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# A comparative study: Changes in endothelial cell count in phacoemulsification with temporal clear corneal incision vs superior scleral incision in grade II & III cataract

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ABSTRACT

**Background:** Endothelial cell loss is a key indicator of the quality of anterior segment surgery like cataract surgery. The amount and integrity of corneal endothelial cells are the two most essential factors determining corneal transparency.
Aim of this study was to compare the endothelial cell loss between the superior scleral tunnel incision and the temporal clear corneal incision for phacoemulsification.
**Design:** Prospective observational study.
**Materials and Methods:** This prospective observational study included 50 patients with grade II and III cataracts undergoing phacoemulsification with a temporal clear corneal incision and 50 patients with a superior scleral tunnel incision. Specular microscopy was used to count ocular endothelial cells before and one month after the surgery.
**Results:** The mean endothelial cell loss was significantly higher with temporal clear corneal incision (14.91% ± 5.13%) in comparison to the superior scleral tunnel incision group (6.58% ± 2.06%).
**Conclusion:** A superior scleral tunnel incision is associated with less postoperative endothelial cell loss as compared to a temporal clear corneal incision and could provide a better visual outcome.



## 1. Introduction

Cataract extraction is the most common ophthalmology surgical procedure. Endothelial cell loss is unavoidable during any type of cataract surgery, and its presence is a key indicator of the quality of anterior segment surgery.[1] The amount and integrity of corneal endothelial cells are the two most essential factors in maintaining corneal transparency. Corneal transparency is important for vision and is mostly determined by the functioning of corneal endothelial cells. In children, these cells have a normal hexagonal shape, but as they become older, they grow larger (polymegathism) and lose their regular hexagonal morphology (pleomorphism).[2–4] In adults, the corneal endothelial cell density (CECD) is usually between 2600 and 2900 cells/mm$^2$. However, it drops in corneal disorders or after anterior segment surgery.[4–6] Corneal edema and visual loss occur when CECD falls below 400–700 cells/mm$^2$. Specular microscopy has become a standard method for measuring endothelial cell density and morphology in vivo. Endothelial damage reduces cell density while increasing mean cell size and disrupting the regular morphological pattern. According to the national blindness and visual impairment survey India (2015-2019), cataracts account for 66.2% of total blindness.[7] As a result, it's critical to figure out which procedure is the safest for the

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endothelium.

Hence, in this study, specular microscopy was used to assess the extent to which the site of the corneoscleral tunnel incision, as well as preoperative and intraoperative factors, impact total or localized peripheral quadrant endothelial cell loss.

## 2. Materials and Methods

This prospective observational study was conducted at the Department of ophthalmology, at a tertiary referral center in western India. The study extended from September 2015 to March 2016 and aimed to assess the postoperative endothelial cell count after cataract surgery by phacoemulsification with a foldable intraocular lens (IOL) implantation, utilizing different surgical incision sites. This study was approved by the Ethics Committees of Dr. S.N. medical college & the associated group of hospitals Jodhpur, Rajasthan, India. All of the patients provided written informed consent before participation.

Patients aged 50 to 70 years with stage II and stage III cataracts having a minimum central endothelial cell density of 1500 cells/mm$^2$ were included in the study. Patients with ocular diseases, such as glaucoma, corneal dystrophy, degeneration, and systemic illnesses (i.e., diabetes mellitus), were excluded from the research.

The sample size was calculated at an alpha error of 0.05 and study power of 90%, assuming the pooled standard deviation of endothelial cell loss to be 17 cells as per the findings of Somil et al.[8] To detect a clinically significant difference of 12 cells in endothelial cell loss among the two groups, a minimum of 42 subjects was required, which was enhanced to 50 subjects in each group.

A total of 50 eligible patients were recruited consecutively in each of the following two groups.

Group A - patients who had phacoemulsification with a 2.8 mm temporal clear cornea incision.

Group B - patients who had phacoemulsification with a 2.8 mm superior scleral tunnel incision.

All patients evaluated for visual acuity, IOP measurement using Goldmann tonometer, complete ocular examination using a slit lamp, and Schirmer's test. The endothelial cell count was determined using a Tomey EM-3000 non-contact specular microscope. The center portion of the cornea was captured using the fixed frame analysis approach. The picture was then transmitted to a computer, where the cell count software performed an extremely precise examination of the endothelial cell layer.

