Stitchless Corneal Transplantation

This new procedure is a major advance in how diseased human cornea with endothelial decompensation is being replaced with healthy donor cornea.

BY THOMAS JOHN, MD

The conventional corneal transplantation surgery, namely penetrating keratoplasty, uses full-thickness corneal replacement with sutures (Figure 1). Stitchless corneal transplantation, or deep lamellar endothelial keratoplasty (DLEK), is sutureless (no corneal sutures). DLEK uses partial-thickness corneal replacement from a healthy donor cornea along with its endothelium.

Stitchless corneal transplantation is a milestone in the history of corneal replacement surgery.

CORNEAL DECOMPENSATION FROM PHACOEMULSIFICATION

Corneal endothelial decompensation may result from uneventful phacoemulsification. Endothelial failure and clouding of the cornea occur more frequently in patients with pre-existing advanced Fuchs' corneal dystrophy, those with very hard cataracts requiring higher phaco power for a long period of time, or patients with a low pre-existing endothelial cell count and a hard nuclear cataract. Corneal clouding after cataract surgery can be a complication of phacoemulsification that requires corneal replacement.

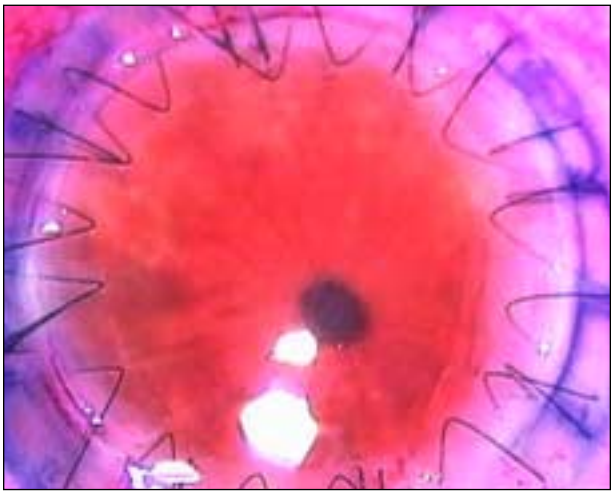

Figure 1. Corneal sutures hold a full-thickness donor cornea in place during penetrating keratoplasty. Additionally, the circular corneal surface wound is full-thickness in the host cornea.

CONVENTIONAL VERSUS STITCHLESS CORNEAL TRANSPLANTATION

Stitchless corneal transplantation is more demanding technically than conventional transplantation, but the postoperative benefits are greater (Table 1). Corneal

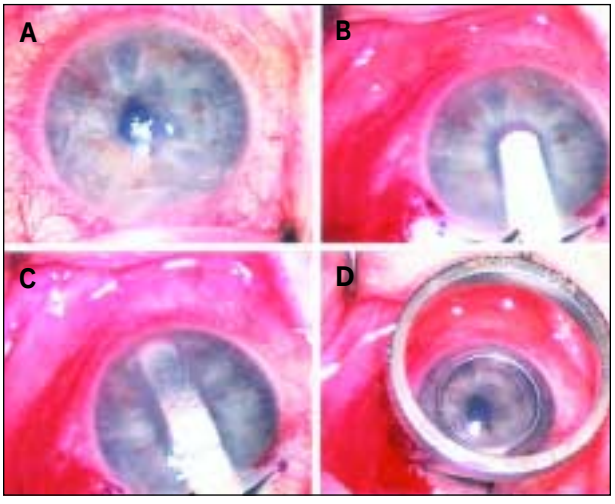

Figure 2. An intraoperative photograph (A) shows the cornea with pseudophakic bullous keratopathy following phacoemulsification and PCIOL implantation. A corneal pocket is dissected (B) through a 350-µm scleral incision. The pocket is extended up to the corneoscleral junction 360°, without perforating onto the corneal surface or into the anterior chamber (C). A Terry trephine is placed within the host cornea through the corneal pocket (D), and the posterior lamellar cornea with its endothelium is trephined.

