Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.47750/jptcp.2023.30.04.016

The Effect of Capsulorhexis Size On Changes In The Anterior Chamber Depth And Iridocorneal Angle In Post Phacoemulsification Patient With Intraocular Lens Implantation

Mentari Nurul Mutmainnah[1,2], Purnamanita Syawal[1,2], Hamzah[1,2,3], Andi Alfian Zainuddin[2,4], Muhammad Abrar Ismail[1,2,3]

[1]Ophthalmology Department, Faculty of Medicine, Hasanuddin University, Makassar 90245, Indonesia

[2]Hasanuddin University Hospital, Makassar 90245, Indonesia

[3]JEC Orbita, Makassar 90222, Indonesia

[4]Public Health Medicine Department, Faculty of Medicine, Hasanuddin University, Makassar 90245, Indonesia

***Corresponding author:** Mentari Nurul Mutmainnah, Ophthalmology Department, Faculty of Medicine, Hasanuddin University, Makassar 90245, Indonesia, Email: tarinurul05@gmail.com

Submitted: 15 January 2023; Accepted: 13 February 2023; Published: 11 March 2023

ABSTRACT

Introduction: In several studies stated that cataract surgery is the most common surgical procedure performed in daily medical practice throughout the world. The success of cataract surgery is greatly influenced by several factors including continuous curvilinear capsulorhexis. From the existing literature to date, not much has been studied about the effect of capsular hexis size on components of the anterior segment of the eyeball such as BMD and iridocorneal angle in patients who have undergone phacoemulsification surgery, for this reason researchers are interested in researching it.

Methodology: This study was conducted on 88 patients with aged related cataracts who underwent phacoemulsification surgery with intraocular lens implantation using consecutive sampling. Divided into two groups with small and large capsulorhexis sizes. Changes in anterior chamber depth and iridocorneal angle before and after surgery were compared between groups.

Results: In the comparison of the two groups there was a significant difference in the average anterior chamber depth between before and after surgery with $p < 0.001$, but the results of comparison of anterior chamber depth between groups did not obtain significant results with $p = 0.573$ ($p > 0, 05$). For the iridiocorneal angle, there were also significant differences on the nasal and temporal sides before and after with $p < 0.05$, but the comparison between groups of small rhexis diameter and large changes in the iridocorneal angle was not significant with $p > 0.05$.

Conclusion: Phacoemulsification surgery with a large rhexis diameter resulted in a shallower chamber depth and narrower iridocorneal angle when compared to patients with a smaller rhexis diameter although it was not statistically significant

Keywords: *Public Service Innovations, Services, Community, GOMT Application*

INTRODUCTION

In several studies stated that cataract surgery is the most common surgical procedure performed in daily medical practice throughout the world. Therefore, it is hoped that the surgical procedures carried out will be more effective with predictable results. (Engren, 2013). Therefore a competent biometric analysis must be carried out before cataract surgery, these components include the axial length of the eyeball, the keratometer and the depth of the anterior chamber. From the measurement results of these components, the refractive error that will occur postoperatively can be estimated by the operator (Lee, 2017)

As found in several studies that there are changes that occur in optical parameters after cataract surgery, including the phacoemulsification procedure. (Dhamankar, 2018) The components that can change after cataract surgery accompanied by the installation of an intraocular lens are the depth of the anterior chamber, iridocorneal angle and intraocular pressure (Zoo, 2020).

Although several studies have found that cataract surgery and intraocular implantation cause clinically proven changes in the anterior chamber and iridocorneal angle, the quantification of these changes is limited by the availability of instruments to assess them (Uchakan, 2008).

In addition to entering the eye chamber with an iridocorneal angle, it also has an important role in postoperative patients, especially for assessing the occurrence of glaucoma in patients. The measurement method used widely to evaluate these parameters is by using goniscopies. However, this method is highly dependent on the visibility of the tissue being evaluated against the iridocorneal angle view. And quantitatively at this time the iridocorneal angle can be evaluated using OCT, UBM and pentacam. This quantitative evaluation will provide important information to eye doctors, especially in glaucoma conditions (Doganay, 2010).

The success of cataract surgery is greatly influenced by several factors, including the stages of surgery carried out according to standards. The continuous curvilinear capsulorhexis technique is one of the important component stages in cataract surgery, where the results of good and precise actions will affect the position of the intraocular lens which is related to the results of the operation and complications that can occur after cataract surgery. Because the position of the IOL is very important in supporting the results of the operation, it is hoped that with a good shape, concentration, capsulorehxis size it will support IOL stability, by forming capsular-optic margin overlap. (Bang, 2019) Cystotome and forceps are instruments that are often used in the capsulorhexis stage. The advantage of using a cystotome when making capsulorhexis compared to forceps is that it reduces the risk of forgetting the part of the cornea, a good picture on the capsulorhexis side, and reduces the risk of loss of viscoelasticity during intraoperative time (Zeng, 2015).

