



Manual Intracorneal Silicone Oil Insertion for Symptomatic Treatment of Bullous Keratopathy in a Patient with Corneal Scarring

Selim Genc, Semih Cakmak, Yusuf Yildirim

Department of Ophthalmology, University of Health Sciences, Beyoglu Eye Training and Research Hospital, Istanbul, Turkey

Abstract

Bullous keratopathy is a result of endothelial loss and the failure of the remaining corneal epithelium to pump leaking water molecules away from the corneal tissue, causing overhydration. In eyes with good visual potential, keratoplasty is the primary treatment. There are also several other approaches to provide temporary improvement until a permanent solution with keratoplasty can be achieved. These alternatives include hypertonic topical sodium chloride (5%) drops, bandage contact lenses, anterior stromal puncture, phototherapeutic keratectomy, amniotic membrane transplantation, conjunctival flaps, and collagen crosslinking. This case report is a description of a different surgical technique using manual lamellar corneal dissection and intrastromal silicone oil insertion to provide symptomatic treatment of bullous keratopathy in an eye with no light perception and significant corneal scarring.

Keywords: Bullous keratopathy, corneal endothelial disease, silicone oil, treatment.

Introduction

Endothelial loss and the failure of the remaining corneal epithelium to pump away the leaking water molecules causes overhydration of the corneal tissue that may present as bullous keratopathy. Fuch's endothelial dystrophy, pseudophakic bullous keratopathy, and many other conditions or substances that can damage the corneal endothelium can result in bullous keratopathy, including anterior chamber intraocular lenses, corneal graft failure, ocular trauma, or the presence of substances in the anterior chamber that can cause endothelial damage, including silicone (1, 2). When the corneal thickness is increased by 30%, there is a greater risk of developing epithelial edema (1, 3). This condition can lead to opacification of the corneal tissue and a severe reduction in visual acuity. In addition, epithelial bullae may develop,

which are very prone to rupture with only minimal trauma, leading to severe pain. Longstanding bullous keratopathy can also lead to corneal infection and corneal scarring (4).

In eyes with good visual potential, keratoplasty is the primary treatment applied in cases of bullous keratopathy. Several other approaches have also been described that may temporarily improve the condition until a permanent solution can be achieved with keratoplasty. These alternatives include hypertonic topical sodium chloride (5%) drops, bandage contact lenses, anterior stromal puncture, phototherapeutic keratectomy, amniotic membrane transplantation, conjunctival flaps, and collagen crosslinking (5–7). Recently, Kymionis et al. (9) reported that a new technique had alleviated the pain of bullous keratopathy in eyes with no visual potential. The authors described a corneal pocket formed with

Address for correspondence: Selim Genc, MD. Beyoglu Goz Egitim ve Arastirma Hastanesi, Saglik Bilimleri Universitesi, Oftalmoloji Anabilim Dalı, Istanbul, Turkey
Phone: +90 532 613 63 91 **E-mail:** gencselim@hotmail.com

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a femtosecond laser and silicone oil added to this pocket to prevent overhydration of the cornea and the development of epithelial edema. Use of a femtosecond laser requires a relatively clear cornea. In this case, a different surgical technique is described using manual lamellar corneal dissection and intrastromal silicone oil applied to provide symptomatic treatment of bullous keratopathy in an eye with no light perception, prognosis, and intense corneal scarring.

Case Report

A 53-year-old female patient presented with pain and lacrimation in the right eye ongoing for 6 months. She had a history of pars plana vitrectomy with a silicone oil tamponade to treat retinal detachment in the same eye 2 years earlier at another ophthalmology clinic. There was no light perception in the right eye and the best corrected visual acuity was 20/20 in the left eye. Slit lamp examination revealed bullous keratopathy in the right eye (Fig. 1a), while the left eye was healthy. The intraocular pressure measured with a Tono-Pen XL applanation tonometer (Reichert Technologies, Depew, NY, USA) was 18 mmHg in the right eye and 15 mmHg in the left eye. The right eye could not be examined with indirect ophthalmoscopy due to corneal opacity. The retina of the left eye was healthy. B-scan ophthalmic ultrasonography (EZ Scan Ophthalmic Ultrasound, AB5500+ A/B Scan; Sonomed Escalon, Wayne, PA, USA) of the left eye confirmed the history of silicone oil insertion without any other posterior segment pathology. Corneal edema was also confirmed with anterior segment optical coherence tomography (OCT) (Visante AS-OCT; Carl Zeiss, Dublin, CA, USA). The central corneal thickness was 1050 μm in the right eye (Fig. 2a). Since the patient had no light perception and no hope of regaining vision, our aim was to protect the eye and alleviate the pain. Therefore, we decided to inject silicone oil into the corneal stroma to prevent leakage of the aqueous humor into the anterior stroma, causing edema and epithelial bullae,

which lead to ocular discomfort and pain.

