Using corneal graft from keratoconic donor for lamellar and penetrating keratoplasties

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We report the use of two corneal grafts derived from a donor, with a history of early stage keratoconus, for lamellar and penetrating keratoplasty. The first graft was used to perform Descemet stripping automated endothelial keratoplasty (DSAEK) in a patient with endothelial dysfunction and advanced pseudoexfoliative glaucoma. The second graft was used for an emergency penetrating keratoplasty in a patient with corneal perforation secondary to uncontrolled herpes keratitis. In the first case, 1 year postoperatively, the graft was clear and attached with no signs of rejection or failure. In the second case, the perforation did not relapse after keratoplasty and the globe retained its structural integrity during the 1-year follow-up.

Key words: Corneal graft, donor, keratoconus, keratoplasty

Corneal grafting requires a well-organized cornea bank able to provide high-quality tissue from donors on a regular basis. The majority of cornea banks work on a common basis of very strict inclusion and exclusion criteria for donors. Nevertheless, they face severe donor shortage hence, alternatives to human cornea grafts are now actively explored. This consideration is especially important for emergent treatments where tissue must be promptly available.

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Keratoconus is a bilateral, noninflammatory, naturally occurring corneal ectatic disorder characterized by progressive thinning and steepening.[1] Despite biomechanical weakening, corneas with mild-to-moderate keratoconus usually maintain good transparency and structural integrity without any endothelial dysfunction.

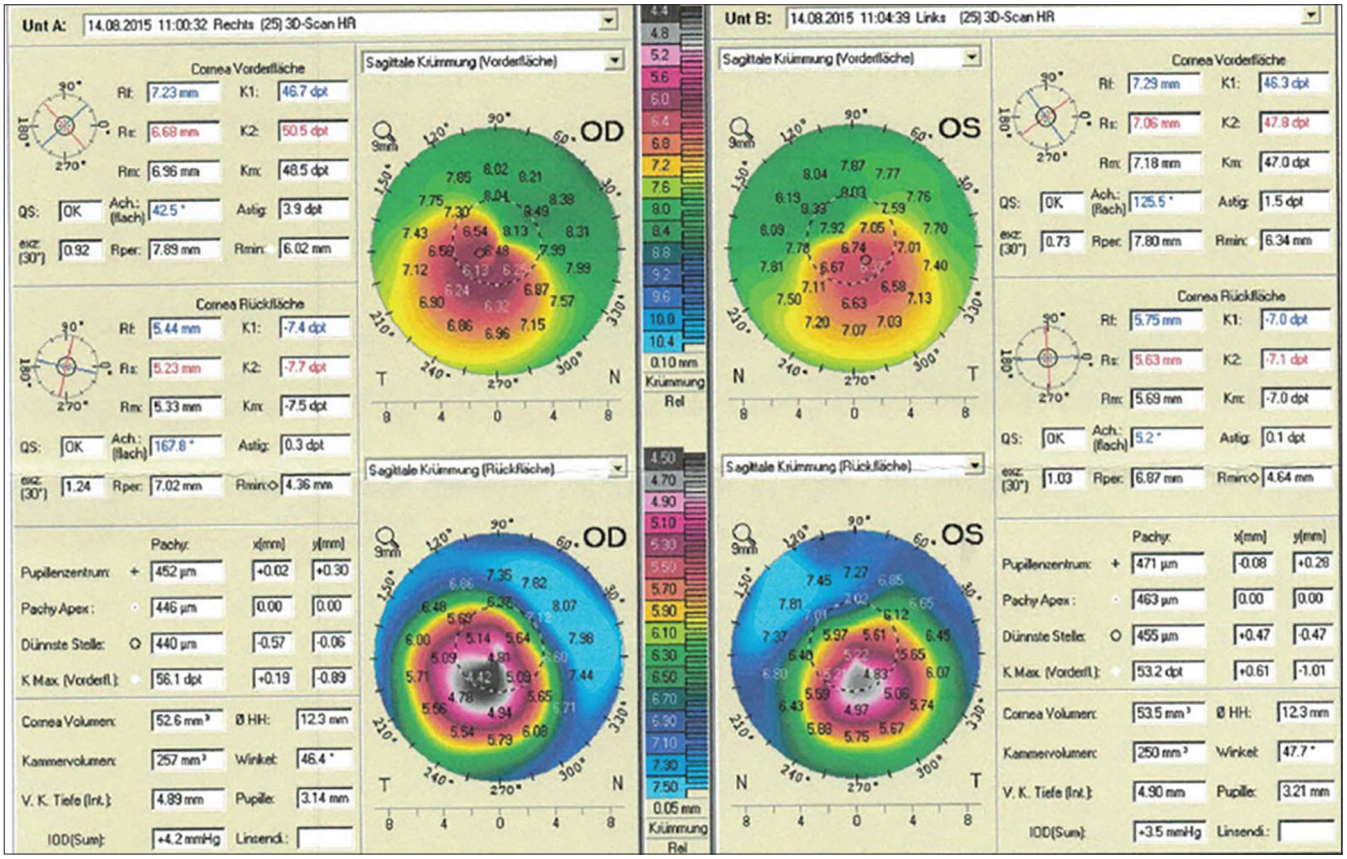

Figure 1: Scheimpflug-based corneal topography of the donor 2 years prior to transplantation revealing bilateral keratoconus, with inferior steepening and corresponding thinning

