Case Reports in Ophthalmology

Case Rep Ophthalmol 2022;13:798–803

DOI: 10.1159/000527331
Received: July 24, 2022
Accepted: September 27, 2022
Published online: October 27, 2022

Case Report

Refractive Corneal Lenticule Extraction on Previous Photorefractive Keratectomy, with Optical Coherence Tomography Study

Antonio Leccisotti[a, b, c] Stefania V. Fields[a] Giuseppe De Bartolo[a]

[a]Siena Eye Laser, Poggibonsi, Siena, Italy; [b]Scuola di Specializzazione in Oftalmologia, Università di Siena, Siena, Italy; [c]School of Biomedical Sciences, Ulster University, Coleraine, UK

Keywords

Myopia · Photorefractive keratectomy · Refractive corneal lenticule extraction · Optical coherence tomography

Abstract

We report the first case of refractive corneal lenticule extraction with the femtosecond laser application CLEAR as retreatment technique after previous laser vision correction. A 42-year-old woman, operated by bilateral photorefractive keratectomy (PRK) 19 years previously, with moderate dry eye, came for post-PRK regression and underwent correction of a residual myopia of −3 −0.5 × 159° D in the left eye by CLEAR. Surgery was uneventful, with a regular laser pattern and a normal dissection of the lenticule. At day 1, uncorrected visual acuity was 20/25; at 3 months, it was 20/20, with a refraction of +0.25 × 115° D. The cornea and interface were regular and transparent; no dry eye symptoms occurred. At 3 months, on optical coherence tomography, the treatment was well centered, the surgical interface was centrally regular, whereas the anterior profile of the stromal surface was slightly corrugated, compensated by a smooth epithelial surface. The present case demonstrates that myopia after PRK can be achieved by CLEAR; an irregular stromal surface may occur, not affecting the visual result in virtue of epithelial remodeling.

Correspondence to:
Antonio Leccisotti, leccisotti@libero.it

Case Rep Ophthalmol 2022;13:798–803
DOI: 10.1159/000527331 www.karger.com/cop

Introduction

Refractive corneal lenticule extraction (RCLE) is a recent technique for the correction of myopia and myopic astigmatism, using a femtosecond laser to delineate an intrastromal lenticule, then extracted through a small incision [1]. By avoiding the creation of a flap, RCLE induces less dry eye [2] and entails less stromal alteration [3] compared to laser in situ keratomileusis (LASIK). A novel RCLE application called CLEAR has recently been launched on the Ziemer Z8 femtosecond laser platform (Ziemer Group, Port), characterized by the combination of low-energy laser pulses at the nanoJoule (nJ) level with high-pulse frequencies (>5 MHz) and computerized control of centration and suction [4]. Only 2 clinical studies on CLEAR have been published so far, evaluating the correction of myopia in virgin corneas [5, 6] but never on eyes previously treated by any laser vision correction technique. We therefore report the first case in which CLEAR was used to correct myopia in an eye that had previously undergone photorefractive keratectomy (PRK), studied with anterior segment optical coherence tomography (AS-OCT).

Case Presentation

A 42-year-old woman had undergone bilateral PRK 19 years previously for the correction of myopic astigmatism as per surgical report; no refractive data were available. Surgery had been uneventful, but in the last 10 years, the vision in the left eye (LE) had deteriorated. No symptoms of dry eye were experienced. The patient sought improvement in the LE.

On examination, the right eye (RE) had an uncorrected distance visual acuity of 20/25 and a corrected distance visual acuity of 20/20 with −0.5 −0.5 × 15° diopters (D). In the LE, uncorrected distance visual acuity was 20/200 and corrected distance visual acuity was 20/20 with −3 −0.5 × 159° D.

Schirmer tear test showed a reduced tear production, with 5 mm in 10 min in both eyes. Noninvasive tear film breakup time (MS-39 CSO, Costruzione Strumenti Oftalmici, Firenze) was 4 s in the RE and 5 s in the LE.

At slit-lamp, the cornea was fully transparent in both eyes, with no haze; the crystalline lens, the vitreous, and the retina were normal. The intraocular pressure was 12 mm Hg in the RE, 14 mm Hg in the LE.

