

A novel case using femtosecond laser-acquired lenticule for recurrent pterygium: case report and literature review

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Abstract

Small incision lenticule extraction (SMILE) is a minimally invasive, safe and flapless femtosecond laser technique used mainly to correct myopia through extraction of a corneal lenticule. Lenticules obtained in this way are transparent and of high quality, and thus, can be used to treat other corneal diseases. A 65-year-old male patient presented with recurrent pterygium complicated by thin cornea. The patient was treated surgically using a SMILE-extracted lenticule to avoid further complications and to maintain eyeball integrity. The lenticule was sutured over the thin section of cornea using 10-0 interrupted nylon sutures and enclosed by a single layer of amniotic membrane. The patient was evaluated using slit-lamp biomicroscopy and anterior-segment optical-coherence tomography. During an 8-month follow-up, the graft remained intact with no sign of rejection and corneal thickness was maintained. Tectonic keratoplasty using a SMILE-extracted lenticule appears to be a safe, cost-effective and reliable method for treating thin cornea due to repeated surgeries for recurrent pterygium. This is the first case of recurrent pterygium complicated by thin cornea managed surgically using a SMILE-extracted lenticule.

Keywords

Lenticule, recurrent pterygium, thin cornea, femtosecond laser

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Introduction

Small incision lenticule extraction (SMILE) is an advanced femtosecond laser refractive technique used to correct myopia and myopic astigmatism through extraction of an intrastromal corneal lenticule without a corneal flap.¹ SMILE has been revealed to have high levels of refractive predictability, stability and safety, and to provide excellent results and patient satisfaction.¹⁻³ Thus, SMILE is increasingly becoming a standard option for the correction of myopia and myopic astigmatism. As the SMILE-extracted lenticule is removed as a single slice, it can be re-implanted for the treatment of corneal defects and perforations. For example, re-implantation of cryopreserved refractive lenticules has been demonstrated in a rabbit model with no reported complications,⁴ and the first human implantation of a SMILE-extracted lenticule from a myopic donor has been described for the correction of high hyperopia in a young patient.⁵ A shortage of corneal grafts to manage corneal perforations and deep corneal defects remains a challenge.⁶ Presently, SMILE-derived lenticules seem to be a likely alternative option for the treatment of corneal disorders.

To the best of the authors' knowledge, the present case report is the first to describe tectonic keratoplasty using a SMILE-extracted lenticule for the treatment of thin cornea due to recurrent pterygium. The treatment described herein represents a safe, feasible, low financial cost and alternative option to corneal donors that are in short supply in countries such as China.

Case report

Written informed consent was obtained from the patient for publication of this case report and all accompanying images. As this case report and review of the literature is intended for information and

educational purposes, ethical approval was not deemed necessary.

A 65-year-old male patient was referred to the Department of Ophthalmology, First Hospital of Jilin University, in February 2017 for the management of recurrent pterygium in the left eye. The patient had a history of pterygium excision using the bare sclera technique, performed three times at his local hospital by an ophthalmologist. At presentation, his best-corrected visual acuity was 20/25 in both eyes, with normal ocular movements in both eyes. On examination, slit-lamp biomicroscopy (performed using an SL 130 Slit Lamp; Carl Zeiss, Oberkochen, Germany) revealed a fleshy, vascularized wing-shaped outgrowth from the conjunctiva, overpassing the limbus onto the cornea at 6 o'clock to 10 o'clock on the nasal side of the left eye (Figure 1a). The growth did not occlude the pupillary area. Anterior-segment optical-coherence tomography (VisanteTM OCT Anterior Segment imaging; Carl Zeiss Meditec, Oberkochen, Germany) revealed thinning of the peripheral cornea to a depth of 0.27 mm due to deeper involvement of the pterygium (Figure 1b). Thus, the patient was admitted for planned pterygium re-excision with tectonic keratoplasty using a SMILE-extracted lenticule plus amniotic membrane patch.

