THE EFFECT OF PHARMACOLOGICAL PUPIL DILATION ON INTRAOCULAR LENS POWER CALCULATION IN PATIENTS INDICATED FOR CATARACT SURGERY

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SUMMARY

Purpose: To evaluate the influence of pupil dilation on ocular parameters measured by optical biometry and the influence of pupil dilation on intraocular lens (PC IOL) power calculation by using the third-generation (SRK/T) and the fourth-generation (Haigis) formula.

Methods: 40 eyes of patients indicated for cataract surgery were included in this study. Each patient was examined by optical biometer firstly without artificial mydriasis (AM) and then after AM, which was achieved using local application of short-term acting mydriatics. Biometric data were measured by Lenstar LS 900 optical biometer, we recorded axial length of the eye (AL), central corneal thickness (CCT), anterior chamber depth (ACD), lens thickness (LT) and corneal astigmatism and optical power of cornea. These data we measured were used for calculation of the PC IOL optical power using both the SRK/T and the Haigis formula. The target postoperative refraction was set to emmetropia. Statistical analysis was performed for evaluation of influence of AM on each ocular parameter and influence of AM on the recommended PC IOL power calculated by the SRK/T and the Haigis formula.

Results: No statistically significant effect of AM on AL, LT and keratometry was demonstrated. On the contrary we demonstrated significant effect on CCT and ACD. No effect of AM on the PC IOL power calculation using the SRK/T formula was proved – the PC IOL optical power before AM and after AM did not differ in any case. When using the Haigis formula for the PC IOL power calculation, the recommended optical power of the PC IOL changed by +0.5 Dpt in 9 eyes, i.e., 22.5 % of the whole group, but statistical analysis did not show this change as statistically significant.

Conclusion: Pharmacological dilation of the pupil significantly affects some intraocular parameters measured by optical biometer and in the case of using the Haigis formula it can influence recommended power of the PC IOL. Conversely, when using the SRK/T formula, pharmacological dilation of pupil does not affect the recommended PC IOL power.

Key words: mydriasis, optical biometry, intraocular lens calculation, SRK/T formula, Haigis formula, keratometry, axial length, anterior chamber depth, cataract surgery

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INTRODUCTION

The purpose of cataract surgery today is not only to remove the non-transparent medium from the optic system of the eye, but also to attain the optimal postoperative refraction by means of the implantation of a posterior chamber intraocular lens (PC IOL). In order to obtain the most appropriate dioptric values of the PC IOL it is of key importance to ensure the most precise possible measurement of the intraocular parameters - "biometry" of the eye. At the same time, an integral component of the ocular examination before the cataract surgery under consideration also includes examination with pharmacological pupil dilation, not only for the purpose of assessing the actual opacity of the lens, but also for the purpose of determining potential pathologies in the region of the vitreous body and posterior segment. According to the evaluated foreign studies, in the majority of centres focusing on cataract and refractive surgery, biometry is performed without artificial mydriasis (AM), although there are centres where biometry is measured in AM within the framework of the preoperative ocular examination. Whether it is the custom to perform optical biometry with or without AM at the given centre, it is appropriate to know the extent to which AM itself influences the measured ocular parameters and thereby also the final calculation of the dioptric value of the PC IOL. This study has set itself the target of identifying the influence of AM on the biometric data and the calculation of the PC IOL value.

