

# Superior forniceal conjunctival advancement pedicles (SFCAP) in the management of acute and impending corneal perforations

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## Abstract

**Objective/aim** Corneal perforations can result from a wide variety of disorders and can lead to devastating visual sequelae. Various surgical procedures have been described to manage nontraumatic corneal perforation. Conjunctival flaps offer an important technique in dealing with such corneal emergencies. We report a modified conjunctival flap procedure referred to as superior forniceal conjunctival advancement pedicle (SFCAP) in the successful management of corneal perforation and impending corneal perforation.

**Patients and methods** Out of 20 patients who underwent SFCAP for non-traumatic corneal perforation and impending perforation, 16 had corneal perforations. Perforations were secondary to acne rosacea (2), advanced bacterial keratitis (6), corneal anaesthesia (2), multiple retinal procedures (2), previous corneal grafts with a compromised ocular surface (3), and advanced Mooren's ulcer (1). **Results** The globe was preserved in all patients. In 14 of the 16 eyes with perforated corneas the pedicle stabilised. One patient, who was a chronic alcoholic, rubbed the eye during sleep detaching the pedicle a week after surgery. However, the ulcer healed and the integrity of the globe was restored. None of these patients developed secondary glaucoma or ptosis.

**Conclusion** SFCAP is an appropriate procedure to manage corneal perforations and impending corneal perforations where donor

material is not available and transplantation of such tissue is not suitable.

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## Introduction

Nonhealing corneal ulcers are resistant to treatment, particularly in debilitated ocular surfaces. The ulcers may progress rapidly and may result in corneal perforations that lead to devastating visual sequelae.<sup>1–3</sup> Restoration of the integrity of the globe and ocular tension is necessary to preserve the visual potential. Surgical options to manage nontraumatic corneal perforations include emergency tectonic corneal grafts, tissue gluing, and patching with exogenous material such as preserved pericardium, dura matter, autologous cartilage, and fascia.<sup>4,5</sup> Conjunctival flaps such as Gunderson flaps and partial conjunctival flaps have also been used fairly extensively in the management of nonhealing ulcers. The Gunderson flap requires extensive dissection of the conjunctiva and furthermore, the flap may totally obscure the view of the cornea after the procedure.<sup>6–10</sup> In Cies's racquet conjunctival flap procedure, a smaller racquet-shaped perilimbal conjunctival flap is mobilised to cover the corneal ulcer.<sup>11</sup> Generally, these conjunctival flaps are considered not suitable to deal with impending perforation and perforated corneas

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as only a very thin layer of conjunctiva covers the ulcer. We have modified the conjunctival flap procedure, which we have named Superior Forniceal Conjunctival Advancement Pedicle (SFCAP), to successfully manage corneal perforations and impending corneal perforations.

### Materials and methods

In all, 20 patients with corneal perforations (P) and impending corneal perforations (IP) underwent SFCAP. A total of 16 presented with a nontraumatic corneal perforation with duration of no longer than 2 days. The remaining four patients had impending perforations due to corneal melt (1) and nonhealing corneal ulcers (3). In all patients, the ocular surface was compromised due to corneal anaesthesia, complicated grafts, multiple retinal detachment surgeries, cicatricial pemphigoid, severe blepharitis and acne rosacea. The details and outcome of the patients are shown in Table 1.

### Technique

The lid speculum separates the lids. The superior bulbar conjunctiva very near to the fornix (approximately 14–15 mm from the limbus) is ballooned with an injection of balanced salt solution. Tenon's capsule is not completely dissected from the conjunctiva when a thicker flap is required. A thicker flap is desirable to seal corneal perforations. A prominent blood vessel is identified and included in the pedicle. Two parallel conjunctival incisions, 4–5 mm apart, are made in the forniceal recess (Figure 1a). This allows fashioning of a conjunctival pedicle with an intact blood supply, and underlying Tenon's capsule. Care is taken not to damage Müller's muscle. The epithelium at the edge of the corneal ulcer is scraped. The advancing edge of the pedicle is placed on the ulcer (Figure 1b). A 10/0 nylon suture is inserted at the 6-clock hour position of the ulcer. Then, the flap is sutured to the edge of the ulcer taking an adequate bite on to the clear cornea. A further seven to 10 interrupted sutures are inserted around the ulcer, securing the pedicle to the site of the corneal ulcer. In this manner, it is possible to secure closure of the perforation and prevent a leak from the anterior chamber. The donor site is closed. A subconjunctival injection of antibiotics is given at the end of the procedure. In two patients, a corneal biopsy was taken from the edge of the ulcer and processed for routine histology and transmission electron microscopy. Postoperative standard medication consisted of chloramphenicol drops four times daily and dexamethasone 0.1% drops four times daily for 1 month. Patients with acne also received oxytetracycline 250 mg twice a day for at least 1 month. (Technique modified by K Ramaesh.)

