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Case Report

Enhancing Visual Acuity through Combined Intraocular Lens Fixation, Penetrating Keratoplasty, and Vitrectomy: The Role of Temporary Landers Wide-Field Keratoprosthesis

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Keywords
Corneal transplantation · Keratoplasty · Corneal endothelium · Artificial cornea

Abstract
Introduction: Complex corneal conditions present surgical challenges and necessitate innovation. Here, we present two cases where we performed intraocular lens trans-scleral fixation using the double-needle Yamane technique, followed by penetrating keratoplasty and vitrectomy using a temporary Landers wide-field keratoprosthesis. ***Case Presentation:*** Case 1 involved a 70-year-old man with an aphakic eye of bullous keratopathy and corneal opacity owing to multiple penetrating and endothelial keratoplasty, endophthalmitis, and herpetic keratitis. His visual acuity was counting fingers at 20 cm before surgery. Penetrating keratoplasty with vitrectomy and intraocular lens scleral fixation was performed using the double-needle Yamane technique, and 10 months postoperatively, his best-corrected visual acuity improved to 0.6, presenting a clear cornea. Case 2 involved a 62-year-old man who underwent penetrating keratoplasty twice for corneal perforation and therapeutic penetrating keratoplasty with vitrectomy for traumatic globe rupture, resulting in the loss of the intraocular lens. The patient exhibited graft failure, and his best-corrected visual acuity was 0.03. Utilizing a temporary Landers wide-field keratoprosthesis, we performed penetrating keratoplasty and intraocular lens trans-scleral fixation without complications. His final best-corrected visual acuity improved to 0.15 with a clear cornea. ***Conclusions:*** Trans-scleral fixation of intraocular lens with penetrating keratoplasty, using temporary Landers wide-field keratoprosthesis, yielded positive clinical outcomes without serious complications.

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Introduction

The surgical view for intraocular manipulation becomes highly restricted in eyes with abnormally non-transparent corneas, such as those with corneal leucoma, corneal dystrophy, traumatic corneal laceration, bullous keratopathy, and failed corneal graft, rendering ophthalmic surgery technically challenging. Penetrating keratoplasty (PK) is a surgical procedure involving the complete replacement of the host cornea with a full-thickness donor corneal graft, following which the transplanted cornea presents transparency [1]. Hence, for patients requiring pars plana vitrectomy (PPV) due to corneal diseases, a combined approach with penetrating PK proves effective. This combination allows surgeons to visualize the retina and vitreous, even in cases of severely opaque corneal eyes, regardless of the corneal condition [2]. Conversely, when PK precedes PPV, concerns arise regarding potential damage to the corneal endothelium of the transplant during PPV and some intraocular manipulations. The use of artificial temporary keratoprosthesis (TKP) during PPV was first described by Landers et al. [3] in 1981. The Landers wide-field TKP (Landers TKP), composed of polymethylmethacrylate, has a clear and solid optical zone. During surgery, the Landers TKP is inserted into a trephined opening in the cornea, providing a clear, stable view of the intraocular contents. Immediately after vitrectomy, the keratoprosthesis is replaced with a corneal graft [4]. Landers TKP is useful in PPV combined with PK for patients with corneal diseases, such as ocular trauma and poor fundus translucency [4, 5].

The Yamane double-needle technique for intrascleral fixation of intraocular lens (IOL) is a surgical approach utilized for patients without a capsular bag; it is widely employed owing to its simplicity compared to IOL suturing and its favorable long-term prognosis [6]. Although several reports describe ocular trauma cases where PPV and PK were performed using Landers TKP, to the best of our knowledge, the present literature reports no surgery reports with IOL scleral fixation. Herein, we report 2 cases in which Landers TKP was used, and PK combined with PPV was performed in two aphakic eyes without serious complications.

Case Report

Case 1

A 70-year-old man, having undergone PK twice and Descemet stripping automated endothelial keratoplasty once for keratoconus following multiple graft failures in his right eye, presented with endophthalmitis. The patient underwent PPV and IOL extraction for an aphakic eye with bullous keratopathy. During the observation period, he presented with herpetic keratitis, and strong corneal opacity persisted after the improvement of the keratitis. Owing to the corneal stromal opacity and corneal edema, the translucency of the anterior chamber was poor (Fig. 1a, b). Anterior-segment optical coherence tomography revealed severe edema in the previous corneal graft (Fig. 1c). The central corneal thickness measured 1,092 μm. His best-corrected visual acuity (BCVA) was counting fingers at 20 cm, and intraocular pressure was 18.0 mm Hg in the right eye. Corneal endothelial cell density was below the measurement limit. Preoperatively, Goldman's Visual Field Test indicated that his central visual field was preserved, and ultrasonography did not reveal any retinal detachment. Therefore, we performed IOL scleral fixation simultaneously combined with PK using Landers TKP to minimize graft endothelial damage.

