TECHNIQUE

Preparation of ultrathin grafts for Descemet-stripping endothelial keratoplasty with a single microkeratome pass

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We present a technique to achieve ultrathin Descemet-stripping automated endothelial keratoplasty (DSAEK). Using a simple method of controlling artificial anterior chamber pressure and drying the corneal surface, it was possible to thin the donor cornea at a rate of 11 μm a minute. When the donor cornea was between 500 μm and 510 μm, a single pass was made using a 350 μm microkeratome head followed by a peripheral dissection. The resulting mean graft thickness was 83.2 μm ± 14.9 (SD) (range 50 to 98 μm) with a mean peripheral graft edge thickness of 106.8 ± 10.9 μm (range 90 to 120 μm). There were no surgical complications, and all grafts remained attached. This is a reliable method for preparing ultrathin donor corneal lenticules for DSAEK in the operating room or eye bank without using multiple microkeratome heads or risking double passes.

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Online Video

Ultrathin Descemet-stripping automated endothelial keratoplasty (DSAEK) represents a bridge between DSAEK and Descemet membrane endothelial keratoplasty (DMEK). This is important because DMEK is currently a technically challenging procedure whereas over the past decade DSAEK has developed into a popular and reliable procedure. The advantages of minimizing the amount of corneal donor stroma in DSAEK or in the recipient in deep anterior lamellar keratoplasty are well recognized.[1–3] We describe the ultrathin DSAEK technique and report the results of applying it in a clinical case series.

SURGICAL TECHNIQUE

The procedure is performed in the operating room with the temperature between 18°C and 21°C (65°F to 70°F) and a relative humidity of 50%. Donor corneoscleral disks are placed on an artificial anterior chamber (Moria SA). The donor corneal epithelium is removed using a polyvinyl alcohol sponge (Merocel, Alcon Laboratories, Inc.). Following a published protocol,[4] the height of the infusion bottle is set at 120 cm and the roller clamp is closed 10 cm before the artificial anterior chamber to increase artificial anterior chamber pressure to 198.8 mm Hg. After the clamp is closed, the pressure in the artificial anterior chamber is measured with an intact eye globe inflation test rig. All load datapoints are gathered from Labview test control software in millimeters of mercury versus the water level height. The anterior corneal surface is continuously dried using a polyvinyl alcohol sponge, achieving a rate of corneal thinning of approximately 11 μm a minute.[4] Corneal thickness is measured using high-resolution anterior segment optical coherence tomography (AS-OCT) (Casia SS-1000, Tomey Corp.).

When the central donor corneal thickness is between 500 μm and 510 μm, an automated microkeratome (Moria SA) with a 350 μm head is used to remove the anterior lamellar cap (Figure 1) (Video 1, available at http://jcrsjournal.org). Manual dissection of the peripheral anterior stromal lamella is performed using a technique similar to the one proposed by Lichtinger et al.[5] using a Mini 1.25 mm crescent blade (Altomed, Ltd.) to prevent thick peripheral graft edges (Figure 2) (Video 2, available at http://jcrsjournal.org). If the horizontal white-to-white corneal diameter is 11.50 mm or longer, a 9.5 mm graft is used; if it is shorter than 11.50 mm, a 9.0 mm trephine size graft is used. A Barron donor cornea punch (Hessberg-Barron, Katena Products, Inc.) is used to create the grafts.

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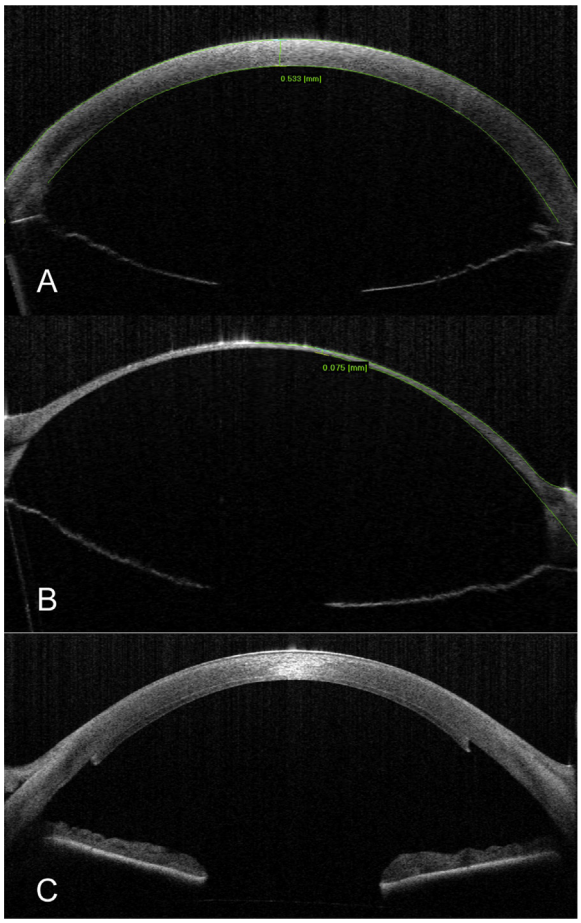

Figure 1. *A*: Anterior segment OCT of donor cornea. *B*: Anterior segment OCT of donor cornea after cutting with microkeratome 350 μm head. *C*: Anterior segment OCT of transplanted graft.

