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ORIGINAL PAPER

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Incidence of Keratoconus in Refractive Surgery Population of Vojvodina - Single Center Study

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ABSTRACT

Introduction: Keratoconus (KCN) is known to affect all ethnicities but its incidence exhibits geographical variability plausibly due to subclinical forms of the disease, differences in diagnostic methods and criteria, or differences in genetic variations in populations. **Aim:** To examine the prevalence of keratoconus among the refractive surgery population of Vojvodina, who underwent refractive surgery screening at Eye Clinic S Svetlost Novi Sad, Serbia from September 2018 to September 2019. This is a single-center study. **Methods:** Retrospective analysis of 876 patients who presented for refractive surgery evaluation. Corneal tomographers represent the gold standard in the detection and classification of corneal ectatic diseases and screening is an essential part of the preoperative diagnostics before any refractive surgery. The corneal tomographer used in this study was a Scheimpflug imaging device (Pentacam AXL, Oculus Optikgeräte GmbH, Wetzlar, Germany). The device was realigned before each measurement. **Results:** Out of a total number of patients, 619 (70,7%) were candidates for corneal refractive surgery procedure, and 257 patients (29,3%) were not. Out of 257 patients that were not candidates for the procedure 157 (61,0%) patients had thin corneas, high myopia/hypermotropia or had some retinal disease; 75 patients (29,1) were keratoconus suspect and 25 patients (9,7%) had keratoconus. KCN patients had a mean age of 29.5 ± 7.7 years, 18 patients (72,0%) were male and 7 patients were female (28%). **Conclusion:** The most cited annual incidence of KCN is 2 approximately 1 per 2,000. Recent data from the biggest Netherland study revealed many different epidemiological results which deprive keratoconus of the community of rare diseases. The incidence of keratoconus in Vojvodina refractive surgery population presented in our Clinic was 2.9%.

Keywords: Keratoconus, epidemiology, refractive surgery, pentacam.

1. INTRODUCTION

Progressive corneal thinning is an essential component of ectatic diseases including keratoconus, pellucid marginal degeneration, and keratoglobus. Hallmarks of corneal thinning are a progressive increase in keratometry, astigmatism and higher-order aberrations (1). Keratoconus is a bilateral, non-inflammatory condition, in which cornea is cone-shaped with anterior surface contour emphasized over the central and paracentral cornea. However, posterior surface changes and changes in corneal thickness are real signs of the ectatic condition because in many subclinical cases of keratoconus anterior surface may be normal (2). Usually, there is some degree of asymmetry between eyes, one eye can have very expressed symptoms while the contralateral eye can present with normal anterior curvature.

Keratoconus is an absolute contraindication for corneal refractive surgery, and detection of it is very important in refractive surgical screening. It is well-known that iatrogenic ectasia is a late complication of Laser in situ keratomileusis (LASIK) (3). Therefore corneal topographic and tomographic measurements have to be complete, including anterior and posterior evaluation maps, corneal surface curvature maps and pachymetric maps that can provide detailed information and confirm suspected ectasia or high-risk corneas (4). Corneal tomographers represent the gold standard in the detection and classification of corneal ectatic diseases. Screening for corneal ectatic diseases such as keratoconus is an essential part of the preop-

erative diagnostics before any refractive surgery. Thanks to the invention of corneal topography, keratoconus is today „easy“ detectable corneal condition compared to the period up to the 1990s. An increase in the number of cases occurring nowadays is probably due to the following technology advancement and better methods of diagnosis. The cause is unknown until the present day and there is a large epidemiological difference between different areas of the world and different ethnicities. The most common factors implicated in the pathogenesis of keratoconus include genetic and environmental factors (5).

2. AIM

To examine the prevalence of keratoconus among the refractive surgery population of Vojvodina, who underwent refractive surgery screening at Eye Clinic Svjetlost Novi Sad, Serbia from September 2018 to September 2019. This is a single-center study.

