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Study of Endothelial Cell Count Changes After Penetrating Keratoplasty (PK) vs Descemet's Striping Endothelial Keratoplasty (DSEK)

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ABSTRACT

Because corneal endothelial cells do not significantly multiply to allow endothelium regeneration, diseases of the corneal endothelium must be treated by transplanting corneal endothelial cells. Penetrating keratoplasty (PK), Descemet membrane endothelial keratoplasty (DMEK) and descemet stripping automated endothelial keratoplasty (DSAEK) are the most popular options for corneal transplants out of the several surgical techniques that have been offered. Endothelial keratoplasty or selective tissue transplantation have become more popular surgical treatments for endothelial disease than full thickness penetrating keratoplasty (PK). In place of penetrating keratoplasty (PK), descemet stripping automated endothelial keratoplasty (DSAEK) is now frequently used to address endothelial dysfunction. The objective of the current study was to assess the effects of PK and DSAEK in the treatment of corneal endothelial disease in terms of graft survival, endothelial cell loss and vision improvement. The current study was out to evaluate the effects of PK and DSAEK on graft survival, endothelial cell loss and visual improvement in the treatment of corneal endothelial disease. The difference between group A (PK) and group B (DSEK) in terms of mean corneal endothelial cell density (MCD) was only determined to be statistically significant after one year ($p = 0.03$). Before, there was no difference between the two group's findings. Pachymetry results between the two groups did not reveal any statistically significant variation. Between the two groups, there was also no statistically significant difference in best corrected visual acuity (BCVA). According to the findings of the current investigation, DSAEK considerably improves mean corneal endothelial cell density (MCD) compared to PK. Therefore, in terms of the endothelial cell density result for corneal endothelial dysfunction, DSAEK may be a better surgical therapy option than PK.

INTRODUCTION

Because corneal endothelial cells do not significantly multiply to allow endothelium regeneration, diseases of the corneal endothelium must be treated by transplanting corneal endothelial cells. The most common transplant operation today according to medicine is corneal transplantation[1]. Amongst the various surgical techniques that have been proposed, penetrating keratoplasty (PK), descemet membrane endothelial keratoplasty (DMEK) and descemet stripping automated endothelial keratoplasty (DSAEK) are the most common options in corneal transplants[2,3]. Endothelial keratoplasty or selective tissue transplantation have become more popular surgical treatments for endothelial disease than full thickness penetrating keratoplasty over time[4]. Penetrating keratoplasty (PK) is thought to be inferior to endothelial keratoplasty (EK). Descemet's stripping endothelial keratoplasty and descemet's stripping automated endothelial keratoplasty (DSAEK) were first reported by price and price in 2005[5-8].

Less astigmatism, more predictable refractive results, quicker visual recovery, a biomechanically more stable globe and a decreased incidence of graft rejection and wound dehiscence following surgery are the main benefits of endothelial keratoplasty[9-11].

In place of penetrating keratoplasty (PK), descemet stripping automated endothelial keratoplasty (DSAEK) is now frequently used to address endothelial dysfunction. In the US, Europe, Australia and Asia, it has already become well-liked for the surgical treatment of corneal endothelial disorders[12-15]. Main complication after DSAEK is donor material detachment and dislocation[9].

Descemet membrane endothelial keratoplasty (DMEK) is more technically difficult than PK and DSAEK even though it requires less tissue to be transplanted, which leads to better visual acuity, quicker visual rehabilitation and a lower rate of rejection[16]. In order to properly assess and compare the safety and efficacy of DSAEK over PK, it is necessary to evaluate visual outcomes in terms of visual acuity, postoperative complications, corneal biomechanical properties and graft survival. Present study was undertaken with an objective to compare the outcomes of PK and DSEK in terms of graft survival, endothelial cell loss and vision improvement in the treatment of corneal endothelial disease.

