• Letter to the Editor •

# Trans-PRK for recurrent epithelial corneal erosion induced by cooking oil accidentally after EVO ICL

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**Dear Editor,**

We report a case with trans-photorefractive keratectomy (PRK) for recurrent epithelial corneal erosion caused by cooking oil after EVO-implantable contact lens (ICL) (EVO Visian ICL; STAAR Surgical AG, Switzerland), which should be distinguished from postoperative complications of EVO-ICL. Most corneal burns are classified as chemical and thermal burns, referring to direct contact injury to the cornea. Corneal morphology changes and symptoms, such as eye discomfort, blurred vision, or loss of visual acuity, may occur immediately following such burns[1]. Few studies have reported corneal thermal burns caused by cooking oil after ocular surgery especially for EVO-ICL, which required differential diagnosis. Herein, we present a case that demonstrates how to distinguish corneal morphological changes. Written informed consent was obtained from the patient for all the information mentioned above and the study adhered to the principles of the Declaration of Helsinki.

A 31-year-old woman complained of wearing glasses for >10y and requested refractive surgery. She wore soft contact lenses for 10y and stopped contact lens use for 3y. The patient's medical history showed that she had keratitis in 2002, but she denied other diseases or surgeries. After medical history and ocular examination, she was diagnosed with high myopia and astigmatism binocularly. She was administered artificial tear eye drops 4-6 times per day and re-examined 25d later. Examination, including corneal topography (Pentacam, Oculus Optikgeräte GmbH, Wetzlar, Germany), ultrasound biomicroscopy, and optical coherence tomography (OCT), indicated that her minimum corneal thickness values were 546 μm in the right eye and 542 μm in the left eye; the anterior chamber depth values were 2.91 mm in the right eye and 2.90 mm in the left eye; the steep keratometry (K) values were 43.8 and 43.6 diopters (D), respectively; and the mean K values were 43.8 and 44.1 D, respectively. After following up for 6mo, the patient's refractive values tended to be stable. The manifest refraction was -8.75/-0.75×70 with a corrected distance visual acuity (CDVA) of 20/22 in the right eye and 9.00/-1.25×20 with a CDVA of 20/25 in the left eye. The patient underwent bilateral EVO-ICL surgery and follow up examinations included uncorrected visual acuity (UCVA), manifest refraction, intraocular pressure (IOP), and vault (Table 1). No complications were observed during this period.

Nine months postoperatively, the patient presented to our hospital with a chief complaint of sudden loss of visual acuity and blurred vision in the left eye. The manifest refraction was -1.00/-1.00×55 with a CDVA of 20/25, IOP of 14.6 mm Hg, and vault of 530 μm. The minimum corneal thickness remained stable, the steep K value was 44.5 D, and the mean K value of 45.2 D. The corneal density map showed high-density reflection in the inferior nasal epithelium of the central cornea of the left eye (Figure 1A), which can also be seen on the corneal epithelium map (Figure 1B) and confocal microscopy (Figure 1C). A cord of hyperreflective substance was attached below the cornea, and the corneal endothelium in this area

**Table 1 Examination data after binocular TICL operation**

| Time | UCVA | | IOP (mm Hg) | | Manifest refraction | | Vault (μm) | |
|---|---|---|---|---|---|---|---|---|
| | OD | OS | OD | OS | OD | OS | OD | OS |
| 1d | 20/25 | 20/20 | 14.4 | 15.3 | NA | NA | 480 | 600 |
| 1wk | 20/25 | 20/20 | 13.2 | 14.1 | NA | NA | NA | NA |
| 1mo | 20/16 | 20/20 | 13.1 | 14.1 | -0.75/-0.25×130 | -0.5/-0.5×42 | 480 | 600 |
| 3mo | 20/16 | 20/20 | 12.3 | 13.6 | NA | NA | 470 | 570 |
| 6mo | 20/16 | 20/20 | 15.6 | 15.2 | -0.5/-0.5×115 | -1/-0.25×25 | 430 | 530 |

TICL: Toric implantable collamer lens; UCVA: Uncorrected visual acuity; IOP: Intraocular pressure; NA: Not applicable; OD: *Oculas dexter*; OS: *Oculus sinister*.

