Original Article

Comparison of the outcomes of phacoemulsification and manual small-incision cataract surgery in posterior polar cataract - A retrospective study

Madhumallika Pathak, Annamalai Odayappan[1], Manas Nath[2], Ramalakshmi Raman[3], Sahil Bhandari[4], Sivagami Nachiappan[5]

Purpose: To compare the visual outcomes and intraoperative complications between phacoemulsification and manual small-incision cataract surgery (MSICS) in cases of posterior polar cataract (PPC). **Methods:** A retrospective study was carried out involving 142 patients (164 eyes) with PPC who underwent cataract surgery between January and December 2017. Data collected include the demographic details, preoperative uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), type of cataract, intraocular pressure, anterior and posterior segment findings, type of surgery performed, intraoperative complications, postoperative UCVA on the first day, UCVA and BCVA at 1 month after surgery, complications, and resurgery details. **Results:** In total, 90 patients (107 eyes) underwent phacoemulsification, and 52 patients (57 eyes) underwent MSICS. There was no significant difference in the mean age, sex, and type of PPC between the two groups (P = 0.326, 0.852, and 0.220, respectively). Patients who underwent phacoemulsification had significantly better preoperative BCVA (P = 0.002). The BCVA on first postoperative day and 1 month after surgery was better in the phacoemulsification group than in the MSICS group (P < 0.001 and 0.002, respectively). The overall incidence of posterior capsular rupture (PCR) was 11.6%, which included the 10.3% in phacoemulsification and 14.0% in MSICS. There was, however, no significant difference in the rates of PCR between the two groups (P = 0.506). **Conclusion:** Phacoemulsification delivered better postoperative visual outcomes than MSICS in PPC patients, whereas the complication rates were similar between the two groups.

Key words: Manual small-incision cataract surgery, phacoemulsification, posterior polar cataract, surgical complications, visual acuity

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_1787_22

Quick Response Code:

Cataract is one of the leading causes of blindness in the world affecting 94 million people globally as of 2020.[1] Phacoemulsification has become the standard procedure for cataract extraction in almost all types of cataracts;[2,3] however, surgery in posterior polar cataract (PPC) is still challenging because of the higher propensity for posterior capsular rupture (PCR).[4] A PCR can happen following the sudden collapse of the anterior chamber, hydrodissection, nucleus rotation, or during epinuclear plate removal. The incidence of PCR in eyes with PPC has been reported to be between 7% and 36%.[5,6] Manual small-incision cataract surgery (MSICS) is widely performed in India because of its cost-effectiveness.[7,8] Both phacoemulsification and MSICS have been found to have similar complication rates in white cataracts.[9] However, there seems to be a paucity of literature regarding their comparative success rates in cases with PPC. Our study aims to bridge this gap by comparing the complication rates and visual outcomes following phacoemulsification and MSICS in patients with PPC.

Methods

Institutional ethics committee approval was obtained from our tertiary eye care center in South India. The research adhered to the tenets of the Declaration of Helsinki. This is a retrospective study where the medical records of all patients with PPC who underwent cataract surgery between January 1 and December 31, 2017 were taken from the records department and analyzed. A total of 142 patients (164 eyes) with PPC who underwent cataract surgery either by phacoemulsification or MSICS were included in the study. Patients who had pseudoexfoliation, small pupils necessitating the use of pupil expanders, corneal

Department of Ophthalmology, Cataract Services, All India Institute of Medical Sciences, Raipur, Chhattisgarh, [1]Department of Glaucoma, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Pondicherry, [2]Department of Cataract, Glaucoma and Refractive Services, ASG Eye Hospital, Kolkata, West Bengal, [3]Department of Biostatistics, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Madurai, Tamil Nadu, [4]Department of Vitreo-Retina, Guru Hasti Chikitsalya, Pipar, Rajasthan, [5]Department of General Ophthalmology, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Pondicherry, Affiliation where the work was primarily carried out: Aravind Eye Hospital, Pondicherry, India

Correspondence to: Dr. Manas Nath, ASG Eye Hospital, Agarpara, B.T. Road, Kolkata - 700 058, West Bengal, India. E-mail: drmanasnath@gmail.com

Received: 22-Jul-2022 Revision: 11-Aug-2022
Accepted: 15-Sep-2022 Published: 25-Oct-2022

