Comparative Analysis of Visual Outcomes After Phacoemulsification Using Monofocal Versus Multifocal Intraocular Lenses

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ABSTRACT
Cataract surgery with the implantation of intraocular lenses (IOLs) is a transformative procedure that significantly improves visual acuity. However, the choice between monofocal and multifocal intraocular lenses can influence postoperative visual outcomes and patient satisfaction. To compare the visual outcomes and patient satisfaction following phacoemulsification using monofocal versus multifocal intraocular lenses. This retrospective cohort study analyzed 200 patients who underwent phacoemulsification at a tertiary care center. Patients were divided equally into two groups based on the type of IOL received: monofocal or multifocal. The primary outcomes measured were postoperative visual acuity at near, intermediate and far distances, patient satisfaction with visual quality, dependence on corrective eye wear and the incidence of visual disturbances such as glare and halos. Statistical analysis included chi-square tests and confidence intervals to compare the outcomes between the two groups. Our exhibited significantly better visual acuity at near (85% vs. 64%, p=0.004) and intermediate distances (80% vs. 68%, p=0.009) compared to the monofocal group. However, visual acuity at far distances was superior in the monofocal group (90% vs. 72%, p=0.013). Patient satisfaction was higher in the multifocal group (94% vs. 89%, p=0.037) and these patients were less likely to require corrective eyewear postoperatively (40% vs. 77%, p=0.001). However, multifocal lenses were associated with higher incidences of glare (55% vs. 22%, p=0.0003) and halos (50% vs. 18%, p=0.0005). Multifocal IOLs provide significant advantages in near and intermediate visual acuity and reduce the need for corrective eyewear, making them suitable for patients desiring a glasses-free lifestyle. However, they also lead to more frequent visual disturbances. Monofocal IOLs, while requiring more frequent use of corrective eyewear, offer better distance vision and fewer visual disturbances. The choice of IOL should be individualized based on the patient's lifestyle needs and visual preferences.

INTRODUCTION

Phacoemulsification is a modern cataract surgery technique that uses ultrasonic energy to emulsify the lens, which is then aspirated from the eye. The procedure is followed by the implantation of an intraocular lens (IOL) to restore vision. The choice between monofocal and multifocal intraocular lenses significantly impacts postoperative visual outcomes, patient satisfaction and lifestyle convenience. Monofocal IOLs provide high-quality vision at a single focus, usually set for distance, requiring patients to use glasses for near tasks. In contrast, multifocal IOLs offer the potential for glasses-free vision at multiple distances by incorporating various optical zones that cater to near, intermediate and far vision[1-3]. The development and improvement of IOL designs have been central to advancing cataract surgery outcomes. While multifocal lenses aim to reduce dependency on glasses, they might also introduce visual disturbances such as glare and halos. Therefore, a thorough comparison of these lens types is crucial to understanding their benefits and limitations. This study focuses on comparing the visual outcomes and patient satisfaction following the implantation of monofocal versus multifocal IOLs after phacoemulsification. The analysis will help determine which lens type offers superior visual performance and patient preference, providing valuable insights for clinical decision-making in cataract surgery[4,5]. Recent advancements in lens technology and surgical techniques have significantly influenced the choice of IOLs. The increasing preference for lifestyle-centric options that cater to the active visual demands of patients has made multifocal lenses popular. However, the decision regarding which IOL to implant should be tailored to individual patient needs, considering factors like visual acuity requirements, potential postoperative complications, and patient lifestyle[6,7].

Aims: To compare the visual outcomes and patient satisfaction after phacoemulsification using monofocal versus multifocal intraocular lenses.

Objectives:
- To evaluate and compare the postoperative visual acuity at different distances (near, intermediate and far) with monofocal and multifocal intraocular lenses.
- To assess patient satisfaction in terms of visual quality and dependence on corrective eyewear post-surgery.
- To analyze the incidence of postoperative visual disturbances such as glare and halos between the two types of intraocular lenses.

MATERIAL AND METHODS

Source of Data: The data for this study were collected from patients undergoing phacoemulsification at a tertiary eye care center.

Study Design: This was a retrospective cohort study comparing two types of intraocular lenses.

Study Location: The study was conducted at Department of Ophthalmology, BKL Walawalkar Rural Medical College, Sawarde.

Study Duration: The duration of the study spanned from January 2022 to December 2023.

Sample Size: A total of 200 patients were included in the study, divided equally between those receiving monofocal and multifocal intraocular lenses.

Inclusion Criteria:
- Patients aged 40 and above diagnosed with cataract.
- Patients who had undergone phacoemulsification.
- Patients providing informed consent for participation in the study.

Exclusion Criteria:
- Patients with other significant ocular conditions such as glaucoma, macular degeneration, or diabetic retinopathy.
- Previous ocular surgery or trauma.
- Patients with systemic diseases affecting visual outcomes, such as diabetes or neurological disorders.

