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Original Research Paper

ASSESSING THE SUBJECTIVE AND OBJECTIVE VISUAL QUALITY OVER THE LONG TERM IN HIGH MYOPIA EYES FOLLOWING THE IMPLANTATION OF A DIFFRACTIVE TRIFOCAL INTRAOCULAR LENS

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ABSTRACT

Background: Excellent surgical abilities are essential for intraocular lens implantation. Additionally, intraocular lenses are expensive. Trifocal intraocular lens implantation is thus not the recommended course of therapy for those with cataracts and high myopia. There aren't many studies on this topic in the Indian setting.

Aim: The purpose of this study was to evaluate the subjective and objective visual quality over the long term following the implantation of a diffractive trifocal intraocular lens (IOL) in high myopic eyes.

Methods: 76 participants with high myopia who had trifocal intraocular lens implantation and phacoemulsification had 106 eyes evaluated for the research. The research evaluated the following criteria after one month, three months, one year, and two years after surgery: objective visual quality, defocus curve, diopter, contrast sensitivity, and visual acuity. The satisfaction questionnaire and the VF-14 scale were evaluated statistically.

Results: The research participants' mean preoperative spherical equivalent was -10.75± 3.96D. Following surgery, 94.3% of the individuals had uncorrected distance visual acuity of 0.1 LogMAR, while 94.3% and 84.9% of the subjects had SEs of ±1.0D and ±0.50 D, respectively. At three months, one year, and two years after surgery, there was no discernible difference in objective visual quality or CS ($p>0.05$).

The study participants' spectacle independence rate was 100%. 10% and 13% of subjects had moderate or severe glare halo, respectively. Additionally, 18.4%, 26.3%, and 23.7% of survey participants reported having trouble seeing small fonts, driving or riding at night, and doing sensitive jobs.

The current study comes to the conclusion that people with high myopia and cataracts who have diffractive trifocal IOL implantation have good close, mid, and distance visual acuity. Trifocal IOL is also a safe, reliable, efficient, and stable therapy option. After surgery, it offers excellent long-term visual quality, great patient satisfaction, and spectacle independence.

Keywords: long-term, visual quality, high myopia, and diffractive trifocal IOL

INTRODUCTION

By the end of 2050, the prevalence of high myopia is predicted to rise from 4% to 9.8%, and the global incidence of myopia is predicted to reach 49.8%. Because of the excessive axial length elongation and ongoing diopter development, high myopia often significantly raises the likelihood of its progression to pathological alterations.[1]

Subjects with severe myopia are far more likely to develop cataracts than those in the emmetropia group, and cataracts typically present early in life, typically between the ages of 30 and 50. Trifocal IOL (intraocular lens) implantation gives patients complete vision, enabling them to reduce their reliance on glasses and attain high-quality vision.2

Because of the relatively complex pathological, physiological, and anatomical conditions in the eye, subjects with high myopia typically have a strong desire to replace the leses; however, the preoperative calculation for the IOL is inaccurate, and the incidence of postoperative and intraoperative complications is high. Therefore, having exceptional surgical abilities is essential for intraocular lens insertion. Trifocal IOLs are rarely the first option for patients with extreme myopia and cataracts because to their comparatively expensive cost.3

There is currently a dearth of information in the literature about the implantation of trifocal IOLs in patients with severe myopia and cataracts, with even less studies coming from India.4 Therefore, the goal of the current study was to evaluate the mid- and long-term results of trifocal IOL implantation in participants with high myopia and cataracts using both subjective and objective visual quality evaluation techniques.

MATERIALS AND METHODS

Assessing the long-term objective and subjective visual quality following the implantation of a diffractive trifocal intraocular lens (IOL) in high myopia eyes was the goal of the current study. The research participants came from the Institute's Department of Ophthalmology. Before participating in the study, all participants and school officials gave their verbal and written informed consent.

The study's inclusion criteria included subjects with axial lengths of ≥26 mm, high myopic patients with cataracts who underwent phacoemulsification and trifocal IOL implantation without any intraoperative complications, and corneal astigmatism of ≤1.0 D, which could be increased to 1.50 D for patients with rule astigmatism.

Subjects with a history of eye surgery, high myopia combined with retinal detachment, maculopathy (including neovascular, traction, atrophic stage A2 and above), high myopia combined with posterior scleral staphyloma, and mental disorders, depression, and/or anxiety were excluded from the study. So were subjects with other eye conditions such as macular degeneration, diabetic retinopathy, uveitis, glaucoma, and keratopathy.

Prior to surgery, a thorough ocular evaluation was performed, and one-, three-, one-, and two-year follow-ups were conducted. High order aberrations, the defocus curve, refraction, contrast sensitivity, visual acuity, and objective visual quality were among the parameters evaluated.

