Corneal collagen crosslinking combined with a new lamellar artificial cornea in a patient with advanced keratoconus

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We describe a case in which a new lamellar keratoprosthesis (Keraklear) was implanted in a patient with progressive keratoconus. Corneal collagen crosslinking was performed just before implantation to stabilize the cornea. No intraoperative or postoperative complications occurred. The corrected distance visual acuity improved from hand motion to 20/40 at 1 year.

Financial Disclosure: No author has a financial or proprietary interest in any material or method mentioned.

JCRS Online Case Reports 2015; 3:29–31 © 2015 ASCRS and ESCRS

Corneal transplantation is the most common transplant procedure performed in North America.1 As the number of people requiring transplants continues to increase, there is an increased demand for donor corneal tissue. Globally, the number of people with corneal blindness requiring a transplant outnumbers the number of available donor corneas. In addition, some people with high-risk characteristics (eg, multiple graft failures, corneal neovascularization) are not good candidates for a corneal transplant.2 Consequently, there has been an increased interest in the use of artificial corneas.

The Keraklear keratoprosthesis (Keramed, Inc.), an artificial cornea made of a proprietary biocompatible polymer, is designed to replace the anterior cornea.3 The device is 7.00 mm in diameter and 300 μm thick; it has a 4.00 mm central optic. There are 18 holes located peripherally to facilitate nutrition, fixation, and hydration to the remaining layers of the cornea (Figure 1).3 Indications include anterior corneal scarring, keratoconus, corneal dystrophies, and failed grafts. There are a number of advantages to using this type of keratoprosthesis: Only a small portion of the existing anterior corneal tissue has to be removed; there is no risk for rejection as the device does not contain donor graft tissue; and the procedure does not penetrate the anterior chamber, which helps to prevent complications such as intraoperative suprachoroidal hemorrhage, vision-threatening infection, and inflammatory retroprosthetic membranes. In addition, in the postoperative period, chronic steroid use is not required. The absence of long-term steroids helps to prevent complications such as glaucoma and cataract formation. Finally, the device has the potential to decrease the demand for cadaveric donor corneal tissue, which is not required.4

Disadvantages of the keratoprosthesis include the possibility of melt around the prosthetic material, infectious keratitis, device extrusion, and limited use in...

Figure 1. The Keraklear artificial cornea.
cases with advanced posterior corneal pathology. In the event of melt around the interface, the device can be explanted and a transplant procedure performed (deep anterior lamellar keratoplasty [DALK] or penetrating keratoplasty [PKP]).

The Keraklear has received European Conformité Européenne approval but is not cleared for use in the United States.

We report a case in which a patient with progressive keratoconus had lamellar keratoprosthesis implantation along with corneal collagen crosslinking (CXL) per the Dresden protocol.

CASE REPORT

A 21-year-old man with progressive keratoconus (Figure 2) was referred to our clinic with deteriorating vision in his right eye. On presentation, the corrected distance visual acuity (CDVA) was hand motion (HM). Normally, a transplant procedure (DALK or PKP) would be considered. Given that the patient had a history of schizophrenia, had a difficult postoperative course following a PKP performed in his left eye, and lived 600 km from our clinic, other less invasive options were considered. After discussion with the patient and family, a combined CXL and lamellar keratoprosthesis implantation procedure was planned.

The patient was taken to the refractive suite after administration of an antibiotic (moxifloxacin 0.5% [Vigamox]) and anesthetic drops (proparacaine hydrochloride 0.5% [Alcaine]). A femtosecond laser (Intralase 60 kHz, Abbott Medical Optics, Inc.) was used to create an 8.0 mm diameter stromal pocket at a depth of 300 μm. A laser trephination with a posterior depth of 315 μm and a diameter of 3.5 mm was then made, centered over the pocket. Corneal collagen crosslinking was performed per the Dresden protocol. The central 3.5 mm disk of the anterior cornea was removed. The lamellar keratoprosthesis (phakic version) was folded using a forceps and inserted into the corneal pocket through the trephination opening with the optic oriented anteriorly. The device was secured with 4 interrupted 10-0 nylon sutures. No intraoperative complications occurred.

Postoperatively, moxifloxacin 0.5% was prescribed 4 times a day for 2 weeks and then tapered and maintained at 1 drop a day; prednisolone acetate (Pred Forte) was prescribed 4 times a day for 1 month and tapered over the following month. In addition, a soft bandage contact lens (Biofinity, CooperVision, Inc.) was placed on the cornea.

At the 1-month follow-up visit, the CDVA had improved to 20/60, the implant was well centered (Figure 3), and there were no signs of device extrusion. Anterior segment optical coherence tomography showed the device was well positioned in the stromal bed (Figure 4). At 6 months, the CDVA was 20/50 and at 1 year, 20/40.
DISCUSSION

Several artificial corneal devices have been created. The Boston keratoprosthesis is the most frequently used by corneal surgeons. With the Boston keratoprosthesis, donor corneal tissue is still necessary and associated long-term complications, such as glaucoma and retroprosthetic membranes, have been described. The Keraklear artificial cornea is designed to replace the anterior portion of the cornea. The posterior cornea with the endothelium is retained, and this is thought to prevent the common complications of other artificial corneas such as endophthalmitis and retroprosthetic membranes. A bilateral corneal graft combined with Keraklear implantation has been described in a patient with severe alkali burns. At 1 month postoperatively, the patient’s CDVA improved from light perception to 20/80 in both eyes. In addition, no postoperative complications were observed.

In our case, the keratoprosthesis was implanted in a patient with progressive keratoconus. The CDVA improved from HM to 20/60 at 1 month, 20/50 at 6 months, and 20/40 at 1 year. No intraoperative or postoperative complications occurred. The intraocular pressure was measured at each follow-up visit with a Tono-Pen (Reichert Technologies) and was within normal limits.

To our knowledge, this is the first patient to have Keraklear implantation along with CXL for keratoconus. Collagen crosslinking has been shown to stabilize and strengthen the cornea in keratoconus patients and should theoretically minimize the risk for corneal melting. In patients having Boston keratoprosthesis surgery, corneal melting is one of the most commonly reported postoperative complications. Studies have shown that CXL performed prior to Boston keratoprosthesis surgery may reduce the risk for melting and stabilize the cornea. As there is limited knowledge about the value of combining CXL and Keraklear implantation, longer follow-up and randomized studies are needed to determine the effect of CXL on patients having lamellar keratoprosthesis surgery.

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