

Case Report

Semi-Autologous Corneal Transplantation with Simultaneous Bilateral Surgery: A Case Report

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Keywords

Autokeratoplasty · Autologous penetrating keratoplasty · Repeat penetrating keratoplasty · Graft survival · Chronic endophthalmitis

Abstract

The present report describes a case of semi-autologous corneal transplantation with bilateral surgery using two operating microscopes simultaneously. An 86-year-old man with history of six prior failed penetrating keratoplasties in his right eye presented with decreased vision. His other eye was deeply amblyopic but had a clear 30-year-old Castroviejo-square graft with an endothelial cell count of 803 cells/mm². A semi-autologous graft was performed from the left eye to the right. Surgery was performed simultaneously on both eyes by two different surgeons using a standard ophthalmic operating microscope as well as a second ENT microscope. Upon trephination of the right failed corneal graft, vitreous opacities were noted and sent for culture. The semi-autologous tissue was directly transferred from the left eye to the right without any storage in preservation media to avoid endothelial cell loss. The semi-autologous graft remained clear in the immediate postoperative period. However, the vitreous cultures grew coagulase-negative Staphylococcus. Despite all efforts, the patient eventually developed a retinal detachment and vision in the right eye decreased to light perception. Autologous penetrating keratoplasty is an option for patients with loss of corneal function in a potentially seeing eye and a clear cornea in a contralateral eye with poor visual potential due to non-corneal disease. This case is unique in that part of the autologous penetrating keratoplasty had

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an old square graft in the center and corneal transplant surgery was done simultaneously in both eyes. It also highlights chronic indolent endophthalmitis as a potential cause of multiple graft failures.

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Published by S. Karger AG, Basel

Introduction

Corneal transplant surgery is one of the most successful allograft transplantation procedures worldwide, with survival rates of corneal allografts reaching up to 95%, 5 years after penetrating keratoplasty (PK) [1]. Despite the high success rates, corneal graft failure may still occur, as a result of allograft rejection or nonimmune mediated endothelial decompensation. In most cases, this leads to the need of a regraft procedure, which is associated with poorer visual outcomes and increased risk of failure after each transplant [2].

Autologous penetrating keratoplasty (APK) is a valuable procedure that minimizes the risk of allograft rejection and the need for postoperative steroids, due to tissue isogeneity [3]. This makes it a viable option for patients with multiple graft failures and/or sub-optimal medication compliance. In contralateral APK, the opacified cornea of a potentially seeing eye is replaced by the clear cornea of the patient's contralateral eye, which has low or no vision, due to a non-corneal disease [4]. Although these criteria are not frequently met, contralateral APK has demonstrated positive results in several retrospective case series [3–6]. Other options in patients with multiple graft failures include a repeat PK with systemic immunosuppression using calcineurin inhibitors and antimetabolites [5], or the use of a keratoprosthesis, such as the Boston keratoprosthesis type 1 (Kpro) [6]. In the meta-analysis of Ahmad et al., [7] KPro eyes seemed to have a higher likelihood of maintaining visual improvement compared to eyes that received a repeat PK after cornea failure.

Herein, we report a unique case of a patient with multiple graft failures in his better seeing right eye, where a contralateral semi-autologous PK from the left eye to the right was performed, along with a simultaneous allogeneic PK in the donor left eye. The present case report was written in accordance with the CARE Guidelines for case reports. The CARE Checklist has been completed by the authors for this case report, attached as supplementary material (for all online suppl. material, see <https://doi.org/10.1159/000531990>).

Case Presentation

An 86-year-old man presented to the cornea service at the Bascom Palmer Eye Institute complaining of decreased vision in his right eye. Past ocular history was significant for measles keratopathy during childhood with corneal scarring in both eyes. In his better seeing right eye, the patient had undergone a total of six PKs in his lifetime, of which the last three only survived for 4–6 months, as well as placement of a glaucoma drainage device (GDD) in the anterior chamber. After the last PK, which was 4 months prior to presentation, he developed high intraocular pressure and underwent implantation of an additional GDD in the sulcus (Baerveldt Glaucoma Implant; Abbott Medical Optics, Abbott Park, IL, USA). He was also on prophylactic oral acyclovir, due to a history of HSV keratitis in that eye. In the left eye, his vision was compromised by dense amblyopia. He had undergone a Castroviejo-square graft in Cuba, almost 30 years prior to presentation, which remained clear. The patient's

medical history was significant for benign prostate hyperplasia, hypertension, hyperlipidemia, and arrhythmia with pacemaker placement in 2007. Systemic medications included atorvastatin, digoxin, metoprolol, and valsartan.

