Management of Vitreoretinal Complications in Eyes With Permanent Keratoprosthesis

Subhransu Ray, MD, PhD; Bilal F. Khan, MD; Claes H. Dohlman, MD, PhD; Donald J. D’Amico, MD

Objectives: To evaluate the spectrum and treatment of posterior segment complications in eyes that had undergone successful keratoprosthesis (KPro) placement and to determine whether transeyelid vitrectomy techniques could be effectively used in eyes otherwise vulnerable to surface exposure.

Design: In the last 10 years, 110 patients received a Dohlman-Doane KPro at the Massachusetts Eye and Ear Infirmary, Boston. We evaluated 22 eyes in 18 patients that required subsequent vitreoretinal surgery to treat posterior segment complications. One surgeon using modified vitreoretinal techniques, as described below, performed all vitreoretinal procedures.

Results: The posterior segment complications included 6 cases of retro-KPro membranes, 13 cases of retinal detachments, and 5 cases of isolated vitreous opacity. All 6 retro-KPro membranes were effectively removed by vitrectomy without significant complication and 3 of these patients enjoyed improvement of visual acuity of at least 5 Snellen lines. Of 13 cases of retinal detachment, 6 patients had some improvement in visual acuity, 5 showed no appreciable change, and 2 had some decline in the final visual acuity. In all 5 cases of isolated vitreous opacity, the media was effectively cleared with pars plana vitrectomy. Three patients enjoyed improvement of visual acuity of at least 3 Snellen lines. Four cases of transeyelid vitrectomy were attempted and anatomical success was achieved in all 4 and vision improved in 3 of these patients. No special surgical complications were encountered in any of the 22 eyes as a result of these modified surgical techniques.

Main Outcome Measures: Best preoperative and postoperative visual acuity and anatomical success were evaluated in relation to the preoperative posterior segment complication.

Conclusions: Modified vitreoretinal surgical techniques can be effectively and safely used to treat posterior segment complications in patients with KPro devices. Retro-KPro membranes and other vitreous opacities were the most amenable to treatment. Retinal complications posed a special challenge. However, all of these cases highlight that modified vitrectomy techniques can be used effectively to manage complications in eyes with severe ocular surface disease without undue exposure of vulnerable tissues.

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Attempts to rehabilitate clinically phthisical eyes and corneas that are refractory to standard keratoplasty have been challenging. Since the first description of an artificial prosthesis in 1789, numerous materials and methods have been used to functionally recreate the anatomy of the cornea. These efforts are summarized in previous publications. These devices suffered from early postoperative failure because of implant extrusion and uncontrollable inflammation. However, with advancements in material design, surgical techniques, and postoperative management, new models of keratoprosthesis (KPros) can provide long-term solutions for both the phthisical eye and end-stage corneal disease. This progress has shifted the focus to late-developing sequelae involving the posterior segment. Posterior segment abnormalities in association with a KPro may be present prior to KPro placement (as a consequence of injury, previous ocular disease, or complication of prior surgical intervention), may develop intraoperatively during KPro placement, or may occur postoperatively. Management of such challenging...
In this article we summarize our experience with pa-
tient’s who underwent KPro surgery and who have re-
quired surgical intervention for posterior segment com-
plications.

PATIENTS AND METHODS

To date, 146 cases of KPro surgery were performed at the Massachusetts Eye and Ear Infirmary, Boston, with 110 cases performed in the last 10 years using modified Dohlman-
Doane KPro designs. These cases included 13 patients with Stevens-Johnson syndrome, 27 with ocular cicatricial pem-
phigoid, 28 cases of alkali burns, and 42 other cases that include trauma, viral keratitis, and various corneal dystro-
phies.