Refrative shock after cataract surgery including phacoemulsification with a change of approximately more than 1.0 diopters (D) from the target refraction has been determined to occur. Several things cause the condition to be inaccurate in biometric measurements and a change in IOL position. The position of the IOL besides affecting the results of postoperative refraction can also affect changes in the anterior chamber and iridocorneal angle. Changes in IOL position can be affected by the ability of IOL fixation, type of IOL, and capsulorhexis construction (Kim, 2001). Changes in the depth of the anterior chamber and the iridocorneal angle will cause deviation in the target refraction and postoperative refraction results (Matthias, 2004). A study conducted by Ning stated that if there is a change of every 1 mm in the anterior chamber, there will be at least a refractive shift of about 0.32D after cataract surgery. It was also found that the depth of the anterior chamber can be a predictive factor for refractive error after cataract surgery. It is stated that subjects with shallow BMD tend to experience myopic shift postoperatively, whereas deep BMD tends to experience hyperopic shift (Ning, 2019). In addition to BMD, the iridocorneal angle can also be a predictor of unexpected refractive errors after cataract surgery, where if in preoperative conditions a narrow iridocorneal angle is found, then after surgery the risk of unexpected myopic errors is more likely to occur (Lee, 2017).

From the existing literature to date, not much has been studied about the effect of capsular hexis size on components of the anterior segment of the eyeball such as BMD and iridocorneal angle in patients who have undergone phacoemulsification surgery, for this reason researchers are interested in researching it.

The aim of this study was to evaluate the stability of the anterior chamber and iridocorneal angle in patients with small and large rhexis.

METHODS

This study is a prospective cohort that evaluates the effect of rhexis size on anterior chamber depth and iridocorneal angle in postoperative phacoemulsification patients with intraocular lens implantation. This research was conducted at JEC Orbita Makassar City. The study time was 3 months from November 2022-January 2023. The population used in this study were patients with age-related cataracts who were treated at JEC Orbita Makassar. The sample in this study is the research population that meets the inclusion criteria. Patients were divided into two sample groups. Group 1 were patients who underwent capsulotomy with small rhexis sizes and group 2 were patients with large rhexis sizes. This research has met the ethical requirements to be carried out from the ethical commission for human health research, Faculty of Medicine, Hasanuddin University number: 500.UN4.6.5.31/PP36/2022. The patient underwent phacoemulsification surgery with intraocular lens implantation in the bag with an optical lens diameter of 6.00 mm and an overall length of 12.50 mm. The capsulorhexis method used is CCC using a modified 3-bend cystotome and utrata forceps. Measurement of the anterior chamber and iridocorneal angle using AS-OCT was performed before surgery and seven days after surgery.

Subject inclusion criteria were patients diagnosed with grade II-V (Burrato Grading) cataracts, the axial length of the eyeball was normal, patients underwent phacoemulsification surgery without complications accompanied by the installation of an intraocular lens with the type of foldable IOL in the bag, anterior chamber and iridocorneal angle. evaluated with AS OCT, and the patient or patient's family agreed to be included in the study and signed an informed consent form.

Subject exclusion criteria were patients who had a history of intraocular inflammation, suffered from glaucoma, had other underlying diseases (comorbids) and had a history of ocular trauma.

The data that has been obtained will be recorded and analyzed using statistical software SPSS (Statistical Packages for Social Science). The results obtained will be displayed in narrative form supplemented by tables or graphs. A p value of less than 0.05 was considered significant.

RESULTS AND DISCUSSION

This study was conducted on 88 patients with age-related cataracts who were treated at JEC Orbita Makassar who were over 50 years old. The research subjects were divided into two groups based on the diameter of the rhexis, namely the diameter of the small rhexis measuring 5 mm and the diameter of the large rhexis measuring 6 mm. The general characteristics of the research subjects and the comparison of the characteristics of the research subjects based on the rhexis diameter are presented in Table 1.

TABLE 1. Distribution of General Characteristics of the Research Sample

Characteristic	Diameter Rhexis				Total		p
	Small (n=43)		Big (n=45)				
	n	%	n	%	n	%	
Age (63.77 ± 8.23 years)							
51-64 years	23	53,5	21	46,7	44	50	0,522
≥ 65 years	20	46,5	24	53,3	44	50	
Gender							
Man	20	46,5	29	64,4	49	55,7	0,090
Woman	23	53,5	16	35,6	39	44,3	
Cataract grade							
2	2	4,7	0	0,0	2	2,3	0,000
3	37	86,0	6	13,3	43	48,9	

4	4	9,3	33	73,7	37	42,0	
5	0	0,0	6	13,3	6	6,8	

Description: chi-square test

In this study, 43 patients (48.9%) had small rhexis diameter and 45 patients (51.1%) had large rhexis diameter. The subjects of this study had an average age of 63.77 ± 8.23 years where research subjects aged 51-64 years and ≥ 65 years had the same proportion. Most of the subjects in this study were male (55.7%) and grade 3 cataracts (48.9%).

Comparison of the characteristics of the study subjects based on the diameter of the rhexis showed that the small rhexis diameter was mostly 51-64 years old (53.5%), while the large rhexis diameter was mostly ≥ 65 years old (53.3%). The results of statistical tests showed that the two groups of rhexis diameter did not differ significantly based on the patient's age with p = 0.522 (p > 0.05).

Based on gender, in the small rhexis diameter group most of the study subjects were women (53.5%), while in the large rhexis diameter group most of the study subjects were men (64.4%). The results of statistical tests showed that the two groups of rhexis diameter did not differ significantly based on the sex of the patient with p = 0.090 (p > 0.05).

Based on cataract grade, in the small and large rhexis diameter group, most of the study subjects had grade 3. The results of statistical tests showed that the two rhexis diameter groups differed significantly based on cataract grade with p = 0.000 (p <0.05).

