Enhancement outcomes after photorefractive keratectomy and laser in situ keratomileusis using topographically guided excimer laser photoablation

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PURPOSE: To evaluate the efficacy and safety of topographically guided excimer laser photoablation to retreat unsuccessful myopic and hyperopic photorefractive keratectomy (PRK) and laser in situ keratomileusis (LASIK).

SETTING: Eye Clinic, San Salvatore Hospital, University of L'Aquila, L'Aquila, Italy.

METHODS: At least 3 months after primary PRK (Group A) or primary LASIK (Group B), 48 eyes of 42 patients were submitted to PRK or LASIK enhancements. The eyes were treated with an excimer laser linked to a computerized videokeratography unit with a topographically supported customized ablation workstation.

RESULTS: The mean follow-up was 27.8 months $\pm$ 8.2 (SD). In Group A, the uncorrected visual acuity (UCVA) changed from 0.5 $\pm$ 0.7 logarithm of the minimum angle of resolution (logMAR) (range 20/600 to 20/200) to 0.1 $\pm$ 0.7 logMAR (range 20/60 to 20/20); the mean best spectacle-corrected visual acuity (BSCVA) changed from 0.1 $\pm$ 0.7 logMAR (range 20/50 to 20/20) to 0 $\pm$ 0.7 logMAR (range 20/50 to 20/20) after the enhancement. In Group B, the UCVA changed from 0.7 $\pm$ 0.8 logMAR (range 20/600 to 20/40) to 0.1 $\pm$ 0.7 logMAR (range 20/40 to 20/20); the mean BSCVA improved from 0.2 $\pm$ 0.8 logMAR (range 20/30 to 20/20) to 0 $\pm$ 1.3 logMAR (range 20/25 to 20/20) after surgery.

CONCLUSIONS: The enhancements using topographically guided excimer laser photoablation with a topographically supported customized ablation method resulted in satisfactory and stable visual outcome with good safety and efficacy after unsuccessful PRK and LASIK.

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Excimer laser refractive surgery has proven to be an effective and safe technique to correct low to medium refractive errors. In eyes with a regular surface and curvature of the cornea, conventional excimer laser photorefractive keratectomy (PRK) or laser in situ keratomileusis (LASIK) can provide good results.[1] Nevertheless, if the cornea has an irregular surface shape, such as reoperation after primary unsuccessful PRK or LASIK, topography-based ablation, which has been adapted to the corneal irregularity, should provide better results. The recently introduced excimer laser customized ablation has proven to be a powerful technique to treat irregular corneas.[2,3] The objective of this study was to determine whether topographically guided excimer laser photoablation can be effective and safe for the treatment of the residual myopia or hyperopia after primary myopic or hyperopic PRK or LASIK.

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PATIENTS AND METHODS

Patients were enrolled between March 2000 and July 2002, after the local ethics committee approved the study protocol. Forty-eight eyes of 42 patients who requested retreatment for significant undercorrection or overcorrection after PRK or LASIK were enrolled in this prospective noncomparative case series.

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Table 1. Mean manifest refraction spherical equivalent in all patients after first refractive procedure (42 patients).

Parameter (Number of Eyes)	Mean MRSE (D) (Range) Preoperative	Mean MRSE (D) (Range) Preoperative	Undercorrected and Overcorrected Eyes
Re-PRK	−6.89 ± 3.15	−1.09 ± 2.37	25 (68%) U
Myopic (28)	(−2 to −15.25)	(−6 to +2.75)	12 (32%) O
Re-PRK	+3.04 ± 1.79	+1.88 ± 1.16	9 (100%) U
Hyperopic (9)	(+0.50 to +5)	(+0.50 to +3.25)	
Re-LASIK	−7.14 ± 1.15	−0.89 ± 2.68	6 (67%) U
Myopic (9)	(−5.25 to −9)	(−4.75 to +2.50)	3 (33%) O
Re-LASIK	+2.50 ± 2.83	−0.50 ± 1.41	1 (50%) U
Hyperopic (2)	(+0.25 to +4.25)	(−1.50 to +0.50)	1 (50%) O