Ultrasound biometry became the first method for attaining reliable measurement of the intraocular parameters essential for the calculation of the dioptric value of a PC IOL, i.e. the axial length of the eyeball (AL) and anterior chamber depth (ACD). If we wish to obtain the PC IOL value, it is necessary to combine ultrasound biometry with keratometry, obtained with the aid of optic methods. Ultrasound biometry as a contact method requires very good co-operation of the patient during the measurement as well as an experienced examiner, since even slightly increased pressure by the ultrasonic probe on the corneal surface causes its flattening, resulting in imprecise performance of biometry [1]. Ultrasound biometry was made more precise by the introduction of the immersion technique of measurement, since it minimises, the pressure exerted by the ultrasonic probe on the corneal surface. Nevertheless, even the immersion technique of measurement requires the application of topical anaesthesia and does not reduce the risk of infection in the measured eye [2,3,4]. At present optical biometry is used as the most precise method of measuring individual ocular parameters for calculation of the PC IOL. This method was introduced into clinical practice in 1999 and immediately became the standard method for biometry of the eye and calculation of the dioptric value of the PC IOL, not only before cataract surgery but also before other refractive procedures. The advantage of optical biometry is that it concerns a contactless method which is highly precise, distinguished by a high degree of repeatability and also reproducibility of the values obtained by this method. Another advantage of optical biometry is the possibility of conducting a precise measurement on an eye with the presence of silicone oil in the vitreous cavity, and it also enables higher precision of measurement in myopic eyes with posterior staphyloma in comparison with ultrasound biometry. A disadvantage of optical biometry is that it is not able to measure eyes with non-transparent optic media, such as hypermature cataract, central corneal scar, haemorrhage into the vitreous cavity etc. Instruments for optical biometry within the framework of one examination measure keratometric data, white-to-white distance (WTW, horizontal distance between both corneal limbuses), central corneal thickness (CCT), anterior chamber depth (ACD), pupil width, central lens thickness (LT) and axial length of the eyeball (AL). To obtain the intraocular parameters, individual facilities use different methods of measurement – IOLMaster 500 (Carl Zeiss Meditec, Jena, Germany), AL-Scan (Nidek, Aichi, Japan) and Pentacam AXL (Oculus, Menlo Park, California, USA), using partial coherence interferometry. Lenstar LS 900 (Haag-Streit, Köniz, Switzerland), Aladdin (Topcon, Tokyo, Japan), Galilei G6 (Ziemer, Port, Switzerland) and OA-2000 (Tomey, Nürnberg, Germany) use optical low-coherence interferometry. The latest technology for measurement of optical biometry is "swept source" OCT (ss-OCT), which uses the IOLMaster 700 (Carl Zeiss Meditec, Jena, Germany) and ARGOS (Movu, Santa Clara, California, USA) [5]. Instruments for optical biometry contain software which places the measured values in formulas for the calculation of the dioptric value of the PC IOL. These formulas have been developed since the beginning of the 1970s and have been progressively improved so as to ensure the required resulting refraction is as precise as possible. With the progress of development, the calculation formulas began to be divided into individual generations. The 1st generation of calculation formulas was theoretical, based on an optic model of the eye and mathematical principles, e.g., the Binkhorst formula published in 1975. The 1st generation also includes formulas obtained on the basis of a regression analysis of postoperative refractions in a cohort of patients who had undergone cataract surgery, in this case the most widely used was the SRK formula introduced in 1980 by 1980 Sanders, Retzlaff and Kraff [6]:

$P = A - 2.5 \times AL - 0.9 \times K$

in which P is the spherical dioptric value of the implanted PC IOL, A represents the A-constant of the implanted PC IOL and K average keratometry in dioptres.

The refraction results following cataract surgery with the use of the 1st generation formulas were not entirely satisfactory. The best results were achieved in patients with an eyeball length of 22–24.5 mm, while in patients with shorter or longer eyes it was necessary to adjust the formula. This led to the 2nd generation of formulas, the most frequently used of which was the SRK II formula, wherein the A-constant was corrected according to the axial length of the eye [7]. Nonetheless, even despite these adjustments, today the 1st and 2nd generation formulas are considered obsolete and are no longer used in clinical practice. Instead of them, 3rd and 4th generation formulas are used.

The 3rd generation of formulas (SRK/T, HofferQ, Holladay1) is the result of a combination of regression and theoretical formulas [8]. These formulas use 2 variables – value of AL and value of keratometry and are further optimised with the aid of a specific factor. In the case of the Holladay formula this is the "surgeon factor" (SF), which is equal to the distance between the anterior surface of the iris and the surface of the implanted PC IOL. The SF is derived from 2 values – from ACD (i.e., the distance between the anterior surface of the cornea and the anterior surface of the lens), which we measure with the aid of an optical biometer, and from the distance between the anterior surface of the cornea and the anterior surface of the iris, which cannot be measured by biometry, but can be calculated as the height of corneal curvature. The Hoffer formula uses an "adjusted value" of anterior chamber depth (personalised ACD), which is specific for each type of PC IOL and is stated by the manufacturer. In practice, the SRK/T formula is the most widely used of all 3rd generation formulas. In addition to the AL value and keratometry value, this formula in its calculation also uses the "A-constant", which is a theoretical constant and depends on several factors such as the type of PC IOL, the material it is produced from, the design of the PC IOL and its position inside the eye. The value of the A-constant is specific for each PC IOL and is stated by its manufacturer.

The 4th generation of formulas was developed from the beginning of the 1990s, and among others it includes the formulas Haigis, Holladay2, Olsen, and Barett Universal II. These formulas use more variables in their calculations, and their common denominator is the most precise possible prediction of an immeasurable factor – effective lens position (ELP), which has an influence on the selection of the correct dioptric value of the implanted PC IOL. The Haigis formula in its calculations reckons with the values AL, ACD and 3 constants (a0, a1, a2) for the purpose of predicting ELP. The Olsen formula predicts ELP with the aid of a C constant and with the aid of the measured values of LT and ACD. The Holladay2 formula requires 7 values for the calculation of ELP: keratometric data, AL, WTW, ACD, LT, preoperative value of refraction and patient age. The Barett Universal II formula uses the lens factor (LF), which is influenced by the values of keratometry, AL and ACD [5]. The full wording of the individual formulas is not ordinarily available for free publication, since the majority is protected by copyright. In the selection of a suitable formula for the calculation of the dioptric value of a PC IOL it is necessary to know what kind of formula is the most suitable considering the given AL of the measured eye.

