Acuity Preserve in Glare Situation in Normal Eyes

Zahra Ghasempour[1*], Behnaz Samet[2], Mehdi Khabazkhoob[3*], Ebrahim Jafarzadehpur[4]

1. *MSc. in Optometry, Department of Optometry, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
2. *MSc. in Optometry, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran*
3. *PhD in Epidemiology, Department of Medical Surgical Nursing, Shahid Beheshti University Of Medical Sciences, Noor Ophthalmology Research center, Noor eye Hospital,Tehran, Iran*
4. *Professor of Optometry and Vision Sciences, Department of Optometry, Iran University of Medical Sciences, Tehran, Iran*

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ABSTRACT

Background and Objective: Glare can affect vision in normal and abnormal individuals. It seems that threshold and normal values of glare have been less mentioned in various sources. The aim of this study was to determine acuity preserve in glare situation in normal subjects.

Methods: 48 subjects (96 eyes) aged 18 to 25 years with normal visual acuity, and without any refractive error participated in this study. The acuity preserve in glare situation was measured at different light intensity conditions with Metro vision glare test at different luminance and visual field.

Results: Glare source in each luminance at the nasal side may show better acuity preserve in glare situation. The maximum score for nasal and temporal source for 1 cd/m^2 condition was 57.398 and 51.282 respectively. The same situation was seen for 5 cd/m^2 (P<0.001). However, in glare for luminance background of 1 cd/m^2, and 5 cd/m^2 were significantly different (P<0.001). The acuity preserve in glare situation for 5 cd/m^2 background was higher than 1 cd/m2 luminance in both temporal and nasal sides.

Conclusion: Acuity preserve in glare situation in luminance of 5cd/m2 in both temporal and nasal was more than1 cd/m^2. Acuity preserve in nasal glare situation was more than temporal glare situation.

Keywords: Glare, Visual field, visual acuity

Corresponding information: Mehdi Khabazkhoob .PhD in Epidemiology, Department of Medical Surgical Nursing, Shahid Beheshti University Of Medical Sciences, Noor Ophthalmology Research center, Noor eye Hospital,Tehran, Iran.
Email: khabazkhoob@yahoo.com Tel: +98-21-82401615

Introduction

Glare is a very important factor in visual function disorder caused by inadequate or high range of luminance. It is characterized by disability (Elliott , 1993), which reduces transparency by the scatter of luminance in the eyes, and discomfort resulting in reduced contrast sensitivity and feeling severe irritation to luminance. Disability is seen in diseases such as, albinism, Rod dystrophies and cone dystrophies, and retinitis Pigmentosa. Discomfort occurs in elderly patients with disorders such as fluorescence and yellowing of the lens, miosis dependent to age, lens opacities, and cataract. Patients with cataract suffer from more glares compared with normal individuals. In addition, glare reduces contrast sensitivity even when age and visual acuity are the same in the fore-mentioned groups. Other factors such as posterior capsular opacities, corneal edema (edema of epithelial is more than stroma) surgery of RK, vitreous opacities, and macular edema are effective in the development of glare (Aslam, 2007; Bar-Gera, 2016).

Glare is a very common complication after LASIK, especially at night, and considered a completely natural process of treatment. During the first week after sur-