Aims and objectives:

- To assess changes in endothelial cell count, changes in thickness of cornea and changes in BCVA after penetrating keratoplasty (PK)
- To assess changes in endothelial cell count, changes in thickness of cornea and changes in BCVA after descemet stripping endothelial keratoplasty (DSEK)
- To compare all the changes between two

MATERIALS AND METHODS

The current study is a prospective cross-sectional study carried out at the Dr. Vitthalrao Vikhe Patil Medical College and Hospital in Ahmednagar from January 2022 to June 2023. Prior to the study's launch, institutional ethics approval was acquired. Total 32 patients undergoing corneal transplant either PK or DSEK fulfilling inclusion and exclusion criteria were enrolled. Study was explained to all participants with written informed consent obtained from all.

Inclusion criteria: Patients over the age of 18 who underwent PK or DSAEK with clear corneal grafts in accordance with the clinical indications were enrolled. Patients over the age of 18 who underwent PK or DSAEK with clear corneal grafts in accordance with the clinical indications were enrolled.

Exclusion criteria:

- Other corneal pathologies associated like hydrops, stromal opacification, Descemet tear, cataract, retinal disorder or glaucoma
- Patient who did not adhere to the recommended follow up

Procedure: A thorough history was taken, followed by a slit lamp examination. Age, gender, place of residence, occupation, history of any eye injuries or prior surgery and clinical diagnosis were all thoroughly documented. Total 32 patients were divided into two groups based on type of surgery performed as:

- **Group A (16):** Patients who underwent penetrating keratoplasty (PK)
- **Group B (16):** Patients who underwent descemet stripping endothelial keratoplasty (DSEK)

A principal author operated on each patient. Standard PK was performed on the patients using a manual trephine and a full thickness corneal transplant was implanted and interruptedly fixed with 10'0 nylon sutures. Under traditional peribulbar anesthesia, Descemet's stripping automated endothelial keratoplasty was carried out. The Moria automated lamellar therapeutic keratoplasty (ALTK) device is used to prepare donor tissue and it has a 300 head. Reverse Sinsky's hook was used to completely take off the descemet membrane and diseased tissue was excised. The donor lenticule was centered by kneading it over the cornea after being placed endothelial side down on the viscoelastic coated sheet glide.

After the treatment, patients stayed in the hospital for at least three to 5 days while the epithelization took place and the corneal edema subsided. following that the patient was evaluated one month, three months, six months and a year following the operation. The following factors were evaluated:

- Recording of BCVA with standard Snellen's chart
- Detailed corneal assessment and other anterior segment details with topcon slit lamp model SL-3F and posterior segment with Heine's omega 180 binocular indirect ophthalmoscope
- Specular microscopy with Konan Noncon Robo non contact specular microscope
- Corneal thickness measurement with Alcon ultrasound contact Pachymeter

Statistical analysis: Statistical analysis was performed with the help of SPSS software, version 20. Data were expressed as mean±SD and frequency with percentages N (%). Unpaired t-test was used to evaluate qualitative data and to study association between two variables. Statistical significance was assumed if P<0.05.

RESULTS

Table 1 showing distribution of demographics, shows that 50-60 years age group was the higher prevalent age group undergoing corneal transplantation.

Table 2 shows that pseudophakic bullous keratopathy (PBK) cases were maximum in occurrence in our study, i.e., 25 (39%) followed by corneal scar cases 21 (33%).

Table 3 shows that when group A (PK) compared with group B (DSEK) for mean corneal endothelial cell density (MCD), it was found significant difference only after 1 year (p = 0.03). Before those results wasn't varied between two groups (Fig. 1).

Table 4 shows Pachymetry results amongst two groups, i.e., group A (PK) and group B (DSEK). Results showed no statistically significant difference at any time of follow up (Fig. 2).

Table 5 shows best corrected visual acuity (BCVA) amongst two groups. Results showed no statistically significant difference at any time of follow up.

