Microkeratome-Assisted Anterior Lamellar Keratoplasty

Lee A. Wiley, MD; Mark A. Joseph, MD; John D. Pemberton, DO

Microkeratome-assisted anterior lamellar keratoplasty has emerged as a surgical option for conditions affecting the clarity of the outer 200 µm of the cornea. Herein we describe the outcome of a simple procedure in which the excimer laser can be used to augment deep tissue removal after both recipient bed and donor graft are prepared with the microkeratome. Our noncomparative interventional case series involved 5 eyes of 4 patients with lattice corneal dystrophy who underwent microkeratome-assisted anterior lamellar keratoplasty. Outcome measures include preoperative and postoperative best spectacle-corrected Snellen visual acuity. Visante ocular coherence tomography data are reported for several of the patients.

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Lamellar keratoplasty is an option for the surgical treatment of anterior stromal dystrophies. The advantages of lower rejection rate and greater trauma resistance are appealing, as is the potential for safer reengraftment for recurrence. These advantages have been offset by the technical difficulty of performing a lamellar procedure with a visual outcome that can rival penetrating keratoplasty. Microkeratome preparation of the donor and recipient bed achieves minimal interface haze and greatly reduces the surgical time.

Herein we describe a procedure for microkeratome-assisted lamellar keratoplasty that is easy to perform and will reproducibly provide spectacle-corrected visual acuity (VA) of 20/40 to 20/30. We report preoperative and postoperative refractive data on 5 consecutive microkeratome-assisted lamellar keratoplasties in 4 patients with lattice corneal dystrophy.

METHODS

Our study is a noncomparative interventional case series of 5 consecutive microkeratome-assisted lamellar keratoplasties performed on 5 eyes of 4 patients with lattice corneal dystrophy. This study was approved by the institutional review board at West Virginia University. Of our 4 patients, 3 had previously undergone phototherapeutic keratectomy laser treatment in the operated eye. All of the patients have had visually disabling recurrences of their lattice dystrophy. Our fourth patient had received phototherapeutic keratectomy laser treatment for recurrence in the penetrating keratoplasty of his fellow eye and did not wish to undergo laser treatment prior to lamellar engraftment owing to the depth of the involvement. All of the patients underwent routine ophthalmic examinations, including best manifest spectacle-corrected Snellen VA, central ultrasonographic pachymetry (Pachette 2; DGH Technology, Inc, Exton, Pennsylvania), and slitlamp examination in which the depth of the stromal involvement was estimated. Preoperative Snellen VA, manifest refraction, and central ultrasonographic pachymetry results are summarized in Table 1. Postoperative best spectacle-corrected VA at the 3-month (range, 63-112 days) and 10-month (range, 210-288 days) intervals were obtained from record review (Table 2).

Visante optical coherence tomography (Carl Zeiss Meditec, Inc, Dublin, California) images were obtained for several patients. The Hansatome (Bausch & Lomb, Inc, Rochester, New York) was used to create a 200-µm flap (hinged superiorly). Following flap creation, the recipient bed was inspected for residual dystrophy deposits and the excimer laser, Visx S4 (Advanced Medical Optics, Inc, Santa Ana, California), was used in photothera-
peutic keratectomy mode to remove a small amount of lattice opacification in 2 patients (Figure 1). After repositioning the flap, a CIBA night and day bandage contact lens (base curve, 8.4; power, −0.25 sphere diopter; diameter, 13.8 mm) (CIBA Vision, Duluth, Georgia) was placed and removed on the first postoperative day. Topical prednisolone acetate 1% (Pred Forte 1%; Allergan, Inc, Irvine, California) and gatifloxacin (Zymar; Allergan, Inc) were used 4 times per day for 1 week.

After 6 weeks to allow the flap to stabilize, the patient was scheduled for lamellar engraftment. The Moria artificial anterior chamber and LSK-1 microkeratome (Moria/Microtek, Inc, Doylestown, Pennsylvania) were used to harvest the graft (Figure 1). The 250-µm head was used to resect the tissue with a maximum diameter of 10 mm. This oversized graft was then trephinated to a 7.25-mm diameter with a Katena corneal trephine (Katena Products, Inc, Danville, New Jersey). The recipient bed was prepared with a 7.0-mm Barron suction trephine, which was advanced to approximately 150 µm (Figure 1). A microsurgical blade was used to complete the dissection to the lamellar bed. The disc of diseased tissue was peeled away with 0.12 forceps. The donor tissue was placed in the recipient bed and rotated to achieve the best qualitative mires with a Mastel ring light (Mastel Precision, Rapid City, South Dakota) as a guide (Figure 1). The graft was affixed with 4 Cardinal sutures followed by a running 10-0 nylon suture.