The patient was operated on under general anesthesia. The corneal epithelium was debrided with the help of an iris spatula to allow visualization of the corneal tissue. A 7.50-mm circular mark was made on the center of the corneal surface in order to be able to observe the exact size of the intrastromal pocket. A 1-mm corneal incision was opened from the limbus at 12 o'clock with a 45° ophthalmic knife to a depth of half of the corneal thickness. The lamellar corneal incision was extended according to the previously made mark at the same corneal depth. An iris spatula was used to dissect the entire marked area in order to construct the pocket. Next, 5000 cSt of silicone oil was injected into the stromal pocket and the corneal incision was quickly closed with 10/0 nylon sutures to prevent leakage of the silicone oil. A slit lamp microscopy image and anterior segment OCT view from the postoperative seventh day can be seen in Figure 2. At postoperative 3 months, our patient's symptoms and epithelial bullous formation were reduced, and no side effects or complications were observed in the follow-up period.

Discussion

In 1965, Levenson et al. (8) published the first experimental study of an intracorneal injection of silicone oil in rabbit and dog models of bullous keratopathy inflicted by mechanical trauma. The authors did not record any tissue reaction associated with the silicone oil implant, and they observed that the silicone oil acted like a barrier that prevented the spread of corneal edema. However, the animals developed anterior stromal atrophy with a crater-like defect covered by epithelium. This was attributed to the presence of a thin anterior stromal tissue and a very thick posterior edematous stroma. In a more recent study, Kymionis et al. (9) formed a stromal pocket for silicone oil insertion with a femtosecond laser and successfully injected silicone oil to prevent the spread of the corneal edema to the anterior stroma. They

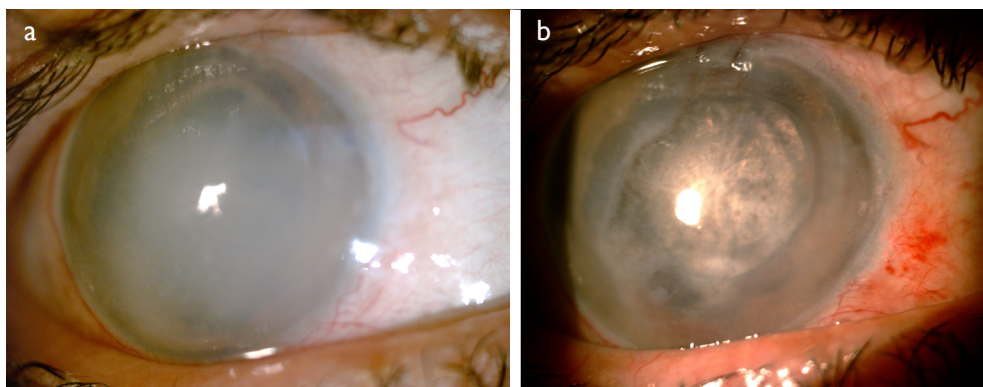


Figure 1. Anterior segment images of the patient. (a) In the preoperative picture, severe corneal edema and bullous keratopathy are visible. (b) The epithelium had improved and the clinical picture of bullous keratopathy had disappeared by postoperative day 7.

reported good postoperative outcomes with improvement in bullous keratopathy and pain. They did not observe any postoperative complications during a follow-up period of 24 to 31 months. Our case had very severe corneal edema, and femtosecond laser-assisted intracorneal pocket formation was not an option due to corneal scarring. Therefore, we designed a different surgical technique to manually construct an intracorneal pocket for silicone oil insertion, which may be useful in patients with corneal scarring.

Silicone oil, as a hydrophobic substance, acted as a barrier to the passage of water to the anterior stroma and prevented the formation of epithelial bullae. This led to resolution of the edema in the anterior stroma and the disappearance of the epithelial bullae. (Fig. 1b and 2b.) The patient's discomfort and pain were relieved following the procedure. The

oxygen supply to the cornea is provided through both the anterior and posterior surfaces, but the nutritional support and glucose supply are exclusively provided by the posterior surface. (10) It is very important to protect the connection between the anterior and posterior surfaces of the cornea in order to maintain a healthy corneal metabolism. (10) An artificial corneal barrier can affect the flow and concentration of oxygen and glucose, and thereby alter the corneal tissue nutrition, with subsequent corneal pathologies. Silicone oil in the anterior chamber may have a toxic effect on the endothelium, but the patient in this case already had endothelial insufficiency. We constructed an intracorneal pocket approximately 7 mm in size and did not observe any indication of corneal hypoxia or malnutrition. Silicone is highly permeable to oxygen. From these findings and the results of previous

