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Comparison of the Effects of Different Multifocal Lenses on Visual Acuity and Patient Satisfaction After Cataract Surgery

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Abstract

Objective: This prospective case series aims to compare and assess visual acuity, patient satisfaction, and the achievement of spectacle independence following trifocal intraocular lens (IOL) implantation in comparison to quadrifocal and monofocal lenses after cataract surgery.

Design: A prospective case series was conducted based on availability.

Materials and Methods: The study involved 18 patients who underwent cataract surgery using phacoemulsification. The patients were categorized into three groups: Group 1 (7 eyes) received trifocal IOL implants, Group 2 (7 eyes) received quadrifocal IOL implants, and Group 3 (4 eyes), the control group, had monofocal lenses implanted.

Results: Six months post-surgery, the average value of uncorrected distance visual acuity (UCDVA) ranged from 0.98 in the first group to 0.9 in the second and third groups. A noteworthy 94.4% of patients across all groups did not require glasses for distance vision, whereas the monofocal group required glasses for near and intermediate distances. There were no significant differences in patient satisfaction rates among the three groups.

Conclusion: The data suggest that distance visual acuity is comparable among all groups, while near vision is superior in the multifocal group. Overall, patient satisfaction remains high across all groups.

Keywords: multifocal and monofocal IOL, phacoemulsification, visual function, glare.

Introduction

It is estimated that approximately 95 million people worldwide are afflicted by cataracts.[1] Cataracts stand as a leading cause of visual impairment and blindness, predominantly affecting individuals over the age of 50.[2] A study conducted in the Finnish population to assess cataract prevalence reveals a significant age-related increase, rising from 2% in individuals under the age of 65 to a staggering 67% among those aged 85 or older. [3] In the United States, the projected total prevalence is expected to double to 50 million cases by the year 2050. [4] Cataracts are a multifactorial ailment, with factors such as age, gender, genetic predisposition, smoking, diabetes mellitus, medication use, and environmental exposure to UVB radiation contributing to its development. [5]

Currently, the sole effective treatment for cataracts is surgical intervention. Cataract surgery holds the position as the most common surgical procedure in healthcare, with over 9.5 million surgeries performed globally each

year.[6] With advancements in surgical technology and techniques, cataract surgery has evolved into a minimally invasive procedure characterized by precise incisions, rapid visual recovery, excellent visual acuity outcomes, and minimal complications for most patients.

The prevailing standard treatment for cataracts involves phacoemulsification with the implantation of a foldable intraocular lens (IOL). The goal of intraocular lens (IOL) implantation is to ensure high-quality visual performance and reduce dependence on eyeglasses. [7,8] While monofocal IOLs are designed to provide clear vision for either near or distant tasks, multifocal IOLs (MIOLs) with refractive or diffractive optical designs, or a combination thereof, have been introduced to overcome this limitation. They enable the treatment of presbyopia and reduce the need for eyeglasses.

In today's world, where common activities such as using phones, tablets, or computers require excellent intermediate vision, multifocal IOLs offer an improvement in intermediate vision without compromising distance and near vision.[9] Patient satisfaction following the implantation of premium multifocal lenses is directly associated to their ability to see clearly without the need for glasses. [10-12]

However, it has been reported that multifocal lenses may reduce contrast sensitivity and increase undesirable visual effects such as glare and halos. This is attributed to the dispersion and redirection of input light energy to multiple focal points. [13,14]

Subsequently, this prospective case series aims to compare and assess visual acuity, patient satisfaction, and the achievement of spectacle independence following trifocal intraocular lens (IOL) implantation in comparison to quadrifocal and monofocal lenses after cataract surgery.

Materials and Methods:

In this prospective, availability-based case series, 18 patients who underwent cataract surgery with phacoemulsification and received either multifocal (trifocal or quadrifocal) or monofocal IOLs were enrolled.

Inclusion criteria comprised the presence of cataracts, preoperative astigmatism less than 1.25 diopters (D), an age range of 46-67 years, and visual acuity (VA) of ≥ 0.3 using Snellen charts. Exclusion criteria included a history of prior ocular surgery, ocular conditions such as glaucoma, uveitis, or retinal diseases, as well as intraoperative and postoperative complications.

Preoperatively, patients underwent a thorough ophthalmic examination, including monocular assessment of uncorrected distance visual acuity (UCDVA) and corrected distance visual acuity (CDVA), uncorrected near visual acuity (UCNVA) and corrected near visual acuity (CNVA), optical biometry and keratometry (IOL Master 400; Carl Zeiss Meditec), corneal topography analysis (Wavelight, Allegro Oculyzer, Erlangen, Germany), slit-lamp biomicroscopy, tonometry, and dilated fundus examination.

The IOL Master was used to measure the axial length, and the Barrett Universal II formula with target refraction for emmetropia was applied for IOL calculations.

One surgeon conducted all the surgeries using local anesthesia. A primary scleral or corneal incision of 2.8 mm was made at 11 o'clock, and two paracenteses (nasal and temporal) were created using a 15 blade. In all cases, a manual capsulorhexis was performed, and cataract extraction was completed using phacoemulsification. IOL implantation took place in the capsular bag through the main incision using an injector. Local antibiotic and steroid eye drops were administered four times a day for three weeks. Postoperative visits were scheduled for the 1st to 2nd day, then at the 25th to 30th day, 60th to 90th day, and finally, the 120th to 180th day after surgery.

Patients were divided into three groups: the first group received multifocal (trifocal) lenses, the second group received multifocal (quadrifocal) lenses, and the third group was scheduled to receive monofocal lenses.

