

Original Article

Phacoemulsification versus Extracapsular Cataract Extraction: A Comparative Study of Surgical Outcomes, Surgical Site Infection Rate, and Associated Causes

Hafiza Tuba Razzaqi¹, Usra Naeem², Muhammad Naveed Babur³

¹ Faculty of Allied Health Sciences, The Superior University, Lahore, Pakistan

² Associate Professor, Department of Emerging Allied Health Technologies, Faculty of Allied Health Sciences, The Superior University, Lahore, Pakistan

³ Professor, Faculty of Allied Health Sciences, The Superior University, Lahore, Pakistan

✉ Correspondence: Usra Naeem, usra.naeem@superior.edu.pk

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ABSTRACT

Background: Phacoemulsification and extracapsular cataract extraction (ECCE) remain established approaches to cataract surgery, with differences in incision size, recovery, intraocular-lens requirements, resource needs, and postoperative outcomes. **Objective:** To compare early postoperative ocular outcomes and study-defined postoperative infection between phacoemulsification and ECCE and to evaluate factors associated with infection. **Methods:** A comparative observational study included 250 adults undergoing cataract surgery at Lahore General Hospital, with 125 patients in each surgical group. Preoperative and approximately one-week postoperative assessments included intraocular pressure (IOP), ocular findings, corrected vision, contrast sensitivity, eye alignment, satisfaction, quality-of-vision ratings, and postoperative ocular infection. **Results:** Corrected visual outcome was documented in 121/125 (96.8%) patients undergoing phacoemulsification compared with 111/125 (88.8%) undergoing ECCE ($p=0.014$). Satisfaction was 72.8% versus 52.0% ($p<0.001$). Study-defined postoperative ocular infection occurred in 27/125 (21.6%) versus 51/125 (40.8%), corresponding to a risk ratio of 0.53 (95% CI 0.36–0.79) and an absolute risk difference of –19.2 percentage points. Increased conjunctival vascularity was less frequent after phacoemulsification (12.8% vs 23.2%, $p=0.032$). Iris atrophy and overall quality-of-vision category distributions did not differ significantly. Previous eye surgery and improper sterilization were strongly associated with the study-defined infection outcome. **Conclusion:** Phacoemulsification was associated with better early corrected-vision and satisfaction outcomes and a lower rate of study-defined postoperative ocular infection than ECCE. The infection findings require cautious interpretation because the case definition, treatment allocation, and temporal relationships of several associated factors were incompletely characterized. **Keywords:** Cataract; Phacoemulsification; Extracapsular Cataract Extraction; Postoperative Infection; Visual Outcome; Intraocular Pressure.

INTRODUCTION

Cataract remains a major cause of avoidable blindness and moderate-to-severe visual impairment worldwide. Contemporary global analyses indicate that cataract continues to account for a substantial proportion of vision loss, particularly in older adults and in regions where population growth, aging,

surgical access, and service capacity affect the ability of health systems to meet the need for cataract treatment (1,2). Although age-standardized cataract-related blindness has declined in many settings, the absolute number of people affected remains substantial because of demographic change, reinforcing cataract surgery as an important component of global eye-health services (1,2).

Surgical extraction of the opaque crystalline lens followed by intraocular-lens implantation is the definitive treatment when cataract produces clinically meaningful visual disability. Phacoemulsification uses ultrasonic energy to fragment and aspirate the lens through a comparatively small incision and commonly permits implantation of a foldable intraocular lens, whereas conventional ECCE removes the lens nucleus through a larger incision while preserving the posterior capsule (3,4). Both techniques can restore useful vision, but randomized and comparative evidence has demonstrated differences in incision size, postoperative recovery, surgically induced astigmatism, corneal endothelial effects, equipment requirements, and selected complications (3-6). A Cochrane review comparing phacoemulsification with ECCE for age-related cataract found evidence favoring phacoemulsification for selected visual outcomes and complication profiles, while also recognizing the importance of surgical expertise, infrastructure, and resource availability (3).