The results of the characteristics of the study subjects showed that between the small rhexis diameter group and the small rhexis diameter group there were significant differences based on grade, but not on age and sex. Thus, the subjects of this study were homogeneous based on age and sex, but not homogeneous based on cataract grade.

Comparison of the depth of the anterior chamber based on the diameter of the rhexis both before and before the phacoemulsification operation is presented in Table 2.

TABLE 2. Comparison of the depth of the anterior chamber before and after phacoemulsification operations based on rhexis diameter.

Operation	Group	n	Min	Max	Mean ± SD	p
Before surgery	Smallh R	43	1,98	3,56	2.74 ± 0.39	0,199
	Rbig hexis	45	1,71	3,57	2.63 ± 0.39	
After surgery	Smallh R	43	2,43	3,71	3.16 ± 0.24	0.018*a
	Rbig hexis	45	2,41	3,62	3.01 ± 0.31	

Description: Independent sample t test

Table 2 shows that before the phacoemulsification operation, the average anterior chamber depth in the large rhexis diameter group was 2.63 ± 0.39 which was shallower than the small rhexis diameter group of 2.74 ± 0.39.

The results of statistical tests showed that there was no significant difference in the depth of the anterior chamber based on the diameter of the rhexis before the phacoemulsification operation with p > 0.05. Table 2 shows that after the phacoemulsification operation, the average anterior chamber depth in the large rhexis diameter group was 3.01 ± 0.31 which was shallower than the small rhexis diameter group of 3.16 ± 0.24. Statistical test results showed that there was a significant difference in anterior chamber depth based on rhexis diameter after phacoemulsification operation with p <0.05.

Comparison of the iridocorneal angle based on the rhexis diameter both before and before the phacoemulsification operation is presented in Table 3.

TABLE 3. Comparison of iridocorneal angles before and after phacoemulsification operations based on rhexis diameter

Operation	Group	n	Min	Max	Mean ± SD	p
Angle of nasal iridocornea						
Before surgery	Small rhexis	43	17,00	44,00	31.18 ± 7.49	0,595
	Large rhexis	45	19,00	44,00	30.40 ± 6.28	
After surgery	Small rhexis	43	26,00	48,00	34.91 ± 5.62	0.066b
	Large rhexis	45	25,00	47,00	32.73 ± 5.81	
Angle of temporal iridocornea						
Before surgery	Small rhexis	43	18,00	42,00	30.86 ± 7.16	0,611
	Large rhexis	45	19,00	43,00	30.13 ±6.19	
After surgery	Small rhexis	43	27,00	48,00	35.46 ± 5.66	0.035*b
	Large rhexis	45	24,00	47,00	32.84 ± 5.76	

Description: aIndependent sample t test; b Mann-Whitney test, *Significant at $p < 0.05$.

Table 3 shows that before the phacoemulsification operation, the average nasal and temporal iridocorneal angles in the large rhexis diameter group were narrower than those in the small rhexis diameter group. The results of statistical tests showed that there was no significant difference in the angle of the nasal or temporal iridocornea based on the diameter of the rhexis before the phacoemulsification operation with $p > 0.05$.

After the phacoemulsification operation, the average nasal iridocorneal angle in the large rhexis diameter group was 32.73 ± 5.81 which was narrower than that in the small rhexis diameter group of 34.91 ± 5.62. The results of statistical tests showed that there was no significant difference in the angle of the nasal iridocornea based on the diameter of the rhexis after the phacoemulsification operation with $p > 0.05$.

After the phacoemulsification operation, the average temporal iridocorneal angle in the large rhexis diameter group was 32.84 ± 5.76 which was narrower than that in the small rhexis diameter group of 35.46 ± 5.66. The results of statistical tests showed that there was a significant difference in the temporal iridocorneal angle based on the rhexis diameter after the phacoemulsification operation with $p <0.05$.

Changes in chamber depth and iridocorneal angle were tested between before and after phacoemulsification operations based on each rhexis diameter. This study also made a comparison of changes in chamber depth and iridocorneal angle after phacoemulsification surgery based on rhexis diameter which is presented in Table 4.

TABLE 4. Test results for changes in chamber depth based on rhexis diameter after phacoemulsification surgery

Rhexis diameter	Front Eye Chamber				pb
	Before surgery	After surgery	pa	ΔMean ± SD	
	Mean ± SD	Mean ± SD			
Small rhexis	2.74 ± 0.39	3.16 ± 0.24	0,000**	0.43 ± 0.32	0,573
Large rhexis	2.63 ± 0.39	3.01 ± 0.31	0,000**	0.39 ± 0.29	

Description: aPaired sample t test; b test Independent sample t test; **Significant at $p < 0.001$; *Significant at $p < 0.05$.

Table 4 shows that at small rhexis diameters, there was a significant difference in the average anterior chamber depth between before and after the phacoemulsification operation with $p <0.001$. The large rhexis diameter showed that there was a significant difference in the average anterior chamber depth between before and after the phacoemulsification operation with p <0.001. In the small rhexis diameter, there was an increase in the depth of the anterior chamber after phacoemulsification operations on average by 0.43 ± 0.32 which was greater than the large rhexis diameter with an average of 0.39 ± 0.29. However, the results of the comparison of changes in anterior chamber depth after phacoemulsification surgery between the small and large diameter rhexis groups showed insignificant results with p = 0.573 (p > 0.05).

