CASE REPORT

Customised component corneal transplantation: a blessing for three patients

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SUMMARY

The existing acute shortage of good quality donor corneas in a developing country like India, prompted us to attempt customised component corneal transplantation. Using this surgical strategy, one corneoscleral button was used for three recipients. Anterior and posterior lamellar discs were used for anterior lamellar keratoplasty and Descemet's stripping endothelial keratoplasty in patients with superficial corneal scar and pseudophakic bullous keratopathy, respectively. From the remnant peripheral corneoscleral rim, a patch graft was taken and used for a case of perforated corneal ulcer. Postoperatively, the two earlier mentioned cases achieved visual acuities of 20/30 and 20/60, respectively, whereas the latter mentioned patient with the patch graft achieved good tectonic stability. This case report highlights the optimal utilisation of a corneoscleral button by customising it for three recipients. Moreover, a patch graft has been introduced in the armamentarium of customised component corneal transplantation for the first time.

BACKGROUND

Customised component corneal transplantation is an evolving surgical strategy that involves selective replacement of affected part of recipient cornea with lamellar buttons of donor cornea.¹ It includes surgical techniques such as anterior lamellar keratoplasty (ALK),² automated lamellar therapeutic keratoplasty (ALT),³ deep anterior lamellar keratoplasty (DALK),³ Descemet's stripping endothelial keratoplasty (DSEK),⁴ Descemet's stripping automated endothelial keratoplasty (DSAEK)⁵ and Descemet's membrane endothelial keratoplasty (DMEK).⁶ Besides the above techniques, even a small patch graft obtained from peripheral healthy donor cornea can be included in this surgical strategy.¹ These surgical techniques offer many advantages over conventional full thickness keratoplasty, including decreased risk of graft rejection, retention of globe integrity and avoidance of complications associated with open sky procedures.⁷ In addition to the above advantages, these surgical techniques entail the utilisation of one donor cornea for multiple recipients. Herein, we report our experience with customised component surgery of the cornea which enabled us to visually rehabilitate two patients and provide tectonic stability in the third recipient.

CASE PRESENTATION

Case 1

A 56-year-old man developed two episodes of viral keratitis in the left eye over 2 years. Ocular

examination revealed distant visual acuity as 20/20 in the right and counting fingers close to face (CFCF) in the left eye. Examination of the right eye was normal. The left eye showed a diffuse corneal scar in the central and paracentral area (figure 1A) involving the superficial one-third to half of corneal depth with no vascularisation. Rest of the anterior and posterior segment examinations were normal. Intraocular pressure (IOP) as measured by non-contact tonometer was 12 mm Hg in the right eye and was digitally normal in the left eye. Anterior segment optical coherence tomography (Visante, Carl Zeiss Meditec) confirmed the maximum corneal scar depth as 210 µm and the patient was registered for ALK in the left eye.

Case 2

A 59-year-old woman underwent cataract surgery in the right eye and did not regain useful vision following the same. Ocular examination revealed visual acuity as light perception with accurate projection of rays in the right eye and 20/20 in the left eye. Examination of the right eye showed mild circumcorneal congestion with hypertrophied corneal epithelium, (figure 1B) stromal oedema and multiple Descemet's membrane folds. The anterior chamber was quiet and a posterior chamber intraocular lens was noted in situ. No other details could be visualised. B-scan ultrasonography (Opro OTI-300) showed a normal posterior segment. Based on the aforementioned clinical features, she was diagnosed to have pseudophakic bullous keratoplasty (PBK) in the right eye and she was registered for DSEK in the same eye.

Case 3

A 62-year-old man reported with redness, pain and reduced vision in the right eye for 2 weeks. Ocular examination revealed visual acuity as CFCF in the right and 20/60 in the left eyes, respectively. Examination of the right eye showed mild circumcorneal congestion with peripheral corneal perforation and prolapsed uveal content between 7 and 8 o'clock meridia, (figure 1C) with surrounding infiltrate and oedema. Corneal sensation was markedly reduced. Anterior chamber was irregular in depth and a cataractous lens was noted. The remaining details could not be visualised. Based on clinical features like old age, unilaterality, peripheral location of corneal ulcer and reduced corneal sensation, a clinical diagnosis of perforated viral corneal ulcer was made. The patient was started on oral acyclovir 400 mg five times a day and he was scheduled for emergency patch graft in the right eye.