LASIK = laser in situ keratomileusis; MRSE = manifest refraction spherical equivalent; O = overcorrected eyes after the original treatment; PRK = photorefractive keratectomy; U = undercorrected eyes after the original treatment

The mean preoperative refraction is shown in Table 1. According to the primary refractive procedure, patients were divided into 2 groups: Group A after PRK and Group B after LASIK. Group A consisted of 37 eyes of 32 patients (13 women and 19 men; mean age 38.3 years ± 8 [SD] [range 23 to 55 years]) (Table 2). Group B consisted of 11 eyes of 10 patients (4 women and 6 men; mean age 39.9 years ± 9.1 [SD] [range 23 to 54 years]) (Table 3). Myopic or hyperopic patients (after primary excimer laser procedure) were newly stratified in the 2 groups.

All eyes enrolled in this study had been treated originally with the MEL-70 excimer laser (Carl Zeiss Meditec) using a standard PRK or LASIK procedure (Hansatome microkeratome [Baush & Lomb], 160 μm plate, 9.5 mm suction ring). The primary indications for retreatment were significant regression or overcorrection relative to the original refractive defect, which led to the patients' request for treatment of their residual refraction. The patients were submitted to a complete ophthalmologic examination including manifest and cycloplegic refraction, uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BSCVA), tonometry, computerized videokeratography using TMS-3 topography (Tomey), 50 MHz ultrasound pachymetry to measure the epithelium and overall corneal thickness (Sonogage), noncontact endothelial specular microscopy (Seed SP500), infrared pupillometry (Colvard, Oasis) and fundus examination.

Two topographic indices were analyzed to verify the changes in corneal surface regularity: surface asymmetry index (SAI) and surface regularity index (SRI). The SAI measures the difference in corneal powers at every ring (180 degrees apart) over the entire corneal surface. The SRI is correlated with the potential visual acuity and measures the local fluctuations in the central corneal power; when the SRI is elevated, the corneal surface in front of the pupil is irregular, leading to a reduction in BSCVA.

In Group A (re-PRK) the mean time between the first treatment and the retreatment was 20.63 ± 25.16 months (range 6 to 108 months). In Group B (re-LASIK), the mean time between the first treatment and the retreatment was 3.82 ± 1.40 months (range 3 to 6 months). Informed consent was obtained from each patient.

The Procedure

Surgery was performed by 1 surgeon (L.S.) using the MEL-70 excimer laser linked to computerized videokeratographer TMS-3 with topographically supported customized ablation workstation (TOSCA). TOSCA is a system that allows performance of topography-supported refractive surgery in which the individual patient corneal topography is measured and converted to a custom ablation profile. The TMS-3 allows viewing of an axial map and an elevation map, which is useful for the planned calculation of the ablation pattern. The colors on the map indicate deviations from a perfect spherical surface. Relatively high areas are not elevations; they are areas just above the sphere. The TOSCA software selects the keratometric value of the perfect sphere as a reference surface (best-fit sphere) and converts this information into a control program for the excimer laser, which exactly ablates the colored elevation (yellowish brown) to the nominal color (green).[4] TOSCA includes the tissue-saving algorithm (TSA) module that achieves a combined correction by piling up spherical and cylindrical correction with sparing of the ablated corneal tissue. The TSA maintains the same ablation profile and allows preservation of and increases in the ablation depth. This algorithm considers

Table 2. Preoperative data before PRK retreatments (32 patients).

Parameter (Number of Eyes)	Age (y)	UCVA (logMAR)	BSCVA (logMAR)	MRSE (D)	Corneal Thickness (μm)	Time
	Mean ± SD (Range)					
Re-PRK	38.27 ± 8.04	0.7 ± 0.7	0.1 ± 0.7	−2.54 ± 2.60	457.39 ± 50.05	26.14 ± 28.77
Myopic (23)	(28 to 55)	(20/60 to 20/25)	(20/60 to 20/20)	(−0.50 to −6)	(407 to 570)	(6 to 108)
Re-PRK	41 ± 9.65	0.3 ± 0.7	0 ± 1	+2.23 ± 0.65	487.18 ± 64.61	14.25 ± 12.38
Hyperopic (14)	(23 to 55)	(20/100 to 20/25)	(20/30 to 20/20)	(+1.25 to +3.25)	(400 to 565)	(6 to 48)

BSCVA = best spectacle-corrected visual acuity; MRSE = manifest refraction spherical equivalent; Time = months elapsed between the first treatment and the retreatment; UCVA = uncorrected visual acuity

Table 3. Preoperative data before LASIK retreatment (10 patients).

