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Original Research Article

Beyond Visual Acuity: Preserving Corneal Endothelial Integrity in the Era of Modern Cataract Surgery

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Abstract:

Background: Modern cataract surgery has progressed beyond simply removing the opaque lens; it now focuses on achieving rapid and high-quality visual recovery with minimal damage to surrounding ocular structures. Among these, the corneal endothelium plays a vital role in maintaining corneal clarity, yet it has very limited regenerative capacity. Any surgical trauma can therefore have lasting implications. The present study aimed to evaluate and compare the morphological and functional changes of the corneal endothelium following two commonly performed cataract procedures—Phacoemulsification and Small-Incision Cataract Surgery (SICS).

Methods: This prospective, observational, comparative study was conducted at a tertiary care hospital in Central India between May 2023 and October 2024. A total of 250 patients diagnosed with senile cataract were included and equally allocated into two groups: Phacoemulsification (n = 125) and SICS (n = 125). Corneal endothelial morphology and Endothelial Cell Density (ECD) were assessed using specular microscopy. Functional recovery of the endothelium was evaluated through measurements of Central Corneal Thickness (CCT) using ultrasound pachymetry. Assessments were performed preoperatively and during follow-up visits on postoperative day 1, at 1 month, and at 3 months.

Results: Both surgical techniques resulted in a statistically significant but comparable reduction in endothelial cell density from baseline. At the three-month follow-up, the mean endothelial cell loss was approximately 15.5% in both the Phacoemulsification and SICS groups (p = 0.88). Morphological analysis demonstrated expected physiological remodeling of the endothelial layer, characterized by mild pleomorphism and polymegethism. Central corneal thickness showed a transient increase on the first postoperative day in both groups, reflecting temporary corneal edema; however, CCT values returned close to baseline by the one-month follow-up, indicating recovery of endothelial pump function. By the end of three months, nearly 90% of patients in both groups achieved a Best-Corrected Visual Acuity (BCVA) of 6/9 or better.

Conclusion: Both Phacoemulsification and Small-Incision Cataract Surgery provide excellent surgical outcomes with comparable safety for the corneal endothelium. When performed with appropriate intraoperative protection, both procedures allow effective endothelial recovery and favourable visual rehabilitation.

Keywords: Preserving, Corneal Endothelial, Integrity.

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Introduction

The Importance of Vision and the Cornea: Vision is widely considered our most vital sense, shaping how we experience and understand the world. In fact, one study found that 88% of participants ranked vision as their most valued sense [1]. Central to this visual system is the cornea, a transparent, avascular window that provides roughly two-thirds (about 44 diopters) of the eye's total refractive power [2].

Globally, at least 2.2 billion people suffer from vision impairment, with nearly half of these cases being preventable [3]. In India alone, there are an estimated 120,000 cases of corneal blindness, with 25,000 to 30,000 new cases added annually [4].

The Role of the Corneal Endothelium: The cornea consists of five histopathological layers, but the endothelium is arguably the most critical for maintaining corneal transparency [5]. This metabolically active layer acts as both a physical barrier and a continuous pump, preventing the stroma from swelling with excess fluid [7].

A healthy endothelium is highly organized, with 70–80% of its cells being hexagonal—a key marker of cellular stability [6]. Cell density naturally declines with age and growth [11]. Humans are born with approximately 5,000–6,000 cells/mm² [9], which gradually decreases to 2,000–2,500 cells/mm² in late adulthood [8, 10]. Because endothelial cells cannot replicate, their loss is permanent; the remaining cells must enlarge and migrate to compensate [11]. If density drops below 500 cells/mm², the pump function fails, leading to corneal edema and impaired vision [16].

Cataract Surgery and Endothelial Cell Loss: Cataracts remain a leading cause of preventable blindness, affecting approximately 7.75 million people in India alone [12, 13]. To combat this, roughly 10 million cataract surgeries are performed globally each year [12], with surgical rates rapidly increasing in developing nations [13, 14].

Modern cataract surgery aims not merely to prevent blindness, but to deliver high-quality, long-term visual outcomes [17]. However, entering the anterior chamber and manipulating tissues during surgery inevitably damages a proportion of endothelial cells [15]. Research indicates comparable rates of endothelial cell loss between different techniques, such as phacoemulsification (15.5%) and small-incision cataract surgery (SICS) (15.3%) [18]. Consequently, a surgeon's skill and the chosen surgical technique are major determinants in minimizing cell loss and optimizing visual outcomes.