DISCUSSIONS

Descemet stripping endothelial keratoplasty (DSEK), a recent discovery in corneal transplantation, allows for the selective replacement of a damaged corneal layer. In comparison to penetrating keratoplasty (PK), it provides a number of benefits, including as quicker visual recovery, milder medically produced astigmatism, a reduced rate of graft rejection and preservation of biomechanical qualities. In present study 32 patients older than 18 years of age

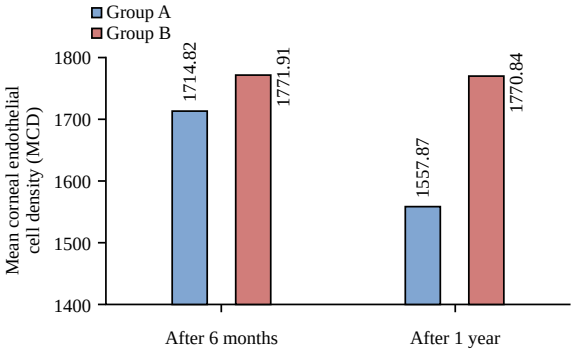

Fig. 1: Distribution of mean corneal endothelial cell density (MCD)

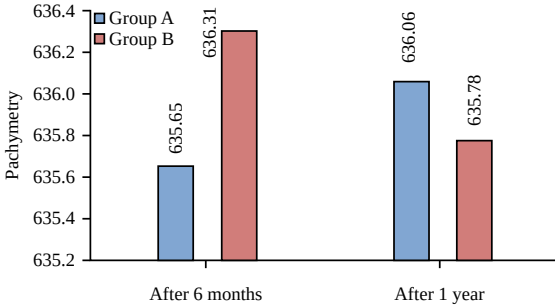

Fig. 2: Distribution of Pachymetry results

Table 1: Distribution of demographics

	Gender		
Age (years)	Male N (%)	Female N (%)	Total N (%)
50-60	11 (34%)	9 (29%)	20 (63%)
60-70	4 (13%)	5 (15%)	9 (28%)
70-80	1 (3%)	2 (6%)	3 (9%)
Total	16 (50%)	16 (50%)	32 (100%)
Mean±SD	58.75±11.24	60.62±12.01	59.68±10.47

Table 2: Distribution of diagnosis

Diagnosis	Right eye N (%)	Left eye N (%)	Total N (%)
PBK	14 (22%)	11 (17%)	25 (39%)
Fuch's dystrophy	5 (8%)	2 (3%)	7 (11%)
Corneal scar	10 (16%)	11 (17%)	21 (33%)
CHED	0 (0%)	1 (2%)	1 (2%)
Failed graft	2 (3%)	1 (2%)	3 (5%)
Adherent leukoma	7 (10%)	0 (0%)	7 (10%)
Total	38 59	26 41	64 (100%)

undergoing either PK or DSAEK according to the clinical indications were enrolled. In order to assess the postoperative outcome, endothelial cell loss and visual improvement were measured. The majority of patients receiving corneal transplants in the current study were in the 50-60 year age range and the most common kind of pseudophakic bullous keratopathy (PBK) was discovered in 25 (39%) instances, followed by corneal scarring in 21 (33%) cases. Gupta and Gupta[17] also showed that 50-60 years was the most common age group. In similar study by Hsiao *et al*.[18] most common indication of PK was graft rejection (42.1%) followed by aphakic bullous keratopathy and pseudophakic bullous keratopathy (16.2%). Trauma-derived corneal scar consisted 14.9 % patients. Bacteria, fungus and acanthamoeba infection were categorized as

Table 3: Distribution of mean corneal endothelial cell density (MCD)

	MCD (cells mm^{-2})			
	Group A	Group B		
Time of evaluation	Mean±SD		t-value	p-value
Pre-operative	2654.43±276.5	2697.91±241.24	0.47	0.63 (NS)
After 1 month	1940.23±318.8	1889.78±275.34	-0.47	0.63 (NS)
After 3 months	1826.06±303.21	1821.88±276.02	-0.04	0.96 (NS)
After 6 months	1714.82±308.01	1771.91±271.86	0.55	0.58 (NS)
After 1 year	1557.87±290.68	1770.84±260	2.18	0.03 (S)