**Table 2 Progress of visual information during the whole period**

| Time | UCVA | Manifest refraction | CDVA | IOP (mm Hg) | Vault (μm) |
|---|---|---|---|---|---|
| Preoperative | | | | | |
| OD | NA | -8.75/-0.75×70 | 20/25 | 15.8 | NA |
| OS | NA | -9.00/-1.25×20 | 20/25 | 14.1 | NA |
| 1mo post-EVO-ICL | | | | | |
| OD | 20/16 | -0.75/-0.25×130 | 20/16 | 13.1 | 480 |
| OS | 20/16 | -0.5/-0.5×42 | 20/16 | 14.1 | 600 |
| 6mo post-EVO-ICL | | | | | |
| OD | 20/16 | -0.5/-0.5×115 | 20/16 | 15.6 | 430 |
| OS | 20/16 | -1/-0.25×25 | 20/16 | 15.2 | 530 |
| 9mo post-EVO-ICL | | | | | |
| OD | 20/20 | Plano | 20/20 | 14.5 | 400 |
| OS | 20/25 | -1.00/-1.00×55 | 20/25 | 14.6 | 530 |
| 1mo post-trans PRK | | | | | |
| OD | 20/20 | Plano | 20/20 | NA | NA |
| OS | 20/20 | -0.25/-0.50×40 | 20/20 | NA | NA |
| 7mo post-trans PRK | | | | | |
| OD | 20/20 | +0.25/-0.50×115 | 20/16 | 12.0 | 400 |
| OS | 20/16 | +0.50/-0.25×90 | 20/16 | 11.7 | 500 |

UCVA: Uncorrected visual acuity; CDVA: Corrected distance visual acuity; IOP: Intraocular pressure; EVO-ICL: EVO Visian implantable contact lens; STAAR Surgical AG; PRK: Trans-photorefractive keratectomy; NA: Not applicable; OD: *Oculas dexter*; OS: *Oculus sinister*.

was not clearly visible. Local Bowman's layer structure seemed absent on the line scan pattern of OCT measurement (Figure 1D). The patient was then administered artificial tear eye drops 4-6 times per day and re-examined 1mo later. No significant changes were observed in the corneal topographic map. During the follow-up period, the patient was treated with fluorometholone, prednisolone acetate ophthalmic suspension, pranopulin, and tacrolimus, but no obvious improvement was observed. We considered the patient's condition to be a corneal injury in the left eye, which should be differentially diagnosed with epithelium, basement membrane, endothelial lesions of the cornea, and keratoconus. To confirm the diagnosis, the patient was asked for her medical history. The patient stated that hot cooking oil splashed in her left eye 1d before she experienced symptoms. Therefore, she was diagnosed with corneal thermal injury due to cooking oil. Based on the above information, she was treated with trans-photorefractive keratectomy (trans-PRK). The optical treatment zone was 6.5 mm, and the ablation depth was 91 μm. One month after surgery, high-density reflection in the inferior nasal epithelium of the central cornea disappeared, and the manifest refraction was -0.25/-0.50×40 with a CDVA of 20/20. Seven months after surgery, the manifest refraction was +0.50/-0.25×90 with a CDVA of 20/16. A series of corneal topographic image changes were shown in Figure 2 and the progress of visual information was concluded in Table 2. The corneal topography before EVO-ICL implantation was demonstrated in Figure 2A, the corneal topography showed local steepening after cooking oil splash was shown in Figure 2B and the recovered corneal morphology after trans-PRK was shown in Figure 2C. No inflammation or epithelial ingrowth was seen on slit-lamp examination 7mo after treatment.

