



Transparent intrastromal corneal lenticule obtained from SMILE surgery as a free graft for the treatment of primary pterygium: A pilot study

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ARTICLE INFO

Keywords:

Primary pterygium
SMILE
Lenticule
Novel
Graft

ABSTRACT

Purpose: To report our initial experience in patients with primary pterygium surgery who had a transparent intrastromal corneal lenticule as a free graft obtained during small incision lenticule extraction (SMILE) surgery. **Observations:** This study enrolled five eyes of 5 patients with pterygium who were surgically treated with single or double free lenticule that was sutured to the defective area of the nasal corneosclera immediately following pterygium excision. All cases with pterygium were primary, and topical mitomycin C was not used at the time of surgery. The mean age of the patients was 51.0 years and 2 of the 5 eyes belonged to male subjects. The patients were followed up for an average of six months. During the follow-up period, the lenticule grafts demonstrated no sign of rejection and were intact in all cases. All patients recovered well with no complications or recurrences at six months postoperatively.

Conclusions and Importance: This report suggests that transparent corneal lenticules obtained during SMILE laser surgery may be used as an alternative novel graft source for the surgical treatment of patients with primary pterygium. It appears to be a safe, easy, cost- and time-effective reliable method.

1. Introduction

Pterygium is a non-cancerous ocular surface lesion of fibrovascular tissue originating more often on the nasal conjunctiva with progressive extension onto the superficial cornea. It has a characteristic triangular wedge appearance. Strong pathogenesis correlates with ultraviolet light exposure and is complicated by squamous cell carcinoma in some cases.¹ A femtosecond laser is used in the treatment of refractive errors, and small-incision lenticule extraction (SMILE) is a recent novel technique for refractive lenticule extraction that employs a 1043 nm laser firing at 500 kHz using VisuMax (Carl Zeiss Meditec, Germany).² This procedure uses a pulse duration of a 220–580 femtosecond laser to excise an intrastromal lenticule through a small corneal incision to treat myopia and myopic astigmatism up to a degree of –10.00 dioptres without creating a flap, resulting in a potentially better corneal biomechanical stability and less disruption of anterior corneal innervation.^{2,3} It shows prompt recovery and results in lower incidences of dry eye symptoms, corneal ectasia, corneal scars, and cataract formation.²

Patients with early or advanced pterygium may need surgical excision for decreased visual acuity, irritating ocular symptoms or signs, and/or restricted ocular motility.⁴ Surgical intervention options include

bare sclera excision, amniotic membrane transplantation, and conjunctival-limbal autograft.¹ However, recurrence rates of pterygium after surgery are common, which may be more symptomatic and problematic to eliminate than primary pterygium. Repeated excisions can also lead to severe complications, including corneal scarring, irregular astigmatism, symblepharon formation, and diplopia secondary to fibrotic restriction of extraocular movements.

The intrastromal corneal lenticules extracted during the SMILE procedure are of high quality and have been used as a graft in recurrent and complicated pterygium in only two cases previously.^{5,6} Herein, the preliminary results of patients with primary pterygium surgery who were treated with intrastromal lenticules as a free graft obtained from SMILE laser surgery are presented for the first time.

2. Case presentation

Informed consent was obtained from the subjects for the surgery and publication of the figures, and the study followed the tenets of the Declaration of Helsinki. Since the presented cases are intended for informational and educational purposes, ethical approval was not deemed necessary. No severe visual impairment or restricted eye

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<https://doi.org/10.1016/j.ajoc.2023.101897>

Received 15 February 2023; Received in revised form 5 July 2023; Accepted 19 July 2023

Available online 24 July 2023

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movement was present, except induced astigmatism in four of five cases. On examination, slit-lamp biomicroscopy revealed the classical clinical appearance of a wedge-shaped growth extending onto the limbus and cornea on the nasal side in all cases, and the pupillary area was not occluded. Due to cosmetic reasons with irritating symptoms and signs ($n = 3$, 60%) (Fig. 1a) or the risk of pterygium progression toward the visual axis ($n = 2$, 40%) (Fig. 2a), surgical intervention was performed using a transparent lenticule as a free graft obtained by SMILE laser surgery.