**Table 1. Preoperative Data**

<table>
<thead>
<tr>
<th>Eye No.</th>
<th>BSCVA</th>
<th>Corneal Thickness by Pachymetry, µm</th>
<th>Manifest Refraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20/100</td>
<td>514</td>
<td>+2.25 + 2.00 × 107</td>
</tr>
<tr>
<td>2</td>
<td>20/60</td>
<td>630</td>
<td>−1.00 + 1.50 × 105</td>
</tr>
<tr>
<td>3</td>
<td>20/70</td>
<td>620</td>
<td>−0.50 + 2.00 × 55</td>
</tr>
<tr>
<td>4</td>
<td>20/200</td>
<td>625</td>
<td>−2.25 + 2.00 × 103</td>
</tr>
<tr>
<td>5</td>
<td>20/100</td>
<td>580</td>
<td>NR</td>
</tr>
<tr>
<td>Mean</td>
<td>20/100</td>
<td>594</td>
<td>−0.75 + 1.75 × 93</td>
</tr>
</tbody>
</table>

Abbreviations: BSCVA, best spectacle-corrected visual acuity; NR, no record.

**Table 2. Postoperative Data**

<table>
<thead>
<tr>
<th>Eye No.</th>
<th>Follow-up, mo</th>
<th>BSCVA</th>
<th>Manifest Refraction</th>
<th>Corneal Thickness by Visante OCT, µma</th>
<th>Corneal Graft Thickness by Visante OCT, µma</th>
<th>Corneal Residual Bed Thickness by Visante OCT, µma</th>
<th>Ablation Depth, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>20/30</td>
<td>+3.00 + 2.25 × 65</td>
<td>599</td>
<td>236</td>
<td>363</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>20/30</td>
<td>−3.50 + 0.50 × 180</td>
<td>598</td>
<td>311</td>
<td>287</td>
<td>NR</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>20/40</td>
<td>−0.75 + 2.75 × 20</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>20/30</td>
<td>Plano + 4.00 × 105</td>
<td>676</td>
<td>223</td>
<td>453</td>
<td>NR</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>20/40</td>
<td>−1.00 + 3.00 × 60</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>56</td>
</tr>
<tr>
<td>Mean</td>
<td>9</td>
<td>20/34</td>
<td>−0.50 + 2.50 × 74</td>
<td>624</td>
<td>257</td>
<td>368</td>
<td>38</td>
</tr>
</tbody>
</table>

Abbreviations: BSCVA, best spectacle-corrected visual acuity; NR, no record; OCT, optical coherence tomography.

a Carl Zeiss Meditec, Inc, Dublin, California.

**Figure 1.** A hinged flap (1) was created with the Hansatome (Bausch & Lomb, Inc, Rochester, New York) and the residual stromal bed deposits were ablated with the excimer laser followed by flap repositioning. At 6 to 8 weeks after flap creation, a 7.00-mm suction trephine centered over the cornea was advanced to the flap–stromal bed interface followed by removal of the opacified lamellar corneal button (2). Donor corneal-scleral tissue was affixed and pressurized in the Moria artificial chamber where a lamellar graft was harvested using a Moria LSK-1, 250-µm microkeratome (Moria/Microtek, Inc, Doylestown, Pennsylvania). The lamellar graft donor tissue was trimmed to a 7.25-mm diameter with a trephine and then placed in the host stromal bed (3). The corneal button was rotated to minimize astigmatism with the guidance of a Mastel ring light (Mastel Precision, Rapid City, South Dakota). The button was finally secured with an 8-bite running 10-0 nylon suture.
After the running suture was tied, the Cardinal sutures were removed. The running suture was adjusted using the Mastroel ring light as a guide to minimize distortion of the graft. Viscoat (Alcon, Inc, Fort Worth, Texas) was used to cover the graft surface prior to patching over tobramycin and dexamethasone ointment (Tobradex; Alcon, Inc). Postoperative medications included Pred Forte 1% at an initial dosage of 4 times per day tapered over 6 weeks and moxifloxacin hydrochloride (Vigamox; Alcon, Inc) 4 times per day for 1 week. Suture removal was performed between 4 and 6 weeks postoperatively.

RESULTS

There were 5 eyes from 4 patients (1 male, 3 female) with a mean age of 41.5 years (range, 28 to 54 years). All of the patients had clinical evidence of corneal lattice dystrophy. The mean preoperative best spectacle-corrected VA was 20/100 (range, 20/60 to 20/200) (Table 1). The mean manifest refraction was −0.75 sphere (range, +2.25 to −2.25) and +1.75 cylinder (range, +1.50 to +2.00) (Table 1). The mean preoperative corneal thickness was 594 (range, 514 to 630) (Table 1). The mean ablation depth was 38 µm (range, 21 to 56 µm); however, only 2 of the 5 eyes underwent laser ablation to remove amyloid deposition. The postoperative mean follow-up time was 9 months (range, 7 to 10 months) (Table 2). Anterior lamellar keratoplasty was performed a mean of 54 days (range, 36 to 90 days) after the microkeratome flap procedure. The mean postoperative best spectacle-corrected VA at follow-up was 20/34 (range, 20/30 to 20/40) (Table 2). The mean manifest refraction at follow-up was −0.50 sphere (range, +3.00 to −3.50) and +2.50 cylinder (range, +0.50 to +4.00) (Table 2). The mean postoperative corneal thickness was 624 µm (range, 598 to 676 µm) (Figure 3), the mean flap thickness was 257 µm (range, 223 to 311 µm), and the mean residual corneal bed thickness was 368 µm (range, 287 to 453 µm) as measured by Visante optical coherence tomography (Figure 4). Only 3 of 5 eyes were measured owing to equipment and patient availability. There were no postoperative complications. The mean postoperative best spectacle-corrected VA improved from 20/100 preoperatively to 20/34 at a mean follow-up of 9 months (Table 2).