Parameter (Number of Eyes)	Mean ± SD (Range)					
	Age (y)	UCVA (logMar)	BCVA (logMAR)	MRSE (D)	Pachymetry (μm)	Time
Re-LASIK	40.25 ± 15.88	0.7 ± 0.7	0.1 ± 0.7	−2.36 ± 1.29	461.37 ± 50.05	4 ± 1.15
Myopic (7)	(32 to 42)	(20/400 to 20/20)	(20/40 to 20/20)	(−1.50 to −4.75)	(411 to 567)	(3 to 5)
Re-LASIK	39.71 ± 3.55	0.7 ± 1	0.1 ± 1	+1.94 ± 0.97	448.75 ± 41.65	4.50 ± 1.91
Hyperopic (4)	(26 to 54)	(20/100 to 20/50)	(20/30 to 20/20)	(+0.50 to +2.50)	(407 to 511)	(3 to 6)

BSCVA = best spectacle-corrected visual acuity; MRSE = manifest refraction spherical equivalent; Time = months elapsed between the first treatment and the retreatment; UCVA = uncorrected visual acuity

the geometric rule that the larger the area and/or the smaller the ray of curvature, the deeper the ablation must be to obtain the desired change and vice versa.

The laser settings were as follows: 193 nm wavelength, 35 Hz frequency, 180 mJ/cm^2 fluence, and 0.25 μm ablation rate. The laser uses a 1.8 mm diameter flying spot with a gaussian profile. An active eye-tracking system oriented to a metal ring acted as an artificial limbus and maintained the centration. A cone for controlled atmosphere was added to the laser output to extract smoke or particles in the air without creating a draft and to remove all obstacles in the path of the laser beam. The refractive goal in all eyes was emmetropia.

Group A

The excimer retreatments were performed using topical anesthesia with oxybuprocaine 0.4% drops; a sterile eyelid speculum was placed in the operative eye. The patient was directed to look into coaxial light (yellow diode), and the ablation was centered on the entrance of the center of the pupil. To remove the corneal epithelium, a calculated deeper ablation using TSA software was setted (mean 57.2 ± 7.4 μm [range 53 to 69 μm]) to the planned TOSCA ablation. After the photoablation, a soft contact lens was applied and a topical antibiotic agent (ofloxacin 0.3%) and artificial teardrops were applied until reepithelialization was completed (from 4 to 6 days). Topical corticosteroids (butyrate clobetasone 0.1%) drops were administered for at least 1 month and then tapered and titrated depending on the corneal haze and refractive outcome.

Group B

After topical anesthesia (lidocaine 4% drops), the cornea was marked with gentian violet to ensure correct replacement of the corneal flap at the end of the procedure (Bansal LASIK Marker, ASICO). Then, the hinged flap was carefully lifted with a Paton spatula and placed against the superior sclera. Before the ablation, the stromal bed was dried with a Merocel sponge (Solan) and was then ready for laser ablation. At the end of the photoablation, the corneal flap was placed back in position without sutures, all debris was irrigated out of the interface, and the flap was centrifugally swept with a Merocel sponge to allow adhesion to the stromal bed. No contact lenses were used in the postoperative period. Eye protection with a hard shield was advised for the day after surgery, and all patients were instructed not to rub their eye. For the first 5 days, patients received ofloxacin 0.3% drops and butyrate clobetasone 0.1% drops 3 times a day. Then they received only butyrate clobetasone 0.1% drops once a day for 10 days.

No patients showed a rise in intraocular pressure during the follow-up. Each patient was examined starting from the first hour after the treatment and after 1, 7, and 15 days, and 1, 6, 12, 24, and 36 months.