sutures are essential for conventional surgery, but they are associated with problems such as sudden breakage with pain, tearing, and foreign body sensation. Sutures can cause keratitis or ulceration, which require corneal cultures and intensive topical antibiotic treatment. Suture-related corneal neovascularization can also occur. The introduction of new blood vessels into an otherwise avascular cornea increases the risk of graft rejection and possible failure that may require conventional corneal transplantation. The circular corneal wound that involves the corneal surface in a conventional corneal transplantation weakens the globe and also induces corneal astigmatism, which often require gas-permeable contact lens fitting. In contrast, in stitchless corneal transplantation, there are no corneal sutures and no wound on the surface of the cornea.

SURGICAL TECHNIQUE

Host Corneal Surgery

The treatment for corneal clouding following cataract surgery, pseudophakic bullous keratopathy, involves the dissection of a corneal pocket through a scleral incision 350 µm deep at the limbus (Figure 2 A, B). This pocket within the cornea is extended up to the corneoscleral junction 360º. It is essential not to perforate the cornea either anteriorly onto the corneal surface or posteriorly into the anterior chamber (Figure 2 C). A low-profile Terry trephine (Bausch & Lomb, Rochester, NY) is introduced into the pocket and centered. Trephination of the host posterior lamellar corneal tissue is carried out after making the globe firm with a viscoelastic injection into the anterior chamber via a side-port stab incision (Figure 2 D). Trephine entry into the anterior chamber is indicated by pupillary distortion and partial collapse of the anterior chamber. Intrastromal corneal scissors and Cindy corneal scissors (Bausch & Lomb) are used to complete the trephine cut 360º (Figure 3 A, B). The recipient posterior stromal disc is then grasped with forceps and removed from the eye via the lamellar-pocket wound at the limbus (Figure 3 C). Viscoelastic is removed from the anterior chamber, and the limbal wound is temporarily closed with interrupted 10–0 nylon sutures (Figure 3 D).

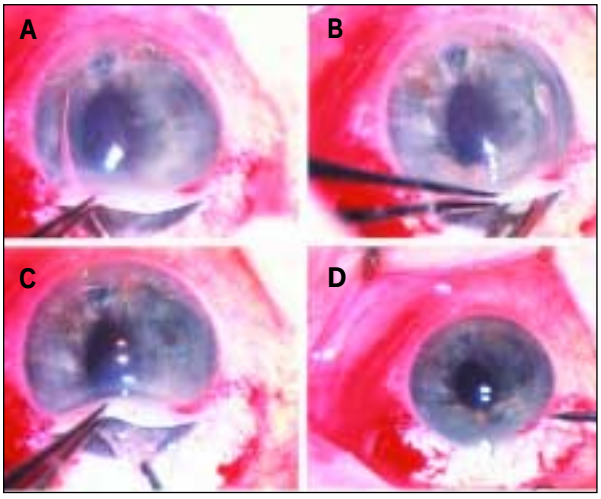

Figure 3. The trephine cut 360° is completed using Cindy corneal scissors (A, B). The posterior host stromal disc with its endothelium is removed from the eye through the superior limbal wound (C). The limbal wound is temporarily closed with interrupted 10–0 nylon sutures (D).

TABLE 1. COMPARISON OF CONVENTIONAL CORNEAL TRANSPLANTATION TO STITCHLESS CORNEAL TRANSPLANTATION

Description of Corneal Replacement	Conventional Full-Thickness	Stitchless Partial-Thickness
Endothelial replacement	Yes	Yes
Corneal endothelial graft rejection	Yes	Yes
Corneal sutures	Yes	No
Corneal surface wound	Yes	No
Significant induced corneal astigmatism	Yes	No
Susceptibility to trauma-related corneal rupture	Yes	No
Suture breakage causing ocular pain and requiring office visit	Yes	No
Suture-related corneal infection	Yes	No
Suture-related corneal neovascularization	Yes	No
Repeat corneal transplantation requires the same amount of time as the first transplantation	Yes	No*

*Repeat surgery requires less time than the first surgery because it only requires disc replacement.

