
Age-related dynamics of eye refraction in children with Down syndrome

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Trisomy 21 gives rise to a variety of traits, all of which have variable penetrance and expressivity within the Down syndrome population. The increased frequency of refractive errors in individuals with Down syndrome has been reported by many authors. The objective of the present study was to identify the ocular refractive findings in patients with Down syndrome in different age groups and to compare them with refractive findings in control groups. The eye refraction examination involved 393 patients (786 eyes) with Down syndrome and 770 controls (1540 eyes). Ocular refractive findings as spherical equivalent were the following in Down's syndrome patients eyes: emmetropia ($7\% \pm 0.1$), hyperopia ($67.4\% \pm 0.3$), and myopia ($23.9\% \pm 0.2$). Refraction couldn't be identified in $1.7\% \pm 0.1$. In control group refractive findings as spherical equivalent were the following: emmetropia ($53.7\% \pm 0.2$), hyperopia ($34.7\% \pm 0.1$), myopia ($11\% \pm 0.1$). Refraction of controls couldn't be identified ($0.6\% \pm 0.1$). Astigmatism in proband group was diagnosed in $29.4\% \pm 0.2$, in control group in $6\% \pm 0.1$. The data revealed that astigmatism in Down syndrome patients is about 4 times as high as in control group. The data confirmed the fact that in Down syndrome patients aged 11–30 years emmetropia does not occur in most individuals. We evaluated the number of hyperopic and myopic diopters per one eye in proband and control groups. In hyperopic refraction group, the hyperopic diopters were on average by one diopter higher in proband group than in control group. In myopic refraction group the myopic diopters were on average by 2.5 diopters higher in Down syndrome group than in control group.

Key words: Down syndrome, proband, controls, hyperopia, myopia, emmetropia, astigmatism

INTRODUCTION

Down syndrome (DS), which is caused by trisomy of the 21st chromosome, is the most frequent chromosomal aberration. Trisomy 21 gives rise to a variety of traits, all of which have different penetrance and expressivity within the DS population, except for the specific type of mental retardation and neonatal hypotonia that are seen in nearly 100% of cases [1]. The isolated occurrence of any of most of the protean systemic and ocular features of DS is not specific to the disorder [2]. 61% of children with DS had ophthalmic disorders needing treatment and monitoring. Furthermore, the percentage of children with ophthalmic disorders increases with age, from 38% in the two- to 12-month-old group to 80% in the five- to 12-year-old

group [3]. The increased frequency of refractive errors in DS individuals has been reported by many authors [4–7].

The objective of this study was to identify ocular refractive findings in DS patients in different age groups and to compare them with refractive findings in control groups.

MATERIALS AND METHODS

The eye refraction examination involved 393 (786 eyes) DS patients and 770 (1540 eyes) controls. The control group consisted of DS patients' parents and siblings. Refraction examination was performed in outpatient departments of Lithuanian district hospitals.

For children under age 16 refraction examination in cycloplegia was performed using cyclopentolate 1% eye drops twice in 40 min before examination. In patients over age 16 refraction was made without cycloplegia. If refraction differed by 0.5 D and more

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in two principal meridians it was considered as astigmatism.

RESULTS AND DISCUSSION

The eye refraction examination involved 393 patients (786 eyes) with DS. Of them emmetropia was diagnosed in 55 eyes ($7\% \pm 0.1$), hyperopia as spherical equivalent in 530 eyes ($67.4\% \pm 0.3$), and myopia as spherical equivalent in 188 eyes ($23.9\% \pm 0.2$). Refraction couldn't be identified in 13 eyes ($1.7\% \pm 0.1$). In which cataract was diagnosed.

770 controls (1540 eyes) underwent refraction examination. In control group emmetropia was diagnosed in 827 eyes ($53.7\% \pm 0.2$), hyperopia as spherical equivalent was found in 535 eyes ($34.7\% \pm 0.1$), myopia as spherical equivalent in 169 eyes ($11\% \pm 0.1$). Refraction couldn't be identified in 9 eyes ($0.6\% \pm 0.02$) of parents (in 3 eyes because of anophthalmus, and in 6 eyes cataract was diagnosed).

In 231 eyes ($29.4\% \pm 0.2$) astigmatism was diagnosed in proband group and in 106 eyes ($6.9\% \pm 0.1$) of controls.

DS patients and controls were grouped into 3 groups according to age: group 1 – from 1 to 10 years (123 DS patients, 54 controls), group 2 – from 11 to 30 years (238 DS patients, 198 controls), group 3 – over 30 years (26 DS patients, 513 controls).