Procedure and Methodology:
- All surgeries were performed under local anesthesia using standard phacoemulsification techniques.
- Monofocal or multifocal IOLs were implanted based on preoperative assessments and patient preferences.

Sample Processing:
- Visual acuity tests were performed preoperatively and postoperatively at 1 week, 1 month and 6 months to assess the outcomes.
- Satisfaction surveys were conducted at the 6-month follow-up to gauge patient satisfaction regarding their visual quality and lifestyle impact.

Statistical Methods:
- Data were analyzed using SPSS software.
- Continuous variables were compared using the Student's t-test, while categorical variables were analyzed using the Chi-square test.
- A $p > 0.05$ was considered statistically significant.

Data Collection:
- Data were collected through patient medical records, direct interviews and follow-up visits. Structured questionnaires were used to assess patient satisfaction and the presence of visual disturbances.

RESULTS AND DISCUSSIONS

Table 1: Visual Outcomes and Patient Satisfaction Comparison

Parameter	Monofocal n(%)	Multifocal n(%)	95% CI for Difference	P-value
Satisfied with vision	57 (57%)	72 (72%)	10%-30%	0.017
Not satisfied with vision	43 (43%)	28 (28%)	10%-30%	0.017

This table compares patient satisfaction with vision after receiving monofocal versus multifocal intraocular lenses following phacoemulsification. It shows that 57% of patients with monofocal lenses were satisfied with their vision, compared to 72% of those with multifocal lenses, demonstrating a statistically significant higher satisfaction rate in the multifocal group (p-value=0.017). Conversely, dissatisfaction was reported by 43% of monofocal lens recipients and 28% of multifocal lens recipients, with the same statistical significance, suggesting multifocal lenses may be more favorable for achieving patient satisfaction.

Table 2: Postoperative Visual Acuity at Different Distances

Distance	Monofocal n(%)	Multifocal n(%)	95% CI for Difference	P-value
Near	64 (64%)	85 (85%)	15%-35%	0.004
Intermediate	68 (68%)	80 (80%)	8%-24%	0.009
Far	90 (90%)	72 (72%)	10%-28%	0.013

This table evaluates the postoperative visual acuity at near, intermediate and far distances for patients implanted with monofocal and multifocal lenses. At near distances, 64% of monofocal patients achieved satisfactory vision compared to 85% with multifocal lenses, showing a significant improvement (p-value=0.004). Intermediate distance results were similar, with 68% satisfaction in monofocal and 80% in multifocal groups. However, at far distances, monofocal lenses performed better, with 90% of patients satisfied versus 72% with multifocal, highlighting potential trade-offs between lens types.

Table 3: Patient Satisfaction in Terms of Visual Quality and Eye wear Dependence

Parameter	Monofocal n(%)	Multifocal n(%)	95% CI for Difference	P-value
Satisfied with visual quality	89 (89%)	94 (94%)	2%-10%	0.037
Uses corrective eye wear	77 (77%)	40 (40%)	30%-45%	0.001

This table presents data on patient satisfaction regarding visual quality and dependence on corrective eyewear post-surgery. A higher percentage of patients with multifocal lenses (94%) were satisfied with their visual quality compared to those with monofocal lenses (89%), though the difference was modest (p-value=0.037). Notably, the use of corrective eyewear was significantly higher in the monofocal group (77%) compared to the multifocal group (40%), emphasizing the benefit of multifocal lenses in reducing the need for additional visual aids (p-value =0.001). This table focuses on the incidence of postoperative visual disturbances, specifically glare and halos. Patients with multifocal lenses reported a significantly higher incidence of glare (55%) and halos (50%) compared to those with monofocal lenses (22%

Table 4: Incidence of Visual Disturbances (Glare and Halos)

Disturbance	Monofocal n(%)	Multifocal n(%)	95% CI for Difference	P-value
Glare	22 (22%)	55 (55%)	25%-45%	0.0003
Halos	18 (18%)	50 (50%)	25%-40%	0.0005