It is an interesting case of sudden loss of visual acuity and blurred vision in the left eye after EVO-ICL. The symptoms occurred 9mo postoperatively, so the possibility of decreased vision caused by postoperative complications of EVO-ICL or

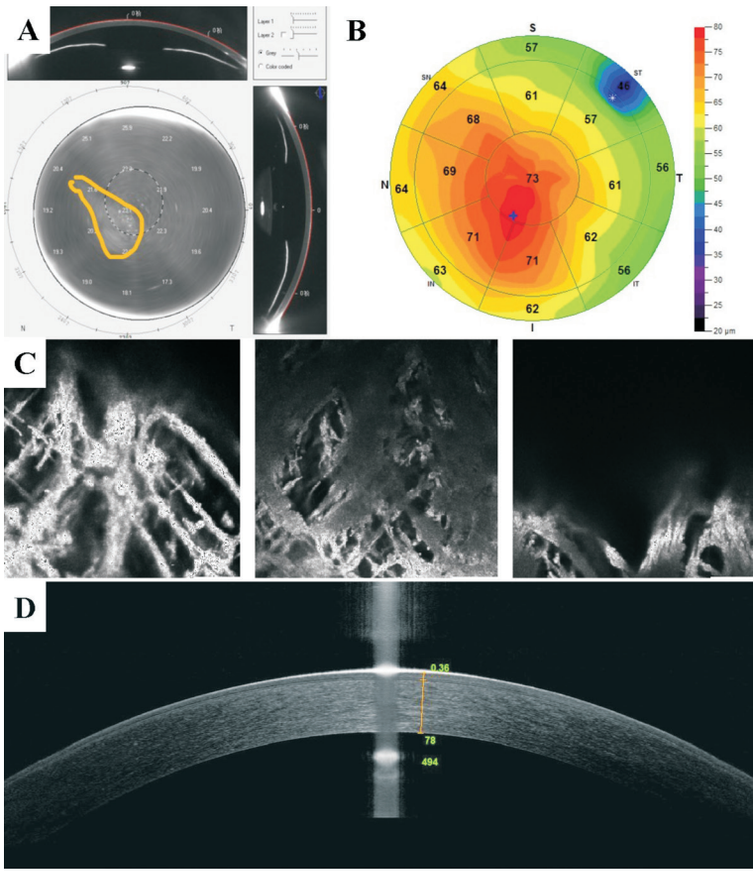


**Figure 1 Results of corresponding examinations** A: Corneal density map showed a high density reflection; B: Epithelium map showed abnormal values; C: Confocal microscopy showed a cord of hyperreflective substance; D: OCT showed local unclear demarcation of the Bowman's structure on cornea. OCT: Optical coherence tomography.

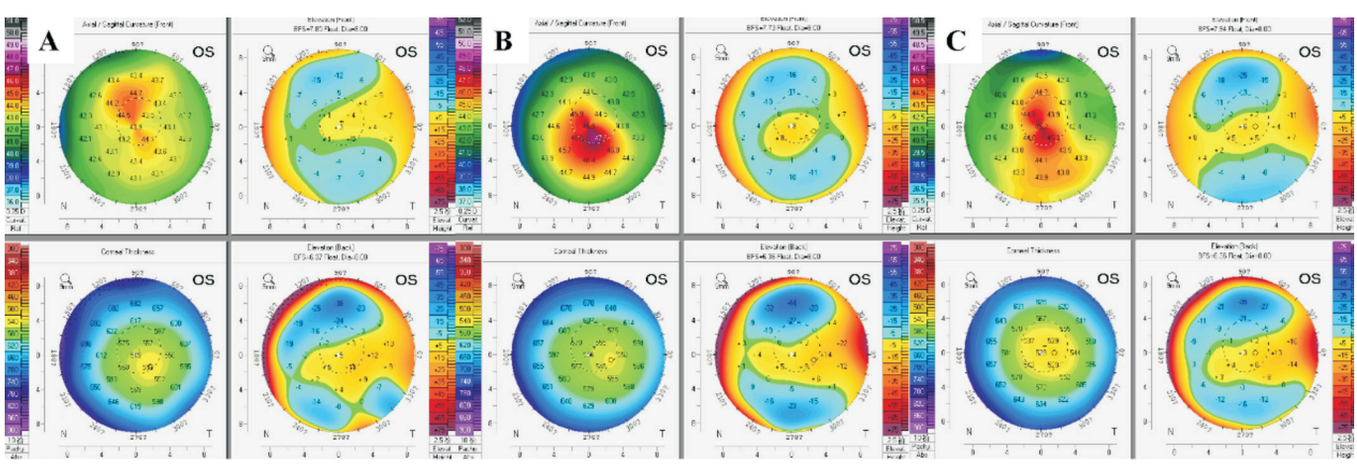


**Figure 2 Corneal topographic images respectively taken during EVO-ICL follow-up period (A), injured by cooking oil (B) and after trans-PRK (C)** ICL: Implantable collamer lens; PRK: Photorefractive keratectomy.

