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Visual Outcome, Refractive Error and Specular Microscopy Parameters Following Successful DSAEK

Meisam Ghanbari [1,*], Mahmood Nejabat [1], Mehrnoosh Maalhagh [1] and Seyed Mohammad Salar Zaheryani [1]

[1] Poostchi Ophthalmology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

[*] *Corresponding author*: Poostchi Ophthalmology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran. Tel: +98+9127336271, Email: meisam.ghanbari@gmail.com.

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Abstract

Background: Descemet stripping and automated endothelial keratoplasty (DSAEK) has gained widespread popularity in the treatment of corneal endothelial dysfunction. In the present study, we evaluated the outcome of DSAEK in our center.

Methods: This retrospective cross-sectional study was conducted on 60 patients, who had undergone DSAEK at least 12 months before in Khalili Hospital, Shiraz University of Medical Sciences. On follow-up, best spectacle-corrected visual acuity (BSCVA), refractive errors and specular microscopy parameters were assessed.

Results: The majority of the studied eyes (49.2%) had a BSCVA within the range of 20/40 to 20/30. BSCVA was worse than 20/200 in 8 (13.3%) patients; 6 (75%) patients showed graft failure and 2 (25%) patients had graft rejection. Mean post-operative astigmatism was 0.29 ± 1.88 diopters. The mean refractive hyperopic shift was 1.30 ± 1.34 diopters. Specular microscopy indicated that 3 (5.1%) patients had cell density of less than 700 cells/mm^2, but in none of the patients cell density was less than 500 cells/mm^2. Furthermore, hexagonality of endothelial cells in 50% of the eyes was 54% to 67%. Mean coefficient of variant was 27.76%. Abnormal variations in specular microscopy findings were mostly confined to endothelial cell density, sparing other parameters.

Conclusions: In general, results of this study demonstrated acceptable BSCVA in the average duration of one-year post-DSAEK regarding late complications such as graft failure, graft rejection and epithelial downgrowth.

Keywords: DSAEK, BSCVA, Specular Microscopy

1. Background

Endothelial keratoplasty aims at selective replacement of the corneal endothelium layer in pathologies where this structure is the only affected part of the cornea (1). Descemet stripping and automated endothelial keratoplasty (DSAEK) is the recent advancement in the evolution of partial corneal transplantation surgery. This technique has gained widespread popularity in the treatment of corneal endothelial diseases and is the most frequently practiced type of endothelial keratoplasty worldwide (1).

Preparation of donor tissue in DSAEK is assisted by an automated microkeratome, which dissects a disc containing the endothelium, Descemet's membrane and a thin layer of posterior stroma (2). A posterior lamellar corneal lenticule is cut from the donor cornea by a microkeratome, which can be set to harvest a desired thickness. Subsequently, the folded donor lenticule is handled into the anterior chamber of the recipient eye through a minor incision, unfolded, and placed against the host stromal surface using an air bubble. It replaces the stripped Descemet's membrane and endothelium of the patient's cornea (2, 3).

Several advantages have been reported for DSAEK, including prompt visual recovery, refractive stability, minimal induced astigmatism, low risk of graft rejection, preservation of the structural integrity of the eye, decreased chance of traumatic wound dehiscence and less common wound and suture-related complications (4, 5). Nonetheless, a number of complications such as initial endothelial cell loss, graft non attachment and interface abnormalities have been reported for this method. The tissue damage that is imposed on the donor cornea leads to the acceleration of endothelial cell loss (6, 7). This will promote late endothelial failure, and eventually, graft decompensation. Thus, prolonging graft survival is one of the main challenges in DSAEK (8).

We designed the present study to report our experi-

ence with DSAEK at Khalili Hospital. We examined the outcome of this surgery in terms of visual acuity, refractive errors, corneal thickness, endothelial cell density, endothelial cell hexagonality and coefficient of variant (CV) of cells in an average duration of one-year post DSAEK surgery.

2. Methods

2.1. Patients and Setting

In this retrospective cross-sectional study, medical records of 60 patients, who had undergone DSAEK surgery during 2016 - 2017 in Khalili Hospital, affiliated to Shiraz University of Medical Sciences, Shiraz, Iran were reviewed. All the subjects were operated in a standardized fashion by the same ophthalmologic surgeon and met all the inclusion criteria. The exclusion criteria were postoperative complications including graft failure or rejection and other complications occurring early post-surgery (less than six months), other non-corneal comorbidities affecting visual acuity such as retinal or optic nerve pathologies, and poor patient cooperation for the assessment of visual acuity.