At the time of presentation, the patient's visual acuity was 1/200 E in his better seeing right eye and hand motion in his left eye. An afferent pupillary defect by reverse was noted in the left eye. Slit-lamp examination of the right eye revealed an edematous corneal graft without keratic precipitates, a pachymetry of more than 800 μm and two well-positioned GDDs (Fig. 1). Mild chronic-appearing vitreous opacities were observed during fundoscopic examination, which was also confirmed with a b-scan ultrasound. The right eye was otherwise quiet with no injection or pain. In the left eye, the Castroviejo-square graft eye was clear, with a thickness of 641 μm and an endothelial cell count of 803 cells/ mm^2 (Fig. 2).

The patient was referred for evaluation of the vitreous opacities to the Retina/Uveitis service and was under close observation for about 6 months without any change on exam or B scan ultrasound (Fig. 3). At that time, repeat corneal intervention was considered.

Management options were thoroughly discussed with the patient and his family and included an endothelial graft under the failed PK, a repeat ABO-matched PK, a Boston Kpro, and a contralateral APK. Given the history of multiple allogeneic graft failures, decision was made to proceed with transfer of the clear Castroviejo graft from the left eye to the right in a semi-autologous contralateral APK and a simultaneous allogeneic PK in the left eye.

Both eyes were prepared for surgery and each surgeon (E.A. and S.P.) was seated superotemporally on the corresponding side. Two different instrument trays (one for each eye) and three separate corneal trephines (two for the host and one for the allogeneic donor) were used. In order to achieve simultaneous bilateral surgery, it was necessary to incorporate a second operating microscope. A microscope used by Ear, Nose and Throat (ENT) specialists was chosen as the second instrument, due to its thinner profile and the longer working distance, which allowed for a good fit to the patient's interpupillary distance that two ophthalmic microscopes could not provide (Fig. 4).

At the start of the case, an allogeneic donor graft was prepared using an 8.75 mm diameter donor Barron corneal donor punch (Barron Precision Instruments, L.L.C. Grand Blanc, Michigan, USA). The failed corneal graft was then removed from the right eye using an 8.25 diameter Hessburg-Barron recipient vacuum trephine and was sent along with a vitreous sample that was retrieved open-sky for culture and pathology. At the same time, the second surgeon harvested the semi-autologous cornea with the old Castroviejo-square graft from the patient's amblyopic left eye. The cornea was carefully trephined with an 8.50 mm diameter Hessburg-Barron recipient vacuum trephine and removed with corneal scissors. The semi-autologous graft was immediately transferred to the right eye for suturing, without storage in preservation medium, in an effort to minimize endothelial cell damage. Both surgeons worked simultaneously, so as to achieve more efficient suturing of the semi-autograft to the right eye and of the allogeneic graft that was prepared at the beginning of the case to the left eye. Both corneas were secured using interrupted 10-0 nylon sutures. At the end of the surgery, 50 mg cefazolin and 2 mg dexamethasone were administered subconjunctivally in a standard 3cc syringe to create the appropriate bleb. The patient's postoperative treatment regimen included: prednisolone acetate 1% every 2 h for 1 week and 4 times a day thereafter; moxifloxacin 0.5% 4 times a day for 1 week, and preservative-free artificial tears 4 times a day.

On the first postoperative day, the semi-autograft in the right eye looked clear, with a pachymetry of 726 μm and the visual acuity was 1/200 E (Fig. 5), whereas the allogeneic graft in the amblyopic left eye had Descemet's folds, a pachymetry of 792 μm and the visual acuity was hand motions. On the first postoperative week, the semi-autologous graft remained clear and the visual acuity remained 1/200 E. However, both the intraoperative vitreous sample and the right host cornea button came back positive for coagulase-negative Staphylococcus.

