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

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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 clockwise 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...
stroma was reached. A corneal button from a 40-year-old donor, with an endothelial count of 3105 cells/mm², 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. 2 F).

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: I) A CAG measuring 10 × 4 mm; II) Two separate CLAUs including the limbal tissue and 2 × 2 mm of the adjacent conjunctiva. The CAG was secured using fibrin glue (Tissuek 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
initial postoperative years [1–3]. The choice of a full-thickness versus a lamellar graft will depend upon 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° 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
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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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

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.
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.

References

[1] Y.F. Yao, B. Zhang, P. Zhou, J.K. Jiang, Autologous limbal grafting combined with deep lamellar keratoplasty in unilateral eye with severe chemical or thermal burn at late stage, Ophthalmology 109 (2002) 2011–2017, https://doi.org/10.1016/s0161-6420(02)01258-7.

[2] R. Fogla, P. Padmanabhan, Deep anterior lamellar keratoplasty combined with autologous limbal stem cell transplantation in unilateral severe chemical injury, Cornea 24 (2005) 421–425, https://doi.org/10.1097/01.ico.0000151550.51556.2d.

[3] M. Omoto, S. Shimmura, S. Hatou, Y. Ichihashi, T. Kawakita, K. Tsutoda, Simultaneous deep anterior lamellar keratoplasty and limbal allograft in bilateral limbal stem cell deficiency, Jpn. J. Ophthalmol. 54 (2010) 537–543, https://doi.org/10.1007/s10384-010-0079-9.

[4] C. Panthier, M. Bouvet, G. Debellemiere, D. Gatine, Conjunctival limbal autografting (CLAU) combined with customised simple limbal epithelial transplantation (SLET) in a severe corneal chemical burn: case report, Am. J. Ophthalmol. Case Rep. 20 (2020), 100906, https://doi.org/10.1016/j.ajoc.2020.100906.

[5] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, SCARE Group, The SCARE 2020 guideline: updating consensus Surgical Case Report (SCARE) guidelines, Int. J. Surg. 84 (2020) 226–230, https://doi.org/10.1016/j.ijsu.2020.10.034.

[6] N. Gupta, J.H. Farooqui, N. Patel, U. Mathur, Early results of penetrating keratoplasty in patients with unilateral chemical injury after simple limbal epithelial transplantation, Cornea 37 (2018) 1249–1254, https://doi.org/10.1097/ICO.0000000000001681.

[7] V.S. Sangwan, M. Fernandes, A.K. Bansal, G.K. Vemuganti, G.N. Rao, Early results of penetrating keratoplasty following limbal stem cell transplantation, Indian J. Ophthalmol. 53 (2005) 31–35, https://doi.org/10.4103/0301-4738.15282.

[8] S.K. Rao, R. Rajagopal, G. Sitalakshmi, P. Padmanabhan, Limbal autografting: comparison of results in the acute and chronic phases of ocular surface burns, Cornea 18 (1999) 164–171, https://doi.org/10.1097/00003226-199903000-00004.

[9] S.M. Moldovan, V. Borderie, M. Baudrimont, L. Laroche, Treatment of unilateral limbal stem cell deficiency syndrome by limbal autograft, J. Fr. Ophtalmol. 22 (1999) 302–309.

[10] R. Shah, C. Puranik, A. Mohamed, V.S. Sangwan, Cultivated limbal epithelial transplantation and penetrating keratoplasty postchemical injury: a 14-year follow-up, BMJ Case Rep. (2017), https://doi.org/10.1136/bcr-2016-217372.

[11] A. Kheirkhah, V.K. Raju, S.C.G. Tseng, Minimal conjunctival limbal autograft for total limbal stem cell deficiency, Cornea 27 (2008) 730–733, https://doi.org/10.1097/QIA.0b013e31815cee8b.