Local anaesthesia was provided using several drops of lidocaine, administered topically, and by subconjunctival injection of 2% lidocaine containing 1:100 000 epinephrine, administered underneath the pterygium. The pterygium head was bluntly dissected off the cornea and the neck of the pterygium was raised from the limbus. The pterygium head and neck were then excised, and fibrovascular tissue was separated from the overlying conjunctiva and dissected. The size of the conjunctival defect was measured to be 13 × 15 mm using a surgical calliper. The autologous conjunctiva was harvested from the

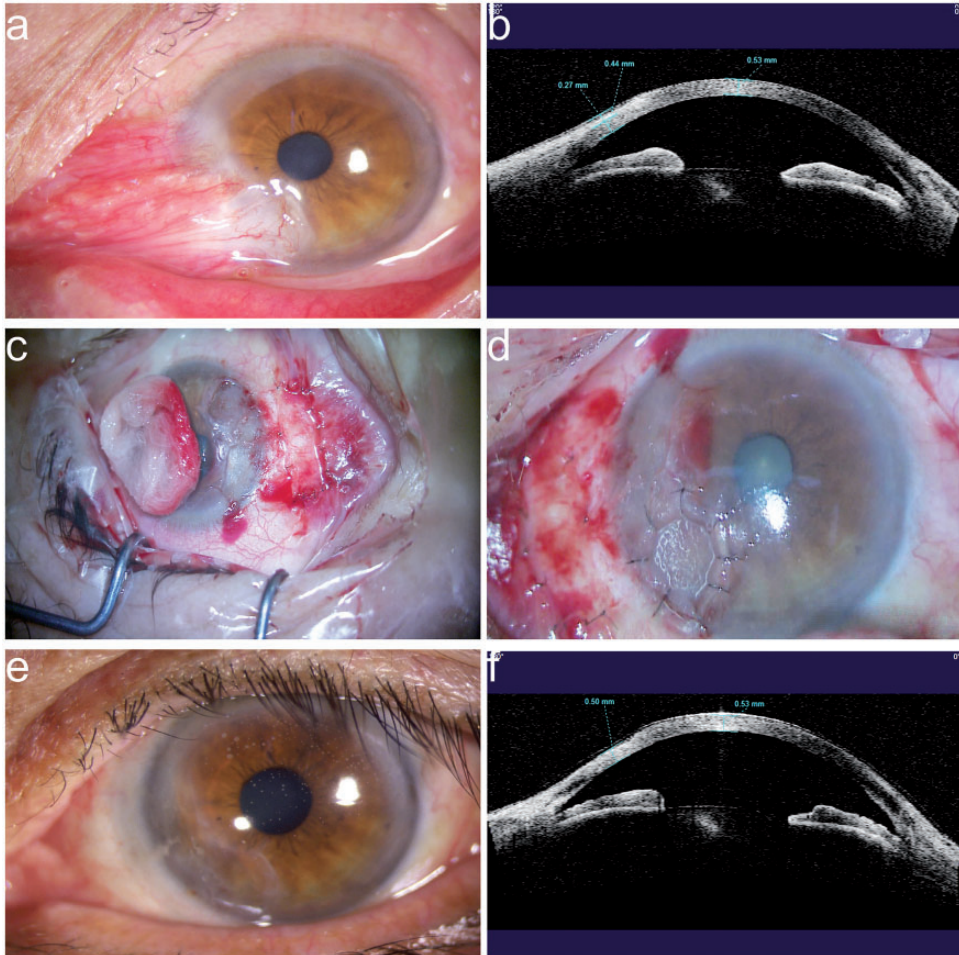


Figure 1 Images of the left eye of a 65-year-old male patient who presented with recurrent pterygium and was treated by pterygium re-excision with tectonic keratoplasty, using a lenticule obtained by small-incision lenticule extraction plus amniotic membrane patch: (a) slit-lamp biomicroscopy of the left eye showing a wing-shaped outgrowth from the conjunctiva, overpassing the limbus onto the central cornea on the nasal side; (b) anterior-segment optical-coherence tomography of the left eye demonstrating the central corneal thickness of 0.53 mm and depth of peripheral corneal involvement due to pterygium of 0.27 mm; (c) intraoperative image showing thin cornea; (d) post-operative image of the left eye showing the trimmed lenticule sutured with interrupted 10-0 nylon sutures; (e) three-month follow-up image with clear graft and no sign of pterygium recurrence; and (f) anterior optical-coherence tomography of the left eye showing a corneal thickness of 0.50 mm.

superio-temporal region without the underlying tenon capsule and sutured using 10-0 interrupted nylon sutures. The section of cornea that was overlapped by the recurrent pterygium was found to be very thin, extending deep into the stroma (Figure 1c).

