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PREVALENCE, DISTRIBUTION AND TYPES OF CORNEAL ASTIGMATISM IN CATARACT SURGERY PATIENTS IN ŠIBENIK COUNTY

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SUMMARY – The aim of the study was to determine the prevalence, distribution and types of corneal astigmatism in cataract surgery patients in Šibenik County. In this retrospective study, keratometric data on 392 eyes of 202 patients admitted for senile cataract surgery to Šibenik General Hospital from April until June 2011 were collected and statistically analyzed. The median age of our patients was 77 (range 50 to 92) years; there were 91 (45%) men and 111 (55%) women. The measured keratometric values ranged from 36.00 to 47.00 diopter. The median of measured corneal astigmatism was 0.75 diopter cylinders (DCyl), ranging from 0 to 6.12 DCyl. In 150 (38.3%) study eyes, corneal astigmatism was in the physiological range of 0.50 DCyl or less, in 118 (30.1%) eyes it was >0.50-1.0 DCyl, and in 124 (31.6%) eyes >1.0 DCyl. Preoperative corneal astigmatism of 1 DCyl or more has a significant influence on postoperative refractive outcome. This imposes the need to consider a possible option for correction of preoperative astigmatism at the time of cataract surgery.

Key words: *Preoperative corneal astigmatism; Cataract surgery*

Introduction

Cataract surgery is one of the most commonly performed ophthalmic surgical procedures worldwide, with a high rate of successful and rapid anatomical and functional visual recovery. With improvements and advances in operating techniques, instruments and technical aids, the patients' as well as the surgeons' demands and expectations are continuously increasing. The main aim of cataract surgery today is rapid visual rehabilitation, the best possible uncorrected visual acuity, and minimal postoperative astigmatism[1].

This brings to interest the question of influence of preoperative and surgically induced corneal astigmatism on the final postoperative unaided visual acuity as well as the question of choosing the best option for correcting preoperative corneal astigmatism at the time of cataract surgery. These options include selective positioning of the phacoemulsification incision, corneal or limbal relaxing incisions, and toric intraocular lens (IOL) implantation.

In this study, we collected information on the prevalence, distribution and types of preoperative corneal astigmatism in a small group of senile cataract surgery patients in Šibenik County. Information like these, especially those provided from large cohort studies, could be very useful in designing local hospital protocols, analyzing the potential cost of the protocols and providing manufacturing companies with parameters to optimize the manufacturing process, stock and clinical application of ophthalmic surgery devices[2,3].

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Patients and Methods

In this retrospective study, we reviewed medical data on patients admitted for senile cataract surgery to General Hospital of Šibenik-Knin County from April until June 2011. All patients operated on had complete medical documentation including medical history and ophthalmologic examination findings. The preoperative routine for all patients was similar and included automated keratometry, complete ophthalmologic examination including visual acuity, refraction, slit lamp examination, applanation tonometry and dilated fundus evaluation, echobiometry and ultrasound B-scan examination. Keratometric data were collected using the Speedy Z autokeratorefractometer (Lombart Instruments, Norfolk, Virginia, USA).

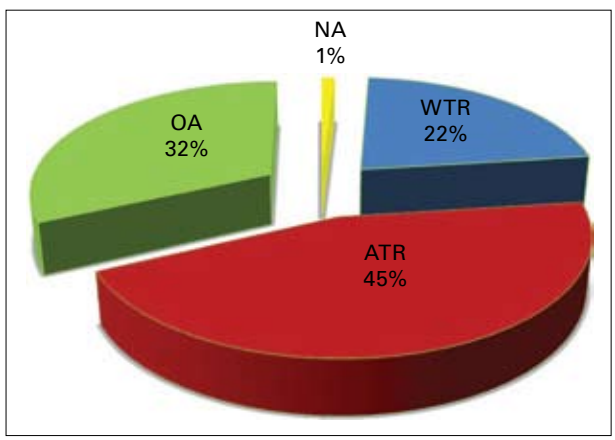
This system performs automatic measurement of central keratometry of the eye (flat x axis and steep x axis). The study inclusion criteria were the presence of cataract and age 50 years or more. Exclusion criteria were irregular astigmatism, corneal disease, previous corneal or intraocular surgery, and history of ocular inflammation. For the part of the analysis, the patients were divided into 4 age groups: 50-60, 61-70, 71-80 and older than 80 years. Corneal astigmatism was designated as with the rule (WTR) when the steep corneal meridian was within 20 degrees of vertical meridian; against the rule (ATR) when the steep corneal meridian was within 20 degrees of horizontal meridian; and oblique astigmatism (OA) if it was neither WTR nor ATR. Completely spherical corneas were designated as no astigmatism (NA).

