Limbal advancement technique in managing acute or impending peripheral corneal perforations

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ABSTRACT

Purpose: To describe the outcomes of a novel technique for the repair of peripheral corneal perforations using autologous limbal tissue.

Methods: Two patients with peripheral corneal perforations with contraindications to other corneal procedures underwent limbal advancements. This technique involves creating a pedicle of the limbus, sclera and conjunctiva to cover the perforation.

Results: The tissue had optimal integration in both patients; no aqueous leaks or flat anterior chambers were noted. None of the patients had recurrence of perforation or ocular discomfort.

Conclusion: In conclusion, this technique is a cost-effective and straightforward alternative for the repair of impending acute peripheral perforations.

1. Introduction

Peripheral corneal ulcers are common due to infections, autoimmune etiologies, and trauma.1,2 The most common complication is corneal melting: this can rapidly progress to corneal perforation and ultimately to the expulsion of intraocular contents and endophthalmitis.3 This is why prompt management of sterile or infectious marginal ulcers is essential. Various treatments have been proposed depending on ulcer size and location. For ulcers smaller than 3 mm, bandage contact lenses and tissue glue have been proposed.4 This is ineffective in cases where collagen lysis progress rapidly due to glue toxicity, augmenting ulcer size, and delaying wound healing. Tectonic grafts with sclera or corneal tissue work well;5 however, a significant downside to this is the unavailability of tissue and the urgent nature of these procedures. Conjunctival flaps are a cheap and quick alternative to cover corneal perforations; they have been widely used, mainly in underdeveloped countries where readily available tissue is not an option. Two types of flaps have been described: Gundersen5 and partial conjunctival flaps.6 Unfortunately, conjunctival flaps’ aesthetic and visual results are limited and can easily detach with lid movements, especially in peripheral ulcers, requiring further surgeries. We propose a new technique for managing acute or impending paralimbal corneal perforations.

2. Materials and methods

Two patients with corneal perforations underwent a limbal advancement procedure. In both patients, the cornea was compromised with sterile corneal ulcers close to the limbus.

3. Technique

An eyelid speculum separates the lids. A linear incision, roughly the size of the base of the ulceration, is performed parallel to the limbus on the healthy non-ulcerated cornea from the same eye with a radial keratotomy diamond knife at a pre-calibrated depth of 500 μm. A laminar dissection from the incision towards the sclera is done with a bent crescent blade extending 1–2 mm into the sclera and coming out underneath the conjunctiva. Thorough debridement of the ulcer is done before positioning the pedicle. The edges are “squared” to fit the newly created patch. The pedicle is positioned overlying the corneal perforation, and separate 10/0 nylon sutures are placed on each border. (Supplemental digital content) Topical antibiotics are instilled at the end...
of the procedure. The postoperative regimen consisted of topical antibiotics (4th generation fluoroquinolone eye drops 4–6 times daily for 10 days. Prednisolone 1% drops are instilled 3 times daily for two weeks. Depending on the etiology of the ulceration, a targeted treatment to control inflammation or infection must be used from the moment of diagnosis and extended after the limbal advancement procedure.

4. Results

We present two patients treated with the Limbal advancement technique.

4.1. Case 1

An 83-year-old male patient presented with a foreign body sensation in his right eye. He had a history of recurrent inferior sterile ulcers treated with cyclosporine and prednisolone. On slit-lamp examination, an inferior arcuate thinning of the cornea with a leaking, small perforation of approximately 1 mm diameter at the 5 o’clock meridian is noted (Fig. 1). He did not have a history of autoimmune disease nor presented any signs of blepharitis or infection. Thus, a possible Mooren’s ulcer diagnosis was made. Due to the peripheral and inferior location of the ulcer, a conjunctival flap is contraindicated, and the patient undergoes a limbal advancement procedure. He had an optimal postoperative period, and sutures were removed 3 months after surgery. He maintained a prednisolone and cyclosporine regimen for 6 months, the eye remained comfortable for 4 years, and no recurrence was noted. The patient died 5 years later due to a pulmonary embolism and metastatic cancer.