Cite this article as: Pathak M, Odayappan A, Nath M, Raman R, Bhandari S, Nachiappan S. Comparison of the outcomes of phacoemulsification and manual small-incision cataract surgery in posterior polar cataract - A retrospective study. Indian J Ophthalmol 2022;70:3977-81.

opacities, retinal or optic nerve pathologies, glaucoma, previous intraocular surgeries, or ocular trauma were excluded. In addition to PPC, the patient could have had any degree of nuclear sclerosis. The PPC was graded according to the Daljit Singh classification.[10] In patients who had a strong clinical suspicion of a preexisting posterior capsular dehiscence, anterior segment optical coherence tomography (ASOCT) was done to confirm its presence.

All surgeries were performed by consultants with more than 5 years of experience and complication rates of less than 2%. Phacoemulsification was the preferred method; however, if the patient had financial constraints, MSICS was performed. All surgeries were routinely performed under peribulbar anesthesia irrespective of the type (MSICS/phacoemulsification) as it eliminates squeezing of lids which in turn reduces positive vitreous pressure.[11]

Data collected include demographic details, preoperative uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), type of cataract, intraocular pressure (IOP), anterior and posterior segment findings, type of surgery performed, intraoperative complications, postoperative UCVA on the first day, UCVA and BCVA at 1 month after surgery, anterior and posterior segment findings, complications, and resurgery details, if any. The visual acuity recorded in Snellen's chart was converted to logMAR for statistical analysis.

Statistical analysis

Descriptive statistics were presented as frequency with percentage. Mean and standard deviations were used for continuous parameters. Median with inter quartile range was used for skewed data. Parametric statistical tests were performed for normally distributed data and nonparametric tests for skewed data. The normality of data was checked using the Shapiro-Wilk test. The two-sample *t* test and Mann–Whitney *U* test were used to determine the significant difference between different groups. The Chi-square test and Fisher's exact test were used to determine the association between different groups. $P < 0.05$ was considered to be statistically significant. All statistical analyses were performed by STATA (14.0, Texas).

Results

A total of 164 eyes of 142 patients with PPC who underwent cataract surgery were included in this retrospective study. Out of them, 90 patients (107 eyes) underwent phacoemulsification and 52 patients (57 eyes) underwent MSICS. Furthermore, 120 patients had unilateral and 22 patients had bilateral PPC. Table 1 shows the number of eyes with different types of PPC and the type of surgery performed.

There was no significant difference in the age and sex distribution between the phacoemulsification and MSICS groups ($P = 0.326$ and 0.852, respectively); however, the preoperative visual acuity was better in the patients who underwent phacoemulsification ($P = 0.02$ for UCVA and 0.0002 for BCVA) [Table 2].

Postoperatively, the visual acuity improved in both groups as expected ($P < 0.001$). The BCVA at 1 month was better in those who underwent phacoemulsification than MSICS ($P = 0.002$) [Table 3]. Furthermore, 93 (87%) patients in the phacoemulsification group and 38 (67%) patients in the MSICS group had BCVA of 6/6 (0 in logMAR) at 1 month postoperatively.

We observed that out of the 107 eyes that underwent phacoemulsification, 96 eyes (89.7%) had no complications. In MSICS, 49 (85.9%) out of the 57 eyes had no complications.

Table 1: PPC type with the type of surgery performed

PPC Type	Phacoemulsification *n* (%)	MSICS *n* (%)	Total *n* (%)	*P**
Type 1	19 (17.7%)	7 (12.2%)	26 (15.8%)	0.361
Type 2	57 (53.2%)	25 (43.8%)	82 (50%)	0.251
Type 3	2 (1.8%)	3 (5.3%)	5 (3%)	0.229
Type 4	29 (27.1%)	22 (38.6%)	51 (31.1%)	0.130
Total	107	57	164	0.220

*Proportion test

Table 2: Demographic details of the study participants

	Phacoemulsification	MSICS	*P*
Age			
n	90	52	0.326*
Mean±SD	47.6±10.4	49.50±12.0	
min-max	27-72	26-70	
Sex[a]			
Male	47 (52.2)	28 (53.8)	0.852#
Female	43 (47.7)	24 (46.1)	
Total	90 (100)	52 (100)	
Preoperative vision[b]			
UCVA	0.6 (6/24)	1 (6/60)	0.020*
IQR	0.32-1.5	0.5-1.8	
BCVA	0.3 (6/12)	0.50 (6/18)	
IQR	0.2-0.5	0.3-1.5	0.0002*

