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MONOFOCAL VS. MULTIFOCAL INTRAOCULAR LENSES IN AGE-RELATED CATARACT: CLINICAL, FUNCTIONAL, AND PATIENT-REPORTED OUTCOMES

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Abstract. *Phacoemulsification with intraocular lens (IOL) implantation is the standard surgical treatment for age-related cataract, aiming to restore visual function and improve quality of life. This prospective study evaluated 80 patients who underwent cataract surgery with either monofocal (n=40) or multifocal (n=40) IOL implantation. Postoperative assessment at 1 and 3 months included uncorrected visual acuity at far, intermediate, and near distances, contrast sensitivity, visual phenomena, and patient satisfaction. Both groups achieved significant improvement in distance vision. Multifocal IOLs provided superior near and intermediate visual acuity and reduced dependence on spectacles, while monofocal IOLs showed higher contrast sensitivity and fewer visual disturbances. These findings highlight the importance of individualized IOL selection based on patient lifestyle, visual requirements, and tolerance for optical side effects to optimize functional outcomes and satisfaction after cataract surgery.*

Keywords: *age-related cataract, phacoemulsification, intraocular lens, monofocal IOL, multifocal IOL, visual acuity, contrast sensitivity, patient satisfaction, spectacle independence.*

Introduction. Cataract is the leading cause of reversible visual impairment worldwide and significantly affects quality of life, particularly in the elderly population. Phacoemulsification with intraocular lens (IOL) implantation is the standard surgical approach to restore visual function.

While monofocal IOLs provide excellent distance vision, they often require additional spectacle correction for near and intermediate tasks. Multifocal IOLs have been developed to improve visual performance at multiple distances, aiming to increase patient independence from glasses. Despite advances in IOL technology, the choice between monofocal and multifocal lenses remains complex [1,2]. Multifocal lenses can be associated with reduced contrast sensitivity and visual phenomena such as halos and glare, which may influence patient satisfaction.

Understanding the clinical and functional outcomes of different IOL types is essential for individualized patient care [3]. The purpose of this study was to compare the clinical and functional outcomes of monofocal and multifocal IOL implantation in patients following cataract surgery.

The objectives were to evaluate visual acuity at far, intermediate, and near distances, assess contrast sensitivity, analyze the frequency and severity of visual phenomena, determine patient satisfaction and dependence on spectacles, and compare overall functional outcomes to guide optimal IOL selection.

Materials and methods. A prospective comparative study was conducted including 80 patients diagnosed with age-related cataract who underwent phacoemulsification with posterior chamber intraocular lens implantation [1]. Patients were divided into two groups: 40 patients received monofocal IOLs (Group I), and 40 patients received multifocal IOLs (Group II).

Inclusion criteria were: age 50–75 years, diagnosis of age-related cataract, corneal astigmatism ≤1.0 D, and absence of retinal or optic nerve pathology. Patients with glaucoma, diabetic retinopathy, age-related macular degeneration, previous ocular surgery, or intraoperative complications were excluded.

All surgeries were performed under topical anesthesia by a single experienced surgeon.

Standard phacoemulsification was followed by implantation of the selected IOL in the posterior chamber. Postoperative follow-up occurred at 1 and 3 months.

The following parameters were evaluated:

1. Uncorrected visual acuity (UCVA) at far (4 m), intermediate (60–80 cm), and near (33–40 cm) distances.
2. Contrast sensitivity under photopic conditions using standardized testing charts.
3. Frequency and severity of visual phenomena (halo, glare) via patient questionnaire, graded as mild, moderate, or severe.
4. Patient satisfaction and dependence on spectacles, assessed using a 5-point Likert scale.

Statistical analysis was performed using Student's t-test for continuous variables and chi-square test for categorical data, with $p<0.05$ considered statistically significant.

Results. All 80 patients completed the study and postoperative follow-up at 1 and 3 months. Both groups demonstrated statistically significant improvement in uncorrected distance visual acuity (UDVA) after phacoemulsification ($p<0.001$ for both). In the monofocal IOL group (Group I), mean UDVA at 3 months was 0.92 ± 0.08, while in the multifocal IOL group (Group II), it was 0.90 ± 0.10 ($p>0.05$), indicating comparable restoration of distance vision.

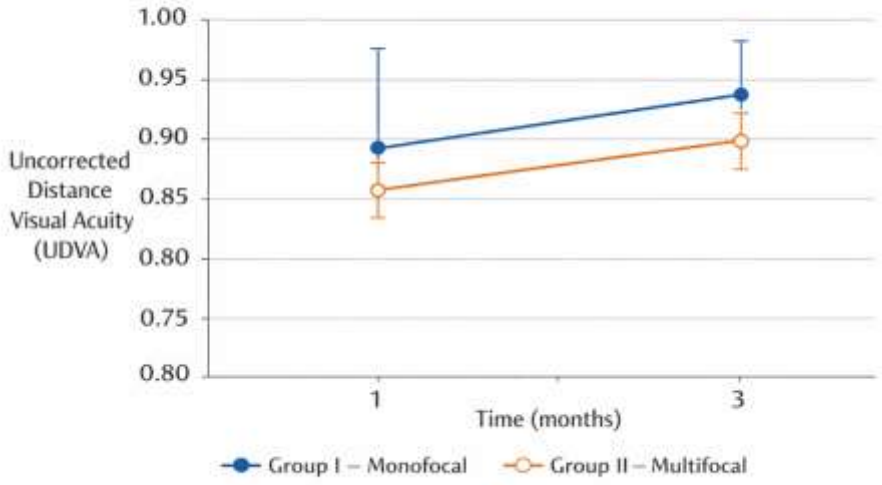

Figure 1. Postoperative UDVA in Monofocal and Multifocal IOL Groups

The graph shows mean uncorrected distance visual acuity (UDVA) at 1 and 3 months after cataract surgery for monofocal (Group I) and multifocal (Group II) IOLs, with error bars representing standard deviation. Both groups showed significant improvement, with similar distance vision at 3 months.

