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Functional acuity contrast sensitivity assessment in young and middle age healthy persons at the day time with and without glare

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Background. As people age, their vision becomes less clear; they can clearly see big objects but experience problems discerning minor things and minor details. The functional acuity contrast test is a very sensitive method used for visual system evaluation which may help to detect the beginning of the disease in case the visual acuity is still normal.

Purpose. To determine functional acuity contrast sensitivity in young and in middle age healthy persons at the day time with and without glare.

Materials and methods. We examined 40–49 yrs (Group 1), and 50–59 yrs (Group 2) healthy persons. The typical Snellen chart (the direction of the gap in Landolt C) was used for the non-corrected and the best-corrected visual acuity testing. Functional acuity contrast sensitivity was measured employing a Ginsburg Box, VSCR- CST-6500, at the day time with and without glare.

Results. Functional acuity contrast sensitivity remained very similar in the age groups of 40–49 years and 50–59 years. However, statistically, it significantly decreased at day time without glare (18 cycle / degree) spatial frequencies ($p = 0.05$). Results in Group 1 as compared to Group 2 decreased from 3.09% to 51.7% at the day time without glare and from 2.16% to 11.61% at the day time with glare.

Conclusion. The facts are that contrast sensitivity remained very similar in the age groups of 40–49 years and 50–59 years at the day time with and without glare.

Key words: functional acuity contrast sensitivity, age groups, daytime, glare

INTRODUCTION

While aging is inevitable, regular eye functions examinations may help to detect early eye problems, and can help to maintain better vision throughout our lifetime. Degenerative deterioration of vision in patients after the age of 40 years is evident (1). These changes reduce the access of light to the retina. With age, the lens becomes yellower and less transparent, the pupil becomes smaller, less able to dilate in conditions of low light, and the integrity

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of the macular pigment and neural pathways is altered (2). These changes lead to decreased light sensitivity, increased glare sensitivity, reduced visual acuity, and prolonged dark adaptation (3). Puell MC et al. findings indicate that mesopic contrast sensitivity both in the presence or absence of glare decreases significantly with age (2). While it has been clearly established that photopic contrast sensitivity diminishes in normal, healthy aging eyes (4, 5, 6), the literature lacks data on changes in mesopic contrast sensitivity throughout middle age persons.

With the help of a regular Snellen's eye chart it is possible to evaluate patients' ability to determine black letters on a white background from the distance, but not to measure the visual quality (7), whereas the functional acuity contrast sensitivity test is considered to be more informative and accurate in examining and evaluating visual functions.

The aim of this research is to determine functional acuity contrast sensitivity in young and in the middle age of healthy persons at the photopic condition with and without glare.

MATERIALS AND METHODS

Having obtained the permission No. BE-2-14 from the Kaunas Regional Biomedical Research Ethics Committee, the study was conducted in the Department of Ophthalmology at the Lithuanian University of Health Sciences. We examined 40 patients 40–49 yrs (Group 1), 77 patients 50–59 yrs (Group 2).

In this study the visual acuity as well as the transparency of the cornea and lens, and the fundus were investigated in the patients. Biomicroscopy was performed in order to assess the corneal and lenticular transparency. The non-corrected and the best-corrected visual acuity (measured in decimals from 0.1 to 1.0) was evaluated using Landolt's rings (C optotypes) by Snellen test types at a 5-meter distance from the chart.

The lens was evaluated on biomicroscopy. The lens was examined using a slit lamp, positioning the illumination source at a 45-degree angle and the light beam being split to 2 mm width.

During each examination refraction was performed, the intraocular pressure was measured and the iris color was noted using the slit lamp. Pupils of the subjects were dilated with tropicamide 1% or cyclogyli 1%. After dilation of the pupils, fundoscopy was performed with an ophthalmoscope of the direct monocular type and the slit-lamp, using a double aspheric lens of +78 diopters. A peripheral retinal examination was performed using an indirect ophthalmoscope. Results of the eye examination were recorded on standardized forms that we developed for this study. Stereoscopic color fundus photographs of the macula were obtained: centered at 45° and 30° to the fovea for a detailed fundus analysis.

Subject inclusion criteria: both gender patients age 30–85 years, no other eye disorders were found on detail ophthalmological examination, participation consent.

Subject exclusion criteria: related eye disorders (high refractive error, cloudy cornea, opacity of the lens (nuclear, cortical and posterior subcapsular cataract), keratitis, acute or chronic uveitis, glaucoma, neovascular age-related macular degeneration or geographic atrophy, diseases of the optic nerve); systemic illnesses (diabetes mellitus, oncological diseases, systemic tissue disorders, chronic infectious diseases, conditions after organ or tissue transplantation), color fundus photography non graduate because of the obscuration in the eye optic system or because of fundus photography quality, functional acuity contrast sensitivity test values were 0.