[a]Represented as *n* (%). [b]Represented as median (Snellen's equivalent) with interquartile range. *Two-sample *t* test/Mann-Whitney test. #Chi squared test/Fisher's exact test. SD: Standard deviation, IQR: Interquartile range

Table 3: Changes in the uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA) in the two groups

	Phacoemulsification	MSICS	*P**
UCVA			
Preoperative	0.6 (6/24)	1 (6/60)	0.020
IQR	0.32-1.5	0.5-1.8	
Postoperative			
1st day	0.2 (6/9)	0.2 (6/9)	0.120
IQR	0-0.3	0-0.5	
1st month	0 (6/6)	0 (6/6)	0.303
IQR	0-0.2	0-0.2	
P[$]	<0.001	<0.001	
BCVA			
Preoperative	0.3 (6/12)	0.5 (6/18)	0.0002
IQR	0.2-0.5	0.3-1.5	
Postoperative			
1st month	0 (6/6)	0 (6/6)	0.002
IQR	0-0	0-0.2	
P[$]	<0.001	<0.001	

*Mann-Whitney test. [$]Wilcoxon signed rank test. IQR: Interquartile range, MSICS: Manual small-incision cataract surgery

One patient each in the phacoemulsification and MSICS group had preexisting PCR noted clinically and confirmed by ASOCT [Fig. 1]. Among the 11 eyes (10.3%) in the phacoemulsification group that had PCR, one had preexisting posterior capsule dehiscence, and in the rest, the PCR occurred in different stages of the surgery. In seven eyes, PCR was noticed during emulsification of the nucleus, two eyes had PCR during last piece of nucleus removal, and one had PCR during cortical aspiration [Fig. 2]. In the MSICS group, among the eight eyes (14.0%) that had PCR, one was preexisting, whereas in all the other cases, the PCR was seen immediately after the nucleus delivery. Among all those with intraoperative PCR, two patients (1.9%) in the phacoemulsification group had nucleus drop, and there was no nucleus drop in the MSICS group. There was, however, no statistically significant difference in the rate of complications between the two groups (P = 0.735) [Table 4].

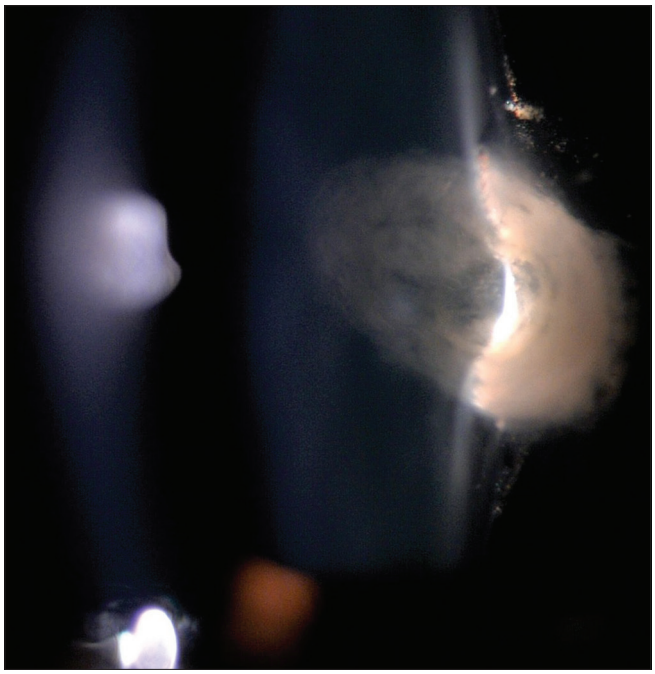

Figure 1: High-magnification slit-lamp photograph showing posterior polar cataract with posterior capsular dehiscence

We found that the PCR rate was higher in type 3 and type 4 PPC than in type 1 or type 2 PPC (P = 0.001) [Table 5]. One patient each in type 1 and type 2 PPC had nucleus drop.