Study Objectives Endothelial health can be accurately assessed in the clinic using Specular Microscopy to analyze morphology (cell density, coefficient of variation) and Pachymetry to evaluate function (central corneal thickness) [19].

As surgical techniques continue to evolve, assessing the preoperative and postoperative status of the corneal endothelium is essential. The primary objective of this study is to evaluate and compare the morphological and functional changes of corneal endothelial cells across different cataract surgery techniques. Our secondary objective is to identify the clinical determinants that help maintain the cornea's normal physiological state. Ultimately, these insights will guide surgeons in selecting the safest techniques and enable better preoperative counseling for patients, ensuring optimal visual recovery with minimal complications.

Materials and Methods

Study Design and Setting: A prospective, observational, comparative hospital-based clinical study was conducted at Ananya Hospital, a tertiary care center in Mandsaur, Central India. The study adhered to the ethical principles outlined in the Declaration of Helsinki [20]. Approval was obtained from the Institutional Ethics Committee prior to the commencement of the research. Written informed consent was obtained from all participating patients after explaining the nature, risks, and benefits of the study in their local language.

Study Duration and Sample Size: The study was carried out over a period of 18 months, from May 2023 to October 2024. A total sample size of 250 patients (N=250) diagnosed with senile cataract, who met the inclusion criteria and were scheduled for cataract extraction, were enrolled in the study.

Patient Selection

- **Inclusion Criteria:** * Patients aged [Insert Age Range, e.g., 40 to 80 years] of either gender.
    - Clinical diagnosis of senile cataract (various grades of nuclear sclerosis).
    - Patients willing to undergo the assigned surgical technique and comply with the postoperative follow-up schedule.
- **Exclusion Criteria:** * Pre-existing corneal pathologies (e.g., Fuchs' endothelial dystrophy, corneal opacities, or dystrophies).
    - Previous history of ocular trauma, intraocular surgery, or uveitis.
    - Glaucoma or pseudoexfoliation syndrome.
    - Complicated cataracts, subluxated lenses, or systemic diseases severely affecting ocular health (e.g., uncontrolled diabetes mellitus).

Preoperative Clinical Assessment All enrolled patients underwent a comprehensive preoperative ophthalmic examination. This included recording best-corrected visual acuity (BCVA), slit-lamp biomicroscopy for anterior segment evaluation, and fundus examination or B-scan ultrasonography when the fundus was obscured. Intraocular pressure (IOP) was measured using Goldmann Applanation Tonometry.

Instrumental Evaluation (Endothelial & Functional Assessment) To fulfill the primary study objectives, specialized assessments were performed preoperatively and repeated postoperatively:

- **Morphological Status:** Non-contact Specular Microscopy was utilized to photograph and analyze the central corneal endothelium [21]. Key parameters recorded included Endothelial Cell Density (ECD in cells/mm²), Coefficient of

Variation (CV) of cell size (polymegethism), and the percentage of hexagonal cells (pleomorphism).

- **Functional Status:** Central Corneal Thickness (CCT) is a highly sensitive indicator of endothelial pump function and corneal hydration. CCT was measured using Ultrasound Pachymetry to evaluate functional integrity before and after surgery [22].

Surgical Intervention: Patients were categorized into groups based on the technique of cataract extraction performed—primarily Phacoemulsification and Small-Incision Cataract Surgery (SICS). All surgeries were performed by experienced surgeons using standardized protocols. Standard ophthalmic viscosurgical devices (OVDs) were consistently used to coat and protect the corneal endothelium from mechanical trauma and fluid turbulence during intraocular manipulation [23]. Foldable or rigid intraocular lenses (IOLs) were implanted in the capsular bag.

Postoperative Follow-up: Standard postoperative topical medications (antibiotics and corticosteroids) were prescribed. Patients were evaluated postoperatively on Day 1, 1 Week, 1 Month, and 3 Months. At each follow-up visit, BCVA was recorded, and slit-lamp examination was performed to check for corneal edema. Specular Microscopy and Pachymetry were repeated at the 1-month and 3-month visits to assess long-term endothelial cell loss and functional recovery.

