Original Article

Eur Arch Med Res 2018; 34 (4): 255-7

Dynamic Pupillometry in Myopia and Myopic Astigmatism Refractive Surgery Candidates

Ali Demircan, Ahmet Demirok

Department of Ophtalmology, Health Sciences University, Beyoğlu Eye Training and Research Hospital, İstanbul, Turkey

Abstract

Objective: The aim of this study was to measure and report the pupillary diameter of myopic refractive surgery candidates and to identify the associated factors.

Methods: This was a retrospective, descriptive, cross-sectional study. Consecutive patients with myopia or myopic astigmatism were included in the study. Patients with accompanying ocular pathologies were excluded. Only one eye of the remaining patients was selected using a random number table. Age, sex, spherical equivalent of manifest refraction (SE), and axial length (AL) were recorded. Scotopic, mesopic, and photopic pupillary diameters were measured with dynamic pupillometery (Sirius, Schwind Eye Tech Solutions AG, Germany).

Results: Eighty eyes of 80 patients were included in the study. The mean age of the patients was 28±6 years, and mean SE was -5.25±2.26 D. The mean AL was 25.41±1.41 mm. The mean scotopic, mesopic, and photopic pupillary diameters were 6.26±0.60, 5.81±0.61, and 4.43±0.68 mm, respectively. SE and AL were not found to be correlated with pupillary size. The mesopic pupillary diameter was slightly higher in females than in males (5.98±0.50 vs. 5.62±0.68; Student t test; p=0.037). There was a statistically significant negative correlation between mesopic and scotopic pupillary diameters and age.

Conclusion: This study investigated the pupillary diameters of myopic refractive surgery candidates and showed that age and sex are the most important determinants of pupillary diameter.

Keywords: Mesopic pupillary diameter, myopia, photopic pupillary diameter, scotopic pupillary diameter

ORCID ID of the author:
Ali D. 0000-0002-4637-2825

Cite this article as:
Demircan A, Demirok A. Dynamic Pupillometry in Myopia and Myopic Astigmatism Refractive Surgery Candidates. Eur Arch Med Res 2018; 34 (4): 255-7.

Corresponding Author:
Ali Demircan

E-mail:
alidemircanctf@yahoo.com

Received: 24.01.2018

Accepted: 11.05.2018

DOI: 10.5152/eamr.2018.59862

INTRODUCTION

Accurate detection of pupillary diameter has an important role in corneal refractive surgery. Selecting an optic zone smaller than the mesopic pupillary diameter in refractive surgery may result in decreased vision quality and patient dissatisfaction (1, 2). Pupillary diameter measurement is routinely performed prior to refractive surgeries, such as laser-assisted in situ keratomileusis (LASIK), photorefractive keratectomy (PRK), and small incision lenticule extraction.

While the scotopic state is defined as an illumination under 0.05 lux (light unit), the photopic state refers to an illumination above 49 lux. An illumination between 0.05 and 49 lux is indicated as mesopic status (3). Visual complaints after refractive surgery are generally associated with mesopic vision (4, 5). There are many studies on pupillary diameter in different populations in the literature; however, there are a limited number of publications on the factors affecting pupillary diameter (6). In addition, the literature on dynamic pupillometry measurements, including photopic and scotopic pupillary diameters, and on the relationship of these measurements with demographic and ocular factors is quite rare in the Turkish population.

In this study, we investigated the photopic, mesopic, and scotopic pupillary diameters in patients admitted to our hospital due to myopic refractive surgery and evaluated the factors affecting pupillary diameters in these three different lighting conditions.

METHODS

In this retrospective, cross-sectional, descriptive study, the files of patients who underwent LASIK due to myopia or myopic astigmatism within 6 months were examined. The required approval for the study was obtained from institutional review Board of Beyoglu Eye Research. The study was performed in accordance with the Declaration of Helsinki. Informed consent was not obtained due to the retrospective nature of this study. Patients with a history of intraocular surgery and trauma and those who had other ocular diseases, such as uveitis and diabetes, and amblyopia were excluded from the study. Only one eye of the patients eligible for the study was included in the study. The patients' eyes to be included in the study were determined as right or left using the random number table.

Standard eye examinations, including best corrected visual acuity, biomicroscopy, intraocular pressure measurement, and fundus examination, were performed for all patients. Corneal topography and dynamic pupillometry measurements were performed with Sirius topography device (Schwind Eye Tech Solutions AG, Germany). Axial length was measured with an optical biometry device (Nidek, Japan). Age, sex, and manifest refraction data of patients were recorded from the patient files.

