CHAPTER 14

Topographically-Guided Trans-Epithelial PRK for Refractive and Therapeutic Purposes

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Every cornea has its own characteristics that make it different from all the others: thickness, shape, radius of curvature, profile, asphericity, and toricity. These are the main elements that new ablative strategies take into consideration with the help of informatics. Good software, therefore, should be able to adapt its surgical program to every kind of presurgically analyzed cornea.

In reality, standard software sets up the ablative strategy by taking into consideration the refractive modification that is worth pursuing, and this is calculated by referring to an ideal cornea model taken as a standard, virtually absolute value. From a physical viewpoint, this set-up may be correct, but often it does not correspond to the final outcome in which, even though refraction has achieved the desired theoretical target, the patient may complain of a less than optimal functional quality. The reason (decentralization, central island) for this is often revealed only by evaluation systems, such as computerized corneal topography.[1] These considerations lead to the conviction that it is necessary to devise a system that will permit the creation of a specific ablative pattern for each cornea that will lead, on the one hand, to the correction of the residual ametropia, and on the other, to the creation of a corneal surface that strays as little as possible from the natural physiological profile. Naturally, in theory, this would also be postulate for correction of irregular forms of astigmatism, which cannot be corrected by common surgical techniques. This is how the idea of the customized ablation, which permits the creation of a customized ablation program, originated.[2]

This program for customized ablation can be created by a corneal topographer that provides an altimetric algorithm. The choice of this kind of topographer is based on the fact that lasers carve the cornea working in microns, not diopters; it is, therefore, essential to think in heights so that the laser and the topographer can work in symbiosis. This idea stems from the assumption that the software conducting the photo ablation keeps to the refractive correction that it has been set to produce and calculates it based on an ideal cornea model.[3]

The excimer laser employed in this research, performed at our clinic, is MEL 70 G (Carl Zeiss Meditec, Dublin, California), a flying spot third-generation laser producing a kind of ablation that may be based on a circular scan or on a randomized scanning spot. The characteristics of the laser are a 193-nm wavelength, a 35-Hz frequency, a 180-mJ/cm^2 fluence, and a 0.25-µm ablation rate. The laser uses a 1.8-mm diameter flying spot with a Gaussian profile. A cone for controlled atmosphere (CCA) is employed on the laser output to remove smoke or particles in the way of the laser beam.[4]

This laser is an interfaceable workstation devised to analyze noticeable corneal map surgical data and, using the Topography Supported Customized Ablation (TOSCA) system (Figure 14-1), it produces a simulation of the effects that laser treatment will have in making a new corneal curvature outline. This system permits surgeons to perform photorefractive treatment supported by topographical data. In fact, a simple topographical image of the patient's eye is turned into a "customized" treatment profile. TOSCA software permits the rectifying of refractive mistakes even in asymmetric, irregular, and refractive defect corneas. After entering the patient's refractive data and calculating the difference between the patient's map and a reference sphere (best-fit sphere), a specific ablation pattern suited to that particular cornea and calculated by the special MEL 70 excimer laser program is obtained. In this case, ablation is performed by a pseudo-randomized scanning. The TOSCA system permits presurgical simulation of the laser ablation showing, step by step, the depth of the ablation in microns. Tissue Save Ablation (TSA) software, which permits up to 70% of ablative tissue to be saved, is associated with the TOSCA software. This customized technique with corneal

Figure 14-1. Representation of TOSCA software.

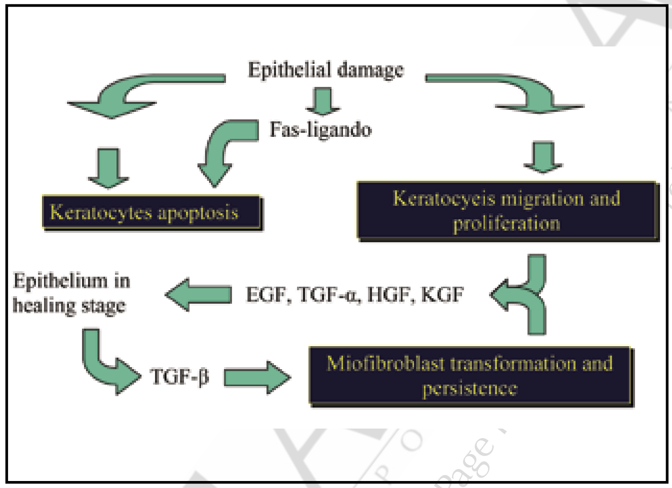

Figure 14-2. Molecular regulation of epithelial cells and keratocytes in corneal recovery process.

