



## RESEARCH

# Safety of Phacoemulsification with Gradual Hydro Dissection on Posterior Polar Cataract

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**Abstract**

**Introduction:** Phacoemulsification has been a procedure of choice for treating cataractous lenses and restoring visual function. Posterior polar cataract have been one of many cases in which phaco surgeons should be careful and aware for more to perform phacoemulsification. One hydrodissection procedure is safe to perform as an alternative to hydrodilation during phacoemulsification for posterior cataract. It is called gradual hydrodissection. **Methods:** This study performed a quasi-experimental pre-post study that tested the safety of gradual hydrodissection in phacoemulsification in 50 eyes of 50 patients. The safety parameter used in this study includes the incidence of posterior capsule rupture and nucleus drop during phacoemulsification until surgery is finished. Descriptive statistics were used to summarize the characteristics of the study participants, such as age, sex, race, eye laterality, and previous intraocular surgery. A paired student's t-test was conducted to compare preoperative and postoperative values for visual acuity and intraocular pressure. The  $P < 0.05$  was considered the level of statistical significance.

**Results:** There was no complication of the posterior capsule during the hydrodissection procedure. There was a statistically significant difference in visual acuity and intraocular pressure before and after surgery by  $P$  value  $< 0.001$ . All of the phacoemulsification studies were considered uneventful and successful. **Conclusions:** Gradual hydrodissection may be safe to be performed in phacoemulsification for posterior polar cataract.

**Keywords:** phacoemulsification; posterior polar cataract; hydrodissection; gradual hydrodissection; posterior capsule complication

**Introduction**

Phacoemulsification has been a procedure of choice for treating cataractous lenses and restoring visual function. It has been proven scientifically and clinically safe for decades. Phacoemulsification has played a significant role in the history and innovations of cataract surgeries.<sup>[1],[2]</sup>

Posterior polar cataract have been one of many cases in which phaco surgeons should be careful and aware for more to perform phacoemulsification. In the case of posterior polar cataracts, the cataractous lens is mostly very sticky with the posterior capsule. It could lead to any posterior capsule.<sup>[3],[4]</sup>

Posterior polar cataract pose a challenge due to a high risk of complications during surgery. The abnormal adhesion of the cataract to the capsule and the weakness of the posterior capsule itself significantly increase the chance of posterior capsule rupture and the nucleus drop. This can lead to further complications, worsen visual outcomes, and require careful surgical techniques to minimize these risks.<sup>[5],[6],[7],[8]</sup>

For a decade, surgeons have been developing hydro delineation instead of regular hydrodissection to battle posterior capsule complications. One hydrodissection procedure is safe as an alternative to hydrodilation during phacoemulsification for posterior cataract.<sup>[9],[10]</sup> It is called gradual hydrodissection.

**Methods**

This study was a quasi-experimental pre-post study that tested the safety of gradual hydrodissection in phacoemulsification. The safety parameters used

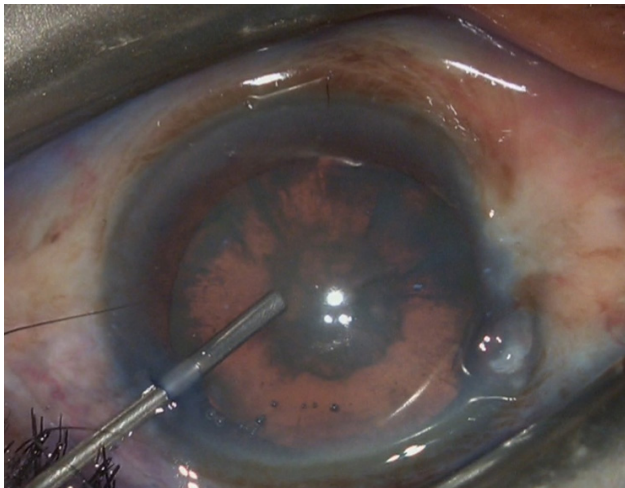


Figure 1. Posterior polar cataract.

in this study include the incidence of posterior capsule rupture and nucleus drop during phacoemulsification until surgery is finished. We record any incidence of complication in binary data (yes or no) and record the additional outcome of the surgery based on the value of visual acuity and intraocular pressure in numerical data (Table 3).