Table 1. Patient characteristics

	Mean ± SD	p
Age (years)		
Female	27.12±5.9	0.69
Male	27.75±6.2	
Axial length (mm)		
Female	25.36±1.5	0.74
Male	25.49±1.2	
Spherical Equations (-D)		
Female	-5.61±20	0.07
Male	-4.83±2.4	
Photopic pupillary diameter (mm)		
Female	4.55±0.5	0.15
Male	4.27±0.7	
Mesopic pupillary diameter (mm)		
Female	5.97±0.5	0.03
Male	5.62±0.6	
Scotopic pupillary diameter (mm)		
Female	6.40±0.5	0.07
Male	6.10±0.6	

Sirius topography device is a topography device that includes Scheimpflug camera and placido disc properties. The pupillometry integrated into the device captures the pupillary diameter dynamically or statically. The patient's face is supported on a chin-rest and a forehead strap, similar to that in a biomicroscope. The person performing the measurement focuses on the pupil with the control arm of the device, captures the clearest image, and waits until the pupillary movement is finished. The device automatically captures pupillary images according to the defined lighting conditions.

Statistical Analysis

Sex was considered as a categorical variable, and the spherical equivalent of manifest refraction (SE), axial length (AL), and age were considered as continuous variables. The values of variables are expressed as the mean and standard deviation (SD). The mean values of sex groups were compared with the Student t test. The correlation between continuous variables and scotopic, mesopic, and photopic pupillary diameters was calculated using the Pearson correlation test. A p value of <0.05 was considered statistically significant.

RESULTS

Eighty eyes of 80 patients were included in the study. The characteristics of patients are shown in Table 1. Of the patients, 45 were female and 35 were male. There was no difference between males and females in terms of age, refractive defects, and AL (Table 1). While there was no difference between females and males in terms of scotopic and photopic pupillary measurements, mesopic pupillary diameter was significantly higher in females than in males (5.98±0.50 vs. 5.62±0.68 mm; Student t test, p=0.03; Table 1). The correlation of pupillary diameter with different factors is shown in Table 2. There was a negative correlation between mesopic and scotopic pupillary diameters and age (p=0.005, r=-0.37; p=0.001, r=-0.45 for mesopic and scotopic conditions, respectively).

DISCUSSION

In this study, pupillary diameters of patients who were admitted to our clinic for refractive surgery were evaluated and their relationship with ocular factors was investigated. Pupillography is a measurement that must be routinely performed before refractive surgery to decide the optical zone to be selected and can be performed with many different devices. When deciding the optical zone before refractive surgery, the mesopic pupillary diameter is generally taken into account (6). Because the pupillary diameter varies with the intensity of light, the conditions under which the measurement is performed are important. In the method applied in our study, after the patient is taken to a room without illumination except that of the measurement device, illumination is provided by the measurement device at an amount varying from scotopic to photopic. The device then records a video and gives scotopic, mesopic, and photopic pupillary diameters. In the literature, studies stating the mean pupillary di-

Table 2. Correlations of continuous variables with pupillary diameters

	Age	Axial length	Spherical Equivalent
Photopic pupillary diameter (mm)	r=0.12 (p=0.384)	r=0.18 (p=0.201)	r=-0.26 (p=0.059)
Mesopic pupillary diameter (mm)	r=-0.38 (p=0.005)	r=0.06 (p=0.648)	r=-0.15 (p=0.275)
Scotopic pupillary diameter (mm)	r=-0.45 (p=0.001)	r= 0.11 (p=0.4)	r=-0.25 (p=0.072)

ameter in patients with refractive surgery give either the clinically significant mesopic pupillary diameter or cycloplegic scotopic pupillary diameter to compare different devices (4, 6, 7). In this study, unlike other studies, pupillary diameters in all the three conditions were reported.

In the literature, there is only one study in which the scotopic pupillary diameter has been measured with Sirius device, and the mean cycloplegic scotopic pupillary diameter was determined as 8.06±0.76 mm (7). In our study, the mean scotopic pupillary diameter (6.26±0.60 mm) was measured in physiological conditions and was expected to be relatively lower. Although there is no study on the diameter of photopic pupils measured in our country in Pubmed and Turkish Medical Directory, this value was found to be 4.56±0.58 mm in females and 4.28±0.77 mm in males in our study ($p>0.05$) and was below 6 mm in all patients. The average mesopic pupillary diameter in the literature ranges from 5.33 to 6.42 mm and considerably varies according to the measurement device (8-12). The mean pupillary diameter of 5.98±0.50 mm in our study is consistent with the results in the literature. In a study conducted in our country, Çakmak et al. (6) reported the mean mesopic pupillary diameter as 6.19 mm in patients admitted to the refractive surgery clinic; however, unlike the one that we used in our study, they used the wavefront analyzer.

Because it has been found in the literature that the measurements made with different devices show statistically significant differences among pupillary diameters (7), direct comparison of these measurement results may have false implications; however, because the measurement repeatability of the dynamic pupillography device we used is high, its relationship with different groups and various factors could be statistically determined.

