Original Article

Phacoemulsificatıon and Intraocular Lens Implantation for the treatment of high myopia with cataract

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Abstract

Background: High myopia, defined as an axial length of ≥26.0 mm, is a common condition worldwide which increases the risk of cataract development. Phacoemulsification is a popular, safe, and effective surgical method for intraocular lens extraction, but cataract surgery in highly myopic eyes is risky procedure with common intraoperative and postoperative complications. **Objective:** To evaluate the outcomes and complications following phacoemulsification and intraocular lens implantation in eyes with cataract and high myopia. **Methods:** This was a prospective observational study performed among 50 eyes of 44 patients with cataract and high myopia who underwent phacoemulsification and intraocular lens implantation. Preoperative and postoperative uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) were measured. Preoperative and postoperative refractive values were measured as spherical equivalent (SE), calculated as the summation of the spherical refractive value and half of the cylindrical value. High myopia was defined as AL ≥ 26.0mm and spherical equivalent (SE) ≤ −6.0 dioptres (D). Target postoperative refractions were within ±1.00 diopters (D). All patients were followed up for three months. **Results:** The mean age of the patients were 50.3 (±6.9) years where 28 (56.0%) patients were male. The mean axial length and IOL were 27.9 (±1.6) and 7.9 (±3.3) respectively. Among the 50 eyes of 44 patients, 33 (66.0%) had nuclear cataract. The mean pre-operative spherical equivalent was -11.0 (±1.9) which significantly decreased to -0.9 (±1.9) post-operatively (p<0.001). Moreover, the mean pre-operative BCVA was 1.5 (±0.4) which significantly decreased to 0.2 (±0.1) post-operatively (p<0.001). Forty nine eyes (98.0%) achieved postoperative BCVA (logMAR) ≤ 0.3. The mean BCVA significantly improved after surgery in mild to moderate high myopia and extremely high myopia (p < 0.001 for both). **Conclusion:** Phacoemulsification and intraocular lens implantation is associated with positive outcomes in patients with cataract and high myopia.

Keywords: Cataract, Phacoemulsification and intraocular lens implantation, high myopia

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Introduction

Cataract is the most common eye condition that causes blindness worldwide, affecting around 65.2 million individuals. Cataracts account for around 51% of blindness and are a key contributor to poor eyesight in both developed and developing countries. The prevalence of cataracts in those over the age of 40 is between 11.8% and 18.8%. Currently, there are no effective techniques for cataract prevention or pharmacological treatment; however, surgical removal of the opaque lens and implantation of an intraocular lens (IOL) can restore vision in cataract patients.[1]

Myopia is the most common refractive error[2] which can be corrected with glasses, contact lenses, and refractive surgery. However, if myopia cannot be completely corrected, it is the leading hidden cause of visual impairment.[3] High myopia is a common condition worldwide,

defined as an axial length of ≥26.0 mm.[4] Its global prevalence was about 163 million patients in 2000, which accounted for 11.6% of all myopia patients, and 2.7% of population around the world. It has been estimated that its prevalence will be increased to 938 million by 2050, which will yield 9.8% of global population, and 19.7% of all myopia subjects.[5] High myopia is a significant risk factor for cataract development, with a 3.8-fold increase in the odds for nuclear cataracts. High myopia and cataracts are major causes of blindness worldwide, especially in East Asia.[6]

Phacoemulsification is currently the most popular surgical method for intraocular lens extraction, and it is also one of the safest and most effective. One of the primary benefits of this procedure is that a small incision is usually self-sealing, significantly shortening the recovery time.[7] Due to advances in phacoemulsification techniques, biometric devices and intraocular lens (IOL) power calculations, cataract surgery is routinely performed in high-myopia patients, and favourable postoperative VA has been observed in most cases.6 However, cataract surgery in the highly myopic eye is thought to be a risky procedure with common intraoperative and postoperative complications.[8,9,10]

The prevalence of eye diseases in Bangladesh is relatively high. Refractive errors, including myopia, hyperopia, and astigmatism, affect a substantial portion of the population, particularly among children and young adults. On the other hand, cataracts, a leading cause of blindness worldwide, also pose a significant burden in Bangladesh, with prevalence increasing with age.[11]

Given the increasing prevalence of high myopia, understanding the best surgical strategies for managing cataracts in these patients is essential. Therefore, the present study aimed to evaluate the outcomes and complications following phacoemulsification and intraocular lens implantation in eyes with cataract and high myopia. This study will contribute to the refinement of surgical techniques, improve postoperative outcomes, and enhance patient care for individuals with high myopia and cataract.

