



Ultrasound Contact Biometry with and without pupil dilation.

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Purpose: To evaluate the difference in ultrasonic biometric measurements and intraocular lens power calculation before and after pupil dilation.

Methods: In this prospective cohort case series, contact ultrasonic biometry measurements before and after pupil dilation were performed on 118 eyes, at the cataract pre-surgery clinic. The parameters compared were axial length (AL), corneal power (mean K) and the corresponding intraocular lens (IOL) power which was calculated using the SRK/T formula. Paired sample t-test was applied. Confidence interval of 95% with α of 0.05 was taken.

Results: This study found statistically no significant difference in pre- and post-dilation calculated IOL power ($p=0.507$). However, statistically there was significant difference between K-reading, anterior chamber depth, lens thickness and axial lengths ($p<0.008$). Vitreous length did not show any difference on dilatation of pupil ($p=0.051$).

Conclusion: This study demonstrates that there is no statistically and clinically significant effect of pupil dilation on biometry measurements for intraocular lens power calculations using SRK/T formula, though significant changes may be noted in K-reading, anterior chamber depth, lens thickness and axial lengths.



Introduction:

This study will include the comparison of A-scan biometry readings with pupil dilatation and without pupil dilatation and also the intra ocular lens (IOL) power before and after pupil dilatation.

A-scan ultrasound biometry is commonly known as a-scan. A-scan is commonly used diagnostic test which use sound waves of high frequency to give thickness of different tissues. It gives measurement of length of eye and other parameters like central corneal thickness (CCT), lens location and anterior chamber depth (ACD) through which many ocular diseases can be determined as primary angle-closure glaucoma. A-scan is mainly used to calculate the axial length of different structures of eye to determine the power of intraocular lens implant after the cataract removal.¹

Pupil size will be under observation to see its effects on axial length results. By taking values of length of different structures like anterior chamber depth, lens thickness calculation of total axial length of eye ball will be done. After measurement of axial length and corneal power formula will be used to calculate the IOL power.²

Luminance of retina varies with pupil size, size of eye, ocular media transitivity and stimulus luminance. This luminance difference may affect IOL power or not it will be disclose here.³ Tropicamide will be used to dilate the pupil and pupil will be consider as dilated pupil which have 2 mm size difference from normal pupil size.

This study will evaluate axial length of structures like lens, vitreous and will evaluate anterior chamber depth before and after pupil dilatation. This will compare values of both before and after pupil dilatation and analyze the differences and give results on the basis of these differences.

This study will include the measurements of axial length (AL), central corneal thickness (CCT), lens thickness, mean keratometry, corneal diameter, anterior chamber depth (ACD) and pupil diameter.⁴

As many studies have investigated that age factor effects the pupil size so it may be differ from person to person.⁵ It is also observed in a study that pupil size have strong relation with log unit of light intensity.⁶ So for this purpose in this study pupil which has 2.50mm size difference to normal pupil size will be considered as a dilated pupil? Diameter of a dilated pupil increases but not in significant ratio.

Pupil size affected the optical quality of eye. It is observed that eyes with large pupil size show low optical quality then eyes with small pupil even they were astigmatic. Size of pupil was not affected by age, color and refractive error. On the other hand there were strong correlation

between amplitude and peak velocity of constriction for the pupil light reflex in normal subjects which was unaffected by age, stimulus intensity, or size of pupil.⁷

As the pupil size has great correlation with age and moderate correlation with spherical equivalent⁸. So in this study effect of pupil size on keratometry reading will be confirmed.

As the axial length of eye has relationship with other ocular parameters like anterior chamber depth (ASD), CCT, retinal sensitivity and even to retinal nerve fiber layer (RNFL). So here we will observe the effect of pupil size on axial length and that will be helpful to study the status of other parameters according to axial length.^{9,10}

CCT was not associated with refractive error, corneal curvature, anterior chamber depth and axial length. CCT is an independent factor unrelated to other ocular parameters.¹¹

Possible influence of pupillary dilatation on biometry was checked out and parameters like corneal curvature, axial length, Pupil diameter and ACD were under observation. Among these variables only varied significantly according to pupil dilatation were ACD and Pupil diameter. The data revealed very good intra observer correlation between measurements made with pupil dilatation and without pupil dilatation.⁴

The ability to perform accurate biometry with pupillary dilatation can facilitate the efficiency of a cataract service because it can be done on the same day of surgery. study was done to compare the axial length repeatability calculation with dilated pupil compared with undilated pupil. In dilated group there was spread of postoperative refractive errors but clinically and statistically there was no significant difference in postoperative refractive errors between the individuals of two categories.¹²