Phacoemulsification, either by a temporal clear corneal incision or by a superior scleral tunnel incision, was done following a standardized protocol under similar operating conditions by the same surgeon:

For phacoemulsification via a temporal clear corneal incision, a side port was created at 1 o'clock, the air was injected into the anterior chamber, and trypan dye was used to stain the anterior capsule. After 20 seconds, the dye was washed using a balanced salt solution (BSS), then viscoelastic hydroxypropyl methylcellulose (HPMC) 2% was injected into the anterior chamber, and capsulorhexis was performed. The clear corneal incision was made 0.50 mm into the clear cornea at the temporal limbus. The incision was created with a 2.8 mm angled keratome, beginning at roughly half of the corneal thickness and extending into the clear cornea to create a 2.8 mm wide, 1.75 mm long tunnel. A stab incision was created at the end of the tunnel to penetrate the anterior chamber.

For superior scleral tunnel incision, firstly, a side port incision was made at 10 o'clock. After that, the air was injected into the anterior chamber then the anterior capsule was stained with trypan blue dye. After 20 seconds, the dye was washed using a balanced salt solution (BSS), then viscoelastic HPMC 2% was injected into the anterior chamber, and capsulorhexis was performed. After reflecting the conjunctiva and tenon's capsule from the limbus, the main port scleral tunnel incision was created starting 1 mm posterior to the superior limbus using a preset depth knife (300 mm). Minimal bipolar cautery was used to achieve hemostasis. The tunnel was extended 1.75 mm into the clear cornea by using a crescent knife, and then the anterior chamber was entered with a 2.8 mm angled keratome.

The stop chop technique was used post-hydro delineation for phacoemulsification. For cortical matter removal, a bimanual irrigation aspiration cannula was used from the side ports by making another side port. The foldable one-piece acrylic IOL was inserted in the capsular bag after uneventful phacoemulsification. The viscoelastic was taken out. Hydration was used to close the main incision. Each patient received a 0.5 ml subconjunctival injection of Amikacin and dexamethasone.

Antibiotics, steroids, cycloplegic, and lubricant eye drops were given as part of the standard postoperative care. Since the early-stage ocular edema hindered the accurate cell count during the specular examination, the evaluation was done one month following surgery. One-month postoperative evaluation included visual acuity, anterior segment slit-lamp examination, and specular microscopy.

### *2.1. Statistical analysis*

Categorical variables were expressed as frequency and percentage and were analyzed using the Chi-square test or Fischer Exact test as applicable. Continuous variables were expressed as mean and standard deviation and were analyzed using an independent sample t-test for comparison between the two groups. A p-value $\leq 0.05$ was considered statistically significant. All statistical analysis was done using Epi info version 7.2.1.0 statistical software.

## 3. Results

The mean age of the participants was 59.46 ± 6.32 years in Group A and 61.22 ± 6.56 years in Group B. Both groups were comparable in relation to their baseline characteristics (Table 1).

**Table 1:** Baseline characteristics of study subjects

| Parameters | Group A (N=50) | Group B (N=50) | P value |
|---|---|---|---|
| **Mean Age (years)** | 59.46 ± 6.32 | 61.22 ± 6.56 | 0.423 |
| **Sex** | | | |
| Male | 26 (52%) | 33 (66%) | 0.222 |
| Female | 24 (48%) | 17 (34%) | |
| **Eye** | | | |
| Right | 26 (52%) | 21 (42%) | 0.432 |
| Left | 24 (48%) | 29 (58%) | |
| **Cataract** | | | |
| Grade II | 29 (58%) | 31 (62%) | 0.838 |
| Grade III | 21 (42%) | 19 (38%) | |

The preoperative endothelial cell counts were similar among the two groups (p = 0.322). The mean endothelial cell loss at 1-month postoperative follow-up was significantly higher in Group A (14.91 ± 5.13%) as compared to Group B (6.58 ± 2.06%), and this difference was statistically significant (p=0.0001) (Table 2).

**Table 2:** Preoperative and postoperative endothelial cell count cells/mm$^2$

| Groups | Group A | Group B | P value |
|---|---|---|---|
| **Pre-operative** | 2576.9 ± 241.1 | 2529.3 ± 238.4 | 0.322 (NS) |
| **Post-operative 1 month** | 2192.8 ± 246.8 | 2364.0 ± 242.6 | <0.001 (S) |
| **% cell loss** | 14.91 ± 5.13% | 6.58 ± 2.06% | <0.001 (S) |

Cataracts are graded using the LOCS II scale. Patients were separated into two groups based on the grade of cataract. Endothelial cell loss was significantly higher in Group A as compared to Group B in both Grade II and Grade III cataracts. The cell loss was more in Grade III cataracts as compared to Grade II cataracts; the difference was, however, not found to be statistically significant (Table 3). In Grade III cataract, the effective Phaco time and operative time is longer, resulting in greater endothelial cell loss.

