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Conjunctival limbal autografting (CLAU) combined with customised simple limbal epithelial transplantation (SLET) in a severe corneal chemical burn: Case report

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ABSTRACT

Purpose: The most common cause of severe limbal stem cell deficiency (LSCD) is chemical injury. We report a case of severe unilateral alkali injury complicated by total LSCD, treated with customized Simple limbal epithelial transplantation (SLET) combined with conjunctival-limbal autografting (CLAU).
Observation: A 23-year-old female sustained a severe unilateral alkali chemical injury, resulting in total LSCD, treated with customized SLET combined with CLAU. We used two autologous limbal biopsies harvested from the fellow eye. One was used for CLAU and the second was split into multiple pieces, and was glued to bare stroma following resection of the corneal pannus. A stable ocular surface was achieved, and the donor eye remained healthy. Visual acuity improved from hand motion initially, to 20/20 over one year post-operatively.
Conclusion and importance: This case report demonstrates the efficacy and safety of customized SLET with supplemental CLAU to treat total LSCD in severe ocular burns.

1. Introduction

Ocular chemical injuries, especially from alkali agents, are emergencies which can lead to severe acute and chronic complications, such as limbal stem cell deficiency (LSCD) with consequent visual impairment.[1] Unilateral LSCD can be treated with autologous limbal stem cell transplantation (LSCT) using the healthy contralateral limbus. Three different surgical approaches have evolved over time: conjunctival-limbal autografting (CLAU), cultivated limbal epithelial transplantation (CLET) and simple limbal epithelial transplantation (SLET). The outcomes of CLAU combined with SLET for primary treatment of severe ocular surface burns cases have not been previously described.

This case describes the use of SLET and CLAU to treat a severe case of LSCD induced by chemical injury in a 23-year-old woman, and highlights the benefits of customising supplemental surgery to achieve excellent anatomical and functional outcomes.

2. Case description

A 23-year-old woman presented to our clinic in October 2018, with pain, redness and reduced vision in the right eye 1 month following chemical injury from an alkali agent. She had received first aid in a previous hospital in the form of immediate ocular irrigation, and was using topical steroid and lubricant eye drops, as well as vitamin A ointment. The left eye sustained no injury. On examination, the unaided visual acuity was 20/80 (0.25 Snellen) in the right eye, which did not improve with pinhole or refraction, and 20/20 in the left eye. Slit lamp examination of the right eye revealed conjunctival congestion, no corneal oedema, a superior conjunctival epithelial defect and a superior corneal epithelial defect. There was conjunctivalization of the peripheral cornea involving 12 clock hours, associated with early corneal neovascularization. Digital intraocular pressure was normal. Thus the patient was diagnosed with grade 5 ocular surface burn (Dua's classification) following chemical injury. The left eye was normal.

The patient underwent an amniotic membrane corneal transplantation (AMT) inlay and overlay in October 2018. In addition to previous treatment, the patient received oral Doxycycline 100 mg and vitamin C 1 g per day. One month on, the patient's vision remained poor, measuring hand motions at 1 m in the right eye. There was pseudopterygium formation encroaching on the inferior-nasal quadrant of the cornea, conjunctivalization of the peripheral cornea involving 12 clock

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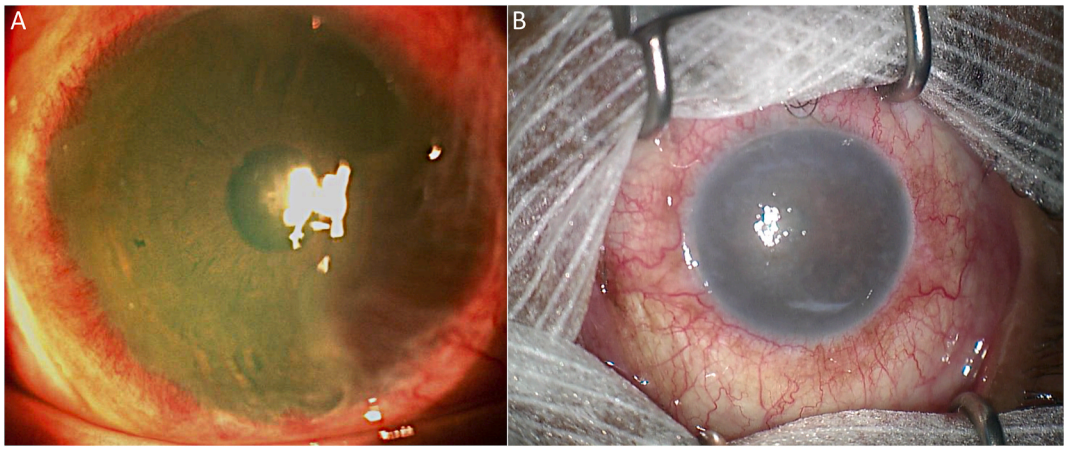