Statistical Analysis

Data were collected postoperatively and entered into an Excel spreadsheet for subsequent analysis (Microsoft, Inc.). Data are reported as mean ± standard deviation (SD). Statistical analysis was performed using the Student *t* test.

RESULTS

All patients were treated once, and no intraoperative or postoperative complications were noted. Forty-eight eyes of 42 patients with a mean follow-up of 27.8 ± 8.2 months (range 12 to 36) were evaluated in the present study.

Visual Acuity and Refractive Outcomes

In both groups the UCVA and BSCVA improved (Tables 4 and 5). The refractive stabilities are shown in Figures 1 through 4.

Group A

The mean manifest refraction spherical equivalent (MRSE) for myopic retreatment was −2.54 ± 2.60 diopters (D) (range −0.50 to −6 D); at the last postoperative examination, it was −0.05 ± 0.66 D (range −0.50 to +0.75 D) ($P<.01$). Mean MRSE for hyperopic retreatment was +2.23 ± 0.65 D (range +1.25 to +3.25 D); at the last postoperative examination, it was +0.03 ± 0.29 D (range −0.25 to +0.50 D) ($P<.01$). All patients (100%) were within ±0.75 D of emmetropia in MRSE. Approximately 77% of patients who had myopic retreatment lost no line of best corrected visual acuity (BCVA); 17% had an increase of 3 lines and 6% of 5 lines. Eighty-two percent of the patients who had hyperopic retreatment neither lost nor gained a line of BCVA; 18% increased by 1 line.

Table 4. Uncorrected visual acuity and BSCRA, MRSE, and pachymetry at final visit after topographically guided PRK retreatments (32 patients).

Parameter (Number of Eyes)	Mean ± SD (Range)			
	UCVA (logMAR)	BSCVA (logMAR)	MRSE (D)	Corneal Thickness (μm)
Re-PRK Myopic (23)	0.1 ± 0.7 (20/50 to 20/20)	0 ± 1 (20/50 to 20/20)	−0.05 ± 0.66 (−0.50 to +0.75)	433.47 ± 24.84 (402 to 459)
Re-PRK Hyperopic (14)	0 ± 0.7 (20/25 to 20/20)	0 (20/20)	+0.03 ± 0.29 (−0.25 to +0.50)	423.36 ± 30.10 (399 to 454)

BSCVA = best spectacle-corrected visual acuity; MRSE = manifest refraction spherical equivalent; UCVA = uncorrected visual acuity

Group B

The mean MRSE for myopic retreatment was −2.36 ± 1.29 D (range −1.50 to −4.75 D); at the last postoperative examination, it was −0.11 ± 0.23 D (range −1 to +1.25 D) ($P<.001$). Mean MRSE for hyperopic retreatment was +1.94 ± 0.97 D (range +0.50 to +2.50 D); at the last postoperative examination, it was +0.06 ± 0.54 D (range −0.25 to +0.50 D) ($P<.01$). Nine eyes (82%) were within ±0.5 D of emmetropia in MRSE and 2 (18%) were within ±1 D. Thirty-three percent of patients who had myopic retreatment neither lost nor gained a line of BCVA; 17% had an increase of 1 line, 17% of 2 lines, and 33% of 3 lines. No patient who had hyperopic retreatment lost or gained a line of BCVA.

Topographic Data

The information provided by videokeratographic system included evaluation of simulated keratometry (SimK), of refractive astigmatism and qualitative–quantitative morphological information of the topographic indices SAI and SRI. The topographic patterns improved in all eyes (Figure 5). When the preoperative and postoperative SAI (0.64 ± 0.36 versus 0.73 ± 0.34, respectively) and the SRI (0.55 ± 0.36 versus 0.64 ± 0.36, respectively) of the TMS-3 videokeratographic maps were compared, the differences reached statistical significance ($P<.05$ in both comparisons).

Group A

The mean preoperative SimK value was 41.43 ± 2.73 D (range 35.74 to 47.33 D); the mean post-retreatment SimK was 40.15 ± 3.36 D (range 35.23 to 47.40 D) ($P = 0.02$). The mean preoperative refractive astigmatism was 1.0 ± 0.99 D (range 0.14 to 3.78 D); post-retreatment it was 0.88 ± 0.72 D (range 0.19 to 2.99 D) ($P<.01$).

