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Phacoemulsification in Patients with High Myopia: A Retrospective Analysis

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ABSTRACT

Background- High myopia, characterized by an elongated eyeball and associated visual impairments, presents unique challenges during cataract surgery due to anatomical variations and potential complications. This study investigated phacoemulsification's refractive and visual results in high myopic eyes.

Methods- This study assessed the medical records of 75 eyes from 60 individuals with high myopia who underwent phacoemulsification to remove cataracts. Axial length, refractive values, and pre-operative and post-operative visual acuity were measured. The Sanders Retzlaff Kraff formula calculates the intraocular lens (IOL) power. The procedure involved a 2.8-mm clear corneal incision, hydro dissection, hydro delineation, and lens nucleus removal. Following the implantation of a foldable monofocal posterior chamber IOL, the capsular bag was filled with viscoelastic material. Post-operative endophthalmitis prophylaxis was provided with intracameral moxifloxacin and topical antibiotics and steroids.

Results- Out of the 60 patients in this study, 28 (46.7%) were male and 32 (53.3%) were female. The frequency of nuclear cataracts was higher than other cataract types. Pre-operative spherical equivalent (SE) and BCVA were significantly higher and lower than postoperatively. Additionally, the study revealed that, in 20% of instances, myopic degeneration was the most common reason for decreased post-operative visual acuity. Age-related macular degeneration followed with 6.7%. Other causes included corneal opacity, diabetic retinopathy, glaucoma, and optic atrophy. Post-operative complications were observed in 10.7% of cases in patients with high myopia, emphasizing the need for careful monitoring and management to optimize post-operative outcomes and visual health.

Conclusion- The study reveals that myopic patient's post-surgery experience better visual acuity and less frequent diabetic retinopathy changes. On the other hand, they deal with issues like glaucoma, optic atrophy, diabetic retinopathy, age-related macular degeneration, and corneal scaropacity.

Key-words: Cataract extraction, High myopia, IOL power, Phacoemulsification, Visual acuity

INTRODUCTION

A global condition known as high myopia is characterized by an axial length (AL) of ≥26.0 mm [1,2]. It is also generally acknowledged that the condition is degenerati-ve and results from the globe's distension, primarily at the posterior region [3,4]. Patients with high myopia have a higher frequency of vitreous and retinal degenerations than the general population [5]. Retinal holes, retinal tears, lattice degeneration, posterior vitreous separation, and liquid vitreous are some of these degenerations. Furthermore, compared to low myopia and/or emmetropic eyes, these eyes are more likely to get glaucoma and retinal detachment (RD) [1,4]. Patients with high myopia with cataracts are predicted to benefit from cataract surgery in terms of both visual and refractive

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issues [2]. Cataract surgery and posterior chamber intraocular lens (PCIOL) implantation (low power, zero power, or minus power) are beneficial for eyes with extremely severe axial myopia [6,7]. Because posterior staphylomas can occur in elongated eyes, calculating IOL power may be a little challenging in those cases [8].

It has been demonstrated that in very myopic patients, the risk for RD increases to 1.3-8.0% following cataract surgery [9,10]. Male gender, age, longer AL, posterior capsule rupture and/or vitreous loss during surgery, and post-operative neodymium are associated with peripheral retinal degeneration with fractures and/or holes. Post-operative RD could be related to yttrium-aluminum-garnet (Nd:YAG) laser posterior capsulotomy, among other potential risk factors [11].

Phacoemulsification is a cataract removal procedure that uses an ultrasound-based system and microsurgical instruments. It begins with a precise 2.5-3.0 mm corneal incision in the temporal region, followed by a separate corneal port(s) [12]. Any stage of cataract formation can be treated with it. A lens with the required optical properties is implanted in place of the excised lens [13]. Topical anesthetic using proparacaine drops applied to the ocular surface is a common first step in phacoemulsification cataract surgery [14]. It is the standard approach to cataract surgery in developed countries. However, phacoemulsification is expensive and requires frequent equipment maintenance. As a result, significant efforts were made in developing nations to make cataract surgery more inexpensive [15]. In this study, we analyse phacoemulsification's refractive and visual results in high myopic eyes.

MATERIALS AND METHODS

This retrospective analysis examined the data of 75 eyes from 60 high myopia patients who underwent phacoemulsification cataract extraction between January 2022 and January 2024 at Shri Balaji Institute of Medical Science, Mowa, Raipur (Central India).

