**Performing Descemet Membrane Endothelial Keratoplasty (DMEK) under a fibrovascular pannus due to chemical burn**

Short running title:

Endothelial keratoplasty after severe chemical burn.

**INTRODUCTION**

This case demonstrates the value of endothelial lamellar transplantation in patients with corneal edema secondary to chemical burn. Chemical injury of the eye is a potentially blinding ocular emergency, most commonly affecting young men. Two-thirds of burns result from an alkali chemical, which often cause more extensive damage than acids. Conjunctival and corneal epithelial damage can lead to opacification and neovascularization of the cornea. Deep penetration of the chemical substance into the anterior segment can cause damage to corneal endothelium, ciliary body and trabecular meshwork and cataract formation, which is often overlooked as the ocular surface damage can obscure the view. Because of the lipophilic nature, alkali agents penetrate more easily and deeply than acids [[1-4](#_ENREF_1)].

The goals of treatment are to normalize ocular surface, prevent glaucomatous damage and improve vision and corneal clarity. The focus in initial treatment is closure of the corneal epithelium, control of intraocular pressure and reduction of inflammation. In the longer term, we can aim to improve vision by LSC transplantation or keratoplasty [[2-5](#_ENREF_2)].

Keratoplasty is useful to improve vision in case of corneal edema or stromal scarring. Open sky keratoplasty is the technique which is regularly used in these patients because decreased corneal clarity compromises an endothelial lamellar approach [[2](#_ENREF_2), [6](#_ENREF_6)].

**CASE DESCRIPTION:**

**Preoperative course**

A 41-year-old man presented to the emergency department for the treatment of a severe work-related bilateral chemical and thermal burn due to cement. He was immediately treated with vigorous eye irrigation but despite this, slit lamp examination revealed bilateral, pale “boiled fish” corneas with limbal ischemia. He was diagnosed with severe ocular chemical burns and graded as Roper Hall grade IV and Dua grade V chemical burns bilaterally (Figure 1A). The best corrected visual acuity of both eyes at presentation was 0.16 (decimal ETDRS score). The further acute treatment consisted of preservative free corticosteroids and antibiotic medication. Systemic treatment with vitamin C, doxycycline and acetazolamide was also started for the first weeks. An amniotic membrane transplantation was performed in both eyes together with placement of a symblepharon ring (Figure 1B).

Autologous serum drops hourly were added to the treatment to promote epithelial closure and support any limbal stem cell (LSC) population that remained. In the left eye, some normal corneal epithelium did grow indicative of some residual LSC function, though it was accompanied by a degree of conjunctival ingrowth. In the right eye however, there was total LSC failure and the conjunctiva formed a complete fibrovascular pannus (Figure 2A). One year after initial presentation, the conjunctivalized epithelium remained closed but the vision had reduced to counting fingers, and the stroma was very thickened and edematous (Figure 4A). Endothelium could not be visualized for specular microscopic counting. We decided to perform a phakic Descemet Membrane Endothelial Keratoplasty (phakic DMEK) to resolve corneal edema as this is a minimally invasive approach. We were concerned at this point whether the limited corneal clarity would impede the procedure.

Afbeelding met binnen

Automatisch gegenereerde beschrijving

***Figure 1****: Preoperative course. One day after presentation (A) showing a pale ‘boiled fish’ cornea with limbal ischemia. We performed an amnion membrane transplantation and symblepharon ring placement (B) the first week.*

**Surgery:**

We use preoperative pilocarpine to constrict the pupil as standard in our DMEK surgery but it is particularly important in phakic DMEK cases to reduce the change of iatrogenic cataract.

