



## Original Research Article

## Assessment of surgical outcome using simple limbal epithelial transplantation in patients of unilateral ocular surface chemical burn: Case series

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## ABSTRACT

**Purpose:** This study aimed to report the surgical outcomes of autologous Simple limbal epithelial transplantation (SLET) performed for unilateral limbal stem cell deficiency (LSCD) following chemical injury.

**Materials and Methods:** This was single centre prospective case series of patients who developed unilateral LSCD after chemical injury and underwent SLET between December 2018 and September 2019 with follow up of 3-6 months. Primary outcome was restoration of completely epithelized avascular corneal surface. The secondary outcome was percentage of eyes which gained vision.

**Results:** This study included 5 eyes of 5 patients with follow up of 3-6 months. Stable corneal surface was obtained clinically in 4 cases out of 5 and visual acuity gain seen in 3 patients. The factors associated with failure of vision improvement were time of chemical injury (during childhood), duration of injury to SLET procedure and previous history of surgical procedure. Complications seen are haemorrhage under hAM, focal recurrence, symblepharon, keratitis and loss of explants post operatively.

**Conclusion:** Autologous SLET is an effective and safe modality for the treatment of unilateral LSCD. It causes stabilization of ocular surface and also facilitates visual improvement. In a developing country like India, with limited facilities in the healthcare system, auto-SLET is a boon for patients with unilateral LSCD.

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### 1. Introduction

Blindness continues to be one of the major public health problems in developing countries. Cataract and corneal diseases are major causes of blindness in countries with less-developed economies.

Out of all the causes for corneal blindness, chemical injuries carry a poor prognosis as they may result in damage of the limbal stem cells and cause limbal stem cell deficiency (LSCD). Chemical injuries to the eye can produce extensive damage to the ocular surface leading to visual impairment and disfigurement therefore there is need of LSCT to prevent this potentially blinding condition. Depending on the source of the donor tissue, LSCT can

either be autologous (from the unaffected fellow eye of the same person) or allogeneic (from another person).

Various treatment modalities have been described over the past few decades for the treatment of limbal stem cell deficiency including Conjunctival limbal autograft (CLAU), keratolimbal allograft (KLAL), Cultivated limbal epithelial transplantation (CLET), Simple limbal epithelial transplantation (SLET).

Simple Limbal Epithelial Transplantation (SLET) is a surgical technique first described by Dr. Sangwan<sup>1</sup> in 2012 for the treatment of limbal stem cell deficiency (LSCD). SLET is a reproducible, single stage technique without the need of a special laboratory setup.

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## 2. Materials and Methods

It was a single centre prospective interventional case series study conducted over a span of one year from December 2018 to November 2019. The proposed study was carried out at the Regional Institute of Ophthalmology (M.D. Eye Hospital, Dr. Katju Road, Nakhas Kona, Prayagraj) after taking permission from ethical committee of M.L.N. Medical College, Prayagraj. After examining 15 patients of Chronic LSCD randomly, 5 patients were undertaken for SLET surgery. The study included the chronic cases of chemical injury (Acid and alkali injury) and excluded the cases of LSCD secondary to causes other than chemical injury or cases with dry eye.

Pre operatively all patients underwent general and ophthalmic evaluation which includes history (demographic details, etiology of LSCD, injury to presentation duration, prior surgery performed, presentation to SLET duration), general Examination, best corrected visual acuity (BCVA), ocular examination including slit lamp examination (presence or absence of eye lid abnormalities, symblepharon and persistent epithelial defects were noted), anterior segment OCT, B-scan ultrasonography, blood investigation (haemoglobin, total leucocyte count, differential leucocyte count, blood sugar, HIV, HBsAg, HCV antigen, coagulation profile).

### 2.1. Anterior segment OCT

Scan images were taken by high-definition cirrus optical coherence tomography (Cirrus HD OCT software version 6.5.0.772; Carl Zeiss Meditec).

Pre operative anterior segment OCT is essential before planning a simple limbal epithelial transplant in cases of chemical injury, in order to-

1. Assess the level of corneal scarring.
2. Rule out pre existing corneal perforation.
3. Assess corneal thickness in order to observe vulnerable areas to avoid perforation intra operatively.