Uncorrected intermediate and near visual acuity (UIVA and UNVA) differed markedly between the groups. In Group I, mean UIVA was 0.38 ± 0.10, whereas in Group II, it reached 0.15 ± 0.07 ($p<0.001$). Similarly, UNVA in Group I was 0.45 ± 0.12 compared to 0.12 ± 0.06 in Group II ($p<0.001$). These results demonstrate that multifocal IOLs provide significantly better visual performance at near and intermediate distances, confirming their functional advantage over monofocal lenses in everyday tasks such as reading or computer work.

Contrast sensitivity measured under photopic conditions was higher in the monofocal IOL group across spatial frequencies of 3, 6, 12, and 18 cycles/degree. For example, at 6 cycles/degree, mean contrast sensitivity was 1.92 ± 0.15 in Group I versus 1.68 ± 0.18 in Group II ($p<0.05$). This indicates that the optical design of multifocal lenses may slightly reduce contrast sensitivity compared with monofocal lenses, which could affect visual quality under low-contrast conditions.

Regarding visual phenomena, 32.5% of patients with multifocal IOLs reported halos and 27.5% reported glare at 1 month postoperatively. In contrast, only 7.5% and 5% of patients in the monofocal group experienced halos and glare, respectively. By 3 months, most symptoms had decreased in intensity, with the majority classified as mild, suggesting partial neuroadaptation over time.

Patient-reported outcomes demonstrated higher satisfaction in the multifocal IOL group for near and intermediate vision. In Group II, 85% of patients reported high or very high satisfaction, compared to 55% in Group I. Spectacle dependence was significantly lower in the multifocal group: only 15% required glasses for near or intermediate tasks, whereas 75% of patients in the monofocal group continued to use spectacles for these distances. No intraoperative or postoperative complications, such as posterior capsular rupture, significant corneal edema, or endophthalmitis, were observed in either group.

Discussion. The results of this study demonstrate that both monofocal and multifocal intraocular lenses (IOLs) provide excellent distance vision following phacoemulsification, confirming the effectiveness and safety of modern cataract surgery. The absence of significant differences in uncorrected distance visual acuity between groups aligns with previous studies, which consistently report that monofocal and multifocal IOLs achieve similar outcomes for far vision. However, multifocal IOLs showed clear advantages in uncorrected near and intermediate visual acuity. The improved performance at these distances supports the concept of multifocal optics, which divides incoming light to provide simultaneous focus at multiple planes. This characteristic allows patients to perform daily activities, such as reading, computer work, and mobile device use, with reduced reliance on spectacles. Similar findings have been reported in clinical trials, where multifocal and trifocal IOLs consistently demonstrated better near and intermediate functional vision compared to monofocal lenses [4,5].

Contrast sensitivity analysis revealed a mild reduction in patients with multifocal lenses compared to monofocal lenses. This phenomenon is likely related to the diffraction and splitting of light inherent in multifocal optics. While this reduction did not prevent functional vision, it may become noticeable under low-contrast conditions, such as night driving or dim lighting, and should be considered when counseling patients preoperatively. Previous studies also report comparable decreases in contrast sensitivity for multifocal lenses, emphasizing the trade-off between extended focal range and optical quality [6].

Visual phenomena, including halos and glare, were more frequently reported in the multifocal group, particularly in the early postoperative period. These symptoms generally decreased over time, reflecting neural adaptation and cortical adjustment to the new optical system. Despite the initial prevalence, patient satisfaction remained high, highlighting that the benefits of spectacle independence often outweigh mild optical side effects.

Patient-reported outcomes confirmed that multifocal lenses significantly reduce dependence on spectacles, with 85% of patients expressing high or very high satisfaction for near and intermediate tasks. Monofocal IOL patients remained highly satisfied with distance vision but continued to rely on glasses for close work, underscoring the importance of individualized lens selection based on lifestyle and visual priorities.

In clinical practice, these findings support careful preoperative counseling and selection of IOL type according to patient needs. Patients prioritizing reading, computer use, or reduced spectacle dependence may benefit most from multifocal IOLs, whereas those with concerns about contrast sensitivity or night driving may prefer monofocal lenses. Balancing optical performance with functional outcomes is essential to maximize patient satisfaction and quality of life after cataract surgery.

Conclusion. Phacoemulsification with intraocular lens implantation is a safe and effective surgical treatment for age-related cataract. Both monofocal and multifocal IOLs provide excellent uncorrected distance vision, restoring functional visual acuity and improving quality of life.

Multifocal lenses offer significant advantages in uncorrected near and intermediate vision, allowing patients to perform daily tasks with minimal dependence on spectacles. In contrast, monofocal IOLs ensure superior contrast sensitivity and are associated with fewer visual phenomena, making them particularly suitable for patients prioritizing distance vision and optimal optical quality.

Patient satisfaction and functional independence from spectacles were higher in the multifocal IOL group, while monofocal lenses remain highly effective for distance-oriented visual needs. The choice between monofocal and multifocal IOLs should therefore be individualized, taking into account patient lifestyle, visual requirements, tolerance for optical side effects, and expectations for spectacle independence.

Overall, this study supports evidence-based selection of intraocular lens type to optimize both clinical and functional outcomes after cataract surgery, emphasizing that personalized IOL choice is essential for maximizing postoperative vision quality and patient satisfaction.

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