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Figure 1 Preoperative photographs in case 1 (A) and case 2 (B) Preoperative schematic diagram in case 3 (C).

TREATMENT

Donor cornea

A good quality donor cornea (endothelial cell density (ECD) 2856/mm², 65% hexagonality, coefficient of variance (COV) 20% and central corneal thickness 510 µm) was retrieved from a male donor of 51 years, who died of cardiac arrest, the same day the emergency patch graft was scheduled. In view of the long waiting list and a shortage of donor corneas, we decided to perform ALK, DSEK and patch graft from the same corneoscleral button.

The corneoscleral button was mounted on a Barron artificial anterior chamber (Katena Products, Inc, USA). After scraping the epithelium, a 3 mm groove was made in the corneal periphery adjacent to the limbus with the help of 300 µm guarded knife. Through the depth of the 300 µm groove, two lamellar dissectors (Indo-German, India), initially straight and then curved, were introduced sequentially in one plane to split the cornea into anterior (approximately 300 µm) and posterior lamellae (approximately 210 µm). An 8 mm disposable trephine (Madhu instruments, Delhi, India) was used to form the anterior and posterior lamellar buttons. Anterior lamellar button was then used for ALK, and the posterior lamellar button for DSEK. With the help of a 5 mm trephine (Madhu instruments, Delhi, India), a patch graft was obtained from the remaining peripheral corneoscleral rim.

Case 1 for ALK

With proper centration, a Hessburg-Barron Vacuum Trephine (Barron Precision Instruments, L.L.C, USA) was rotated for 360° (one-quarter rotation: trephine penetrates to a depth of 63 µm) and approximately 250 µm of anterior host corneal tissue was excised. The anterior lamellar button of donor cornea was transplanted using sixteen 10-0 interrupted nylon sutures (Ethicon Johnson and Johnson, USA).

Case 2 for DSEK

After descemetorrhesis, an 8 mm posterior lamellar button of donor cornea was introduced into anterior chamber through a

5 mm temporal tunnel incision with the help of cystotome and sheet glide. Three 10-0 monofilament nylon sutures were used to close the scleral incision.

Case 3 for patch graft

After preparing the recipient bed with a 4.5 mm corneal trephine, a 5 mm patch graft was placed and sutured to the corneoscleral rim with eight 10-0 interrupted nylon sutures.

OUTCOME AND FOLLOW-UP

Case 1

Postoperatively, topical steroid (eyedrop predforte acetate 1%) in tapering dosage for 6 months, topical antibiotic (eyedrop moxifloxacin 0.5%) for 2 weeks and lubricant (Tears Naturale Free) was started. At 3 months, corneal astigmatism, based on corneal topography (EyeSys System 2000, Poland) was −4.8 DCyl@80°. Selective suture removal was started at 3 months, on monthly basis, till corneal astigmatism fell below four dioptres. At last follow-up (figure 2A) that is, at 6 month, the visual acuity was 20/30 with −1.75 DCyl@70° and a clear graft well opposed to host cornea by ten 10-0 interrupted nylon sutures.

Case 2

Postoperatively, the drug regimen was the same as described for ALK. At last follow-up (figure 2B) that is, at 6 month, the patient visual acuity was 20/60 with −1.5 DCyl@120° and a clear host cornea. ECD was 1656 mm² with 55% hexagonality and 35% COV.

Case 3

Postoperatively the drug regimen was the same as described above for case 2. At 6 months follow-up (figure 2C) the patch graft was seen to be completely conjunctivalised. The visual acuity was light perception in the operated eye due to the presence of cataract. The required IOL power was calculated from K readings (41.5@103°, 43.5@13°) obtained from corneal topography and the axial length (23.5 mm) from A scan. Cataract

Figure 2 Postoperative photographs in case 1 (A), 2 (B) and 3 (C).

extraction, PCIOL implantation and limbal relaxing incision were performed at 7 months post patch graft surgery. At 1-month following the cataract extraction, the visual acuity was noted to have improved dramatically to 20/30 with -0.75 DCyl@105° and proper centration of the IOL was seen.