Contrast sensitivity was measured employing a Ginsburg Box, VSCR- CST-6500, with a Functional Acuity Contrast Test (FACT) chart at phothopic (at the day time, 85 cd/m^2) and mesopic (at the night time, 3 cd/m^2) luminance with and without glare at 5 standard spatial frequencies: 1.5; 3; 6; 12; 18 cycles per degree (8). Functional acuity contrast sensitivity was performed in case of the best-corrected visual acuity.

A statistical analysis was performed using the computer program SPSS/W 13.0 (Social Sciences Statistical Package Program for Windows, Inc., Chicago, Illinois, USA). χ^2 test was used for comparing frequencies of qualitative variables. Statistically significant difference was considered if $P < 0.05$.

RESULTS

Non-corrected visual acuity in Group 1 was statistically better: 0.86 ± 0.28 vs. 0.69 ± 0.33

Table 1. Visual acuity in Groups 1 and 2

Group	Age	N (eyes)	Non-corrected visual acuity ± SD	Best-corrected visual acuity ± SD
Group 1	40–49 years	40 (80)	0.86 ± 0.28	0.98 ± 0.93
Group 2	50–59 years	77 (153)	0.69 ± 0.33	0.97 ± 0.11

Table 2. Functional acuity contrast results in young and middle age healthy persons

Functional acuity contrast at the day time without glare					
Age group	Cycle / degrees ± standard deviation				
	A (1.5)	B (3.0)	C (6.0)	D (12.0)	E (18.0)
Group 1	66.04 ± 26.04	104.65 ± 44.64	106.46 ± 56.73	45.31 ± 30.85	**20.04 ± 17.31**
Group 2	64.00 ± 22.85	97.44 ± 40.76	96.89 ± 53.74	37.78 ± 34.91	**9.68 ± 9.11**
Decreasing in times between Groups 1 and 2	1.03	1.07	1.09	1.19	**2.07**
Decreasing in percents between Groups 1 and 2	3.09	6.89	8.99	16.62	**51.7**
Functional acuity contrast at the day time with glare					
Age group	Cycle / degrees ± standard deviation				
	A (1.5)	B (3.0)	C (6.0)	D (12.0)	E (18.0)
Group 1	74.64 ± 29.19	105.23 ± 47.05	111.25 ± 55.75	42.51 ± 36.40	18.44 ± 18.38
Group 2	72.49 ± 23.18	102.97 ± 35.36	108.74 ± 26.90	41.79 ± 35.91	16.30 ± 13.09
Decreasing by time between Groups 1 and 2	1.06	1.02	1.02	1.02	1.13
Decreasing by percent between Groups 1 and 2	2.88	2.15	2.26	1.69	11.61

($p = 0.018$), but the best-corrected visual acuity was not (Table 1).

Functional acuity contrast sensitivity remained very similar in the age groups of 40–49 years and 50–59 years. However, statistically, it significantly decreased at the day time without glare (18 cycle / degree) spatial frequencies ($p = 0.05$) (Table 2).

Results in the second group compared to the first group decreased from 3.09% to 51.7% at the day time without glare, and from 2.16% to 11.61% at the day time with glare (Table 2).

DISCUSSION

The decrease of functional acuity contrast sensitivity is directly associated with the patients' age and visual acuity, but in our research, as we see (Table 1), the best-corrected visual acuity was statistically insignificant, so it means that visual acuity could not influence contrast sensitivity results. Our results revealed that functional contrast sensitivity was very similar in both middle age patients groups, and it decreased from 3.09% to 51.7% at the day time without glare, and from 2.16% to 11.61% at the day time with glare. Mostly contrast sensitivity decreased at the day time without glare in 18 spatial frequency.

