

Effects of Artificial Endothelial Layer on Extreme Cornea Edema Patient with Abnormal Eye Structure

Peng Rongmei MD^{1,2}, Yu Ting MD^{1,2}, Yuan Bowei MD^{1,2}, Liu Enshuo MD^{1,2}, Zhang Jiaxin MD^{1,2},
Zhang Xuanjun MD^{1,2} and Jing Hong MD^{1,2*}

¹Department of Ophthalmology, Peking University Third Hospital, China

²Key Laboratory of Vision Loss and Restoration, Ministry of Education, China

*Corresponding author: Jing Hong, MD, PhD, Department of Ophthalmology, Beijing the University
third Beijing Hospital the University Eye center, No. 49, Haidian Garden North Road, Beijing, China
100191, Tel: 00 86-010-8226-6566; Fax: 00 86-010-8208-9951

Abstract

Purpose: To report the effect of the artificial endothelial layer on corneal endothelial decompensation resulting in extreme corneal edema.

Methods: One patient with extreme corneal thickness due to severe endothelial decompensation underwent artificial endothelial layer (EndoArt, EyeYon Medical, Israel) implantation. The details of preoperative, intraoperative and postoperative ocular condition were reported. It included implant attachment situation, visual acuity, intraocular pressure (IOP), central corneal thickness (CCT) and intraoperative challenges.

Result: A 63-year-old female presented with endothelial decompensation in the left eye following two glaucoma filtration surgeries, cataract extraction and intraocular lens implantation. Descemet's stripping automated endothelial keratoplasty was performed. The graft failure happened following cyclophotocoagulation at 11 months postoperative endothelial keratoplasty. The preoperative CCT was

1892 μm , which resulted in poor intraoperative visibility. The anterior chamber depth was 1.565 mm. With a complicated procedure process, the artificial endothelial layer was implanted successfully. The EndoArt detached on the second postoperative day due to loss of the support of gas which entered into the posterior segment. Rebubbling was performed twice on the second and seventh postoperative day respectively. The EndoArt was attached and corneal edema gradually decreased. There was limited improvement in visual acuity from preoperative hand movement (HM) to postoperative finger count (FC) due to the glaucoma associated optic nerve damage. At the 6-week follow-up, central corneal thickness (CCT) decreased to 684 μm . IOP was elevated due to 360° anterior synechia which was controlled by anti-glaucoma eye drops.

Conclusion: In this case severe corneal edema was effectively treated with the artificial endothelial layer, which needs to be further confirmed by larger sample size study.

Keywords: Artificial endothelial layer; Endothelial dysfunction; Severe corneal edema

Introduction

Endothelial decompensation can lead to corneal edema and blurred vision. The main method is Endothelial Keratoplasty (EK) which cannot be performed in severe corneal edema patients due to the poor intraoperative visibility [1,2]. Instead, Penetrating Keratoplasty (PKP) would be performed on such eyes with increased surgical risk. Adding Intraocular Pressure (IOP) fluctuation and a shallow anterior chamber, it usually ends in failure with any type of keratoplasty [2]. The artificial endothelial layer (EndoArt, EyeYon Medical, Israel) is a lenticule of a thin a cellular hydrophilic acrylic implant that acts as an artificial fluid barrier [3]. This paper reports details of this synthetic inert implant used in eyes with extreme corneal edema.

Case Presentation

The left eye of a 63-year-old female developed glaucoma 2 years ago following glaucoma filter surgery twice and cataract surgery. Endothelial decompensation occurred that DSAEK was performed 1.5 years ago. The IOP fluctuated and was controlled by two anti-glaucoma eye drops. The vision became blurry at 11 months postoperative DSAEK after cyclophotocoagulation. The cornea became increasingly white within 6 months (Figure 1a). The Central Corneal Thickness (CCT) was 1892 μm (recipient 1658 μm , decompensated graft 234 μm) (Figure 1b). The Anterior Chamber Depth (ACD) was 1.565

mm. The visual acuity was HAND MOVEMENT (HM). The IOP was 7 mmHg.

