Easy Bubble: Pachymetry-assisted Big-Bubble Deep Anterior Lamellar Keratoplasty

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ABSTRACT: We present a simple, effective and reproducible technique for deep anterior lamellar keratoplasty. Using a diamond knife, set at 90% of corneal thickness (90 degrees meridian), at the limbus a radial incision was made and a corneal pocket was created. A specially designed cannula was placed deep into the corneal stroma and air was injected for stromal dissection. The air bubble pushed down Descemet’s membrane and the endothelium. Partial-thickness trephination of 8 mm was performed. The anterior stroma was removed with Vannas scissors and the donor button was sutured. The main advantage of this technique is the very low learning curve required as well as the evenness of stromal dissection with almost no residual tissue left over Descemet’s membrane.


INTRODUCTION

Deep anterior lamellar keratoplasty (DALK) is a surgical technique for cornea replacement, in which the healthy host corneal endothelium is preserved. Keratoconus patients are those who benefit most from a successful DALK procedure, since the endothelium of these patients is usually normal and should therefore be maintained.

Several studies comparing visual outcomes between penetrating keratoplasty (PK) and DALK have shown similar results.1-4 Initially, DALK was performed using manual corneal dissection.5 The greatest limitation of early DALK techniques was that they left variable amounts of residual stroma. This provided a scaffold for vascular ingrowth or led to variable amounts of postoperative scarring in the interface due to the remaining vessels. Also, an uneven or irregular dissection plane could impair visual acuity. The main disadvantage of DALK is the significant learning curve required to master the technique. Moreover, it is a time-consuming procedure, particularly when the stroma needs to be manually separated from Descemet’s membrane.

Anwar and Teichmann’s6 big-bubble technique of injecting air into the corneal stroma to isolate Descemet’s membrane markedly improved DALK outcomes. Removing the overlying stroma completely created a clear graft interface without irregularities. Visual outcomes are excellent, and postoperative interface problems from vascularization of the recipient corneal bed are minimal.

The present technique allows for a deep and smooth separation of the corneal stroma from Descemet’s membrane which in turn improves the lamellar keratoplasty technique.

SURGICAL TECHNIQUE

The surgical procedure was performed under peribulbar anesthesia. This intervention shares the initial steps of intrastromal corneal ring segment implantation. Initially, partial-thickness trephination of 8 mm was performed. Using a diamond knife set at 90% of corneal thickness (90 degrees meridian), almost at the limbus (Figure 1A, 1B and 1C), a 0.9 mm radial incision was formed and a corneal pocket was created using the Ferrara spreader (Figures 2A, 2B and 2C). Air was injected into the created pocket to create a deep separation between Descemet’s membrane and the posterior stroma (Figures 3A, 3B and 3C). Blunt-tipped Vannas scissors were used to remove anterior stromal tissue along the edge of partial thickness trephination (Figure 4).
The donor cornea was punched out from the endothelial side, oversized by 0.5 mm in comparison to recipient trephination. The graft endothelium was completely removed. The donor button was sutured into place using continuous or 16 interrupted 10-0 nylon sutures (Figure 5).

Postoperative medication included moxifloxacin and dexamethasone four times a day for a week and tapered over a period of 6 weeks. Lubricants were used several times a day. The sutures were removed 3 months post-surgery.

**DISCUSSION**

Several lamellar keratoplasty techniques have been described for treatment of keratoconus. Anwar and Teichmann described the big-bubble technique to achieve separation of Descemet’s membrane from stroma after intrastromal air injection. This technique has been widely used as a technique which provides rapid and satisfactory outcomes comparable to PK. The technique allows safe and direct access to Descemet’s plane, with the advantages of shortening surgical time, reducing the risk of perforation, and exposing a smooth, even surface of excellent optical quality. However, a big bubble is not formed in all cases and sometimes more than one injection of air into the deep stroma is required before cleavage between Descemet’s membrane and the stroma is achieved. In these cases, repeated injections of air infiltrating the corneal stroma may cause complete whitening of the central cornea within the area of trephination, making it difficult to recognize the line of separation between Descemet’s membrane and the stroma.

Fast visual rehabilitation after DALK is determined by the depth of the stromal dissection, with the best results occurring with the baring of the recipient Descemet’s membrane. The attempt to bare Descemet’s membrane can be complicated by its perforation, which can cause conversion to PKP or the collection of aqueous humor in the recipient–donor interface (i.e., double anterior chamber), leading to stromal opacity.
In addition, perforation at an earlier surgical stage leads to shallower dissection and slower visual recovery because of stromal haze at the interface. One advantage of the described technique is that the location of the main incision is out of the optical zone (OZ) of the recipient trephination, i.e. is located at the limbus, and trephination is at a 7.5 mm OZ. The incision depth is given by anterior segment optical coherence tomography, which provides a very precise measurement of the incision depth (Figures 6A and B). Therefore, in the case of perforation or shallow incision, an additional incision can be made at another site, which enables the surgeon to accomplish the deep dissection without the need to convert to PKP. Moreover, additional incisions do not impair the trephination once the incision is made far from the 7.5 OZ.

The increased safety of DALK and the potential for better visual outcomes in expertly performed procedures justifies the effort required for corneal surgeons to master the procedure and the additional operating room time expended. Another potential advantage is the utility of using less optimal tissue for PKP with lower endothelial cell counts or longer periods of time between death and preservation and time in preservation to expand the donor pool for optical keratoplasty.

The new DALK technique presented here provides a precisely measured deep separation between Descemet’s membrane and the posterior corneal stroma. Moreover, this new technique requires a shorter learning curve for the surgeon, which is important as it can be a reliable technique when compared to other DALK techniques or even the PK.

REFERENCES