To date no universal formula exists which guarantees high precision upon the use with any AL. On the basis of retrospective analyses, it was determined that the precision in the case of average AL (22.0–25.99 mm) is high in the case of all 3rd and 4th generation formulas, whereas in shorter eyes (20–21.99 mm) the formulas Haigis, Holladay2 and HofferQ manifest high precision, while for medium-length eyes (26.0–27.99 mm) and long eyes (28.00–30.0 mm) it is most suitable to use the formulas SRK/T and Holladay2 [9].

A number of studies are available in the professional literature, dealing with the influence of AM on intraocular parameters determined by means of optical biometry and subsequently on the calculated recommended dioptric value of the PC IOL. It is known that the intraocular parameters are influenced upon the use of mydriatics on the pupil. In practice a short-term acting mydriatic agent containing tropicamide is often used (Unitropic®, Unimed Pharma s.r.o., Slovakia) with a parasympatholytic effect, as well as phenylephrine (Neosynephrin-POS®, Ursapharm s.r.o., Czech Republic) with a sympathomimetic effect, causing not only dilation of the pupil upon the relaxation of the musculus sphincter pupillae and contraction of the musculus dilatator pupillae, but also cycloplegia by influencing the function of the musculus ciliaris. The influence of mydriatic agents on the musculus ciliaris causes an increase in tension of the fibres of the suspensory apparatus, and thereby a slight flattening of the anterior and posterior surface of the lens and its shift in a posterior direction. With regard to the fact that 3rd generation formulas do not use ACD and LT values for the calculation of the PC IOL, AM should not have an influence on the calculation of the PC IOL. By contrast, in the case of 4th generation formulas, which use ACD and LT values, the calculated dioptric values of the PC IOL should be influenced.

METHOD AND COHORT

The study incorporated a total of 40 patients indicated for cataract surgery at the Department of Ophthalmology at the Military Hospital in Brno. Only one eye in each patient was included in the study. All the patients were informed in advance about the purpose of the study and consented to their inclusion in the study. Data was gathered during the period from March to May 2020. Patients who had already undergone a surgical procedure on the eye indicated for cataract surgery were excluded from the study, as were patients with a very dense cataract which prevented the performance of optical biometry, patients with another ocular pathology such as corneal dystrophy or other disorder of the cornea which worsened its transparency, uveitis, glaucoma, advanced form of age-related macular degeneration, diabetic retinopathy, conditions following retinal vascular occlusions or other ocular pathologies preventing the correct fixation of the eye during biometric examination. Each patient was examined twice by an optical biometer, first of all without AM and later in AM, which was achieved by repeated application of eye drops with a content of 1 % tropicamide (Unitropic®) and 10 % phenylephrine (Neosynephrin-POS®). The biometric examination in AM was performed 1 hour after the application of mydriatic agents. Each of the patients was examined always by the same doctor, and the biometric data were obtained with the aid of the instrument Lenstar LS 900. The values of AL, CCT, ACD, LT were recorded, and of the keratometric data corneal astigmatism and average corneal power. For the purpose of calculating the dioptric value of the PC IOL, the biometric data obtained without AM and in AM were substituted in the SRK/T formula and the Haigis formula. The calculation was performed for the planned implantation of the single-piece monofocal aspheric PC IOL Rayner RayOne RAO600C (Rayner Intraocular Lenses Ltd., Worthing, Great Britain). The A-constant of this lens for the SRK/T formula is 118.6, and the constants for the Haigis formula are a0 = 1.17, a1 = 0.4 and a2 = 0.1. The manufacturer produces these lenses in intervals of 0.5 Dpt (within the range of the values +8.0 Dpt to +30.0 Dpt) and in intervals of 1.0 Dpt (within the range of the values -10.0 Dpt to +7.0 Dpt and +31.0 Dpt to +34.0 Dpt). The resulting dioptric value of the PC IOL was selected so that the resulting postoperative refraction was equal to the lowest residual myopic spherical equivalent. The obtained data were statistically processed in the statistical program SPSS, and within the framework of the statistical analysis, differences were determined between the measured values before mydriasis and after mydriasis of the pupil. The normal distribution of these differences was then verified with the aid of a Shapiro-Wilk normality test. In the case of those values which met normal distribution, a single-sample t-test was used to verify the hypothesis on the influence of AM for the given parameter, for the others a non-parametric analogue of a t-test was used to verify the hypothesis, namely a single--sample Wilcoxon test. The level of statistical significance of the influence of AM on the individual parameters was set at α = 0.05. For the purpose of clarity, box graphs were created from the obtained data, in which the central "box" part is bordered from below by the 1st quartile and from above by the 3rd quartile. The horizontal line within the framework of the central "box" part delineates the median and the symbol "x" designates the mean value. The "whiskers" of the box graph delineate the values that lie within the framework of 1.5 times the interquartile range. Outside of this range the outlying values are indicated.