All of the implanted KPro devices are of the original or modifications of the Dohlman-Doane design. Preop-
erative criteria and surgical placement of the KPro were pre-
viously described. Preoperative evaluation typically required ultrasound eval-
uation, although in rare cases indirect ophthalmoscopy was sufficient to characterize the posterior segment abnormal-
ity. Doppler ultrasound of the optic nerve head for verifica-
tion of integrity of the central retinal vessels was per-
fomed in patients with questionable light perception or suggestive of irreversible retinal damage. In the specific case of retro-KPro membranes, referral for pars plana vitrec-
tomy (PPV) was made after either failure of the Nd:YAG capsulotomy to achieve the desired outcome or when it was determined that such laser treatment could induce further complications, as in the case of thick fibrovascular mem-
brenes. In cases of suspected endophthalmitis, initial treat-
ment attempts were made with intravenous antibiotics fol-
lowing vitreous tap and injection. If these treatments failed to achieve vitreous clearing, they were referred for PPV with culturing of a vitreous sample.

Cases with vitreous hemorrhage were referred to the vitreoretinal service when an underlying retinal tear or de-
tachment was suggested. Initial studies included B-scan ultrascanography when direct visualization was impaired. In most cases of retinal detachment, direct visualization of the retina identified the detachment. However, B-scan ul-
trascanography was used to identify the extent of the det-
tachment, sites of possible tears, as well as points of vitre-
ous adhesions. In most cases of retinal pathology, direct intraoperative visualization provided the most accurate and useful characterization.

SURGICAL TECHNIQUES

Because the anterior segment anatomy is frequently fore-
shortened in eyes undergoing KPro surgery, often with pro-
found fibrosis and contracture in the area of the iris root and ciliary body, incisions for vitrectomy were located as ante-
riorally as possible in these cases. To place the incisions just beyond the KPro back plate, 9-mm marks spanning the KPro center were placed as entry sites for 3-port or 2-port PPV. Entry sites were made through the conjunctiva with a microvitreoretinal blade. Infusion was established using a va-
riety of techniques. Although conventional sutured cannu-
las were used, it was more common to use a bent 21-gauge butterfly needle with the tubing taped to the eyelid to main-
tain position. This later technique had the advantage of main-
taining a formed globe from the beginning of the surgery. Bottle height was maximized to maintain the chamber and facilitate intraocular hemostasis. Zeiger and bent microvit-
reoretinal blades were alternatively used to incise and free the retro-KPro membranes from the back plate, and the frag-
ments were removed with the vitrector. Once adequate vis-
ualization is achieved, the remainder of the vitreous is re-
moved as necessary. Patient 2 demonstrates a case of simultaneous retro-KPro membrane and endophthalmitis (Figure 2).

Three-port vitrectomy was used in all cases of sus-
ppected retinal pathology to allow for maximal visualiza-
tion and flexibility in tissue manipulation. A Charles irriga-
ting contact lens was initially used for visualization of the anterior vitreous. Further manipulations were per-
formed using a contact wide-field viewing system with a 130° wide-angle lens to maximize peripheral visualization. When necessary, endolaser photocoagulation was per-
formed with a straight-probe. A 3000-centistoke silicone oil was used at the end of the case for prolonged retinal tamponade in most cases, but long-acting gases were also used. The eye was filled to the edge of the KPro back plate.

Many patients who a KPro device have severe ocular surface disease necessitating the placement of a transeye-
lid type II KPro device. To avoid disturbing this interface, a microvitreoretinal blade was used to simultaneously pen-
trate full thickness through the eyelid, conjunctiva, and sclera into the vitreous space. Infusion was established with a 21-gauge butterfly-needle technique. The remainder of the techniques are similar to those described earlier for the transconjunctival approach. The ports were closed with deep 10-0 nylon skin sutures without the need for scleral su-
tures. Such a procedure was required in case 3 in which a dense retro-KPro membrane limited visual acuity and was refractory to Nd:YAG treatment. Figure 3 shows the sur-
Surgical techniques used in the treatment of this patient.