topography link has been employed by us to perform excimer laser photorefractive keratectomy (PRK) transepithelially (TE). Use of the TE-PRK technique gives the advantage of preventing chemical or mechanical removal from allowing stromal irregularity[5] to remerge. In fact, when topographically-linked PRK surgery is practiced, the datum used is a topographical map also including the epithelium that when the ablation is performed, behaves as a kind of a masking fluid. Another advantage of surface transepithelial ablation is that it promotes a lower incidence of events that may result in epithelial damage. In fact, during the corneal healing process, a molecular rearrangement of epithelial cells and keratocytes occurs. Epithelial damage determines the release both of interleukin 1, which provokes keratocytical apoptosis, and the platelet-derived growth factor (PDGF), which determines a proliferation and migration of keratocytes. The latter activates the release of other growth factors (EGF, TGS-α, HGF, KGF) that permit the epithelium to heal. Reepithelization, by itself, determines the release of the growth factor TGF-β that provokes the transformation and the persistence of fibroblasts (Figure 14-2).[6-8]

The efficiency and safety of transepithelial topographically guided ablation in the treatment of an irregular corneal profile has been assessed on several corneal pathologies and postsurgery conditions such as irregular astigmatism after keratoplastic, enhancements, corneal opacity therapeutic treatment, and LASIK complications.

After a refractive corneal surgery, laser retreatment is always a rather difficult topic. A whole series of issues, such as patient expectations, the presurgery situation, the outcome obtained, etc, must be considered. The surgeon has to know the patient's history and understand which of the multiple variables have determined the unsuccessful result. Refraction, biomicroscopy, computerized videokeratography, and pachymetry are indispensable to identify every change in the corneal curvature that may have occurred during the follow-up as a result of the pharmacological therapy.[9,10]

If the initial refractive procedure has been correctly performed, the reason for failure must be related to a biologically anomalous response.[11] The choice of retreatment must be decided with the patient, explaining all possible risks and benefits.[12]

Nowadays, requests for excimer laser resurgery are due principally to the desire to achieve emmetropization or to improve the loss of vision in qualitative terms with respect to the presurgery condition, regardless of the refractive profit.

The reasons for performing excimer laser retreatment may be hypo/hypercorrections, regressions, decentralization, or small optical areas. When performing retreatment after a PRK surgery, the causes leading to visual damage must be carefully evaluated. Possible causes of regressions after PRK and LASIK surgery are classifiable as depending on the patient (eg, age, systemic pathologies), the kinds of instrument employed (eg, large beam, scanning and flying spot laser), the treatment parameters (kind of laser beam produced and possible ablation geometries), and differing postoperative therapy. Local postsurgery therapy can influence the refraction process during adaptation and minimize the appearance of corneal haze.[13]

In fact, at varying times after surface stromal ablation in areas subjected to photo ablation, it is possible to observe the formation of disorganized neocollagen that is co-responsible for haze. When this occurs at a high rate (>2 Heitzmann scale), it may determine an alteration both in the quality and the quantity of the vision, especially when assessed at a low contrast. Some studies have shown that epithelial hyperplasia after PRK modifies the normal thickness of the epithelium, sometimes doubling it. Disorganized subepithelial neocollagen is constituted *ex novo* by synthesized mucus polysaccharides and glycosamminoglicans.[14,15] Spadea et al, in research conducted on 50 eyes employing a high frequency ultrasound technique (50 MHz), noted a slightly above (or below) average increase of the corneal thickness equal to 6.5 μm after LASIK surgery to correct myopia between 5.0 and 12.0 D.[16] Finally, Chayet et al pointed out that regression causes corneal ectasia, corneal hydration, stromal synthesis, and epithelial hyperplasia.[17] This work may consequently cause hyper- or hypocorrection, astigmatism, and myopic regression leading to consideration of retreatment. Therefore, in consideration of our necessity for safety and effectiveness, it would be appropriate to apply a technique that reduces tissue leak and does not lead to the insurgence of haze.[18]

Photo therapeutic keratectomy (PTK) is a laser technique useful for treating superficial corneal pathologies such as cicatrix, dystrophy, epithelial erosion, and regular band keratopath; fibrosis after radial keratectomy (RK) or penetrating keratoplasty (PKP); and opacity after PRK, delaying or eliminating the need for a corneal transplant.[19-22]

The success of PTK is related to the corneal transparency, the regularity of the corneal profile, and the refraction obtained, but the predictability of PTK is poor due to the lack of standardization. Therefore, the possibility of achieving good refractive outcomes in pathological corneas is firstly dependent upon the surgeon's ability and, sometimes, unpredictable factors.[23,24] In fact, PTK is an efficient method for obtaining corneal transparency by removing the opacity situated in the anterior third of the stromal thickness; however, it is a difficult technique with a low predictability due to lack of standardization.[25-27] On the contrary, the procedure becomes easier and faster when topographically guided PTK is applied. In recent research conducted on 29 eyes with postsurgery corneal irregularities the introduction of excimer laser customized ablation proved to be a technique suitable for treating such irregularities, with an improvement of the visual acuity (VA).[28,29] Transepithelial customized PTK seems to be a powerful technique for treating corneal irregularities, ensuring good corneal transparency, and preventing haze formation.[30-32]

The appearance of high and irregular astigmatism after PKP is often difficult to correct with glasses, and it is not always possible to apply contact lenses because they may determine peripheral corneal vascularization with a consequent increased risk of a rejection.[33,34] In some research, it has been reported that about 20% of the patients successfully subjected to PKP later had to undergo refractive surgery. In spite of the improvement of suture techniques and their modulation, postsurgery astigmatism is still a problem connected to keratoplasty. Several surgical techniques have been devised to treat post-PKP astigmatism.