Fig. 1. (**A-B**) Right eye as seen before the SLET. (**A**) Right eye one month after AMT showing nasal pannus with corneal conjunctivalization, and neovascularization of the peripheral cornea involving 12 clock hours. (**B**)Three months after AMT, right eye shows severe corneal oedema.

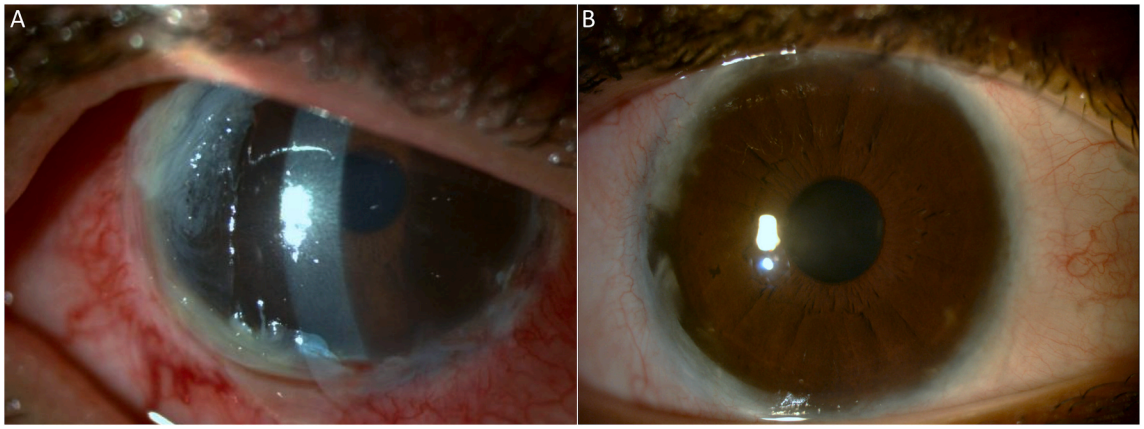

Fig. 2. (**A-B**) Postoperative follow-up of the right eye. (**A**) Right eye at two months postoperatively showing completely epithelialized surface and (**B**) at one year, a clear cornea with no recurrence of LSCD.

hours, and a persistent inferior corneal epithelial defect. There was no residual active inflammation (Fig. 1). A diagnosis of total unilateral LSCD was made.

Further surgical intervention was planned, and the patient underwent autologous SLET combined with CLAU in the right eye, in December 2018 (Video 1). Donor tissue was harvested from two grafts of 4 mm area in the superior and inferior limbus of the left eye, including one with a small conjunctival flap of 2 mm away from the limbus. The conjunctiva was repositioned and held in place using fibrin glue (Tisseel®). We performed a nasal peritomy, removed all the vascular pannus from the right eye and de-epithelialized the cornea. A conjunctival limbal autograft (CLAU) was held in place over the nasal diseased cornea with fibrin sealant. A piece of donor limbal tissue was cut in six and then distributed on the bare corneal stromal with fibrin glue after pannus resection. Finally, an overlay AMT was held in place with Tisseel® and a back-and-forth absorbable suture. Postoperatively, the patient received topical dexamethasone 0.1%, tobramycin 0.3% eye drops in her right eye, which was gradually tapered over 3 months.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ajoc.2020.100906

At 2-month follow-up, the patient's corrected visual acuity was 20/40 with a fully epithelialized and stable ocular surface (Fig. 2A). There was gradual dissolution of the limbal biopsy explants, reduction in stromal scarring, and improvement in corneal clarity. At most recent follow-up, 13 months post surgery, the right corneal surface was stable, epithelialized and avascular, with further improvement in vision to 20/20 with spectacles (Fig. 2B). The donor site was healthy in the left eye, with no evidence of donor site LSCD.