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RESULTS

Of the 110 cases of KPro placement in the last 10 years at the Massachusetts Eye and Ear Infirmary, there were a total of 22 cases in 18 patients with posterior segment complications. The most common posterior segment problems encountered were retro-KPro membranes, endophthalmitis, retinal detachments, epiretinal membranes, and vitreous hemorrhages. The most common posterior segment complication requiring surgical intervention was retinal detachment, which was found either in isolation or in combination with a vitreous opacity in 13 cases. The retinal detachments were seen in association with other retinal pathology including extensive cyclic membranes, epiretinal membranes, proliferative vitreoretinopathy, subretinal fibrosis, and other preretinal vitreous adhesions. There were 6 cases of retro-KPro membrane, 3 of which were in isolation. Two of the remaining 3 were seen in association with a retinal detachment, and the last was in the setting of concurrent endophthalmitis. Additionally, there were 5 cases of isolated vitreous opacity related to endophthalmitis in 4 cases and chronic uveitis in 1 case.

SURGICAL OUTCOMES

All 6 retro-KPro membranes were effectively removed by vitrectomy without significant hemorrhage and with complete clearing of the visual axis. The 3 patients with isolated retro-KPro membrane (cases 1, 3, and 4) enjoyed improvement of visual acuity of at least 5 lines of Snellen. The 1 patient associated with endophthalmitis (case 2) saw an improvement from light perception to 20/200. The 2 remaining patients (cases 20 and 22) were in the setting of a concurrent retinal detachment and saw minimal to no improvement in vision, although the membrane was effectively cleared from the optical axis.

Of the 13 cases of retinal detachment, 6 patients had some improvement in visual acuity (cases 9, 11, 15, 18, 19, and 20), 5 showed no appreciable change (cases 10, 12, 14, 21, and 22), and 2 had some decline in final visual acuity (cases 16 and 17). Anatomical success could not be achieved in 4 patients despite aggressive surgical intervention. Of the 6 patients who showed some visual improvement, 4 had some other vitreous opacity that was simultaneously cleared at the time of detachment repair; 2 with vitreous hemorrhage (cases 11 and 15) and 1 each with uveitis (case 18) and retro-KPro membrane (case 20). Of the remaining 7 patients who saw either no improvement or a decline in vision, 3 patients demonstrated extensive proliferative vitreoretinopathy (cases 16, 17, and 21). In all but 4 patients (cases 14, 19, 20, and 21), the retina was successfully anatomically reattached postoperatively. The 4 patients who were determined to be inoperable were secondary to proliferative vitreoretinopathy and chronic scarring.

In all 5 cases of isolated vitreous opacity (cases 5 through 8 and 13), the media was effectively cleared with a PPV approach. Three of these patients enjoyed improvement of visual acuity of at least 3 Snellen lines (cases 5 through 7). One patient (case 8) had a chronic wound leak around the KPro stem that progressed to device extrusion. One patient with chronic uveitis (case 13) developed a retinal detachment postoperatively.

Four cases of transeyelid vitrectomy were performed (cases 3, 18, 19, and 22). In all 4 cases anatomical success was achieved and vision improved in 3 of these patients (cases 3, 18, and 19), with patient 3 enjoying dramatic improvement from hand motions to 20/20 visual acuity after removal of a thick fibrovascular retro-KPro membrane. No surgical complications were seen in any of these patients that could be associated with the transeyelid approach.

In summary, in all 22 cases of vitreoretinal surgery performed for posterior segment complications in KPro eyes, no special surgical complications were induced by these modified techniques. No cases of uncontrolled vitreous hemorrhage, retinal detachment, giant retinal tears, choroidal detachment, endophthalmitis, or KPro device damage were noted in any of the aforementioned cases.