Inclusion criteria- Patients with an AL assessed by ultrasonography biometry of ≥26 mm was included in the research.

Exclusion criteria- Individuals who had any ocular or systemic conditions besides excessive myopia that could affect visual acuity, complications during surgery, or retinal detachment were excluded from the study.

Methodology- The best-corrected visual acuity (BCVA) and uncorrected visual acuity (UCVA) were tested on a Snellen chart both before and after surgery [16]. By multiplying the spherical refractive value by half of the cylindrical value, the spherical equivalent (SE) was used to determine the pre-operative and post-operative refractive values. Using A-scan ultrasound biometry, the axial length was measured. The Sanders Retzlaff Kraff (SRK)-T formula was used to determine the IOL power. The post-operative refractive target was set at 0.0 diopters to 0.5 diopters. The calculated power of the IOL was varying between -8.0 and +16.0 diopter.

A single surgeon carried out each operation. A steel blade was used to make a superotemporal 2.8-mm clean corneal incision while the patient was under sub tenon anesthesia. After that, a dispersive viscoelastic material was added to the anterior chamber. A curvilinear capsulorhexis was performed following which the steps of hydrodissection and hydrodelineation were carried out. Next, a sideport entrance was made using a 19-gauge microvitreoretinal (MVR) knife. The "stop and chop" method (Phaco Glaxy Pro, Appasamy, India) was used to remove the lens nucleus. Next, coaxial irrigation/aspiration was used to aspirate the cortex. A cohesive viscoelastic material was injected into the capsular bag using an injector device before a foldable monofocal posterior chamber IOL (Acryfold hydrophilic foldable PCIOL, Supraphob hydrophobic foldable PCIOL) was implanted. After that, the viscoelastic material was fully aspirated. Stromal hydration was used to seal the openings, intracameral moxifloxacin was given to prevent post-operative endophthalmitis. For one week following surgery, topical steroids and antibiotics were used four times each day and six times every day, respectively. The following three weeks were spent tapering down the dosages of topical steroids.

Statistical analysis- LogMAR acuity was used instead of Snellen acuities for statistical analysis and comparisons. The post-operative SE of refraction and logMAR visual acuities were compared to pre-operative data using the chi-square test and t-test, with P values less than 0.05 indicating statistical significance.

Ethical approval- The local ethics committee approved the study protocol. We got informed consent from every study participant.

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RESULTS

Of the 60 patients in this study, 28 (46.7%) were men and 32 (53.3%) were women. The average age was 55.10 ± 15.03 years (35-75). Thirty-five eyes (46.7%) had nuclear cataracts, 20 (26.7%) had cortical cataracts, and 20 (26.7%) had posterior subcapsular cataracts. Nuclear cataracts occurred much more frequently than other cataract types (p=0.049). Thirty-five patients (58.3%) had bilateral cataracts, whereas 25 (41.7%) had unilateral ones. The AL was 27.77 ± 1.08 (26-33) mm, whereas the IOL power was 6.07 ± 5.67 (-3.0 to +14.0) D. The pre-operative SE [-18.09 ± 6.01 (-8.00 to -25.00) D] was significantly greater than the post-operative SE [-2.08 ± 0.03 (0.00 to -3.00) D; p<0.001]. Additionally, there was a significant difference between the pre-operative BCVA [0.88 ± 1.27 (0.30-1.50) logMAR] and post-operative BCVA [0.32 ± 0.18 (0.00-1.00) logMAR] (p=0.001).

Table 1: Pre-operative and post-operative characteristics.

Variables	Number (%), mean ± SD	Range
Sex		
Male	28 (46.7%)	
Female	32 (53.3%)	
Age (years)	55.10 ± 15.03	35 to 75
Cataract types		
Nuclear	35 (46.7%)	
Cortical	20 (26.7%)	
Subcapsular	20 (26.7%)	
Laterality		
Unilateral	25 (41.7%)	
Bilateral	35 (58.3%)	
Axial length (mm)	27.77 ± 1.08	26 to 33
IOL power (D)	6.07 ± 5.67	-3.00 to +14.00
Pre SE (D)	-18.09 ± 6.01	-8.00 to -25.00
Post SE (D)	-2.08 ± 0.03	0.00 to -3.00
Pre BCVA (logMAR)	0.88 ± 1.27	0.30 to 1.50
Post BCVA (logMAR)	0.32 ± 0.18	0.00 to 1.00