gery, glare is felt by the patient, but it decreases during the cornea recovery. This complication in patients with larger pupil after surgery is more obvious (Yoon , 2005). It was found that in patients with keratoconus, glare leads to visual function defect, and its effects reduce the contrast of visual acuity (Pesudovs, 2004). The visual function during recovery and return to the initial state (adaption to low levels of luminance after contact with eyes) decreases (Stringham, 2011 ; West , 2002; Hassan, 2002). The visual function and recovery time associated with glare are affected by environmental parameters (restricting lighting conditions and the placement of light source), individual parameters (vision health, glaucoma, corneal edema, macular edema, and age i.e., with increasing age an increase occurs in opacities and opacity of media, and consequently rises the scatter of light and glare), and parameters of glare (the brightness level that is directly related to glare, the angle of glare source, the size of glare source which is usually 0.3 or 0.6 degrees, and duration of exposure) (Hammond, 2013; Vos, 2003; Stringham, 2008; Sakamoto, 2002; Mahjoob, 2016; Sewall, 2016). The measurement of first type of glare is made by setting peripheral luminance conditions, and the seeing through the devices such as Miller-Nadler Glare Tester and Brightness Acuity Test. Glare clinical implication in the visual impairment related to mild cataract is the loss of vision in the open space and disability to drive at night. Another implication is the detection of visual impairment due to anterior segment pathology instead of retinal pathology, because glare sensitivity increases significantly in the anterior segment disorders (Aslam , 2007; Bar-Gera, 2016). Glare can cause driving in jeopardy due to scatter of light on the retina., the first complaint related to vision in older people is driving at night and in front of the light (Theeuwes, 2002). Hence, given the importance of glare and vision dysfunction, the aim of this study was to determine the threshold of acuity preserve in glare situation in normal subjects.

Materials and Methods

Participants in this study were 48 subjects aged 18 to 25 years. After the preliminary examination and taking partial history, we made sure that the visual acuity in all participants was 10/10 or better in both eyes. Explanations about the study, how to test, and approximate time of the study were presented to subjects. Then, oral consent for participation was obtained after a full understanding of the content. Testing was performed in mesopic condition. Acuity preserve in glare situation was measured using the Metro vision (MonCv3; Metrovision, Pérenchies, France).

This test uses a series of optotypes on a black background (figure 1). These optotypes are 30 English letters which are arranged in 10 half concentric circles from the glare source, and placed in 3 lines for radial. To meet this test, a device with light sources was equipped with high brightness on either side of the screen, and the examination was performed with the light source on the right or left. These optotypes, under the angle of vision of 15 minutes arc, were observed corresponding to a visual acuity of 0.33 (20/60). These include English letters, and the distance between the light source and optotypes, are as follows:

The first circular = 60 minutes of arc

The second circular = 90 minutes of arc

The third circular = 120 minutes of arc

Three sets of tests were available and each with a different brightness levels of optotypes of 1 cd/m^2 (for a person with normal vision function), 5cd/m^2, and 100cd/m^2 (for a person with variable function). The light-emitting effect is significantly increased by the use of low lighting optotypes. The light levels used for measurement were considered at the end of the examination. Each set included 4 tests with a different arrangement of letters (to avoid memory effects) and two different positions of the light source (right or left). For each of these cases, there was a separate image, and by choosing any of the tests, choice test image was displayed on the screen, while the light source of glare was turned on at the same time. The patient sat within 2.5 meters from the screen, so that the subject was aligned horizontally and vertically with the screen. One eye closed, and an image was selected for examination of the right eye which the light source was on the right side to shine the tem-

poral light into the eyes. The situation was reversed for the left eye. Then, the number of letters correctly diagnosed was noted. The purpose of this test was to evaluate the acuity preserve in glare situation, especially for the assessment of driving ability.

Fig 1. Glare Test, Letters Light Source and Arrangement

Results

This study was conducted on 48 participants, including 27 women and 21 men aged 18 to 25 years, with the mean age of 21.28±1.09 years. The descriptive statistics of the acuity preserve in glare situation were obtained for optotypes with two luminescence of 1 cd/m2 and 5cd/m2 , and in both nasal and temporal sides. Mean, standard deviation, and maximum and minimum for the right eye and the left eye are shown in Table 1.