Fig. 1. Slit-lamp photograph of the patient's right eye. The corneal graft of the right eye appears edematous, without keratic precipitates.

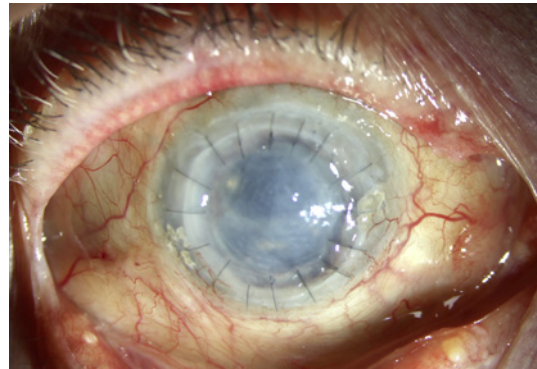
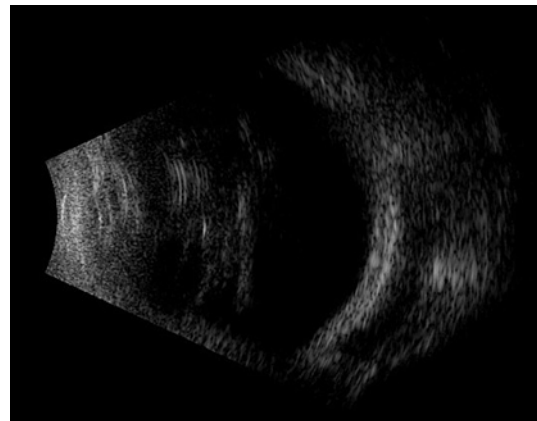


Fig. 2. Slit-lamp photograph of the patient's left eye. In the center of the patient's cornea, the Castroviejo-square graft remains clear.



Fig. 3. B-scan ultrasound of the patient's right eye revealing vitreous opacities that were stable for 6 months prior to the semi-autologous cornea transplantation.



Therapeutic efforts with serial intravitreal vancomycin (1 mg/0.1 mL) injections were made but the inflammation did not subside, and the patient's vision progressively declined. The semi-autograft remained clear until the eighth post-operative week. At the tenth postoperative week, the patient developed a total retinal detachment with proliferative vitreoretinopathy. This was managed with pars plana vitrectomy using a temporary keratoprosthesis, insertion of silicone oil, and an allogeneic PK. The patient's vision in the right eye decreased to light perception, while the allogeneic graft used in the patient's amblyopic left eye remained clear for 3 years.



Fig. 4. Photograph of the surgery set-up, depicting the Ear, Nose and Throat (ENT) microscope, as well as its longer working distance. The two surgeons (E.A. and S.P.) are seated superotemporally on the corresponding side.

Discussion

The management of patients with multiple corneal graft failures is challenging and the therapeutic options are limited, namely a repeat transplantation procedure, most commonly a PK, or the implantation of an artificial cornea, also known as keratoprosthesis. Endothelial procedures, such as Descemet stripping automated endothelial keratoplasty (DSAEK) or Descemet membrane endothelial keratoplasty (DMEK) can also be attempted. In cases of graft failure, however, repeat PK appears to provide equal or better graft survival rates when compared to endothelial procedures [8–11]. Keane et al. [8] showed that a repeat PK was associated with higher graft survival rates compared to endothelial keratoplasty after a failed PK. In another study by Roberts et al. [9], DMEK and DSAEK had higher 12-month failure rates under a failed PK compared to PK revision. Moreover, it is important to point out, that graft survival decreases with every revised procedure [12]. Given the fact that this would be our patient's 7th regrant, the risk of allogeneic graft failure would be extremely high irrespective of the procedure performed.

