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Case report

# Mini-conjunctival autograft combined with deep anterior lamellar keratoplasty for chronic sequelae of severe unilateral chemical burn: A case report

Anahita Kate [a], Sayan Basu [b,c,*]

[a] The Cornea Institute, KVC Campus, LV Prasad Eye Institute, Vijayawada, India
[b] The Cornea Institute, KAR Campus, LV Prasad Eye Institute, Hyderabad, Telangana, India
[c] Prof. Brien Holden Eye Research Centre (BHERC), LV Prasad Eye Institute, Hyderabad, Telangana, India

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ABSTRACT

*Introduction and importance:* This case describes a novel technique combining a mini-conjunctival limbal autograft (CLAU) with a deep anterior lamellar keratoplasty (DALK) in a case of chemical injury sequelae.
*Case presentation:* A 19-year-old female presented with total limbal stem cell deficiency (LSCD) and a vascularized corneal scar in the visual axis of the left eye, 4 years following a chemical injury. In order to treat the LSCD and simultaneously visually rehabilitate the patient, a mini-CLAU with DALK was carried out. Two separate one clock-hour CLAUs were harvested from the right eye and secured in the left. The graft was clear in the initial postoperative period and maintained its clarity over 15 months of follow period with a visual acuity of 20/30 with scleral contact lenses. The mini-CLAUs sustained a stable and well epithelialized corneal surface during the same period.
*Clinical discussion:* The use of the mini-CLAUs instead of the traditional CLAU circumvents the complication of an iatrogenic LSCD in the donor eye as the size of the donor grafts is smaller (1–2 clock hours versus 6–8 clock hours). Despite the smaller size, these grafts are efficacious in maintaining a well epithelialized corneal surface even in cases of total LSCD. The autologous nature of the graft defers the need for immunosuppression and its peripheral location facilitates ease of the surgical technique when combined with a keratoplasty.
*Conclusion:* This novel single-staged procedure is an effective technique to reestablish a stable ocular surface and to visually rehabilitate cases of chronic chemical injury with good long-term outcomes.

## 1. Introduction

LSCD has numerous surgical options available for its management such as SLET, CLAU, keratolimbal allograft, etc. The choice of one surgical technique over the other depends on the degree of LSCD, surrounding adnexal involvement and the ocular surface wettability. These procedures aim at restoring a stable ocular surface which also helps to improve the visual acuity to a certain extent. Nevertheless, in the presence of significant corneal stromal scarring, transplant of LSC alone will not result in adequate visual rehabilitation. In such cases, a keratoplasty can be planned either simultaneously or sequentially. Although a few series have described the technique and outcomes of simultaneous keratoplasty and CLAU, the limbal grafts harvested in these series were nearly half of the normal limbus which can result in iatrogenic LSCD in the donor eye [1–3]. To prevent this a modified mini-CLAU with 1–2 clock-hours of limbal tissue can be harvested. Though the procedure has been described in isolation, there no reports of combination of mini-CLAU with LK [4]. And so, here we describe a case of chemical injury sequelae where a DALK with mini-CLAU was performed. This report is as per the SCARE-2020 criteria [5].

## 2. Case presentation

A 19-year-old female presented with history of chemical injury

*Abbreviations:* LSCD, Limbal stem cell deficiency; LSC, limbal stem cells; LSCT, limbal stem cell transplant; SLET, Simple limbal epithelial transplant; LK, lamellar keratoplasty; DALK, Deep anterior lamellar keratoplasty; CAG, Conjunctival autograft; CLAU, conjunctival limbal autograft; AS-OCT, anterior segment optical coherence tomography; AM, Amniotic membrane.

* Corresponding author at: Prof. Brien Holden Eye Research Centre (BHERC), LV Prasad Eye Institute, Hyderabad, Telangana, India.
*E-mail address:* sayanbasu@lvpei.org (S. Basu).

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(calcium hydroxide) to the left eye, 4-years prior to presentation. The patient had undergone AM-grafting during the acute phase and she complained of decreased vision since then. There was no significant family or drug history. At presentation, vision was counting fingers. Slit-lamp examination revealed a wet ocular surface with a symblepharon in the superior conjunctiva. There was total LSCD with a pannus in all quadrants. A full thickness vascularized leucomatous scar measuring 6 × 9 mm was present in the visual axis (Fig. 1A). A normal anterior chamber was visible through the inferior cornea with a clear lens. The posterior segment was also hazily visualized and appeared normal. In the right eye, the ocular examination was within normal limits with a distant and near vision of 20/20, N6 respectively.

