Corneal Transplantation as a Refractive Surgical Procedure

Francis W. Price, Jr, MD

Penetrating keratoplasty (PK) has been an essential procedure to restore clear vision to those with cloudy or diseased corneas for over half a century. In addition, it has been a catalyst for the development of refractive surgery procedures, which are required to restore functional vision to eyes with clear grafts but high levels of residual astigmatism or anisometropia. To help restore sphericity to highly astigmatic grafts, Troutman1,2 refined relaxing incisions, which are modifications of Bates’ transverse keratotomy described in 1894. Rowney et al3 described early techniques of topographic measurements to help plan these secondary procedures, techniques that led to computerized video-keratography. The advent of excimer laser corneal surgery allowed photorefractive keratectomy (PRK) and laser in situ keratomileusis to be used to treat residual astigmatism and spherical refractive errors and anisometropia directly on the graft.

Despite these advances in secondary refractive procedures, astigmatic errors, prolonged refractive instability, and the inability to accurately predict final refractive outcome have continued to plague standard PK.4 Countless discussions, lectures, and papers have proposed various suturing techniques and trephination methods to improve refractive results after PK. Yet the inherent necessity to close a full-thickness circumferential wound with compression sutures frequently results in unstable, unpredictable, irregular refractive results. The management of patients with PK is typically labor-intensive with frequent examinations and procedures, increased costs, and both physician and patient frustration with prolonged or poor visual rehabilitation.

Following Melles’ introduction of posterior lamellar corneal grafting techniques, more predictable refractive outcomes after corneal transplantation are becoming a reality, because the anterior corneal curvature is altered minimally.5 The procedure, which involves transplanting a thin disc of posterior donor stroma and endothelium into the recipient eye, has undergone an interesting evolution. Melles’ original technique, posterior lamellar keratoplasty, consisted of manually dissecting the recipient and donor corneas at 80% to 90% stromal depth using curved blades, then excising the posterior recipient stroma and endothelium with small, curved scissors. After the donor tissue was trephinated, the posterior stroma and endothelium were placed endothelial side down on a viscoelastic-covered spatula for insertion into the recipient eye through a 9-mm corneoscleral incision, and air was injected to press the donor button up into the recipient bed. The only sutures were used to close the corneoscleral incision.

Posterior lamellar keratoplasty became a completely sutureless procedure after Melles demonstrated that the donor tissue could be inserted through a 5-mm scleral tunnel incision if it was first folded in half with the endothelial-side facing inward and protected by viscoelastic.6 Deep lamellar endothelial keratoplasty (DLEK) is similar to posterior lamellar keratoplasty but uses modified instrumentation.7

Surgeons were slow to adopt posterior lamellar keratoplasty/DLEK because it was technically challenging. However, recent advances have simplified the procedure. Melles8 demonstrated that Descemet’s membrane and endothelium could be scraped off the recipient cornea to prepare a bed for the donor tissue. This newer technique of Descemet’s stripping with endothelial keratoplasty obviates the difficult recipient lamellar dissection and excision steps of DLEK. Gorovoy has found that in lieu of manual dissection, the donor tissue can be effectively dissected using a microkeratome to remove a 300- or 350-µm anterior flap prior to transplanting the remaining posterior stroma and endothelium (personal communication, June 2004).

Advantages of Descemet’s stripping with endothelial keratoplasty (DSEK) compared to PK include:

• the recipient cornea remains structurally intact and is more resistant to injury;
no intricate suture placement methods (single running, double running, running-interrupted) are required;
- questions about when to remove sutures and concerns about late wound dehiscence following suture removal are eliminated;
- the risk of expulsive intraoperative suprachoroidal hemorrhage is virtually eliminated because a 5-mm scleral tunnel incision can be closed quickly;
- the preoperative refractive status of the eye is essentially preserved;
- recovery of useful vision occurs within weeks; and
- visual fluctuations are minimal during the healing process.

Advantages of DSEK compared to the posterior lamellar keratoplasty or DLEK techniques include:
- no complex recipient trephination techniques are required;
- less potential for trauma to the anterior chamber and lens;
- minimal concerns about inducing ectasia in eyes that have had previous refractive surgery that thinned the cornea, an increasingly frequent possibility as our corneal refractive patients age; and
- eyes receiving DSEK can also have subsequent corneal refractive surgery to correct refractive errors.

One limitation of DSEK is the induction of a small hyperopic shift that probably occurs due to mechanisms associated with preparing the donor tissue, but this may be eliminated with future refinements of the technique. Additional follow-up is required to evaluate long-term endothelial cell viability.

Forty years ago, a clear graft after PK was considered an excellent result for patients with Fuchs’ dystrophy, just as clear media in an aphakic eye was considered an excellent outcome after cataract surgery. Presently, corneal transplant patients expect excellent corrected vision with minimal astigmatism. A successful cataract extraction now includes elimination of distance refractive errors, and soon elimination of both near and distance spectacle correction. Likewise, corneal transplant recipients will soon expect refractive-neutral grafts with stable visual rehabilitation in several weeks. Excellent refractive outcomes along with rapid visual recovery will be the key to having happy surgical patients. What a change we have seen in the past half-century!

REFERENCES