Corneal features on AS-OCT and Placido topography (both performed by MS-39) were central pachymetry, RE 441 μm and LE 482 μm; central epithelial thickness, 61 μm in the RE and 64 μm in the LE; regular posterior elevation in both eyes; regular central flattening due to previous ablation at anterior tangential topography in both eyes (Fig. 1). The stromal surface and epithelium shared a regular anterior profile (Fig. 2, top).

Considering the reduced stromal thickness (421 μm) and the altered tear film tests, it was decided to treat the LE by CLEAR, targeting emmetropia with an optical zone of 6.5 mm and a 130 μm cap. A week later, lenticule extraction was performed in the LE by our technique [6]. Briefly, the femtosecond handpiece was laid on the cornea, the treatment centered on the corneal vertex, the lenticule delineated by the laser. Then the supero-temporal incision was opened, the lenticule isolated by a Reinstein Lenticule Separator (Malosa MMSU1297S) and extracted by tying forceps.

At surgery, no difficulties were encountered at any stage, with no difference from a routine case on a virgin cornea. The laser bubble pattern was regular and dissected without effort.

At day 1, the cornea was transparent, with mild edema; UCVA was 20/25. At 3 months, UCVA was 20/20, refraction +0.25 × 115° D, the cornea and interface regular and transparent;

Case Rep Ophthalmol 2022;13:798–803
DOI: 10.1159/000527331

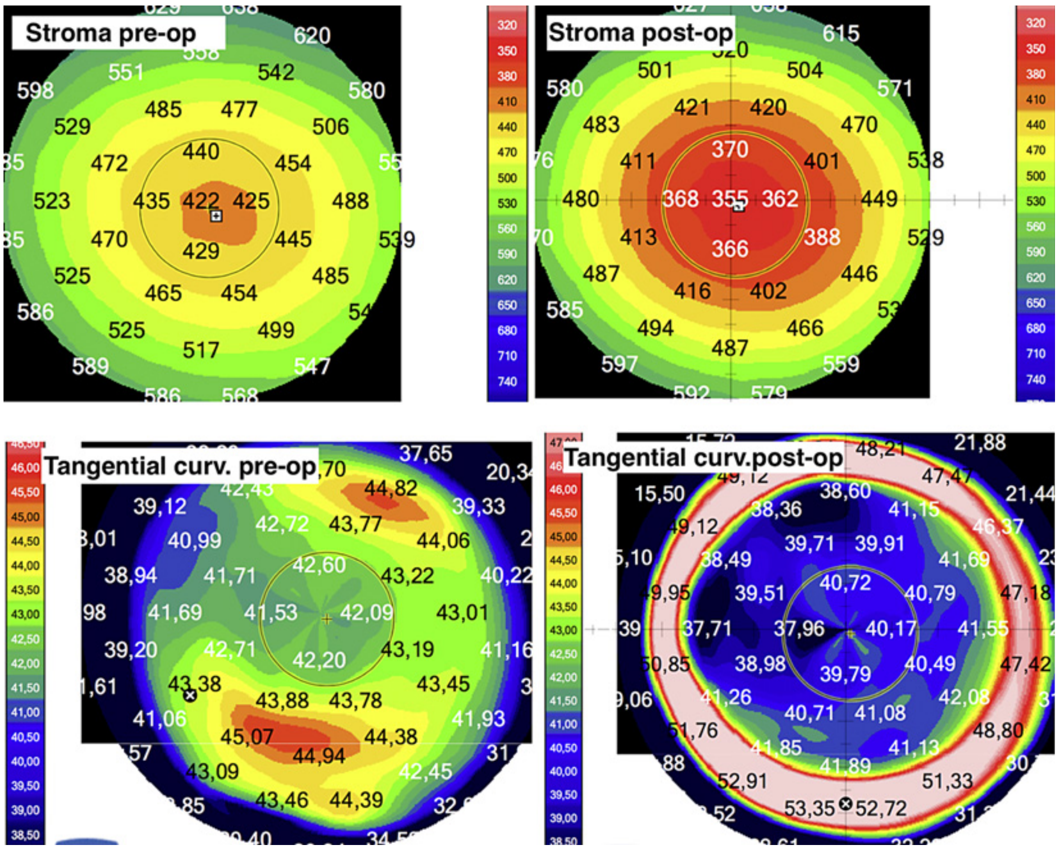

Fig. 1. Changes in corneal thickness and curvature after refractive lenticule extraction with femtosecond laser in an eye previously operated by myopic photorefractive keratectomy (PRK) at anterior segment optical coherence tomography (AS-OCT). Top left: preoperative stromal thickness map. Top right: postoperative stromal thickness map, showing a further central thinning. Bottom left: preoperative anterior tangential curvature, in which the previous astigmatic ablation is revealed by central flattening and 2 curved zones at 1 and 7 o'clock. Bottom right: postoperative anterior tangential map, with a large red ring surrounding the optical zone. The maximum flattening is 2 diopters. The treatment is well centered, with a 6.8 mm optical zone and a stromal thickness of 354 µm.