The preoperative AS-OCT of the left eye revealed a full thickness scar which was denser in the posterior stroma (Fig. 1B). And so, to provide visual rehabilitation and simultaneously address the LSCD the patient was taken up for an autologous LSCT with DALK in the left eye under general anesthesia. The surgery was performed by a senior, experienced surgeon. Intraoperatively, a 360-degree peritomy followed by peripheral dissection to identify the plane of the fibrovascular pannus was carried out. Once identified the pannus was completely excised (Fig. 2A, B,C). Subsequently, a manual lamellar dissection of the cornea, extending from one end of limbus to the other, was undertaken (Fig. 2D, E). This was continued until an optically clear plane in the posterior stroma was reached. A corneal button from a 40-year-old donor, with an endothelial count of 3105 cells/mm$^2$, was selected for grafting. A 11 mm trephine was used and the graft was secured to the host bed with 16 interrupted 10–0 nylon sutures (Fig. 2F).

A conjunctival autograft measuring 15 × 10 mm was then obtained from the superior conjunctiva of the left eye along with two separate clock-hours (1,11 o' clock) of limbal tissue (Fig. 2G,H,I). The conjunctival graft was dissected from the underlying tenons and the limbal tissue was harvested in continuation with the conjunctival tissue by extending into the cornea using a 15-number blade along the plane of the conjunctival epithelium until a clear strip of cornea was noted. The harvested CLAU was then divided into three parts: l) A CAG measuring 10 × 4 mm; ll) Two separate CLAUs including the limbal tissue and 2 × 2 mm of the adjacent conjunctiva. The CAG was secured using fibrin glue (Tisseel Kit, Baxter AG, Vienna, Austria) over the superior bare sclera (Fig. 2J). The CLAUs were placed at the 6 and 9 o' clock positions with the limbal part of the graft overlying the sutured corneal button and secured with fibrin glue (Fig. 2K). An AM was then draped over the cornea with the same glue and a bandage contact lens was placed over the AM(Fig. 2L).

Postoperatively the patient was started on topical steroids (prednisolone acetate 1%, four times/day) and antibiotics in the left eye. The steroids were tapered over 3 months until a maintenance dose of twice/day was reached. Topical steroids (prednisolone acetate 1%) and antibiotics (moxifloxacin 0.5%) both four times/day, were initiated in the right eye. The former was rapidly tapered over a period of one month. Oral prednisolone (20 mg once/day, tapered over 1 month) was also given. Three months after the surgery, a clear graft with a well epithelialized ocular surface and a corrected visual acuity of 20/30 with scleral contact lenses (SCL) was noted (Fig. 3A,B,C). An early anterior cortical cataract was present. The healing in the donor eye was uneventful.

Five months after the transplant, the patient had an episode of stromal rejection which was managed medically with topical steroids (Fig. 3D,E,F). Fifteen months after the surgery, the vision was maintained with SCL, and the ocular surface was stable with an intact epithelium. The degree of cataract was unchanged, and the intraocular pressure was normal. The posterior segment was also normal. AS-OCT of the left eye revealed the depth of manual dissection to be up to the pre-descemetic layer in all quadrants (Fig. 3E).

## 3. Discussion

Almost all cases of chronic chemical injury require LSCT eventually, however its timing depends on the severity of the disease. Preoperative assessment of corneal scarring and the degree of visual morbidity that can be attributed to it is essential. A dense fibrovascular pannus may obscure details of the underlying stroma and this often leads to a misjudgment of the grade of corneal scarring. Presence of significant scarring can be ascertained from the infra-red image of the cornea on an AS-OCT (Fig. 1C). The extent to which the anterior chamber structures are visualized will help understand the density of the corneal scar which in turn will determine the need for a secondary surgery for visual rehabilitation.

When required, a keratoplasty can be planned either simultaneously with the LSCT or sequentially. Delaying the keratoplasty will allow the surface to stabilize and often this, along with the regenerative properties of the LSC, results in remodeling of the scar. Several of these cases may benefit from a contact lens, thus deferring the need for a keratoplasty. A keratoplasty is performed only when adequate clearing of the stromal opacification does not occur. Studies have reported good outcomes with this two-staged procedure, however, there is a delay of 6–12 months before the second surgery can be performed, which in turn postpones the visual rehabilitation [6,7]. Also, the secondary surgery may inadvertently damage the transplanted LSC. These problems are circumvented in a single-staged procedure. The visual outcomes following a combined procedure are good with >90% of the grafts maintaining clarity over the