Local anesthesia was provided with topical administration of proparacaine hydrochloride (Alcaine, 0.5%) and subconjunctival injection of lidocaine 20 mg/ml containing 0.0125 mg/ml (Jetokain, 2ml). Following an incision at the limbus, the pterygium head and neck were excised from the corneal surface (Figs. 1b and 2b). Fibrovascular tissue was scraped using a No.15 surgical blade, and Tenon's capsule was removed.

Pre-operative serological tests for donors were done and found to be negative for HIV, hepatitis, and infection. The donor lenticule was obtained simultaneously during elective SMILE laser treatment (VisuMax Femtosecond laser, Carl Zeiss Meditec AG, Jena, Germany) from our patients with refractive errors between 3.00 and 5.00 diopters (spherical equivalent). The donor lenticule diameter was approximately 6.8 mm (Fig. 1b, black arrow), and the thickness was 40–60 μm .² Subsequently, a single (Fig. 1c, white arrow) or double (Fig. 2b, arrows) lenticule was transported in the serum physiologic within 1 h following SMILE surgery, transferred in the same day to the bare sclera without trimming, and sutured to the recipient's defective area using interrupted 10-0 nylon sutures. The lenticule was juxtaposed to the conjunctiva-limbal area where the pterygium tissue was excised, which covers 1–2 mm of peripheral cornea (Figs. 1c and 2b). Postoperatively, the patients used a

3-month course of topical antibiotics (moxifloxacin, MOXAÍ®), corticosteroids (prednisolone acetate, NOR SOL® forte) three times a day, and topical immunosuppressant (0.05% cyclosporine, OCURIN®) eye drops.

The mean age was 51 years (35–65 years). Presenting symptoms were redness, irritation, and foreign body sensation in all patients. Five patients (3 women, 2 men) with primary pterygium were treated with this approach. The eyes were closely followed up for a mean of 6 months and monitored for possible ocular side effects or complications after the surgery. On the first postoperative day, all patients ($n = 5$, 100%) experienced a gritty feeling and itchiness due to suturing. Slit-lamp biomicroscopy showed the lenticule to be stable and firm in all cases. The next visit was performed 2 weeks later, which revealed complete re-epithelialization in all eyes (100%) (Fig. 2c). The sutures were therefore removed in all patients. On the sixth-month follow-up day, there were no complications or recurrence in any of the cases (Figs. 1d and 2d).

3. Discussion

Pterygium is a relatively common, benign, fibrovascular conjunctival tissue with progressive corneal involvement, which is classified as a degenerative disorder. The most common symptoms and signs are conjunctival redness and irritation that probably represent active inflammation and vascularization. Patients usually seek medical advice in case of visual impairment affecting their activities of daily living or for cosmetic purposes. Pterygium that exceeds 3.5 mm beyond the limbus can induce corneal astigmatism.⁷ Small pterygia with no extent of corneal encroachment can be treated with several medications for symptomatic relief, including artificial tears.⁸ However, pterygia that are threatening the visual axis via astigmatism, opacity, or ocular