at AS-OCT, the treatment was well centered, with a 6.8 mm optical zone, a stromal thickness of 354 µm, a cap thickness of 132 µm (Fig. 1). On the AS-OCT section, the CLEAR surgical interface was centrally regular and mildly irregular in the periphery, with a slightly irregular anterior profile of the stromal surface, compensated by a smooth epithelial surface (Fig. 2, bottom). The posterior cornea showed no changes. The patient had no symptoms of dry eye.

Discussion

In our case, a good refractive result was achieved by RCLE with the CLEAR application in an eye that had previously undergone PRK. Surgery and outcome mirrored a normal CLEAR case. Only one case of RCLE on previous PRK is reported in the literature, performed with a different laser platform (VisuMax, Zeiss Meditec), and achieving a good result; no AS-OCT study was, however, performed [7].

The correction of refractive errors after PRK can be addressed by several techniques. Repeat PRK has the disadvantage of pain, slow recovery, possible induction of haze [8].

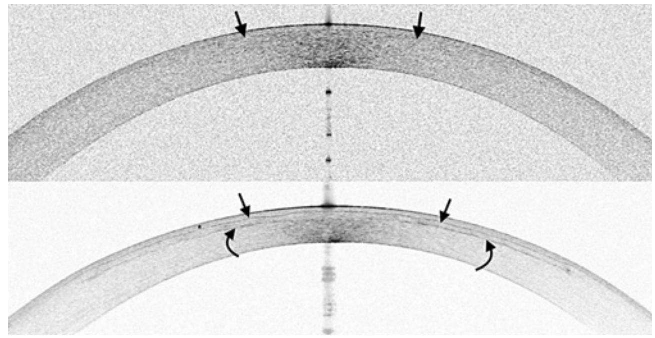

Fig. 2. Same eye as in Fig. 1. Top: preoperative AS-OCT horizontal corneal section. A regular profile of the anterior stromal surface, deprived of the Bowman's membrane by previous PRK, is shown by straight arrows. Bottom: postoperative AS-OCT horizontal corneal section. The straight arrows point to the anterior stromal surface; the curved arrows indicate the interface resulting from the lenticule extraction; an asterisk is within the epithelial layer. Cap thickness is 132 μm. While the lenticule interface shows a more regular profile, the anterior stromal surface is slightly corrugated; this irregularity is compensated by epithelial growth, giving the corneal surface a smooth appearance.

Microkeratome LASIK is rarely performed because of the reduced accuracy of the thickness of the flap in eyes in which stromal thickness is already affected by previous surgery [9]. Femtosecond LASIK is an ideal method of correction after PRK because it allows thinner and more precise flaps [10]; it can be, however, be characterized by postoperative dry eye and is therefore less indicated in eyes with a compromised tear film. In our case, the presence of altered Schirmer and breakup time was the reason why RCLE was chosen.

As with all enhancement cases, safety calculations are important to prevent ectasia [11]. The epithelial thickness may considerably increase after myopic PRK, making epithelial mapping a fundamental step [12]. Cap thickness should be calculated in order to include at least 60 μm of stroma as a thicker stroma increases the corneal biomechanical strength and reduces the damage to the superficial corneal nerves, thus maintaining the stimulus for tear production [2]. The use of a single incision may contribute to preservation of corneal nerves. Ideally, the stromal bed should be at least 250 μm thick [11].

It is uncertain whether nomogram adjustments are required in previously operated corneas. In a series of femtosecond LASIK over PRK, the standard nomogram was predictable [10], and in the previous report of RCLE over PRK, no nomogram changes were suggested [6].