Over recent years, LASIK has been tested as a treatment for ametropia in post-PKP: this procedure has one remarkable advantage because, by maintaining the anatomical integrity of the Bowmann membrane, it does not excessively modify physiology of the cornea; however, this surgical procedure has been associated with complications causing significant alterations to vision.[35,36] Several studies have highlighted that complications may occur, especially during creation of the flap: the percentage ranges from 0.3% to 10%. These risks may depend either on the mechanical action or on the surgeon's lack of experience.[37-40] The risks include the creation of buttonholes, free-caps, and incomplete or irregular flaps.[41,42]

Several authors have proposed alternative surgical techniques to treat flap-shaping complications. One is to replace the flap and retreat after at least 3 months; another is transepithelial ablation.[43]

The advantage of using the transepithelial PRK technique is that it avoids the possibility that mechanical or chemical removal of the epithelium will give rise to stromal irregularity resulting from an unsuccessful cut. In fact, during topographically linked PRK surgery, a topographical map is applied that also includes the epithelium, which behaves as a kind of masking fluid during the ablation procedure, subsequently producing a homogeneous surface.[44-46]

Technical Characteristics of TOSCA

TOSCA is an advanced system for acquiring data on the morphology of a corneal surface required to plan the subsequent MEL 70 excimer laser surgery. Using a CCD video camera, the TMS-3 (Tomey, Nagota, Japan) topographer evaluates the corneal surface of the patient's eye and measures the correct corneal profile curvature. The memorized images are visualized in real time on the monitor. The connected computer works out the data and permits the software to interpret the results obtained afterwards as well as analyzing the collected images. These TMS-3 recorded images are chosen and sent to the TOSCA software; finally, the data are further elaborated and transferred to the MEL 70 excimer laser to perform a customized treatment. The software processes the data inside the MEL 70 excimer laser to "pilot" the ablation pattern.

Before the treatment, the depth of ablation required to remove corneal opacity is measured; subsequently, the corneal epithelial thickness measured by ultrasound pachimetry is added by the TSA software to the ablation planned with the TOSCA system. This is necessary to perform a correct transepithelial procedure.

To avoid the hyperopic effect of central PTK ablation, we employ a rectification factor to prevent an excessive hyperopization. In effect, by calculating the ablation thickness, assessed at 5 mm in the central cornea area according to Munnerlyn's (diopters = ablation x 3/ optical area^2) formula, a hyperopic rectification factor is added.[47]

Surgical Technique

A patch is placed over the eye that will not be operated, while a sterile eyelid speculum is inserted into the eye to be treated after topical anesthesia by instillation with 0.4% oxyprobocaine drops. The patient is instructed to stare at a coaxial light (yellow diode), and the surgeon performs the ablation transepithelially, using the center of the pupil as the focus point. An active eye-tracking system, oriented on a metal ring, monitors centration. After photoablation, a therapeutic soft contact lens is used until complete reepithelization

Table 14-1

Preoperative Data Before Topographically-Guided Transepithelial PRK Retreatments (33 eyes)

	Age Mean ± SD (range)	*UCVA Mean ± SD (range)*	*BSCVA Mean ± SD (range)*	*MRSE Mean ± SD (range)*	*Corneal Thickness Mean ± SD (Range)*	*Time Mean ± SD (Range)*
Myopic Re-PRK (21)	38.27 ± 8.04 (28 to 55)	20/28± 20/28 (20/60 to 20/25)	20/100 ± 20/28 (20/60 to 20/20)	-2.54 ± 2.60 (-0.50 to -6)	457.39 ± 50.05 (387 to 570)	26.14 ± 28.77 (6 to 108)
Hyperopic Re-PRK (12)	41 ± 9.65 (28 to 55)	20/67 ± 20/28 (20/100 to 20/25)	20/20 (20/30 to 20/20)	+2.23 ± 0.65 (+1.25 to 3.25)	487.18 ± 64.61 (400 to 565)	14.25 ± 12.38 (6 to 48)

Table 14-2

Postoperative Uncorrected and Best Spectacle-Corrected Visual Acuity and Corneal Thickness After Topographically Guided Transepithelial PRK Retreatments (33 eyes)

	UCVA Mean ± SD (range)	*BSCVA Mean ± SD (range)*	*MRSE Mean ± SD (range)*	*Corneal Thickness Mean ± SD (range)*
Myopic Re-PRK (21)	20/20 ± 20/28 (20/50 to 20/20)	20/20 ± 20/30 (20/50 to 20/20)	-0.07 ± 0.38 (-0.50 to +0.75)	423.47 ± 24.84 (333 to 432)
Hyperopic Re-PRK (12)	20/20 ± 20/25 (20/25 to 20/20)	20/20 (20/20)	+0.09 ± 0.26 (-0.25 to +0.50)	423.36 ± 53.10 (356 to 525)

(from 4 to 8 days), antibiotic drops, and artificial teardrops are administered. Subsequently, corticosteroid-based drops are prescribed three times a day for at least a month, and later they are scaled down depending on the corneal haze and the refractive outcome. In the group of transepithelial topo-customized PRK retreatments, 25 eyes of 22 patients (12 male and 10 female), aged between 21 and 55 years (mean, 39.2 ± 8.6 SD), 14 patients had a myopic refractive defect (-2.50 ± 0.7 SD), and 11 patients had a hyperopic defect (+2.2 ± 0.6 SD) (Table 14-1).