Statistical analysis was performed using Statistica 7.0 statistical package. Kruskal-Wallis test and χ^2-test were used on data processing. A *P* value less than 0.05 was considered statistically significant.

Results

A review of the available clinical records identified 392 eyes of 202 cataract patients that met the criteria for inclusion in the study. Table 1 shows demographic characteristics of study patients. Prevalence distribution of corneal astigmatism values showed corneal astigmatism 0.50 DCyl or less in 150 (38.3%), corneal astigmatism between 0.51 and 1.0 DCyl in 118 (30.1%), astigmatism between 1.01 and 2.0 DCyl in 98 (25%), astigmatism between 2.01 and 3.0 DCyl in 13 (3.3%) and corneal astigmatism higher than 3.0 DCyl in 13 (3.3%) eyes. These results show that 31.6% of analyzed eyes had corneal astigmatism higher than 1.0 DCyl.

As shown in Figure 1, only 1% of all examined eyes had spherical corneas (NA), 22% had WTR astigmatism, 45% had ATR astigmatism, and 32% had OA. Figure 2 presents histogram of prevalence distribution of WTR, ATR and OA according to age groups. There was a statistically significant increase in the incidence of ATR and decrease in the incidence



NA = no astigmatism; OA = oblique astigmatism; WTR = with the rule (corneal astigmatism); ATR = against the rule (corneal astigmatism)

Fig. 1. Axis distribution of corneal astigmatism in all 392 eyes.

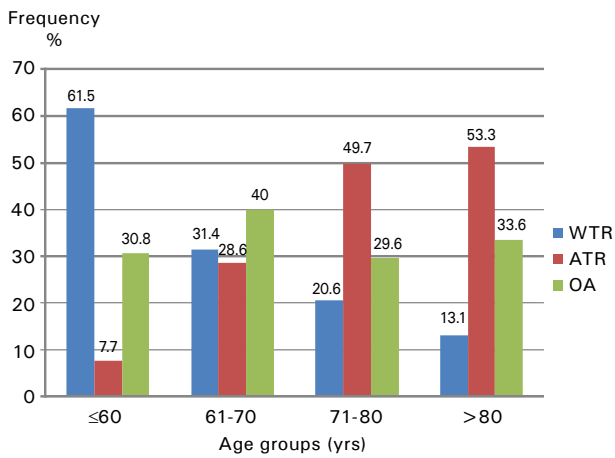


Fig. 2. Histogram of with the rule (WTR), against the rule (ATR) and oblique (OA) astigmatism frequency distribution according to age groups.

of WTR proportionally with age, while the incidence of OA did not show significant relationship with age (χ^2=28.7; P<0.001).

Discussion

There are several recent studies which investigated preoperative corneal astigmatism in cataract surgery patients[2-5]. Comparison of demographic characteristics of patients showed no significant difference between these studies including our study except for the number of eyes examined. The range of corneal astigmatism was up to 4.50 DCyl in the study by Riley *et al.*[5], up to 6.12 DCyl in our study, and up to 6.75 DCyl in the study by Ferrer-Blasco *et al.*[3]. In most studies, the median of corneal astigmatism was 0.75 DCyl with the exception of the study by Lekhanont *et al.*[4] who report 0.88 DCyl. The range of keratometry values was also similar, with slightly lower values in our sample (36.00-47.00 D *vs.* 38.00-48.00 D reported by Ferrer- Blasco *et al.*[3] and 38.00-49.00 D by Lekhanont *et al.*[4], while Riley *et al.*[5] report the highest keratometry values of 39.00-51.00 D).