Under general anesthesia, we first punched out the recipient cornea at a diameter of 7 mm after disinfection with marking and sutured the Landers TKP (7.2 mm diameter) using 10-0 Nylon at six points. Next, we created three ports using a 25 G vitrectomy system and

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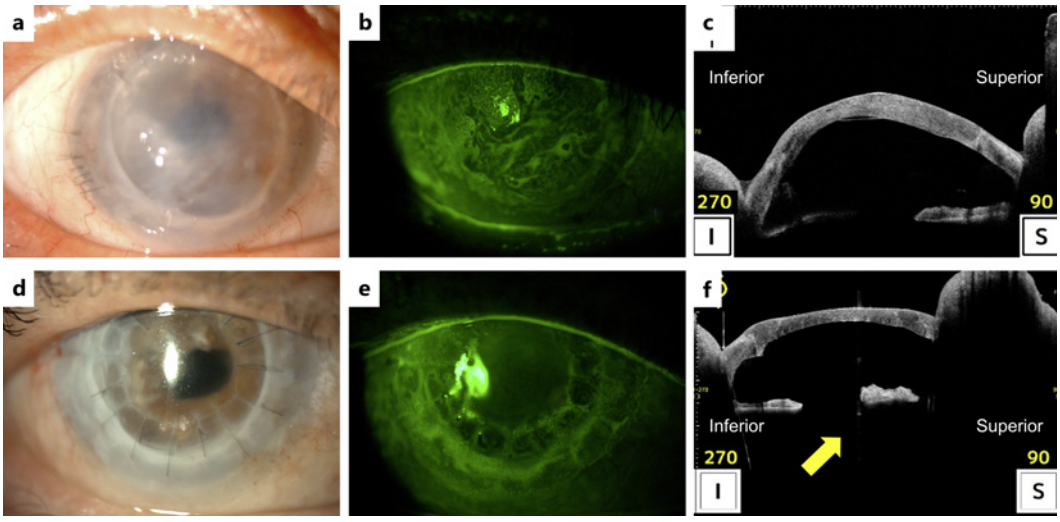

Fig. 1. Case 1 anterior segment before and after PK and IOL scleral fixation using Landers TKP. **a** Image of slit-lamp microscope before surgery. Bullous keratopathy presenting corneal edema of the transplanted cornea was observed. **b** Fluorescent staining image of the anterior segment before surgery. Corneal edema was confirmed with fluorescent staining. **c** Image of anterior-segment optical coherence tomography before surgery. Corneal edema was noted with a central corneal thickness of 1,092 μm. No IOLs were used. **d** Image of slit-lamp microscope after surgery. The transplanted cornea was clear, and the intraocular condition was clearly confirmed. **e** Fluorescent staining image of the anterior segment after surgery. There was no epithelial defect or corneal edema. **f** Image of anterior-segment optical coherence tomography after surgery. Corneal edema was not observed. Intraocular fixation was confirmed. The IOL was visible (arrow). IOL, intraocular lens; PK, penetrating keratoplasty; TKP, temporary keratoprosthesis.

performed a core vitrectomy. Although poor mydriasis made it difficult to shave the peripheral vitreous body, we could clearly observe the fundus through the transparent Landers TKP. A 3-piece IOL (NX-70 S, Santen pharmaceutical) was inserted and fixed using the double-needle Yamane technique [7]. In short, a 30 G needle was inserted into the eye through the sclera to draw the haptics of the IOL out of the eye, and the haptics were inserted into the lumen of the 30 G needle. The other haptics were inserted in the same way, and the bilateral 30 G needles were removed. After adjusting the length of the haptics and position of the IOL, the end of the haptics was ablated to create a flange, which was implanted into the sclera. We removed the three 25 G ports and subsequently replaced the Landers TKP with a 7.5 mm corneal donor graft before suturing with 16 10-0 nylon single sutures. Postoperatively, we initiated topical medication of 0.1% nepafenac three times daily, along with 0.5% moxifloxacin and 0.1% betamethasone six times daily, which was gradually tapered. Additionally, 3% acyclovir ophthalmic ointment once daily was initiated. No general or perioperative ophthalmological complications occurred.