As reported by Doyle et al. [4], the distribution of refractive errors among infants with DS is close to normal. In a normal refractive development, a low to medium grade hypermetropia with a wide distribution is present in infancy. During the second year of life, the mean refraction normally changes towards emmetropia or slight hypermetropia. At the same time the distribution of refractive values narrows [4]. Studies described in literature indicate that this normal process does not occur in DS patients [5]. The prevalence of hyperopia in our age group of 0–10 years ($82.9\% \pm 0.6$) was comparable with that of normal infants ($56.5\% \pm 0.7$), but in DS group it was 1.5 times higher. We have found that in this age group of DS patients the percentage of emmetropia ($5.7\% \pm 0.1$) was very low as compared with that in normal infants ($40.7\% \pm 0.6$) (Fig. 1).

In non-disabled teenagers we would expect about 83% emmetropic (plus or minus 0.25D), 13% myopic, and 4% hyperopic eyes. In children with Down syndrome refractive errors distribution with age widens, and the prevalence of refractive errors increases. Astigmatism also tends to decrease with emmetropization [4].

In DS patients 11–30 years old the dominant refraction is hyperopia ($64.3\% \pm 0.4$), myopia increases to $29.6\% \pm 0.2$, and emmetropia remains stable at a low level ($6.1\% \pm 0.1$). The distribution of refraction

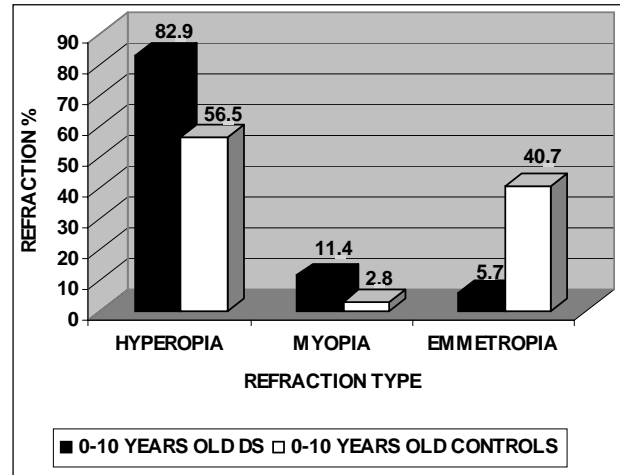


Fig. 1. Distribution of eye refraction in patients aged 0–10 years

in control group changes toward emmetropia up to $68.2\% \pm 0.4$, myopia also increases to $11.7\% \pm 0.2$. Myopia in control group is 2.5 times lower than in DS group. In our findings emmetropization failed to occur in most DS individuals (Fig. 2).

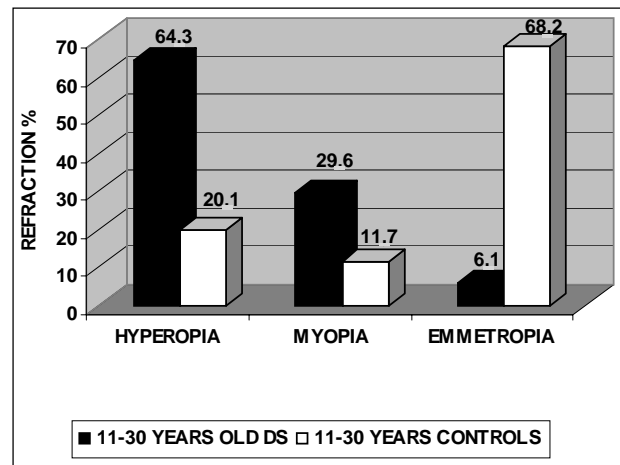


Fig. 2. Distribution of eye refraction in patients aged 11–30 years

In control over 30 years subjects aged refraction tends to change to hyperopia. Hyperopia reaches $38.8\% \pm 0.2$ in this age control group. In DS patients aged over 30 years hyperopia and myopia are rather at the same level ($39.2\% \pm 0.8$ and $37.3\% \pm 0.8$). Emmetropia reaches $23.5\% \pm 0.7$, but it is almost 2 times lower than in control group ($50.2\% \pm 0.2$) (Fig. 3).

According to literature, the range of astigmatism in DS patients is wide and varies from 22% [6] to 60% [7]. Refractive examination revealed astigmatism in 231 eyes ($29.3\% \pm 0.2$), *i.e.* about 4 times as high as in control group ($6.9\% \pm 0.1$).

The distribution of astigmatism in DS and control groups according to age showed that at the age from