The donor lenticule was extracted during an elective procedure using a VisuMax[®] Femtosecond laser (Carl Zeiss Meditec AG, Jena, Germany) from a patient with refractive correction spherical equivalent of -8.50 diopters, thus ensuring that the

donor lenticule central thickness was ≥ 100 μm . The lenticule cap thickness was 120 μm and the optical zone was 6.5 mm. The donor was negative for human immunodeficiency virus, syphilis, hepatitis, infection, corneal disease, and malignancy. The lenticule was then trimmed to equal the size of the corneal defect and sutured to the recipient using interrupted 10-0 nylon sutures (Figure 1d). Finally, the cornea was covered with amniotic membrane that was attached using Ethicon Vicryl 10-0 sutures (Johnson & Johnson Health Care Systems, New Brunswick, NJ, USA). A 0.3% tobramycin plus dexamethasone eye ointment (S.A. Alcon-Couverture N.V., Purrs, Belgium) was applied into the conjunctival sac. Postoperatively, topical steroid (1% prednisolone acetate; Allergan, Irvine, CA, USA) was prescribed four times daily for 4 months, and gradually tapered and stopped in the 5th month. Additionally, antibiotic eye drops (0.3% Ofloxacin; Allergan) were administered four times daily for 4 weeks.

On the first postoperative day, the patient experienced a mild foreign-body sensation and slit-lamp biomicroscopy showed conjunctival congestion with a well-positioned corneal graft, amniotic membrane patch and intact sutures. Complete epithelialization was achieved during the first postoperative week. On the second week follow-up, the amniotic membrane was resolved and the conjunctival sutures were removed. At the 3-month follow-up, the corneal suture was removed and the patient's best-corrected visual acuity was 20/25 in the left eye; there was no pterygium recurrence and the graft was clear (Figure 1e). Anterior-segment optical-coherence tomography revealed the corneal thickness to be 0.50 mm (Figure 1f). The patient was then assessed every 2 weeks for 8 postoperative months. At the 8-month follow-up, the patient's best-corrected visual acuity was 20/25 and the graft was intact.

Discussion

Pterygium is a benign, slow growing, wing-shaped ocular surface proliferative disorder with hyperplastic growth of corneoconjunctival fibrovascular tissue covering the cornea.⁷ Despite the availability of various surgical techniques, including pterygium re-excision alone or combined with β -irradiation, and/or the use of conjunctival grafts, amniotic membrane transplantation and lamellar keratoplasty, pterygium recurrence remains a major challenge for ophthalmologists.^{8,9} Re-excision of the recurrent pterygium is problematical as it may lead to corneal thinning and extensive scarring of the cornea, which may result in corneal perforations and sight-threatening outcomes.⁸ Hence, corneal thinning must be promptly managed to conserve the anatomic structure of the cornea and to avoid further complications, including infection, secondary glaucoma, ocular morbidity, and absolute visual loss.⁶ Lamellar keratoplasty is a specific treatment used when the cornea overlapped by pterygium has become thinned or scarred due to prior surgeries.¹⁰ The foremost limitation for lamellar keratoplasty is a scarcity of donor corneas, particularly in developing nations, where the requirement is very high.¹¹ Even though records show that keratoplasty procedures in China have increased from 5 000 to 8 000 per year, the lack of corneal donors remains a major challenge.¹¹

Small incision lenticule extraction is an innovative flapless refractive surgery for the correction of myopia, during which an intrastromal corneal lenticule is separated and removed. The thickness of the extracted lenticule depends upon the diopter of myopia to be corrected. Studies in lenticules extracted during the SMILE procedure have been performed in animal models,¹² as well as in human clinical applications, including intrastromal lenticule implantation for the management of hyperopia,^{5,13,14} presbyopia,¹⁵