In all patients with PCR, automated anterior vitrectomy was done if vitreous disturbance was present, the residual lens material was removed, an intraocular lens (IOL) was placed in the sulcus, and the main incision was sutured. The two patients with nucleus drop required vitreoretinal intervention. Pars plana vitrectomy with nuclear fragment removal and IOL implantation in the sulcus was performed on the same day. None of the other patients required any re-intervention.

Postoperatively, it was found that four eyes (three in the phacoemulsification group and one in the MSICS group) had transiently raised IOP on the 1st postoperative day; however, only one out of these four eyes had intraoperative PCR. Cystoid macular edema was detected at 1 month follow-up in one patient who had undergone MSICS but had no intraoperative complications.

Discussion

We compared the two techniques of cataract surgery in terms of postoperative visual outcome and intraoperative complications. We found that both phacoemulsification and MSICS were equally safe in cases with PPC. Phacoemulsification is the preferred technique of cataract surgery among most eye surgeons all over the world irrespective of the type of cataract.[3,12-14] It is particularly preferred in PPC cases as the technique is a closed chamber one.[4] However, not every center is equipped with a phacoemulsification machine, and maintenance costs are high. MSICS can also be safe in PPC if appropriate techniques are employed during the surgery. The incidence of PCR in our current study on PPC patients was 11.6%. This is higher than the general PCR rate (1.9%–3.5%) in cataract surgery.[15] PCR may occur more commonly in PPC because of the thin central posterior capsule or a preexisting congenital dehiscence. Because of the high risk of PCR, surgery in a PPC case is one of the greatest challenges for a cataract surgeon. Many techniques have been described to reduce the chances of PCR. Some of these techniques include performing an inside-out hydrodelineation to keep the cushion of epinucleus as well as to reduce stress on the zonules. Slow-motion phacoemulsification has also been suggested, that is, keeping all the parameters on the lower side. Rotation of the

Table 4: Intraoperative complications in phacoemulsification and MSICS groups

Complications	Type of surgery		Total *n* (%)	*P**
	Phacoemulsification (*n*=107) *n* (%)	MSICS (*n*=57) *n* (%)		
PCR	11 (10.3%)	8 (14.0%)	19 (11.6%)	0.735
Nucleus drop	2 (1.9%)	-	2 (1.2%)	

*Fisher's exact test

Table 5: Complication rates according to the type of posterior polar cataract (PPC)

	Type of PPC				Total	*P**
	1	2	3	4		
Total number of cases	26	82	5	51	164	
Posterior Capsular Rupture (PCR) *n* (%)	3 (11.5%)	4 (4.9%)	3 (60%)	9 (17.6%)	19 (11.6%)	0.003