The study was conducted at the Sabang Merauke Eye Center (SMEC) Eye Hospital, Medan, Indonesia, from June 2022 to July 2023. The participants were diagnosed as posterior pole cataract (Figure 1) and were chosen by simple random sampling. Each participant underwent a comprehensive ophthalmologic examination. Participants had to meet the criteria to be included in the study: pole posterior cataract patient, best corrected visual acuity of less than 20/70, presence of a normal conjunctiva, cornea, anterior chamber, iris, and pupil. Participants also had suitable lens opacities for optical biometry and spectral domain optical coherence tomography (SD-OCT) examinations, intraocular pressure (IOP) below 21 mmHg, and were willing to participate in the study.

Table 1. Baseline characteristics.

Age at baseline	
Years	64.83 ± 16.45
Sex, number of eyes (%)	
Male	16 (32)
Female	34 (68%)
Race, number of eyes (%)	
Indonesian Malay	32 (64)
Indonesian Chinese	18 (36)
Eye laterality, number of eyes (%)	
Right	30 (60)
Left	20 (40)
Previous Intraocular surgery, number of eyes (%)	
Yes	0 (0)
No	50 (100)

Table 2. Number of surgery complications.

Description	N (Total)	Percentage (%)
The incidence of the complication		
Posterior capsule rupture	0/50	0
Nucleus drop	0/50	0

Table 3. Preoperative and postoperative visual acuity and intraocular pressure after phacoemulsification.

	Preoperative (mean)	Postoperative (mean)	P-value
Visual acuity (decimal)			
Uncorrected	0.15 ± 0.147 (0.025-0.66)	0.83 ± 0.284 (0.6-1.0)	< 0.001
Best corrected	0.21 ± 0.125 (0.05-0.66)	0.93 ± 0.144 (0.76-1.0)	< 0.001
Intraocular pressure (mmHg)			
	17.86 ± 2.70 (16-20)	13.20 ± 2.21 (11-16)	< 0.001

Note: Data presented as mean ± standar deviation (range)

Patients with normal-tension glaucoma, age-related macular degeneration, diabetes mellitus, hypertension, and other systemic diseases were excluded from this study. Optical biometry data were obtained using an optical biometer (IOLMaster® 500; Carl Zeiss Meditec AG, Jena, Germany).

The institutional review board approved this study, and the study design followed the principles of the Declaration of Helsinki. The subjects underwent phaco surgery using the phaco chop technique with bimanual irrigation–aspiration and intraocular lens (IOL) hydroimplantation. A venturi-based phaco machine was used (Stellaris; Bausch and Lomb Incorporated, Rochester, NY, USA) under an operating microscope (model M822®, Leica Microsystems, Wetzlar, Germany). Gradual hydrodissection was performed by filling a sterile solution with continuous curvilinear capsulorhexis (CCC) into a capsular bag to separate corticocapsular adhesion. In this study, gradual hydrodissection was performed by injecting sterile solution step by step instead of one continuous injection. Phacoemulsification was performed by only one surgeon. All possible complications, including posterior capsule complications, were monitored meticulously.

Before phacoemulsification, the eyes were instilled with tropicamide 1% eye drops (Mydriatil; PT Cendo Pharmaceutical, Indonesia) and diclofenac sodium 0.1% eye drops (Noncort; PT Cendo Pharmaceutical, Indonesia). A sterile irrigating solution (Ecosol; B Braun Indonesia), a viscoelastic material 1:3 mixture of 2% chondroitin sulfate (Yotavis; Aurolab, India) and 3% sodium hyaluronate (Hyotek3%; Teknomek Medikal, Turkey), and 0.5% levofloxacin intracameral administrative antibiotic (Optiflox; PT Erela Indonesia) were used during phaco. After phaco, the eyes were instilled with 0.5% levofloxacin eye drops (LFX; PT Cendo Pharmaceutical, Indonesia) six times daily and diclofenac sodium 0.1% eye drops six times daily for one week.