**Table 3:** Endothelial cell loss (cells/mm$^2$) in grade II and grade III cataract

| | Group A | Group B | P value |
|---|---|---|---|
| **Grade II cataract** | 14.39 ± 4.39 | 6.33 ± 2.08 | <0.001 (S) |
| **Grade III cataract** | 15.63 ± 6.04 | 6.99 ± 2.01 | <0.001 (S) |
| **P value** | 0.404 | 0.276 | |

## 4. Discussion

The cornea's normal thickness and transparency are maintained by the corneal endothelium's barrier function and active fluid pump.[9] range of variables can harm corneal endothelial cells during and after cataract surgery. Free radical production during phacoemulsification, ultrasonic energy used, mechanical stress from tools, the presence of lens fragments chattering, and types of ocular visco-surgical devices and irrigation solutions used are all intraoperative variables associated with corneal endothelial injury. Endothelial alterations are crucial indicators of surgical trauma and are used to assess surgical techniques.[10]

There was a consistent reduction in cell density over the one-month follow-up period in this study. It should be noted that the time it takes for the endothelial cell count to stabilize following cataract surgery is unknown. Cell loss has been shown to stabilize three months following simple cataract surgery.[11,12] Despite the apparent stability of endothelium morphologic features, long-term cell loss has been seen.[13–15]

The results of mean cell loss during phacoemulsification are inconsistent in the literature. In a study of 40 patients, Ravalico et al[14] investigated the endothelial function following ECCE and phacoemulsification. Endothelial cell density decreased by 10.1% in ECCE patients and by 8.5% in phacoemulsification cases 30 days after surgery. Further research on uneventful phacoemulsification three months following a superior limbal incision reveals 12.03%, 18.3%, and 8.5% endothelial cell loss.[15–17]

Our results showed reduced endothelial cell damage (6.44% ± 0.62%) for the temporal scleral tunnel incision compared to 8.39% ± 0.61% mean cell loss for the temporal clear corneal incision, which appear to be close to those of Dick and coauthors,[18] who discovered a 7.9% mean decline in endothelial cell density. Werblin TP reported that one year after standard uncomplicated phacoemulsification surgery, there was a 9% loss of endothelial cells.[10]

Giorgio Beltrame and colleagues[19] found reduced endothelial cell loss in their investigation. They observed that a 5.5 mm clear corneal incision resulted in a 22% loss of endothelial cells after 3 months of follow-up. They observed that scleral tunnel incision resulted in an average loss of 17% of endothelial cells during the three-month follow-up. The scleral tunnel incision resulted in statistically lower postoperative endothelial cell loss than the clear corneal incision. In our investigation, the scleral tunnel incision resulted in less endothelial loss than the clear corneal incision, which was consistent with the findings of Giorgio Beltrame and colleagues.[19]

Despite the use of viscoelastic material, we suspect that the higher cell loss in the clean corneal incision group is due

to mechanical damage from the phaco tip or the equipment used to place the IOL, as previously discussed.[20]

A scleral tunnel incision was linked with less postoperative endothelial damage than a clear corneal incision. This is most likely due to the location of the scleral tunnel, which results in less direct (phaco tip, IOL insertion) and indirect (mechanical corneal striae) damage.

## 5. Conclusion

According to the study, both groups lost central corneal endothelial cells after phacoemulsification. In both groups, endothelial cell losses were higher in grade III cataracts than in grade II cataracts. Group A has a 14.39±4.39% loss in Grade II and a 15.63±6.04% loss in Grade III cataracts after the first postoperative month, whereas Group B has a 6.33±2.08% loss in Grade II and a 6.99±2.01% loss in Grade III cataract. When gender, sex, age, and other demographic characteristics were included, there was no statistically significant difference in endothelial cell losses between the two groups. The loss of corneal endothelial cells was 14.91±5.13% in Group A (tCCI) and 6.58±2.06% in Group B in the first month after surgery (sSTI).

The findings of the study imply that the superior scleral tunnel incision causes less corneal endothelial cell loss than the temporal clear corneal incision.