While post-PRK, the stromal surface and the epithelium had a regular appearance, after CLEAR, the anterior stromal surface was slightly corrugated; this irregularity was compensated by epithelial growth, having thicker area in depressed stromal zones, giving the corneal surface a smooth appearance. This feature, not evidenced in previous studies on RCLE, might explain a slower visual recovery compared to LASIK [13], caused by postsurgical irregularities, only later equilibrated by changes in the epithelium layer. In conclusion, the present case demonstrated that correction of myopic error after PRK can be accomplished by CLEAR; it is uncertain whether in corneas lacking the Bowman's membrane, an irregular stromal surface may result, not affecting the visual result in virtue of epithelial remodeling.

Statement of Ethics

The subject has given a written informed consent to publish the case (including images). The study has been granted an exemption from requiring ethics approval by the Institutional

Review Board at Siena Eye Laser. Ethical approval is not required for this study in accordance with national guidelines.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

No funding received.

Author Contributions

Antonio Leccisotti has contributed to the conception, drafting, and final approval and agreed to be accountable to all aspects of the work. Stefania V. Fields has contributed to the interpretation of data, drafting, and final approval and agreed to be accountable to all aspects of the work. Giuseppe De Bartolo has contributed to the analysis of data, revising, and final approval and agreed to be accountable to all aspects of the work.

Data Availability Statement

All data generated or analyzed during the study are included in this article.

References

1 Sekundo W, Kunert KS, Blum M. Small incision corneal refractive surgery using the small incision lenticule extraction (SMILE) procedure for the correction of myopia and myopic astigmatism: results of a 6 month prospective study. Br J Ophthalmol. 2011 Mar;95(3):335–9.
2 Xu Y, Yang Y. Dry eye after small incision lenticule extraction and LASIK for myopia. J Refract Surg. 2014 Mar; 30(3):186–90.
3 Sinha Roy A, Dupps WJ Jr, Roberts CJ. Comparison of biomechanical effects of small-incision lenticule extraction and laser in situ keratomileusis: finite-element analysis. J Cataract Refract Surg. 2014 Jun;40(6):971–80.
4 Izquierdo L, Sossa D, Ben-Shaul O, Henriquez MA. Corneal lenticule extraction assisted by a low-energy femtosecond laser. J Cataract Refract Surg. 2020 Sep;46(9):1217–21.
5 Doga AV, Kostenev SV, Mushkova IA, Nosirov PO. [Results of corneal lenticule extraction for correction] [Article in Russian]. Vestn Oftalmol. 2020 Jun;136(6):214–8.
6 Leccisotti A, Fields SV, De Bartolo G. Refractive corneal lenticule extraction with the CLEAR femtosecond laser application. Cornea. 2022;Epub Ahead of Print.
7 Kankariya VP, Grentzelos MA, Dube AB, Kymionis GD, Pallikaris IG. Small incision lenticule extraction retreatment in a patient with high residual refractive error after photorefractive keratectomy: a case report. Indian J Ophthalmol. 2021 Feb;69(2):436–8.
8 Moshirfar M, Villarreal A, Thomson AC, West WB Jr, McCabe SE, Quinonez Zanabria E, et al. PRK enhancement for residual refractive error after primary PRK: a retrospective study. Ophthalmol Ther. 2021 Mar;10(1): 175–85.
9 Comaish IF, Domniz YY, Lawless MA, Webber SK, Rogers CM, Sutton GL. Laser in situ keratomileusis for residual myopia after photorefractive keratectomy. J Cataract Refract Surg. 2002 May;28(5):775–81.
10 Leccisotti A, Fields SV, De Bartolo G. Femtosecond LASIK retreatments after primary myopic photorefractive keratectomy (femtosecond LASIK retreatments of PRK). Cornea. 2022;Publish Ahead of Print.
11 Reinstein DZ, Carp GI, Archer TJ. SMILE surgery planning and VisuMax software. In: Reinstein DZ, Carp GI, Archer TJ, eds. The surgeon's guide to SMILE: small incision lenticule extraction. Thorofare: Slack; 2018. p. 53–85.

12 Sedaghat MR, Momeni-Moghaddam H, Gazanchian M, Reinstein DZ, Archer TJ, Randleman JB, et al. Corneal epithelial thickness mapping after photorefractive keratectomy for myopia. J Refract Surg. 2019 Oct;35(10): 632–41.
13 Chiche A, Trinh L, Saada O, Faure JF, Auclin F, Baudouin C, et al. Early recovery of quality of vision and optical performance after refractive surgery: small-incision lenticule extraction versus laser in situ keratomileusis. J Cataract Refract Surg. 2018 Sep;44(9):1073–9.