Table 1. Descriptive Statistical Indicators of Acuity Preserve in Glare Situation in both Nasal and Temporal in the Right Eye and the Left Eye

Minimum		Maximum		Mean ±Standard Deviation				Luminance of Optotype (cd/m²)
				Left eye		Right eye		
Temporal	Nasal	Temporal	Nasal	Temporal	Nasal	Temporal	Nasal	
43.601	49.484	51.282	57.398	41.175±19.58	62.906±20.29	44.358±0.78	53.779±16.24	1
88.052	93.922	93.917	97.778	89.787±12.04	97.146±7.84	92.56±17.38	95.004±11.12	5

Table 2. Comparison of Temporal and Nasal Acuity Preserve in Glare Situation of both Eyes in two Luminance Conditions

Luminance of Optotype (cd/m²)	Standard Deviation Difference	Mean Difference	P Value
1	25.096	6.155	P<0.001
5	14.272	4.899	P<0.001

Table 3. Comparison of Acuity Preserve in Glare Situation in two Luminance Levels on either Side of Field of View

Field of View	Standard Deviation Difference	Mean Difference	*P* Value
Nasal	17.926	42.442	*P*<0.001
Temporal	17.416	43.699	*P*<0.001

Discussion

This study aimed to investigate the acuity preserve in glare situation in normal subjects, and was conducted in 96 eyes with normal vision. The result of the test according to Table 1 and 3 for optotypes with luminance of and 5 cd/m2 was significant (P<0.001) better than 1 cd/m2. The acuity preserve in glare situation increased in more luminance (5cd/m^2), consistent with other studies (Theeuwes, 2002; Van der Mooren, 2016). It showed that more contrast needed for preserving the visual acuity in a glare source condition. However, we expect glare source would reduce the contrast sensitivity and visual acuity, detection and perception of low luminance (1 cd/m^2) optotypes may be more difficult than high contrast (5 cd/m^2) optotypes. Both temporal and nasal field of view may show better result with higher (5 cd/m^2) luminance condition (Table 3). In a similar study conducted in a population aged 20 to 65 years, it was shown that with increasing brightness, and visual acuity decreases, the acuity preserve in glare situation increases, and consequently leads to an increase in driving problems at night. In another survey on drivers on the highway, it was found that with increasing light intensity (over 2 cd / m^2) the acuity preserve in glare situation increases (McCann, 2018; Mou, 2017) . In another study on the relationship between the size of the light source and glare, it has been suggested that by increasing the size of the light source, the glare reduces due to a decrease of the optical focus (Renzi-Hammond, 2016; Mehri, 2017). Milner et al. investigated glare correlation with age and light in a population aged 18 to 79 years. They found that glare increases with increasing age and lighting (Milner, 2010).

Table 1 and 2 show that acuity preserve in glare situation in nasal glare source is better than in temporal glare source. It means the acuity preservation in temporal side of retinal is much better than nasal side of retinal. In the temporal retinal, the density of photoreceptors, especially cone, ganglion, and bipolar cells, are better than nasal side (Goodale, 2018; Maddess, 2011). As a result, the stimulation will be increased especially by activation of the receptor of the ganglion cells (Goodale, 2018; Maddess 2011).

In several studies, the effect of glare was specified on visual acuity, contrast sensitivity, and other functions of the vision. Niesen U et al. expressed that the scatter of light inside the eye causes the disability. Increasing scatter with increasing age even in non-cataract persons leads to increase glare problems (Bloomfield, 2001). In case of cataract and corneal changes, for example refractive surgery, scatter will be higher (Mainster, 2012). In a study it was stated that disability and decreased contrast sensitivity occur in most cases after PRK. In one study, in the ages of 50 to 59 years, the glare discomfort increased considerably with age (Davison, 2011). The study was done in a normal population, and it was shown that the size of the glare disk is related to age, such that from 50 to 59 years the effect starts, and leads to the scatter of light in the retina, the lack of a clear image of the target, and reduced contrast sensitivity (Niesen, 1997). In similar studies that have been conducted to determine the glare temporality, it is established that glare occurs because of the light sources in the environment, and results in decreased contrast sensitivity and lack of a clear image of the target (Puell, 2013).

Conclusion

The acuity preserve in glare situation in luminance of 5cd/m^2 in both temporal and nasal was more than 1 cd/m^2. Nasal acuity preserve in glare situation was much better than temporal glare source. Therefore, in a specific light condition, direction of the glare source and contrast of objects may affect the visual discrimination.