DONOR CORNEAL SURGERY

The donor corneal endothelium is coated with viscoelastic, and the cornea with its attached scleral rim is placed in a Bausch & Lomb artificial chamber. The artificial chamber is

pressurized with Optisol (Bausch & Lomb), followed by partial trephination, anterior lamellar dissection, and excision of the anterior stromal disc (Figure 4 A). I first described the use of indocyanine green (ICG) within the human cornea and its use to stain the donor corneal disc.[1] The donor cornea is then flipped on itself such that the green-stained donor corneal stroma rests on a Moria Teflon block (Moria, Antony, France) with the stromal side down. This donor cornea is held in place with vacuum, and trephination is carried out using a Moria trephine in a guillotine fashion (Figure 4 B). The deep stromal-endothelial donor disc is carefully transferred onto a viscoelastic-coated Ousley spatula (Bausch & Lomb) with the endothelial side down.

DONOR DISC TRANSPLANTATION

The donor disc is introduced into the host anterior chamber under air and placed in the host bed of the pre-resected central area (Figure 4 C). Staining of the donor disc with ICG helps the surgeon to properly align the disc in the bed (Figure 4 D). The superior scleral wound is closed with interrupted 10–0 nylon sutures. The air bubble is decreased in size, and additional BSS is injected into the anterior chamber. At the end of the procedure, a collagen shield soaked in antibiotics and a steroid is placed on the ocular surface.

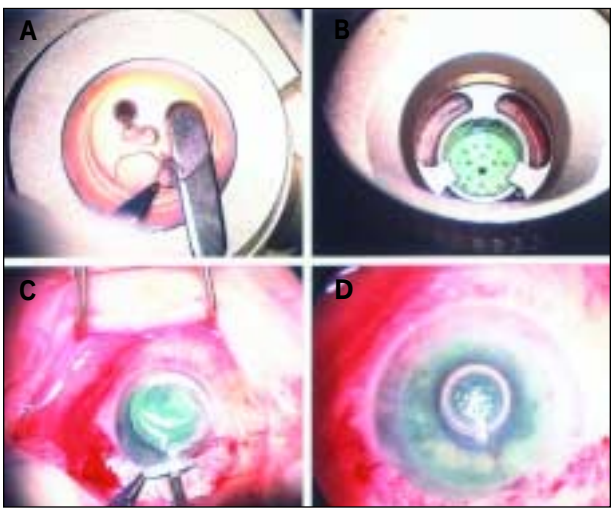

Figure 4. In the lamellar dissection of the donor cornea within an artificial chamber, the endothelium is precoated with viscoelastic, and the artificial chamber is pressurized with Optisol. The epithelial surface is on top (A). The donor cornea—with the stromal side down on a Moria Teflon block—is held in place with vacuum, and trephination is carried out using a Moria trephine in a guillotine fashion (B). The donor disc is introduced into the host anterior chamber under air and placed in the host corneal bed of the pre-resected central area (C). Intraoperatively, the ICG-stained donor lamellar disc is well centered, with healthy donor endothelium (D).

OBSERVATIONS

Conventional corneal transplantation surgery with full-thickness donor corneal tissue is the gold standard for corneal replacement surgery, but this position is being challenged by stitchless corneal transplantation surgery, specifically DLEK.[1-8] The advantages of a stitchless corneal transplantation surgery are significant, and continued study is warranted. Whether this technique will ultimately prove to be superior to the conventional technique in all aspects of corneal replacement surgery, including the final visual outcome, is yet to be determined in a repeated, multicenter fashion. Mark Terry, MD, of Portland, Oregon, is directing a multinational multiyear effort called the *Endothelial Keratoplasty Group* to study DLEK.

The interface in stitchless corneal transplantation surgery is a component that is absent with conventional surgery. Application of laser technologies in the dissection of the donor and host corneas can result in a superior interface compared with current manual dissection techniques. In conclusion, I believe stitchless corneal transplantation surgery is a major advance in the way we replace diseased human cornea with endothelial decompensation with healthy donor corneal endothelium. ■

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