Patients were followed for minimum of 3-6 months period

1. Visual acuity: at every visit
2. S/L examination: at every visit

## 3. Observation and Results

During this study, we have examined 15 patients of chronic limbal stem cell deficiency out of which, after thorough slit lamp examination and ruling out dry ocular surfaces, we have performed simple limbal epithelial transplantation.

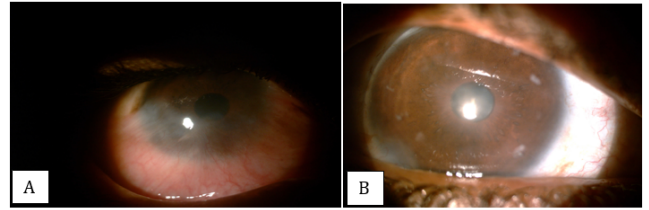


Fig. 1:

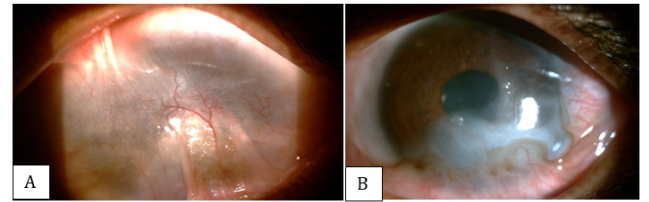


Fig. 2:

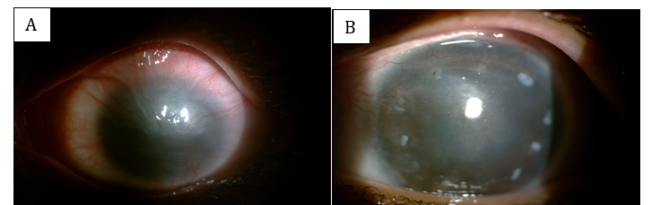


Fig. 3:

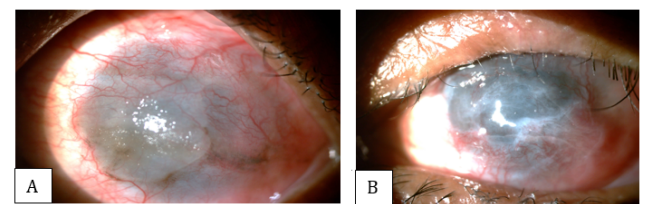


Fig. 4:

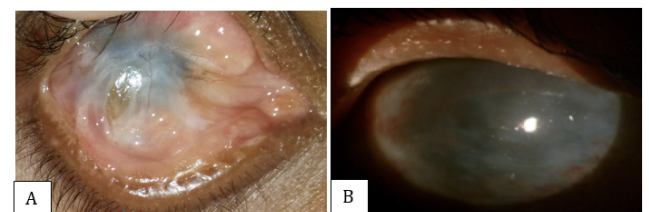


Fig. 5:

**Table 1:** Characteristics of patients undergoing simple limbal epithelial transplantation for unilateral limbal stem cell deficiency

Characteristics	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
<b>Sex</b>					
Male/ Female	Male	Male	Male	Female	Female
<b>Laterality</b>					
Right/ Left	Right	Left	Left	Left	Right
<b>Cause of ocular burn</b>					
Alkali/ Acid/ Thermal/ Unknown	Alkali	Alkali	Alkali	Alkali	Alkali
<b>Prior ocular surgery</b>					
AMG/LSCT/Other/None	None	None	None	Yes but details not available	AMG –assessed preoperatively. MMG-clinically seen
<b>BCVA at presentation</b>					
6/60 or worse/6/60 or better/	6/18	HM	HM	HM	HM
<b>Final BCVA</b>					
6/60 or worse/6/60 or better	6/12	6/60	CF 2M	HM	HM
<b>Symblepharon</b>					
Yes/ No	No	Yes Superiorly and inferiorly (partial)	Yes Superiorly (partial)	No	Yes Superiorly (almost total)
<b>Extent of LSCD(clock hours)</b>					
Total 12/Partial 6-11	Partial	Total	Total	Total	Total
<b>Duration between ocular burn and SLET</b>					
Follow up after SLET	10 year	8 year	8 months	10year	10 year
<6 months/ >6 months	7 months	6 months	4 months	4 months	3 months