Two years after surgery, a satisfaction questionnaire and VF-14 scale were filled out. The following measures were used to evaluate visual acuity: UNVA (uncorrected near visual acuity) 40 cm, UIVA (uncorrected intermediate visual acuity) 80 cm, UDVA (uncorrected distance visual acuity) 5m, DCNVA (distance corrected near visual acuity), DCIVA (distance corrected intermediate visual acuity), and CDVA (best corrected distance visual acuity). After distance vision was fully corrected, contrast sensitivity was tested in each eye using an analyzer at a distance of 2.5 meters.

With spatial frequencies of 3, 6, 12, and 18 cpd, the highest contrast that could be discerned in both a dark and bright environment was measured, and the findings were statistically examined. Comprehensive optometry was used to evaluate the postoperative CDVA, and a lens was placed in front of the eyes with a 0.5D unit decrease from +1.00 D to -4.00 D.

The Oslen formula for the Pentacam platform and the Barrett universal II formula were used to assess IOL power. When there was a significant discrepancy between the two, Kane's formula was used for rectification. The same physician performed all of the operations while under topical anesthetic. Steep axis incision was used to treat astigmatism throughout the procedure, and residual astigmatism was decreased for astigmatism brought on by the procedure in all individuals.

ANOVA, the chi-square test, the student's t-test, Fisher's exact test, the Mann Whitney U test, and SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) were used to statistically evaluate the obtained data. A p-value of less than 0.05 was regarded as the significance level.

RESULTS

Assessing the long-term objective and subjective visual quality following the implantation of a diffractive trifocal intraocular lens (IOL) in high myopia eyes was the goal of the current study. The study evaluated 106 eyes from 76 high myopia patients who had trifocal intraocular lens implantation and phacoemulsification.

The research evaluated the following criteria after one month, three months, one year, and two years after surgery: objective visual quality, defocus curve, diopter, contrast sensitivity, and visual acuity. The satisfaction questionnaire and the VF-14 scale were evaluated statistically. The average age of the research participants was 53.12±4.68 years, according to the assessment of their characteristics. In the current study, there were 65.78% (n=50) females and 34.21% (n=26) men. The research participants' mean preoperative corneal astigmatism (D) was -0.64±0.25 D. Preoperative SE was -10.75±3.96 D on average. 0.11 (0-0.19) LogMAR was the mean preoperative CDVA (LogMAR). The average preoperative UDVA was 1.3 LogMAR (1.1, 1.8). According to Table 1, the mean axial length was 27.93±1.24 mm.

According to the study's findings, the DCNVA for postoperative visual acuity (LogMAR) was 0.04±0.06, 0.03±0.05, 0.02±0.04, and 0.02±0.04 after one month, three months, one year, and two years, respectively. UNVA was 0.04±0.06, 0.03±0.04, 0.02±0.05, and 0.03±0.0 at one month, three months, one year, and two years, respectively. The DCIVA was 0.04±0.05 at one month, 0.03±0.05 at one year, 0.02±0.04 at two years, and 0.04±0.05 at one month. The UIVA was 0.04±0.04, 0.03±0.05, 0.03±0.04, and 0.02±0.04 after one month, three months, one year, and two years, respectively. The CDVA was 0.03±0.06, 0.02±0.04, 0.02±0.04, and 0.02±0.05 after one month, three months, one year, and two years, respectively. According to Table 2, the UDVA for one month, three months, one year, and two years was 0.04±0.06, 0.03±0.05, 0.02±0.04, and 0.02±0.04 accordingly.

When the study participants' postoperative refractive errors were evaluated, their respective DS (diopter of spherical power) values were 0.04±0.26, 0.05±0.34, 0.01±0.33, and -0.03±0.34 at one month, three months, one year, and two years. At one month, three months, one year, and two years, the corresponding spherical equivalent (SE) was -0.18±0.24, -0.13±0.31, -0.21±0.34, and -0.18±0.43. At one month, three months, one year, and two years, the DC (diopter of cylindrical power) was -0.44±0.66, -0.36±0.59, -0.44±0.64, and -0.29±0.54 in that order (Table 3).

DISCUSSION

In this study, 106 eyes from 76 patients with high myopia who had trifocal intraocular lens implantation and phacoemulsification were evaluated. The research evaluated the following criteria after one month, three months, one year, and two years after surgery: objective visual quality, defocus curve, diopter, contrast sensitivity, and visual acuity.

The satisfaction questionnaire and the VF-14 scale were evaluated statistically. The current study's design was similar to that of the earlier research conducted by Kaur G et al. in 2021 and Shah VC et al. in 2010, both of which reported study designs that were equivalent to the current study.