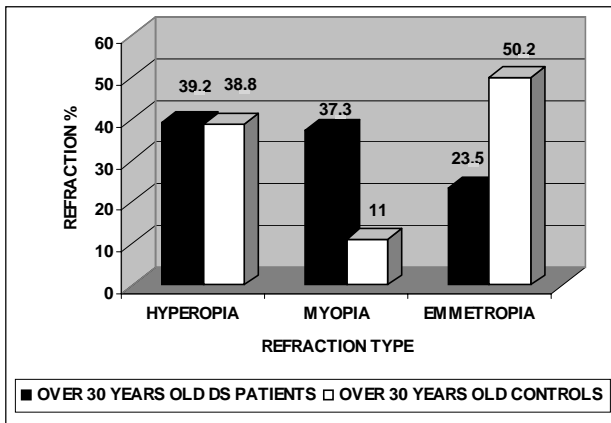


Fig. 3. Distribution of eye refraction in patients aged over 30 years

1 to 10 years astigmatism in DS patients was 3.3 times more frequent than in control group. Astigmatism tends to decrease with emmetropization in normal population, but this appears not to occur in DS patients [4]. At the age from 11 to 30 years, astigmatism in DS patients was 6.1 times more frequent than in control group. It is known that corneal topography changes from “with the rule” to “against the rule” with aging in normal population [8]. Individuals with Down syndrome age more rapidly than normal. However, it is unlikely that this is the cause among these Down syndrome patients, as the onset of more rapid aging does not occur until much later [8]. The level of astigmatism remains high also in DS patients aged over 30 years and is 2.1 times as high as in control group (Fig. 4).

We evaluated the amount of hyperopic and myopic diopters per one eye in proband and control groups. Our data showed that in hyperopic refraction group the hyperopic diopters on average are about one diopter higher in proband than control group. Myopic diopters on average are by about 2.5 diopters higher in DS than in control group.

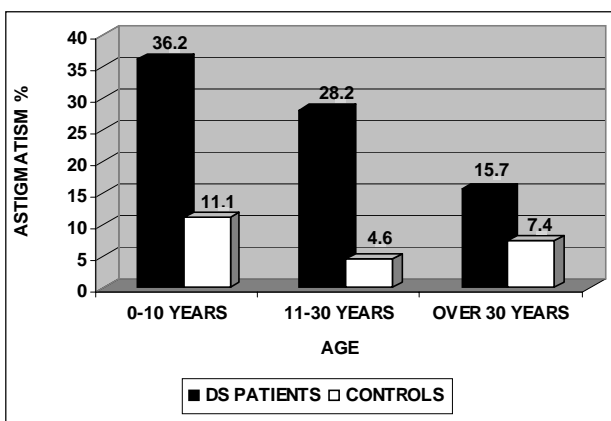


Fig. 4. Distribution of astigmatism according to age

CONCLUSIONS

1. The refractive examination results for infants show a different distribution of refractive errors in patients with Down syndrome and in the age-matched group of non-disabled siblings.

2. In the group of patients with Down syndrome aged 11–30 years, no emmetropia was found in most individuals.

3. The prevalence of astigmatism is among Down syndrome patients about 4 times as high as in control group.

4. In Down syndrome patients, hyperopic and myopic diopters on average are about one diopter and 2.5 diopters, respectively, higher compared to control group.

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References

- Hernandez D, Fisher EMC. Human Mol Gen 1996; 5(7): 1411–6.
- Catalano RA. Surv Ophthalmol 1990; 34(5): 385–98.
- Roizen NJ, Mets MB, Blondis TA. Dev Med Child Neurol 1994; 36(7): 594–600.
- Doyle SJ, Bullock J, Gray C et al. Br J Ophthalmol 1998; 82: 793–6.
- Haugen OH, Høyding G, Lundström I. Br J Ophthalmol 2001; 85: 714–9.
- Caputo AR, Wagner RS, Reynolds DR et al. Clin Pediatr (Phila) 1989; 28(8): 355–8.
- da Cunha RP, Moreira JB. Am J Ophthalmol 1996; 122(2): 236–44.
- Hayashi K, Hayashi H, Hayashi F. Cornea 1995; 14(5): 527–32.

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SERGANČIŲJŲ DAUNO SINDROMU AKIŲ REFRAKCIJOS AMŽIAUS POKYČIAI

S a n t r a u k a

Darbo tikslas: ištirti refrakcijos pasiskirstymą įvairiose sergančiųjų Dauno sindromu amžiaus grupėse ir palyginti su kontrolinės grupės akių refrakcija. Ištirta 393 Dauno sindromu sergančių asmenų akių refrakcija ir 770 sveikų kontrolinių asmenų (probandų tėvų bei probandų brolių ir seserų) akių refrakcija. Sergančiųjų Dauno sindromu iki 10 metų amžiaus refrakcijos ydų pasitaikė dažniau negu tarp sveikų atitinkamo amžiaus tiriamųjų. 11–30 metų amžiaus tarpsniu nepastebėta ryškaus hipermetropinės refrakcijos sumažėjimo, kaip yra įprasta sveikiems bendramamžiams. Šioje amžiaus grupėje emetropija nustatyta tik 6,1% ± 0,1% sergančiųjų Dauno sindromu, kai kontrolinėje grupėje – 68,2% ± 0,4. Astigmatizmas nustatytas 29,4% ± 0,2% sergančiųjų Dauno sindromu, t. y. maždaug 4 kartus dažniau negu kontrolinėje grupėje (6,9% ± 0,1).