After donor graft preparation, the host is prepared as described by Price and Price.[6] Briefly, a 5.0 mm sclerocorneal incision is made and the recipient Descemet membrane is stripped to 9.0 mm. (Note that the cord length of the graft inside the eye is slightly less than 9.0 mm even for a 9.5 mm trephine.[7]) The donor graft is transferred to a Busin glide (Moria SA) endothelial side up. After removal of the host Descemet membrane, the disk is introduced into the anterior chamber using a single-use 25-gauge forceps (Busin et al.[8] pull-through technique). After the graft is unfolded and positioned centrally, a full air fill of the anterior chamber is maintained for 10 minutes. The corneal incision is then closed with an interrupted 10-0 nylon suture. Enough air is removed and replaced with a balanced salt solution to avoid pupil blockage.

The postoperative corticosteroid regimen consists of prednisolone acetate 1.0% eyedrops instilled 4 times daily for the first 6 months, tapered by 1 drop per month to once-daily use, and of chloramphenicol eyedrops instilled 4 times a day for the first week only.

Results

Ten donor corneas were obtained from the Manchester Eye Bank and cultured using conventional eye-bank techniques. The donor age varied between 60 years and 74 years,

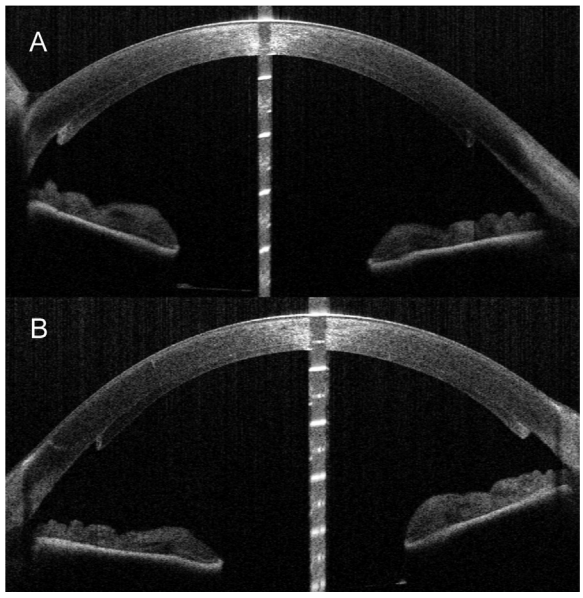

Figure 2. Anterior segment OCT of endothelial graft in 2 meridians, vertical (*A*) and horizontal (*B*), to show the profile of the graft.

endothelial cell count (ECC) was between 2400 cells/mm^2 and 2800 cells/mm^2, and time between death and preservation was between 30 hours and 36 hours. All the tissues were prepared successfully in a single attempt without perforation, and a graft thickness of less than 100 μm was achieved (Table 1). A mean of 15 minutes was required to prepare an ultrathin DSAEK graft (range 10 to 25 minutes). The mean posterior lamellar graft thickness measured immediately after the cut was 83.2 ± 14.9 μm (range 50 to 98 μm), and the peripheral graft edge thickness was 106.8 ± 10.9 μm (range 90 to 120 μm) (Figure 2).

In all cases, the graft was attached on the first postoperative visit and no re-bubbling was necessary. At 4 to 6 weeks, the ECC obtained using a noncontact specular microscope (Cellchek XL, Konan Medical) ranged between 1900 cells/mm^2 and 2100 cells/mm^2 in 6 of 10 patients; images of sufficient quality to measure endothelial cell density could not be obtained in 4 patients. At 3 months, the mean corrected distance visual acuity was 20/30 (0.16 ± 0.2 logMAR) and the mean central graft thickness measured using AS-OCT was 69.9 ± 20.8 μm (range 40 to 90 μm).

DISCUSSION

Microkeratome-assisted dissection of donor corneas has become the gold standard for preparing grafts for endothelial keratoplasty, primarily because of the ease and reproducibility of this technique and the excellent quality of the stromal surface.[9] Recently, femtosecond laser technology has been used by several authors in a limited series of patients but is not yet widely used because of the high costs involved and the suboptimum quality of the surfaces obtained with this type of dissection, which is strongly influenced by the characteristics of the donor tissue (hydration, thickness, clarity).[10,11] A major limitation of microkeratome dissection, however, is its poor accuracy in determining the final thickness of the dissected tissue,