SD: Standard deviation; IOL: Intraocular lens; SE: Spherical equivalent; BCVA: Best-corrected visual acuity

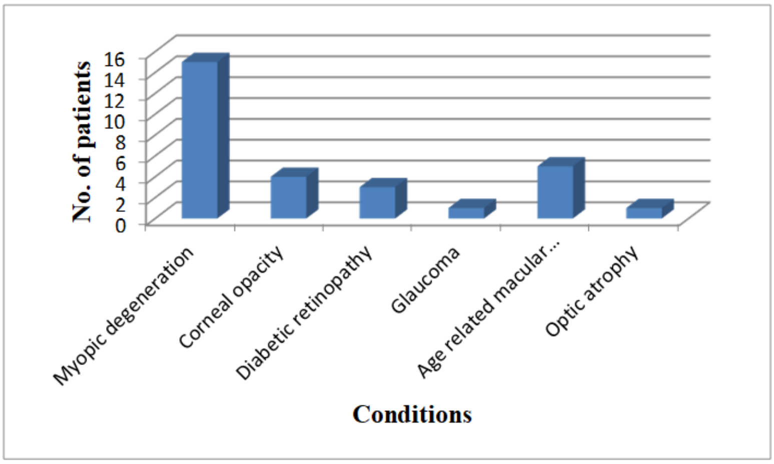

Fig. 1: Causes of decreased post-operative visual acuity.

The data presented in Fig. 1 shows the causes of decreased post-operative visual acuity in the study population. The findings indicate that myopic degeneration was the most common cause of decreased post-operative visual acuity in the study, accounting for 20% of the cases. Age-related macular degeneration

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followed with a prevalence of 6.7%. Other causes, such as corneal scar/opacity, diabetic retinopathy, glaucoma, and optic atrophy had lower frequencies ranging from 1.3% to 5.3%. These findings highlight the importance of identifying and managing these underlying conditions to optimize visual outcomes following cataract surgery in patients with obscured fundus views.

In patients with high myopia, post-operative complications were observed as follows: posterior capsule opacity occurred in 10.7% of cases, cystoid macular edema in 4%, and retinal detachment in 1.3% (Fig. 2). These complications highlight the potential risks associated with surgical interventions in individuals with high myopia, emphasizing the importance of careful monitoring and management to ensure optimal post-operative outcomes and visual health.

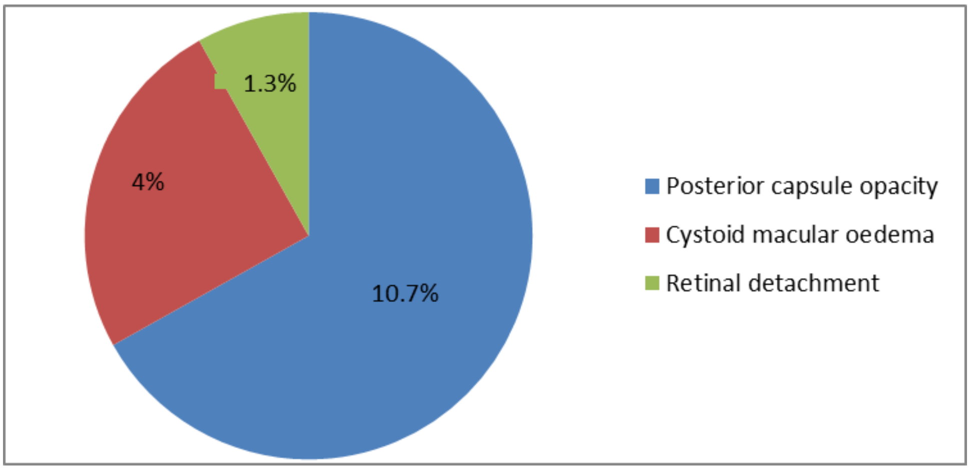

Fig. 2: Post-operative complications in patients with high myopia

DISCUSSION

Various research papers have extensively studied phacoemulsification in patients with high myopia. A retrospective analysis of cases with high myopia undergoing phacoemulsification revealed that special attention is required during surgical technique and intraocular lens (IOL) selection [17]. Additionally, comparing different surgical methods for high myopia cataracts, supracapsular phacoemulsification was simpler, quicker, and associated with fewer complications than intracapsular phacoemulsification [18]. Moreover, a study on phacoemulsification in diabetic patients highlighted that visual outcomes post-surgery are influenced by refraction and axial eye length, with myopic patients showing better visual acuity and less frequent diabetic retinopathy changes [19]. Furthermore, a study on glaucomatous patients with cataracts demonstrated a significant reduction in intraocular pressure post-phacoemulsification, particularly in primary open-angle glaucoma patients [20].