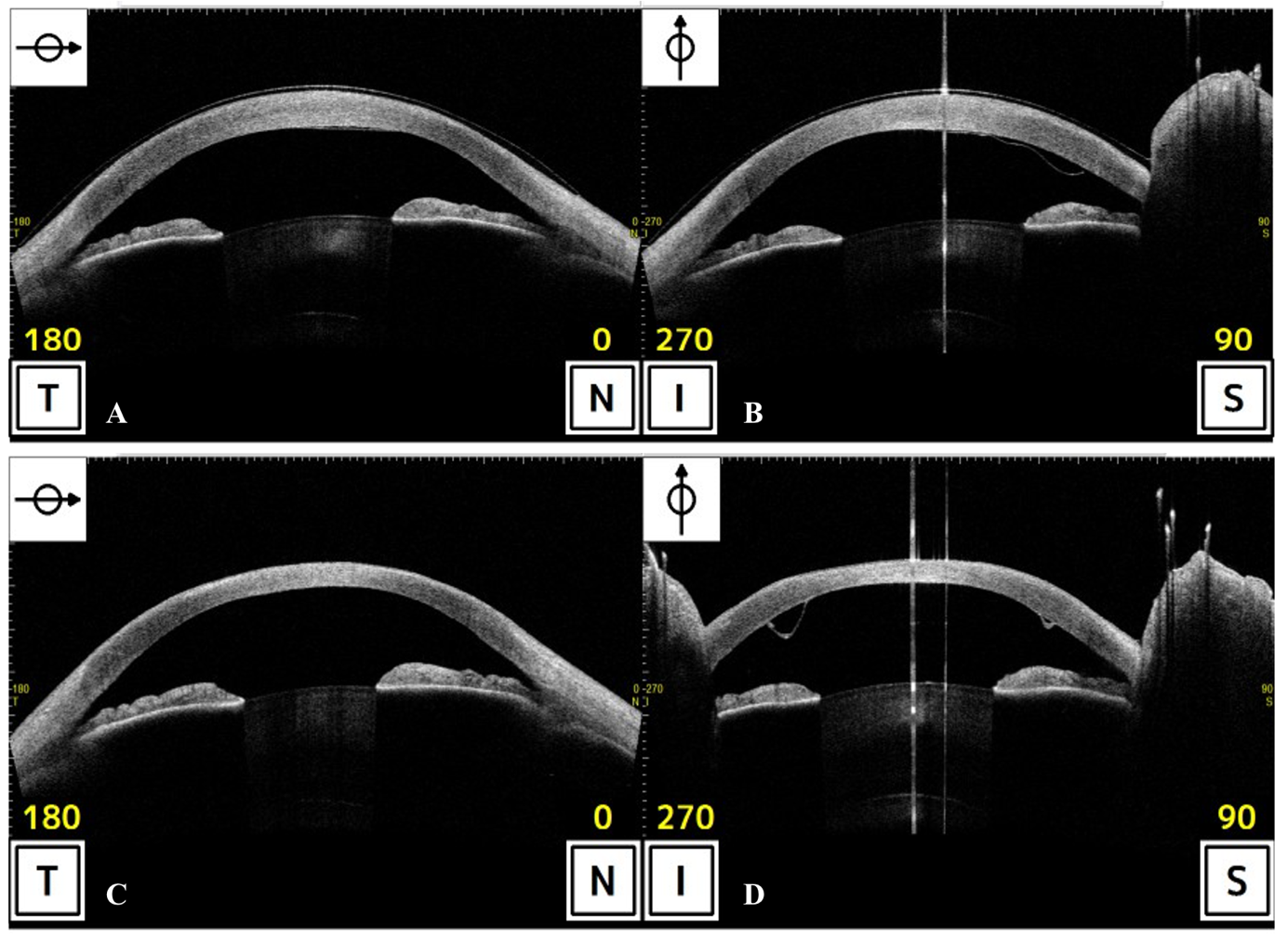
Visibility at start of the surgery was poor (Figure 2A) so we started the case with an excision of the corneal conjunctivalization, pannus tissue and hazy epithelium using a crescent knife. This led to better visibility of corneal endothelium and anterior chamber (Figure 2B), and the surgery could be performed, though under a hazy cornea (Figure 2B-D). The descemetorhexis was complicated by the presence of a retrocorneal membrane which had to be removed using a descemetorhexis forceps, after which the endothelium could be scored and peeled in the normal way. Intraoperative OCT was of considerable added benefit as we could use it to ensure the correct orientation of the graft prior to lifting the DMEK with air (Figure 2C). The eye was pressurized for 30 minutes after which the air bubble was reduced to 50% and pressurized with balanced salt solution (BSS). Subconjunctival antibiotics and corticosteroids were then administered to complete the case.