RESULTS

Table 1 describes the cohort of 40 patients who were included in this study. The average age of the patients was 74 years, women were represented in the cohort in a percentage of 57.5 %, mean visual acuity of the eyes indicated for cataract surgery which were included in the study was 0.55.

The mean value of AL before mydriasis of the pupil was 23.16 ± 0.86 mm (range 21.10–25.38 mm), after mydriasis the mean value of AL was 23.16 ± 0.87 mm (range 21.09–25.40 mm), thus no statistically significant influence of AM was demonstrated on AL (p = 0.32). A comparison of values is presented in graph 1.

The mean value of CCT before mydriasis of the pupil was 550 ± 6 µm (range 488–599 µm), in AM the mean CCT value was 556 ± 27 µm (range 491–614 µm), thus for this parameter a statistically significant influence of AM was demonstrated (p = 0.001), see graph 2.

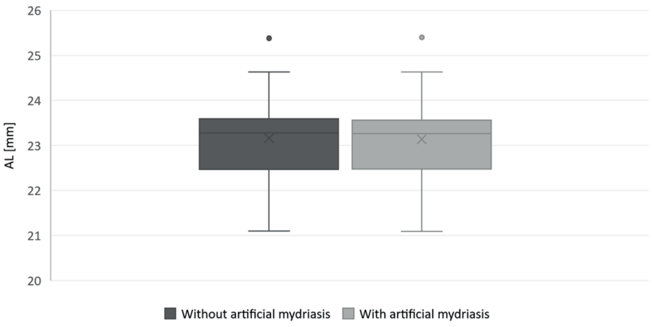
A statistically significant influence of AM was also demonstrated on the deepening of the anterior chamber (p = 0.012) – average value of ACD before mydriasis was 3.01 ± 0.33 mm (range 2.23–3.52 mm), after mydriasis the ACD value was ACD 3.07 ± 0.35 mm (range 2.31–3.71 mm) – the change is illustrated in graph 3.

The mean value of LT before the application of mydriatic agents was 4.73 ± 0.45 mm (range 3.99–5.96 mm), 1 hour after application the mean LT value was LT 4.71 ± 0.45 mm, (range 3.96–5.91 mm), thus no statistically significant influence of AM on LT was demonstrated (p = 0.07), see graph 4.

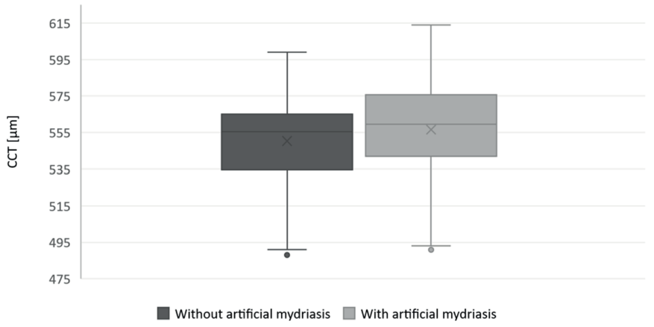
Mean corneal astigmatism before mydriasis of the pupil was 0.85 ± 0.68 Dpt (range 0.00–2.63 Dpt) and the mean value of corneal power was 43.9 ± 1.3 Dpt (range 40.76–47.52 Dpt). No statistically significant influence of AM was demonstrated for these values (p = 0.06, respectively p = 0.22) – after mydriasis of the pupil mean corneal astigmatism was 0.91 ± 0.67 Dpt (range 0.00–2.92 Dpt) and the value of mean optical corneal power was 43.9 ± 1.3 Dpt (range 40.74–47.51 Dpt). With the given parameters, the dioptric value of the PC IOL calculated with the aid of the SRK/T and Haigis formula was targeted at postoperative refraction equal to the lowest residual myopic spherical equivalent. Without mydriasis of the pupil the mean of the values of PC IOL calculated with the aid of the SRK/T formula was 21.5 ± 2.7 Dpt (mean 21.5 Dpt, range 15.0–27.5 Dpt), the mean of the values of PC IOL obtained with the

Table 1. Description of set of patients

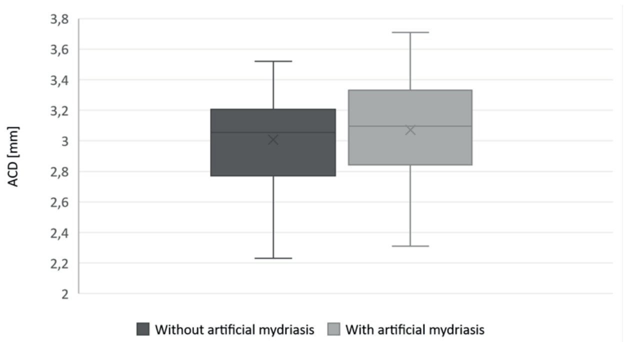
Age [years]	
Mean	74
Standard deviation	10
Maximum	91
Minimum	46
Sex	
Men	17
Women	23
Best-corrected visual acuity	
Mean	0.55
Standard deviation	0.24
Minimum	0.10
Maximum	0.90
Pupil diameter [mm]	
Mean	7.23
Minimum	5.75
Maximum	8.22



