Penetrating Keratoplasty Performed by Residents

Ethan M. Kutzscher, MD; Andrew L. Sorenson, MD; Daniel F. Goodman, MD

Objective: To report the results of penetrating keratoplasty performed by residents.

Method: A retrospective medical record review of all patients undergoing penetrating keratoplasty performed by residents at our institution from April 1998 to April 2002.

Results: Forty penetrating keratoplasty procedures were performed by 8 residents. The most common indication was keratoconus (17 eyes [43%]), followed by corneal scarring (14 eyes [35%]). Mean preoperative best-corrected visual acuity was 20/250. No intraoperative complications were reported. Mean follow-up time was 15 months. Postoperatively, mean best-corrected visual acuity was 20/40, mean postoperative astigmatism was 3.4±2.1 diopters, and graft survival was 92.5%. Postoperative complications included elevated intraocular pressure, wound dehiscence, and endophthalmitis.

Main Outcome Measures: Best-corrected visual acuity, postoperative astigmatism, graft survival, and intraoperative and postoperative complications.

Conclusion: Residents can be introduced to penetrating keratoplasty and achieve surgical success with intraoperative and postoperative complication rates similar to those previously published.

Arch Ophthalmol. 2004;122:1333-1336

METHODS

The medical records of all patients undergoing PK from April 1998 to April 2002 performed by residents at California Pacific Medical Center (CPMC) were reviewed for the following data: patient demographics, ocular diagnoses, preoperative clinical course, operative technique and procedures, intraoperative and postoperative complications, and postoperative clinical course.

All patients were examined and approved for surgery by a senior resident and a member of the corneal faculty. The informed consent process was performed by the senior resident, often in the presence of the supervising faculty surgeon. This included a lengthy discussion of the postoperative diligence required by the patient and surgeon following PK. All surgical procedures were performed using general anesthesia, sterile technique, standard trephination techniques, and 16 interrupted sutures.

Under the supervision of a corneal faculty member, residents performed all critical
operative BCVA was available for 33 of 40 eyes and is summarized in the Table. Patients were grouped according to duration of follow-up. Seven eyes did not have a recording for postoperative BCVA. This was owing to death (1/7) or the absence of a manifest refraction at the time of data collection (6/7). Mean postoperative BCVA was 20/40 (range, 20/15-no light perception), with 22 eyes (67%) attaining a postoperative BCVA of 20/40 or better. Causes of postoperative BCVA < 20/200 (8 eyes) included graft failure (3), occlusion amblyopia (1), macular hole (1), persistent hyperplastic primary vitreous variant (1), undiagnosed preexisting retinal detachment (1), and endophthalmitis (1).

The most common postoperative complications were elevated intraocular pressure (IOP) (10 eyes [25%]) and wound dehiscence (4 eyes [10%]). Elevated IOP pressure was defined as persistent IOP greater than 21 mm Hg requiring treatment. Elevated IOP was controlled with topical pressure-lowering agents in all eyes. Wound dehiscence was both traumatic (2/4) and spontaneous in the immediate postoperative period secondary to suture dehiscence (2/4). All cases were repaired without complication.

Allograft rejection (controlled) occurred in 3 eyes (7.5%) and was managed with topical steroids. Graft failure was defined as a totally opacified corneal graft secondary to corneal edema. This occurred in 3 (7.5%) of 40 eyes and in 3 (13%) of 23 eyes with more than 1 year of follow-up. Thus, when considering all grafts with at least 1 year of follow-up (n = 23), 20 (87%) were clear.

Untolerated astigmatism occurred in 2 eyes (5%), and infectious suture abscess, shallow anterior chamber (grade 1), and choroidal detachment occurred in 1 eye (2.5%) each.

The most significant postoperative complication was acute postoperative endophthalmitis. After uncomplicated PK with extracapsular cataract extraction and posterior chamber intraocular lens placement, on postoperative day 4, the patient had a complete hypopyon. 30% graft dehiscence (secondary to tissue necrosis), and visual acuity of no light perception. Despite surgical repair of the dehiscence, vitrectomy, and intravitreal antibiotic injection, the vision did not improve. Vitreous cultures grew Pseudomonas aeruginosa. The patient eventually required enucleation for ocular discomfort.

Postoperative astigmatism measurements were available for 29 of 40 eyes. There were 11 eyes that did not have a recording for postoperative astigmatism. This was due to enucleation (1/11), graft failure (3/11), or lack of measurement in the immediate postoperative period (7/11). Two thirds of these measurements were recorded using manual keratometry and the other third, using manifest refraction. When both measurements were available, we used the larger of the 2 (always manual keratometry) for our data analysis. Mean ± SD postoperative astigmatism for all eyes was 3.4 ± 2.1 diopters (D) (range, 0.5-8.0 D); for eyes with 6 to 12 months’ follow-up, 3.2 ± 2.4 D (range, 0.5-8.0 D); and for eyes with more than 1 year of follow-up, 3.5 ± 2.0 D (range, 1.0-7.0 D).