## 6. Conflict of Interest Statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## 8. Ethical Committee

Office of principals & controller, Dr. S.N. medical college & associated group of hospitals, Jodhpur. No.F.1/Acad/MC/JU/15/16575.

## References

1. Binder PS, Sternberg H, Wickham MG, Worthen DM. Corneal endothelial damage associated with phacoemulsification. *Am J Ophthalmol*. 1976;82:48–54.
2. Bourne WM, Nelson LR, Hodge DO. Central corneal endothelial cell changes over a ten-year period. *Invest Ophthalmol Vis Sci*. 1997;38(3):779–82.
3. Huang J, Maram J, Tepelus TC, Sadda SR, Chopra V, Lee OL. Comparison of Noncontact Specular and Confocal Microscopy for Evaluation of Corneal Endothelium. *Eye Contact Lens*. 2018;44(44 Suppl 1):144–50.
4. Rao SK, Sen PR, Fogla R, Gangadharan S, Padmanabhan P, Badrinath SS. Corneal endothelial cell density and morphology in normal Indian eyes. *Cornea*. 2000;19(6):820–3.
5. Yee RW, Matsuda M, Schultz RO, Edelhauser HF. Changes in the normal corneal endothelial cellular pattern as a function of age. *Curr Eye Res*. 1985;4(6):671–8.
6. González-Méijome JM, Jorge J, Queirós A, de Matos SCP, Parafita MA. Two single descriptors of endothelian polymegethism and pleomorphism. *Graefes Arch Clin Exp Ophthalmol*. 2010;248(8):1159–66.
7. National Blindness And Visual Impairment Survey 2015-2019. Available from: https://indiavisionatlasnpcb.aiims.edu/national-blindness-and-visual-impairment-survey-2015-2019/.
8. Jagani SN, Lune AA, Magdum RM, Shah AP, Singh M, Datta D. Comparison of endothelial cell loss by specular microscopy between phacoemulsification and manual small-incision cataract surgery. *Niger J Ophthalmol*. 2015;23(2):54–9.
9. Tuft SJ, Coster DJ. The corneal endothelium. *Eye (Lond)*. 1990;4(Pt 3):389–424.
10. Werblin TP. Long-term endothelial cell loss following phacoemulsification: a model for evaluating endothelial damage after intraocular surgery. *Refract Corneal Surg*. 1993;9(1):29–35.
11. Kosrirukvongs P, Slade SG, Berkeley RG. Corneal endothelial changes after divide and conquer versus chip and flip phacoemulsification. *J Cataract Refract Surg*. 1997;23(7):1006–12.
12. Galin MA, Lin LL, Fetherlof E, Obstbaum SA, Sugar A. time analysis of corneal endothelial cell density after cataract extraction. *Am J Ophthalmol*. 1979;88(1):93–6.
13. Bourne WM, Nelson LR, Hodge DO. Continued endothelial cell loss ten years after lens implantation. *Ophthalmology*. 1994;101(6):1014–22.
14. Kohlass M, Stahlhurt O, Tholuck J, Richard G. Entwicklung der Hornhautdicke und-endothezelldichte nach Kataraktextraktion mittels phacoemulsifikation. *Ophthalmologe*. 1997;94:515–8.
15. Bates AK, Cheng H. Bullous keratopathy: a study of endothelial cell morphology in patients undergoing cataract surgery. *Br J Ophthalmol*. 1998;72(6):409–12.
16. Ravalico T. Endothelial cell loss after ECCE and Phacoemulsification. *J Cataract Refract Surg*. 1997;23:1000–6.
17. Kohnen T. Corneal endothelium: an important structure for cataract and refractive procedures (editorial). *J Cataract Refract Surg*. 1997;23:967–8.
18. Diaz-Valle D, Castillo BD, Sanchez JM, Castillo A. Endothelial damage with cataract surgery techniques. *J Cataract Refract Surg*. 1998;24(7):951–5.
19. Dick HB, Kohnen T, Jacobi FK, Jacobi KW. Long-term endothelial cell loss following phacoemulsification through a temporal clear corneal incision. *J Cataract Refract Surg*. 1996;22(1):63–71.
20. Beltrame G, Salvetat ML, Driussi G, Chizzolini M. Effect of incision size and site on corneal endothelial changes in cataract surgery. *J Cataract Refract Surg*. 2002;28(1):118–25.

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