TABLE 5. Test results for changes in nasal and temporal iridocorneal angles based on rhexis diameter after phacoemulsification surgery.

Rhexis diameter	Before surgery	After surgery	pa	ΔMean ± SD	pb
	Mean ± SD	Mean ± SD			
Angle of Nasal Iridochronea					
Small rhexis	31.19 ± 7.49	34.91 ± 5.61	0,001*	3.72 ± 7.00	0,331
Large rhexis	30.40 ± 6.28	32.73 ± 5.81	0,066	2.33 ± 6.29	
Angle of the Temporal Iridocheroea					
Small rhexis	30.86 ± 7.16	35.46 ± 5.66	0,000**	4.60 ± 0.89	0,143
Large rhexis	30.13 ± 6.19	32.84 ± 5.76	0,035*	2.71 ± 6.17	

Description: aPaired sample t test; b test Independent sample t test; **Significant at p < 0.001;

*Significant at p < 0.05.

Table 5 shows that at small rhexis diameters, there was a significant difference in the average nasal iridocorneal angle between before and after the phacoemulsification operation with p <0.05. The large rhexis diameter showed that there was no significant difference in the average nasal angle of the iridocorneal angle between before and after the phacoemulsification operation with p > 0.05. In small rhexis diameter, the iridocorneal angle widening on the nasal side after phacoemulsification operation was an average of 3.72 ± 7.00 which was larger than that of large rhexis with an average of 2.33 ± 6.29. However, the results of the comparison of changes in the nasal angle of the iridocorneal angle after phacoemulsification surgery between the small and large rhexis diameter groups showed no significant results with p = 0.331 (p > 0.05).

In the small rhexis diameter, there was a significant difference in the average temporal angle of the iridocorneal angle between before and after the phacoemulsification operation with p <0.001. The large rhexis diameter showed that there was a significant difference in the average temporal angle of the iridocorneal angle between before and after the phacoemulsification operation with p <0.05. The small rhexis diameter widened the temporal side of the iridocorneal angle after the phacoemulsification operation with an average of 4.60 ± 0.89 which was larger than the large rhexis diameter with an average of 2.71 ± 6.17. However, the results of the comparison of changes in the temporal iridocorneal angle after phacoemulsification surgery between the small and large rhexis diameter groups showed no significant results with p = 0.143 (p > 0.05)

This study was conducted on age-related cataract patients where an average age characteristic was 63.77 ± 8.23 years, most were male (55.7%) and 48.9% had grade 3 cataracts. This trend was also found by Salsabila and Nasrul, the majority of patients with cataracts are male patients with an age group of more than 56 years in the senile cataract population in NTB. (Salsabila, 2021) In contrast to studies in Sweden reporting that risk factors for cataracts are age > 70 years, female sex and myopia (Hugossona and Ekstrom, 2020). A retrospective cohort study of 1,632 cataract surgeries performed from 2007 to 2010 obtained from the cataract register of the Malaysian National Eye Database showed that the mean patient age was 66.9 years with equal sex distribution between males and females (Thanigasalam et al., 2015).

Age was found to be a major risk factor for developing cataracts in both men and women. This can be explained in relation to the presence of oxidative stress that has accumulated in lens proteins over the years. Based on gender, it was reported that women have a higher risk of cataracts than men, which is related to the role of estrogen in protecting the lens from oxidative stress. A decrease in estrogen levels after menopause will increase the risk of cataracts (Hugossona and Ekstrom, 2020). Estrogen exerts anti-aging effects including metabolic beneficial effects, neuroprotection, telomere preservation, and anti-oxidative properties. There is protection by physiological concentrations of 17b-estradiol against H2O2-induced oxidative stress in lens epithelial cells. Estrogen-mediated protection of the lens is exerted via a non-genomic, ie, receptor-independent mechanism, possibly through extracellular phosphorylation of signal-regulated kinases (ERK1/ERK2), members of the mitogen-activated protein kinase (MAPK) signaling pathway (Zetterberg and Celojevic, 2014). In addition, it can be explained that lens changes can function as a marker of aging. Glutathione (GSH) levels, one of the most important antioxidant agents of the lens, are found to be much higher outside the cortical fiber cells where GSH is synthesized. With increasing age, the percentage of oxidized GSH in the nucleus increases, making it more susceptible to oxidation (Song et al., 2014).

In this study, more patients with age-related cataracts who underwent surgery were found to be male than female. This can be related to the scope of cataract surgery. Women may hide their pain and feel embarrassed asking for family support, whereas men tend to express a strong desire for better eyesight. In some cases, women do not perceive cataracts as a disease or surgery as a necessity. A study conducted in the United States revealed that 20% to 29% of women aged 40 and over with eye disease were unaware of any reason to seek eye care, which is the second major barrier to eye surgery coverage after cost. Cataract surgery coverage is stated to be a problem in most regions of the world, especially for the female population (Lou et al., 2018).

With regard to surgery, the effectiveness of phacoemulsification in increasing visual acuity was found to be similar between men and women (Mahayana et al., 2018). Cataract surgery is the most common intraocular surgery performed worldwide and has advanced technically in recent years. Phacoemulsification has been reported to result in fewer complications and better visual outcomes. Gender and age, causes of cataracts, systemic comorbidities and surgeon's grade did not affect the improvement of vision after phacoemulsification surgery (Thanigasalam et al., 2015).