It is well known that corneal astigmatism changes with age from WTR to ATR[6-9]. The cornea might change its flattest meridian toward the 90 degree axis with age[6]. In addition, changes in the crystalline lens as a consequence of aging, sclerosis and loss of transparency could also contribute to this shift from WTR to ATR[3,10]. Corneal ATR astigmatism was predominant in all studies, from 45% in our study to up to 62% in the study by Lekhanont *et al.*[4]. We also recorded a statistically significant increase in the incidence of ATR astigmatism and decrease in the incidence of WTR astigmatism proportionally with patient age. The proportion of eyes across the studies with corneal astigmatism equal to or higher than 1.0 DCyl ranged from 31.6% in our study to up to 40.4% in the study by Khan and Muhtaseb[2]. This level of residual astigmatism after phacoemulsification will significantly influence the final postoperative refractive outcome, leaving the patient symptomatic with the need of additional correction. According to a recent study by Hayashi *et al.*[11], distance visual acuity decreases by more than 1 line when 0.50 DCyl is added to the best distance refraction. The same amount of astigmatism changes high-contrast visual acuity by approximately 1 logMAR line[12]. Therefore, reduction of astigmatism greater than 0.50 DCyl will noticeably improve visual acuity. Corneal astigmatism can be managed at the time of cataract surgery by positioning corneal incision on the steep axis of the cornea, using single or paired relaxing corneal or limbal incisions, and toric IOL implantation. These procedures can be used alone or in combination, and each has its limitations.

Considering the previously presented results, a relatively high percentage of cataract patients (31.6% to 40.41%) may benefit from one of these procedures. Although our study was limited by a small number of subjects, the results can give useful information to surgeons and hospitals when planning operations and designing local hospital protocols. A similar larger study will be needed to reveal the profile of corneal characteristics within the population, which can help the national health insurance service assess the demand and the cost for the use of toric IOL as well as the manufacturers to match their toric IOL parameter range to cover the range of astigmatism prevalent in the population.

Table 1. Demographic characteristics of study patients

Number of patients/eyes	202/392
Gender (male/female)	91/111
Age range (yrs)	50-92
Age median (yrs)	77
Range of corneal astigmatism (DCyl)	0.0 to 6.12
Median of corneal astigmatism (DCyl)	0.75
Range of keratometry (D)	36.00-47.00
Mean keratometry (D)	
flat ± SD	42.8±1.53
steep ± SD	43.7±1.51

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Sažetak

UČESTALOST, DISTRIBUCIJA I VRSTE KORNEALNOG ASTIGMATIZMA KOD BOLESNIKA S KATARAKTOM NA ŠIBENSKOM PODRUČJU

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Cilj studije bio je odrediti učestalost, distribuciju i vrste kornealnog astigmatizma kod operacije katarakte na šibenskom području. U ovoj retrospektivnoj studiji prikupljeni su i statistički analizirani keratometrijski podaci za 392 oka kod 202 bolesnika zaprimljena u Opću bolnicu Šibensko-kninske županije radi operacije senilne katarakte u razdoblju od travnja do lipnja 2011. godine. Medijan dobi bolesnika iznosio je 77 godina (raspon 50 do 92 godine). U ukupnom broju bolesnika bio je 91 (45%) muškarac i 111 (55%) žena. Raspon izmjerenih keratometrijskih vrijednosti kretao se od 36.00 do 47,00 dioptrija. Medijan izmjerenih vrijednosti kornealnog astigmatizma iznosio je 0,75 dioptrijskih cilindara (DCyl), a izmjerene vrijednosti kretale su se u rasponu od 0-6,12 DCyl. Kornealni astigmatizam unutar fizioloških granica od 0,50 DCyl ili manji utvrđen je kod 150 (38,3%), kornealni astigmatizam >0,50-1,0 DCyl kod 118 (30,1%), a kornealni astigmatizam veći od 1 Dcyl kod 124 (31,6%) oka. Prijeoperacijski kornealni astigmatizam od 1 DCyl ili veći ima značajan utjecaj na poslijeoperacijski refraktivni ishod. Ovo nameće potrebu da se razmotre moguće opcije korekcije prijeoperacijskog kornealnog astigmatizma tijekom operacije katarakte.

Ključne riječi: *Prijeoperacijski kornealni astigmatizam; Kirurgija katarakte*