square test, $P = 0.063$).

Discussion

The relationship between the degree of anisometropia and the depth of amblyopia is still controversial, and there are no established limits of anisometropia that will certainly cause amblyopia.^[5,6] In our study, we could not find any correlation between the degree of anisometropia and depth of amblyopia or visual acuity in the amblyopic eye. The absolute refractive error differences were similar, however, when, we considered the type of refractive error, myopia was significantly higher in the anisometric group. It can be speculated that better near vision in myopia can be adequate for visual system development while the hypermetropic subjects with poorer near vision may experience higher optical defocus resulting in amblyopia.

Previous studies showed that the age at which treatment (occlusion and spectacles) was begun had no effect on the best visual acuity.^[7,8] According to our results, the age at correction with spectacles was not significantly different between anisometropes, with and without amblyopia. As we did not include the data related to previous treatment in the amblyopic group, it would be impossible to speculate on the effect of amblyopia treatment, but the important point was, the nonamblyopic anisometropes achieved normal visual acuity without previous amblyopia treatment and their spectacle correction was given at a similar age to the amblyopes.

The prevalence of anisometropia varies according to the age (1–2% during infancy, 5.6% between the ages of 16 and 19 years).^[9,10] We may speculate that in our anisometric subjects, anisometropia has developed at a later age, later during the critical period so that amblyopia did not develop.

In this study, we tried to find out binocularity in natural anisometropes but there was no significant correlation between the level of anisometropia and stereopsis and fusion. The precise means by which anisometropia leads to decrease in visual acuity and stereoacuity is not clear and a threshold value is difficult to define.^[11] The possible mechanism responsible for subnormal binocularity can be suppression scotoma in

the anisometric eye, but the development of scotoma in some subjects with anisometropia but not in others is hard to explain. Amblyopia may develop with lower degrees of anisometropia or there can be no amblyopia even in the presence of a significant level of anisometropia. There should be some additional factors making children more vulnerable to the effect of anisometropia or some mechanisms protecting them from the adverse effects of anisometropia. This can either be an inherent, developmental, hereditary or congenital vulnerability or immunity or the time of the visual impairment.^[4,8]

In conclusion, we still need more investigations about the etiology and pathophysiology of amblyopia to prevent and treat this common eye problem.

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