Methods

The study protocol was approved by the Ethical Review Committee of NIO&H, Dhaka. Informed consent was obtained from all study participants.

This was a prospective observational study performed in the Department of Cataract, National Institute of Ophthalmology and Hospital (NIO) from January 2024- December 2024. A total of 50 eyes of 44 patients with cataract and high myopia who underwent phacoemulsification and intraocular lens implantation were consecutively included in this study. Patients with any systemic or ocular disease other than high myopia that may influence visual acuity, intraoperative complications, or retinal detachment were excluded. Preoperative and postoperative uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) were measured. Preoperative and postoperative refractive values were measured as spherical equivalent (SE), calculated as the summation of the spherical refractive value and half of the cylindrical value. Axial length measurements were performed using an IOL Master Optical Biometer (Carl Zeiss Meditec AG, Jena, Germany). The SRK/T formula was used for IOL power calculations. Fundus examinations were performed preoperatively.

High myopia was based on measurement of axial length instead of refraction because of refractive change caused by cataract itself.[8] In the study, high myopia was defined as AL ≥ 26.0mm[12] and spherical equivalent (SE) ≤ −6.0 dioptres (D)[13]. Target postoperative refractions were within ±1.00 diopters (D). The high-myopia patients were further divided into two subgroups according to myopic severity based on the ALs: mild to moderate high myopia (defined as 26.0 ≤ AL < 30.0mm and extremely high myopia (defined as AL ≥ 30.0mm)[6]

Each operation was performed by a single surgeon (SC). Under Peribulbar anesthesia, a 2.8-mm clear corneal incision was made superotemporally with a keratome. Trypan blue was given in anterior chamber (AC) for staining of anterior capsule. Then Ringer's solution was used to wash out the blue from AC. The anterior chamber was then filled with a dispersive

(Hydroxypropylmethylcellulose, Easy Visc, Germany) viscoelastic material. After continuous curvilinear capsulorhexis, hydrodissection and hydrodelineation were performed. Then, a sideport entrance was created with a 15° knife. The lens nucleus was removed using the "stop and chop" technique (Sovereign Compact, Phacoemulsification System, AMO, USA). Subsequently, the cortex was aspirated with coaxial irrigation/ aspiration. The capsular bag was filled with a cohesive (Na Hyaluranate 1.6, Easyluron, Germany) viscoelastic material before a foldable monofocal posterior chamber IOL (Acriva, VSY, Turkey) was implanted in the capsular bag through an injector system. The viscoelastic material was then aspirated completely. The entrances were closed with stromal hydration, and finally, intracameral moxifloxacin was administered for postoperative endophthalmitis prophylaxis. Topical antibiotics 4 times a day, and topical steroids 6 times a day were administered for 1 week postoperatively. Topical steroid doses were then tapered over the subsequent 3 weeks. All patients were followed up for three months.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics software version 26 (SPSS Inc., Chicago, IL). Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample. Association of quantitative variables were assessed by paired sample t test where $p<0.05$ considered as significant. Here, all p values were two sided.