Afbeelding met tekst

Automatisch gegenereerde beschrijving***Figure 2:*** *Intraoperative course. Visibility at start of the surgery was poor (A) and we performed an excision of fibrovascular pannus using a crescent knife. After this, the visibility of corneal endothelium and anterior chamber improved (B). Intraoperative OCT was used to ensure correct graft orientation (C). The DMEK graft was correctly oriented and aligned against the stroma at the end of the procedure (D).*

**Postoperative Course**

The postoperative period was complicated by two episodes of detachment graded more than 30% (Figure 3B). A rebubble was performed twice, 2 weeks and 4 weeks after the operation. While most of the graft could be attached to the stroma, a small curl in the graft remained (Figure 3D). Three weeks after the second rebubble, the corneal edema decreased. Central pachymetry on corneal OCT decreased from 1077 µm preoperative to 586 µm (Figure 4). His vision also improved slightly, with a visual potential of 0.4 with pinhole. The corneal epithelium healed and remained closed with limbal vascularization confined to the periphery (Figure 5).



***Figure 3****: Anterior segment OCT before second rebubble showing graft detachment of > 30% (A, B). After rebubbling, the graft was attached and a small curl inferotemporal remained (C, D).*

Afbeelding met tekst, binnen, verschillend, scherm

Automatisch gegenereerde beschrijving

***Figure 4****: Topography measurements by corneal OCT showing corneal pachymetry preoperatively (A) and 3 weeks postoperatively (B).*

*Afbeelding met oranje, plastic, cosmetisch, sluiten

Automatisch gegenereerde beschrijving*

***Figure 5****: Postoperative slit lamp examination.*

**DISCUSSION:**

While the commercial corneal LSC product for LSC transplantation is approved in Belgium, it was not a viable option for this patient since this is an autologous graft meaning that the donor cells must be harvested from the patient’s contralateral eye. His small region of functional cells was too limited to harvest as doing so could compromise the sight of his better eye. LSC transplantations with autograft are therefore not an option for severe bilateral burns. Limbal allograft from a healthy donor (preferably a relative) is an option but results are poor with limited long-term success rates and multiple complications such as rejection [[7](#_ENREF_7), [8](#_ENREF_8)]. Penetrating keratoplasty can be performed, but this has high risks of postoperative complications and rejection.

The patient is our case suffered from corneal edema due to endothelial damage, which made the cornea hazy. We decided to perform a Descemet membrane endothelial keratoplasty (DMEK) instead of the traditional penetrating keratoplasty because recent data suggest that improving the corneal edema, together with topical corticosteroids, can provide improvements in vision despite LSC failure [[9](#_ENREF_9)]. The advantage of this lamellar technique is a reduced risk of rejection and lack of suture-related complications. There is nevertheless a higher rate of graft detachment and rebubble in eyes with a history of trauma, which may lead to early graft failure [[10](#_ENREF_10), [11](#_ENREF_11)]. Poor visibility during surgery may compromise anterior segment surgery, although clarity can be improved intraoperative by removing overlying epithelial haze, conjunctivalization and pannus tissue. The use of intraoperative OCT can also help to improve safety and visibility during DMEK procedure [[5](#_ENREF_5), [12](#_ENREF_12)].

Alleviating corneal edema leads to improvement of vision and corneal clarity, even in the presence of LSC failure [[5](#_ENREF_5)]. A healthy corneal endothelium and stroma can also reduce epithelial thickness and corneal neovascularization [[13](#_ENREF_13)] making DMEK a viable, minimally invasive option to provide modest clinical improvement in these difficult-to-treat cases.

**CONCLUSION:**

Paradoxically, endothelial keratoplasty is a useful treatment option in patients suffering from corneal edema after chemical burn. Visual acuity and epithelial function may improve by relieving edema. A hazy and vascularized epithelium due to the chemical damage is not a contra-indication for a posterior lamellar technique if performed by experienced surgeons.

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