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Conflict of interest statement

Authors declared no conflict of interest.

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مقالهٔ پژوهشی

حفظ تیزبینی در شرایط خیرگی در چشم‌های طبیعی

زهرا قاسم‌پور[۱]، بهناز صامت[۲]، مهدی خبازخوب[۳*]، ابراهیم جعفرزاده‌پور[۴]

۱. کارشناس ارشد بینایی‌سنجی، گروه بینایی‌سنجی، دانشکدهٔ علوم توانبخشی، دانشگاه علوم پزشکی شهید بهشتی، تهران، ایران
۲. کارشناس ارشد بینایی‌سنجی، بیمارستان فارابی، دانشگاه علوم پزشکی تهران، تهران، ایران
۳. دکتری تخصصی اپیدمیولوژی، گروه جراحی پرستاری، دانشگاه علوم پزشکی شهید بهشتی، بیمارستان چشم پزشکی نور، مرکز تحقیقات چشم پزشکی نور، تهران، ایران
۴. استاد، گروه بینایی‌سنجی، دانشکدهٔ علوم توانبخشی، دانشگاه علوم پزشکی ایران، تهران، ایران

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نویسندهٔ مسئول:
مهدی خبازخوب
دکتری تخصصی اپیدمیولوژی، گروه جراحی پرستاری، دانشگاه علوم پزشکی شهید بهشتی، بیمارستان چشم پزشکی نور، مرکز تحقیقات چشم پزشکی نور، تهران، ایران
پست الکترونیک:
khabazkhoob@yahoo.com

تلفن:
۰۲۱-۸۲۴۰۱۶۱۵

چکیده

زمینه و هدف: خیرگی (گلر) بربینایی افراد سالم و بیمار مؤثر است؛ اما در منابع مختلف مقادیر مستندی از شدت خیرگی و تغییرات تیزبینی به چشم نمی‌خورد. هدف از این مطالعه، ارائهٔ مقادیر مرجع برای حفظ تیزبینی در میزان‌های مختلف گلر در چشم‌های طبیعی انجام شده است.

روش کار: ۴۸ نفر (۹۶ چشم) در محدودهٔ سنی ۱۸ تا ۲۵ سال با تیزبینی طبیعی و بدون هیچ‌گونه عیب انکساری چشمگیری در این مطالعه شرکت کردند. حفظ تیزبینی در شرایط مختلف گلر و در شدت‌های متفاوت با دستگاه Metro vision، در روشنایی مختلف و میدان دید متفاوت ارزیابی شد.

یافته‌ها: قرارگرفتن منبع گلر در بخش نازال می‌تواند باعث حفظ بهتر تیزبینی فرد شود. مقادیر بیشینهٔ گلر به‌ترتیب در سمت نازال و تمپورال در شدت cd/m^2 ۱ برابر ۵۷/۳۹۸ و ۵۱/۲۸۲ بود. شرایط مشابهی برای شدت cd/m^2 ۵ نیز مشاهده شد که تفاوت معنی‌داری را ($P < ۰/۰۰۱$) در سمت نازال و تمپورال نشان می‌دهد؛ هرچند نتایج ثبت‌شده در دو شدت cd/m^2 ۱ و cd/m^2 ۵ نیز تفاوت معنی‌داری را نشان می داد($P < ۰/۰۰۱$). حفظ تیزبینی در دو سمت نازال و تمپورال برای شدت cd/m^2 ۵ بالاتر بود.

نتیجه‌گیری: حفظ تیزبینی در شدت cd/m^2 ۵ در دوسمت تمپورال و نازال شرایط بهتری را نسبت به cd/m^2 ۱ نشان می‌دهد. پاسخ غیرخطی سیستم بینایی می‌تواند موجب این تفاوت باشد. البته متقارن نبودن و نامتساوی بودن بخش نازال و تمپورال، یافتهٔ مهمی از تفاوت حساسیت سیستم بینایی در فیلدهای مختلف است.

واژه‌های کلیدی: گلر، میدان بینایی، تیزبینی