A New Surgical Technique of Microkeratome-Assisted Deep Lamellar Keratoplasty With a Hinged Flap

Dimitri T. Azar, MD; Sandeep Jain, MD; Robert Sambursky, MA

We describe a new surgical technique of microkeratome-assisted deep lamellar keratoplasty for treating patients with corneal stromal disease and normal endothelium. A microkeratome is used to create a hinged anterior stromal flap in the host cornea, and the diseased stroma is resected or ablated. A complementary donor stromal button, prepared using a microkeratome and an artificial anterior chamber, is transplanted prior to repositioning of the flap. The flap may be lifted at a later date, and an excimer laser used to correct residual refractive errors. Notwithstanding the preliminary and theoretical nature of this report, this technique may improve the outcomes of deep lamellar keratoplasty and may allow for decreased postoperative complications.

Penetrating keratoplasty is currently the surgical method of choice for treating corneal diseases that involve the stroma and endothelium. High astigmatism, endothelial rejection, loss of corneal clarity, and considerable visual impairment may complicate the postoperative course. Endothelial cell loss, pleomorphism, and polymegethism may progress following surgery and result in late graft failure. Lamellar keratoplasty (LK) may avoid many of these problems, but it is limited by delayed epithelialization, persistent epithelial defects, irregular astigmatism, difficult surgical technique, and graft/host interface haze and vascularization.

In selected patients with considerable corneal stromal disease and normal endothelium, deep LK under a hinged host flap may be a viable alternative surgical approach. This surgical technique involves performing LK by using a microkeratome to create a hinged anterior corneal flap, resecting or ablasting the host stromal abnormalities, and transplanting a complementary donor stromal button (which is prepared using a microkeratome and an artificial anterior chamber). In theory, this approach may be valuable in corneal stromal dystrophies and stromal scarring secondary to traumatic, inflammatory, or infectious causes. It has 2 potential theoretical advantages: (1) The host epithelium and endothelium are preserved, which may reduce the risk of graft rejection, and (2) the superficial hinged corneal flap may reduce astigmatism and surface irregularities. We describe herein our preferred surgical technique used to perform microkeratome-assisted deep LK.

SURGICAL PROCEDURE

Radial and diagonal alignment marks are placed on the host cornea centered over the pupil with a conical marker inked with a sterile skin marker or gentian violet solution. The corneal marks allow for subsequent reapposition of the anterior stromal flap. A microkeratome (Automated Corneal Shaper or Hansatome; Bausch & Lomb Inc, Rochester, NY) is used to dissect a hinged anterior corneal flap, measuring 8.5 to 9.5 mm in diameter and 130 to 180 µm in thickness (Figure 1, step 1). The following steps are involved in fashioning the desired corneal flap. The suction ring is placed over the patient’s cornea, and great care is taken to ensure centration over the pupil. The suction is activated, and the intraocular pressure is checked to ensure that it is more than 65 mm Hg. The microkeratome head is then placed into position and is allowed...
to course across the suction ring in forward and reverse directions. The hinged anterior corneal flap is temporarily elevated, and the thickness of the residual stroma (host resection bed) is measured using a pachymeter.

The donor stromal button is prepared using a dedicated artificial anterior chamber (Bausch & Lomb Inc.). A microkeratome is used to dissect a 110-µm anterior corneal cap (Figure 2, A). The microkeratome is allowed to course across the donor tissue without the stop, thus an 8.5-mm anterior corneal-free cap is created (which is discarded). The donor anterior corneal cap is made thinner than the recipient’s hinged corneal flap so that the remaining donor stroma is of sufficient thickness to allow for a second microkeratome pass (which creates an 8.5-mm donor stromal lenticule) (Figure 1). The thickness of the donor stromal lenticule resected by the second microkeratome pass is determined by choosing a plate similar in depth to the thickness of the host resection bed. Next, a 6-mm trephine is used to punch the donor stromal lenticule to create the donor stromal button.

The recipient hinged anterior corneal flap is elevated with a flat spatula, exposing the underlying stroma. A 6-mm trephine is used to perform a partial-thickness trephination. The depth of the trephination is set at approximately 90% of the previously performed pachymetry. Next, lamellar keratectomy is performed. Air, isotonic sodium chloride solution, or viscoelastic material may be injected into the corneal stroma prior to trephination to facilitate lamellar keratectomy. Lamellar dissection is initiated from the partial-thickness trephine incision using a spatulated dissector blade. Once the plane of dissection is established at the depth of trephine incision, further dissection is performed with to-and-fro movements of the spatula to split the corneal stroma delimited by the trephine mark. This lamellar dissection removes a layer of deep stromal corneal tissue (Figure 2, C). The remaining stromal lamellae covering the Descemet membrane are removed using microscissors (Figure 2, D). If the corneal abnormalities are limited to the mid stroma, excimer laser ablation can be used to remove diseased cornea, avoiding the posterior stromal manipulations and the associated risk of perforating the Descemet membrane.