Our patient met the criteria for contralateral APK by having an opacified cornea in their potentially seeing right eye and a clear cornea in their left eye, which had poor vision due to amblyopia. Therefore, we decided to proceed with a contralateral autologous PK as tissue isogeneity would be associated with a lower the risk of rejection compared to an allograft [3]. Up to this date, 103 cases of contralateral APK have been reported in the literature with an overall success rate of 77.4% at a mean follow-up time of 54 months [3, 4, 13–15]. The results of the APK case reports published in the last 10 years are summarized in Table 1.

The uniqueness of our case is focused on three main aspects. First, the autologous graft harvested from the left eye included a square Castroviejo graft in its center, which, therefore, renders the procedure a semi-autologous PK. To our knowledge, this is the first case of contralateral semi-autologous PK reported in the literature. In theory, the presence of an allograft inside the autograft could have increased the risk of graft rejection in the intermediate or late postoperative period [16]. However, it is important to acknowledge, that in this 30-year-old graft, there is also the possibility that the endothelial cells may have been already replaced centrally by the patient's own peripheral cells. The semi-autograft remained clear until the eighth postoperative week. The total retinal detachment, that the patient developed, was managed surgically on the tenth postoperative week. By that time, the semi-autograft had become hazy and, therefore, had to be removed. As a result, a conclusion with regard to the immunologic response against the semi-autograft could not be drawn.

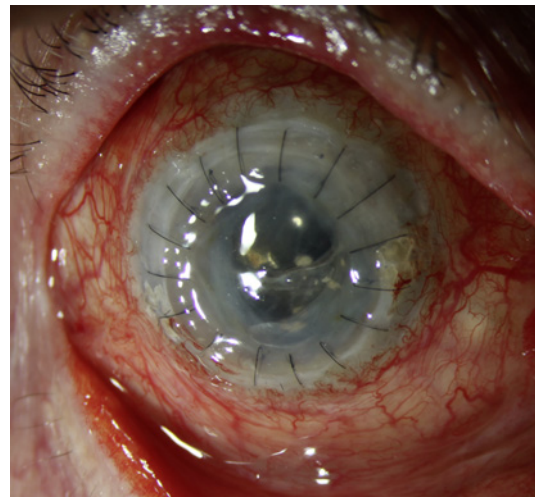


Fig. 5. Slit-lamp photograph of the patient's right eye on the first postoperative day depicting a clear semi-autograft.

Table 1. The most recent autologous penetrating keratoplasty (APK) case reports and outcomes

	Country	Eyes (N)	Mean age, years	Indication for APK (N eyes)	Previous graft failure, N eyes	Glaucoma, N eyes	Glaucoma drainage device (GDD), N eyes	Mean follow-up, months	APKs with clear status, N
Martinez et al. [3] (2013)	United States	5	71.4	CGF (5)	5	4	5	35	1
Sharma et al. [4] (2012)	India	9	63	L (4), BK (5)	Not mentioned	2	Not mentioned	51	8
Perez-Balbuena et al. [5] (2017)	Mexico	11	58	CGF (2), BK (7), OR (1), CB (1)	2	8	7	26	8
Sanjuan et al. [6] (2021)	Spain	31	52	ED (20), PMD (1), L (8), DCK (1), CU (1)	20	14	Not mentioned	135, 6	23
Situla [15] (2019)	Nepal	1	65	CU (1)	0	1	0	24	1

CGF, corneal graft failure; L, leukoma; BK, bullous keratopathy; OR, ocular rosacea; CB, corneal burn; ED, endothelial decompensation; PMD, pellucid marginal degeneration; DCK, deep calcium keratopathy; CU, corneal ulcer.

Another novelty of our case was the performance of bilateral keratoplasty (the semi-autologous and the allogeneic one) simultaneously, by having two surgeons in the operating room, one for each eye. Simultaneous bilateral procedures are not a new concept in ophthalmology, as they have been described in cataract, strabismus, and posterior-segment surgery among others [17]. However, these procedures are rather immediately sequential, as the second eye is operated upon only after the operation on the first eye has been completed.