A 50% dextrose solution was used as a dehydrating eye drop to increase the visibility. The decompensated endothelial lenticule was removed. A sterile air bubble was injected into the anterior chamber for 10 minutes to re-dehydrate. Visibility was slightly improved, but still blurry. The artificial endothelium was implanted into the anterior chamber with forceps. The insertion and unfolding procedures were difficult to perform as the anterior chamber was shallow and visibility was limited. An air bubble mixed with 12% sulfur hexafluoride was injected into the anterior chamber to support the layer. The orientation of the layer is determined by an " F " sign marking on the periphery of the layer. This layer was sutured with 10-0 nylon through the upper part of the cornea to avoid detachment. The postoperative topical medication regimen was tobramycin and dexamethasone drops 4 times daily for one month and tapered off or changed to low-dose corticosteroid eye drop according to the anterior chamber inflammation. No immunosuppressive therapy was used. This layer was detached on the second postoperative day (**Figure 1c**) due to the loss of support as the gas entered the posterior segment. Rebubbling was performed on the second and seventh postoperative days, respectively (**Figure 1f**). Since then, the layer has attached well (**Figure 1g-j**). Fibrin exudation connected iris with the edge of layer at the early stages of the postoperative period, which was controlled by subconjunctival injection of dexamethasone. With the CCT decreased to 684 μm 6 weeks postoperatively (**Figure 1e**), visual acuity was slightly improved to finger count (FC) due to glaucoma fundus damage. The intraocular pressure increased to 29 mmHg, 3 months after the surgery due to the 360° anterior synechia which was controlled by antiglaucoma eye drops (**Figure 1h**). The cornea remained transparent in the area where the artificial endothelial layer was attached (**Figure 1i**).

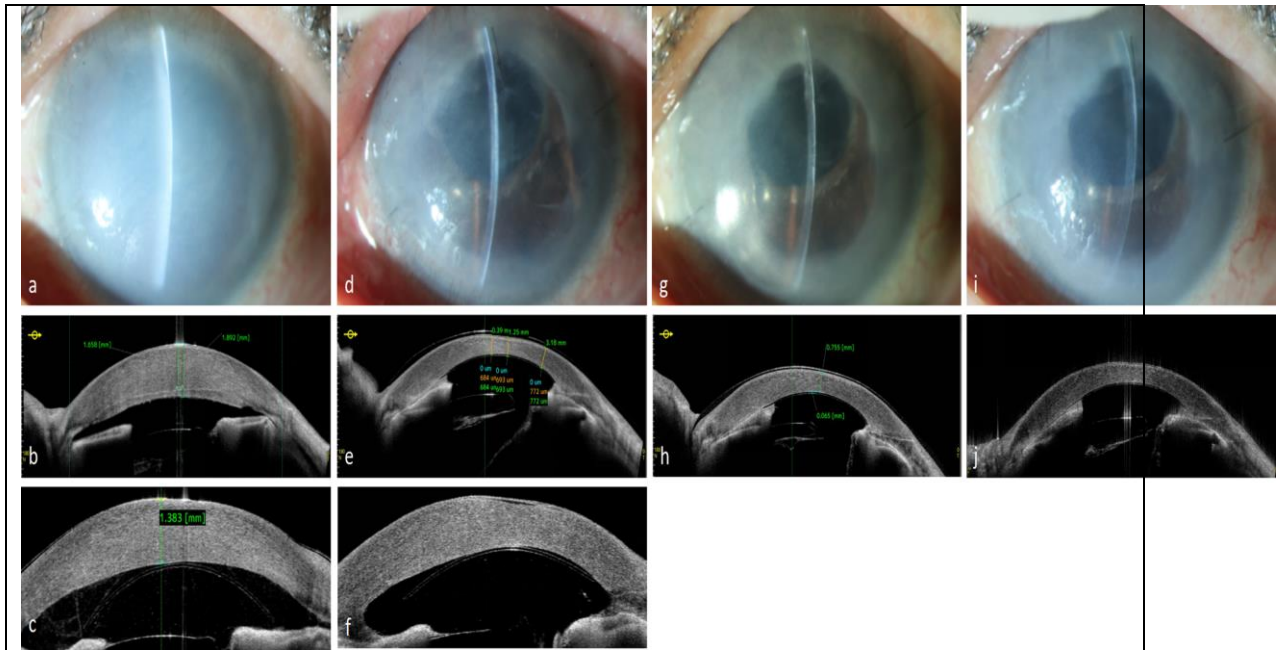


Figure 1: The corneal appearance and thickness of the eye. (a,b) Preoperative situation; (c) The layer was detached on the second day after the operation; (d, e) The attached area became transparent at 1 month after the surgery. Anterior iris synechia can be observed by OCT; (f) Partial layers detached on the seventh postoperative day; (g,h) The central cornea was still transparent at 3 months after the surgery. The anterior synechia was obvious; (i,j) The central cornea was still transparent at 8 months after the surgery. The anterior synechia became 360 degrees.