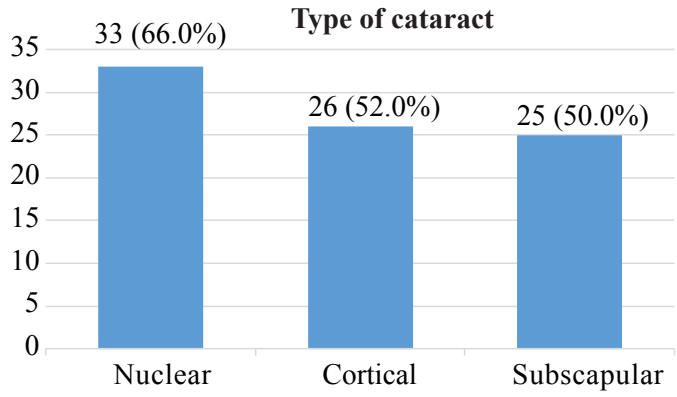
Results

Table I: Baseline characteristics of highly myopic eyes undergoing cataract

Table 1: Baseline characteristics of highly myopic eyes undergoing cataract

surgery (n=50) Baseline characteristics	Number (percentages)
Gender	
Male	24 (48.0%)
Female	26 (52.0%)
Age (years) (Mean ±SD)	50.3 ±6.9
Laterality	
Right	28 (56.0%)
Left	22 (44.0%)
Axial length (Mean ±SD)	27.9±1.6
IOL power (D) (Mean ±SD)	7.9±3.3

The mean age of the patients were 50.3 (±6.9) years where 28 (56.0%) patients were male. The mean axial length and IOL were 27.9 (±1.6) and 7.9 (±3.3) respectively (table I).



multiple response

Figure I: Type of cataract

Among the 50 eyes of 44 patients, 33 (66.0%) had nuclear cataract. The proportion of cortical and subscapular cataract were 52.0% (n=26) and 50.0% (n=25) respectively (figure I).

Table II: Comparison of spherical equivalent and BCVA before and after surgery

Criteria	Pre-operative	Post-operative	p value
Spherical equivalent	-11.0 (±1.9)	-0.9 (±1.9)	<0.001a
BCVA	1.5±0.4	0.2±0.1	<0.001a

a=Paired sample t test

The mean pre-operative spherical equivalent was -11.0 (±1.9) which significantly decreased to -0.9 (±1.9) post-operatively (p<0.001). Moreover, the mean pre-operative BCVA was 1.5 (±0.4) which significantly decreased to 0.2 (±0.1) post-operatively (p<0.001) (table II).

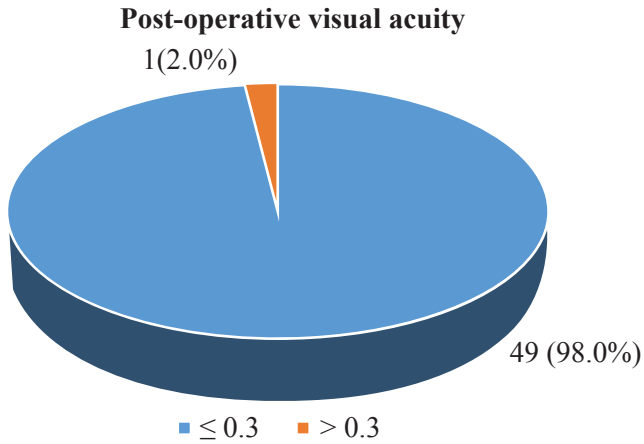


Figure II: Post-operative visual acuity

Among the 50 eyes, 49 (98.0%) achieved postoperative BCVA (logMAR) ≤ 0.3 (figure II).