COMMENT

The increase in long-term stability of KPro devices resulted in a shift in the types of complications encountered. There have been 173 cumulative postoperative years with vision of 20/200 or better starting from preoperative visions of counting fingers or worse over the period 1990 through 2000. The factors that have improved surgical outcome include glaucoma shunts, changes in KPro design, prophylactic antibiotics, and immunomodulators. Traditional complications such as corneal melt, implant extrusion, and glaucoma still figure prominently. However, the most common causes for failure are encountered in the posterior segment. Leading among these is uncontrollable uveitis as well as other causes of posterior segment pathology such as retro-KPro membrane, endophthalmitis, and retinal detachment. Management of these complications requires modified vitreoretinal techniques.

RETRO-KPro MEMBRANES

Approximately 30% of eyes will eventually develop retro-KPro membranes. Most are amenable to Nd:YAG laser treat-
<table>
<thead>
<tr>
<th>Patient No./ Age, y</th>
<th>Pre-KPro Diagnosis</th>
<th>Pre-KPro Visual Acuity</th>
<th>Type of KPro Device†</th>
<th>Best KPro Visual Acuity</th>
<th>Posterior Segment Complication</th>
<th>Visual Acuity Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/32</td>
<td>Graft-vs-host disease</td>
<td>LP</td>
<td>I</td>
<td>20/25</td>
<td>Retro-KPro membrane and anterior vitreous membranes</td>
<td>20/400</td>
</tr>
<tr>
<td>2/68</td>
<td>Atopy</td>
<td>HM</td>
<td>I</td>
<td>20/20</td>
<td>Endophthalmitis, vitreous debris, and retro-KPro membranes</td>
<td>LP</td>
</tr>
<tr>
<td>3/34</td>
<td>SJS</td>
<td>HM</td>
<td>II</td>
<td>HM</td>
<td>Retro-KPro membrane</td>
<td>HM</td>
</tr>
<tr>
<td>4/61</td>
<td>OCP</td>
<td>HM</td>
<td>I</td>
<td>20/25</td>
<td>Retro-KPro membrane</td>
<td>HM</td>
</tr>
<tr>
<td>5/74</td>
<td>Pseudophakic bullous keratopathy</td>
<td>HM</td>
<td>I</td>
<td>20/25</td>
<td>Sterile endophthalmitis</td>
<td>HM</td>
</tr>
<tr>
<td>6/72</td>
<td>Trauma after cataract extraction</td>
<td>CF 1 ft</td>
<td>I</td>
<td>20/40</td>
<td>Endophthalmitis</td>
<td>HM</td>
</tr>
<tr>
<td>7/26</td>
<td>Corneal NV of unclear origin</td>
<td>CF 1 ft</td>
<td>I</td>
<td>20/25</td>
<td>Endophthalmitis and anterior vitreous membranes</td>
<td>LP</td>
</tr>
<tr>
<td>8/39</td>
<td>Burn patient</td>
<td>HM</td>
<td>I</td>
<td>20/25</td>
<td>Endophthalmitis and leak</td>
<td>LP</td>
</tr>
<tr>
<td>9/30</td>
<td>Chemical burn after failed grafts</td>
<td>HM</td>
<td>I and Vlt</td>
<td>†</td>
<td>Macula-off RD</td>
<td>HM</td>
</tr>
<tr>
<td>10/58</td>
<td>OCP</td>
<td>LP</td>
<td>II</td>
<td>HM</td>
<td>Vh, preretinal clot, and peripheral traction RD</td>
<td>LP</td>
</tr>
<tr>
<td>11/49</td>
<td>JRA</td>
<td>HM</td>
<td>I and Vlt</td>
<td>†</td>
<td>Vitreous debris and elevated macula</td>
<td>HM</td>
</tr>
<tr>
<td>12/58</td>
<td>Syphilis, uveitis, and hypotony</td>
<td>HM</td>
<td>I and Vlt</td>
<td>†</td>
<td>Uveitis</td>
<td>HM</td>
</tr>
<tr>
<td>12/78</td>
<td>OCP</td>
<td>CF 4 ft</td>
<td>II and Vlt</td>
<td>LP</td>
<td>VH and RD</td>
<td>LP</td>
</tr>
<tr>
<td>14/42</td>
<td>Alkalai burn</td>
<td>HM</td>
<td>I and Vlt</td>
<td>20/60</td>
<td>RD and PVR, and soft eye</td>
<td>HM</td>
</tr>
<tr>
<td>15/55</td>
<td>SJS</td>
<td>CF 4 ft</td>
<td>II and Vlt</td>
<td>20/25</td>
<td>Uveitis, dislocated IOL, and RD with identified break</td>
<td>HM</td>
</tr>
<tr>
<td>16/46</td>
<td>Congenital rubella after graft failures</td>
<td>HM</td>
<td>I</td>
<td>20/400</td>
<td>Retro-KPro membrane, cyclic membrane, and macula-on RD</td>
<td>HM</td>
</tr>
<tr>
<td>17/37</td>
<td>Alkalai burn after failed grafts</td>
<td>LP</td>
<td>II</td>
<td>20/25</td>
<td>Leak, VH, total RD adherent to KPro, and giant retinal tear and PVR</td>
<td>LP</td>
</tr>
<tr>
<td>...</td>
<td>Fuch dystrophy with failed grafts</td>
<td>...</td>
<td>I</td>
<td>20/200</td>
<td>Retro-KPro membrane and RD</td>
<td>HM</td>
</tr>
</tbody>
</table>