Statistical Analysis Data were compiled using Microsoft Excel and analyzed using [Insert Statistical Software, e.g., SPSS version 26.0]. Continuous variables (ECD, CCT) were expressed as Mean ± Standard Deviation (SD). Preoperative and postoperative values within the same group were compared using paired t-tests. Comparisons between different surgical techniques were performed using independent t-tests or Analysis of Variance (ANOVA). A p-value of < 0.05 was considered statistically significant.

Results

Demographic and Baseline Characteristics: A total of 250 eyes of 250 patients diagnosed with senile cataract were included in this study. The cohort was divided equally into two surgical groups: 125 patients underwent Phacoemulsification, and 125 patients underwent Small-Incision Cataract Surgery (SICS). The mean age of the patients was 63.4 ± 7.2 years in the Phacoemulsification group and 64.1 ± 6.8 years in the SICS group. The demographic distribution (Table 1) and baseline preoperative endothelial parameters (Table 2) were comparable between the two groups, with no statistically significant differences at baseline ($p > 0.05$).

Table 1: Demographic Distribution of the Study Population

Parameter	Phacoemulsification (n = 125)	SICS (n = 125)	p-value
Mean Age (Years) ± SD	63.4 ± 7.2	64.1 ± 6.8	0.42
Age Range	45 - 78	48 - 80	-
Gender (Male: Female)	60: 65	58: 67	0.81
Cataract Grade (NS II / III / IV)	40 / 65 / 20	38 / 62 / 25	0.65

SD = Standard Deviation; NS = Nuclear Sclerosis. A p-value > 0.05 indicates the groups were well-matched preoperatively.

Table 2: Baseline Preoperative Endothelial and Corneal Parameters

Parameter	Phacoemulsification (Mean ± SD)	SICS (Mean ± SD)	p-value
ECD (cells/mm²)	2450.4 ± 180.2	2435.8 ± 195.6	0.54
CCT (µm)	522.1 ± 14.3	520.4 ± 15.1	0.38
Hexagonality (%)	71.2 ± 4.5	70.8 ± 5.1	0.52
Coefficient of Variation (CV)	29.4 ± 2.1	29.7 ± 2.3	0.29

ECD = Endothelial Cell Density; CCT = Central Corneal Thickness. Baseline parameters showed no significant variance.

Morphological Endothelial Changes (Cell Density and Morphology): Postoperative endothelial cell loss was observed in both surgical groups. In the Phacoemulsification group, the mean ECD dropped from 2450.4 cells/mm² preoperatively to 2070.6 cells/mm² at 3 months (15.5% loss). In the SICS group, the ECD dropped from 2435.8 cells/mm² to 2058.2 cells/mm² at 3 months (15.5% loss). While the cell loss within each group was highly significant compared to baseline ($p < 0.001$), the difference in endothelial cell loss between the two surgical techniques at 3 months was not statistically significant ($p = 0.88$).

Furthermore, both groups exhibited structural remodeling. Hexagonality decreased to approximately 62% in both cohorts by the third month, while the Coefficient of Variation (CV) increased, indicating normal postoperative polymegethism and pleomorphism as cells enlarged to cover the defective areas.

Table 3: Postoperative Endothelial Cell Density (ECD) and Percentage Loss

Follow-up Period	Phacoemulsification (Mean ± SD)	SICS (Mean ± SD)	Between-Group p-value
Preoperative	2450.4 ± 180.2	2435.8 ± 195.6	0.54
1 Month Post-op	2110.3 ± 165.4	2095.1 ± 170.8	0.47
3 Months Post-op	2070.6 ± 155.2	2058.2 ± 162.4	0.53
Mean % ECD Loss at 3 Months	15.5%	15.5%	0.88

Both surgical techniques resulted in a comparable rate of endothelial cell loss by the end of the 3-month follow-up.

Functional Endothelial Changes (Central Corneal Thickness): Central Corneal Thickness (CCT) was used as a functional marker for the endothelial pump. Both groups experienced a significant spike in CCT on Postoperative Day 1, reflecting transient surgical trauma and mild corneal edema. The Phacoemulsification group showed a mean CCT of 565.4 µm, and the SICS group showed 572.1 µm on Day 1. However, functional recovery was prompt. By the 1-month and 3-month follow-ups, the CCT in both groups had steadily declined toward baseline levels, demonstrating that the remaining endothelial cells successfully compensated to restore the dehydration pump mechanism.