2.2. Data Gathering

Eligible patients were contacted and asked to visit the Poostchi Ophthalmology Clinic for a follow-up examination if at least 12 months had passed from their surgery. In the clinic, complete ophthalmic evaluation including examinations for best spectacle-corrected visual acuity (BSCVA) by Snellen chart, refractive errors and specular microscopy was performed for each patient. Follow up course and medications were the same in all the patients unless there were special conditions that needed distinct treatment.

2.3. Statistical Analysis

Data were analyzed using SPSS, version 20.0. Descriptive analysis was performed on all the quantitative variables and expressed as percentages, as well as mean and standard deviation (SD).

3. Results

A total of 60 patients with a mean age of 59.77 $\pm$ 9.28 years (age range: 27 - 72 years) met the inclusion criteria. Among these 60 patients, 25 were diagnosed with Fuchs endothelial corneal dystrophy and 35 patients with pseudophakic bullous keratopathy. Further, 25 patients who were diagnosed with Fuchs endothelial corneal dystrophy were phakic.

3.1. Visual Acuity and Refractive Errors

The majority of the eyes (49.2%) had a BSCVA within the range of 20/30 to 20/40. The highest estimated BSCVA was 20/25, and 26.6% of the patients had BSCVA equal to or better than 20/30. BSCVA was worse than 20/200 in 13.3% (8 patients) of the patients; 5% (3 patients) of the patients had visual acuity in range of hand motion (HM) to 1-meter finger count (FC), 5% (3 patients) had BSCVA better than 1-meter FC, but worse than 4-meter FC, and the remaining 2 (3.3%) patients had BSCVA of 6-meter FC. Low vision in these eight patients was concordant with hazy cornea confirmed by slit lamp examination; hence, specular microscopy was not applicable in these patients. Out of these eight patients, 2 (25%) patients had keratic precipitates (KP) with anterior chamber reaction (ACR) in slit lamp examination, which was in favor of graft rejection (25%). The remaining 6 (75%) patients showed clinically significant persistent corneal edema in slit lamp examination, and thus they were considered as graft failure. The average time for graft failure in these patients was nine months after surgery. In addition, mean post-operative astigmatism was 0.29 $\pm$ 1.88 diopters (95% CI [-0.1857, 0.7657]). An average refractive hyperopic shift of 1.30 $\pm$ 1.34 (95% CI [0.961, 1.639]) diopters was also noticed (Table 1).

Table 1. Visual Acuity and Refractive Error Outcome

Parameters	Mean $\pm$ SD	Range	CI
BSCVA	0.5 $\pm$ 0.22	< 0.10[a] - 0.80	95% CI [0.444, 0.556]
Sphere	1.30 $\pm$ 1.34	-8.50 - 0.50	95% CI [0.961, 1.639]
Cylinder	0.29 $\pm$ 1.88	-6.75 - 6.00	95% CI [-0.1857, 0.7657]
Axis	80.75 $\pm$ 49.10	10 - 175	95% CI [68.3262, 93.1738]

Abbreviations: BSCVA, best spectacle-corrected visual acuity; CI, confidence interval.
[a]Further explanation in the text.

3.2. Intraocular Pressure

Intraocular pressure (IOP) was measured with air puff tonometer and Goldmann applanation tonometer. Five (8.3%) patients had IOP values more than 21 mmHg with a maximum measured value of 27 mmHg. They were referred to a glaucoma specialist for further evaluation. Glaucoma work-up considered these eyes as post DSAEK glaucoma. Topical anti-glaucoma medication was started for these patients.

3.3. Specular Microscopy Parameters

Specular microscopy showed that approximately 20% of grafted corneas had an endothelial cell density of less

than 1000 cells/mm^2. Three (5.1%) patients had cell density of less than 700 cells/mm^2. No patients had cell densities below 500 cells/mm^2. Furthermore, endothelial cell hexagonality percentage was 54% to 67% in 50% of the eyes. Mean CV was 27.76%, and 57% of values ranged from 21% to 32%. Interestingly, abnormal variations in specular microscopy findings were mostly confined to endothelial cell density, sparing other parameters such as hexagonality and CV.

3.4. Central Corneal Thickness

Central corneal thickness, measured by specular microscopy, showed a range of 490 to 682 microns. We found that 50% of the eyes had a thickness of 547 microns or less. Four (6.8%) patients had corneal thickness above 600 microns.