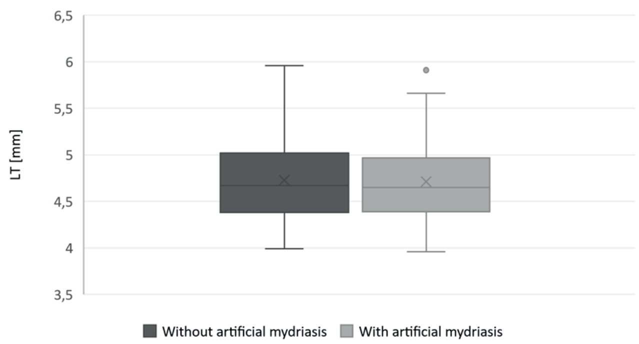
Graph 1. Comparison of the axial length (AL) values measured without artificial mydriasis and with artificial mydriasis



Graph 2. Comparison of the central corneal thickness (CCT) values measured without artificial mydriasis and with artificial mydriasis



Graph 3. Comparison of the anterior chamber depth (ACD) values measured without artificial mydriasis and with artificial mydriasis



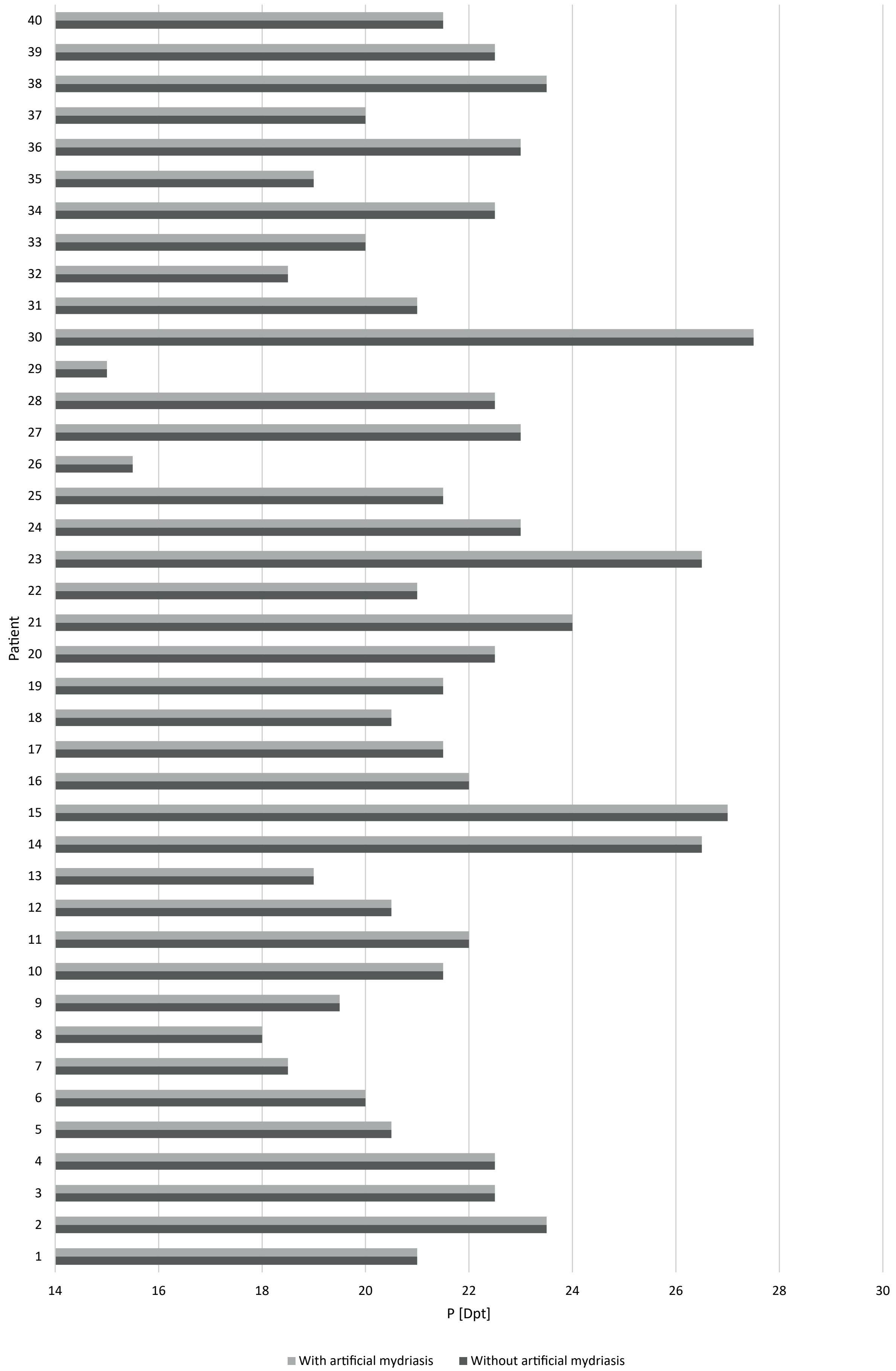
Graph 4. Comparison of the lens thickness (LT) values measured without artificial mydriasis and with artificial mydriasis