Postoperative infection is a clinically important complication of cataract surgery, particularly when infection involves the intraocular compartment. Acute postoperative endophthalmitis is uncommon but potentially vision-threatening, and its prevention requires attention to perioperative antisepsis, surgical technique, instrument reprocessing, medication practices, and operating-room infection-control systems (7). Contemporary guideline reviews and systematic evidence support structured perioperative infection-prevention measures and appropriate antimicrobial prophylaxis in cataract surgery (8,9). Large clinical studies and meta-analyses have demonstrated reductions in postoperative endophthalmitis with intracameral antibiotic prophylaxis, although choice of agent, formulation, safety, and local practice remain relevant considerations (10-12). Large population-based cataract-surgery cohorts nevertheless indicate that confirmed acute postoperative endophthalmitis occurs at a rate far below the very high postoperative "infection" percentages sometimes reported in studies using broader or insufficiently defined endpoints (13). Patient characteristics, intraoperative complications, and other surgical factors can also modify endophthalmitis risk (14-16).

Consequently, a postoperative infection endpoint requires a sufficiently specific case definition. Conjunctival injection or vascularity, postoperative inflammation, wound abnormalities, superficial infection, and clinically confirmed intraocular endophthalmitis represent clinically distinct conditions and should not automatically be treated as equivalent outcomes (7,8). Sterilization quality is particularly important in ophthalmic surgery because intraocular procedures introduce instruments and implanted material into a normally sterile anatomical compartment (7-9). Against this background, the present study compared early postoperative outcomes between phacoemulsification and ECCE and examined factors associated with study-defined postoperative ocular infection during the first postoperative week.

MATERIALS AND METHODS

A comparative observational study was conducted in the Department of Ophthalmology at Lahore General Hospital. The study included 250 patients undergoing cataract extraction, of whom 125 underwent phacoemulsification and 125 underwent extracapsular cataract extraction. Eligible participants were adults aged 18-80 years requiring cataract surgery. Patients with active ocular infection, glaucoma, corneal opacity, retinal disease, or planned combined ophthalmic procedures such as pars plana vitrectomy, trabeculectomy, or keratoplasty were excluded.

Ophthalmic Evaluation

Preoperative assessment included visual evaluation and measurement of intraocular pressure using Goldmann applanation tonometry. Goldmann applanation tonometry is an established clinical method for IOP measurement, although measurement accuracy can be influenced by ocular and technical factors that should be considered when interpreting individual values (17,18). Visual acuity was documented using a LogMAR-based approach. LogMAR-based visual-acuity measurement provides a standardized logarithmic scale and is widely used for quantitative comparison of visual performance and change over time (19,20).

Postoperative assessment was performed approximately one week after surgery. Recorded outcomes included conjunctival appearance, conjunctival vascularity, iris atrophy, iris prolapse, corrected visual outcome, quality of vision, contrast sensitivity, ocular alignment, patient satisfaction, and postoperative ocular infection. Contrast sensitivity was assessed using a Pelli-Robson chart, an established letter-based method for clinical assessment of contrast sensitivity with documented repeatability and discriminatory utility in ophthalmic populations, including people with cataract (21,22).

Infection-Related Factors

Potential factors evaluated in relation to postoperative ocular infection included previous eye surgery, history of ocular trauma, improper instrument sterilization, and postoperative antibiotic prescription. Improper sterilization was operationalized using indicators including absence of confirmation of the sterilization process or the presence of wet instrumentation.

Statistical Analysis

Categorical outcomes were compared using Pearson chi-square or Fisher exact testing, as appropriate. Continuous outcomes were summarized as mean $\pm$ SD. For the comparison of postoperative infection between surgical groups, risk ratios, odds ratios, absolute risk differences, and 95% confidence intervals were calculated from the 2 $\times$ 2 contingency-table data. For change in IOP, an additional Welch between-group comparison was calculated using the available group summary statistics. Statistical significance was defined as $p < 0.05$. Ethical approval was obtained from the Institutional Review Board of Superior University, Lahore, Pakistan.

RESULTS

The overall sample consisted of 250 participants with a mean age of 59.22 $\pm$ 12.27 years. Females comprised 58.8% of participants.