*KPro indicates keratoprosthesis; LP, light perception; PPV, pars plana vitrectomy; ellipses, not applicable; HM, hand motions; SJS, Stevens-Johnson syndrome; OCP, ocular cicatrical pemphigoid; CF, counting fingers; NV, neovascularization; Vlt, anterior or open-sky vitrectomy; RD, retinal detachment; AFX, air-fluid exchange; SO, silicone oil; JRA, juvenile rheumatoid arthritis; VH, vitreous hemorrhage; PRV, proliferative vitreoretinopathy; ERM, epiretinal membrane; soft eye, an eye in which there is no detectable intraocular pressure; and IOL, intraocular lens.

†A type I Dohlman-Doane KPro has a 7-mm-diameter front plate with a central 3.5-mm, optically clear zone and a 7-mm-base diameter back plate. This device is used in patients with adequate tear film stability. A type II Dohlman-Doane KPro has a 7-mm-diameter front plate and a central 3.5-mm, optically clear zone along with a 2-mm anterior hub that protrudes through eyelid tissues, and a 8.5-mm-base diameter back plate. This device is used in patients with severe ocular surface disease.

‡The follow-up period ranged from 3 to 6 months after the last surgical procedure.
TABLE I

<table>
<thead>
<tr>
<th>Procedure Performed</th>
<th>Best Post Procedure Visual Acuity†</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPV, membrane removal, and vitreous membrane excision</td>
<td>20/30</td>
<td></td>
</tr>
<tr>
<td>PPV, membrane removal, and vitreous washout</td>
<td>20/200</td>
<td>Bacterial toxic retinopathy</td>
</tr>
<tr>
<td>Transeyelid and membrane removal</td>
<td>20/20</td>
<td>Transeyelid approach</td>
</tr>
<tr>
<td>PPV and membrane removal</td>
<td>20/200</td>
<td>Poor optic nerve health</td>
</tr>
<tr>
<td>New KPro, open-sky vitrectomy, and removal of anterior vitreous membranes</td>
<td>20/100</td>
<td></td>
</tr>
<tr>
<td>PPV</td>
<td>20/100</td>
<td>Optic nerve cupping and atrophy</td>
</tr>
<tr>
<td>New KPro, open-sky vitrectomy, and removal of anterior vitreous membranes</td>
<td>20/40</td>
<td></td>
</tr>
<tr>
<td>PPV Type II KPro and PPV with perfluoron, AFX, and SO</td>
<td>LP</td>
<td>KPro extrusion</td>
</tr>
<tr>
<td>PPV and SO</td>
<td>LP</td>
<td>Retina remains attached</td>
</tr>
<tr>
<td>Type I KPro, PPV, and SO</td>
<td>HM</td>
<td>Melt and second KPro</td>
</tr>
<tr>
<td>Type I KPro and open-sky vitrectomy</td>
<td>HM</td>
<td>Developed RD</td>
</tr>
<tr>
<td>PPV, membrane excision and SO</td>
<td>LP</td>
<td>Long-term RD with scarring</td>
</tr>
<tr>
<td>PPV, stripping of posterior hyaloid, and SO</td>
<td>20/200</td>
<td>Second RD</td>
</tr>
<tr>
<td>PPV, ERM peel, retinotomy, endodrainage, AFX, and SO</td>
<td>HM</td>
<td>Attached retina, but pale optic nerve</td>
</tr>
<tr>
<td>PPV, ERM peel, retinotomy, endodrainage, AFX, endolaser, and SO</td>
<td>LP</td>
<td>Retina remains attached</td>
</tr>
<tr>
<td>Transeyelid PPV, endodrainage, endolaser, AFX gas to mobilize IOL, and SO</td>
<td>20/320</td>
<td>Transeyelid approach, but had second RD</td>
</tr>
<tr>
<td>Transeyelid PPV, ERM peel, retinotomy, endodrainage, AFX, endolaser, and SO</td>