Table 1 A summary of published clinical data regarding the clinical use of lenticules obtained via small incision lenticule extraction (SMILE) to treat patients with various corneal disorders

Author	Year	Design and sample size	Layers of lenticule	Indication	Conclusion
Pradhan et al. ⁵	2013	Case report 1 eye	Single layer	Hyperopia correction	Correction of hyperopia by implantation of a SMILE-extracted lenticule from a myopic donor patient was achieved with no adverse side-effects during a 1-year follow-up
Ganesh et al. ¹³	2014	Cohort study 9 eyes	Single layer	Hyperopia correction	Cryopreserved SMILE-derived lenticule may be a safe and effective alternative to excimer laser ablation for hyperopia
Wu et al. ¹⁹	2015	Prospective study 6 eyes	Double layer	Corneal perforation closure	Application of SMILE lenticules may be a useful and safe surgical substitute for treatment of corneal perforation for future management
Sun et al. ¹⁴	2015	Case series 5 eyes	Autologous Single layer	Hyperopia correction	Implantation of an autologous SMILE-extracted lenticule for hyperopia correction is effective, safe and stable, while predictability must be improved in the future
Xue et al. ¹⁷	2015	Retrospective case series 5 eyes	Multilayer	Corneal perforation closure	Multilayered SMILE-extracted lenticule for sealing the corneal perforation seems to be a beneficial alternative during an emergency
Bhandari et al. ¹⁸	2016	Case series 7 eyes	Single and double layer	Microperforation and complicated tear management	The patch graft using fibrin glue from the SMILE-derived lenticule is practical, safe, and a reasonable surgical alternative for the treatment of microperforations and complicated corneal tears
Jiang et al. ²⁰	2016	Retrospective study 22 eyes	Single layer and multilayer	Corneal ulcer and perforation closure	Tectonic keratoplasty using SMILE-derived lenticule is effective as an emergency treatment option for corneal ulcer and perforation
Zhao et al. ¹⁶	2016	Prospective pilot study 6 eyes	Single layer	Corneal dystrophy	For a short period, the use of SMILE-derived lenticule for an epikeratophakia procedure to treat corneal dystrophy seems reasonable and safe
Jacob et al. ¹⁵	2017	Case series 4 eyes	Single layer	Presbyopia correction	PEARL corneal inlay using a SMILE-derived lenticule is a safe and effective treatment option for presbyopia correction
Abd Elaziz et al. ²¹	2017	Prospective interventional study 7 eyes	Single layer	Corneal perforation closure	Use of SMILE-derived corneal stromal lenticule is a safe, low cost, simple and efficient surgical option for closure of corneal perforation

PEARL, Presbyopic allogenic refractive lenticule.

corneal dystrophies,¹⁶ microperforations, corneal ulcers and perforations.^{17–21} A review of published literature regarding the human application of SMILE-extracted lenticules in various ocular diseases is summarized in Table 1. Lenticules obtained using the SMILE procedure are reported to be clear, transparent, and high-quality grafts.²²

In the present case, the patient had undergone pterygium excision three times at his local hospital, but still experienced a recurrence of pterygium. Moreover, anterior-segment optical-coherence tomography showed a deeper involvement of the cornea, and during surgery, the cornea was found to be very thin. Thus, tectonic keratoplasty using a SMILE-derived lenticule was performed to prevent further complications, and the cornea was enclosed in an amniotic membrane patch. Tectonic keratoplasty is a surgical technique to replace the damaged or diseased cornea with healthy corneal tissue. In the present case, the surgical outcome was better compared with previous corrective surgeries, and the graft was clear with no corneal neovascularization. In addition, there was no change in preoperative and postoperative best-corrected visual acuity. Finally, the patient received the SMILE-derived lenticule without additional financial cost.

In conclusion, tectonic keratoplasty using a SMILE-extracted lenticule is a safe and reasonable alternative option for the management of corneal thinning due to recurrent pterygium. Additionally, SMILE-extracted lenticules may solve the burden of donor scarcity associated with the significant financial cost of donor corneas in developing nations such as China, resulting in better cosmetic and functional outcomes.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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