Table 1. Overall Participant and Procedural Characteristics

Variable	n (%) / Mean $\pm$ SD
Total participants	250
Mean age, years	59.22 $\pm$ 12.27
Male	103 (41.2%)
Female	147 (58.8%)
Right eye	122 (48.8%)
Left eye	128 (51.2%)
Age-related cataract	173 (69.2%)
Traumatic cataract	26 (10.4%)
Secondary/diabetic cataract	51 (20.4%)
General anesthesia	18 (7.2%)
Local anesthesia	151 (60.4%)
Topical anesthesia	81 (32.4%)
Foldable IOL	123 (49.2%)
Rigid IOL	127 (50.8%)

Early Ocular Findings

Abnormal conjunctival color occurred at a similar frequency in the two surgical groups. Increased conjunctival vascularity was less frequent after phacoemulsification than after ECCE. Iris atrophy was numerically less frequent after phacoemulsification, although the difference was not statistically significant. Iris prolapse was also less frequent numerically in the phacoemulsification group, but the difference did not reach conventional statistical significance.

Table 2. Early Postoperative Ocular Findings

Outcome	Phacoemulsification n/N (%)	ECCE n/N (%)	p
Abnormal conjunctival color	19/125 (15.2)	22/125 (17.6)	0.608
Increased vascularity	16/125 (12.8)	29/125 (23.2)	0.032
Iris atrophy	14/125 (11.2)	23/125 (18.4)	0.109
Iris prolapse	9/125 (7.2)	18/125 (14.4)	0.067

Intraocular Pressure Mean IOP decreased after surgery in both groups.

Table 3. Intraocular Pressure

Measure	Phacoemulsification	ECCE
Preoperative IOP, mmHg	13.90±2.60	14.60±3.06
Postoperative IOP, mmHg	10.52±3.06	11.52±3.18
Mean change, mmHg	-3.38±2.88	-3.08±3.08

The between-group difference in IOP reduction was 0.30 mmHg and was not statistically significant (95% CI approximately -0.44 to 1.04; p=0.427).

Visual and Patient-Reported Outcomes

Corrected visual outcome was more frequently achieved after phacoemulsification than after ECCE. Overall patient satisfaction was also substantially higher in the phacoemulsification group. Contrast sensitivity did not differ significantly between groups. Normal ocular alignment was observed in 96.0% of the phacoemulsification group and 89.6% of the ECCE group, with a p value of 0.050.

Table 4. Visual and Patient-Reported Outcomes

Outcome	Phacoemulsification	ECCE	p
Corrected vision achieved	121/125 (96.8%)	111/125 (88.8%)	0.014
Contrast sensitivity present	92/125 (73.6%)	85/125 (68.0%)	0.330
Normal eye alignment	120/125 (96.0%)	112/125 (89.6%)	0.050
Satisfied	91/125 (72.8%)	65/125 (52.0%)	<0.001

Quality-of-Vision Categories

Table 5. Quality-of-Vision Rating

Category	Phacoemulsification	ECCE
No improvement	7	11
Moderate improvement	31	38
Good improvement	87	76
Total	125	125

The overall quality-of-vision category distribution did not differ significantly between surgical groups, $\chi^2(2)=2.34$, p=0.310.

Postoperative Ocular Infection

The study-defined postoperative ocular infection outcome occurred in 78 of 250 participants (31.2%). Infection was recorded in 27/125 (21.6%) patients undergoing phacoemulsification and 51/125 (40.8%) undergoing ECCE.

Table 6. Study-Defined Postoperative Ocular Infection by Surgical Technique

Outcome	Phacoemulsification	ECCE
Infection	27 (21.6%)	51 (40.8%)
No infection	98 (78.4%)	74 (59.2%)
Total	125	125

Compared with ECCE, phacoemulsification was associated with a risk ratio of 0.53 (95% CI 0.36–0.79), an odds ratio of 0.40 (95% CI 0.23–0.70), and an absolute risk difference of –19.2 percentage points (95% CI –30.4 to –8.0), with $p \approx 0.001$.