The transplanted corneal graft became clear after 2 months. At 10 months postoperatively, his BCVA improved to 0.6 with a rigid gas-permeable lens. Although corneal edema temporally appeared near the center of the graft at 2 years and 3 months postoperatively, edema tended to decrease with increasing dosage of 0.1% betamethasone eye drops from one to three times daily, which was later reverted to once daily. Graft clarity, anterior chamber transparency, and epithelial condition were satisfactory 3 years post-surgery (Fig. 1d, e). The sutures had adequate adhesive strength, kept holding the corneal graft in place, and were not removed. Corneal endothelial cell density was maintained at 1,005 cells/mm^2, and the central cornea thickness was 609 μm (Fig. 1f).

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Case 2

A 62-year-old man, having undergone PK twice in the left eye for corneal perforation, experienced traumatic globe rupture with loss of the IOL. Subsequently, we performed therapeutic PK with anterior vitrectomy using a cryopreserved cornea, but his corneal graft thickened with subepithelial edema, resulting in graft failure (Fig. 2a). The central corneal thickness was 834 μm (Fig. 2b). Preoperatively, his BCVA was 0.03, and intraocular pressure was 7.0 mm Hg. Owing to corneal epithelial opacity, the translucency of the anterior chamber was poor. Corneal endothelial cell density was below the measurement limit. Goldman's Visual Field Test indicated preservation of the central visual field, and ultrasonography revealed no retinal detachment.

Given the patient's history of three PK procedures, IOL scleral fixation was simultaneously performed with optical PK using Landers TKP to maintain the corneal graft for a long time. Under general anesthesia, the Landers TKP (7.2 mm diameter) was sutured using 10-0 Nylon after punching off a 7 mm wide recipient cornea (Fig. 2c). We created three ports using a 25 G vitrectomy system. We clearly observed the periphery of the fundus through the Landers TKP and could shave the vitreous body precisely following core vitrectomy. Next, the IOL was fixed intrasclerally using the Yamane technique (Fig. 2d) [7]. A guide needle was inserted into the eye, and a 3-piece IOL (NX-70 S, Santen pharmaceutical) was fixed in the open-sky condition after removing the Landers TKP. Finally, the donor corneal graft was implanted using 10-0 Nylon, and subsequently, the three 25 G ports were removed. Postoperatively, we initiated topical medication of 0.1% bromfenac twice daily, along with 0.1% betamethasone and 0.3% gatifloxacin six times daily, which was gradually tapered.

The corneal graft became clear 1-month post-surgery (Fig. 2e) without corneal edema, as evaluated using anterior-segment optical coherence tomography (Fig. 2f). We did not remove the suture of the transplanted cornea. His BCVA improved to 0.15 with a rigid gas-permeable lens. No ophthalmologic complications were observed. Details of the surgical technique for case 2 are available in the online supplementary video (for all online suppl. material, see https://doi.org/10.1159/000540287).

Discussion

We demonstrated the feasibility of performing PK, PPV, and IOL intrascleral fixation using the double-needle Yamane technique in patients with highly opacified corneas, employing the Landers TKP. This technique reduces potential complication risks by streamlining surgery, eliminating the need for a two-stage approach and enabling prompt vitreoretinal intervention [8]. Eyes with abnormal corneas, which make it difficult to observe the retina and vitreous body of the eye, are sometimes associated with lens problems, such as artificial aphakia or IOL deviation. Several treatment strategies are available to implant an IOL in such eyes, depending on the cornea's transparency. If the transparency is sufficient for surgery, then IOL scleral fixation may be performed first, followed by a two-stage corneal transplantation. If the corneal opacity is strong, then PK is first performed, after which IOL fixation is scheduled several months later. However, the issue is that the corneal endothelium of the first transplanted cornea would be damaged during secondary IOL fixation. The Landers keratoprosthesis, being made of hard polymethylmethacrylate with a central core of polyethylene glycol, is designed to preserve its integrity from peripheral suturing and allow reusability. However, the Eckardt TKP is made of optically clear soft silicone with a hydrophilic surface to provide a wider optical zone and shorter vertical length, compared to the Landers TKP [9]. Additionally, its increased elasticity optimizes peripheral molding and sealing to be irregular