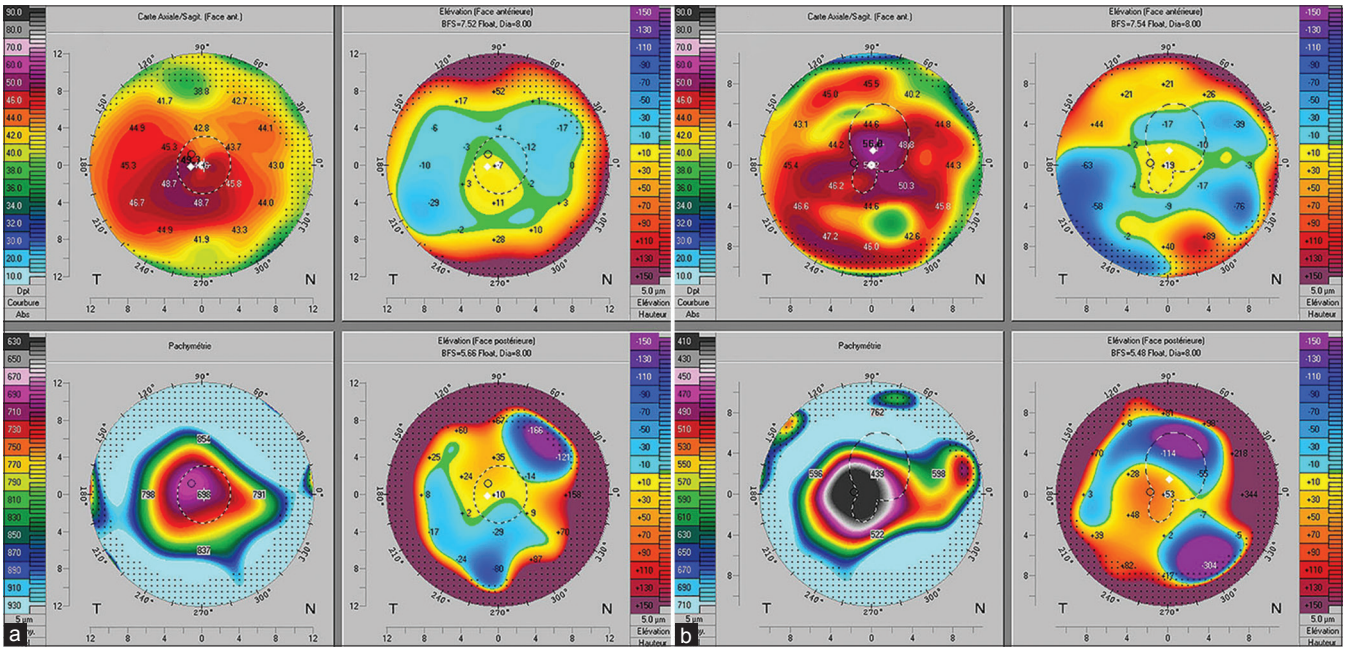

Figure 2: (a) Scheimpflug-based corneal topography of 1-year following DSAEK. (b) Scheimpflug-based corneal topography of 1-year following PKP

In this report, we present two patients who received corneas from the same donor and who had a history of early-stage keratoconus, during a period of local tissue shortage.

Case Report

The corneal grafts were harvested from the same 73-year-old donor. The donor's cornea Scheimpflug imaging (Pentacam, Oculus Instruments, Wetzlar, Germany) and ophthalmic history were available for 2 years before the donor passed away. Diagnosis of keratoconus was reported on topographical examination with keratometry readings of 46.70/50.50/56.10 diopters (D) and 46.30/47.80/53.20 D at the right and left eye, respectively. The thinnest corneal thickness was 440 μm and 455 μm for the right and left eye, respectively [Fig. 1]. No corneal scarring was reported. Both corneas were carefully examined by our cornea bank specialist upon graft preparation and no opacities were evident. According to the Amsler-Krumeich classification, the donor was presenting stage II keratoconus in the right eye and stage I keratoconus in the left eye.