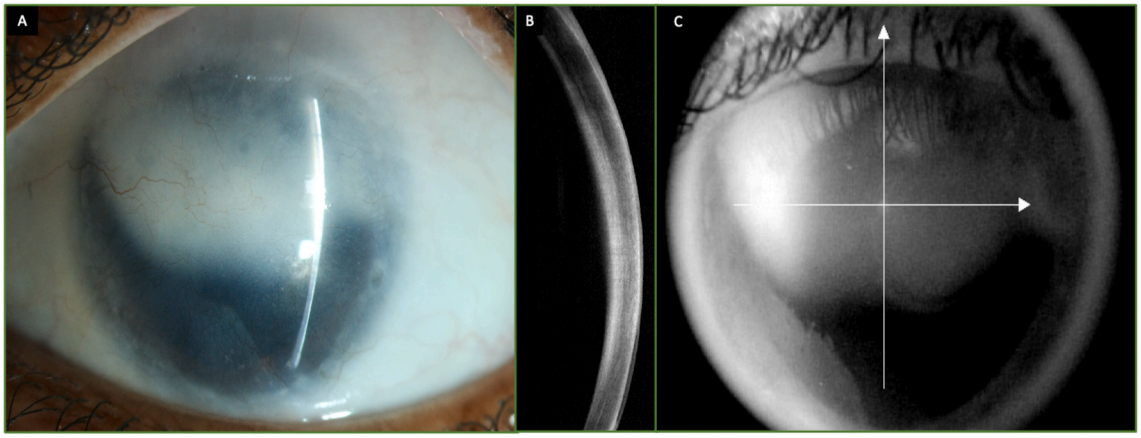


**Fig. 1.** This collage of images shows the preoperative images. A) Left eye showing total LSCD with a full thickness vascularized leucomatous scar measuring 6 × 9 mm present in the visual axis. B) Line scan of OCT showing a full thickness scar which is denser in the posterior stroma C) The anterior chamber details are visible through the inferior cornea however the superior cornea appears opaque on the infrared image.