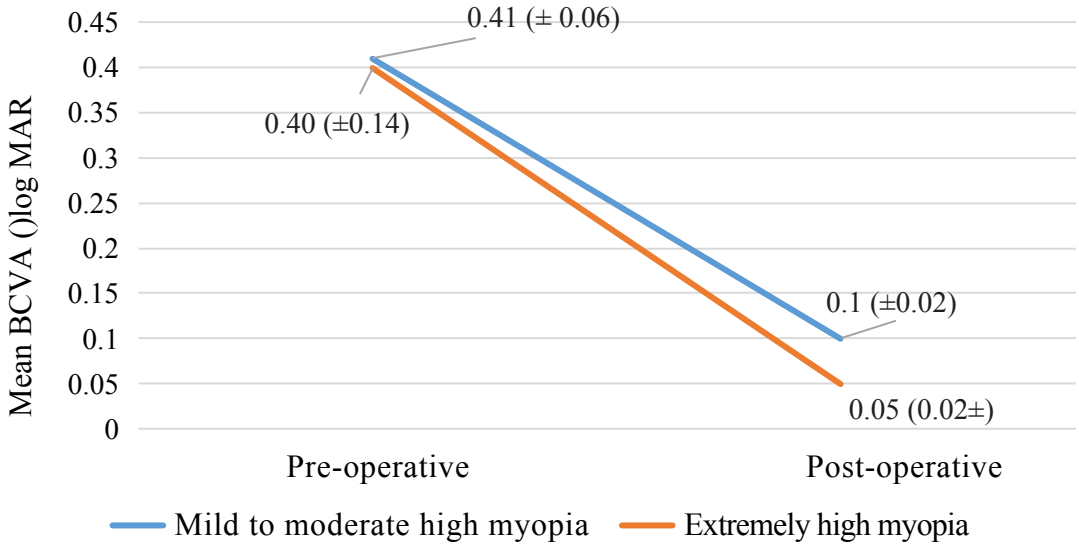


Figure III: Comparison of pre-operative and post-operative BCVA among mild to moderate high myopia and extremely high myopia

The mean BCVA significantly improved after surgery in mild to moderate high myopia and extremely high myopia (p < 0.001 for both) (figure III).

Discussion

Myopia is one of the most common eye diseases globally. Eyes with high myopia tend to develop earlier-onset and more progressive nuclear cataracts and posterior capsular cataracts. Currently, surgery is the only effective therapeutic method for cataract treatment.[14] Cataract surgery can be challenging in high myopes despite ongoing advances in the surgical technique and instrumentation.[15] The present study aimed to evaluate the outcomes and complications following phacoemulsification and intraocular lens implantation in eyes with cataract and high myopia. In this study, most of highly myopic eyes experienced good postoperative visual performance following phacoemulsification and intraocular lens implantation.

Nuclear cataract is well known for its myopic shift in refraction.[16] Majority of the eyes had nuclear cataract (66.0%) followed by cortical (52.0%) and subscapular cataract (50.0%). Higher proportion of nuclear cataract was also mentioned in other studies[4,8]

After surgery, the mean pre-operative spherical equivalent significantly decreased. Similar finding was presented by the retrospective study of Cetinkaya et al.[4] where the preoperative SE significantly decreased postoperatively.

In this study, the mean pre-operative BCVA significantly decreased after phacoemulsificatıon and intraocular lens implantation. Among the 50 eyes, 98.0% achieved postoperative BCVA (logMAR) ≤ 0.3. Patients were further sub-grouped into mild to moderate high myopia and extremely high myopia group and the mean BCVA significantly improved in both groups. The case-control study of Tan et al.[6] found that the mean BCVA improved significantly postoperatively. Moreover, 91.1% in the high-myopia group achieved postoperative BCVA (logMAR) ≤ 0.3. They also found that the mean BCVA significantly improved after surgery in both subgroups. The retrospective study of Tsai et al.[8] found that 61.5% highly myopic eyes had good postoperative visual improvement. This difference might be the difference in study design as Tsai et al.[8] performed a retrospective study where two patients were below the age of 40 years, 30.8% patients underwent extracapsular cataract extractions and 19.2% had pre-existing maculopathy before surgery. In Turkey, Cetinkaya et al.[4] observed good postoperative outcomes following phacoemulsification surgery in patients with cataract and high myopia.

Cataract surgeries in eyes with high axial myopia can be more challenging due to problems such as loose zonules and fluctuating anterior chamber depth. Some studies reported a posterior capsular rupture rate up to 9.3 %.[17] (Lam et al., 2016). The posterior capsular rupture rate of the present study was 2.0%. Similar reports were presented by other authors. The prospective study of Zuberbuhler et al.[18] found that 2.8% patients had posterior capsular rupture while Lam et al.[17] found that the posterior capsular rupture rate was 1.5 %.

Conclusion

Phacoemulsification with intraocular lens (IOL) implantation is a safe and effective surgical approach for treating cataracts in patients with high myopia. The procedure significantly improves visual acuity, although special considerations are required due to the unique anatomical and refractive challenges associated with high myopia..

Limitations

Short follow up period was the main drawback of this study. Furthermore, noncomparative study design and limited sample size were other limitations of this study.