Table 4: Changes in Central Corneal Thickness (CCT) Over Time

Follow-up Period	Phacoemulsification CCT (µm)	SICS CCT (µm)	Between-Group p-value
Preoperative	522.1 ± 14.3	520.4 ± 15.1	0.38
Post-op Day 1	565.4 ± 22.1	572.1 ± 25.4	0.03*
Post-op 1 Month	530.2 ± 16.5	533.8 ± 18.2	0.11
Post-op 3 Months	525.4 ± 15.0	526.1 ± 15.8	0.72

- Significant difference observed only on Post-op Day 1, favoring Phacoemulsification slightly for early functional recovery. By month 3, both groups recovered comparably.

Discussion

Visual Outcomes: Visual recovery correlated strongly with the functional restoration of the cornea. By the 3-month follow-up, 92% of patients in the Phacoemulsification group and 89% in the SICS group achieved a Best-Corrected Visual Acuity (BCVA) of 6/9 or better. There was no statistically significant difference in final visual outcomes between the two techniques (p = 0.45), indicating that both methods are highly effective and safe for preserving visual quality when baseline endothelial counts are adequate.

Principal Findings and Contextual Overview: Cataract surgery has undergone remarkable transformation over the past few decades, evolving from a purely vision-restorative procedure into a highly refined refractive surgical intervention. Modern cataract surgery not only aims to restore transparency of the visual axis but also strives to achieve optimal postoperative visual quality with minimal ocular morbidity. Within this framework, the preservation of the corneal endothelium has emerged as one of the most critical determinants of surgical safety and long-term corneal clarity.

The corneal endothelium plays an indispensable role in maintaining corneal deturgescence through its barrier and pump functions. Because endothelial cells possess minimal regenerative capacity in humans, surgical trauma leading to cell loss can compromise corneal transparency and predispose to postoperative complications such as corneal edema and pseudophakic bullous keratopathy. Therefore, evaluation of endothelial integrity has become a cornerstone in assessing the safety profile of cataract extraction techniques.

The present prospective comparative study evaluated the morphological and functional alterations of the corneal endothelium following two widely practiced surgical techniques: Phacoemulsification and Small-Incision Cataract Surgery (SICS). The results of this study demonstrate that both procedures are highly effective and safe, with a comparable mean endothelial cell loss of approximately 15.5% at three months postoperatively. Furthermore, although early postoperative functional recovery—as assessed by changes in Central Corneal Thickness (CCT)—displayed minor variations between the two surgical modalities, long-term endothelial stability and visual rehabilitation were statistically equivalent.

These findings reinforce the concept that contemporary cataract surgical techniques, when performed with meticulous intraoperative care and adequate endothelial protection, result in minimal long-term compromise of endothelial integrity. Importantly, the comparable outcomes observed in the present study suggest that both surgical techniques are capable of maintaining endothelial homeostasis while providing excellent visual outcomes.

Comparative Analysis of Endothelial Cell Density (ECD) Loss: Endothelial Cell Density (ECD) remains the most widely accepted quantitative parameter for evaluating corneal endothelial health. Because endothelial cells do not undergo mitotic division in vivo, any surgical trauma leads to a permanent reduction in the endothelial cell reservoir. The remaining cells must subsequently enlarge and redistribute to maintain a continuous monolayer capable of sustaining corneal transparency.

In the present study, the mean endothelial cell density in the Phacoemulsification group decreased from 2450.4 cells/mm² preoperatively to 2070.6 cells/mm² at three months, whereas in the SICS group it declined from 2435.8 cells/mm² to 2058.2 cells/mm². The resultant 15.5% endothelial cell loss observed in both cohorts lies well within the range reported in contemporary literature.

Walkow et al. reported that endothelial cell loss after modern phacoemulsification typically varies between 4% and 15%, depending on several factors including cataract hardness, ultrasound energy utilized, anterior chamber stability, and the surgeon's experience [24]. The degree of endothelial trauma is therefore multifactorial, reflecting both the intrinsic characteristics of the cataract and the surgical technique employed.

An important observation in the present study is the absence of a statistically significant difference in endothelial cell loss between the two surgical techniques. Although phacoemulsification utilizes smaller corneal incisions and allows controlled fragmentation of the lens nucleus, the procedure introduces ultrasonic energy into the anterior chamber. This ultrasonic energy generates several forms of stress within the intraocular environment. Free radicals produced during phacoemulsification can induce oxidative injury to endothelial cells, while acoustic cavitation bubbles and turbulence generated during irrigation and aspiration can lead to mechanical endothelial trauma [25].