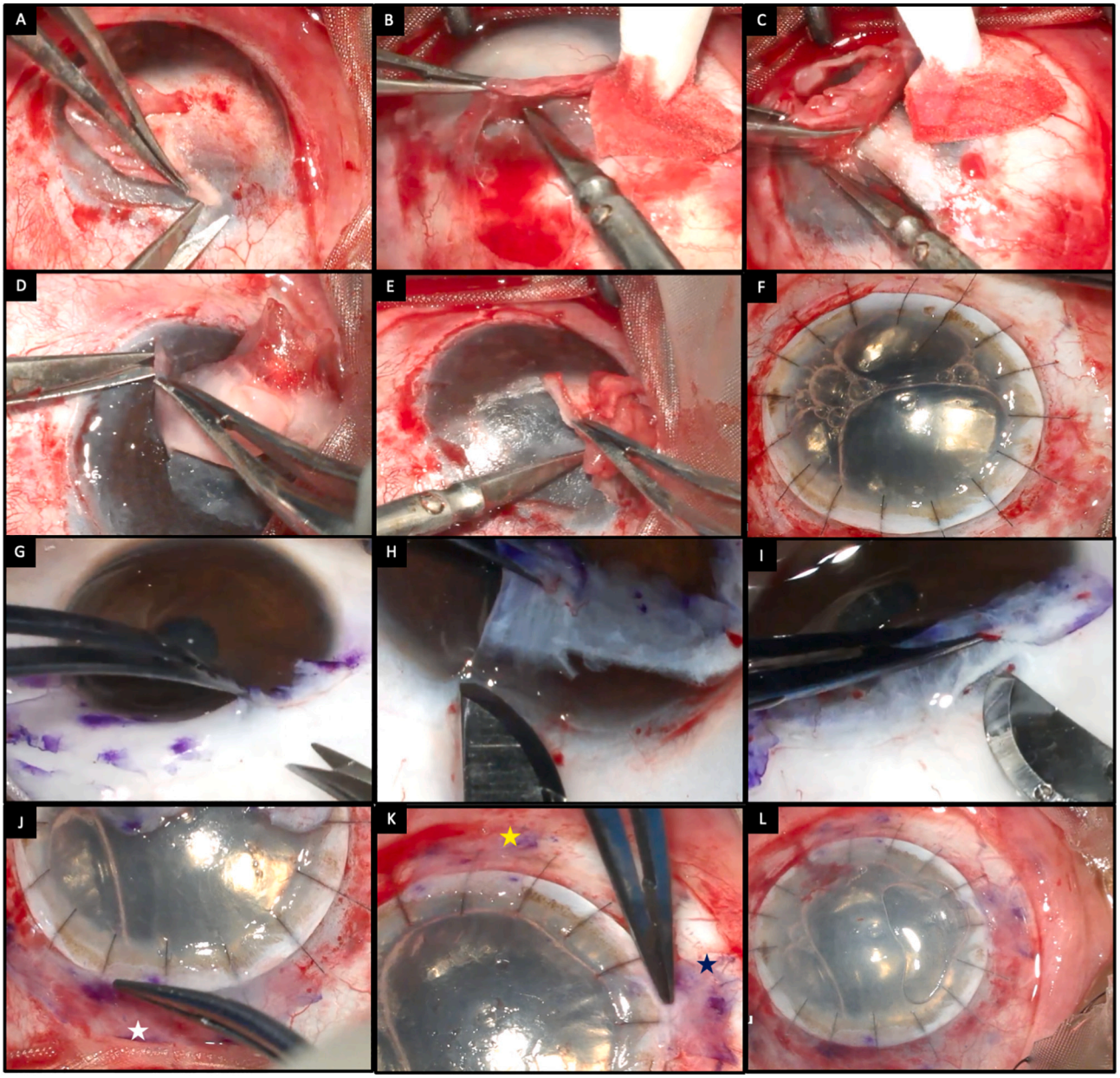


**Fig. 2.** This collage depicts the intraoperative steps of mini-Conjunctival limbal autograft with deep anterior lamellar keratoplasty. A, B, C) Dissection and excision of the fibrovascular pannus D, E) Manual lamellar dissection of the cornea F) Donor button is secured with interrupted 10–0 monofilament nylon sutures G) Harvesting of the conjunctival autograft (CAG) which is being dissected from the underlying tenons H) Extension into the cornea to delineate the limbal tissue at 11 o clock and I) at 1 o clock J) Securing the CAG over the superior bare scleral area with fibrin glue (white star) K) securing the limbal autografts at 6 (yellow star)and 9 o clock positions (black star) L) Amniotic membrane is draped over the cornea and tucked under the free conjunctiva with a BCL over the membrane. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

initial postoperative years [1–3]. The choice of a full-thickness versus a lamellar graft will depend upon of the density of posterior stromal scarring. However, when a penetrating keratoplasty is performed, even with surface stabilization, because of the prior history of inflammation and a vascularized host bed, the graft remains high-risk and can reject. Thus, whenever possible a lamellar graft must be attempted.

The choice of LSCT may determine the rate of epithelialization postoperatively. In SLET, since the LSCs are placed in the mid periphery, there is circumferential spread of the epithelial tissue. Conversely, in cases of CLAU, there is unidirectional centripetal migration of epithelium and so there may be delayed healing of the central island of cornea. However, in case of graft failures requiring repeat keratoplasties, the peripherally located LSC in CLAU will offer more freedom in planning the size of these future grafts. Although traditional CLAU requires 1–2 grafts involving up to 6 mm of limbal tissue, the lower limit of excisable graft required to maintain a stable epithelial surface is uncertain. The greatest advantage of mini-CLAU lies in preserving the donor limbus, as only up to 2 clock-hours of LSC is harvested. No epithelial issues were noted in our case of total LSCD demonstrating the efficacy of these smaller grafts. A few studies have reported inadequate epithelial stability with grafts involving $<90^{o}$ of limbus while others have demonstrated good epithelialization with two clock-hour grafts [8–11]. Another added advantage of mini-CLAU is that the procedure may be attempted even in cases with partial LSCD in the donor eye, provided the residual limbus is at least 6 clock-hours. This ensures an autologous graft, rendering long term immunosuppression unnecessary. The