Results

The study included 18 patients (18 eyes) who underwent cataract surgery and were divided into three groups based on the implanted intraocular lenses: multifocal (trifocal) lens, multifocal (quadrifocal) lens, and monofocal lens.

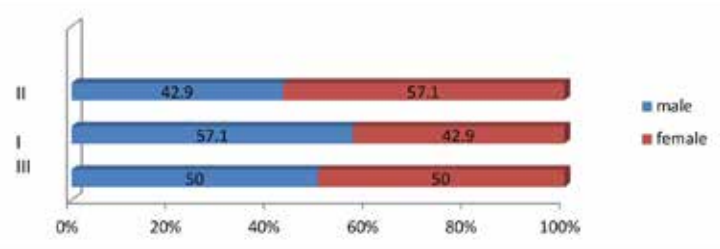
The average age of the patients was 55.0±5.7 years. Specifically, in the first group, the average age was 52.0±3.7, in the second group, it was 54.4±5.2, and in the third group, it was 61.5±4.8 (Table 1).

Gender distribution across the study groups was roughly equal and not statistically significant (Graph 1).

Table 1: Demographic Characteristics of Patients

Group/age	average	number	Std. Dev.
I Trifocal lenses	52.0	7	3.696846
II Quadrifocal lenses	54.4	7	5.191568
III Monofocal lenses	61.5	4	4.795832

Graph 1: Gender Distribution of Patients in the Study Groups



The average preoperative uncorrected distance visual acuity (UCDVA) varied from 0.5 in Group I, 0.3 in Group II, to 0.25 in Group III.

After 6 months post-operation, the average UCDVA stood at 0.98 in Group I, 0.9 in both Groups II and III.

Only one patient in the first group required glasses for distance vision. On the other hand, 50.0% of patients in the third group needed glasses for intermediate distance, and all four required them for near vision. Patients in the first and second groups did not require glasses for intermediate or near vision (Table 2).

Table 2: Overview of Glasses Requirement

		Far		Intermediate		Near	
group/need for glasses		number	%	number	%	number	%
I	yes	1	14.3	0		0	
	no	6	85.7	7	100.0	0	
II	yes	0		0		0	
	no	7	100.0	7	100.0	0	
III	yes	0		2	50.0	4	100.0
	no	4	100.0	2	50.0	0	0

Discussion

The primary objectives of cataract surgery today are to optimize visual outcomes and enhance postoperative patient satisfaction. Nowadays, cataract surgery patients seek to be completely free from glasses, aiming for optimal vision at all focal points to maintain independence and productivity in work and leisure activities. [15] [16]

Diffractive trifocal IOLs offer an extended range of visual acuity, from near to intermediate to distance. [17,18] However, dispersion of incoming light into multiple focal points can diminish the amount of energy directed at each of these points, potentially impacting visual acuity at all distances. [19]

This study aims to compare the effectiveness of trifocal and quadrifocal lenses in providing a continuous range of vision and also compares their performance to spherical monofocal IOLs.

Both trifocal and quadrifocal lenses demonstrated a high level of visual acuity at near, intermediate, and distance. Among the patients followed so far, trifocal lenses showed comparable monocular uncorrected distance visual acuity (UCDVA) compared to quadrifocal lenses.

This aligns with the high levels of predictability in refraction achieved, with almost all eyes (99%) having postoperative spherical equivalents within ±0.50 D. These results are similar to, and even better than, those reported in other studies on multifocal lenses.[20-22]

While both multifocal lenses ,when compared to monofocal lenses demonstrated comparable distance visual acuity, they exhibit superior monocular vision at near and intermediate distances. In this study, the need for glasses in the multifocal groups was observed in only one patient (14.3%), specifically for distance, in the trifocal group.

Surprisingly, in the quadrifocal group, no patient required glasses at any distance, which is notably high. Although other studies have also confirmed independence from glasses with multifocal lenses, up to 87.5%, [23] the results in this study show even more promising outcomes in terms of reduced dependence on glasses.

In the monofocal group, 2 patients (50%) required glasses for intermediate vision, and all 4 patients (100%) needed glasses for near vision. The use of glasses for intermediate and near distances is significantly lower in the multifocal groups, while it remains insignificant for distance vision. Independence from the use of glasses is one of the primary reasons why patients opt for multifocal lens implantation, and the results so far indicate that multifocal lenses meet these expectations.

Interestingly, in response to a satisfaction questionnaire, the results were similar in all three groups. All patients with implanted trifocal lenses expressed high satisfaction, rating their vision after surgery as 10.This indicates that they would choose the same lens again and recommend it to family or friends. In the quadrifocal group, the average rating was 3.47, which is statistically non-significant.

Although not statistically significant, patients reported higher levels of overall satisfaction with the trifocal lens compared to the quadrifocal lens. Similar high levels of satisfaction following multifocal lens implantation have also been reported in other studies. [24,25]

However, patients in the trifocal group reported more

noticeable glare and halos (rated at 1.6) compared to the quadrifocal group (rates at 1), while no patients in the monofocal group experienced such issues. Glare and halos are common unwanted effects associated with multifocal lenses, occurring 3.5 times more frequently then with monofocal lenses. [26,27] However, when asked how bothersome these symptoms are, the average response from both multifocal groups was minimal and statistically non-significant.

Conclusion

Based on our current data, distance visual acuity appears similar between trifocal and quadrifocal groups, as well as the monofocal group, while near visual acuity is superior in the multifocal groups compared to the monofocal group.

Patient satisfaction is quite high for both multifocal groups and surprisingly for the monofocal group as well.

Multifocal lenses are associated with less dependence on glasses but also with an increased likelihood of experiencing glare and halos compared to the monofocal group.

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