3. MATERIAL AND METHODS

The study included 876 patients that underwent refractive surgical screening in Eye Clinic Svjetlost Novi Sad, Serbia, between September 2018 and September 2019. All included subjects were from different parts of Vojvodina. The current study used a topography-based approach to examine the incidence of keratoconus in patients presenting to our clinic seeking refractive surgery. Standard ophthalmologic examination was conducted and corneal tomographic assessment with the Scheimpflug imaging device (Pentacam AXL, Oculus Optikgeräte GmbH, Wetzlar, Germany) was performed. One eye of each patient was measured five consecutive times. Patients were asked to blink before each measurement and to keep their eyes wide open during measurement while fixating on the fixation target. The device was realigned before each measurement. Tomographer was used with standard settings. To reduce the influence of the operator, the tomographer was used in automatic release mode, which means that the measurement started as soon as positioning requirements for the respective tomographer were within the limits predefined by the manufacturer. The Pentacam AXL acquired 25 Scheimpflug images within each measurement. The Pentacam AXL includes a software whose export function provides elevation and pachymetry data maps in Cartesian coordinates with 0.1 mm sampling-resolution in the horizontal and vertical direction and 1 μ m in the direction along the keratographic axis.

Only measurements with a quality status QS = 'OK' were accepted. Invalid data points were excluded. Only eyes with five successful measurements were considered in the analysis. Repeatability refers to the variation between repeated measures of the same eye under the same conditions. We distinguish between repeatability and corrected repeatability: The repeatability is expressed as the within-subject standard deviation (SDw) of the corneal tomography (elevation and pachymetry) measurements without correction of misalignment. The corrected repeatability is the SDw of measurements after correction of misalignment (rotation, translation) between consecutive measurements.

Correction of misalignment was performed using the

fifth measurement as a landmark to realign the other four measurements. To enable a direct comparison between repeatability and corrected repeatability, the fifth measurement was not included in the calculation of repeatability and corrected repeatability. Exclusion criteria were: patients younger than 18 years of age or patients with a history of ocular surgery or trauma. Written informed consent was obtained from all patients. All study conduct adhered to the tenets of the Declaration of Helsinki. Patients were classified as having keratoconus if the following criteria were met: corneal thickness <500 μ m, asymmetric bowtie on corneal topography map – inferior/superior (I/S) asymmetry >1.4 D, corneal steepening \geq 47 D, posterior elevation >20 μ m. Keratoconus suspects were patients where one of the following criteria was met: corneal thickness <450 μ m, asymmetric bow tie on corneal topography map, I-S asymmetry >1.2 D, corneal steepening \geq 48 D, or posterior elevation >25 μ m. Frequency and prevalence data are presented in percentages (%).

4. RESULTS

Out of 876 patients included in this study, 424 of them underwent refractive surgery (48,4%), 257 patients were not suitable candidates for refractive surgery (29,3%) and 195 patients (22,2%) were refractive surgery candidates, but chose not to undergo a procedure.

The main reason for not getting refractive surgery was keratoconus, and there were 25 discovered cases out of 257 patients (9,7%), 75 patients were keratoconus suspect (29,1%). Patients who were not candidates with thin corneas

Reason	Patients	%
Keratoconus	25	9,7
kertoconus suspect	75	29,1
thin cornea	31	12
high hypermetropia	54	21
high myopia	36	14
previous corneal disease	8	3,1
unstable refraction	17	6,6
retinal disease	9	3,5
previous corneal refractive surgery	2	0,8

Table 1. Reasons for not undergoing corneal refractive surgery

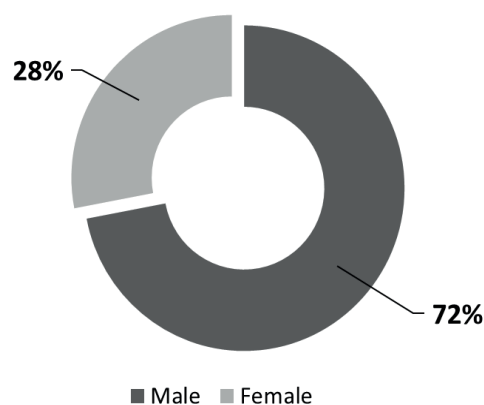


Figure 1. Distribution of keratoconus by gender

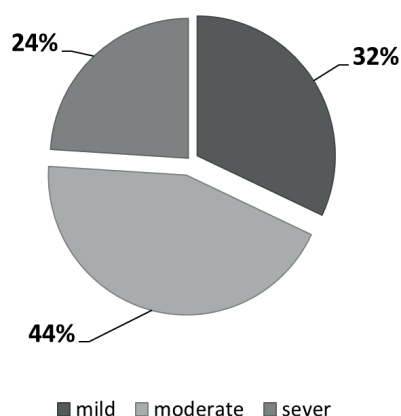


Figure 2. Distribution of keratoconus by stage

or high myopia/hypermotropia or had some retinal disease or other reason (157 patients-61%) (Table 1.)