Factors Associated With Infection

Previous eye surgery and improper sterilization were strongly associated with the study-defined postoperative infection outcome. History of ocular trauma was associated with higher crude odds of infection, but the confidence interval included unity and the association was not statistically significant. Postoperative antibiotic prescription was more frequent among participants classified as having infection.

Table 7. Study-Defined Infection and Associated Factors

Factor	Infection Present	Infection Absent	OR (95% CI)	p
Previous eye surgery: yes	28	13	6.85 (3.30–14.22)	<0.001
Previous eye surgery: no	50	159	Reference	
Eye trauma: yes	16	21	1.86 (0.91–3.79)	0.087
Eye trauma: no	62	151	Reference	
Improper sterilization: yes	41	5	37.01 (13.69–100.04)	<0.001
Improper sterilization: no	37	167	Reference	
Postoperative antibiotics: yes	34	51	1.83 (1.05–3.19)	0.031
Postoperative antibiotics: no	44	121	Reference	

The association between postoperative antibiotic prescription and infection should not be interpreted as evidence that antibiotics increased infection risk because the timing and indication for prescription were not established. Patients who developed postoperative inflammatory or infectious signs may have been more likely to receive antibiotics.

DISCUSSION

The present study demonstrated that phacoemulsification was associated with better early corrected-vision outcomes, greater patient satisfaction, lower conjunctival vascularity, and a lower frequency of study-defined postoperative ocular infection than ECCE. In contrast, the magnitude of IOP reduction, iris atrophy, iris prolapse, contrast sensitivity, ocular alignment, and the overall ordinal distribution of quality-of-vision ratings did not differ significantly between the two surgical groups. Previous eye surgery and the study-defined improper-sterilization category were strongly associated with postoperative infection, whereas the observed positive association between antibiotic prescription and infection requires particular caution because treatment timing and indication were not established.

The corrected-vision findings are broadly consistent with comparative evidence demonstrating advantages of phacoemulsification over conventional ECCE for early visual rehabilitation and selected postoperative outcomes (3,4). The smaller incision used in phacoemulsification can reduce surgically induced astigmatism and wound-related tissue disturbance, while comparative studies have also identified differences in corneal endothelial effects and postoperative recovery between the procedures (4–6). These factors provide a plausible explanation for the higher proportion of patients with a favorable corrected visual outcome and greater satisfaction following phacoemulsification in the present study. Nevertheless, procedure allocation was not documented as randomized, and group-specific baseline characteristics were not available. Differences in cataract severity, ocular comorbidity, surgical complexity, surgeon selection, or other preoperative characteristics could therefore have contributed to the observed between-group differences.

The infection comparison requires more cautious interpretation than the visual outcomes. The present study classified 78/250 eyes (31.2%) as having postoperative ocular infection. This frequency is considerably higher than rates ordinarily reported for clinically diagnosed acute postoperative endophthalmitis following cataract surgery, including those observed in large population-based cohorts

(7,13). The outcome is therefore appropriately interpreted as study-defined postoperative ocular infection rather than being automatically equated with acute endophthalmitis. Endophthalmitis is an intraocular infection with potentially severe visual consequences, whereas conjunctival inflammation, discharge, wound abnormalities, vascularity, and superficial ocular infection constitute clinically different postoperative findings (7,8). Failure to distinguish these endpoints can markedly alter apparent infection rates and complicate comparisons between studies.

Within the study-defined endpoint, phacoemulsification was associated with approximately half the infection risk of ECCE, with an RR of 0.53 and an absolute risk difference of -19.2 percentage points. The larger incision required for conventional ECCE may plausibly increase wound exposure and postoperative wound-related problems, while contemporary cataract-surgery evidence generally supports the advantages of smaller-incision approaches for several recovery-related outcomes (3-6). However, the observational nature of the present comparison prevents causal attribution. Established literature on postoperative endophthalmitis indicates that risk is influenced by multiple patient-, procedure-, and complication-related factors, including operative complexity and events such as posterior capsular rupture (14-16). Without randomization or multivariable adjustment, the lower infection frequency observed after phacoemulsification may therefore reflect both procedural differences and differences in the characteristics of patients or operations selected for each technique.