The donor stromal button is then transplanted onto the host bed (Figure 1). The hinged anterior corneal flap is laid back over the donor stromal button; its margins are approximated to previously applied corneal marks (Figure 2, E) and allowed to seal into place. Sutures are placed to secure the corneal flap (Figure 2, F). Alternatively, a bandage contact lens may be used.

Lamellar keratoplasty is an attractive alternative to penetrating keratoplasty for the treatment of stromal disorders associated with intact endothelial function. Despite the preliminary and theoretical nature of this report, we believe that this is the first published report of a surgical technique of deep LK using a microkeratome to create a hinged anterior stromal flap and a dedicated artificial anterior chamber to create a complementary donor button.

Our technique of microkeratome-assisted LK differs from other LK surgical techniques. We believe that there are potential advantages to creating a hinged anterior stromal corneal flap. Since the corneal flap is lined with the patient’s own epithelium, the occurrence of postoperative epithelial defects, or epithelial rejection, would be theoretically reduced. The hinged corneal flap and preplaced alignment marks may allow for improved postoperative reapposition. This may potentially create an optically smoother corneal surface with reduced incidence of high astigmatism. The flap may be lifted at a later date, and an excimer laser used to correct residual refractive errors. In addition, there is a theoretical benefit in dealing with vision-threatening complications, such as expulsive hemorrhage, as the hinged corneal flap can quickly secure the wound with less suturing. Despite these putative advantages, our technique may be quite complex. Clinical studies
are needed to determine whether this technique indeed reduces graft/host interface problems, improves visual outcomes, or is potentially a practical alternative for traditional LK techniques.

The concept of deep LK is not new. Previous published reports have confirmed the advantages and limitations of LK. In a retrospective review, Soong et al reported postoperative visual acuity of 20/50 or better in 38% of eyes that underwent LK for corneal diseases such as dystrophies (Granular, Reis-Buckler), aniridic keratopathy, corneal scars, and keratoconus. Major causes of poor postoperative visual acuity were (1) graft/host interface haze and/or vascularization in 44% of cases, (2) graft surface irregularities and/or astigmatism in 42% of cases, and (3) persistent epithelial defects in 21% of cases.

Panda et al reported less suture-induced astigmatism following deep LK using a Paufique knife compared with penetrating keratoplasty using a standard technique. Sugita and Kondo reported dramatic improvement of average visual acuity after deep stromal LK in 106 patients (20/200 OU preoperatively and 20/30 OU postoperatively) but noted that the Descemet membrane was punctured in 39% of eyes. Their technique involved an initial trephination of the cornea to three quarters of its depth, followed by lamellar keratectomy aided by hydrodelamination. Melles et al performed deep stromal LK in 7 patients and observed astigmatism ranging from 1.0 diopter (D) to 3.5 D. Their technique involved filling

Figure 2. A. The microkeratome is engaged into a dedicated anterior chamber to prepare the donor lenticule. B. A spatula is used to lift the host anterior corneal flap (arrowhead). The edge of the microkeratome cut (large arrow) and trephination of the stromal bed (small arrows) are seen. C. A spatula and forceps are used to split and dissect the stromal lamellae overlying the Descemet membrane. D. Microscissors and forceps are used to remove the remaining stromal lamellae (arrow). E. The host corneal flap is refloated over the transplanted donor button. F. Sutures are placed to secure the corneal flap (arrow).
the anterior chamber with air and lamellar dissection to create a stromal pocket across the cornea just superficial to the Descemet membrane using a custom-made dissection blade. Melles et al. have also performed posterior corneal transplantation in a patient with pseudophakic bullous keratopathy and reported a pseudo-anterior chamber to prevent sideways slippage of the donor button. Since we have not yet critically evaluated our preferences, their potential for improving outcomes remains strictly speculative.

Accepted for publication October 25, 1999.

This study was supported by the New England Corneal Transplant Research Fund (Dr. Azar), the Research to Prevent Blindness Inc., New York, NY, Lew R. Wasserman Merit Award (Dr. Azar), and the Massachusetts Lions Eye Research Award (Dr. Azar).

Reprints: Dimitri T. Azar, MD, Corneal and Refractive Surgery Services, Massachusetts Eye and Ear Infirmary, 243 Charles St, Boston, MA 02114 (e-mail: dazar@meei.harvard.edu).

REFERENCES