The overall prevalence of keratoconus in our study sample was 2,9% in all patients and 9.7% in patients who were not candidates for refractive surgery. Most of the patients with keratoconus were male (72%) (Figure 1.). The age of those patients was between 22 and 37 years.

Bilateral keratoconus was detected in almost all patients (96%). The frequency percentage of KCN according to severity was 32% for mild, 44% for moderate and 24% for severe keratoconus. (Figure 2.)

5. DISCUSSION

Information about the incidence of keratoconus in Europe, and in the world generally, is still not well investigated. The lack of data on the prevalence of this corneal disease is partly due to insufficient research, an insufficient amount of work on the subject, but to a large extent still undiagnosed cases. Studies that have been performed around the globe to assess the incidence of keratoconus have estimated the overall incidence of keratoconus at 50 cases per 100,000 people (0.05%) (6) . The incidence of keratoconus in the United States has been estimated to be 54.5 cases per 100,000 people (0.06%) (7) . It should be noted that these studies date back to the 1990s and since they do not provide more recent data we have to consider them with retreat. However, due to the lack of new data, they nevertheless provide indicative insights into the presence of keratoconus. Several recent studies have been conducted in Europe. Nielsen K. and al. estimated the prevalence of hospitalized keratoconus cases in Denmark at 86 patients per 100,000 residents and the incidence at 1.3 per 100,000 per year (8) . They reported an increase in the annual incidence rate from 1.24 per 100,000 person-years in 2003 to 3.83 per 100,000 in 2011. and the average incidence rate of 2011-2015 was 3.60 per 100,000 person-years (9) . The study conducted in the Netherlands took a sample of 4 million patients who were in a mandatory health insurance database and has shown a prevalence of 13.3 in 100,000. Ljubić et al. took a sample of 2254 patients and came to the prevalence in Macedonia that amounted to 6.8 in 100,000

(5) . If we show the results of our study per 100,000 people, then we get a prevalence of 0.02%

Keratoconus affects both genders, and it is still unclear whether there is significant gender predominance. Although in most studies keratoconus is more common in men, as reported by Pobelle-Frasson in 2002 (62%), Owen in 2003 (59%) and Ertan (62%) in 2009 (10). Our study confirms a more frequent occurrence of keratoconus in the male population. Furthermore, men are at a significantly higher risk of developing at a younger age than women (11, 12) . Ertan et al. found that most keratoconus patients are diagnosed between 21 and 40 years of age (13) . Our sample contributes to this. The data of keratoconus severity in our study refers that moderate keratoconus is the most prevalent, while severe cases are present in a smaller number. This consistent with the information given in a study by Rafati S. and al. in Iran. In their survey, about 93% of the patients had bilateral KCN, and the frequency of moderate and severe keratoconus was similar to its frequency in Asian populations but higher than in other ethnic populations, especially European populations (14) . For instance in Lebanon a high prevalence of 3.3%, in Indian rural areas 2.3%, while there is a lower prevalence in the cold north of Denmark, Finland and Russia (15) .

Keratoconus is known to be a hereditary disease, and thus its prevalence is conditioned by ethnicity and region. A survey conducted on the theme „Influence of ethnic origin on the incidence of keratoconus and associated atopic disease in Asians and white patients“ has shown that Asians were significantly more likely to present with keratoconus. The higher incidence in this population was highly suggestive of a genetic factor that is significant in the etiology. The atopic disease was significantly less common in Asians compared to Caucasians, supporting the theory of a different etiology in these patients (16) .

Our study has several limitations related to its retrospective study design and a relatively small sample size. As we only evaluated keratoconus patients attending our clinic, the odds of selection bias are increased and the generalizability of the results is decreased. Thus, further prospective studies with a larger number of patients are needed and planned to get a better insight into the prevalence of keratoconus in Serbia.

6. CONCLUSION

The prevalence of keratoconus in this sample was 2,9 % out of 876 patients who participated in the study. Keratoconus patients were mostly male with a moderate stage of the disease. These results contribute to those obtained in previous studies conducted in Europe.

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