In slit lamp examination, 4 (6%) patients had evidence of trivial epithelial downgrowth without clinical significance and remained untreated (Table 2).

4. Discussion

Endothelial decompensation has various causes such as Fuchs endothelial corneal dystrophy, pseudophakic bullous keratopathy, buphthalmos and herpes simplex virus endotheliitis. In this cross-sectional retrospective study, we considered the long-term results of DSAEK surgery in patients with Fuchs endothelial corneal dystrophy and pseudophakic bullous keratopathy after surgery; early post-operative complications could not be assessed. Late complications such as graft failure, graft rejection and epithelial downgrowth were evaluated.

Results of this study showed acceptable BSCVA in the average duration of one year post DSAEK. BSCVA was almost in the same range as that in prior studies (2, 3). New methods of DSAEK including ultrathin and double pass microkeratome technique achieve better BSCVA outcomes. A study revealed that 47.5% of the patients treated with ultrathin DSAEK method gained 20/20 visual acuity (5).

In our study, mean post-operative refractive error demonstrated mild hyperopic shift (1.30 $\pm$ 1.34 diopters) and mean post-operative astigmatism was 0.29 $\pm$ 1.88 diopters. Post-operative refractive errors were similar to those in previous studies (4).

In the current study, 8.3% of the eyes were diagnosed with post DSEAK glaucoma and topical anti-glaucoma medication was started. Prior studies revealed that glaucoma post DSAEK surgery is mostly controlled by topical medications, and a minority of patients may need glaucoma surgery (9). The most essential risk factor for the development of glaucoma after DSAEK is preexistence of glaucoma and ocular hypertension (10).

Mean of pachymetry in our study was 545.92 $\pm$ 44.12, which was less than that in prior studies (3, 5). To explain the possibility of this variation in donor tissues thickness, cell density data is required, which is one of the limitations of this study. Despite previous studies, in this study all the parameters of specular microscopy such as cell density, hexagonality and CV have been reported.

Average endothelial cell density was 966.64 $\pm$ 175.21 in our study, which is less than that in prior studies (4). According to prior studies, average endothelial cell loss was 1426 cells/mm^2 (approximately 42 - 50% loss) (4, 8). One of the pitfalls in this study was preoperative missing data of donor tissues, although it has been proved that there is no correlation between preoperative donor endothelial cell count and post-operative endothelial cell density (11, 12).

Results of this study demonstrated that CV and hexagonality are parameters with less variability after DSAEK and have less reliability for the prediction of healthy graft rather than cell density. There is a lack of data in previous studies about these two parameters to be compared.

Graft rejection and graft failure mostly occur in the first year after surgery (13). In this study, the rates of graft failure and rejection after an average duration of one year post DSAEK surgery were assessed. Results demonstrated that graft rejection occurred in 2 (3.3%) patients and presented with ocular pain and decreased vision, also slit lamp examination revealed KP with ACR. These two patients had their first episode of rejection after one year and were treated with oral corticosteroids. Graft failure occurred in 6 (10%) patients, all of whom presented with clinically significant corneal edema and decreased vision. Hjortdal et al. showed that graft rejection in DSAEK in comparison with penetrating keratoplasty (PK) is less frequent, although the risk of early graft failure is higher in DSAEK surgery (13, 14).

It has been proved that the frequency of graft rejection in DSAEK surgery is low, but there are some conditions that may influence the risk of rejection including eyes with prior glaucoma, steroid responsive ocular hypertension and African-American race (6).

Graft rejection and graft failure are less frequent in newer methods of DSAEK such as ultra-thin DSAEK or in DSAEK using donor insertion device (15-17). The results of this study can be used to compare different transplantation techniques, including traditional PK, and more importantly, newer endothelial keratoplasty methods such as DMEK and DMET. When the two latter procedures become

Table 2. Specular Microscopy Parameters Outcomes

Parameters	Mean ± SD	Range	CI
Pachymetry	545.92 ± 44.12	490 - 682	95% CI [534.75, 557.08]
Coefficient of variant (CV)	27.76 ± 7.13	16 - 45	95% CI [25.95, 29.56]
Hexagonal cell	57.89 ± 8.74	26 - 72	95% CI [55.67, 60.10]
Cell density	966.64 ± 175.21	657 - 1470	95% CI [922.30, 1010.97]

popular enough in our center, comparative studies will be beneficial.

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Footnote

Ethical Considerations This study was done considering the Helinsky protocol and was approved by Ethical Committee of Shiraz University of Medical Sciences, Shiraz, iran.

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