Mean uncorrected visual acuity (UCVA) changed from 20/50 ± 20/67 SD to 20/28 ± 20/67 SD. Mean best spectacle-corrected visual acuity (BSCVA) that presurgically was 20/22 ± 20/100 SD changed to 20/20 ± 20/100 SD postsurgically (Table 14-2).

The mean of the presurgery refractive data expressed in spherical equivalent was -0.8 ± 0.9 SD, whereas the postsurgery mean was 0.4 ± 0.9 SD (Figure 14-3 and 14-4).

The presurgery mean of the average central corneal power was 40.01 ± 2.38 D and after repeat PRK treatment was 38.97 ± 1.9 D. Keratometric astigmatism mean in presurgery was 1.6 ± 1.51 D, while in postsurgery it was 0.87 ± 0.3 D.

Haze was assessed on the Heitzmann scale (0 to 5). None of the patient's eyes were retreated for significant opacities due to primary treatment (haze >2). In our patients, corneal haze showed a sudden rise between 3 and 6 months after retreatment and, in the aftermath, gradually diminished. No patient has a haze score higher than 2 (Figure 14-5).

Phototherapeutic Keratectomy

Twenty-six eyes of 24 patients were selected, all 24 patients (22 male and 2 female) with a mean age of about 50.8 ± 17 SD (range, 20 to 74 years old). The preoperative corneal pathologies treated during our research were caused by postinfectious scarring in 6 eyes, post-traumatic scarring in 18 eyes, and post-PRK scarring in 2 eyes (Figure 14-6). In all the eyes, the trauma or infection had occurred more than 2 years previously, whereas for those damaged by PRK, the treatment had been performed at least 1 year before. Each patient was treated once, and complications such as reepithelialization delays, recurrent infections, and increased intraocular pressure induced by topical corticosteroid use were not noted (Table 14-3).

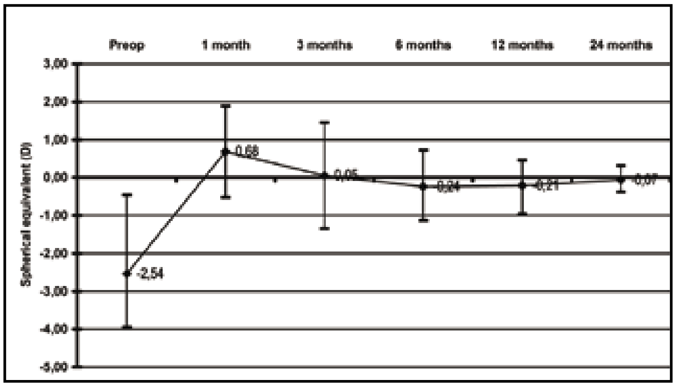

Figure 14-3. Change in spherical equivalent of manifest refraction over time after topographically guided trans-epithelial PRK myopic retreatment (21 eyes).

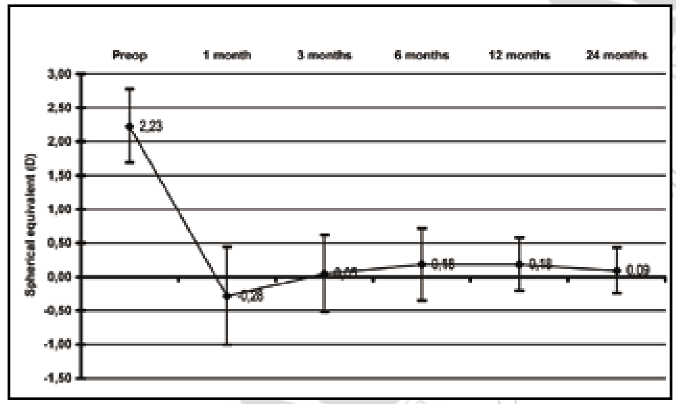

Figure 14-4. Change in spherical equivalent of manifest refraction over time after topographically guided transepithelial PRK hyperopic retreatment (12 eyes).