Discussion

Endothelial decompensation has become the main indication for EK. Son, HS et al. [2] reported that patients with a history of glaucoma, glaucoma surgery, and previous graft failure or bullous keratopathy had been reported to be associated with repeated keratoplasty. It means the fluctuated intraocular pressure, filtering blebs, repeated EK, and severe corneal edema will affect the success rate of EK. All of the factors above were present in our patient. From **Figure 1**, we realize that the cornea is too white to see the details of the anterior chamber. The anterior chamber is too shallow to insert and place the EK graft. This means too many endothelial cells would be lost if we insisted on EK [4,5]. Furthermore, the anterior and posterior chambers of the eye were connected. In addition to the existing filtering bleb, the air bubble could not be stabilized leading to graft dislocation [6]. When the graft is detached, endothelial cells would be further lost after the rebubbling [2,7]. For penetrating keratoplasty, a graft is too thin to match with the recipient. Therefore, the postoperative results and Prognosis of Keratoplasty (PKP/EK) for this eye would be poor. The artificial endothelial layer is an acellular, inert layer which suits such patients exceptionally well. When we performed the surgery, the biggest challenge was poor visibility.

We used two methods to reduce corneal edema so that we could see the layer position. Due to the acellular characteristic of the layer, we could reverse the layer if it has been oriented the wrong way. Also, we could touch it without damaging any endothelial cells. In addition, IOP was elevated because of the anterior synechia, as a result, the surgery would fail if we insisted on keratoplasty. In contrast, the cornea remained transparent in this situation due to the artificial endothelial layer. The main complication for these patients is detachment of the implanted layers. The two cases reported by Dr. Auffarth [3] were both partially detached post operatively, and needed re-bubble. In our case, the layer detached on the first day due to the air entering the posterior chamber following the postural change. The layer was attached well after the rebubbling, showing that the long-acting gas can reduce the possibility of detachment. Fixing the layers with sutures may be another way to reduce the likelihood of detachment. From this case, we concluded that an artificial endothelial layer is an effective method to alleviate severe corneal edema which needs to be further determined by larger sample size studies, as the main complication may be associated with the detachment of the layer.

Funding Support

National Natural Science Foundation of China (81800801, 31271045).

References

1. [Gu S, Peng R, Xiao G, Hong J. DSAEK-Severe corneal edema after corneal edema and post-DSAEK ECL increases graft ECL. Eye Contact Lens. 2022;48:250-255.](#)
2. [Son HS, Lum F, Li C, Schein O, Pramanik S, Srikumaran D. Risk factors for repeat keratoplasty after endothelial keratoplasty—an iris registry analysis. Am J Ophthalmol. 2022;242:77-87.](#)
3. [Auffarth GU, Son HS, Koch M, et al. Implantation of an artificial endothelial layer for the treatment of chronic corneal edema. Cornea. 2021;40:1633-8.](#)
4. [Hayashi T, Oyakawa I, Kato N. Learning techniques for Descemet's membrane endothelial keratoplasty in Asian patients with shallow anterior chamber. Cornea. 2017;36:390-3.](#)
5. [Alqudah AA, Bauer AJ, Straiko M, Terry MA. Endothelial keratoplasty: relationship between recipient anterior chamber depth and endothelial cell loss. Medicine \(Baltimore\). 2019;98:e16171.](#)

6. [Nahum Y, Leon P, Mimouni M, Busin M. Factors associated with graft detachment after primary Descemet stripping automated endothelial keratoplasty. Cornea. 2017;36:265-8.](#)
7. [Gerber-Hollbach N, Baydoun L, Lopez EF, et al. Clinical Outcomes of Graft Detachment and Rebleeding After Descemet's Endothelial Keratoplasty. Cornea. 2017;36:771-6.](#)

Citation of this Article

Rongmei P, Ting Y, Bowei Y, Enshuo L, Jiaxin Z, Xuanjun Z and Hong J. Effects of Artificial Endothelial Layer on Extreme Cornea Edema Patient with Abnormal Eye Structure. *Mega J Case Rep.* 2024;7(4):2001-2006.

Copyright

©2024 Hong J. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) or licensor are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.