Two cases of significant astigmatism required keratorefractive procedures for correction. The above quantification of astigmatism reflects the corneal measurements prior to these keratorefractive procedures.

### Table

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>No. of Eyes</th>
<th>Mean BCVA</th>
<th>20/15-20/40</th>
<th>20/50-20/70</th>
<th>20/70-20/100</th>
<th>&lt;20/200</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 mo</td>
<td>1</td>
<td>NLP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3-6 mo</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6-12 mo</td>
<td>12</td>
<td>20/53</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>&gt;1 y</td>
<td>20</td>
<td>20/33</td>
<td>16</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>All Eyes Measured</td>
<td>33</td>
<td>20/40</td>
<td>22</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

Abbreviations: BCVA, best-corrected visual acuity; NA, not applicable; NLP, no light perception.
Residents in our program have excellent exposure to PK, with each resident performing an average of 5 PK procedures during their training. A typical CPMC resident first performs PK during the second year of training, only after approximately 30 extracapsular cataract procedures, didactics regarding corneal surgery, assisting faculty and senior residents performing PK, and extensive practice with and without faculty supervision in a microsurgical wet lab.

The most common indication for PK in our series was keratoconus (17 patients [43%]). This is consistent with some series in the literature where keratoconus has surpassed pseudophakic corneal edema as the leading indication for PK. The number of patients requiring PK for pseudophakic corneal edema was low in our series.

Surgical success was evaluated by reviewing postoperative BCVA, postoperative astigmatism, and graft survival. The prognosis for surgical success depends on the preoperative indication for PK. While some diagnoses carry a favorable prognosis (keratoconus), others are quite the opposite (advanced surface disease with loss of limbal stem cells). The surgical success in any PK series is partially dependent on the percentage of different indications present in the series.

Mean postoperative BCVA was 20/40, with 22 eyes (67%) attaining a postoperative BCVA of 20/40 or better. This compares favorably with a range of 20/25 to 20/60 published by experienced corneal surgeons. The group of patients with more than 1 year of follow-up had better mean BCVA (20/33) than those in the 6- to 12-month follow-up group (20/53), which is consistent with previously published reports of BCVA stabilizing across time after PK.

Mean ± SD postoperative cylinder was 3.4 ± 2.1 D. This also compares well with previously published data looking at postoperative astigmatism by corneal fellows (3.27-D change from preoperative astigmatism) and corneal specialists (2.0-5.4 D). We used manifest refraction for final postoperative astigmatism if manual keratometry was not performed (approximately one third of our cases). This also compares well with previously published data for measuring postoperative astigmatism.

This study was performed as a retrospective analysis. Also, it would have been useful to have BCVA and manifest refraction, manual, and topographic keratometry values for all 40 eyes. However, in the first few postoperative months, the emphasis was on evaluating patients post-PK in our cornea clinic includes IOP, the health of the corneal graft, graft-host approximation as an origin of large amounts of irregular astigmatism, and detecting posterior segment pathologic features. Values for BCVA, manifest refraction, topographic keratometry, and manual keratometry are obtained for some, but not all, patients in the early postoperative period.

In summary, results of this series indicate that with excellent supervision residents can be safely introduced to PK and achieve surgical success and intraoperative and postoperative complication rates similar to those previously published. We attribute the postoperative results of PK by CPMC residents to appropriate selection of patients, proper preoperative patient counseling, resident and patient diligence, and excellent teaching and supervision by the corneal faculty at CPMC.

Submitted for publication June 24, 2003; final revision received October 13, 2004; accepted January 6, 2004.

We thank the cornea faculty at California Pacific Medical Center, San Francisco, for their dedication to resident teaching and patient care: David DeMartini, MD; Jonathan Diamont, MD; Bernd Kutzscher, MD; Karen Oxford, MD; Niraj Patel, MD; Lee Schwartz, MD; Michael Turan, MD; David Vastine, MD; and Robert Webster, MD.

Dr Kutzscher had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Correspondence: Ethan M. Kutzscher, MD, 1850 Sullivan Ave 540, Daly City, CA 94015 (ethankutzscher@yahoo.com).
REFERENCES


Correction

Omission in Acknowledgments. In the Clinical Sciences article by Murphy et al titled “Neutralizing Tumor Necrosis Factor Activity Leads to Remission in Patients With Refractory Noninfectious Posterior Uveitis,” published in the June 2004 issue of the ARCHIVES (2004;122:845-851), an omission occurred in the Acknowledgements section on page 890. In that section, the following statement should have appeared as the second paragraph, immediately following the acceptance dates: “Drs Murphy and Greiner contributed equally to this study and stand as joint first authors.”