<td>CF</td>
<td>Extensive distortion from subretinal fibrosis</td>
</tr>
<tr>
<td>PPV, AFX, open-sky excision of membranes, and SO</td>
<td>CF</td>
<td>All 4 retinal quadrants bound into proliferative scar at cornea and LP vision inoperable retina</td>
</tr>
<tr>
<td>PPV, perfluoron, AFX, and dense inoperable membranes</td>
<td>LP</td>
<td></td>
</tr>
<tr>
<td>Transeyelid PPV, membrane removal, retinotomy, AFX, and SO</td>
<td>HM</td>
<td>Transeyelid and retina remains attached</td>
</tr>
</tbody>
</table>

As with any intraocular surgery, one of the most debilitating complications is endophthalmitis. In KPro surgery, the rate of sterile endophthalmitis is higher than in other intraocular procedures. This may be secondary to immune reaction to antigens released during tissue melt and necrosis. The clinical picture of sterile and infectious endophthalmitis can be varying and confounding, but in general, sterile endophthalmitis is more insidious in onset and occurs in the absence of substantial ocular pain or injection. Vitreous taps, as well as intravitreal and intravenous antibiotics are administered in cases suggestive of endophthalmitis. The initial antibiotics of choice are vancomycin hydrochloride and ceftazidime, though these are tailored once the culture results become available. The most common organisms are endogenous flora and include Streptococcus species, Staphylococcus species, Propionibacterium acnes, Candida species, Cryptococcus species, and Moraxella species. Surgical vitrectomy in infectious cases can be performed for vitreous biopsy, debulking of organism load, and removal of vitreous scaffolding on which the organisms may proliferate. Vitrectomy in these cases may also theoretically reduce the risks of subsequent vitreoretinal fibrosis and adhesions as well as their subsequent complications.

RETIINAL DETACHMENTS

Treatment of retinal detachment in KPro-treated eyes is challenging both in visualization as well as surgical access to involved retinal tissues. Retinal detachments may be secondary to retinal breaks, but may also be due to vitreoretinal adhesions and proliferative vitreoretinopathy that accompany chronic inflammation. In such cases, removal of the instigating traction is paramount to successful results. Another visually significant finding in chronic inflammation is epiretinal membrane formation, as demonstrated in patient 17. While basic surgi-
cal principles are obeyed in KPro-treated eyes, the surgical approaches must be modified to achieve good visual outcome. Scleral buckling procedures are often of limited value owing to the compromised scleral and anterior segment tissues seen in these disease states. One of the great limitations lies in the lack of a suitable expansile substance to achieve adequate retinal tamponade. Although we are able to achieve anatomical success in many of these cases, and in many cases stabilize the vision, the prognosis for visual restoration remains poor. Perhaps earlier intervention or prophylactic treatment in high-risk cases may increase the success rate.