In our case, the surgeons worked simultaneously, one on each eye. This was achieved by using two different types of microscopes, namely an ENT and an ophthalmic microscope in order to minimize open-sky time and facilitate the immediate transfer of the 30-year-old square graft from the left eye to the right. The decision to proceed with a second ENT microscope instead of an ophthalmic one was based on the ENT's thinner profile and longer working distance [18] in order to fit to the patient's interpupillary distance.

The semi-autologous cornea of the left eye had a rather low endothelial cell count of 803 cells/mm². Simultaneous surgery meant immediate graft transplantation, avoiding the storage of the semi-autologous graft in preservation medium and, thus, avoiding additional endothelial cell loss. Preservation damage during surgery has been suggested as a possible risk factor for acute loss of donor endothelium, eventually leading to endothelial decompensation and autologous graft failure [19–21]. In our case, no primary donor failure was noted as the semi-autologous graft remained clear in the immediate postoperative period.

Moreover, simultaneous surgery by two surgeons limited the time of open-sky surgery, thus lowering the risk of expulsive hemorrhage. One surgeon was suturing the semi-autograft to the right eye while the other surgeon was suturing the allogeneic graft to the left eye. To this date, two cases of expulsive hemorrhage have been described as a complication of contralateral APK in the blind recipient eye. In these cases, the authors used either a temporary keratoprosthesis or an oversized glycerin-preserved cornea on the recipient site to provide tectonic support [4, 13]. Along with other proposed measures, such as preoperative mannitol infusion and control of the intraocular and systemic blood pressure, simultaneous surgery could provide another alternative in controlling the risk of this dreadful complication in APK cases.

Third, our case highlights chronic indolent endophthalmitis as a possible cause of multiple graft failures. Postoperative endophthalmitis has been reported after PK with an incidence of 0.08–0.77%, with coagulase-negative *Staphylococcus* being the second most common pathogen [22]. The incidence of chronic postoperative endophthalmitis is unknown, with a single-centered study reporting a 0.017% incidence after cataract surgery [23]. Chronic endophthalmitis can present as a recurrent and low-grade uveitis, starting two to 3 months postoperatively, with vitreous involvement as the disease progresses [24], or even mimic an endothelial immune reaction after PK [25]. In our patient's right eye, a chronic endophthalmitis was discovered only postoperatively since the assessment of common chronic endophthalmitis signs was complicated by the opacified cornea.

It is important to suspect indolent endophthalmitis in patients with history of multiple graft failures, especially when each graft fails soon after the transplantation procedure. The patient's last corneal graft prior to the APK procedure failed only 4 months after transplantation. We, thus, suspect that the indolent chronic endophthalmitis was likely the cause of the patient's previous graft failures. Although there are no guidelines in place to address these cases, we believe that in cases of multiple graft failures and even mild intravitreal opacities, obtaining a vitreous sample to exclude endophthalmitis before surgery could be a reasonable option. After corneal surgery, the removed graft should also be sent for culture, as was done in this case.

In summary, this is the first reported case of simultaneous bilateral keratoplasty with a semi-autologous graft using two operating microscopes (an ophthalmic and an ENT one) by two surgeons at the same time. This leads to decreased open-sky time, more efficient suturing of the recipient and donor corneas, and limits any preservation media-related endothelial cell loss, thus contributing to autograft survival. Finally, chronic indolent endophthalmitis should be considered in patients with history of multiple graft failures and should be treated adequately prior to any additional corneal procedure.

Statement of Ethics

The study was performed in accordance with the Helsinki Declaration of 1964, and its later amendments. Informed written consent was obtained from the patient for publication of this case report and accompanying images. Ethical approval is not required for this study in accordance with local or national guidelines.

Conflict of Interest Statement

Dr. Palioura is a consultant for Alcon. The authors declare no other conflict of interest related to this work.

Funding Sources

Supported by the NIH Center Core Grant (P30EY014801) and the Research to Prevent Blindness Unrestricted Grant (GR004596-1).

Author Contributions

A.G., A.C., S.P., and E.A., contributed in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; S.P., N.K., and D.K. took part in drafting, revising, or critically reviewing the article; S.P. and E.A. gave final approval of the version to be published. All authors have agreed on the journal to which the article has been submitted and agree to be accountable for all aspects of the work.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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