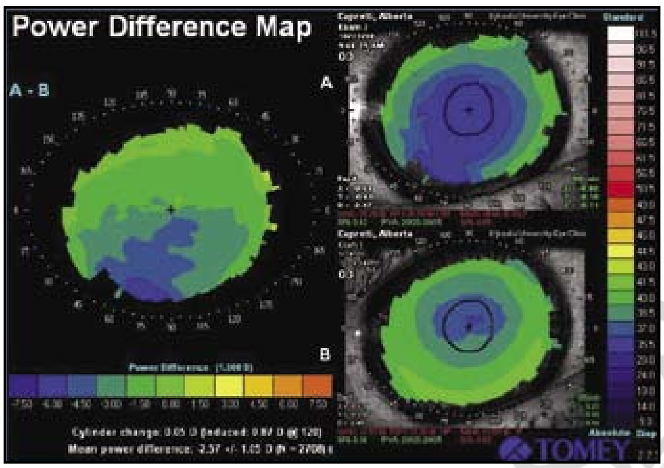

Figure 14-5. The differential map (left) shows the improved corneal profile obtained from before (bottom right) and after (top right) (plano; VA 20/20) topographically guided transepithelial treatment.

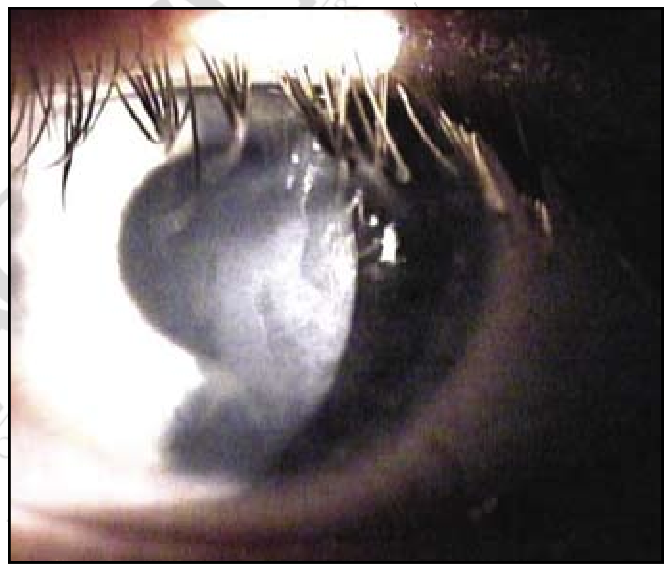

Figure 14-6. Patient DBS, male, 20 years old. Refraction LE +1 sph. November 1999: postinfectious (herpes virus) superficial corneal opacities.

Haze always proved to be inferior to 1, on the Heitzmann scale (from 0 to 5). Corneal transparency was shown to have improved in every eye by comparing presurgery biomicroscope images with the postsurgery ones (Figures 14-7 and 14-8). Both the UCVA and the BSCVA increased and the differences were statistically significant (respectively p=0.008 and p<0.001).

Spherical equivalent refractive data can be seen in Figure 3. By comparing the presurgery spherical equivalent data to the final refractive outcome, statistically significant differences have not been shown by the Student *t* test (p >0.05). The UCVA showed a statistically significant improvement (p = 0.008), from a presurgical mean value of 20/200 ± 20/200 SD (range, 20/1200 to 20/30) to a postsurgical mean value of 20/50 ± 20/100 SD (range, 20/600 to 20/20), whereas the BSCVA went from 20/50 ± 20/100 SD (range, 20/1200 to 20/25) to 20/25 ± 20/100 SD (range, 20/63 to 20/20) (p <0.001). BSCVA increased in every eye by 2 or more lines in 76.9% of the eyes and by 1 line in the remaining 23.1% (Figure 14-9).

Spherical equivalent refraction went from a presurgical mean value of -0.125 ± 2.77 SD (range, -4.5 to +5.5 D) to a postsurgical mean value of +1.33 ± 1.28 SD (range, 1.0 to +3.5 D) with a mean refraction value significantly modified (p = 0.019) of +1.45 ± 2.61 SD (range, -4.5 to +6.0 D); 34.6% of the eyes (9/26) showed a hyperopic shift ≥1.0 D (Table 14-4). Spherical equivalent refractive data is shown in Figure 14-10. Twenty-three percent of the eyes (6/26) had a final refraction within ±0.5 D from emmetropia, 50% (13/26) within ±2.0 D, and 100% (26/26) within ±4.0 D.

PRK After LASIK Complication

Two patients were evaluated. Each one had previously undergone PKP surgical: one for a keratoconus and one for an unsatisfactory outcome of the previous PRK. The two male patients had an average age of 30 ± 4 SD (range, 28 to 32 years old).

Eighteen months after PRK surgery in each eye, we removed the sutures and, after a further 6 months, due to