Accurate biometry and intraocular lens (IOL) power calculations have consequence in patient satisfaction and depend on correct determination of eye length, IOL position, refractive power of the cornea, and selection of the proper IOL formula. Having correct knowledge about these variables will make it easier to achieve correct and satisfactory results in both the normal eyes and eyes that have had previous surgeries, including keratorefractive procedures.¹³

Statistically Extraction of cataract is now routinely followed by the intra ocular lens implant. This requires biometry preoperatively. Study was undertaken to observe the accuracy of axial length measurement with pupil dilatation. There was no significant difference in



measurement with and without pupil dilatation. Biometry on dilated pupil can give accurate results so it is suggested that biometry performed on pupil dilatation and following ocular assessment may prove as an efficient and time saving activity.¹⁴ It is also important to know that no significant change in axial length is noted before and after cataract surgery.¹⁵

Value of flare decrease after pupil dilatation and remain constant. Anterior chamber width was significantly increased and it remains in this state until pupil goes into its normal state. Mean Pupil diameter also increased after dilation but these changes were not significant.¹⁶

It was studied that which factors have relation with mesopic pupil size and it analyzed that mesopic pupil size had strong correlation with age and moderate correlation with spherical equivalent. Pachymetry and keratometry had weak correlation which is statistically significant but clinically it was insignificant.⁸

Axial length has more effect on IOL power calculation than corneal curvature or keratometry readings but both of these factors effect IOL power calculation and error in one of these values will also affect IOL power and other biometry reading.¹⁷

Pupil dilation not highly effects the biometry reading but it produce somehow accuracy in results of biometry and also produce ease for patients and medical technologist.¹⁴

Accurate biometry and preoperative calculation of intraocular lens power are indispensable procedures in obtaining optimal post-operative results in patients subjected to intraocular lens implantation.¹⁸

Aims & Objectives:

These were to evaluate the effect of pupil size on readings of biometry, to evaluate the effect of pupil size on IOL power, to evaluate the effect of pupil dilation on axial length and to evaluate the effect of pupil dilation on corneal curvature.

Materials and Methods:

Cooperative patients of age group 15-35 years with normal, emmetrope, phakic eyes were taken. Dependent variables were axial length (measured in millimeters), anterior chamber depth (mm), pupil diameter and IOL power. Independent variables were pupil diameter, age, gender, laterality and keratometry. Place of study was pre-surgical evaluation room for cataract surgery in College of Ophthalmology and Allied Vision Sciences, Mayo hospital, Lahore, Pakistan. The study was performed in three months from June to August, 2014. Sampling method was non-probability purpose and convenient sampling. Total 60 individuals with 119 eyes were included in the study. The study design was cohort analytic. Data collection was done with self-made pro forma. Data was analyzed using SPSS v20 software. Main test used was paired sample t-test. Quantitative variables like age will be described in mean and standard deviation. Qualitative variables will be expressed in frequencies and percentages.

Results:

The results of the study are tabulated in table 1 and 2 and their p-values are mentioned accordingly. Scatter plot of final calculation for IOL without and with dilaltion is shown in figure 1. The R2 value of this correlation was 0.596.

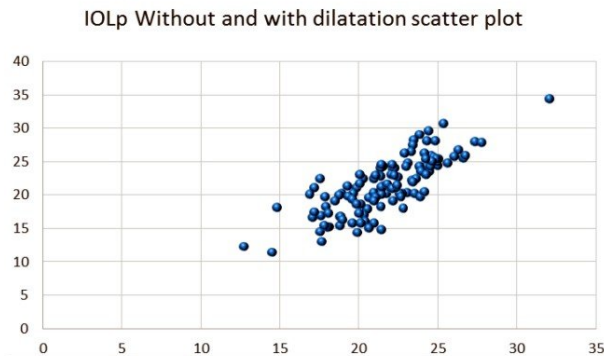
Table 1. Descriptive data of ocular biometry parameters without and with pupil dilatation.