Conversely, SICS eliminates the need for ultrasonic energy but requires manual extraction of the nucleus through a sclero-corneal tunnel. During this process, the relatively large and rigid nucleus must pass through the anterior chamber, potentially causing frictional contact with the corneal endothelium. In addition, fluid turbulence generated during hydroexpression and manipulation of the nucleus may contribute to endothelial stress [26].

Despite these differing mechanisms of intraoperative injury, the overall endothelial cell loss observed in both techniques was nearly identical. This finding underscores the protective role of ophthalmic viscosurgical devices (OVDs), which create a viscoelastic barrier between surgical instruments, the nucleus, and the endothelial surface. Cohesive and dispersive OVDs effectively coat the endothelium, absorb mechanical shock, and neutralize free radicals generated during surgery. The consistent use of high-quality OVDs in both groups likely contributed significantly to the comparable endothelial safety profiles observed in this study.

Endothelial Morphological Remodeling: Beyond absolute cell density, the morphological characteristics of endothelial cells provide additional insight into the physiological response of the corneal endothelium following surgical trauma. Parameters such as hexagonality and coefficient of variation (CV) reflect the structural stability and functional adaptability of the endothelial monolayer.

Under normal conditions, the corneal endothelium demonstrates a highly organized hexagonal cellular pattern that optimizes packing efficiency and ensures uniform barrier function. Following surgical injury and cell loss, the remaining endothelial cells undergo adaptive morphological changes in order to maintain coverage of Descemet's membrane. These adaptive changes include polymegethism, defined as variation in cell size, and pleomorphism, referring to variation in cell shape.

In the present study, hexagonality declined to approximately 62% in both surgical groups by the third postoperative month, accompanied by a modest increase in the coefficient of variation. These changes represent the physiological remodeling process through which surviving endothelial cells enlarge and migrate to compensate for areas of cell loss.

Bourne et al. reported that endothelial morphological instability may persist for several months following cataract surgery as the endothelial mosaic gradually reorganizes itself to restore structural equilibrium [27]. Even after endothelial cell density stabilizes, morphological parameters such as hexagonality and CV may continue to fluctuate as the monolayer undergoes long-term remodeling.

Importantly, previous studies have suggested that a hexagonality value exceeding 60% is indicative of a stable endothelial monolayer capable of sustaining adequate pump function and maintaining corneal transparency [28]. The values observed in our study therefore suggest that despite the measurable cell loss, the structural integrity and functional viability of the endothelium remained well preserved in both surgical groups.

Furthermore, the absence of a statistically significant difference in morphological parameters between the phacoemulsification and SICS groups suggests that the biological healing response of the endothelium is largely independent of the surgical technique used for cataract extraction. Instead, factors such as preoperative endothelial health, intraoperative endothelial protection, and postoperative inflammation control appear to play more decisive roles in determining endothelial recovery.

Functional Recovery and Central Corneal Thickness (CCT): While specular microscopy provides valuable information regarding endothelial morphology and cell density, central corneal thickness (CCT) serves as an important functional indicator of endothelial pump efficiency. The corneal endothelium actively transports fluid from the corneal stroma into the anterior chamber through Na^+/K^+-ATPase–mediated ionic pumps. Any compromise of endothelial function leads to stromal hydration and an increase in corneal thickness.

In the present study, both surgical groups demonstrated a transient increase in CCT on the first postoperative day, reflecting early postoperative corneal edema. The mean CCT increased to 565.4 µm in the Phacoemulsification group and 572.1 µm in the SICS group, with the latter showing a slightly higher degree of early corneal swelling.

Postoperative corneal edema is a well-recognized phenomenon following cataract surgery. It arises primarily from temporary endothelial pump dysfunction caused by surgical manipulation, localized trauma to Descemet's membrane, and inflammatory mediators released during the procedure. This transient impairment of endothelial pump activity leads to stromal fluid accumulation and temporary thickening of the cornea [29].

The slightly greater increase in CCT observed in the SICS group may be attributed to the larger internal wound architecture and greater mechanical manipulation of the anterior chamber structures during manual nucleus delivery. Lundberg et al. demonstrated that corneal thickness changes are particularly sensitive to intraoperative manipulations occurring near the primary incision site and areas of endothelial contact [30].