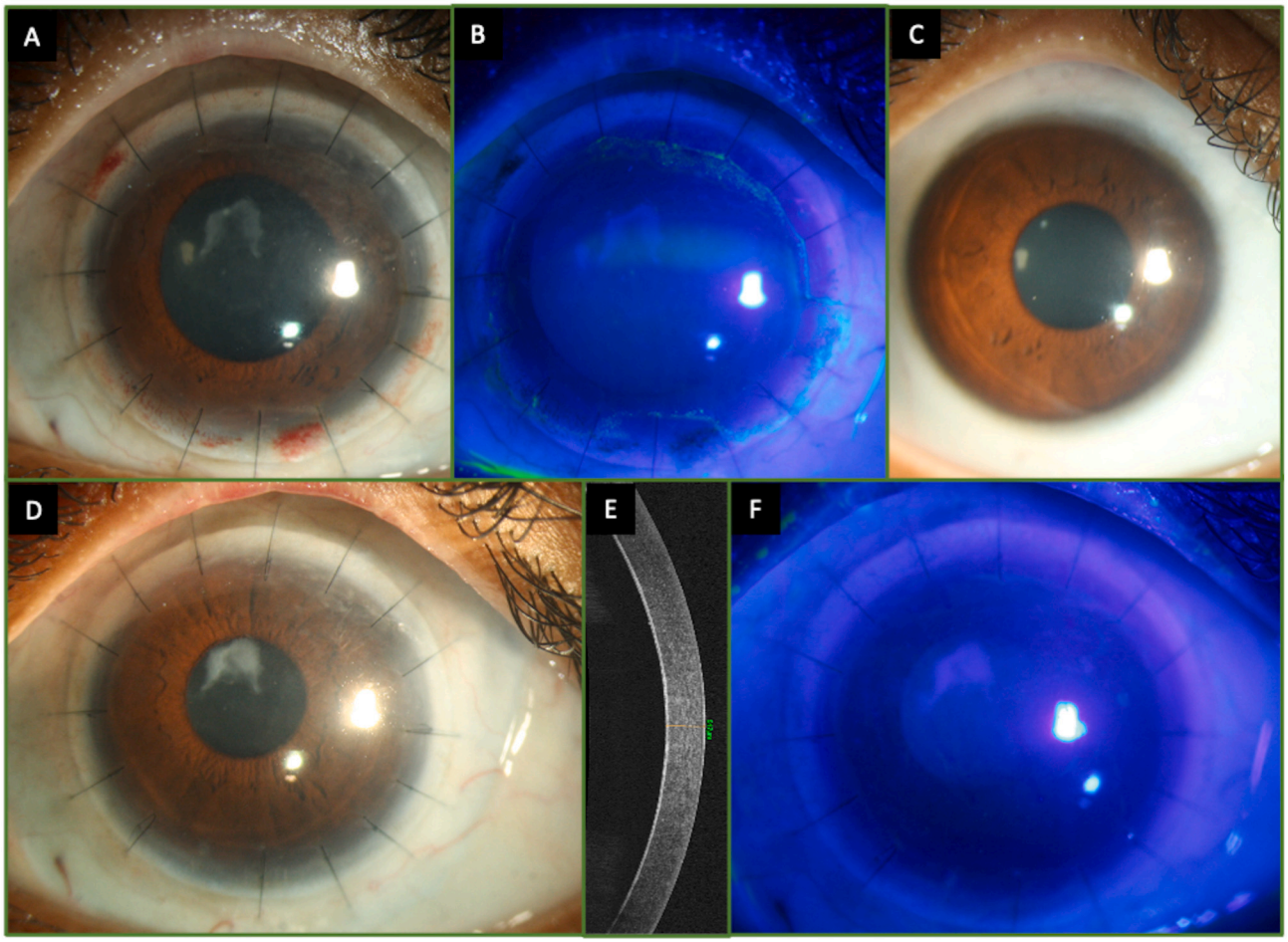


**Fig. 3.** This collage of images shows the postoperative three months (A, B, C) and 6 months (D, E, F). A) A clear graft with a well epithelialized surface that is stain negative (B) (C)Donor site from the right eye is healthy with no focal limbal stem cell deficiency (LSCD) D) Graft clarity is maintained E) OCT line scan showing the level of manual dissection to be up to the pre-descemetic layer F) A well epithelialized surface with no stain positive areas is noted.

decreased antigenic load from an autologous graft is of particular importance when a keratoplasty is also planned to reduce the risk of graft rejection.

## 4. Conclusion

Our case details a one-stage procedure of mini-CLAU with DALK which ensures that there is no delay in the visual rehabilitation of the patient. It also highlights the efficacy of mini-CLAU, with only 2–3 clock-hours of LSC, in maintaining a stable epithelial surface in cases of total LSCD. These smaller grafts also preserve the integrity of the donor limbus. Thus, this novel combination is a viable option for restoring both the visual function and the epithelial stability in cases of chronic chemical injury.

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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## Provenance and peer review

Not commissioned, externally peer-reviewed.

## Ethical approval

Ethics committee approval was not required for this manuscript because it is a clinical case report.

## Research registration (for case reports detailing a new surgical technique or new equipment/technology)

Not applicable.

## Patient perspective

After undergoing multiple interventions without any significant visual or cosmetic gain I was worried and stressed. However, after I underwent the corneal and limbal stem cell transplant I was very satisfied with the outcome especially in terms of the vision.

## Guarantor

Dr. Sayan Basu

## CRediT authorship contribution statement

Study concept or design: SYB
Writing and revising the paper: AK, SYB

## Declaration of competing interest

The authors have no conflicts of interest to declare.

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