Sex and age, which were among the factors examined in our study, were found to be related to pupillary diameter, but refractive defect and AL were not. Similar to our study, a negative correlation has been reported between age and pupillary diameter in the literature (6, 13-15). Although Win et al. found a negative relationship between age and pupillary diameter, no relationship was found between sex and refractive defect (13). Similarly, Netto et al. (14) found age and pupillary diameter to be related but not sex and refractive defect. Jones et al. (15) also concluded that there was no relationship between sex and pupillary measurements in a group of 48 patients. In contrast to these studies, mesopic pupillary diameter was found to be significantly larger in females than in males in the study by Çakmak et al. (6); however, photopic and scotopic pupillary diameters were not evaluated. In our study, the relationship of sex with photopic and scotopic pupillary diameters was also investigated, but no statistically significant difference was found. Çakmak et al. (6) also did not find a relationship between AL and pupillary diameter, which is consistent with our results.

CONCLUSION

In this study, we aimed to present the characteristics of myopia and myopic astigmatism in patients who were refractive surgery candidates in our country. It was an advantage that photopic, mesopic, and scotopic pupillary diameter measurements were performed with dynamic pupillometry measurement in each patient. In fact, although our patient group was in a relatively narrow age range, there was a relationship between age and not only mesopic pupillary diameter but also scotopic pupillary diameter. We believe that similar studies performed on patients with different characteristics in larger patient series will further contribute to the literature.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was not obtained due to the retrospective nature of the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - Ali.D., A.D.; Design - Ali.D., A.D.; Supervision - Ali.D., A.D.; Data Collection and/or Processing - Ali.D., A.D.; Analysis and/or Interpretation - Ali.D., A.D.; Literature Search - Ali.D., A.D.; Writing Manuscript - Ali.D., A.D.; Critical Review - Ali.D., A.D.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Haw WW, Manche EE. Effect of preoperative pupil measurements on glare, halos, and visual function after photoastigmatic refractive keratectomy. J Cataract Refract Surg 2001; 27: 907-16. [CrossRef]
2. Holladay JT. The high cost of inaccurate pupillometry. Rev Ophthalmol 2002; 9: 47-9.
3. Rosen E. The pupil and refractive surgery. In: Essential in Ophthalmology, Cataract and Refractive Surgery. Verlag Berlin Heidelberg: Springer, 2005; pp. 289-302. [CrossRef]
4. Schallhorn SC, Kaupp SE, Tanzer DJ, Tidwell J, Laurent J, Bourque LB. Pupil size and quality of vision after LASIK. Ophthalmology 2003; 110: 1606-14. [CrossRef]
5. Schmidt GW, Yoon M, McGwin G, Lee PP, McLeod SD. Evaluation of the relationship between ablation diameter, pupil size, and visual function with vision-specific quality-of-life measures after laser in situ keratomileusis. Arch Ophthalmol 2007; 125: 1037-42. [CrossRef]
6. Çakmak HB, Cagil N, Simavli H, Duzen B, Simsek S. Refractive error may influence mesopic pupil size. Curr Eye Res 2010; 35: 130-6. [CrossRef]
7. Altan C, Kaya V, Basarir B, Celik U, Azman E, Akar S, et al. Comparison of 3 pupillometers for determining scotopic pupil diameter. Eur J Ophthalmol 2012; 22: 904-10. [CrossRef]
8. Bootsma S, Tahzib N, Eggink F, de Brabander J, Nuijts R. Comparison of two pupillometers in determining pupil size for refractive surgery. Acta Ophthalmol Scand 2007; 85: 324-8. [CrossRef]
9. Cheng AC, Lam DS. Comparison of the Colvard pupillometer and the Zywave for measuring scotopic pupil diameter. J Refract Surg 2004; 20: 248-52.
10. McDonnell C, Rolincova M, Venter J. Comparison of measurement of pupil sizes among the colvard pupillometer, procyon pupillometer, and NIDEK OPD-scan. J Refract Surg. 2006; 22: 1027-30.
11. Schmitz S, Krummenauer F, Henn S, Dick HB. Comparison of three different technologies for pupil diameter measurement. Graefes Arch Clin Exp Ophthalmol 2003; 241: 472-77. [CrossRef]
12. Wickremasinghe SS, Smith GT, Stevens JD. Comparison of dynamic digital pupillometry and static measurements of pupil size in determining scotopic pupil size before refractive surgery. J Cataract Refract Surg 2005; 31: 1171-6. [CrossRef]
13. Winn B, Whitaker D, Elliott DB, Phillips NJ. Factors affecting light-adapted pupil size in normal human subjects. Invest Ophthalmol Vis Sci 1994; 35: 1132-7.
14. Netto MV, Ambrósio R, Wilson SE. Pupil size in refractive surgery candidates. J Refract Surg 2004; 20: 337-42.
15. Jones R. Do women and myopias have larger pupils? Invest Ophthalmol Vis Sci 1990; 31: 1413-5.