### Case 1

An 83-year-old female patient presented with a red eye and had a large necrotic corneal ulcer with hypopyon (Figure 2a). The cornea was anaesthetic and the perilimbal conjunctiva was inflamed. *Staphylococcus aureus* was isolated from the scrapings. In spite of intensive antibiotic therapy, the corneal ulcer perforated 2 days after admission to hospital. She underwent a SFCAP (Figure 2b). The flap had a good vascular supply; the anterior chamber formed within 24 h and the hypopyon resolved over a period of 4 days. The ulcer healed with a stable globe and the eye remained comfortable (Figure 2c). Although the patient had good visual potential, she did not wish to undergo further keratoplasty and cataract surgery.

### Case 6

A 75-year-old male patient presented with redness and pain in the left eye, with reduced vision. He noticed a sudden gush of fluid coming from the eye and the eye became soft to the touch. He had chronic acne rosacea with significant blepharitis. A peripheral corneal perforation was evident on examination (Figure 2d). He underwent a SFCAP flap under general anaesthesia (Figure 2e). Postoperatively, he received oral oxytetracycline in addition to antibiotic and prednisolone eye drops. The anterior chamber formed within 24 h. The ulcer healed with a stable globe, the eye remained comfortable and the final visual acuity improved to 6/9 (Figure 2f).

### Results

A total of 20 patients underwent conjunctival advancement pedicle flaps. The preoperative visual acuity ranged from 6/18 to no perception of light. In all, 16 of the patients had perforated (P) corneal ulcers and four were impending perforations (IP). In 12 of the patients with good visual potential, the anterior chamber formed within 24 h and in the remaining eight patients, within 48 h. With time the pedicle became less oedematous, and the blood vessels became less prominent. There was no discomfort related to the flap in any of the patients. The globe was preserved in all patients, and in 12, the visual potential was also preserved. One patient with acne rosacea developed a corneal melt adjacent to the perforation previously managed with the pedicle flap. This patient received a successful second conjunctival rotation flap. In both patients with acne, the vision improved to 6/9. None of these patients developed secondary glaucoma or ptosis.

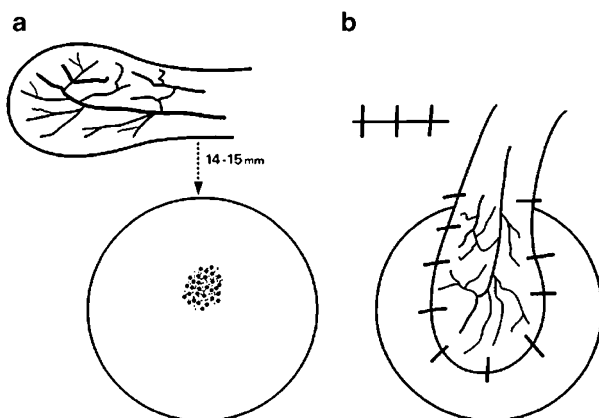
**Table 1** Characteristics of the 20 patients who underwent SFACP

Case	Age	Sex	Clinical diagnosis	State of the cornea	Outcome
1	F	83	Corneal ulcer secondary to <i>Staph. aureus</i> . Anaesthetic cornea (Figure 2)	P	AC formed within 24 h Ulcer healed Visual potential preserved
2	F	45	Corneal melt on anaesthetic corneal graft	IP	A second corneal melt developed adjacent to the previous corneal melting; a second graft was performed inferiorly Ulcer healed Visual potential preserved
3	M	72	Chronic HSV keratitis. Anaesthetic cornea	P	AC formed within 24 h Ulcer healed Visual potential preserved
4	M	62	Chronically infected corneal graft secondary to <i>Moraxella</i> infection. Previous multiple surgeries. Blind eye	P	Corneal perforation healed Globe was preserved Comfortable eye
5	F	62	Suppurative keratitis	P	AC formed within 24 h Ulcer healed Visual potential preserved
6	M	75	Peripheral corneal melt secondary to acne rosacea related keratitis (Figure 3)	P	AC formed within 24 h Ulcer healed Final visual acuity 6/9
7	F	58	Corneal ulcer secondary to <i>Strep. pneumoniae</i>	IP	Ulcer healed Visual potential preserved
8	M	47	Peripheral corneal melt secondary to acne rosacea related keratitis	P	AC formed within 24 h Ulcer healed Final visual acuity 6/9
9	M	69	Chronic nonhealing corneal ulcer secondary to cicatricial pemphigoid	IP	Pedicle retracted after 1 week Ulcer healed Visual potential preserved
10	F	90	Corneal ulcer secondary to <i>Staph. aureus</i>	IP	Pedicle retracted after 6 weeks  Ulcer healed Visual potential preserved
11	M	63	Corneal ulcer on graft	P	Ulcer healed Globe preserved
12	M	52	Corneal ulcer on an eye with previous numerous retinal procedures	P	Ulcer healed Globe preserved
13	F	32	Advanced neglected Mooren's ulcer	P	Ulcer healed Globe was preserved Comfortable eye
14	F	74	Corneal ulcer. Previous multiple retinal procedures	P	Ulcer healed Globe preserved
15	F	63	Suppurative keratitis	P	AC formed within 24 h Ulcer healed Visual potential preserved