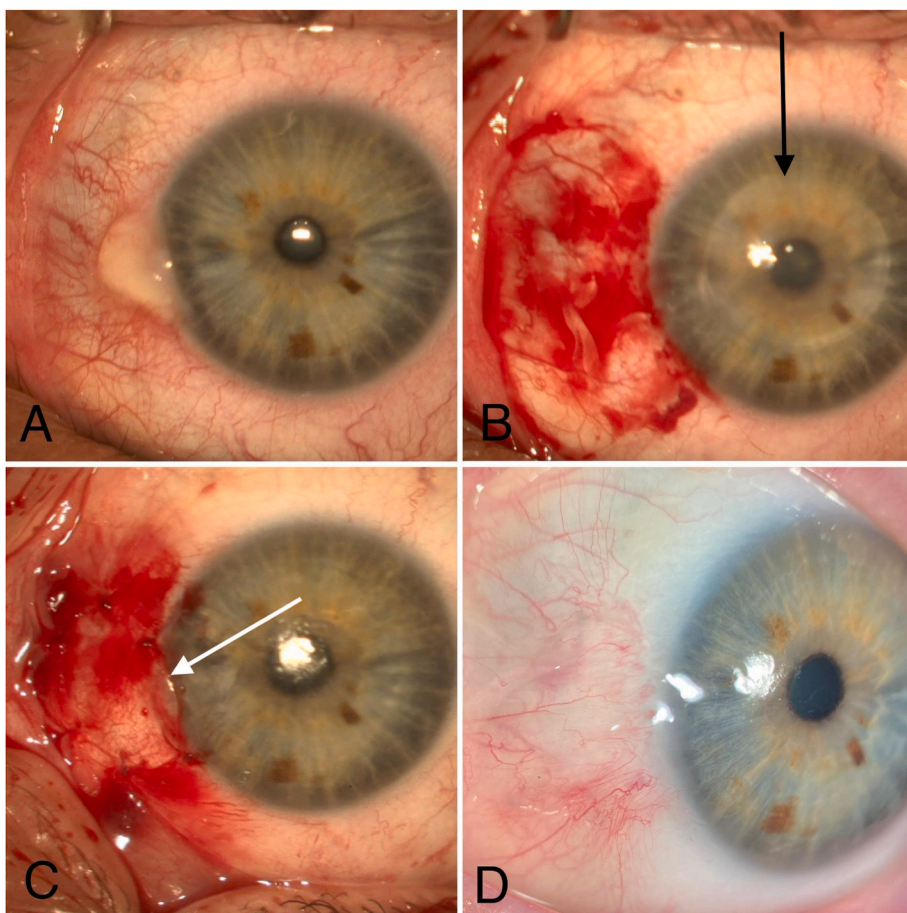


Fig. 1. Intraoperative microscopic ocular images of the first case of our patients with primary pterygium treated with a SMILE-extracted lenticule graft; **A**, the early pterygium tissue on the nasal side of the left eye in a patient who required surgery for cosmetic purposes; **B**, excision of the pterygium tissue and the obtained lenticule on the cornea measuring 6.8 mm (black arrow); **C**, the lenticule placed on the defective area (white arrow), which was sutured to the corneosclera using 10-0 interrupted nylon sutures, covering the peripheral cornea 1–2 mm; **D**, postoperative six-month appearance.