In this study, it was found that the phacoemulsification operation significantly increased the depth of the anterior chamber. This result is in line with the study of Huang et al. (2011) in his research to determine the relationship between changes in anterior chamber angle and anterior chamber depth with decreased intraocular pressure after uncomplicated phacoemulsification with the result that anterior chamber depth increased from 2.23 mm to 3.75 mm after 6 months of phacoemulsification surgery with IOL implantation. Similar results were reported by Altan et al. (2004) that in a nonglaucomatous eye with a wide open iridocorneal angle preoperatively, smooth phacoemulsification reduced IOP and increased anterior chamber depth significantly over 6 months. Phacoemulsification and intraocular lens (IOL) implantation in noglaucomatous patients with cataracts were also reported to decrease intraocular pressure (IOP) and increase anterior chamber depth from 3.1 ± 0.8 mm to 3.8 ± 0.8 mm (after 1 month). post operation.

Several studies have also revealed that the depth of the anterior eye has an important role in postoperative refractive errors. Where in addition to the anterior chamber, several ocular parameters including the length of the eyeball axis, lens thickness, the IOL formula used, and the position of IOL implantation also have an influence on postoperative refractive errors. It is also said that the effective lens position can also give an idea of the possibility of IOL deviation which will lead to refractive errors in the form of myopia or hyperopia, where one of the important indicators for estimating the effective lens position after surgery is the depth of the anterior chamber. (which is 2019)

In a study conducted by Fallah et al stated that the tendency to increase depth in BMD often causes myopic shift, whereas in shallower BMD conditions postoperative hyperopic shift will occur (Fallah, 2017). However, it should be remembered that the magnitude of changes in the anterior chamber can also be affected by the depth of the preoperative chamber, in deep anterior chamber conditions before surgery the increase in the depth of the eye chamber tends to be less than in shallower eye chamber conditions. In addition, according to Muzyka, the axial length of the eyeball can also affect the condition of the depth of the anterior chamber after surgery, relative changes in the anterior chamber tend to have a greater chance in the condition of patients with short eyeball axis length (57%) compared to normal eyes (44%) or long axial eyeball length (42%). (Muzyka, 2016).

Phacoemulsification surgery in primary filtered angle closure glaucoma patients was also reported to increase anterior chamber depth from 2.082 ± 0.244 to 3.673 ± 0.222 mm after 3 months postoperatively (Hussein et al., 2020). Phacoemulsification and IOL implantation have also been reported to reduce IOP and improve vision in eyes with medically uncontrolled primary angle closure glaucoma. The mechanisms underlying the results observed after surgery are related to increased anterior chamber depth, widened drainage angle, and increased aqueous outflow into the trabecular meshwork (Zuo et al., 2020).

The depth of the anterior chamber will affect the optical system in the eyeball, besides that the clinical pathological conditions of the anterior chamber will give an overview of abnormalities in the angle of the chamber. The anterior chamber is a space filled with aqueous humor in the eye, located between the iris and the innermost surface of the cornea. The aqueous humor is a clear liquid that fills the anterior chamber. The anterior chamber depth decreases below 2.5 mm, the risk of angle closure glaucoma increases (Rufer, 2010).

Simple phacoemulsification cataract surgery can significantly increase anterior chamber depth and by decreasing intraocular pressure. The phacoemulsification operation resulted in a decrease in lens thickness and significantly altered the anterior chamber depth. Several studies have interpreted the mechanisms of phacoemulsification and reduced intraocular pressure, including disengagement of pupillary block, posterior displacement of the iris-lens diaphragm, widening of the anterior chamber angle, and re-opening of the peripheral anterior synechiae. In addition, the active expansion and retraction of the trabecular meshwork with intraocular pressure causes various fluctuations, including blinking and eye movements. The combined Schlemm tube within the valve forms a mechanical aqueous drainage pump system, which provides stable short-term and long-term regulation of intraocular pressure. With Schlemm meshwork and trabecular tube ossification, the aqueous drainage pump gradually fails so that the amount of fluid that pulses into the aqueous vein decreases. The lens gradually thickens (Hafez, 2020).

Phacoemulsification has also been reported to release endogenous prostaglandin F2 so as to increase uveoscleral outflow. Theoretically, postoperative shrinkage of the lens capsule can lead to increased posterior traction on the scleral spur, expanding the trabecular meshwork and canal lumen (Huang et al., 2011). Phacoemulsification can relieve pupillary occlusion and reduce the angle of crowding caused by the thickened, anteriorly located lens. Mechanical deepening of the anterior chamber with viscoelastic infusion and saline during phacoemulsification (Zuo et al., 2020).

In this study, phacoemulsification surgery significantly widened the nasal and temporal iridocorneal angles. Similar results were reported by Altan et al. (2004) that in nonglaucomatous eyes with an open iridocorneal angle before surgery, phacoemulsification that proceeds smoothly at the time of surgery will reduce IOP and increase the width of the iridocorneal angle significantly for 6 months. Cataract surgery with IOL implantation can cause anterior chamber changes in normal and glaucoma patients. Modern cataract surgery is stated to provide a decrease in postoperative intraocular pressure, this is related to the extraction of the natural lens which will then increase the volume and depth of the anterior chamber, accompanied by a widening of the angle between the iris and the cornea, and the finding of the iris which will tend to point backwards (Dadaci, 2015).