aid of the Haigis formula was 21.6 ± 2.9 Dpt (median 22.0 Dpt, range 14.5–28.0 Dpt). Subsequently a calculation of the PC IOL values was performed from the values obtained in AM. In the case of calculation with the aid of the SRK/T formula there was no change of the calculated PC IOL value in any case, i.e., the mean value of PC IOL was 21.5 ± 2.7 Dpt (median 21.5 Dpt, range 15.0–27.5 Dpt), while by contrast there was a change of the mean of PC IOL values obtained with the aid of the Haigis formula to 21.7 ± 2.9 Dpt (median 22.0 Dpt, range 15.0–28.0 Dpt). In the case of use of the Haigis formula, the PC IOL value before mydriasis and after mydriasis of the cornea differed in 9 patients (i.e., 22.5 % of the entire cohort of patients), and always concerned an increase of the dioptric value by +0.5 Dpt. However, a statistical analysis did not demonstrate the influence of AM on the calculation of PC IOL with the aid of the Haigis formula ($p = 0.346$). The influence of AM on the calculation of PC IOL with the aid of the SRK/T formula is presented in graph 5 – the values remain unchanged, the influence of AM on the calculation of PC IOL with the aid of the Haigis formula are presented in graph 6 – a change of +0.5 Dpt occurred in 9 patients.