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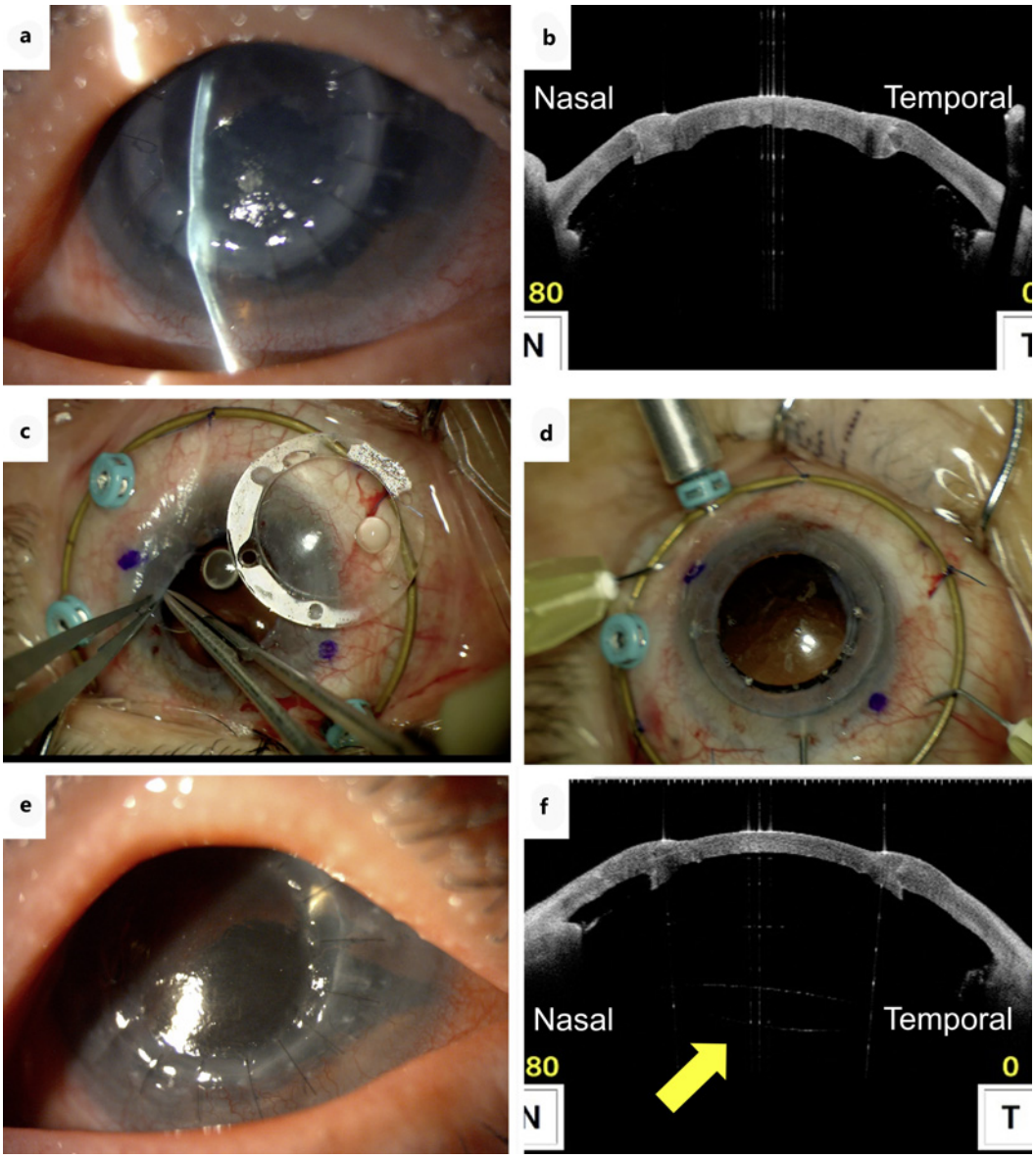