4.2. Case 2

A 59-year-old female patient with a 3-year history of penetrating keratoplasty in the right eye presented with red eye, foreign body sensation and decreased vision. She also had a past ocular history of glaucoma controlled with laser cyclophotocoagulation. On examination, the graft was edematous, with peripheral corneal neovascularization and Descemet folds. She had a dyscoric pupil, corectopia, and 360° anterior synechiae seen on gonioscopy. She starts treatment for graft rejection (Topical prednisone acetate 1% every 3 h), and after one-month, corneal thinning at 2 o’clock is noted at a suture site; it progresses to a micro-perforation in the next 7 days, which we treated with an eyepatch for 36 h, she achieved resolution with this treatment. After 3 months, she presented with severe thinning, hypotony, positive Seidel (Fig. 2a.) and athalamia. Due to the peripheral and eccentric location of the ulcer that would require a large 9–10 mm corneal button and her history of glaucoma, a repeat keratoplasty is contraindicated because of a high risk of rejection. A limbal advancement was done (Fig. 2b.) The patient had an optimal postoperative period; she had no discomfort; sutures were removed at 5 months after surgery. We performed High-Resolution OCT before suture removal (Fig. 2c and d); the tissue had excellent integration. She used frequent artificial tears in her first 6 postoperative months, and no recurrence of the perforation was noted.

5. Discussion

Corneal ulcers are an ophthalmological emergency. Prognosis depends on prompt treatment of the ulcer. When perforation is imminent, there is sometimes enough time to retrieve donor tissue to tamponade the thin area, which is often impossible in some scenarios. Tissue glue has been moderately effective in the long term to tamponade the perforation; some report a success rate of 22%–72%. Scleral patches have been used in medium to large perforations, but these provide limited aesthetic and visual results. Surgeons have been looking for novel techniques using autologous tissue as an alternative to complete or lamellar corneal grafts due to the scarcity of tissue in some countries. A technique using autologous sclera with a hinged flap was reported in one patient and showed excellent functional and visual outcomes in a child. Tenon patch grafts have also been recently reported as an option in corneal perforations, acting successfully as a plug, in a high percentage of cases. Conjunctival flaps are a well-known alternative that works efficiently in many cases. Ironically, the downside with this type of tissue is its elasticity, added to blinking, its nature makes it very difficult to stay in place in peripheral ulcers. Our technique is ideal for those cases, where conjunctival flaps are usually displaced with eye movements. The sclera used in the limbal advancement technique provides stability and strength to the pedicle, differing from more loose conjunctiva seen in conjunctival flaps. After debridement of the ulcerated tissue, an overhang including limbal vasculature is fitted perfectly into the cornea. Using vascularized tissue is an advantage compared to cyanoacrylate glue due to the healing potential it confers.

Another essential factor is astigmatism generated by the sutures and irregular corneal tissue. Generally, because of the peripheral nature of the ulcers, their distance from the visual axis, and the small amount of tissue used, we believe the amount of induced astigmatism is very low. With time, in our technique, the sutures become loose, and not much traction is produced at the site of the limbal advancement; this process is similar to the postoperative period of lamellar keratoplasties.

The causes of peripheral ulcers are extensive, most commonly due to autoimmune diseases, but infectious keratitis frequently results in this type of ulcer, specifically by Staphylococcus aureus. We have not performed this new technique on infectious ulcers; this has yet to be studied.

It is important to note that surgical debridement of necrotic tissue is crucial. Studies have found that actively melting corneas are rich in metalloproteinases and IL-6. Covering devitalized tissue with healthy limbal tissue might induce inflammation, necrosis of the flap, limbal ischemia, or corneal neovascularization. Fibrin glue has been previously used on scleral patches and to perform sutureless lamellar keratoplasty to replace nylon sutures. Advancing the limbus produces some degree of tension that might not adhere with fibrin glue, we hope to test this material in the future to determine its suitability with our technique.

Some limitations of this report are the low number of patients and short follow-up time. In the future we expect to include more cases with

Fig. 1. Preoperative slit-lamp photograph of the right eye showing a paralimbal inferonasal perforation.
a broader variety of ulcer etiologies and longer follow-ups. So far, we have used this technique in very compromised eyes that probably will not improve in terms of visual acuity, without using extra tissue. We hope to assess visual acuity and astigmatism after the procedure, which was not possible in our patients due to severe glaucoma, maculopathy, and choroidal effusion. Regardless, this simple technique proves to be safe and effective in these cases and can be considered by surgeons.

In conclusion, this technique is a cheap and effective alternative to repairing impending or acute peripheral perforations. The main advantages of this technique are its autologous nature, which minimizes the risk of an exuberant inflammatory response; non-requirement of allogenic tissue, opposite to scleral or corneal tectonic grafts, and which usually delays intervention; finally, the limbal advancement does not obstruct the corneal surface like conjunctival flaps.

Patient consent

The patient(s)/patient’s legal guardian consented to publication of the case in writing/orally.

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Intellectual property

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

Research ethics

Written consent to publish potentially identifying information, such as details or the case and photographs, was obtained from the patient(s) or their legal guardian(s).

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.

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Appendix A. Supplementary data

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