Table 1 (continued)

Case	Age	Sex	Clinical diagnosis	State of the cornea	Outcome
16	F	52	Corneal ulcer secondary to atopic kerato conjunctivitis and secondary infection. Two failed amniotic grafts	P	Patient rubbed off CPG but perforation sealed  Visual potential preserved
17	M	78	Suppurative keratitis	P	Ulcer healed Globe preserved
18	F	78	Suppurative keratitis	P	Ulcer healed Globe preserved
19	M	67	Corneal ulcer on graft	P	Ulcer healed Globe preserved
20	F	29	Suppurative keratitis	P	AC formed within 24 h Ulcer healed Underwent subsequent penetrating keratoplasty

P: perforated cornea; IP: impending corneal perforation.

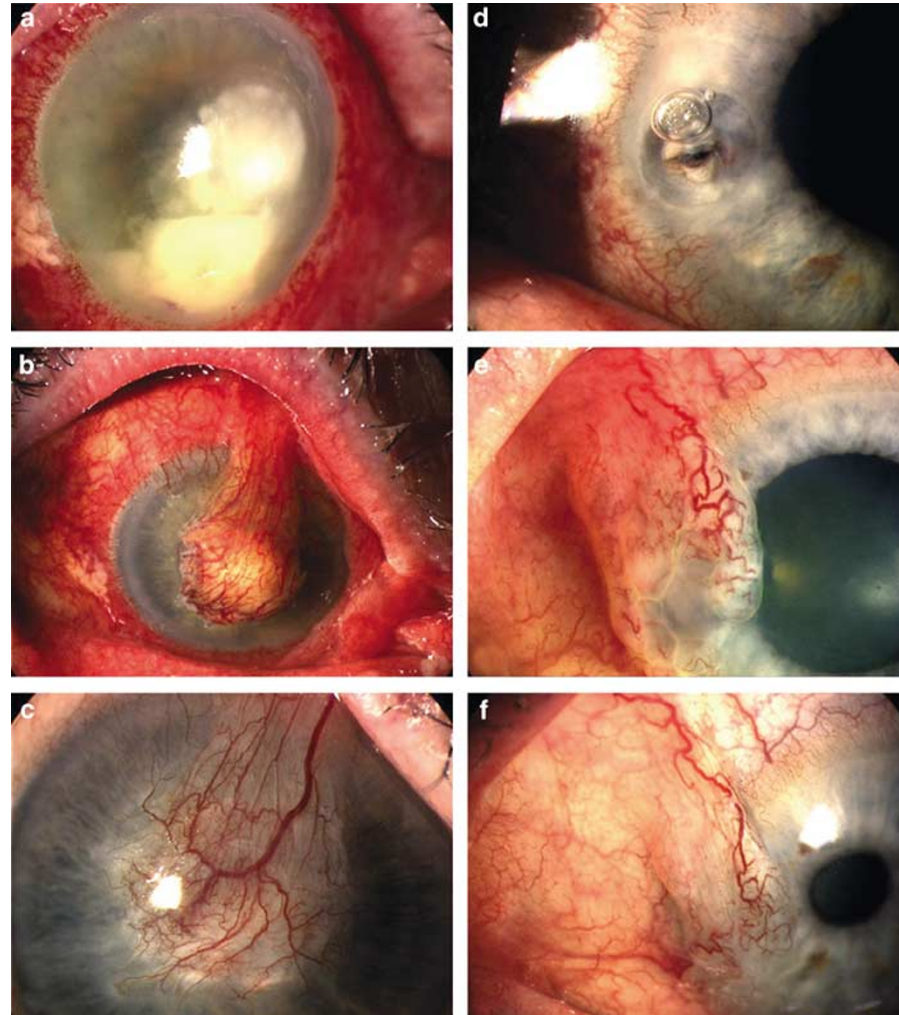


**Figure 1** (a) Two parallel conjunctival incisions, 4–5 mm apart were made in the forniceal recess. This allows fashioning of a conjunctival pedicle with the underlying Tenon’s capsule with an intact blood supply. (b) Necrotic material is removed as much as possible. The advancing edge of the pedicle is placed on the ulcer. A 10/0 nylon suture is inserted at the 6-clock hour position of the ulcer. The graft is sutured to the edge of the ulcer taking an adequate bite on to the clear cornea.