Fig. 2. Case 2 anterior segment before and after PK and IOL scleral fixation using Landers TKP. **a** Image of slit-lamp microscope before surgery. A thickened opaque cornea after therapeutic keratoplasty was noted. **b** Image of anterior-segment optical coherence tomography before surgery. Corneal edema was noted with a central corneal thickness of 834 μm. **c** Surgeon's view of the microscope on suturing the Landers TKP to the cornea after punching out the recipient cornea. **d** Surgeon's view of the microscope on intrascleral fixation of the IOL. **e** Image of slit-lamp microscope after surgery. **f** Image of anterior-segment optical coherence tomography after surgery. No corneal edema was noted, with a central corneal thickness of 594 μm. The IOL was visible (arrow). IOL, intraocular lens; PK, penetrating keratoplasty; TKP, temporary keratoprosthesis.

corneal defects. Eckardt TKP is reportedly effective for IOL intrascleral fixation with PK [10]; however, reports on the outcomes of Landers TKP are lacking. The characteristics of the two types of keratoprosthesis are summarized in Table 1. Our current case report describes a single surgery for simultaneous PK and IOL scleral fixation using Landers TKP, which would help enhance the surgeon's view.

Table 1. Characteristics of representative keratoprosthesis

	Landers wide-field temporary keratoprosthesis	Eckardt temporary keratoprosthesis
Components	Polymethylmethacrylate	Silicone
Diameter	6.2 mm, 7.2 mm, and 8.2 mm	7.0 mm and 8.0 mm
For phakic/aphakic eyes	Phakic/aphakic eyes	Phakic/aphakic eyes
Multiple use	Non-disposable	Non-disposable

For aphakic eyes without capsules, scleral fixation of IOL provides visual rehabilitation. IOL scleral fixation using the double-needle Yamane technique takes significantly less time than IOL suturing [11]. Therefore, we applied this technique in combination with PK using Landers TKP. In the first case, IOL scleral fixation was performed under Landers artificial cornea placement, while in the second case, guide needles were first inserted, followed by removal of the Landers, and then the IOL was inserted through the trephined corneal hole for scleral fixation under open-sky conditions. When fixing the IOL in an open-sky setting without the cornea, as seen in case 2, scleral fixation of IOL requires careful consideration to monitor the perioperative intraocular pressure fluctuations and risk of expulsive hemorrhages. IOL fixation using Landers TKP involves several technical issues compared to procedures without it. The continuous leakage from the interface between Landers TKP and the host cornea makes vitreous shaving with ocular indentation technically difficult. We were able to perform this technique in case 2 but faced difficulties in case 1. For case 1, the trocar cannula setting was challenging due to severe leakage. Moreover, the IOL haptic and 30 G needle were not easy to manipulate owing to the limited field of view of the IOL through the Landers TKP.

Correction of irregular astigmatism with rigid gas-preamble lenses resulted in corrected visual acuity up to 0.6 post-surgery in case 1 and 0.15 in case 2. This result was relatively better than previously reported visual acuity [5]. Combining PPV with PK procedures requires multiple complicated manipulations during PPV, such as internal limiting membrane peeling, vitreous shaving, fluid-air or air-silicone-oil exchange, and the use of perfluorocarbon liquids. The preoperative retinal condition may affect the BCVA and retinal stability post-surgery, and the rate of stable retinas ranged from 43% to 92% in the previously reported cases [8, 12]. Our 2 patients' history of multiple internal ophthalmic surgeries, including corneal transplantation, and the absence of severe fundus diseases, such as retinal detachment or proliferative vitreoretinopathy, may contribute to the good outcome of our study. Additionally, both corneal grafts remained clear after Landers TKP usage. In a previous report presenting trauma cases, 37.5% of the patients demonstrated hypotony [5]; however, our study recorded no cases of intraocular pressure reduction, assuming that ciliary body function was preserved.

Temporary keratoplasty can be applied for IOL fixation and other retinal diseases, such as retinal detachment, in patients with corneal opacity [4]. Eyes with severe ocular trauma, especially those that present with corneal injury or blood-stained cornea, are associated with posterior segment problems; therefore, temporary keratoplasty enables a single combined surgery for eyes with ocular injuries [13]. The availability of an artificial cornea may allow surgical salvage of vision in cases that were previously considered difficult to operate on. Collaboration between vitrectomy and corneal transplant surgeons is required to effectively manage severe ocular injuries.

In conclusion, we demonstrated that the trans-scleral fixation of the IOL with PK can be performed with good clinical outcomes using Landers TKP without serious complications to the patient. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material.