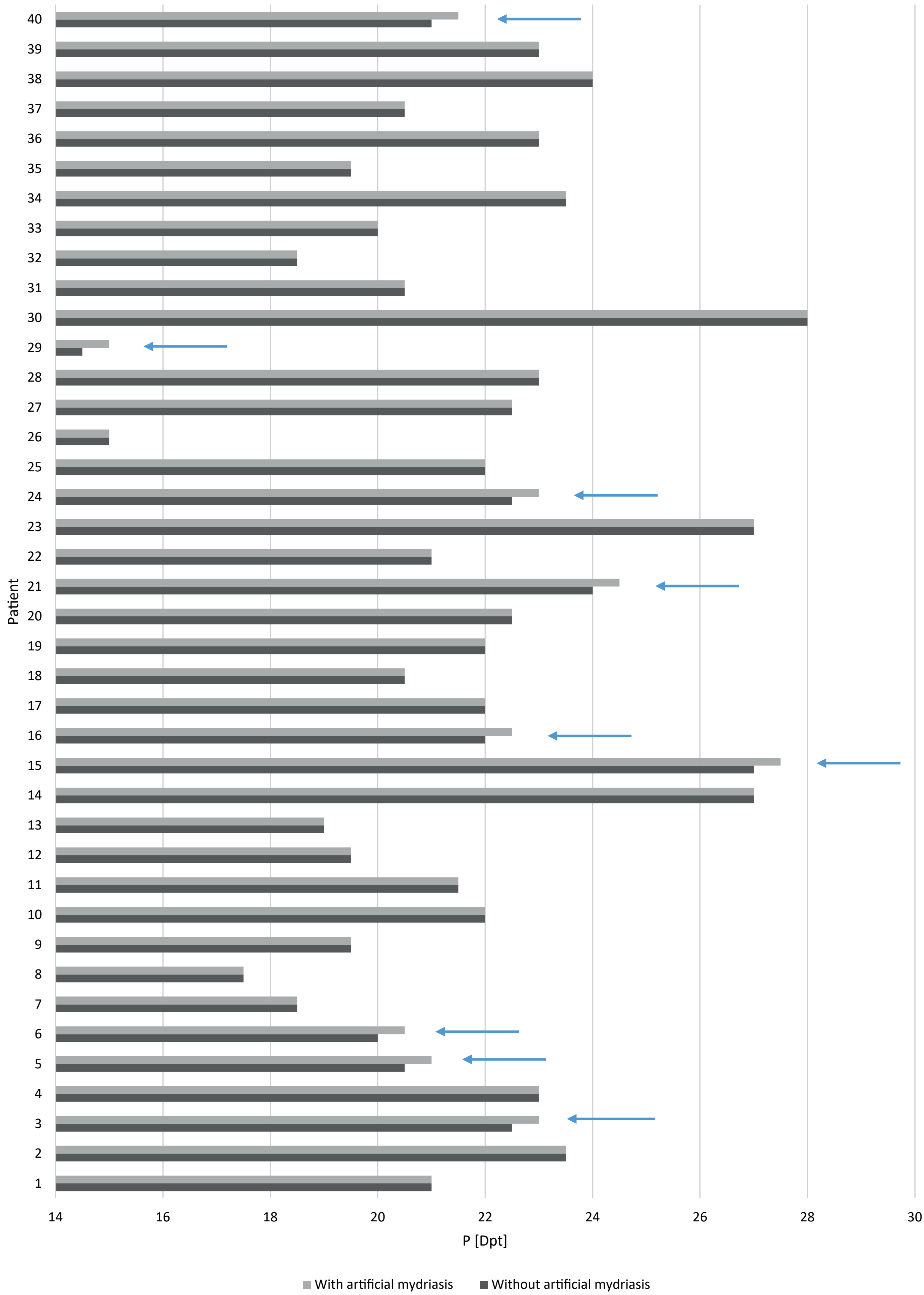
DISCUSSION

The statistically insignificant change of AL after dilation of the pupil is entirely in accordance with the results of other studies and confirms the high degree of repeatability and reproducibility of measurements obtained with the aid of optical biometry, in our case the optical biometer Lenstar LS 900 [10,11,12]. In our study, as in the majority of other studies, the measurements were conducted on patients of higher age (average 74 years), who already had markedly restricted or entirely absent accommodation capacity. A number of studies which focused on the influence of AM on AL in younger patients with preserved accommodation state a higher variability of AL values after dilation of the pupil and increase of AL on average by +0.01 mm. In this case, the difference of AL of 0.01 mm causes a change to the recommended dioptric value of the PC IOL by ±0.028 Dpt, which is an insignificant change from a clinical perspective [13,14]. The influence of accommodation itself on the biometric data was examined in a study conducted by Drexler et al. [10]. Their results state that accommodation of the lens in an average of 4–5 Dpt during measurement with an optical biometer leads to an increase of AL by 0.005–0.013 mm. Upon the performance of optical biometry, it is therefore appropriate to take into consideration the age of the patient and his or her accommodation capacity, and if necessary supplement optical biometry in cycloplegia.

A further examined parameter in our study was the influence of AM on CCT values. A statistically significant increase of CCT was demonstrated, on average by 6 µm. However, this increase does not occur due to the influence of AM itself, but as a consequence of the local application of mydriatic agents. This influence of mydriatics has been demonstrated in several studies. The mechanism



Graph 5. Influence of artificial mydriasis on calculation of intraocular lens power (P) using SRK/T formula



Graph 6. Influence of artificial mydriasis on calculation of intraocular lens power (P) using Haigis formula (the arrow highlights each value that has changed)

of effect of mydriatics on increasing CCT is not entirely clarified, authors most often consider direct impairment of the integrity of intercellular links between the cells of the corneal epithelium, which leads to the onset of slight swelling of the corneal tissues. According to the conducted studies, this increase in CCT is only temporary, reaching its maximum approx. 1 hour after the application of mydriatic agents, and returning to the original value approx. 4 hours after their application [15]. This temporary increase of CCT after the application of mydriatics has no clinically significant influence on the calculation of the PC IOL, though it is necessary to reckon with this when planning laser refractive operations.

Optical biometry was also used to obtain the keratometric data necessary for the calculation of the optical power of the PC IOL. Our results, in which no influence of AM was demonstrated on corneal astigmatism or optical corneal power, are entirely in accordance with those of other authors. Some authors state that although an optical biometer provides relevant keratometric data, if implantation of a toric PC IOL for correction of corneal astigmatism is under consideration, it is appropriate to supplement examination by corneal topography [5,16,17].

In accordance with other studies, we demonstrated a significant influence of AM on deepening the anterior chamber. All the studies including our own state a significant increase in values of ACD, since the influence of AM leads to a shift of the iridolenticular complex in a backwards direction [18,19].

In the case of LT values, the results of the studies are not so consistent. Our study did not demonstrate a statistically significant influence of AM on LT values, on average there was only minimal thinning of the lens in a front-to-back direction (on average by -0.02 mm). A similar minimal influence on LT values was determined by authors who included patients of higher age indicated for senile cataract surgery in their cohort, in whom it was possible to expect only minimal or zero accommodation capacity. By contrast, according to expectations, studies conducted on young patients with preserved accommodation demonstrated significant thinning of the lens due to the influence of AM [10,13,16,19,20,21].