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References

1. Chen X, Xu J, Chen X, Yao K. Cataract: advances in surgery and whether surgery remains the only treatment in future. Advances in Ophthalmology Practice and Research. 2021 Nov 1;1(1):100008.
2. Han X, Liu C, Chen Y, He M. Myopia prediction: a systematic review. Eye. 2022 May;36(5):921-9.
3. Qi J, Yuan J, Zhou Y, Guo R, Zhang Y, Dai Q, Liu Y. Clinical efficacy of modified phacoemulsification in the treatment of high myopia with cataract: a systematic review and meta-analysis. Annals of Palliative Medicine. 2021 Oct;10(10):105560566-10566.
4. Cetinkaya S, Acir NO, Cetinkaya YF, Dadaci Z, Yener Hİ, Saglam F. Phacoemulsificatıon in eyes wıth cataract and high myopia. Arquivos brasileiros de oftalmologia. 2015 Sep;78:286-9.
5. Gao L, Li M. Clinical efficacy of phacoemulsification combined intraocular lens implantation for treatment of high myopia with cataract: A protocol of systematic review. Medicine. 2020 Dec 4;99(49):e23215.
6. Tan Y, Liu L, Li J, Qin Y, Sun A, Wu M. Effect of cataract surgery on vision-related quality of life among cataract patients with high myopia: a prospective, case-control observational study. Eye. 2022 Aug;36(8):1583-9.
7. Benítez Martínez M, Baeza Moyano D, González-Lezcano RA. Phacoemulsification: Proposals for improvement in its application. InHealthcare 2021 Nov;9(11):p. 1603.
8. Tsai CY, Chang TJ, Kuo LL, Chou P, Woung LC. Visual outcomes and associated risk factors of cataract surgeries in highly myopic Taiwanese. Ophthalmologica. 2008 Feb 22;222(2):130-5.
9. Chong EW, Mehta JS. High myopia and cataract surgery. Current Opinion in Ophthalmology. 2016 Jan 1;27(1):45-50.
10. Fesharaki H, Peyman A, Rowshandel M, Peyman M, Alizadeh P, Akhlaghi M, Ashtari A. A comparative study of complications of cataract surgery with phacoemulsification in eyes with high and normal axial length. Advanced Biomedical Research. 2012 Jan 1;1(1):67.
11. Chowdhury IH, Hasan MM, Hamid SAT, Abdulmajeed SM. Epidemiology of eye diseases in Bangladesh. IP Int J Ocul Oncol Oculoplasty 2024;10(2):67-73.
12. Zhang J, Tan X, Wang W, Yang G, Xu J, Ruan X, Gu X, Luo L. Effect of axial length adjustment methods on intraocular lens power calculation in highly myopic eyes. American Journal of Ophthalmology. 2020 Jun 1;214:110-8.
13. Wang SK, Guo Y, Liao C, Chen Y, Su G, Zhang G, Zhang L, He M. Incidence of and factors associated with myopia and high myopia in Chinese children, based on refraction without cycloplegia. JAMA ophthalmology. 2018 Sep 1;136(9):1017-24.
14. Liang X, Luo S, Deng K, Li L. Comparison of macular changes and visual outcomes between femtosecond laser-assisted cataract surgery and conventional phacoemulsification surgery for high myopic cataract patients. BMC ophthalmology. 2024 May 15;24(1):212.
15. Ozbek ZE, Saatci AO, Durak I, Gunenc U, Kaynak S. Phacoemulsificatıon and Intraocular Lens Implantation in Eyes with Long Axial Length. Annals of Ophthalmology. 2007 Jul;39:217-21.
16. Pesudovs K, Elliott DB. Refractive error changes in cortical, nuclear, and posterior subcapsular cataracts. British journal of ophthalmology. 2003 Aug 1;87(8):964-7.
17. Lam JK, Chan TC, Ng AL, Chow VW, Wong VW, Jhanji V. Outcomes of cataract operations in extreme high axial myopia. Graefe's Archive for Clinical and Experimental Ophthalmology. 2016 Sep;254:1811-7.
18. Zuberbuhler B, Seyedian M, Tuft S. Phacoemulsification in eyes with extreme axial myopia. Journal of Cataract & Refractive Surgery. 2009 Feb 1;35(2):335-40.