**GENERAL PRINCIPLES**

Despite the exact nature of the surgical procedure, several common obstacles emerge in KPro-treated eyes. These include obtaining adequate surgical exposure, visualization, and hemostasis. Though exposure and visualization are limited in a closed eye system, we prefer this to the intraoperative complications encountered in open-sky techniques. During PPV, a wide-angle lens system may be used with the illumination of a light pipe to obtain more posterior and peripheral views. Two-port vitrectomy is often adequate in simple cases of vitreous washout, membrane peel, or obtaining a biopsy specimen. However, in more complicated scenarios, standard 3-port vitrectomy is required. During instrument manipulation, care must be taken to avoid damage to the back plate, as iatrogenic opacities in the visual axis will limit visual prognosis. Finally, as blood in the vitreous is an active stimulant, special care must be paid to limiting hemorrhage, both intraocular as well as spillover from external ports. Beginning the surgery with an intraocular penetration by a 21-gauge needle for irrigation limits hemorrhage, permits additional instrument introductions, and prevents the transient inadvertent collapses seen with sutured cannula techniques. The maintenance of a closed, firm eye throughout the procedure is perhaps the single most important aspect in achieving successful visual outcomes in these eyes. We advocate a limited vitreous washout at procedure completion if significant red blood cells are present. Postoperative management includes topical antibiotics, 1% atropine sulfate, and steroids which may be administered periocularly.

Special interest is given to patient 3, who, to our knowledge, is the first case of transeyelid PPV. To preserve the stability of type II KPro devices, it was crucial...
to obtain surgical access without disrupting the protective surface barriers. Vitrectomy in type II KPro devices poses a unique challenge in all 3 categories of exposure, visualization, and hemostasis. Full-thickness vitrectomy requires a modified infusion device, for which we used a 1.5-in, 21-gauge, butterfly-infusion needle that we inserted as the very first maneuver. This was followed by transeyelid penetration with a microvitreoretinal blade for additional instrument access across the eyelids. With experience, it became relatively straightforward to reintroduce various instruments across these transeyelid incisions into the eye. It is possible that the use of cannulated vitrectomy incisions would be beneficial in these cases to facilitate navigating the instruments across the eyelid and sclera.

**CONCLUSIONS**

The previous cases demonstrate that modified surgical techniques may be successfully used to treat visually devastating complications in KPro-treated eyes. Though general vitreoretinal surgical principles are obeyed, special attention is paid to exposure, visualization, and hemostasis. Keratoprosthesis surgery is itself an evolving field, and management of posterior segment complications will
similarly require continual modification. There are several limitations, which still await technological and surgical advancements. The vision rescued by heroic anterior segment surgery in end-stage ocular disease can be preserved by continued diligence and innovation in the management of associated vitreoretinal complications.

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REFERENCES


Ophthalmological Numismatics

Carl Ferdinand von Graefe (1787-1840) at age 24 years was the youngest appointed professor of surgery and director of the surgical-ophthalmologic clinics at the University of Berlin. He is a founder of the field of modern plastic surgery and devised operations for blepharoplasty, rhinoplasty, and cleft palate. He was also the father of Albrecht von Graefe. The medal shown was engraved by C. K. Pfeuffer and struck by Loos for von Graefe’s 42nd birthday in 1829. The obverse (Figure 1) depicts his bust facing left surrounded by an inscription. The reverse (Figure 2) depicts an inscription surrounded by an oak wreath.

Courtesy of: Jay M. Galst, MD, 30 E 60th St, New York, NY 10022.