Statement of Ethics

This clinical study adhered to the tenets of the Declaration of Helsinki. This retrospective review of patient data did not require ethical approval in accordance with local/national guidelines. Written informed consent was obtained from the patients for publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All authors attest that they meet the current ICMJE criteria for authorship. T.Z., T.O., and T.M. contributed to the design and conduct of the study. T.Z., T.O., Y.T., M.K., T.T. (Toyono), K.S., T.T. (Toyama), and T.M. contributed to the collection, management, analysis, and interpretation of data. T.U., M.A., and T.M. contributed to the preparation, review, and approval of the manuscript.

Data Availability Statement

All data generated or analyzed during this study are included in this published article. Further inquiries can be directed to the corresponding author.

References

1 Tan DT, Dart JK, Holland EJ, Kinoshita S. Corneal transplantation. Lancet. 2012;379(9827):1749–61. https://doi.org/10.1016/S0140-6736(12)60437-1
2 Ikeda T. Pars plana vitrectomy combined with penetrating keratoplasty. Semin Ophthalmol. 2001;16(3):119–25. https://doi.org/10.1076/soph.16.3.119.4199
3 Landers MB 3rd, Foulks GN, Landers DM, Hickingbotham D, Hamilton RC. Temporary keratoprosthesis for use during pars plana vitrectomy. Am J Ophthalmol. 1981;91(5):615–9. https://doi.org/10.1016/0002-9394(81)90061-1
4 Moshirfar M, Peterson C, Ronquillo YC, Hoopes PC. Temporary keratoprostheses in anterior and posterior segment surgery: a narrative review of their history and development. Surv Ophthalmol. 2023;68(4):728–45. https://doi.org/10.1016/j.survophthal.2023.01.011
5 Mayalı H, Kayıkçıoğlu Ö, Altınışık M, Bıçak F, Kurt E. Clinical results in patients with combined penetrating keratoplasty and vitreoretinal surgery using Landers wide-field temporary keratoprosthesis. Turk J Ophthalmol. 2019;49(5):270–6. https://doi.org/10.4274/tjo.galenos.2019.87059
6 Jacob S, Kumar DA, Rao NK. Scleral fixation of intraocular lenses. Curr Opin Ophthalmol. 2020;31(1):50–60. https://doi.org/10.1097/ICU.0000000000000632
7 Yamane S, Ito A. Flanged fixation: Yamane technique and its application. Curr Opin Ophthalmol. 2021;32(1):19–24. https://doi.org/10.1097/ICU.0000000000000720
8 Gelender H, Vaiser A, Snyder WB, Fuller DG, Hutton WL. Temporary keratoprosthesis for combined penetrating keratoplasty, pars plana vitrectomy, and repair of retinal detachment. Ophthalmology. 1988;95(7):897–901. https://doi.org/10.1016/s0161-6420(88)33089-7

9 Gallemore RP, Bokosky JE. Penetrating keratoplasty with vitreoretinal surgery using the Eckardt temporary keratoprosthesis: modified technique allowing use of larger corneal grafts. Cornea. 1995;14(1):33–8. https://doi.org/10.1097/00003226-199501000-00006
10 Yokogawa H, Kobayashi A, Okuda T, Mori N, Masaki T, Sugiyama K. Combined keratoplasty, pars plana vitrectomy, and flanged intrascleral intraocular lens fixation to restore vision in complex eyes with coexisting anterior and posterior segment problems. Cornea. 2018;37(Suppl 1):S78–85. https://doi.org/10.1097/ICO.0000000000001716
11 Yalcinbayir O, Avci R, Ucan Gunduz G, Mavi Yildiz A, Cetin Efe A, Baykara M. Comparison of two techniques in posterior lens dislocations: scleral suture fixation vs. modified Yamane intrascleral lens fixation. J Fr Ophtalmol. 2022;45(1):13–9. https://doi.org/10.1016/j.jfo.2021.09.009
12 Nowomiejska K, Haszcz D, Forlini C, Forlini M, Moneta-Wielgos J, Maciejewski R, et al. Wide-field Landers temporary keratoprosthesis in severe ocular trauma: functional and anatomical results after one year. J Ophthalmol. 2015;2015:163675. https://doi.org/10.1155/2015/163675
13 Roters S, Szurman P, Hermes S, Thumann G, Bartz-Schmidt KU, Kirchhof B. Outcome of combined penetrating keratoplasty with vitreoretinal surgery for management of severe ocular injuries. Retina. 2003;23(1):48–56. https://doi.org/10.1097/00006982-200302000-00008