Group B

The mean preoperative SimK value was 40.44 ± 3.72 D (range 36.16 to 46.44 D); after retreatment the mean SimK was 38.29 ± 3.14 D (range 34.82 to 45.56 D) ($P = .02$). The mean preoperative refractive astigmatism was 1.34 ± 0.80 D (range 0.47 to 3.12 D); after the retreatment, it was 0.61 ± 0.30 D (range 0.21 to 0.96 D) ($P<.01$).

Corneal Thickness

Group A

The mean preoperative ultrasound central pachymetry was 462.36 ± 71.72 μm (range 417 to 567 μm); after retreatment it was 433.40 ± 38.23 μm (range 395 to 525 μm).

Group B

The mean preoperative ultrasound central pachymetry was 468.57 ± 55.76 μm (range 413 to 570 μm); after the retreatment it was 388.33 ± 48.30 μm (range 382 to 506 μm).

Endothelial Data

The mean endothelial cellular density (ECD) and coefficient of variation (CoV) were unchanged in both groups during the entire follow-up.

Table 5. Uncorrected visual acuity and BSCVA, MRSE, and pachymetry at final visit after topographically guided LASIK retreatments (10 patients).

Parameter (Number of Eyes)	Mean ± SD (Range)			
	UCVA (logMAR)	BSCVA (logMAR)	MRSE (D)	Corneal Thickness (μm)
Re-LASIK Myopic (7)	0 ± 0.7 (20/30 to 20/20)	0 ± 1 (20/25 to 20/20)	−0.11 ± 0.23 (−1 to +1.25)	427.53 ± 14.71 (413 to 499)
Re-LASIK Hyperopic (4)	0 ± 0.7 (20/25 to 20/20)	0 (20/20)	+0.06 ± 0.54 (−0.25 to +0.50)	413.67 ± 10.43 (403 to 479)

BSCVA = best spectacle-corrected visual acuity; MRSE = manifest refraction spherical equivalent; UCVA = uncorrected visual acuity

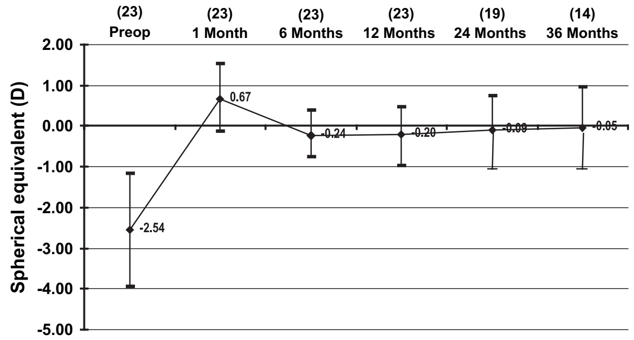

Figure 1. Change in MRSE over time after topographically guided trans-epithelial PRK myopic retreatment (number of eyes).

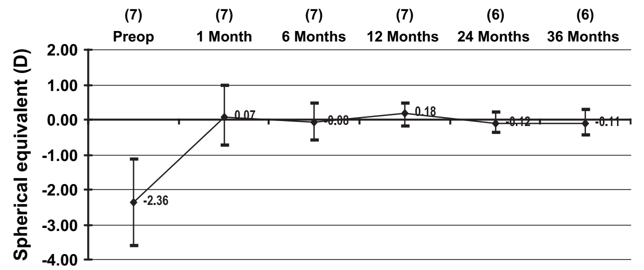

Figure 3. Change in MRSE over time after topographically guided LASIK myopic retreatment (number of eyes).

Group A

The mean ECD was 2147.83 $\pm$ 107.47 cells/mm^2 (range 1893 to 2341 cells/mm^2) and 2101 $\pm$ 124.04 cells/mm^2 (range 1688 to 2542 cells/mm^2) preoperatively and postoperatively, respectively (P>.05). The mean CoV was 45.32 $\pm$ 4.88 cells/mm^2 (range 39 to 57 cells/mm^2) and 44.06 $\pm$ 5.21 cells/mm^2 (range 34 to 54 cells/mm^2) preoperatively and postoperatively, respectively (P>.05).