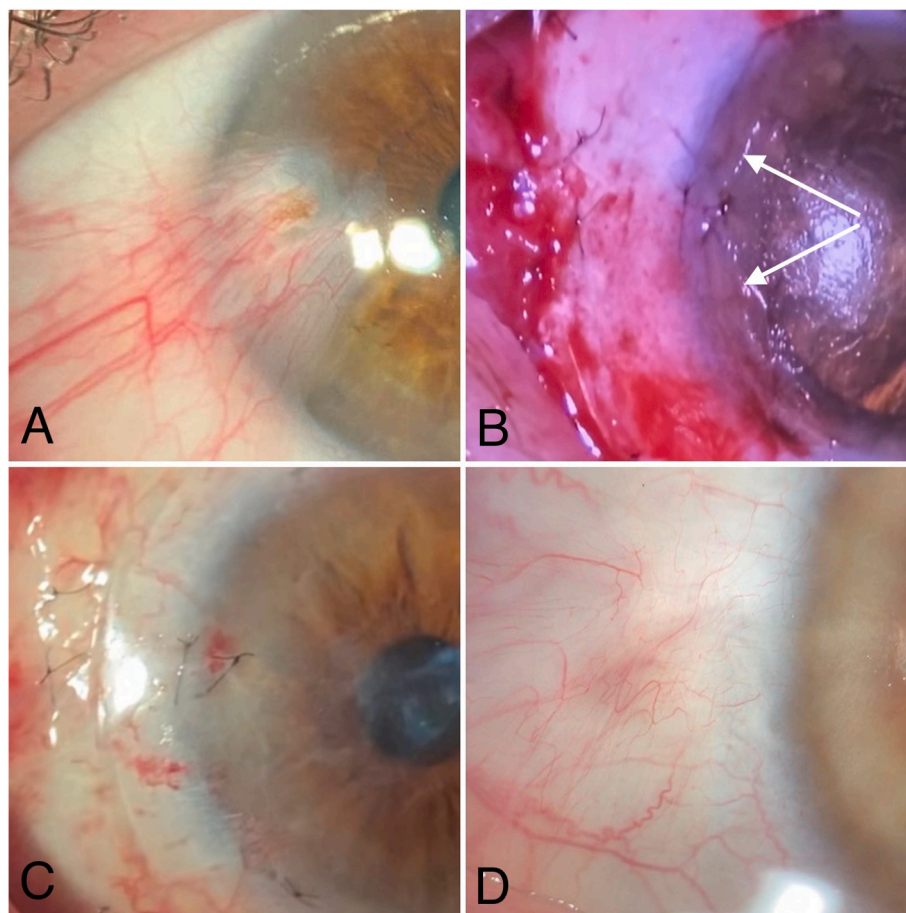


Fig. 2. A, A case with advanced pterygium exceeding 3.5 mm beyond the nasal limbus of the right eye; B, excision of the large pterygium tissue and placement of a double lenticule on the defective area (white arrows) using 10-0 interrupted nylon sutures, which covers the peripheral cornea 1–2 mm; C, postoperative 14-day appearance with a contact lens just before the removal of the sutures; D, postoperative six-month appearance.

motility restriction require immediate surgical excision.^{7,8}

Therapeutic interventions for pterygium consist of simple excision with the bare sclera, amniotic membrane transplantation, or conjunctival-limbal autograft.^{1,8} Simple bare sclera excision results in a recurrence rate of 30–80%, and it is therefore advised to be combined with adjuvant therapies like mitomycin C to reduce the risk of relapse, though avascular scleral lesions may be encountered after the surgical excision, which was stated to be successfully treated with topical erythropoietin without any ocular or systemic adverse effects.⁹ However, the recurrence rates remain a major challenge despite using adjuvant measures. Moreover, recurrent pterygium cases are associated with a higher rate of further recurrence and secondary complications when compared with primary pterygium.¹⁰ Most of the recurrences typically appear within four months postoperatively, and the pterygium is not likely to recur after 6–12 months.¹⁰ In a study, Katircioglu et al.¹¹ compared 3 techniques and reported that amniotic membrane closure and conjunctival autografts were found to be equally effective in the prevention of primary pterygium recurrence.¹¹ In addition, conjunctival autografts combined with mitomycin C have been demonstrated to be as effective as the abovementioned two techniques to prevent recurrence in the treatment of recurrent pterygium.¹¹ Similarly, a recent analysis of randomized controlled studies supports pterygium excision with conjunctival autograft fixation using fibrin glue, followed by patching until the first postoperative visit.⁸ In addition, surgical adjuvants and postoperative use of artificial tears and topical cyclosporine were stated to further reduce recurrence. However, there was no consensus regarding the optimal dose, frequency, and duration of postoperative use of topical steroids.⁸ In our cases, all five cases did not recur at

least during the follow up period of this pilot investigation.