#### 4. Discussion

In this study, the simple limbal epithelial transplantation technique was used to restore corneal epithelium in 5 patients with unilateral stem cell deficiency. Out of all the causes of limbal stem cell deficiency, we found that chemical injury due to alkali contributes maximum number.

##### 4.1. Prognostic categorization of patients

Ideal patient for this procedure(SLET) are patients with unilateral stem cell deficiency with clinically non inflamed wet ocular surface. schirmer's test and fluorescein staining was done pre operatively to assess the degree of wettability. Prognostic categorization was done based on presenting features in the affected eye. Schirmer's test was done it was found that out of 5 patient studied, 3 patient shows normal

>15mm of wetting of schirmer's strip, 1 patient shows mild and 1 patient shows moderate grade of schirmer's test.

Patient 1 had minimal conjunctival inflammation with absent dryness no prior history of AMG, or history of multiple surgery previously. No eye lid abnormality was seen, organised anterior segment and normal digital IOP. Patient 2 has presence of symblepharon superiorly with no history of previous surgery. Patient 3 presented to us 10 months back in acute phase of lime injury and was managed conservatively. After two months patient developed LSCD, it was complicated by presence of symblepharon superiorly and inferiorly. Patient 4 had history of multiple surgeries previously, there was severe conjunctival inflammation, a patch of keratinization and corneal thickness of 300 micron was present and schirmer's in this case was of moderate grade. Patient 5 too had history

of previous surgery elsewhere, presence of symblepharon superiorly, keratinization with adequate stromal and pannus thickness, history of MMG was assessed clinically and intraoperatively it was found amniotic membrane graft was done. As per the grading of limbal stem cell deficiency patients given by Shanbag et al,<sup>2</sup> Patient 1,2 3 were graded as fair and patient 4,5 as poor.

#### 4.2. Ocular surface stabilisation

In our study, stable corneal surface was achieved in 4 (80%) cases out of 5 by 2 weeks. Patient 4 got epithelial defect at post operative day 21 which healed by 4 weeks. In patient 5 we found epithelial defect in inferior cornea at day 14, so we placed the bandage contact lens thereafter again, patient had stable ocular surface by 4 weeks. Sangwan et al<sup>1</sup> followed patients for 1 year and found a completely avascular and stable surface by 6 weeks in all six patients he studied. SLET with sandwich technique was done by Amescua et al<sup>3</sup> in 4 patients with unilateral partial (2 eyes) and total (2 eyes) limbal stem cell deficiency secondary to ocular burn. Regular corneal epithelium and a quiet ocular surface was obtained in all 4 patient by 4 weeks. A multicentric study by Vazirani et al<sup>4</sup> was done in 68 eyes of 68 patients who underwent SLET across eight centre in three countries. 57 patients (80%) were having completely, avascular corneal surface.

#### 4.3. Complications

No studies have reported serious adverse outcomes of the donor eye. Localised, non progressive focal LSCD of donor site was reported in two cases which do not affect visual acuity in study by Vazirani et al.<sup>4</sup> Pyogenic granuloma was also reported in two donor eyes at the site of limbal tissue excision in a study by Basu et al.<sup>5</sup> The most common complication of the recipient eye after SLET was focal recurrence of LSCD which was reported in 18% to 31% eyes.

We found that none of the fellow eyes demonstrated any donor site LSCD or other complications. Typically, the donor site epithelial defect had completely healed by 1 week. The most common observation in the donor eye was subconjunctival haemorrhage, which resolved by 1 month in all cases.

In our study, in the recipient eye focal recurrence was seen in second patient (20%) after 2 months, symblepharon in third patient (20%), self limiting haemorrhage under amniotic membrane in 4 patients (80%), loss of transplants in one patient (20%), keratitis in fourth patient (20%).