	Dilatation	N	Mean	Standard Error	Std. Deviation	Minimum	Maximum	p-Value
K - reading (mm)	No	118	7.4932	.02613	.28387	6.75	8.18	0.003
	Yes	118	7.5721	.04037	.43849	6.58	8.85	
ACD	No	118	3.9993	.02894	.31441	3.18	4.99	0.000
	Yes	118	4.3846	.04867	.52866	3.22	5.83	
Lens Thickness	No	118	4.6981	.08183	.88890	2.96	8.06	0.002
	Yes	118	4.6047	.08732	.94849	2.46	7.20	
Vitreous	No	118	13.6053	.06921	.75184	11.56	15.32	0.051
	Yes	118	13.5153	.07670	.83312	11.21	15.72	
Axial length	No	118	22.3026	.11283	1.22565	18.24	25.36	0.007
	Yes	118	22.5047	.13072	1.42000	17.60	25.99	
IOL power	No	118	21.6489	.29542	3.20909	14.01	30.45	0.507
	Yes	118	21.4914	.37166	4.03726	11.09	32.93	



		Mean	Std. Deviation	Std. Error	Confidence Interval		p - Value
					Lower	Upper	
Pair 1	K - reading (WOD&WD)	-.07890	.28491	.02623	-.13084	-.02696	.003
Pair 2	ACD (WOD&WD)	-.38525	.42734	.03934	-.46316	-.30734	.000
Pair 3	Lens Thickness (WOD&WD)	.09331	.32176	.02962	.03464	.15197	.002
Pair 4	Vitreous (WOD&WD)	.08992	.49611	.04567	-.00053	.18036	.051
Pair 5	Axial Length (WOD&WD)	-.20203	.80009	.07365	-.34790	-.05616	.007
Pair 6	IOL power (WOD&WD)	.15746	2.56909	.23650	-.31092	.62584	.507

Table 2. Analysis of paired data.



WOD = without dilatation of pupil. WD = with dilated pupil.

Figure . Scatter plot between IOL power with (x axis) and without (y axis) pupil dilatation. R^2 linear = 0.596.

Discussion:

It's important to know that there are many factors that affect normal function of eyes. One of them is cataract. Before performing cataract surgery biometry of effected eye is done to calculate IOL power.^{14,19} Axial length and corneal curvature are main factor that affect the biometric readings. Change in Axial length may largely affect the biometric results of IOL.¹⁷

Corneal curvature and formulas are also very important factors that effects IOL power calculations.¹⁹ Biometry may be performed without pupil dilation and with pupil dilation. As pupil size can affect the anterior chamber depth. To see effect of pupil size on biometric measurements this study includes difference in biometric measurements before and after pupil dilation.^{20,21}

Axial length is very important factor not only for

biometry but for many other functions of eye as retina and others structures of eye.^{22,23} Axial length can also affect refractive status, optic disc parameters of eye and accommodation may affect axial length.^{24,25}

Axial length may affect refractive error and IOL calculations. It is very important in IOL power calculation. A little change to axial length may change the IOL power at large scale.¹⁸

Correct Intra ocular lens power calculation is very important in cataract surgery otherwise this may result in dissatisfied patient and may embarrass surgeon after surgery. So while calculating IOL power, it is very important to take care about all factors and there accuracy that can affect IOL power to prevent any complication in future.²⁶

It is important to know that as axial length, corneal curvature is also very important factor to biometric reading. Change in corneal curvature also affect biometric reading so to perform accurate biometry and to calculate accurate and comfortable IOL power it is very important to take accurate corneal curvature and not to ignore its accuracy at all. This not only affects the IOL power but many other function of eye as refractive status etc.²⁷

This study is mainly to calculate the effect of pupil size or pupillary dilation on all the factors affection IOL power calculation and also on final IOL power calculated by summing up of all these factors and using formula.

Pupil size may affect many functions of eye as pupil size affect anterior chamber depth, refractive status of eye and many other eye functions and structures.²⁸

This is very important to know that pupil size has no significant correlated with glare and halo symptoms. Pupil



size may be effected by many environmental factors like hypergravity etc.²⁹

Many other studies were also read to take important contents and material which help us to complete and compile healthy and acceptable results of our study. As axial length and corneal curvature effect many structures and visual function of eye so they are the main factors to calculate IOL power so any change in both of them will change the IOL power at large scale.³⁰

Many previous studies resulted that there is no significant difference in axial length and corneal curvature before and after pupil dilation so these are the factors that can affect IOL power so there was no change in IOL power calculation before and after pupil dilation.¹⁹

All the studies discussed the basic idea of no change in IOL power before and after pupil dilation and no effect of pupil size on axial length and corneal curvature.

Conclusion:

This study concluded that there is no effect of pupil size on calculations for IOL power to be implanted during cataract surgery.

IOL power calculated before and after pupil dilation was strongly correlated with R^2 of 0.596 and there was no significant difference in reading before and after pupil dilation.

Recommendations:

It is recommended that biometry done either with pupil dilation or without pupil dilation will give same results so in both conditions result will consider correct and approved. However, significant changes can be found in other parameters but collectively they does not affect the final calculation of IOL power.

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