The first graft, deriving from the eye with stage II keratoconus, was used to perform Descemet stripping automated endothelial keratoplasty (DSAEK) in an 83-year-old patient with endothelial dysfunction. The patient had a history of advanced pseudoexfoliation glaucoma treated with bilateral trabeculetomies in the '80s followed by bilateral cataract surgery in the left and right eye in 2005 and 2012, respectively. In 2011 he developed pseudophakic bullous keratopathy in the left eye and was treated with a DSAEK in August 2012 that failed later on and was retreated with Descemet membrane endothelial keratoplasty (DMEK) in March 2016. Later on, the right eye showed signs of endothelial decompensation with associated corneal edema and reduced visual acuity. In January 2018, his corrected distance visual acuity (CDVA) was limited to counting fingers in the right eye due to advanced glaucoma and was 0.3 on the Snellen chart in the left eye. The right eye cornea showed a diffuse stromal and epithelial edema with associated Descemet folds, a pachymetric reading of 801 μm and an otherwise closed epithelium and quiescent anterior segment with a functioning bleb superiorly. The left eye showed an attached and clear endothelial graft and cornea with a quiescent anterior segment. The pressure was 12 mmHg in the right eye and 15 mmHg in the left eye on Goldman applanation tonometry. We performed DSAEK under general anesthesia on the right eye in January 2018. The donor cell count was 2266 cells/mm^2 with thickness of 177 μm and a 7.75 mm trephination was made on the donor's cornea. A descemetorhexis was completed with viscoelastic in the anterior chamber and the remaining Descemet membrane removed with a forcep. After removal of the viscoelastic, the donor cornea was placed on a Busin glide inserter, injected in the anterior chamber followed by an air bubble to maintain the graft in position. One month after the surgery the visual acuity improved to 0.1 in the right eye, the pressure was controlled at 15 mmHg and the graft was attached and clear. One year postoperatively, CDVA was 20/125 and intraocular pressure was maintained at 10 mmHg. The graft was clear and attached, no visible sign of rejection or failure was documented. Scheimpflug imaging reported a Kmax of 49.3D, a minimal pachymetry of 686 μm with moderately elevated posterior elevation map and normal anterior elevation map [Fig. 2a].

The second graft (stage I keratoconus) was used for an emergency penetrating keratoplasty (PKP) in a patient with corneal perforation due to uncontrolled herpes keratitis in the right eye. It was previously treated four consecutive times with cyanoacrylate glue followed by an amniotic membrane graft but the corneal melting progressed with persisting athalamia and a CDVA of counting fingers (CF). An emergency PKP was performed. Subsequently at 1-year follow-up, CDVA was 20/400 and IOP 11 mmHg. The graft was clear with no signs of failure or rejection. On postoperative topographical examination, Kmax was 56.80 D with minimal thickness of 366 μm; posterior and anterior elevation maps were also outside normal limits [Fig. 2b].

Discussion

In this report, we propose that keratoconic corneas could be potential candidates for corneal transplantation in a period of shortage in patients with limited visual acuity or for emergency grafting. We also suggest that the use of anterior segment optical coherence tomography (AS-OCT) could be a valuable tool to implement in the initial screening of local cornea banks, to carefully discriminate among the donated corneas between advanced and scarred versus early keratoconus if no donor ophthalmological examination report is available.

The biomechanical strength of the human cornea is mainly defined by the anterior stroma.[2] Thus, the graft in DSAEK has no role in the biomechanics of the cornea but only in the restoration of endothelial function. Consequently, an ectatic donor may not be a strict contraindication and visual acuity improvement might indeed be expected, provided that the disease spares deep stroma and endothelium in nonadvanced cases. However, the risk of corneal perforation during donor preparation is probably higher due to the increased curvature of the cornea and a curvature mismatch at the posterior surface of the donor is also to be expected between the donor and the receiver and should be kept in mind.

In the second case, the use of keratoconic graft in emergency PKP led to satisfying results of corneal perforation management. As all the layers of the cornea are transplanted in PKP, only early-stage keratoconus can be selected and used for emergent purposes in selected patients as scarred advanced keratoconus will reduce any potential improvement in visual acuity and may jeopardize the result due to advanced thinning. Goto *et al*. have reported the use of corneas obtained from keratoconus patients as emergency transplants.[3] In our case, the perforation did not relapse after PKP and the globe retained its structural integrity.

Although the structure of the donor cornea is not compromised in mild-to-moderate keratoconus, there is still a theoretical risk of keratoconus development on the recipient. Scarce reports describe the development of keratoconus post keratoplasty in patients with another initial diagnosis.[4-6] Authors in those cases speculate that disease was transmitted by the donor cornea. Nevertheless, use of such corneas in emergency keratoplasty remains justified, since the goal of the treatment of the acute disease is not jeopardized.

Conclusion

In conclusion, flexibility in the exclusion criteria regarding donors with early-stage keratoconus seems to be a possible

alternative of tissue management during periods of shortage especially for patients with poor visual potential or in emergency grafting. Ectatic disorders seem not to preclude the use of the graft for endothelial keratoplasty if the endothelium is not compromised.

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Conflicts of interest

There are no conflicts of interest.

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