Group B

The mean ECD was 2122.18 $\pm$ 129.78 cells/mm^2 (range 1928 to 2298 cells/mm^2) and 2039.10 $\pm$ 133.42 cells/mm^2 (range 1726 to 2216 cells/mm^2) preoperatively and postoperatively, respectively (P>.05). The mean CoV was 44.21 $\pm$ 7.90 cells/mm^2 (range 38 to 53 cells/mm^2) and 42.77 $\pm$ 4.65 cells/mm^2 (range 35 to 50 cells/mm^2) preoperatively and postoperatively, respectively (P>.05).

Corneal Complications

No case of delayed reepithelialization was noted. Anterior stromal haze was evaluated using Heitzmann criteria (from 0 to 5).[5] After the primary treatment, no eye in this series of patients presented a haze score greater than 1. In Group A, corneal haze registered a peak between 3 and 6 months after the retreatment and afterwards decreased gradually; no patient presented in the last examination a haze score grater than 1. Interface haze after LASIK retreatment (Group B) was minimum (trace) or absent. No case of epithelial ingrowth, debris, diffuse lamellar keratitis, infections, or keratectasia occurred.

DISCUSSION

Excimer laser PRK and LASIK have proven to be effective and safe techniques to correct low to medium refractive errors. Unfortunately, regressions toward the initial myopic or hyperopic state and overcorrection are serious problems, limiting the predictability of excimer laser refractive outcome. An estimated 10% to 20% of patients require enhancement after PRK and 5.5% to 28% after LASIK.[6,7] Retreatment of a patient who has had excimer laser refractive surgery calls for careful consideration. Possible causes of regression after PRK and LASIK surgery depend on

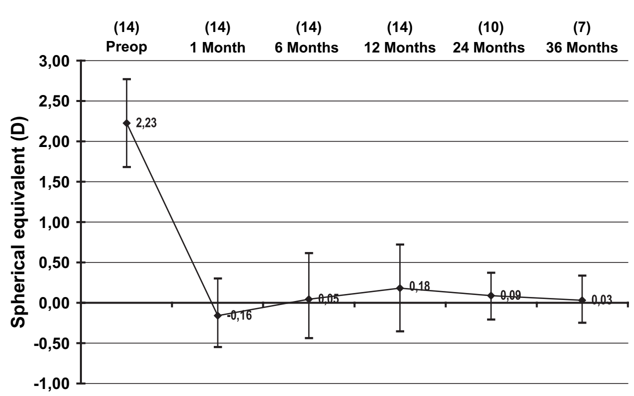

Figure 2. Change in MRSE over time after topographically guided trans-epithelial PRK hyperopic retreatment (number of eyes).

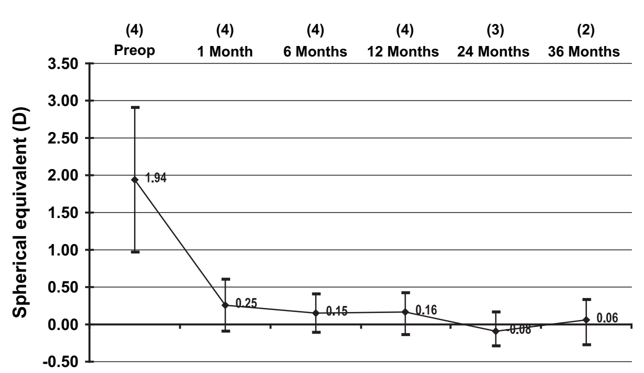

Figure 4. Change in MRSE refraction over time after topographically guided LASIK hyperopic retreatment (number of eyes).