## Discussion

Corneal perforations lead to persistent leak, prolonged hypotony and a flat anterior chamber, which all may lead to endophthalmitis, peripheral anterior synechiae, cataract formation, and even expulsive haemorrhage.<sup>6,8,12</sup> Restoration of the integrity of the globe is paramount to restore vision. Nontraumatic corneal perforations often occur in eyes with debilitating ocular surface disorders, which further compromise the therapeutic approach.<sup>2</sup> In this small group of patients, SFACP was successfully used to seal the perforation and restore the integrity of

the globe. The conjunctival flap acts as a biological patch, having tropic, protective, and analgesic effects.<sup>2,9,10</sup> In the method we describe, the conjunctival pedicle is advanced from the superior fornix along with its blood supply. Advancing the conjunctiva from the fornix has several advantages. The extent of conjunctival dissection is very much less than in Gunderson and other similar techniques, where fairly extensive perilimbal conjunctival dissection and mobilisation is required.<sup>2,8-10,13</sup> Furthermore, in the superior forniceal region, conjunctiva is fairly redundant, vascular, and usually well preserved. These are features that facilitate dissection and mobilisation without compromising the donor site, for example should future procedures such as trabeculectomy be contemplated. Corneal perforations are associated with a chronically debilitated ocular surface and inflamed perilimbal conjunctiva is very friable during dissection, thus making the SFACP technique a more pertinent option. In Gunderson and other conjunctival flaps, a thin layer of conjunctiva is mobilised following peritomy. In these techniques, the flaps overlying necrotic ulcers are prone to undergo necrosis with the risk of the conjunctiva sloughing; this may be due to poor vascularity of the perilimbal conjunctival tissue. To avoid this complication, a thorough surgical debridement of the necrotic corneal stroma should be attempted; however, this is not always practical. In our series, we did not encounter any cases of conjunctival necrosis or sloughing of conjunctiva that overlay necrotic corneal tissue. This may be attributable to the high vascularity of the SFACP that facilitates resolution of the necrotic tissue and provides essential vascularity to enhance healing. Furthermore, central



**Figure 2** (a) Photograph showing a large necrotic corneal ulcer with secondary perforation. (b) Appearance of the eye immediately after the SFACP procedure. (c) Appearance of the eye 2 months after surgery. (d) Photograph showing a peripheral corneal perforation in a patient with acne rosacea-related keratitis. (e) Appearance of the eye immediately after the SFACP procedure. (f) Appearance of the eye 2 months after surgery. Final visual acuity improved to 6/9.

large suppurative corneal ulcers often induce vascularisation from the peripheral cornea, and the end result is a vascularised cornea with a central corneal scar. None of the patients we managed with SFACP developed any peripheral corneal vascularisation. SFACP rapidly eliminates the necrotic tissue and therefore the stimulus for the production of vasogenic substances. This leaves the peripheral cornea avascular, which is advantageous should future corneal grafts be required. Ultrastructural studies of actively melting human corneas have shown stimulated polymorphonuclear leucocytes, phagocytosis, and degranulation.<sup>14,15</sup> Collagenases produced by polymorphs and degenerating corneal epithelium are positively implicated in corneal melting.<sup>14,15</sup> The presence of occasional polymorphs between the disrupted collagen lamellae and no evidence of infection in our cases supports this mechanism of corneal melting.

Vascular conjunctival pedicles may facilitate the neutralisation of such enzymes and halt the melting process. Sealing the perforation is essential to restore the intraocular pressure and to prevent endophthalmitis. In the SFACP technique, this is achieved by suturing along the edge of the pedicle towards the limbus. Small corneal perforations may initially be managed with tissue glue combined with a bandage contact lens.<sup>16–18</sup> The function of cyanoacrylate glue is to provide tectonic support in addition to a barrier effect.<sup>16–20</sup> The tectonic support to the stroma enhances neovascularisation and repair. Although the glue provides good tectonic support, it does not contribute to the healing of the corneal ulcer and perforation. Furthermore, glue results in a rough surface and should always be protected by a bandage contact lens, which is not ideal in an eye with a debilitated ocular surface. The use of corneal grafts in these situations

carries poor prognosis; the risk of graft rejection is very high, which would necessitate immunosuppressive therapy with its potentially serious side effects.<sup>21–25</sup> Availability of donor material is another drawback of this technique. All the patients we managed experienced pain relief and were able to reduce the frequency of medication and duration of hospital stay and none developed a painful blind eye. Psychological trauma associated with enucleation and evisceration can be hard to bear for many patients. Four of our patients did not have any visual potential and declined enucleation of the globe preferring a more conservative approach. In these circumstances, SFACP provides an alternative method to other invasive procedures.

### Conclusion

SFACP is an appropriate procedure in managing acute and impending corneal perforations where donor corneal material is not available and transplantation of such tissue is not suitable.

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