The iridocorneal angle is an important component in determining the diagnosis of glaucoma (Rufer, 2010). In postoperative patients, widening of the iridocorneal angle and decreased intraocular pressure are conditions that are often encountered both in patients with glaucoma disorders and in patients with normal eye conditions (Altan, 2004). Evaluation of the morphology of the irido-corneal angle, especially using AS-OCT, reported that all indicators of the iridocorneal angle would increase after lens extraction in all subjects, especially in patients with Asian race. After cataract extraction and replacing crystalline lenses with intraocular implants whose thickness is thinner, the iris will be located further back which will then widen the anterior chamber and the irido-corneal angle (Vu et al., 2019). Another study reported that the preoperative convex iris shape changes to a flat shape after cataract extraction due to posterior movement of the iris with an increase in anterior chamber depth and also posterior displacement of the iris base after lens removal causes widening of the iridocorneal angle (Hussein et al., 2020).

In this study, the increase in chamber depth and nasal and temporal iridocorneal angles after phacoemulsification surgery was not significantly different based on rhexis size. Nonetheless, increased chamber depth and right and left iridocorneal angles were more common in small rhexis diameters. This means that the impact of phacoemulsification surgery on the eye chamber and iridocorneal angle is more common in small rhexis diameter than large rhexis diameter. This means that the size of the rhexis is inversely related to the increase in anterior chamber depth and iridocorneal angle, although it is not significant.

In previous studies it was reported that decreased IOP was associated with increased anterior chamber depth and iridocorneal angle. Previous studies suggest that there is an inverse relationship between capsulorhexis size and the amount of IOP reduction. Those with small capsulorhexis sizes tend to have lower IOP than subjects with larger rhexis sizes. Capsular fibrosis after cataract surgery causes centripetal traction on the ciliary processes and reduces aqueous humor secretion to some extent. After surgery, prostaglandin F2x increases facilitation of flow through the uveoscleral pathway and PGE enhances it through the trabecular meshwork. Improvement in the uveoscleral pathway contributes to the reduction in IOP after cataract surgery in nonglaucomatous eyes with preoperative open angles. The reduction in IOP following successful phacoemulsification procedures in several studies is multifactorial. We suggest that reduced aqueous humor secretion, increased uveoscleral outflow, or both are important mechanisms in increasing conventional trabecular outflow (Altan et al., 2004).

Postoperative refractive shock with a change of approximately more than 1.0 diopters (D) from the defined refractive target is likely to occur. Several things cause this condition, including inaccuracy in biometric measurements, another condition, namely a change in IOL position. The position of the IOL besides affecting the results of postoperative refraction can also affect changes in the anterior chamber. Changes in the depth of the anterior chamber will cause deviation in the refractive target and postoperative refractive conditions. Changes in IOL position can be influenced by several factors including IOL design, IOL material, and the size of the intraoperative capsulorhexis. The condition of the axial IOL shifts anteriorly causing myopic shift and posteriorly causing hyperopic shift. And according to the results of a study by Matthias, the single piece IOL type was found to be more stable, minimizing the incidence of axial shift, with a more stable BMD condition. (Matthias, 2004).

With regard to rhexis size, it has been reported that a small rhexis 4.5 to 5.0 mm, which lies overlapping with the optic portion of a 5.5 mm intraocular lens (IOL), and a large rhexis 6.0 to 7.0 mm, which lies not Ovelaping of the lens optic, otherwise a small rhexis would be more effective in preventing the development of posterior capsule opacities. In addition, the size of the small rhexis is associated with less occurrence of wrinkling of the posterior capsule than the large rhexis (Aykan et al., 2003). The rhexis is small in diameter, centrally located and regular in shape resulting in less posterior capsule opacification after phacoemulsification. When the capsulorhexis rim is regular, the disintegrating force acting on the lens capsule is the same, and much less fibrosis occurs. If the edges of the capsulorhexis are irregular, the forces acting on the lens capsule are different, so it will affect the occurrence of capsule fibrosis in the posterior part (Langwińska-Wośko et al., 2011).

In a study of patients undergoing small and large capsulorhexis it was reported that there was a significant increase in anterior chamber depth only in the large capsulorhexis group on the first postoperative day. On the 90th postoperative day, the anterior chamber depth increased significantly in both the small and large capsulorhexis groups when compared to preoperative values. There was a statistical difference between the 90-day anterior chamber depth values between the small and large groups

(Cekic et al., 1999). Smaller rhexis (5.5 mm and less) than large rhexis (estimated size 5.5–6 mm) are at risk for tearing of the anterior capsule margin with possible extension to the posterior capsule. This increases the probability of the nucleus falling out. Large rhexis can avoid this complication in phacoemulsification (Joshi and Muley, 2017). In this study, a comparison was made between small and large rhexis with results that did not differ significantly in changes in the anterior chamber and iridocorneal angles. Rhexis that are too large can cause IOL movement anteriorly more postoperatively than small rhexis (Iwase et al., 2008). The movement then these conditions will affect the anterior chamber, iridocorneal angle, intraocular pressure and postoperative refractive error. Although in this study the results of visual acuity measurements and refractive correction were not carried out, it is hoped that in other studies the conditions of postoperative refraction could be further identified where based on existing literature the depth of the anterior chamber also plays an important role in the results or postoperative refractive errors. In addition, it was reported that the depth of the anterior chamber will be greatly influenced by several factors such as age, gender, body posture, lens thickness and eyeball axis length (Joshi, 2011).