Statistical analyses were performed using IBM SPSS® Statistics version 28 (IBM Corporation, Armonk, NY, USA). Descriptive statistics are presented as mean  $\pm$  standard deviation. Paired student's t-test identified the differences between preoperative and postoperative data sets.  $P < 0.05$  was considered the level of statistical significance.

## Results

A total of 50 of 50 patients suffering posterior polar cataract underwent phacoemulsification were included in this study. The baseline clinical characteristics of participants are presented in Table 1. The mean age was  $64.83 \pm 16.45$  years (41-81 years). Female patients (34 eyes, 68%) were predominant. The right eyes are more (30, 60%) than the left. All participants were Indonesian, and none had had previous intraocular surgery.

From 50 participants, we found that none of the research subjects experienced surgery complications, such as posterior capsule rupture and nucleus drop during and after the surgery.

The visual acuity and IOP before and after phacoemulsification are shown in Table 2. Postoperative uncorrected visual acuity was significantly improved by  $0.15 \pm 0.147$  (0.025-0.66) versus  $0.83 \pm 0.284$  (0.6-1.0) with  $P < 0.001$  (Table 3). Respectively, postoperative best corrective visual acuity was statistically significantly improved by  $0.21 \pm 0.125$  (0.05-0.66) versus  $0.93 \pm 0.144$  (0.76-1.0) with  $P < 0.001$ . On the other side, postoperative IOP was decreased considerably by  $17.86 \pm 2.70$  (16-20) mmHg versus  $13.20 \pm 2.21$  (11-16) mmHg,  $P < 0.001$  (Table 3).

## Discussion

Regular hydrodissection in cases of posterior polar cataract has been reported to cause many posterior capsule complications, including posterior capsule rupture, vitreous prolapse, and nucleus drop.<sup>[9],[10],[11],[12]</sup>

So far, hydrodeliation is considered a safe measure to prevent complications of the posterior capsule. However, this step often leaves epinucleus at the end of the segment removal step. Part of the remaining epinucleus can be removed by epinucleus removal procedure, however, on the other hand, part of it must be completed by aspiration irrigation procedure, all of which can extend the time of surgery and have the potential to increase corneal edema and it might affect the results of surgery.<sup>[9],[10],[12],[13]</sup>

Gradual hydrodissection is a procedure that keeps phacoemulsification fast, efficient, and friendly to the cornea yet simultaneously makes the condition of the posterior capsule safer. In this study, there were no complications, zero case of posterior capsule complications, and 100% cases of uneventful phacoemulsification. Improved visual acuity and

statistically significant decrease of intraocular pressure in this study proves the successful procedure of phacoemulsification with gradual hydrodissection procedure in cases of posterior polar cataracts.<sup>[14],[15]</sup>

While posterior polar cataract surgery can sometimes lead to unavoidable complications, we used gradual hydrodissection techniques to reduce complications in the patient's eye. The gradual hydrodissection approach aims to safely remove the cataract without compromising the posterior capsule complication, such as posterior capsule rupture and nucleus drop, while maintaining visual acuity and intraocular pressure outcome.

## Conclusions

Gradual hydrodissection is a safe and effective maneuver of phacoemulsification technique with significant improvement in postoperative uncorrected and best-corrected visual acuity, decreased postoperative intraocular pressure, and no surgery complications were reported from the 50 patients with posterior polar cataract who participated in the study. Further research with a more significant number of samples at multi-centers in the future is expected to be carried out to obtain more exciting information about the safety of gradual hydrodissection in phacoemulsification for posterior polar cataracts.