A core part of our study was the examination of the influence of AM on the recommended dioptric value of the PC IOL, calculated with the aid of the SRK/T and Haigis formulas. When we used the SRK/T formula for calculation, no influence of AM on a change of the recommended dioptric values of the PC IOL was demonstrate in any case. These results are to be expected, since no significant changes of the parameters with which the SRK/T formula calculates, i.e. AL and keratometric data, occurred due to the influence of AM. By contrast, upon the use of the Haigis formula the value of the calculated PC IOL before and after AM differed in 9 patients (i.e. 22.5 % of the entire cohort of patients, and always concerned an increase of the dioptric value by +0.5 Dpt. No statistically significant influence of AM was demonstrated on the calculation of PC IOL according to the Haigis formula, although this shift of +0.5 D in a section of the patients can be considered clinically significant, since it influences the resulting postoperative refraction. This increase in the dioptric values in a section of the patients can be explained by the fact that for estimating of the effective lens position (ELP) the Haigis formula uses ACD values, which increased by an average of 0.06 mm due to the influence of mydriasis – this increase of ACD then causes a shift of ELP in the optic system of the eye in a posterior direction. If we target the required refraction at emmetropia, it is necessary to compensate for this posterior shift of ELP upon an unchanged value of AL by increasing the dioptric value of the PC IOL so as to achieve a focalisation of rays directly on the retina. Our results are in accordance with those of other authors who in their studies used 3rd and 4th generation formulas, in which the majority of authors examine the influence of AM using 3rd generation formulas, most often SRK/T, while 4th generation formulas are less widely represented in the studies. Khambhiphant et al. [22] in their study on 373 eyes determined significant differences in the values of ACD after pupil dilation, whereas the values of AL, corneal curvature and calculated PC IOL with the aid of the SRK/T formula did not differ significantly. Teshigawara et al. [23] evaluated the influence of AM on values of ACD, LT and also its influence on the calculation of PC IOL according to 3rd generation (HofferQ, SRK/T) and 4th generation (Haigis, Holladay2) formulas on 162 eyes of patients before cataract surgery. The result was a significant influence of AM on ACD and LT values. Upon the use of 3rd generation formulas there was a change of the dioptric value of the recommended PC IOL only in 1 case (i.e. 0.6 % of patients in the entire cohort), whereas in the case of 4th generation formulas a change occurred in 26 cases (16.0 % of patients in the cohort), thus similar results were produced to those in our study. Rodriguez-Raton et al. [16] evaluated biometric parameters without and with AM in 107 of patients before cataract surgery. They describe zero influence of pupil dilation on AL and a significant influence on ACD. Pupil dilation had no influence on the value of the recommended dioptric value of PC IOL upon the use of the SRK/T formula, and by contrast significantly influenced this value upon the use of the Haigis formula. Similarly, studies by Hegazy [24] (study on 86 eyes), Adler et al. [25] (318 eyes), Bakbak et al. [18] (33 eyes) and Arriola-Villalobos et al. [19] (81 eyes) on patients before cataract surgery did not demonstrate any influence of AM on the calculation of PC IOL with the aid of the SRK/T formula. Arriola-Villalobos et al. furthermore incorporated the 4th generation formula Holladay2 into their study. Unlike our study and the studies by other authors, in which upon the use of 4th generation formulas the recommended PC IOL values were influenced by AM, Arriola-Villalobos et al. demonstrated zero influence of AM on the calculation of PC IOL according to the Holladay2 formula. Their result may be due to the fact that the Holladay formula uses 7 different parameters for the prediction of ELP, including ACD, in which an increase of ACD following mydriasis of the pupil need not have such a significant influence on ELP in the case of the Holladay formula as with the Haigis formula. On the basis of our results and those of other authors, it is possible to assert that pupil dilation upon the use of the SRK/T formula has no influence on the recommended dioptric value of the PC IOL, while by contrast upon use of the Haigis formula, pupil dilation may influence the selection of the PC IOL by increasing the value of ACD.

A certain limitation of our study is the size of the cohort of patients indicated for cataract surgery, which did not enable division of eyes into groups according to AL values into shorter, medium-length and long eyes so as to enable an examination of the influence of AM on the recommended PC IOL value in these individual groups. A further suitable extension of this study would be an evaluation of whether postoperative refractive results obtained by implantation of a PC IOL calculated from biometric data obtained before or after pupil dilation are more optimal.

On the basis of our experience with the instrument Lenstar LS 900 and the experiences of other authors [5,24], it is suitable to note that pupil dilation increases the chance of measuring AL in patients with a dense nuclear and posterior subcapsular cataract. If we therefore do not succeed in performing optical biometry in a patient with such a dense opacity without mydriasis of the pupil, it is possible to try performing optical biometry in AM before we perform biometry with the aid of ultrasound, which in contrast with optical biometry requires greater experience on the part of the examiner and may be burdened with a larger error of measurement.

Whether optical biometry is performed in the given centre without pupil mydriasis or after mydriasis, it is highly appropriate for this centre to conduct a retrospective evaluation of the refractive results in its patients, and for this evaluation to be incorporated in the selection of the most suitable PC IOL for further patients who are still awaiting this surgical procedure.

CONCLUSION

Pharmacological pupil dilation, which is necessary within the framework of ocular examination in patients before cataract surgery, significantly influences certain intraocular parameters measured by optical biometry, and in the case of use of the Haigis formula may influence the recommended dioptric value of the PC IOL. By contrast, upon use of the SRK/T formula, pharmacological pupil dilation does not influence the recommended dioptric value of the PC IOL.

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