*Fisher's exact test

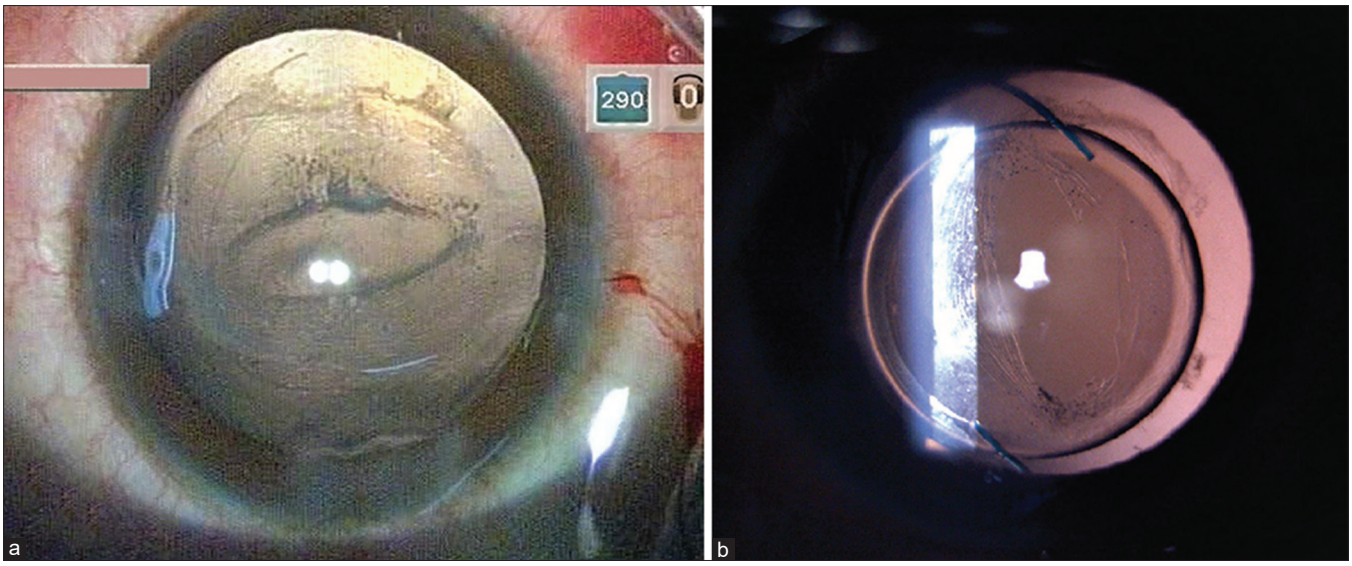

Figure 2: (a) Intraoperative image showing fish tail type of posterior capsular rent noted during cortex aspiration. (b) Postoperative image showing a stable intraocular lens in the sulcus after a posterior capsular rent

nucleus needs to be avoided. Step-by-step phaco chop technique creating multiple nuclear fragments and emulsification of the fragments with epinuclear cushion beneath enhances the safety.[16-18] Furthermore, keeping a capsulorhexis to 5 mm may provide the surgeon with adequate support in case sulcus fixation of IOL is required. However, most of these techniques have been described in phacoemulsification. The effectiveness of MSICS in PPC has barely been reported, although MSICS is a widely performed surgical procedure in developing countries.

In general, we tend to give intravenous mannitol pre-operatively to reduce vitreous pressure in both MSICS and phacoemulsification. After completion of capsulorhexis, we manually separate the cortex from the anterior lens capsule with the help of cyclodialysis spatula in both procedures, avoid hydrodissection, use hydrodelineation instead, and inject viscoelastics simultaneously through the side port whenever irrigating instruments are taken out from the eye. Specifically, in MSICS, we prefer a bimanual prolapse of the nucleus, viscoelastic assisted nucleus delivery, and use Simcoe's cannula preferably through side ports alone for irrigation and aspiration of the cortex. All these steps prevent fluctuation in the anterior chamber depth which puts undue stress on the posterior capsule throughout the surgery.

We find that the phacoemulsification resulted in slightly better postoperative vision than MSICS. This finding may be biased as the phacoemulsification group had a better preoperative vision than the MSICS group, indicating a lesser grade of cataract. Moreover, a larger incision in MSICS would have led to higher surgically induced astigmatism and aberrations.[19]

The intraoperative PCR rate was comparatively less in our cohort of PPC patients (11.6%). Chetinkaya *et al.*[20] compared the techniques of viscodissection and hydrodissection in PPC cases undergoing phacoemulsification and found that 13% of the cases had PCR with viscodissection and 28.5% had PCR with hydrodissection. Langwińska-Wośko *et al.*[21] in their retrospective study on intraoperative complications in PPC cases also found PCR in 18% of the cases undergoing phacoemulsification. Vasavada *et al.*[4] in their study on surgical approaches to PPC mentioned that by applying certain strategies such as inside-out hydrodelineation and maintaining the anterior chamber depth throughout the surgery with better understanding of phacodynamics and surgical expertise, the PCR rate in PPC cases can be been reduced to 6%–7%.

The strengths of the study lie in its large sample size and inclusion of patients who underwent MSICS. A fixed time limit of 1 month was used to compare the data on visual acuity between the two groups to have uniformity of the data. The limitations are that it is a retrospective study with multiple surgeons. However, all surgeons who performed surgery on PPC patients were vastly experienced. The sample distribution was not equal between the two groups. The grading of the cataract could have influenced the surgical decision and visual outcome. The keratometric reading had not been assessed in the postoperative period precluding analysis of the amount of surgically induced astigmatism. A slightly longer follow-up of 3 months or more might have been better; however, the proportion of the sample population who turned up for review after the 1-month visit was very low to give any useful additional information. Further prospective studies in PPC patients with similar grades of cataract preferably with randomization incorporating ASOCT may provide additional knowledge on the safety and efficacy of phacoemulsification or MSICS in PPC.