This research is a study that uses a modified cystotome for measuring capsular hexis where this method has not been widely used in capsular hexis processes. In this study we have limitations. One of them is that it is difficult to obtain results of examination of the parameters of the anterior chamber and corneal irido angle in the first few days after surgery because of the edema condition of the cornea which tends to occur a lot, this makes it difficult to obtain US OCT photographic results. In addition, the measurement results that were expected to be obtained on the 20-30th postoperative day could not be fulfilled because most of the subjects were referrals from other health facilities that were far from the examination site so that the patient tended to carry out controls in their area of origin. Several other parameters can also be further investigated in future studies such as the effect of AXL, preoperative ACD on ACD and iridocorneal angles in subjects with small and large rhexis. Then maybe in future research further studies can also be carried out using several different types of IOL including in terms of IOL material, design, and IOL size, because in this study only the same type of IOL was used.

CONCLUSION

The phacoemulsification operation with a large rhexis diameter resulted in a shallower chamber depth when compared to patients with a smaller rhexis diameter, and the iridocorneal angle obtained in a large rhexis was narrower when compared to patients with a smaller rhexis diameter, but not significantly. It is necessary to carry out further research with a larger sample, and a longer follow-up time to confirm the results of the effect of caspulorhexis diameter on BMD and corneal irido angle. It is recommended for further research, that research is carried out specifically by differentiating the subject's age, axial length, anterior chamber depth and preoperative iridocorneal angle which may provide more specific results on the effect of rhexis size with changes in chamber depth and iridocorneal angle. Analysis of preoperative refractive targets and postoperative refractive errors can also be carried out in future studies, because based on previous studies the condition of the anterior chamber depth before surgery can be a predictive factor for refractive abnormalities that may arise after phacoemulsification surgery. Research using different materials, designs, and IOL sizes has affected the rhexis size with changes in chamber depth and iridocorneal angle.

REFERENCES

1. Lee, W. et al., 2017. Correlations between preoperative angle parameters and postoperative unpredicted refractive errors after cataract surgery in Open angle glaucoma (AOD 500). Yonsei Medical Journal, 58(2), p.432.
2. Zuo, C. et al., 2020. Effect of phacoemulsification on anterior chamber angle in eyes with medically uncontrolled filtered primary angle-closure glaucoma. Journal of Ophthalmology, 2020, pp.1–6.
3. Uçakhan, Ö.Ö., Özkan, M. & Kanpolat, A., 2009. Anterior chamber parameters measured by the Pentacam CES after uneventful phacoemulsification in Normotensive Eyes. Acta Ophthalmologica, 87(5), pp.544–548.
4. Doganay, S. et al., 2008. Evaluation of anterior segment parameter changes using the Pentacam after uneventful phacoemulsification. Acta Ophthalmologica, 88(5), pp.601–606.
5. Bang, S.P. & Jun, J.H., 2019. Comparison of postoperative axial stability of intraocular lens

and capsulotomy parameters between precision pulse capsulotomy and continuous curvilinear capsulotomy. Medicine, 98(48).