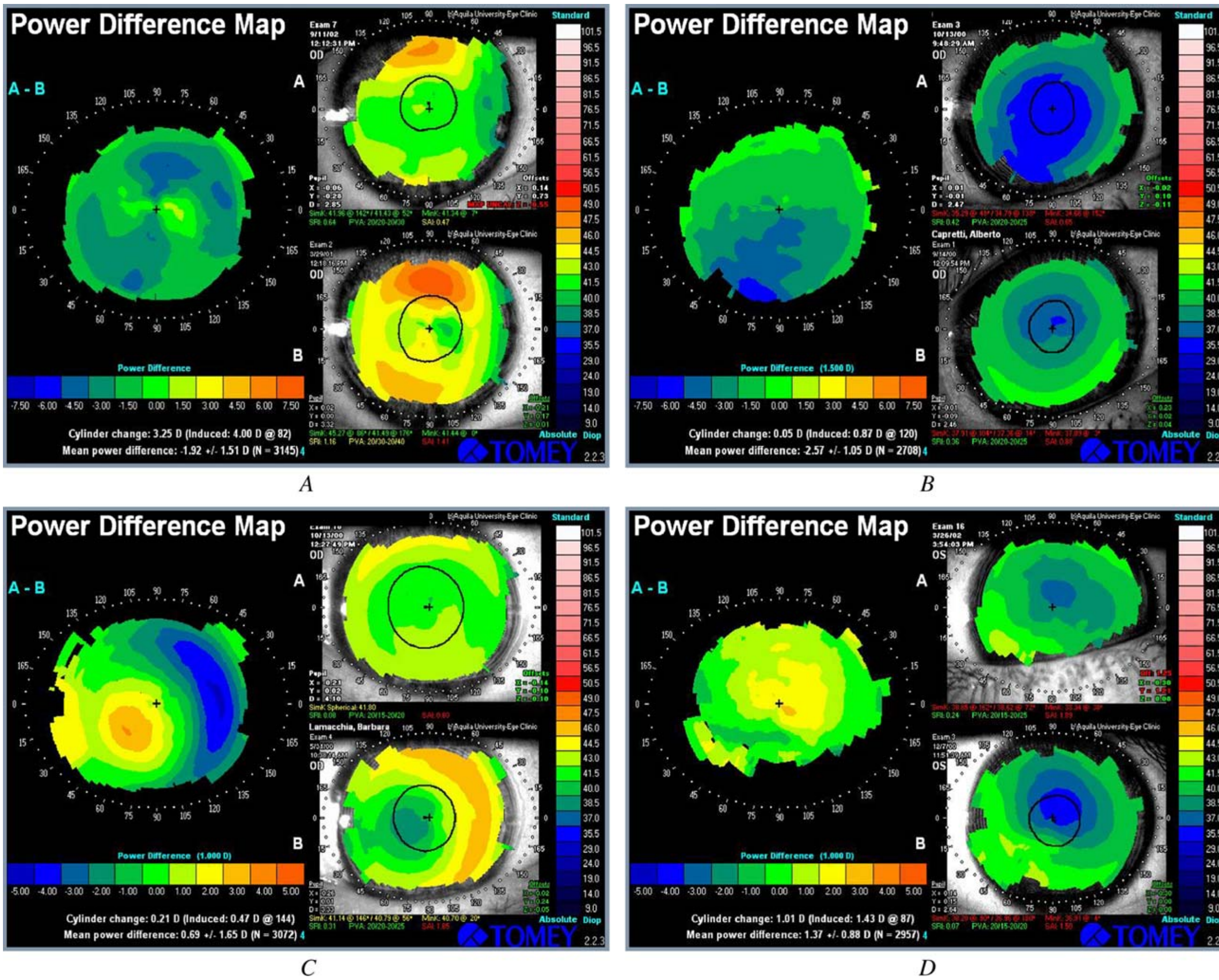

Figure 5. The differential map (*left*) highlights the improved corneal profile obtained before (*bottom right*) and after (*top right*) topographically guided transepithelial PRK or LASIK. *A*: Patient SS, woman, 35 years old. Preoperative MRSE was −6.75 with a BSCVA of 20/20. Four years after PRK, the refractive error was −1.25 (BSCVA 20/20). The calculated TOSCA ablation in the optical zone was 85 μm and the epithelial thickness, 55 μm. Using TSA software, 55 μm ablation was added for an overall superficial corneal ablation of 140 μm in the optical zone (including epithelium). The final postoperative MRSE was plano with a BSCVA of 20/20. *B*: Patient CA, man, 42 years old. Preoperative original MRSE was −9.00 D with a BSCVA of 20/20. Four months after LASIK, the refractive error was −1.75 D (BSCVA 20/30). The calculated TOSCA ablation in the optical zone was 123 μm. The final postoperative MRSE was −0.25 with a BSCVA of 20/20. *C*: Patient LB, woman, 35 years old. Preoperative MRSE was −6.50 D with a BSCVA of 20/20. Eight months after PRK, the refractive error was +2.00 D (BSCVA 20/20). The calculated TOSCA ablation in the optical zone was 48 μm and the epithelial thickness, 51 μm. Using TSA software, 51 μm ablation was added, for an overall superficial corneal ablation of 99 μm in the optical zone (epithelium included). The final postoperative MRSE was plano with a BSCVA of 20/20. *D*: Patient DL, man, 54 years old. Preoperative MRSE was −7.25 D with a BSCVA of 20/20. Two months after LASIK, the refractive error was +2.50 D (BSCVA 20/20). The calculated TOSCA ablation in the optical zone was 58 μm. The final postoperative MRSE was −0.25 with a BSCVA of 20/20 (PVA = potential visual acuity; SAI = surface asymmetry index; SRI = surface regularity index).

patient, type of instruments, parameters of treatment, and different postoperative therapy. The surgeon should determine and consider any errors in evaluation and performance. Refraction, biomicroscopy, and videokeratography are required to detect any changes in corneal curvature that might have occurred during follow-up in response to pharmacologic therapy. If the initial refractive procedure was correctly conducted, the reason for failure is related to the individual's biological response in terms of abnormal healing process to the laser treatment or to biomechanical changes in the cornea. Variability of stromal repair can depend on patient's general conditions and age. The presence of general pathologies associated (tendency toward hyperglycemia or diabetes) can delay reepithelialization; even diseases of immune system can determine changes in the healing process.