Table 14-3

Preoperative Data Before Topographically-Guided Transepithelial PTK Treatments

Patient	Corneal Pathology	S.E.	UCVA	BCVA	Corneal Thickness	Maximum Ablation
# 1	Post-traumatic	-3.5	20/200	20/63	464	137
# 2	Post-traumatic	+3.75	20/600	20/25	572	150
# 3	Postinfectious	+1	20/100	20/32	415	132
# 4	Post-traumatic	0	20/1200	20/1200	580	120
# 5	Post-traumatic	-4	20/600	20/32	455	150
# 6	Postinfectious	-4.5	20/100	20/50	547	160
# 7	Post-traumatic	+2.5	20/600	20/25	563	128
# 8	Post-traumatic	+1.75	20/50	20/25	582	141
# 9	Post-traumatic	+5.5	20/600	20/100	587	101
# 10	Postinfectious	-1	20/50	20/32	539	147
# 11	Post-traumatic	0	20/32	20/32	424	154
# 12	Post-traumatic	-1.5	20/200	20/63	481	132
# 13	Post-PRK	-2	20/200	20/25	406	149
# 14	Post-PRK	-3	20/600	20/25	426	88
# 15	Post-traumatic	-2.5	20/200	20/63	474	127
# 16	Postinfectious	-1	20/50	20/32	536	137
# 17	Post-traumatic	+3.25	20/600	20/25	583	150
# 18	Postinfectious	-1	20/100	20/32	417	132
# 19	Post-traumatic	0	20/1200	20/1200	545	122
# 20	Post-traumatic	-3.75	20/600	20/32	465	150
# 21	Postinfectious	-1.5	20/100	20/50	555	120
# 22	Post-traumatic	+3.5	20/600	20/25	568	128
# 23	Post-traumatic	+1.75	20/50	20/25	574	131
# 24	Post-traumatic	+4.5	20/200	20/100	578	101
# 25	Post-traumatic	0	20/32	20/32	442	154
# 26	Post-traumatic	-1.5	20/200	20/63	418	112

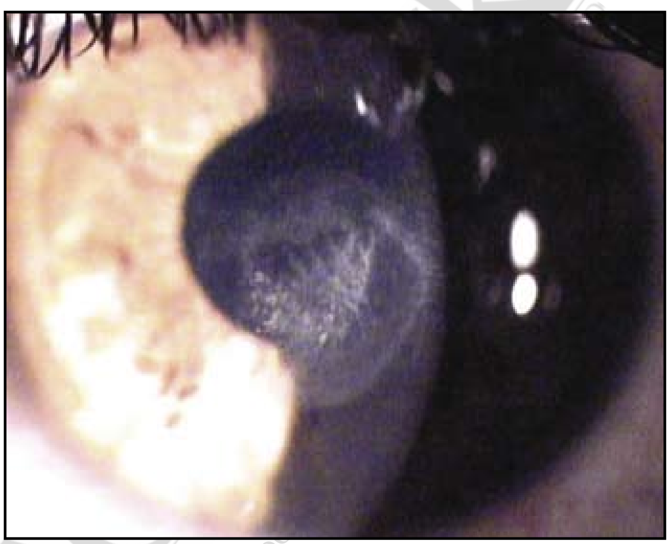

Figure 14-7. Patient DBS, male, 20 years old. Refraction LE +2 sph = +2.50 cyl (70°). December 2000: remarkable reduction of superficial corneal opacities.

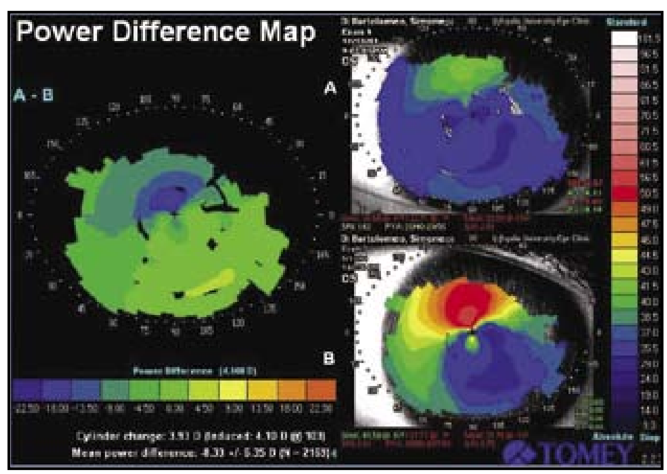

Figure 14-8. Comparison between imagines before (bottom right) and after (top right), the better corneal clarity permit a gain of 4 Snellen lines, obtaining 20/20 of BCVA; differential map (left).

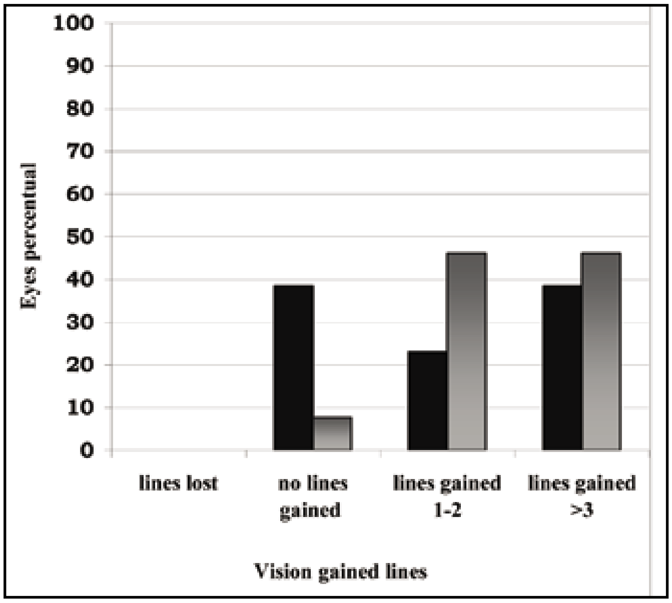

Figure 14-9. Gained line after topographically guided transepithelial PTK.