6. Zeng, Y. & Gao, J.-hua, 2015. Continuous curvilinear capsulorhexis in cataract surgery using a modified 3-bend cystotome. Journal of Ophthalmology, 2015, pp.1–5.
7. Kim, JS., Shyn, KH. 2001. Biometry of 3 types of intraocular lenses using Scheimpflug photography. J CATARACT REFRACT SURG—VOL 27.
8. Matthias, G., Findl, O., Menapace, R., Kriechbaum, K., Koeppl, C., Buehl, W., Drexler, W. 2004. Effect of haptic design on change in axial lens position after cataract surgery. J Cataract Refract Surg 2004; 30:45–51
9. Ning, X., Yang, Y., Zhang., 2019. BMC Opthalmology. Anterior chamber depth-a predictor of refractive outcomes after age related cataract surgery.
10. Lee, W. et al., 2017. Correlations between preoperative angle parameters and postoperative unpredicted refractive errors after cataract surgery in Open angle glaucoma (AOD 500). Yonsei Medical Journal, 58(2), p.432.
11. Salsabila, C., Nasrul, M., Geriputri, I N. (2021) Prevalensi dan Karakteristik Pasien Katarak Senilis di RSUD Provisnis Nusa Tenggara Barat pada Periode Januari-Juni 2019. Jounral Kedokteran Unram, 2021, 10(3):509-514
12. Hugosson, M., & Ekström, C. (2020). Prevalence and risk factors for age-related cataract in Sweden. Upsala Journal of Medical Sciences, 125(4), 311–315. https://doi.org/10.1080/03009734.2020.1802375
13. Thanigasalam, T., Reddy, S., & Zaki, R. (2015). Factors associated with complications and postoperative visual outcomes of cataract surgery; A study of 1,632 cases. Journal of Ophthalmic and Vision Research, 10(4), 375–384. https://doi.org/10.4103/2008-322X.158892
14. Song, E., Sun, H., Xu, Y., Ma, Y., Zhu, H., & Wei Pan, C. (2014). Age-Related cataract, cataract surgery and subsequent mortality: A systematic review and Meta-Analysis. PLoS ONE, 9(11). https://doi.org/10.1371/journal.pone.0112054
15. Lou, L., Ye, X., Xu, P., Wang, J., Xu, Y., Jin, K., & Ye, J. (2018). Association of sex with the global burden of cataract. JAMA Ophthalmology, 136(2), 116–121. https://doi.org/10.1001/jamaophthalmol.2017.5668
16. Mahayana, I. T., Setyowati, R., Winarti, T., & Prawiroranu, S. (2018). Outcomes of manual Small Incision Cataract Surgery (mSICS) compared with phacoemulsification from population based outreach eye camp, in Yogyakarta and Southern Central Java Region, Indonesia. Journal of Community Empowerment for Health, 1(1), 6–10. https://doi.org/10.22146/jcoemph.36867
17. Huang, G., Gonzalez, E., Peng, P.-H., Lee, R., Leeungurasatien, T., He, M., Porco, T., & Lin, S. C. (2011). Anterior chamber depth, iridocorneal angle width, and intraocular pressure changes after phacoemulsification: Narrow vs open iridocorneal angles (Archives of Ophthalmology (2011) 129, 10, (1283-1290)). Archives of Ophthalmology, 129(11), 1497. https://doi.org/10.1001/archophthalmol.2011.350
18. Altan, C. et al., 2004. Anterior chamber depth, iridocorneal angle width, and intraocular pressure changes after uneventful phacoemulsification in eyes without glaucoma and with open iridocorneal angles. Journal of Cataract and Refractive Surgery, 30(4), pp.832–838.
19. Ning, X., Yang, Y., Zhang., 2019. BMC Opthalmology. Anterior chamber depth-a predictor of refractive outcomes after age related cataract surgery.
20. Fallah, MR., Beiki, H., Mohammadi SF., Latifi, G., Ashrafi, E., Fallah Tafti], Z,. Anterior chamber depth change following cataract surgery in Pseudoexfoliation syndrome; a preliminary study. J Ophthalmic Vis Res. 2017;12(2):165–9.
21. Muzyka-Wozniak, M., Ogar, A,. Anterior chamber depth and iris and lens position before and after phacoemulsification in eyes with a short or long axial length. J Cataract Refract Surg. 2016;42(4):563–8.
22. Hussein, M. A., Salamah, M. A., Shawky, M. M., & Solaiman, K. A.-M. (2019). Changes in Anterior Chamber Depth and Angle Before and After Phacoemulsification of Intumescent Cataract. Zagazig University Medical Journal, 0(0), 0–0. https://doi.org/10.21608/zumj.2019.15051.1360
23. Rüfer, F., Schorder, A., Klettner, A., Frimpong-Boateng, A., Roider, J., Erb, C. 2010. Anterior chamber depth and iridocorneal angle in healthy White subjects: effects of age, gender and refraction. Department of Ophthalmology University of Schleswig-Holstein. https://doi.org/10.1111/j.1755-3768.2009.01588.x
24. Melancia, D., Abegão Pinto, L. & Marques-Neves, C., 2015. Cataract surgery and intraocular pressure. Ophthalmic Research, 53(3), pp.141–148.
25. Vu, A. T., Bui, V. A., Vu, H. L., Quyet, D., Van Thai, T., Nga, V. T., Dinh, T. C., & Bac, N. D. (2019). Evaluation of anterior chamber depth and anterior chamber angle changing after phacoemulsification in the primary angle close suspect eyes. Open Access Macedonian Journal of Medical Sciences, 7(24), 4297–4300. https://doi.org/10.3889/oamjms.2019.378

26. Aykan, Ü. et al., 2003. The effect of capsulorhexis size on development of posterior capsule opacification: Small (4.5 to 5.0 mm) versus large (6.0 to 7.0 mm). European Journal of Ophthalmology, 13(6), pp.541–545.
27. Langwińska-Wośko, E., Broniek-Kowalik, K., & Szulborski, K. (2011). The impact of capsulorhexis diameter, localization and shape on posterior capsule opacifcation. In Medical Science Monitor (Vol. 17, Nomor 10). https://doi.org/10.12659/MSM.881984
28. Çekiç, O. & Batman, C., 1999. The relationship between capsulorhexis size and anterior chamber depth relation. Ophthalmic Surgery, Lasers and Imaging Retina, 30(3), pp.185–190.
29. Joshi, R. S., & Muley, S. J. (2017). Combined 30-degree bevel up and down technique against 0-degree phaco tip for phacoemulsification surgery of hard cataracts. Clinical Ophthalmology, 11, 1073–1079. https://doi.org/10.2147/OPTH.S131921
30. Iwase, T., Tanaka, N., & Sugiyama, K. (2008). Postoperative refraction changes in phacoemulsification cataract surgery with implantation of different types of intraocular lens. European Journal of Ophthalmology, 18(3), 371–376. https://doi.org/10.1177/112067210801800310
31. Joshi, R. S., & Muley, S. J. (2017). Combined 30-degree bevel up and down technique against 0-degree phaco tip for phacoemulsification surgery of hard cataracts. Clinical Ophthalmology, 11, 1073–1079. https://doi.org/10.2147/OPTH.S131921