Table 4: Distribution of pachymetry results

	Pachymetry (microns)			
	Group A	Group B		
Time of evaluation	Mean±SD		t-value	p-value
After 1 month	650.37±37.40	650.53±36.73	0.012	0.99 (NS)
After 3 months	635.81±36.05	636.84±35.25	0.080	0.93 (NS)
After 6 months	635.65±36.30	636.31±36.16	0.050	0.95 (NS)
After 1 year	636.06±34.51	635.78 ± 34.48	-0.020	0.98 (NS)

Table 5: Distribution of best corrected visual acuity (BCVA)

	BCVA			
	Group A	Group B		
Time of evaluation	Mean±SD		t-value	p-value
Pre-operative	0.43±0.12	0.44±0.10	0.25	0.79 (NS)
After 1 month	0.34±0.12	0.35±0.09	0.26	0.79 (NS)
After 3 months	0.25±0.11	0.24±0.08	-0.29	0.77 (NS)
After 6 months	0.23±0.11	0.21±0.08	-0.58	0.56 (NS)
After 1 year	0.19±0.10	0.17±0.08	-0.62	0.53 (NS)

non-viral infection which comprised 4.6% (11/241). yang *et al*.[19] in their study found the enrolled patient's mean age was >60 years. kim *et al*.[20] in their study found among a total of 26 patients 19 were males and 7 were females. Mean age was 60.48±10 in DSEK group and 60.17±13 years in PK group. In present study when group A (PK) compared with group B (DSEK) for mean corneal endothelial cell density (MCD), it was found significant difference only after 1 year (p = 0.03). Before those results wasn't varied between two groups. Pachymetry results amongst two groups showed no statistically significant difference. Best corrected visual acuity (BCVA) amongst two groups also showed no statistically significant difference. In similar study by Hsiao *et al*.[18] they found survival rate of PK was 43.5%, while that of DSAEK was 59.5%. yang *et al*.[19] in their study revealed that the DSAEK group had less loss of endothelial cell density than the PK group (diff. in means was -292.05 cells mm^{-2}, p<0.001). kim *et al*.[20] in their study found that the mean preoperative BCVA was similar in DSAEK and PK (1.89±0.48 vs. 1.95±0.63, respectively, p = 0.241). Both groups showed improvement in visual outcomes after surgery, with better BCVA in the DSAEK group compared with the PK group. Mean preoperative donor ECD was 2,570±462 cells mm^{-2} in the DSAEK group and 2,720±448 cells mm^{-2} in the PK group. In the DSAEK group, endothelial cell loss was 25% during the first month, 31% at 6 months and 40% at postoperative 2 years. In the PK group, endothelial cell loss was 19% during the first month, 27% at 6 months, and 61% at postoperative 2 years. Postoperative ECD was higher in the PK group up to 6 months but this trend reversed and was higher in the DSAEK group after postoperative 6 months. Dooren *et al*.[21] in their study found that the early-phase postoperative endothelial cell loss in DSAEK was much higher and faster (decay half time was 2.2 months) compared with PK (half time, 12.8 months).

Many corneal surgeons favor PK because of the relative ease of the procedure. However, PK carries with it a number of postoperative complications such as high and irregular astigmatic changes and prolonged visual rehabilitation, ocular surface problems and long-term endothelial cell loss. As endothelial keratoplasty techniques have evolved, DSAEK has become a widely used method whose major advantages include stability of refraction and faster visual rehabilitation.

CONCLUSION

Generally speaking, thicker grafts are thought to increase mean corneal endothelial cell density (MCD) postoperatively, presumably by giving endothelial cells more intraoperative support. However, this idea runs counter to the widespread practice of using the thinnest graft possible to enhance optical outcomes as in DSAEK. Present study result suggests that DSAEK results in a significantly greater improvement in mean corneal endothelial cell density (MCD) compared with PK. Hence, DSAEK may be a better surgical treatment option than PK in terms of endothelial cell density outcome for corneal endothelial dysfunction.

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