Current surgical techniques for phacoemulsification in patients with high myopia include supracapsular phacoemulsification, intracapsular phacoemulsification, prechop technique, and modified phacoemulsification. Studies have shown that supracapsular phacoemulsification is simpler, uses less energy, takes less time, and has fewer complications than intracapsular phacoemulsification [18]. Additionally, the pre-chop technique benefits cataract patients with highly liquefied or vitrectomized vitreous, especially those with hard nuclear cataracts, as it reduces phaco time and complications [17]. Furthermore, a modified phacoemulsification technique has been developed to prevent Lens-Iris Diaphragm Retropulsion Syndrome (LIDRS) and other complications during cataract surgery in vitrectomized eyes [21]. These techniques offer tailored approaches to address the challenges of high myopia in cataract surgery.

It is well-recognized that highly myopic eyes are more likely to develop nuclear cataracts [22–24]. Compared to other forms of cataract, nuclear cataracts were far more common in our study. When comparing post-operative refraction measures to traditional applanation ultrasound treatments, non-contact optical biometry employing partial coherence laser interferometry (IOL Master) yields more precise and trustworthy results [25]. Pupil dilation, macular degeneration-related fixation instability, and media opacity cause such thick cataracts,

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vitreous hemorrhage, or corneal scars all have an impact on IOL Master measurements and have the potential to introduce biometric mistakes [25,26].

To achieve good visual results, the IOL power must be calculated. An axial length measurement may be inaccurate if posterior staphyloma is present. Research suggests that B-scan ultrasonography should be done in older patients with posterior staphyloma to prevent axial length measurement mistakes since these patients typically have higher axial length [27,28]. Since employing positive power IOL constants for both positive and negative power IOLs raises the hyperopic refractive error with axial length, optimizing IOL constants improves the accuracy of IOL power estimates [27,29,30]. In severely myopic eyes, the SRK/T formula has been more accurate than previous formulations in calculating the IOL power. It has been demonstrated, however, that in eyes with highly long axial lengths, the Haigis formula yields the most accurate IOL power estimation [31,32].

In this study, myopic degeneration was the most common cause of reduced post-operative visual acuity, accounting for 20% of cases. This finding is consistent with previous research done by Cai *et al.*, that has highlighted myopic macular degeneration as a significant contributor to visual impairment post-cataract surgery [33]. Myopic degeneration can lead to structural changes in the retina, particularly at the macula, affecting central vision and overall visual acuity. Additionally, the study reported glaucoma, optic atrophy, and other less common causes in smaller proportions. Glaucoma-related optic neuropathy can lead to irreversible vision loss if not managed appropriately before or after cataract surgery [34]. Optic atrophy, characterized by damage to the optic nerve, presents challenges in achieving significant visual improvement postoperatively.

The present study also showed the incidence of various post-operative complications. The findings indicate that posterior capsule opacity occurred in 10.7% of cases, cystoid macular edema in 4%, and retinal detachment in 1.3% of patients with high myopia. Comparing these results with a similar study by Malagola *et al.* [35] on posterior vitreous detachment and cystoid macular edema post-cataract surgery, some interesting parallels and differences can be observed. Malagola's study focused on developing cystoid macular edema following cataract surgery. In contrast, the current study examines post-operative complications after retinal detachment repair, specifically in patients with high myopia.

LIMITATIONS

The retrospective nature of the analysis may introduce selection bias and limit the generalizability of the findings. The study does not provide detailed information on the specific surgical techniques and intraocular lens options, which could impact the outcomes and complications observed. Furthermore, the study does not explore the long-term stability of visual outcomes and the occurrence of late complications in patients with high myopia after cataract surgery.

CONCLUSIONS

The present study concludes that myopic patients showed better visual acuity and less frequent diabetic retinopathy changes post-surgery. Patients with high myopia had glaucoma, optic atrophy, diabetic retinopathy, age-related macular degeneration, and corneal scaropacity as post-operative sequelae. Age-related macular degeneration was the second most common cause of decreased post-operative visual acuity, behind myopic degeneration. More research is warranted to understand the underlying mechanisms and risk factors for myopic degeneration and its impact on visual acuity post-cataract surgery.

CONTRIBUTION OF AUTHORS

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