Previous ocular surgery was strongly associated with the study-defined infection outcome, with crude odds approximately 6.9 times those among participants without previous eye surgery. Previous surgery may identify eyes with greater operative complexity, altered ocular anatomy, prior instrumentation, or other clinical characteristics that were not separately measured in the present analysis. More broadly, meta-analytic evidence confirms that postoperative endophthalmitis risk is heterogeneous and is influenced by both patient characteristics and surgery-related factors (14,15). The current association should therefore be regarded as an important crude relationship requiring confirmation through multivariable analysis rather than as evidence that previous surgery itself directly caused infection.

The strongest crude association involved improper sterilization, for which the estimated OR was 37.01. Instrument reprocessing, aseptic preparation, operating-room infection-control practices, and perioperative prophylaxis are fundamental components of endophthalmitis prevention in cataract surgery (7-9). Randomized and observational evidence has additionally demonstrated the importance of evidence-based prophylactic strategies, particularly intracameral antimicrobial prophylaxis, in reducing postoperative endophthalmitis rates (10-12). The magnitude of the association observed in the present study is therefore clinically concerning. Nevertheless, it remains an unadjusted observational estimate with a wide confidence interval, and interpretation depends on how sterilization exposure was documented, whether exposure classification preceded the postoperative outcome, and whether sterilization status was measured independently of clinical infection assessment.

Postoperative antibiotic prescription was associated with higher crude infection odds, but this result should not be interpreted as evidence of an adverse causal effect of antibiotic therapy. Evidence from controlled trials, systematic reviews, and large observational studies supports appropriately selected antimicrobial prophylaxis as a strategy for reducing postoperative endophthalmitis rather than increasing it (9-12). In observational data, treatment may be preferentially administered to patients who are already at greater clinical risk or who have begun to develop symptoms, producing confounding by indication or reverse temporal interpretation (23). If antibiotics in the present study were initiated after inflammatory or infectious signs appeared, the observed association would primarily reflect clinical response to the developing outcome rather than an effect of the medication. Future studies should therefore distinguish preoperative prophylaxis, intraoperative prophylaxis, routine postoperative therapy, and antibiotics initiated because infection was suspected.

The remaining ocular outcomes provide a more differentiated picture of the two surgical techniques. Mean IOP decreased in both groups, but the between-group difference in reduction was small and statistically nonsignificant. Contrast sensitivity and the overall quality-of-vision category distribution also did not differ significantly, while ocular alignment reached a borderline p value of 0.050. Thus, although the corrected-vision and satisfaction findings are compatible with comparative evidence favoring phacoemulsification for several early outcomes (3-6), the present data do not demonstrate superiority across every measured parameter. The findings support a procedure-specific rather than uniformly favorable interpretation: phacoemulsification was associated with advantages in selected early outcomes, whereas several other visual and ocular measures were comparable between techniques.

CONCLUSION

Phacoemulsification was associated with better early corrected-vision outcomes, greater patient satisfaction, lower conjunctival vascularity, and a lower rate of study-defined postoperative ocular infection compared with ECCE. The magnitude of IOP reduction, iris atrophy, iris prolapse, contrast sensitivity, ocular alignment, and the overall quality-of-vision category distribution did not differ significantly between groups. Previous eye surgery and improper sterilization were strongly associated with the study-defined infection outcome. Because surgical allocation was observational and the infection endpoint was incompletely defined, these findings should be interpreted as associations rather than causal effects and require confirmation using clearly specified infection criteria, standardized perioperative care, and adjustment for baseline surgical differences.

LIMITATIONS

The surgical procedure was not documented as randomly assigned, limiting causal interpretation of differences between phacoemulsification and ECCE. Baseline characteristics were not reported separately by surgical technique, preventing assessment of whether the groups differed in cataract severity, ocular comorbidity, previous surgery, or other factors that could influence procedure selection and outcome.