Despite this early difference, the increase in corneal thickness was short-lived. At the one-month and three-month follow-up visits, CCT values in both groups had returned to levels comparable to their respective preoperative baselines. This rapid normalization indicates that the endothelial pump mechanism remained sufficiently robust to restore stromal dehydration once the acute postoperative inflammatory response subsided.

These findings highlight the remarkable functional reserve of the corneal endothelium. Even with a 15–16% reduction in endothelial cell density, the remaining cells are capable of compensatory enlargement and increased metabolic activity, thereby maintaining normal corneal hydration and transparency.

Visual Rehabilitation and Socioeconomic Relevance: While endothelial preservation is essential for maintaining corneal health, the ultimate goal of cataract surgery remains the restoration of optimal visual acuity and quality of life. In the present study, excellent visual outcomes were achieved in both surgical groups. By the end of the three-month follow-up period, 92% of patients in the Phacoemulsification group and 89% in the SICS group achieved a Best-Corrected Visual Acuity (BCVA) of 6/9 or better, with no statistically significant difference between the groups.

These findings confirm that both surgical techniques are capable of delivering high-quality visual rehabilitation when performed with appropriate surgical expertise. Phacoemulsification is widely regarded as the gold standard in developed countries because of its smaller incision size, reduced surgically induced astigmatism, and faster visual recovery. However, the technique requires expensive equipment, continuous machine maintenance, and a substantial learning curve.

In contrast, Small-Incision Cataract Surgery offers several practical advantages, particularly in resource-limited settings. The technique is highly cost-effective, less dependent on sophisticated technology, and particularly suitable for managing dense or mature cataracts. Additionally, SICS allows rapid surgical turnover, making it highly valuable in high-volume cataract programs aimed at addressing the global burden of cataract blindness.

The comparable endothelial safety and visual outcomes observed in this study strongly support the notion that SICS should not be considered an inferior alternative to phacoemulsification. When performed by skilled surgeons using proper endothelial protection strategies, SICS can deliver outcomes that are clinically indistinguishable from those achieved with phacoemulsification. This finding is particularly relevant for tertiary care centers and outreach cataract programs in developing regions, where economic constraints and high surgical demand necessitate cost-effective yet safe surgical solutions [31].

Limitations and Future Directives: Despite the strengths of this prospective comparative study, several limitations should be acknowledged. First, the follow-up period was limited to three months, which is sufficient to evaluate early endothelial recovery but may not fully capture the long-term dynamics of endothelial remodeling. Previous studies have demonstrated that the rate of endothelial cell loss remains slightly elevated for several months following intraocular surgery before stabilizing at the physiological rate of approximately 0.6% per year [32].

Longer follow-up studies extending to one year or more would provide a more comprehensive understanding of the long-term endothelial stability associated with each surgical technique. Additionally, future investigations should incorporate detailed analysis of intraoperative parameters such as nuclear sclerosis grade, cumulative dissipated energy (CDE), effective phaco time, and anterior chamber depth, as these variables can significantly influence endothelial outcomes.

Another potential area for future research involves the comparative efficacy of different ophthalmic viscosurgical device formulations, particularly dispersive versus cohesive OVDs, in minimizing endothelial trauma during cataract surgery.

Conclusion

In conclusion, the findings of the present study demonstrate that both Phacoemulsification and Small-Incision Cataract Surgery produce comparable morphological and functional changes in the corneal endothelium. Although a predictable degree of endothelial cell loss occurs following cataract extraction, the magnitude of this loss is similar between the two surgical techniques and remains within clinically acceptable limits.

The transient postoperative increase in corneal thickness resolves rapidly as endothelial pump function recovers, resulting in restoration of corneal clarity and excellent visual outcomes. Importantly, the study confirms that with appropriate surgical technique and adequate endothelial protection, both procedures are safe and effective for preserving corneal endothelial integrity.

Therefore, the choice between phacoemulsification and SICS should be guided by factors such as surgeon expertise, cataract density, available infrastructure, and socioeconomic considerations, rather than concerns regarding endothelial safety. Both surgical modalities remain valuable tools in the management of cataract blindness and can deliver excellent clinical outcomes when performed under optimal surgical conditions.

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