COMMENT

Lamellar keratoplasty was first performed more than 100 years ago. Lamellar transplantation has many obvious advantages over penetrating keratoplasty, including im-

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**Table 1.** Anterior segment pachymetry mapping of patient 1. The plus symbol indicates the vertex position.

<table>
<thead>
<tr>
<th>Range, mm</th>
<th>Minimum, µm</th>
<th>Average, µm</th>
<th>Maximum, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>514</td>
<td>519</td>
<td>519</td>
</tr>
<tr>
<td>2-5</td>
<td>517</td>
<td>567</td>
<td>619</td>
</tr>
<tr>
<td>5-7</td>
<td>584</td>
<td>632</td>
<td>697</td>
</tr>
<tr>
<td>7-10</td>
<td>645</td>
<td>691</td>
<td>797</td>
</tr>
</tbody>
</table>

**Figure 2.** Postoperative slitlamp photograph of patient 1 demonstrating the running 10-0 nylon suture securing the anterior lamellar corneal donor tissue.

**Figure 3.** Visante optical coherence tomography (Carl Zeiss Meditec, Inc, Dublin, California) anterior segment pachymetry mapping of patient 1. The plus symbol indicates the vertex position.
proved structural integrity, less chance for graft rejection, reduced surgical risk, rapid healing, and ease of repeatability. The disadvantages of lamellar procedures include the technical difficulty of manually dissecting donor and host tissues, with attendant interface scarring and irregular astigmatism leading to inferior visual outcomes.

Microkeratome-assisted lamellar keratoplasty provides a simple and rapid means of achieving a smooth lamellar bed and donor, which minimizes graft-host interface scarring and opacification. Deeper stromal opacification can be addressed with the excimer laser applied to the recipient bed as long as adequate residual corneal tissue is retained for structural integrity. Irregular astigmatism may be further minimized by orienting and suturing the donor graft under the guidance of qualitative intraoperative keratometry.

Although this case series involves only 5 eyes of 4 patients, the visual outcomes with microkeratome-assisted anterior lamellar keratoplasty in patients with lattice dystrophy are encouraging. All of the 5 eyes treated with microkeratome-assisted anterior lamellar keratoplasty achieved a best spectacle-corrected VA of 20/40 or better. Visante optical coherence tomographic images reveal an excellent graft-host edge apposition and a smooth compact interface (Figure 4). No patient has detectable interface opacification (Figure 2).

Microkeratome-assisted anterior lamellar keratoplasty does have important limitations. Patients who have significant stromal pathological findings extending into the posterior half of the stroma may require a deep lamellar or penetrating keratoplasty. If the patient’s cornea exhibits areas of elevation or thinning, these will be reproduced by the microkeratome when creating the recipient flap.

The small selection of microkeratome heads limits the choice for depth of the recipient bed, although the excimer laser can augment the removal of deeper opacification within the limits of preserving adequate residual stromal tissue. Even with recipient and donor lamellar resections performed with a microkeratome and qualitative intraoperative keratometry to guide graft orientation and suture placement, irregular astigmatism limits spectacle-corrected VA to the range of 20/40 to 20/30. It remains to be determined whether femtosecond-laser lamellar procedures will circumvent some of the limitations of mechanical microkeratome lamellar preparations and provide better visual outcomes.

Patient 5 has chosen to wear rigid gas-permeable contact lenses for correction. Although spectacle correction achieves VA of only 20/40, the contact lens corrects this to 20/20. The improvement with rigid contact lens correction suggests that irregular astigmatism, not residual opacity, limits visual recovery in this patient.

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Correspondence: Lee A. Wiley, MD, West Virginia University Eye Institute, PO Box 9193, Morgantown, WV 26506 (lwiley@hsc.wvu.edu).

Financial Disclosure: None reported.

REFERENCES


Figure 4. Visante optical coherence tomography (Carl Zeiss Meditec, Inc, Dublin, California) anterior segment view of the corneal interface after microkeratome-assisted anterior lamellar keratoplasty of patient 1.

Archives Web Quiz Winner

Congratulations to the winner of our October quiz, Alireza Majidi, Tohid Hospital, Sanandaj, Iran. The correct answer to our October challenge was solitary fibrous tumor of the sclera. For a complete discussion of this case, see the Clinicopathologic Reports, Case Reports, and Small Case Series section in the November Archives (Su GW, Perez N, Simons KB, Harris GJ. Solitary fibrous tumor of the sclera. Arch Ophthalmol. 2007;125[11]:1572-1574).

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