Very Late-Onset Corneal Scarring After Photorefractive Keratectomy Induced by Cataract Surgery

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ABSTRACT

PURPOSE: To report two cases with very late-onset scarring of the cornea after photorefractive keratectomy (PRK) induced by cataract surgery.

METHODS: Case report and literature review.

RESULTS: Two patients presented with a subepithelial corneal scar more than 20 years after PRK. Scarring occurred within the first few months after cataract surgery. Scar tissue was successfully removed by laser-assisted anterior lamellar keratoplasty.

CONCLUSIONS: A few cases of late-onset corneal scarring after PRK have been described in the literature following trauma or ophthalmic surgery. Due to the need for cataract surgery in an aging population with previous PRK, this might become a more common problem.


Photorefractive keratectomy (PRK) was clinically introduced in 1987 for myopia correction.1,2 PRK evolved into a safe procedure but was largely supplanted by LASIK due to postoperative pain and delayed visual recovery.3 One of the complications of PRK is the development of a subepithelial scar during the first 6 postoperative months that may persist for years.4,5 This should not be confused with the subepithelial transient haze, which becomes apparent at approximately 1 month after PRK, peaks at 3 to 6 months, and typically starts fading after 1 year.6 Late-onset haze/scarring after PRK has been described anecdotally, especially after triggering events such as light damage and trauma.7,8 We present two cases with central subepithelial scarring triggered by otherwise uneventful phacoemulsification more than 20 years after PRK.

CASE REPORTS

Case 1
A 46-year-old man underwent PRK in both eyes in 1991 for myopia correction of -7.00 diopters (D) (Summit ExcimMed UV2000; Summit Technology, Waltham, MA, 5-mm optical zone). Approximately 1 year earlier, peripheral laser coagulation for retinal degeneration had been performed in both eyes. Apart from that, no other ophthalmic treatments were reported and no mitomycin C (MMC) was used intraoperatively. Twenty years later, in April 2011, a reduction of corrected distance visual acuity (CDVA) to 20/50 due to nuclear cataract was diagnosed in the left eye and phacoemulsification with implantation of an aspheric IOL was performed without any intraoperative or early postoperative complications. At the time of surgery, the cornea was reported clear and free of opacities. Immediate postoperative visual acuity was 20/50, improving to 20/30 after 7 months. A Nd:YAG capsulotomy was performed in April 2012. During the following months CDVA decreased further and a central subepithelial scar was reported in the anterior stroma by November 2012.

In November 2013, the patient was referred to our clinic with a central subepithelial scar (Figure 1A) and a CDVA of 20/100 without further improvement by pin-hole. Ophthalmic examination showed a regular pseudophakia with an in-the-bag IOL without any retinal pathology. Anterior segment optical coherence tomography demonstrated subepithelial corneal scar tissue approximately 180 µm thick (Figure 1B). In March 2014, a femtosecond laser-assisted anterior lamellar keratoplasty was performed with a resection depth of 200 µm and a diameter of 8 mm (Figure 1C). The graft thickness was 180 µm and the diameter was 8.2 mm. The lamella was attached with a running suture (nylon 10-0). One month after the surgery, the eye achieved a CDVA of 20/50, improving to 20/30+ by pin-hole. Refractive rehabilitation including IOL exchange and topography-guided surface ablation is planned. Visual rehabilitation including IOL exchange (anisometropia > 3.00 D) and topography-guided surface ablation is planned.

Case 2
A 51-year-old woman underwent excimer laser PRK for -5.00 D in both eyes in 1990 (Summit ExcimMed UV2000; Summit Technology, 4.5-mm optical zone). No scarring reaction was reported in the documentation and MMC was not used. In September 2011, phacoemulsification was performed without intraoperative or post-
operative complications. CDVA was 20/25 in December 2011 but deteriorated to 20/60 in September 2012, when we first saw the patient. The visual loss was accompanied by significant myopia from a spherical equivalent of -1.00 D in December 2011 to -6.75 D in September 2012. A subepithelial scar (Figures 2A-2B), 130 µm deep, was recorded. In November 2012 we performed a femtosecond laser-assisted anterior lamellar keratoplasty (host: 9 mm diameter, depth: 140 µm; graft: 9.3 mm diameter, 130 µm thickness). After removal of the suture, CDVA increased to 20/30 with a refraction of -2.00 cyl -1.0/45. The patient opted for no further treatment.

DISCUSSION

Early postoperative corneal haze occurs up to 6 months after PRK even in low myopia, but in most of the cases resolves within the first 12 months and is considered an early postoperative side effect of PRK rather than a complication. In contrast, postoperative subepithelial scarring occurs more frequently after correction of high myopia or repeated treatments and usually develops during the first postoperative year. Late-onset corneal haze, which is described with onset later than 6 months postoperatively, has been correlated to high ultraviolet irradiation, trauma, and retinal surgery. The two cases presented developed a corneal scar more than 20 years after PRK and we assume that cataract surgery triggered the scarring process because visual loss did not occur until months after phacoemulsification.

The formation of stromal haze and scarring is believed to be caused by apoptosis of keratocytes followed by the development of myofibroblasts and disorganization of the extracellular matrix due to amorphous deposition of collagen. Transforming growth factor-beta plays an important role in the activation of the myofibroblasts, the apoptosis seems to be triggered by interleukin-1 and tumor necrosis factor alpha.

MMC is currently used after surface ablation, but this was not accepted in 1990. The use of MMC greatly
reduces the rate of scarring after PRK. It is not known whether there is a long-term effect that would have prevented the development of late-onset scarring.

In superficial scars, transepithelial phototherapeutic keratectomy with intraoperative MMC is a possible therapeutic option, but in the two cases presented the scar tissue extended to more than 100 μm deep and phototherapeutic keratectomy may result in the risk of additional scarring.\(^{10}\) especially in an eye that had previous laser refractive surgery. Anterior lamellar keratoplasty may bear the risk of increased glare due to interface problems\(^{11}\); however, the surface quality of superficial cuts has been significantly increased with the advent of the femtosecond laser.\(^{12-14}\)

Although still rare today, phacoemulsification after previous PRK will become more frequent within the near future because the middle-aged patients of the 1990s will inevitably start developing cataracts approximately 20 to 30 years later. We believe that the risk of late-onset postoperative subepithelial scarring should be included in appropriate preoperative counselling for these patients.

**AUTHOR CONTRIBUTIONS**

Study concept and design (IF, TS); data collection (TGS, DZ); writing the manuscript (IF); critical revision of the manuscript (TGS, DZ, TS); administrative, technical, or material support (TS); supervision (TS)

**REFERENCES**