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## References

- [1] Jaggernath J, Gogate P, Moodley V, Naidoo KS. Comparison of cataract surgery techniques: Safety, efficacy, and cost-effectiveness. *Eur J Ophthalmol* 2014;24:520-526. <https://doi.org/10.5301/ejo.5000413>.
- [2] Pardianto G, Moeloek N, Reveny J, Wage S, Satari I,

- Sembinging R, et al. Retinal thickness changes after phacoemulsification. *Clin Ophthalmol* 2013;7:2207-2214. <https://doi.org/10.2147/OPTH.S53223>.
- [3] Vasavada AR, Vasavada VA. Managing the posterior polar cataract: An update. *Indian J Ophthalmol* 2017;65:1350-1358. [https://doi.org/10.4103/ijo.IJO\\_707\\_17](https://doi.org/10.4103/ijo.IJO_707_17).
- [4] Mohan S, Mohan S, Rajan M. Taming the polar bear: Ten tips to manage posterior polar cataract. *Indian J Ophthalmol* 2023;71:320-321. [https://doi.org/10.4103/ijo.IJO\\_2023\\_22](https://doi.org/10.4103/ijo.IJO_2023_22).
- [5] Anand S, Rani N. Posterior Polar Cataract and Its Management. *Surg Sci* 2015;06:304-310. <https://doi.org/10.4236/ss.2015.67046>.
- [6] Ravindra M, Bali J, Adarsh D, Bali O. Posterior polar cataract: Hydrodissection and nucleus rotation in manual small-incision cataract surgery not a taboo with proper fluidics. *Indian J Ophthalmol* 2022;70:4051. [https://doi.org/10.4103/ijo.IJO\\_1588\\_22](https://doi.org/10.4103/ijo.IJO_1588_22).
- [7] Vasavada A, Vasavada V. Managing the posterior polar cataract: An update. *Indian J Ophthalmol* 2017;65:1350. [https://doi.org/10.4103/ijo.IJO\\_707\\_17](https://doi.org/10.4103/ijo.IJO_707_17).
- [8] Chandrashekhara S, Ghosh A, Rengappa R. Trident technique of safe nuclear emulsification in posterior polar cataracts. *Indian J Ophthalmol* 2024;72:123-125. [https://doi.org/10.4103/IJO.IJO\\_1377\\_23](https://doi.org/10.4103/IJO.IJO_1377_23).
- [9] Gimbel H V. Hydrodissection and hydrodelineation. *Int Ophthalmol Clin* 1994;34:73-90. <https://doi.org/10.1097/00004397-199403420-00006>.
- [10] Hua X, Dong Y, Du J, Yang J, Yuan X. Phacoemulsification with hydrodelineation and OVD-assisted hydrodissection in posterior polar cataract. *BMC Ophthalmol* 2018;18:165. <https://doi.org/10.1186/s12886-018-0845-8>.
- [11] Vasavada AR, Raj SM, Vasavada V, Shrivastav S. Surgical approaches to posterior polar cataract: a review. *Eye (Lond)* 2012;26:761-770. <https://doi.org/10.1038/eye.2012.33>.
- [12] Titiyal JS, Kaur M, Shaikh F, Rani D, Bageshwar LMS. Elucidating intraoperative dynamics and safety in posterior polar cataract with intraoperative OCT-guided phacoemulsification. *J Cataract Refract Surg* 2020;46:1266-1272. <https://doi.org/10.1097/j.jcrs.000000000000256>.
- [13] Chakrabarti A, Nazm N. Posterior capsular rent: Prevention and management. *Indian J Ophthalmol* 2017;65:1359-1369. [https://doi.org/10.4103/ijo.IJO\\_1057\\_17](https://doi.org/10.4103/ijo.IJO_1057_17).
- [14] Carolan JA, Liu L, Alexeeff SE, Amsden LB, Shorstein NH, Herrinton LJ. Intraocular pressure reduction after phacoemulsification: A matched cohort study. *Ophthalmol Glaucoma* 2021;4:277-285. <https://doi.org/10.1016/j.ogla.2020.10.002>.
- [15] Ling JD, Bell NP. Role of cataract surgery in the Management of Glaucoma. *Int Ophthalmol Clin* 2018;58:87-100. <https://doi.org/10.1097/IIO.000000000000234>.