Conclusion

Both phacoemulsification and MSICS have similar safety in PPC patients with phacoemulsification having a marginally better visual outcome. MSICS being the most performed cataract surgery in developing countries can be safely performed in PPC patients where facilities are limited.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: An analysis for the Global Burden of Disease Study [published correction appears in Lancet Glob Health 2021;9:e408]. Lancet Glob Health 2021;9:e144-60.
2. Olson RJ. Cataract surgery from 1918 to the present and future-Just imagine! Am J Ophthalmol 2018;185:10-3.
3. Upadhyay S, Sharma P, Chouhan JK, Goyal R. Comparative evaluation of modified crater (endonucleation) chop and conventional crater chop techniques during phacoemulsification of hard nuclear cataracts: A randomized study. Indian J Ophthalmol 2022;70:794-8.
4. Vasavada AR, Raj SM, Vasavada V, Shrivastav S. Surgical approaches to posterior polar cataract: A review. Eye (Lond) 2012;26:761-70.
5. Flaxman SR, Bourne RRA, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, *et al.* Global causes of blindness and distance vision impairment 1990-2020: A systematic review and meta-analysis. Lancet Glob Health 2017; 5:e1221-34.
6. Vasavada AR, Vasavada VA. Managing the posterior polar cataract: An update. Indian J Ophthalmol 2017;65:1350-8.
7. Mohanty M, Prasan V, Vivekanand U. Conventional extracapsular cataract extraction and its importance in the present day ophthalmic practice. Oman J Ophthalmol 2015;8:175-8.
8. Singh K, Misbah A, Saluja P, Singh AK. Review of manual small-incision cataract surgery. Indian J Ophthalmol 2017;65:1281-8.
9. Venkatesh R, Tan CS, Sengupta S, Ravindran RD, Krishnan KT, Chang DF. Phacoemulsification versus manual small-incision cataract surgery for white cataract. J Cataract Refract Surg 2010;36:1849-54.
10. Kalantan H. Posterior polar cataract: A review. Saudi J Ophthalmol 2012;26:41-9.
11. Nath M, Odayappan A. Commentary: Pearls in posterior polar cataract. Indian J Ophthalmol 2020;68:595596.
12. Riaz Y, de Silva SR, Evans JR. Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract. Cochrane Database Syst Rev 2013;10:CD008813.
13. Gogate PM, Kulkarni SR, Krishnaiah S, Deshpande RD, Joshi SA, Palimkar A, *et al*. Safety and efficacy of phacoemulsification compared with manual small-incision cataract surgery by a randomized controlled clinical trial: six-week results. Ophthalmology 2005;112:869-74.
14. Chakrabarti A, Singh S. Phacoemulsification in eyes with white cataract. J Cataract Refract Surg 2000;26:1041-7.
15. Greenberg PB, Tseng VL, Wu WC, Liu J, Jiang L, Chen CK. *et al.* Prevalence and predictors of ocular complications associated with cataract surgery in United States veterans. Ophthalmology 2011;118:507-14.
16. Vasavada AR, Vasavada VA, Raj SM. Approaches to a posterior polar cataract. Saudi J Ophthalmol 2012;26:51-4.
17. Lee MW, Lee YC. Phacoemulsification of posterior polar cataracts—A surgical challenge. Br J Ophthalmol 2003;87:1426-7.
18. Allen D, Wood C. Minimizing risk to the capsule during surgery for posterior polar cataract. J Cataract Refract Surg 2002;28:742-4.
19. Tong N, He JC, Lu F, Wang Q, Qu J, Zhao YE. Changes in corneal wavefront aberrations in microincision and small-incision cataract surgery. J Cataract Refract Surg 2008;34:2085-90.
20. Cetinkaya S, Cetinkaya YF, Dadaci Z, Acir NO. Phacoemulsification in posterior polar cataract. Arq Bras Oftalmol 2016;79:218-21.
21. Langwińska-Wośko E, Szulborski K, Broniek-Kowalik K. The complications during phacoemulsification in patients with posterior polar cataract. Klin Oczna 2011;113:16-8.