[7] An adequate production in quantity, but mainly in quality, of tear film is essential for correct lamination of the epithelium during healing process.[8] The important factors that result from photoablative surgical procedures are the quality of surface ablation and the creation of a new corneal profile which do not induce an epithelial hypertrophy, with significant curvature variations.[9,10] Finally, postoperative topical therapy can modulate the evolution of refraction during the assessment after PRK and minimize the appearance of corneal haze.[11] Decentration of treatment, the presence of a small optical zone (evaluated through computerized corneal topography), and an overcorrection may determine the request for a retreatment.[12]

The success rate of enhancement is generally lower than that of the primary procedure.[13,14] The risk factors for retreatment include degree of attempted correction, initial and residual astigmatism, age, and sex.

The recently introduced excimer laser customized ablation seems to be a powerful technique to treat corneal irregularities and may increase the success rate in retreatments.[2,3] In the present study, we found, after a mean follow-up of almost 2 years, an improvement in MRSE from −2.54 to −0.05 for PRK myopic retreatments and from −2.36 to −0.11 for LASIK myopic retreatments; from +2.23 to +0.03 for PRK hyperopic retreatments and from +1.94 to +0.06 for LASIK hyperopic retreatments. All patients had a refractive error within ±0.75 D after the PRK enhancement and within ±1.00 D after the LASIK enhancement. Also, the topographic patterns significatively improved in all eyes for SAI and for SRI topographic indices, and the UCVA results were 20/50 or better in PRK retreatment group and 20/30 or better in LASIK retreatment group. These results are better if compared with the results obtained using standard PRK and LASIK retreatment techniques.[10,11,15–19]

The choice of performing a transepithelial ablation is secondary to the consideration that the epithelial layer might change and mask the corneal surface irregularity. Therefore, when adopting a topographically guided excimer laser PRK, an epithelium inclusive videokeratography map is used, which uses the epithelium like a masking agent. On the other hand, we accept the risk of creating a small irregular ablation when the laser is applied to some points on the epithelium and to others on the stroma as the result of different ablation rates.[20]

In conclusion, the enhancement techniques using topographically guided excimer laser photoablation with topographically supported customized ablation method may obtain a satisfactory and stable visual outcome with good safety and efficacy and no vision-threatening complications in selected cases after PRK and LASIK.

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