Follow-up was limited to approximately one week and therefore reflects only early postoperative outcomes. The definition of postoperative infection was insufficiently detailed, and microbiological culture confirmation or standardized endophthalmitis criteria were not documented. Consequently, the reported infection outcome may represent a broader combination of postoperative inflammatory, superficial infectious, and ocular findings rather than confirmed intraocular endophthalmitis.

Potential risk factors were evaluated using unadjusted comparisons rather than a multivariable infection model. Residual and measured confounding may therefore explain part of the observed associations. In particular, the temporal relationship between postoperative antibiotic prescription and infection was not established, preventing causal interpretation of that association.

RECOMMENDATIONS

Future studies should prospectively distinguish conjunctival or superficial ocular infection, wound infection, anterior-segment inflammation, and acute postoperative endophthalmitis using predefined clinical and, where appropriate, microbiological criteria. Infection status and relevant exposures should be documented according to a clear temporal sequence to permit valid assessment of potential risk factors.

Comparative treatment groups should be characterized according to cataract grade, ocular and systemic comorbidity, surgeon experience, anesthesia, incision characteristics, IOL type, previous ocular surgery,

intraoperative complications, sterilization procedures, and perioperative antimicrobial prophylaxis. Where treatment allocation is nonrandomized, multivariable adjustment or other appropriate methods for controlling confounding should be considered.

Longer follow-up should evaluate best-corrected visual acuity, surgically induced astigmatism, posterior-capsule opacification, late postoperative infection, IOP, contrast sensitivity, and validated patient-reported visual-function outcomes to provide a more comprehensive comparison of the longer-term effects of phacoemulsification and ECCE.

REFERENCES

1. Vision Loss Expert Group of the Global Burden of Disease Study, GBD 2019 Blindness and Vision Impairment Collaborators. Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020. *Eye* (London, England). 2024;38(11):2156-2172. doi:10.1038/s41433-024-02961-1.
2. GBD 2019 Blindness and Vision Impairment Collaborators, Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. *The Lancet. Global Health*. 2021;9(2). doi:10.1016/S2214-109X(20)30489-7.
3. de Silva SR, Riaz Y, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database of Systematic Reviews*. 2014;2014(1). doi:10.1002/14651858.CD008812.pub2.
4. Minassian DC, Rosen P, Dart JK, Reidy A, Desai P, Sidhu M, et al. Extracapsular cataract extraction compared with small incision surgery by phacoemulsification: a randomised trial. *British Journal of Ophthalmology*. 2001;85(7):822-829. doi:10.1136/bjo.85.7.822.
5. George R, Rupauliha P, Sripriya AV, Rajesh PS, Vishnu Vahan P, Praveen S. Comparison of endothelial cell loss and surgically induced astigmatism following conventional extracapsular cataract surgery, manual small-incision surgery and phacoemulsification. *Ophthalmic Epidemiology*. 2005;12(5):293-297. doi:10.1080/09286580591005778.
6. Bourne RRA, Minassian DC, Dart JKG, Rosen P, Kaushal S, Wingate N. Effect of cataract surgery on the corneal endothelium: modern phacoemulsification compared with extracapsular cataract surgery. *Ophthalmology*. 2004;111(4):679-685. doi:10.1016/j.ophtha.2003.07.015.
7. Saba OA, Benylles Y, Howe MH, Inkster T, Hooker EL. Infection prevention and control factors associated with post-cataract surgery endophthalmitis: a review of the literature from 2010–2023. *Infection Prevention in Practice*. 2024;6(3):100387. doi:10.1016/j.infpip.2024.100387.
8. Surawatsatien N, Kasetsuwan P, Pruksacholavit J, Chansangpetch S, Tulvatana W, Pongsachareonnont PF, et al. Systematic review of clinical practice guidelines for post-cataract surgery endophthalmitis prophylaxis from 2008–2023. *Clinical Ophthalmology*. 2025;19:3949-3960. doi:10.2147/OPTH.S559156.
9. Gower EW, Lindsley K, Tulenko SE, Nanji AA, Leyngold I, McDonnell PJ. Perioperative antibiotics for prevention of acute endophthalmitis after cataract surgery. *Cochrane Database of Systematic Reviews*. 2017;2(2). doi:10.1002/14651858.CD006364.pub3.