Table 14-4

Postoperative Data After Topographically-Guided Transepithelial PTK Treatments

Patient	SE	UCVA	BCVA	Corneal Thickness
# 1	+2.5	20/200	20/25	374
# 2	+3.5	20/600	20/20	522
# 3	+3.25	20/100	20/20	395
# 4	+2	20/200	20/63	530
# 5	0	20/20	20/20	305
# 6	+1	20/25	20/20	457
# 7	+0.25	20/40	20/20	543
# 8	+2	20/40	20/20	532
# 9	+1	20/63	20/32	547
# 10	+1	20/50	20/25	462
# 11	0	20/25	20/25	394
# 12	0	20/50	20/50	429
# 13	-1	20/25	20/20	347
# 14	-1	20/25	20/20	387
# 15	+2	20/200	20/25	404
# 16	+1.5	20/50	20/25	456
# 17	+3	20/600	20/20	525
# 18	+3.25	20/100	20/20	359
# 19	+2.5	20/200	20/63	502
# 20	+0.25	20/20	20/20	308
# 21	+0.75	20/25	20/20	433
# 22	+2	20/40	20/20	534
# 23	+2	20/40	20/20	526
# 24	+1	20/63	20/32	542
# 25	0	20/25	20/25	349
# 26	+1.75	20/50	20/50	368

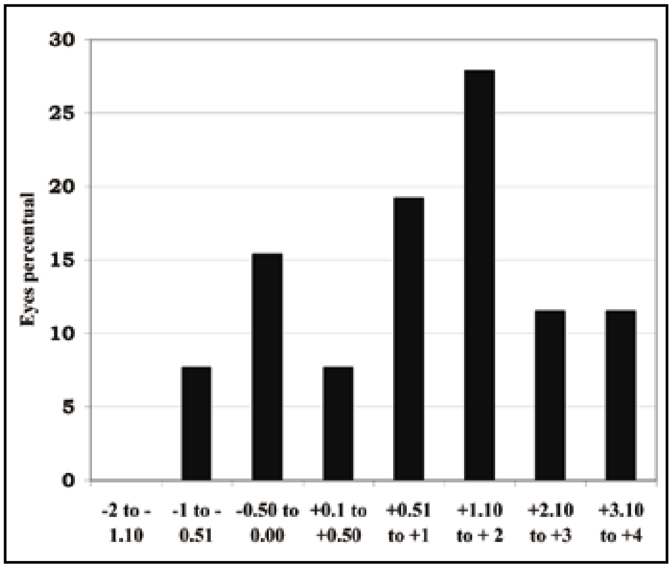

Figure 14-10. Change in spherical equivalent of manifest refraction over time after topographically guided trans-epithelial PTK.

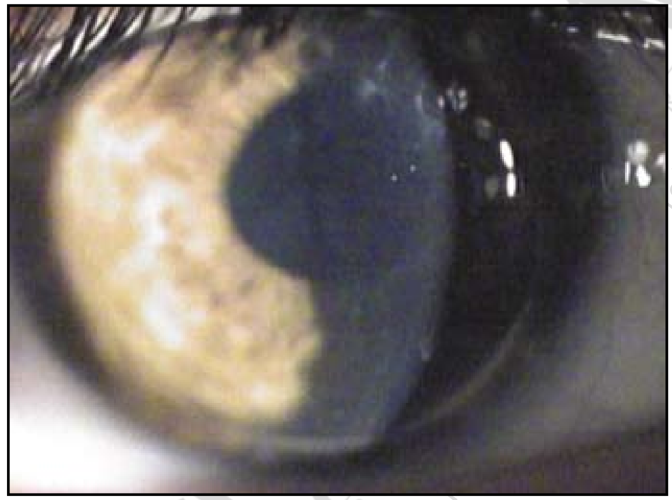

Figure 14-11. Patient RZ, male, 31 years old. Preoperative Refraction RE -1.50 sph = +6 cyl (110 degrees). October 2003: outcome after buttonhole complication.

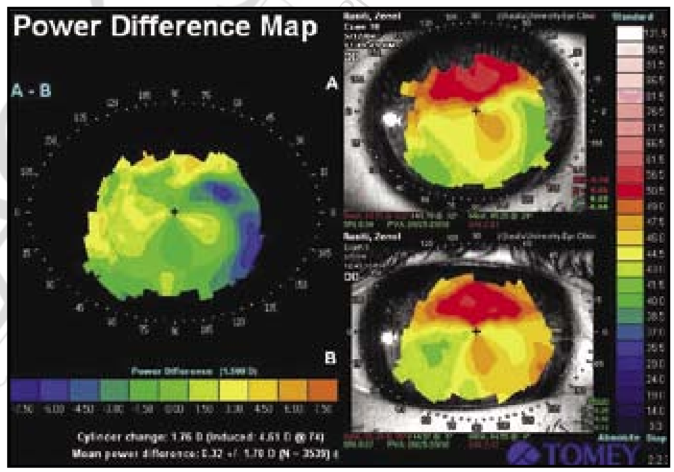

Figure 14-13. Comparison between images before (bottom right) and after (top right), the best corneal transparence permits a gain of 1 Snellen line, obtaining 20/20 of BCVA; differential map (left).