There are not many studies analyzing contrast sensitivity impact on age (9–16). The study done by Owlsely et al. found out that functional acuity contrast sensitivity began decreasing at the age of 40, whereas by the age of 80, the functional acuity contrast sensitivity of 83% of the patients decreased in high spatial frequencies (9). Other study suggests that mesopic contrast sensitivity and glare sensitivity seem to remain fairly stable until the age of 50 years, and it was found in this research that subjects under 50 years of age lost less than 0.1 log contrast unit in glare, while in subjects older than 50 years, a large proportion lost between 0.2 and more log contrast units (2). In our research we found contrast sensitivity significantly decreased at the day time without glare in high spatial frequencies in older persons group, and we are in agreement with these two studies because contrast sensitivity remained very similar in the age groups of 40–49 years and 50–59 years at the day time with and without glare. Shahina et al. carried out a research with younger and older patient groups, and found out that the functional acuity contrast sensitivity decreased with older age too (10). Nio et al. examined 100 healthy persons between 20 and 69 years of age and confirmed that the functional acuity contrast sensitivity decreased with aging from the 8th spatial frequency, and noticed that in patients from 40 to 79 years of age whose visual acuity was 1.0 or better 9.4% of patients with intact visual acuity had lower contrast sensitivity (12). It is known that with age, the lens becomes yellower and less transparent, the pupil becomes smaller, less able to dilate in conditions of low light, and the integrity of the macular pigment and neural pathways is altered (2). These changes lead to decreased light sensitivity, increased glare sensitivity, reduced visual acuity, and prolonged dark adaptation (3). Most subjects in the oldest age group failed to discriminate contrast with glare (2). Further, in some subjects of varying age, no contrast log units were lost at all or even better contrast was discriminated with glare than without glare. These results might be explained by the pupillary miosis induced by glare possibly having a pinhole effect in some persons and offset any loss in contrast sensitivity due to blur in glare conditions (2). These research findings suggest that mesopic contrast sensitivity improves as photopic visual acuity increases (2). This indicates that the same occurs in mesopic as in photopic conditions, in which there is high correlation between the Pelli-Robson chart contrast sensitivity (low spatial frequency) and high contrast visual acuity (18, 19). It was discovered that functional acuity contrast sensitivity decreased with age in high spatial frequencies; however, the FACT results in medium spatial frequencies did not seem to depend on the age (17). In photopic luminance conditions, the decline in contrast sensitivity is also greatest at older ages, as noted by Haegerstrom et al. (20) and Rubin et al. (19). In this last study performed on 2,500 subjects between the ages of 65 and 85 years, a 0.1 decrease in log Pelli-Robson contrast sensitivity (low spatial frequency) per decade was observed (19). A similar decline per decade was observed in the study from 50 years onwards in mesopic conditions done by Puell MC et al. (2). Consistent with the decline in contrast sensitivity noted here in elderly subjects, reports in the literature on aging indicate that even in the absence of ocular disease there are normal age-related changes in visual function.

CONCLUSIONS

Our results are in agreement with the studies done by other authors, and our study suggests that contrast sensitivity remained very similar in the age groups of 40–49 years and 50–59 years at the day time with and without glare but mostly was affected at the day time without glare in high spatial frequency.

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FUNKCINIO KONTRASTINIO JAUTRUMO IŠTYRIMAS JAUNIEMS IR VIDUTINIO AMŽIAUS SVEIKIEMS TIRIAMIESIEMS DIENOS METU SU AKINANČIA ŠVIESA IR BE JOS

Santrauka

Įvadas. Žmonėms senstant jų regėjimas darosi ne toks aiškus, jie gali ryškiai matyti didelius objektus, bet vis sunkiau įžiūri mažus daiktus ar mažas detales. Funkcinis kontrastinis jautrumas yra labai tikslus tyrimo metodas, naudojamas regos sistemai ištirti. Jis padeda aptikti ligos pradžią, kai regos aštrumas dar nepakitęs.

Darbo tikslas. Ištirti funkcinį kontrastinį jautrumą sveikiems jauniems ir vidutinio amžiaus tiriamiesiems dienos metu su akinančia šviesa ir be jos.

Tyrimo medžiaga ir metodai. Buvo ištirti 40–49 m. (I grupė) ir 50–59 m. (II grupė) amžiaus sveiki tiriamieji. Nekoreguotas ir geriausias koreguotas regos aštrumas vertintas naudojant Landolto žiedus (C optotipais) pagal Sneleno principą. Funkcinis kontrastinis jautrumas tirtas pagal Dr. Arthuro P. Ginsburgo metodiką OPTEC 6500 aparatu naudojant skirtingo kontrasto ir erdvinio dažnio sinuso bangos groteles dienos metu su ir be akinančios šviesos.

Rezultatai. Funkcinio kontrastinio jautrumo tyrimo rezultatai 40–49 m. ir 50–59 m. amžiaus grupių buvo labai panašūs, tačiau statistiškai reikšmingai mažesni dienos metu be akinančios šviesos (18 ciklai / laipsnis) erdviniame dažnyje (p = 0,05). II grupės rezultatai, palyginti su I grupe, sumažėjo nuo 3,09 % iki 51,7 % dienos metu be akinančios šviesos ir nuo 2,16 % iki 11,61 % dienos metu su akinančia šviesa.

Išvada. Funkcinis kontrastinis jautrumas 40–49 m. ir 50–59 m. amžiaus grupių dienos metu tiek su akinančia šviesa, tiek ir be jos išliko labai panašus.

Raktažodžiai: funkcinis kontrastinis jautrumas, amžiaus grupės, dienos metas, akinanti šviesa