According to the study's findings, the average age of the participants was 53.12±4.68 years, which was used to evaluate their characteristics. In the current study, there were 65.78% (n=50) females and 34.21% (n=26) men. The research participants' mean preoperative corneal astigmatism (D) was -0.64±0.25 D. Preoperative SE was -10.75±3.96 D on average.

0.11 (0-0.19) LogMAR was the mean preoperative CDVA (LogMAR). The average preoperative UDVA was 1.3 LogMAR (1.1, 1.8). Axial length was 27.93±1.24 mm on average. These results were in line with those of Ganesh S et al. (2017) and Li QM et al. (2020), who evaluated participants with similar demographics to the current study and implanted diffractive trifocal intraocular lenses (IOLs) in high myopic eyes.

The DCNVA at one month, three months, one year, and two years was 0.04±0.06, 0.03±0.05, 0.02±0.04, and 0.02±0.04 for postoperative visual acuity (LogMAR), respectively. UNVA was 0.04±0.06, 0.03±0.04, 0.02±0.05, and 0.03±0.0 at one month, three months, one year, and two years, respectively.

The DCIVA was 0.04±0.05 at one month, 0.03±0.05 at one year, 0.02±0.04 at two years, and 0.04±0.05 at one month. The UIVA was 0.04±0.04, 0.03±0.05, 0.03±0.04, and 0.02±0.04 after one month, three months, one year, and two years, respectively. The CDVA was 0.03±0.06, 0.02±0.04, 0.02±0.04, and 0.02±0.05 after one month, three months, one year, and two years, respectively. UDVA was 0.04±0.06, 0.03±0.05, 0.02±0.04, and 0.02±0.04 for one month, three months, one year, and two years, respectively. These findings concurred with those of Yang Y et al. (2018) and Cochener B et al. (2012), who found that postoperative visual acuity (LogMAR) as DCNVA, UNVA, DCIVA, CDVA, and UDVA produced outcomes similar to the current study in their individual investigations.

The diopter of spherical power (DS) at one month, three months, one year, and two years was 0.04±0.26, 0.05±0.34, 0.01±0.33, and -0.03±0.34 in relation to the evaluation of surgical refractive errors in study participants. At one month, three months, one year, and two years, the corresponding spherical equivalent (SE) was -0.18±0.24, -0.13±0.31, -0.21±0.34, and -0.18±0.43. At one month, three months, one year, and two years, the DC (diopter of cylindrical power) was -0.44±0.66, -0.36±0.59, -0.44±0.64, and -0.29±0.54, in that order. The present study's results were consistent with those of Altemir–Gomez I et al. (2020) and Martinez–de–la–Casa JM et al. (2017), who revealed postoperative refractive errors that were similar to those of their investigations.

CONCLUSION

The present study, within its limitations, concludes that diffractive trifocal IOL implantation results in good near, intermediate, and distance visual acuity in subjects having high myopia and cataract. Also, trifocal IOL is a stable, predictable, effective, and safe treatment method. It provides good long-term visual quality following surgery with high patient satisfaction and spectacle independence.

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Characteristics	**Number (n=76)**	**Percentage (%)**
Gender		
Males	26	34.21
Females	50	65.78
Mean age (years)	53.12±4.68	
Mean Preoperative corneal astigmatism (D)	-0.64±0.25	
Mean Preoperative SE (D)	-10.75±3.96	
Mean Preoperative CDVA (LogMAR)	0.11 (0-0.19)	
Mean Preoperative UDVA (LogMAR)	1.3 (1.1, 1.8)	
Mean axial length (mm)	27.93±1.24	

Table 1: Characteristics of study subjects

Mean visual acuity	1 month	3 months	1 year	2 years
DCNVA	0.04±0.06	0.03±0.05	0.02±0.04	0.02±0.04
UNVA	0.04±0.06	0.03±0.04	0.02±0.05	0.03±0.0
DCIVA	0.04±0.05	0.03±0.05	0.02±0.04	0.02 ±0.04
UIVA	0.04±0.04	0.03±0.05	0.03±0.04	0.02±0.04
CDVA	0.03±0.06	0.02±0.04	0.02±0.04	0.02±0.05
UDVA	0.04±0.14	0.02±0.06	0.02±0.07	0.02±0.06

Table 2: Postoperative visual acuity (LogMAR)

Mean refraction	1 month	3 months	1 year	2 years
DS	0.04±0.26	0.05±0.34	0.01±0.33	-0.03±0.34
SE	-0.18±0.24	-0.13±0.31	-0.21±0.34	-0.18±0.43
DC	-0.44±0.66	-0.36±0.59	-0.44±0.64	-0.29 ±0.54

Table 3: Postoperative refractive errors in study subjects