SMILE is a novel refractive procedure to treat myopia with or without astigmatism and is performed under topical anesthesia without creating a corneal flap.² The surfaces of intrastromal lenticules that are extracted during this procedure are of high quality and have been used in several cases to treat various corneal disorders including hyperopia and presbyopic correction, corneal dystrophies, corneal micro-perforations, pellucid marginal corneal degeneration, corneal ulcers, corneal dermoid, and corneal ectasia. Two eyes with recurrent pterygium have recently been treated with this novel graft.^{5,6} However, to our knowledge, the primary use of corneal lenticule in naïve pterygium cases has not previously been reported.

Using a SMILE-derived lenticule graft for the treatment of primary pterygium has several advantages. **1)** The healthy upper conjunctiva is untouched, which prevents possible scar formation. Therefore, such an undamaged upper bulbar conjunctiva may be used for possible glaucoma surgery in the future, including trabeculectomy. **2)** The undamaged conjunctiva may be used as a free graft for cases with other pathological conditions such as symblepharon repairing. **3)** It may be accessed easily and obtained several times as needed. **4)** The surgery can be repeated, which is time- and cost-effective.

4. Conclusion

This report demonstrated for the first time that transparent corneal lenticules obtained during SMILE surgery may be used as a novel lamellar tectonic keratoplasty graft for the treatment of primary pterygium cases, which appears to be a safe, easy, cost- and time-effective

reliable method that is an alternative to conjunctival donors. Future studies in large series may be warranted, and the use of fibrin glue can be considered as an alternative to sutures.

Patient consent

Informed written consent was obtained regarding the publication of the figures.

Authorship

The authors attest that they meet the current ICMJE criteria for Authorship.

Data availability

No data was used for the research described in the article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Mirza E, Gumus K, Evereklioglu C, et al. Invasive squamous cell carcinoma of the conjunctiva first misdiagnosed as a pterygium: a clinicopathologic case report. *Eye Contact Lens*. 2008;34(3):188–190.
2. Evereklioglu C, Sener H, Mutlu SN, et al. Top 50 most-cited articles on SMILE surgery between 2010 and 2022: a correlation comparison between conventional bibliometrics and current altmetrics of research impact. *Int J Ophthalmol*. 2023;43(7):2521–2532.
3. Guo H, Hosseini-Moghaddam SM, Hodge W. Corneal biomechanical properties after SMILE versus FLEX, LASIK, LASEK, or PRK: a systematic review and meta-analysis. *BMC Ophthalmol*. 2019;19(1):167.
4. Fonseca EC, Rocha EM, Arruda GV. Comparison among adjuvant treatments for primary pterygium: a network meta-analysis. *Br J Ophthalmol*. 2018;102(6):748–756.
5. Pant OP, Hao JL, Zhou DD, et al. A novel case using femtosecond laser-acquired lenticule for recurrent pterygium: case report and literature review. *J Int Med Res*. 2018;46(6):2474–2480.
6. He N, Song W, Gao Y. Treatment of Mooren's ulcer coexisting with a pterygium using an intrastromal lenticule obtained from small-incision lenticule extraction: case report and literature review. *J Int Med Res*. 2021;49(6), 3000605211020246.
7. Jain AK, Pandey DJ. Evaluation of change in pterygium induced keratometric astigmatism in patients following pterygium excision with autologous graft surgery. *Nepal J Ophthalmol*. 2020;12(24):191–200.
8. Patel ED, Rhee MK. Surgical techniques and adjuvants for the management of pterygium. *Eye Contact Lens*. 2022;48(1):3–13.
9. Feizi S, Javadi MA. Topical erythropoietin as a novel treatment for necrotizing scleritis after pterygium surgery: a pilot study. *Cornea*. 2021;40(8):1011–1017.
10. Desai NR, Adams B. Cryopreserved amniotic membrane using the TissuTuck technique: a sutureless approach for pterygium surgery. *Cornea*. 2023;42(2):181–185.
11. Katircioglu YA, Altiparmak UE, Duman S. Comparison of three methods for the treatment of pterygium: amniotic membrane graft, conjunctival autograft and conjunctival autograft plus mitomycin C. *Orbit*. 2007;26(1):5–13.