In our series of patients, early complication (<3 days) included haemorrhage under amniotic membrane which usually resolved without any consequences. Intermediate complication (4-15days) included epithelial defect, and microbial keratitis. Delayed complication (15 days- 3

months) which were seen in our patients includes neovascularization, focal recurrence and symblepharon.

Focal recurrence was noticed in the area of maximum severity of preoperative symblepharon. Hence, one of the causes for such recurrence could be the extensive damage of the conjunctiva during initial injury and a focal loss of the conjunctival stem cell. Since, the focal recurrence in our patient was neither progressive nor encroaching the pupillary area, we do not opted for resurgery.

Neovascularisation was seen in patient 1 after SLET surgery at day 45 which was managed by giving oral steroids. This is contrary to previous studies because most of the immunological rejection is seen following allogenic simple limbal epithelial transplantation. But since the neovascularisation regressed following the administration of oral steroids, we believe that there may be a component of immunity involving auto-SLET as well.

Patient 4 (20%) presented with microbial keratitis at post operative day 7 with loss of amniotic membrane with loss of limbal grafts. None of the previous studies mentioned clearly about the microbial keratitis following SLET. Nevertheless, since total corneoscleral surface is bared, and post operatively steroid drops were instilled, it could be well appreciated that loss of amniotic membrane will predispose to infection.

#### 4.4. Risk factors

We found presence of symblepharon, post operative loss of limbal grafts history of previous surgery, duration of injury to SLET duration were the possible risk factors for the poor outcome of the surgery. To avoid perforation, thin corneas should be identified using an OCT before the surgery. However, OCT examination is not full proof for avoiding perforation intraoperatively and one should be ready with cyanoacrylate glue &/or tenon patch graft for management of perforation.

#### 4.5. Visual acuity

Rates of improvement of visual acuity in this study are comparable with those reported in earlier studies. In our study, improvement of visual acuity was seen in 3(60%) patient out of 5 cases operated. Pre-SLET visual acuity were HM (four eyes), 6/18 (one eye). Post SLET visual acuity were 6/12 (one eye), 6/60 (one eye), CF (one eye), HM (two eyes) at final follow-up. A longer injury to SLET duration have poor impact on prognosis of results. Two patients achieved stable corneal surface but with only one line improvement of vision, the probable explanation would be amblyopia. In a study by Vikas Mittal et al,<sup>6</sup> he recommends timely SLET in paediatric patients of LSCD in order to avoid amblyopia as well as timely management of amblyopia. Visual acuity improved from worse than 6/60 in all recipient eyes before surgery to 6/12 or better in all four

eye(100%) in a study by Sangwan et al.<sup>1</sup>

## 5. Limitations

One of the lacunae in our study was the smaller sample size, but review of literature also shows that the smaller size in previous studies as chemical injury patients are infrequent. Out of chemical injury patients only few percent of patients are ideal candidates for SLET. We have encountered 15 patients of chronic LSCD, out of those we performed surgery in only 5 patients because patients selection is important criteria for success of SLET surgery.

Procurement of amniotic membrane and use of BAXTER glue were the cost limiting factors in this study as we have conducted study in a regional institute, most of the patients were from poor socio economic background. We need more patients and longer follow-ups to assess the exact surgical outcome. However, the initial results are very encouraging. We believe especially in developing countries, where the patients cannot afford expensive surgeries like CLET, it should be treatment of choice for unilateral LSCD.

The uniqueness of this study is its authenticity, with a minimum follow-up of at least 6 months involving a regional institute of mostly rural population. Furthermore, a single surgeon, eliminating chances of interobserver variations, did the surgery and all the follow-ups.

## 6. Conclusion

To conclude, considering the satisfactory initial results we obtained in four of our five patients, it seems that the SLET technique may be a good alternative in treating unilateral total limbal stem cell deficiency. Some modifications must be devised to allow its usage in dry eye patients, as majority of the chronic LSCD patients on which we couldn't operate were of dry eye.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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