3. Discussion

This case of a severe alkali ocular injury was successfully treated using CLAU combined with SLET, resulting in a healthy cornea and good visual acuity over 1-year post-operatively.

The management of chemical injuries depends on the stage of presentation. In this acute stage, goals of treatment included re-epithelialisation, control of inflammation, and maintenance of a normal intraocular pressure.[1] Failure of epithelialisation can lead to stromal scarring, stromal melt, corneal perforation, corneal infections,[1] and ultimately visual impairment. AMT is most often employed in conjunction with medical therapy in acute injuries to reduce inflammation and induce epithelialisation, but without inferring any long-term benefits,[2,3] especially in terms of improving visual acuity.

In our case, despite medical treatment and an AMT, the patient had a persistent epithelial defect, corneal conjunctivalization and corneal neovascularization related to unilateral total LSCD. When patients have extensive corneal conjunctivalization[4] and a unilateral LSCD, they can be treated with autologous LSCT, which can be performed using various techniques. Contrary to allogenic transplantation, autologous transplantation techniques avoid the risk of graft rejection and prolonged immunosuppression.[5] Autologous LSCT can be performed either by direct grafting of limbal epithelial cells, or after cultivating them in vitro

on a biological membrane (CLET). Direct grafting of limbal epithelial cells, CLAU and SLET, have better anatomical and functional success rates in comparison to CLET.[6]

SLET, first reported in 2012,[7] avoids the need for a large donor graft contrary to CLAU, but the risk of failure is higher in the presence of symblepharon[8,9] or inflammation. Optimization of the ocular surface including rapid resolution of inflammation is important to give the best chance for successful outcome. Furthermore, the most common complication of SLET is the focal recurrence of LSCD,[8] which can limit visual recovery. Vazirani et al. suggested that repeat SLET can be of benefit. A case series of four children found that the three partial success patients had originally presented with more severe injury and extensive LSCD. They repeated a SLET combined with conjunctival autograft transplant, resulting in an epithelialized, avascular and stable corneal surface.[10] The patient, in this case, had total LSCD with an extensive nasal pseudo-pterygium close to the visual axis, and a persistent inferior corneal epithelial defect associated with a high risk of symblepharon and central stromal scarring. Only three months following the initial injury, we performed LSCT to avoid the progress of the pseudo-pterygium in this young patient. Although the early management of LSCD involved a higher risk of LSCT failure, good management of inflammation controls it. We considered two options. Firstly, we could perform a SLET alone, with a higher risk of focal pannus recurrence because of the pseudo-pterygium, the risk of symblepharon and early timing if intervention. Secondly, we could choose a customised SLET combined with a mini-CLAU positioned at the pannus level to avoid the risk of SLET failure.[9] This had to be balance against an increased risk to the donor eye of losing a significant amount of limbal tissue. However use of the mini-CLAU technique limits this risk. Therefore, this latter technique was preferred for our young patient.

The underlying stroma was relatively healthy, and the ocular surface showed no signs of inflammation. Therefore, we decided not to place the limbal biopsy segments on amniotic membrane, but rather on the de-epithelialized stroma, using Bowman's layer for migration. CLAU of SLET without AMT have been shown to effectively treat total LSCD after chemical injury[11,12]

At one-year post-operative follow-up, the patient had a successful outcome with complete corneal re-epithelialisation, a clear cornea, and visual acuity of 20/20 with no recurrence of LSCD. This case demonstrates successful outcome using SLET combined with mini-CLAU in a case of a unilateral ocular alkali burn, with maintenance of a healthy corneal surface for over one year of follow-up. To the best of our knowledge, this is the first case reported in the literature of an alkali injury managed with primary customized SLET combined with mini-CLAU. Future studies in this area, comparing combined surgery with mini-CLAU v SLET alone, may help to delineate the indications and role of this novel technique in similar situations.

Patient consent

Consent to publish this case report has been obtained from the patient in writing.

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Authorship

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

Declaration of competing interest

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