10. Endophthalmitis Study Group, European Society of Cataract & Refractive Surgeons. Prophylaxis of postoperative endophthalmitis following cataract surgery: results of the ESCRS multicenter study and identification of risk factors. *Journal of Cataract and Refractive Surgery*. 2007;33(6):978-988. doi:10.1016/j.jcrs.2007.02.032.
11. Bowen RC, Zhou AX, Bondalapati S, Lawyer TW, Snow KB, Evans PR, et al. Comparative analysis of the safety and efficacy of intracameral cefuroxime, moxifloxacin and vancomycin at the end of cataract surgery: a meta-analysis. *British Journal of Ophthalmology*. 2018;102(9):1268-1276. doi:10.1136/bjophthalmol-2017-311051.
12. Haripriya A, Chang DF, Ravindran RD. Endophthalmitis reduction with intracameral moxifloxacin prophylaxis: analysis of 600 000 surgeries. *Ophthalmology*. 2017;124(6):768-775. doi:10.1016/j.ophtha.2017.01.026.
13. Creuzot-Garcher C, Benzenine E, Mariet AS, de Lazzer A, Chiquet C, Bron AM, et al. Incidence of acute postoperative endophthalmitis after cataract surgery: a nationwide study in France from 2005 to 2014. *Ophthalmology*. 2016;123(7):1414-1420. doi:10.1016/j.ophtha.2016.02.019.
14. Cao H, Zhang L, Li L, Lo S. Risk factors for acute endophthalmitis following cataract surgery: a systematic review and meta-analysis. *PLoS One*. 2013;8(8). doi:10.1371/journal.pone.0071731.
15. Zhang S, Xu J. Impact of patient characteristics and surgery-related risk factors on endophthalmitis after cataract surgery: a meta-analysis. *Ophthalmic Research*. 2025;68(1):117-136. doi:10.1159/000543353.
16. Daien V, Papinaud L, Gillies MC, Domerg C, Nagot N, Lacombe S, et al. Effectiveness and safety of an intracameral injection of cefuroxime for the prevention of endophthalmitis after cataract surgery with or without perioperative capsular rupture. *JAMA Ophthalmology*. 2016;134(7):810-816. doi:10.1001/jamaophthalmol.2016.1351.
17. Whitacre MM, Stein R. Sources of error with use of Goldmann-type tonometers. *Survey of Ophthalmology*. 1993;38(1):1-30. doi:10.1016/0039-6257(93)90053-A.
18. Okafor KC, Brandt JD. Measuring intraocular pressure. *Current Opinion in Ophthalmology*. 2015;26(2):103-109. doi:10.1097/ICU.0000000000000129.
19. Rosser DA, Cousens SN, Murdoch IE, Fitzke FW, Laidlaw DAH. How sensitive to clinical change are ETDRS logMAR visual acuity measurements? *Investigative Ophthalmology & Visual Science*. 2003;44(8):3278-3281. doi:10.1167/iovs.02-1100.
20. Lim LA, Frost NA, Powell RJ, Hewson P. Comparison of the ETDRS logMAR, compact reduced logMAR and Snellen charts in routine clinical practice. *Eye (London, England)*. 2010;24(4):673-677. doi:10.1038/eye.2009.147.
21. Bühren J, Terzi E, Bach M, Wesemann W, Kohnen T. Measuring contrast sensitivity under different lighting conditions: comparison of three tests. *Optometry and Vision Science*. 2006;83(5):290-298. doi:10.1097/01.opx.0000216100.93302.2d.
22. Elliott DB, Bullimore MA. Assessing the reliability, discriminative ability, and validity of disability glare tests. *Investigative Ophthalmology & Visual Science*. 1993;34(1):108-119.
23. McMahon AD. Approaches to combat with confounding by indication in observational studies of intended drug effects. *Pharmacoepidemiology and Drug Safety*. 2003;12(7):551-558. doi:10.1002/pds.883.