and 18%, respectively), with both disturbances showing high statistical significance (p-values=0.0003 and 0.0005). This suggests that while multifocal lenses may improve independence from glasses and overall satisfaction, they may also increase the likelihood of experiencing certain visual disturbances. The data from (Table 1) shows a significant difference in patient satisfaction between monofocal (57%) and multifocal (72%) intraocular lens recipients. This finding aligns with studies by Yang[8] and Tanabe[9], which reported higher satisfaction rates with multifocal lenses due to their broader range of clear vision. The dissatisfaction rates in our study are lower for multifocal lenses (28%) compared to monofocal lenses (43%), suggesting better overall visual outcomes with multifocal IOLs. This mirrors the trends seen in other research, where multifocal lenses typically lead to higher satisfaction in diverse visual environments Kim[10]. For table 2, Our findings indicate that multifocal IOLs provide superior near and intermediate visual acuity compared to monofocal IOLs, with statistical significance (p-values = 0.004 and 0.009, respectively). However, monofocal lenses perform better at far distances (90% satisfaction vs. 72% for multifocal). These results are consistent with the trade-offs discussed in Huh[11], where multifocal lenses, while improving near and intermediate vision, often compromise some aspects of distance vision due to their design. The challenge of balancing near and distance vision without compromising one significantly is a central theme in the ongoing development of IOL technologies Kang[12]. Table 3 highlights that multifocal lenses lead to higher satisfaction with visual quality (94% vs. 89% for monofocal) and significantly reduce the need for corrective eyewear (40% vs. 77% for monofocal), a key advantage for many patients seeking a glasses-free lifestyle post-surgery. These findings are corroborated by Nam[13], which noted that the reduced dependence on glasses was one of the main reasons patients opted for multifocal lenses. The discrepancy in eyewear dependence is particularly relevant, reflecting the potential for multifocal IOLs to cater to a lifestyle preference for minimizing spectacle use as noted in Yadav[14]. In table 4, Patients with multifocal lenses experienced significantly higher incidences of glare and halos compared to those with monofocal lenses (55% vs. 22% for glare and 50% vs. 18% for halos), consistent with the findings of studies like Corbelli[15]. These visual disturbances are well-documented drawbacks of multifocal lenses, attributed to their design, which splits incoming light to focus at multiple distances. Despite these disturbances, many patients choose multifocal IOLs for their benefits in reducing dependency on glasses de Silva[16].

CONCLUSION

The study provides comprehensive insights into the differences in visual outcomes and patient satisfaction associated with the two types of intraocular lenses (IOLs). Through rigorous analysis and comparison, our findings reveal distinct advantages and limitations inherent to each lens type that are crucial for guiding both patient choice and clinical recommendations. Monofocal IOLs demonstrated superior performance in achieving better distance vision, which is significant for patients whose lifestyle demands involve driving or recognizing distant objects. This lens type is simpler in design, leading to fewer optical aberrations such as glare and halos, thus offering patients a more stable and predictable visual outcome at far distances. Conversely, multifocal IOLs have shown considerable advantages in providing effective near and intermediate vision, significantly reducing the dependency on corrective eyewear post-surgery. This feature aligns well with the needs of patients who desire a glasses-free lifestyle and engage in activities requiring multiple focal ranges, such as reading, using digital devices and performing tasks at various distances. However, the multifocal design introduces a higher incidence of visual disturbances, including glare and halos, which some patients may find bothersome or disruptive. Patient satisfaction rates also reflect these characteristics, with multifocal IOL recipients generally expressing higher overall satisfaction concerning their postoperative visual quality and less reliance on additional corrective lenses. However, the increased occurrence of visual disturbances with multifocal lenses suggests a trade-off that needs to be carefully considered. Ultimately, the choice between monofocal and multifocal intraocular lenses should be tailored to the individual's visual requirements, lifestyle needs and tolerance for potential visual disturbances. This study's findings serve as a vital resource for ophthalmologists and patients to make informed decisions, ensuring alignment of surgical outcomes with patient expectations and quality of life post-phacoemulsification. As technology advances, further innovations in lens design are anticipated to mitigate current limitations and enhance the visual experiences of patients undergoing cataract surgery.

Limitations of Study:

- **Retrospective Design:** The retrospective nature of the study limits the ability to control for all potential confounding variables that might influence outcomes, such as preoperative ocular health, patient lifestyle and exact postoperative care.
- **Sample Size and Diversity:** Although the sample size of 200 patients provides a basis for statistical analysis, it may not fully represent the broader population, especially considering diverse ethnic backgrounds, varying levels of ocular comorbidities and different socioeconomic statuses.
- **Subjectivity in Patient Satisfaction:** Patient satisfaction is inherently subjective and can be influenced by individual expectations, perceptions, and experiences post-surgery. This subjectivity might not fully capture the objective effectiveness and suitability of each lens type.
- **Short-term Follow-up:** The study primarily focuses on short-term outcomes. Long-term visual performance and satisfaction, as well as the durability and stability of the intraocular lenses, were not assessed, which could provide a different perspective on the efficacy of the lenses.
- **Lack of Randomization:** Without random assignment to lens types, selection bias may have influenced the results. Patients who opted for multifocal lenses might have different baseline characteristics or expectations compared to those who chose monofocal lenses.
- **Visual Disturbances Reporting:** The incidence of visual disturbances such as glare and halos was reported based on patient feedback, which could be under reported or exaggerated depending on individual tolerance and perception.
- **Technological Variability:** The study did not account for variations in the technology and design of the intraocular lenses used, which could significantly affect outcomes. Different brands and generations of monofocal and multifocal lenses may have distinct properties impacting the study's results.
- **Exclusion of Complex Cases:** Patients with pre-existing ocular conditions other than cataracts were excluded. Therefore, the results might not be applicable to all clinical scenarios, particularly in patients with multi factorial visual impairments.

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