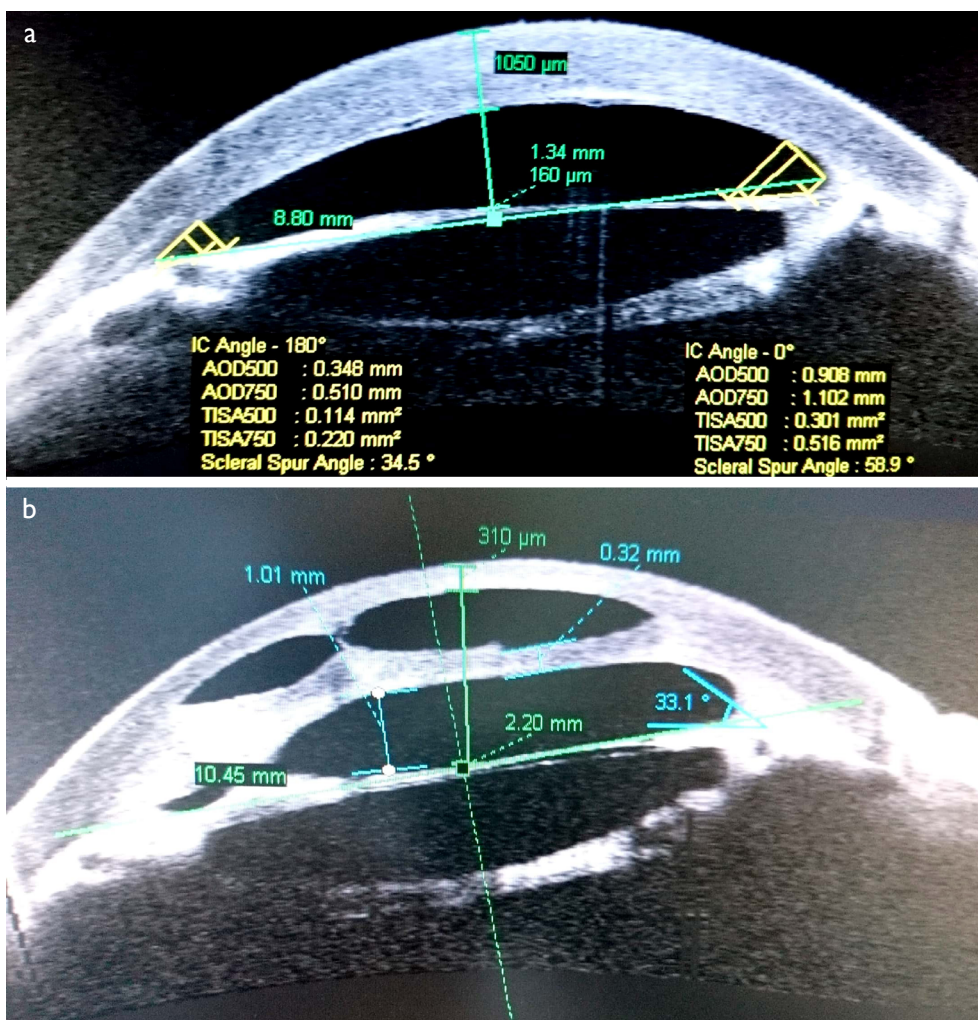


Figure 2. Anterior segment optical coherence tomography images of the patient. (a) In the preoperative picture, the corneal edema is evident, and the central corneal thickness is 1050 µm with an angle-angle length of 8.80 mm. (b) On postoperative day 7, the intrastromal pocket and the silicone oil layer can be seen. The corneal thickness in front of the silicone oil was measured at 310 nm, while the thickness behind the oil layer was 320 nm. Resolution of the corneal edema in the anterior stroma and epithelial bullae is also visible. The angle-angle length was 10.45 mm.

reports of femtosecond-assisted corneal pockets, it was also assumed that the remaining peripheral corneal connection was sufficient to sustain corneal metabolism. No anterior stromal atrophy was observed in our case, as in other studies of intracorneal silicone oil injection. Although our technique provided promising results, larger studies with a longer follow-up period are needed to confirm these findings.

Disclosures

Informed consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Involved in design and conduct of the study (SG, SC, YY); preparation and review of the study (SG, SC, YY); data collection (SG, SC, YY).

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