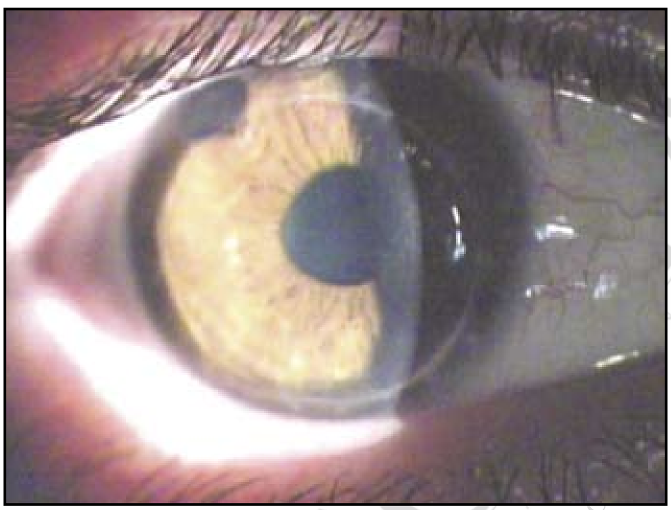

Figure 14-12. Patient R.Z., male, 31 years old. Refraction RE +0.75 sph = -2 cyl (10 degrees). May 2004: improvement of clinic features.

the presence of a high-order astigmatism, we decided to perform LASIK surgery. In both cases, the LASIK procedure was aborted because of the formation of a buttonhole (Figure 14-11). The flap has been carefully replaced, and a soft therapeutical lens has been applied. After trans-epithelial topo-customized PRK, both patients presented an improvement in both corrected and uncorrected VA.

Case 1

After LASIK treatment, during which a buttonhole complication occurred, the refraction shown went from -2 sph = -3.5 cyl (180 degrees) to -3.5 sph = -4 cyl (180 degrees). The UCVA changed from 20/67 to 20/100 and the corrected one from 20/20 to 20/30. After the transepithelial customized PRK surgery (Figure 14-12) was performed, the refraction shown was -1 sph = -0.50 cyl (25 degrees), the UCVA was 20/30 and the corrected one was 20/20, and there was an improvement of 4 lines in both the UCVA and BSCVA. The mean of the average central corneal power presurgically was 42.69 D, while after transepithelial customized PRK treatment, it was 41.0 D (Figure 14-13). The presurgical keratometric astigmatism mean was 8.3 D, becoming 2.01 D after surgery.

Case 2

For some days after LASIK, when a buttonhole occurred, subjective refraction remained unaltered, equal to -1.5 sph = +6 cyl (110 degrees). Neither UCVA nor BSCVA underwent any change, remaining respectively at 20/600 and 20/50. After transepithelial customized PRK surgery, the refraction shown was +0.75 sph = -2 cyl (10 degrees), UCVA was 20/67, and corrected VA was 20/50 with an improvement in UCVA of 3 lines. The mean of the average central corneal power presurgically, was 45.1 D and after transepithelial customized PRK treatment was 46.6 D. Presurgically, the keratometric astigmatism average was 8.4 D, and postsurgically, it was 6.1 D. The customized technique excimer laser PRK with a transepithelial computerized corneal topographer link is a new procedure, not yet completely standardized but that has been employed in our experience to correct refraction defects in the corneal morphological component too.[48,49]

The decision to perform transepithelial ablation is secondary to the consideration that the epithelial bed modifies and covers corneal surface irregularities. However, the risk of performing an ablation that may produce some minor irregularities has to be accepted, since in some points, laser spots characterized by a different ablation rate, work on epithelium, whereas in other points, they work on the stroma.[50,51]

In our experience, the efficiency and safety of customized PTK proves high when seeking to improve an irregular corneal profile caused by several corneal pathologies and postsurgical conditions with irregular astigmatism.

Moreover, with standard PTK, the well-known hyperopic shift is a high price to pay to achieve corneal transparency. Therefore, the main application for this technique is the treatment of myopic eyes, but refractive changes are very unpredictable. Starr has reported an average hyperopic shift of 2.81 D, with 63% of the eyes showing hyperopia of ≥1.0 D and a maximum of 15.75 D.[52]

In our experience, after trans-epithelial customized PRK, the average hyperopic shift was only 1.45 D, with 34.6% of the eyes showing hyperopia of ≥1.0 D and a maximum of 6.0 D.

In conclusion, the topo-customized PRK technique performed transepithelially has produced a range of positive data, but it has some limits too: a lack of direct and sure connection between the topographical map and the ablation center. Moreover, ablation percentage for opaque and pathological corneal tissue differs from that of the normal stromal components, and this may cause irregular and asymmetric ablation.[53,54]

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