complications related to high myopia should be considered. After a series of ocular examinations and medical history, we highly suspected that the morphological changes of the cornea were due to thermal damage caused by hot cooking oil.

Corneal thermal injury, usually involving the epithelial and Bowman membranes, is characterized by local edema, repeated erosion, corneal vascularization, and intraconjunctival epithelial growth. Corneal ulcers and perforations can be seen in more severe cases[1]. Pain and vision loss are common symptoms. In this case, the patient developed decreased vision acuity 1d after coming into contact with hot cooking oil. Corneal thermal injury can lead to a series of pathophysiological changes. Ruan *et al*[2] reported limbal stem cell deficiency after corneal thermal injury. Ward *et al*[3] found that thermal injury could activate the migration of corneal Langerhans cells to the center of the cornea and release interleukin-1 and tumor necrosis factor-α, stimulating the extension and contraction of dendrites and increasing

the chance of contact with antigen-reactive T cells. Ahn and Kim[4] proposed that a delayed-type hypersensitivity reaction caused by the onset of corneal infiltration after thermal burn would result in collagen contraction and steepening of the corneal center. Similarly, we observed characteristic corneal morphological changes in this patient on a corneal density map and confocal microscopy. However, in the case described by Ahn and Kim[4], diffuse stromal infiltration and slight edema were seen in the injured patient's cornea without significant epithelial defect or anterior chamber reaction. These results suggest that the pathophysiological changes in corneal thermal burns vary with the degree of injury.

Although the corneal epithelium is fragile, it rapidly regenerates. Corneal injury can usually be healed within 24 to 48h through regeneration, migration, proliferation, differentiation of limbal stem cells, and extracellular matrix remodeling, depending on the size and depth of the defect, as reported by Willmann *et al*[1] Based on this characteristic, the treatment of corneal thermal injury focuses on inhibiting inflammation and accelerating corneal epithelialization. In the case reported by Ahn and Kim[4], with the drug combination of prednisolone plus levofloxacin topical treatment and prednisolone systemic treatment for 3wk, the patient's UCVA recovered from 20/250 to 20/20, and the front stromal infiltration was completely eliminated. Since conservative treatment proved to be effective, we treated the patient in this case with a combination of drugs including fluorometholone, prednisolone acetate ophthalmic suspension, pranopulin, and tacrolimus before the pathogenic cause was identified. Unfortunately, no significant improvement was achieved. Due to the patient's delayed healing and the possibility of a fiber scar caused by corneal thermal injury, we chose trans-PRK to reshape the corneal epithelium and weighing pros and cons. The patient recovered well after surgery, and the manifest refraction returned to +0.50/-0.25×90 with a CDVA of 20/16. Therefore, the treatment of corneal thermal injury should be selected according to the actual condition. When antibiotics combined with hormones and other drugs have no obvious effects, surgical laser therapy can be considered. In more serious cases with widespread corneal scarring or a lack of limbal stem cells, limbal stem cell transplantation and amniotic membrane transplantation can be used for treatment[5].

Although this is a rare case, clinicians should be aware that thermal injury of the eye is an ocular emergency that requires appropriate management and treatment after obtaining a complete history and thorough ocular examination.

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**Authors' contributions:** Ma Y and Zhao J interpreted the patient data and drafted the manuscript. Zhao J and Zhou XT critically revised the manuscript. Zhou XT performed the surgery. Zhao J, Shi WR, Wang XY, Niu LL and Yao PJ performed the examination and analyzed the data. All authors read and approved the final manuscript.

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