DISCUSSION

Diseases affecting the cornea are a significant cause of blindness in the developing world. In India, they account for an approximate figure of 6.8 million blind people, and of these, about 1 million are suffering from bilateral blindness.⁸ The answer to corneal blindness lies in corneal transplantation. However, the status of eye donation is quite grim in India. As per Sharma *et al*,⁹ there is an annual requirement of 300 000 corneas, however, only 15 000 are made available. This brings about a huge gap between demand and supply. In order to address this gap, customised component corneal transplantation appears an exciting technique as it seems to have the potential to reduce the demand by a threefold magnitude.

The concept of component surgery of cornea was pioneered by Shimmura¹⁰ in 2004. Subsequently, Vajpayee *et al*¹ carried forward this concept of using the donor cornea for three recipients that is, the anterior lamellar disc for a case of macular corneal dystrophy, the posterior lamellar disc for a case of PBK and the peripheral corneoscleral rim for limbal stem cell transplantation. Encouraged by these results, Sharma *et al*⁹ demonstrated that a single donor cornea on being dissected with a microkeratome could be successfully transplanted into two recipients (one recipient undergoing ALTK and the other DSEK). Heindl *et al*¹¹ have shown recently that, performing DMEK with the stripped Descemet's membrane with attached endothelium and DALK with the remaining corneal stroma, provided superior visual outcomes for both the recipients. Most recently, Jhanji *et al*,¹² in a review article laid emphasis on appropriate utilisation of all components of donor corneal button. They concluded that the concept of 'Targeted corneal transplantation' should be adopted world wide in order to reduce the shortage of donor corneas thereby decreasing the burden of corneal blindness. In an evolutionary modification of the above reports, we even utilised a part of peripheral corneoscleral rim in the form of a patch graft, as in case 3. To the best of our knowledge this novel approach has not been published as a part of the armamentarium of customised component corneal transplantation before.

In this exploratory case series, we have been successful in treating three patients using only one corneoscleral button. Both case 1 and case 2 achieved good visual outcomes at last follow-up. Similarly, case 3 achieved adequate tectonic stability, thus preserving the integrity of the eyeball. Our approach of customised component corneal surgery enjoys certain obvious advantages. Routine adoption of this technique is definitely going to nearly treble the available corneal tissue supply which, in turn will help in reducing the backlog of corneally blind patients in a developing country like India.

Our approach has certain limitations. First, we have split the cornea by the manual dissection technique. This technique is considered inferior to microkeratome dissection technique.¹³ However, we achieved optimal visual outcomes in the two former cases without significant astigmatism and interface haze. Second, this approach requires careful planning and preparation as it is not always easy to schedule patients in same sitting both for DSEK and ALK. Despite these shortcomings however, we

would like to unhesitatingly endorse our technique vis-à-vis the microtome dissection one, in a developing country like India because of the obvious economical advantages it confers.

This case report highlights the successful outcome of customised component corneal transplantation that is, using one corneoscleral button for three recipients. This is a small step towards the solution of an everlasting problem of shortage of good quality donor tissue in India. Also, for the first time, we have introduced the patch graft in the armamentarium of customised component corneal transplantation.

Learning points

- ▶ Customised component corneal transplantation is an innovative concept especially for developing world where there is an acute shortage of good quality donor tissue.
- ▶ Besides using anterior and posterior layers of donor cornea for anterior lamellar keratoplasty and Descemet's stripping endothelial keratoplasty, it is a novel concept to use corneoscleral rim for patch graft.
- ▶ It is advisable that manual dissection technique for splitting of cornea works equally well and should be promoted especially in developing world where cost is a major issue for purchasing microkeratomes for cornea dissection.

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