DMEK Simplified, Deftly

A novel method for preparation of Descemet membrane endothelial keratoplasty (DMEK) grafts is here. It uses a punch but doesn’t lay a finger (or forceps) on the corneal endothelial cells.

By Marc Muraine

The availability of corneal tissue, as with other organs for transplantation, relies on the goodwill of people to bequeath them for use after their death. Numbers are finite; this is a precious resource.

For a number of diseases, such as Fuchs’ dystrophy, bullous keratopathy (or the failure of previous penetrating keratoplasty), the current standard of care is endothelial keratoplasty, where the patient’s diseased corneal endothelium is replaced with an endothelial graft. Two major techniques for the preparation of such grafts have been developed: Descemet Stripping Automated Endothelial Keratoplasty (DSAEK) and Descemet Membrane Endothelial Keratoplasty (DMEK). Although DSAEK is relatively simple to perform, the transplant retains the stroma and Descemet’s membrane, which can distort vision after implantation. DMEK utilizes only the endothelium from the donor cornea which, once grafted, reproducibly gives good visual outcomes. However, the preparation, manipulation and placement of a DMEK graft is particularly challenging to learn and perform.

I sometimes found it difficult to perform this surgery because of the risk of tearing the Descemet’s Membrane, when we have to hold the membrane with forceps. Furthermore, traditional DMEK is performed under balanced salt solution (BSS) – the “SCUBA” technique – which has one big problem: once the detachment has been performed, the graft always rolls up with the endothelium to the outside. That’s because every time you leave the tissue free in solution, it spontaneously does this. It makes placement of the graft within the anterior chamber much more difficult than if the endothelium was on the inside of the roll. It was clear to me that matters needed to be rethought.

Punch It Out

The first change that I made was to the circular trephination of the donor tissue. When I first started doing this dissection ten years ago, I did so by placing an air bubble in the stroma. This detached the tissue of interest from the endothelial-side components. Following this I performed circular trephination. I wanted to find the real plane between the Descemet’s membrane and the stroma, but it was difficult to obtain this planal dissection every time; the dissection was often within the stromal layers.

Sometimes when I performed this superficial trephination it wasn’t successful over the entire 360°. However, far from being an issue, this incomplete trephination led to improvements. In the area where trephination was unsuccessful, if I could detach the Descemet’s membrane from right to left I had the plane of dissection outside the section; I could enter in the middle of the cornea very easily at this point. To do this deliberately, I simply broke the circular trephine’s blade over 30°. The technique was published in the American Journal of Ophthalmology in 2013 (1).

However, homemade broken blades aren’t ideal for use in corneal surgery. Sometimes it’s difficult to break the circular blade to obtain the 330° section of the Descemet’s membrane. And when you are using a broken blade you can’t press too hard, in case you perforate the lot. So I wondered if it was possible to design a punch, where the blade was missing over 30° and where there was a stop at around 300 μm, so that even if it was pressed hard on the top of the endothelium, it didn’t perforate the entire circle. That would reproducibly section the Descemet’s membrane at 330° (Figure 1).

Sunny Side Up

Once punched, the donor cornea is placed endothelial side up in an artificial chamber, sealed, and the area that was punched is stained with Trypan blue (Figure 2). The graft is then protected by methylcellulose, and the Descemet’s membrane between trephination and limbus is peeled back with forceps, leaving an upside-down flap at the hinge (that is, the 30° region is not punched out). Manual dissection under the hinge flap is performed and is extended 1 mm into the graft area, initiating a delamination plane and permitting hydrodissection of the Descemet’s membrane until it is completely detached. This is a difference to the SCUBA approach. The dissection is not under BSS when we perform the separation of the Descemet’s membrane – at all times, it is in contact with the underlying stroma, which has implications later in the procedure. The hydrodissection has another advantage...
Figure 1. The Muraine technique. (a) Place the punched donor cornea on the artificial chamber, inflate and close the valve to stabilise the chamber and reverse the cornea – the endothelium now faces upwards. (b) On both sides of the zone where Descemet’s membrane was not cut, the peripheral endothelium can be easily detached with a spatula or Troutman forceps to create a small, easily-lifted flap. (c) The jaws of a pair of Troutman forceps are slipped under the flap to ensure the correct detachment of the Descemet membrane over a length of 2–3 mm. (d) Hydrodissection with a 27 gauge cannula mounted on a syringe filled with balanced salt solution (BSS) detaches the endothelium. (e–f) The endothelial graft is folded over itself, with the endothelium towards the interior into a “burrito” shape, with the aid of the 27 gauge cannula. (g) The Descemet membrane graft, rolled up with the endothelium on the inside, is then placed into an IOL injection cartridge chamber.
Figure 2 (a). The Muraine Punch (Moria Surgical, Antony, France). (b) Close-up view.