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Corneal morphology and visual outcomes in LASIK patients after orthokeratology: A pilot study

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A R T I C L E I N F O

Keywords:
Orthokeratology
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Myopia progression

A B S T R A C T

A statement of Significance: For the first time, this study shows that corneas that previous undergone orthokeratology treatment do not respond differently to LASIK compared with previous soft contact lens wear experience.
Purpose: To evaluate and compare the corneal morphology and visual outcomes of long-term soft and orthokeratology (OK) contact lens fitting in wearers undergoing corneal refractive surgery (LASIK) for myopia correction.
Methods: Sixteen (16) myopic patients wearing hydrophilic soft contact lens (SCL, n = 8 subjects, control group) and OK (n = 8 subjects, OK group) lenses who undergone LASIK were retrospectively evaluated. Preoperative fitting of contact lenses and one year postoperative were studied using Pentacam (Oculus, Inc. GmbH, Wetzlar, Germany). Corneal pachymetry and volume, corneal topography, anterior and posterior surface elevation data and the anterior surface aberrometry of the cornea were recorded and used for fitting.
Results: Age, refractive error and topographic parameters before LASIK did not showed statistically significant differences between the two study groups. LASIK post-treatment results showed identical changes in both control and OK groups and did not show significant differences in all the parameters evaluated. The changes on corneal parameters and HOA due to refractive surgery intervention were not different between Control and OK group ($p > 0.050$).
Conclusions: Corneal changes due to OK treatment are reversible after its discontinuation. The present study gives an overview of how OK does not impair future LASIK surgery for the correction of myopia and does not influence the success/results of such intervention. These findings suggest that OK CL wear does not change corneal biomechanics and does not compromise a possible LASIK refractive surgery. Although this is a pilot study and there is a need of evaluate this results/changes in future studies.

1. Introduction

The prevalence of myopia has significantly grown in the last decades, mainly affecting the Asian countries [1], and is becoming a global concern affecting North America [2] and Europe [3]. Recent estimates suggest that half the world's population will become myopic by 2050 [4], with problems associated with the increased risk of different ocular pathologies, some of them definitively affecting vision [5].

Over the last three decades, several optical and surgical procedures have been introduced for myopia correction [6]. Considering that cornea is the main optical element of the eye, changes in its shape directly influence the power of the eye and its focus. The flattening (or reshaping) of the front corneal surface has been a popular method to achieve myopia correction [7]. Laser-assisted surgical corneal reshaping has become increasingly popular since the late nineties, while contact lens assisted corneal reshaping (orthokeratology or OK) has experienced a rebirth in the early 2000′s [8,9]. The later has been the consequence of improvements in hyperpermeable lens material's and designs that allows wearing lenses overnight and a fast-corneal reshaping. While the effects of OK are transient and reversible, Laser-Assisted in Situ Keratomileusis (LASIK) surgery is permanent. Therefore, some patients wear OK lenses while they do not meet the criteria

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to perform surgery (age, refractive stability, etc.) and decide to perform surgery later in life [10].

In LASIK surgery, a thin flap of tissue involving the epithelium, Bowman's membrane and anterior stroma is removed, followed by stromal tissue photoablation and relocation of the flap. As a result, the central stroma thins and the corneal biomechanical resistance is changed. On the other hand, the long-term wear of OK contact lenses flattens the central cornea, inducing a slight thinning of the central epithelium, and transient histological changes in terms of subbasal nerve plexus and keratocyte density [11]. Though these changes are believed to be transient, there is the possibility that such changes influence in some way the outcomes of refractive surgery. Queirós et al. demonstrated that OK induces significantly stronger changes in anterior corneal curvature [7] and higher order aberrations compared to LASIK surgery [12]. Changes in corneal curvature due to lens reshaping might be involved in the overexpression of several molecular biomarkers including Epidermal Growth Factor (EGF) and Matrix Metaloproteinase 9 (MMP-9), in direct proportion to the amount of myopia being corrected, suggesting the OK compressive effect and mechanical trauma as the main causes of the inflammatory upregulation [13,14]. Several authors suggested that therapeutical control of preoperative EGF should be undertaken for the possibility of myopic regression control [13,15]. Lohmann et al., reported an increased epithelial wound healing response with EGF increased levels, associated with postoperative refractive outcome several months after myopic LASIK. Recently, González-Pérez et al., found that EGF and MMP-9 were expressed differently in those LASIK patients showing myopia regression within 1 year after surgery [13,14]. Hiraoka et al., have shown that corneal flattening and optical quality is recovered after 1 month without lens wear [16]. Interestingly, Wu et al. found a residual flattening effect in long-term wearers of OK lenses, but this study did not include a control group to discard ageing effects in corneal curvature that could account for such changes [17]. Other authors found transient changes in the biomechanical properties of the cornea [18,19], but such changes are transient and disappear after lens wear discontinuation.

OK is a corneal refractive therapy that besides the changes in peripheral image focus that is believed to slow myopia progression during the treatment, also provides changes in the topography of the cornea. However, with discontinuation of OK therapy, refraction and corneal topography recovers to that before OK [20].

Over the last three decades, corneal refractive surgery has emerged as an attractive corrective option to people with low-to-moderate refractive errors, particularly in myopic patients. LASIK has allowed millions of people worldwide to avoid their dependence on spectacles or contact lenses [10]. Although LASIK is not applied for the purpose of myopia control, both treatments induce an increase of corneal power at the periphery of the treatment area, which results in a paracentral increase in spherical equivalent myopic defocus effect, higher in OK [7]. Patients who initially wear orthokeratology lenses might at a certain point after refractive stabilization opt for LASIK surgery as a modality to avoid dependency on wearing a corrective device [21]. In a case report, Kang and Swarbrick observed a significant period of time of OK lens discontinuation before considered the patient suitable for LASIK surgery [22].

Considering the impacts of OK in corneal physiology and anatomy, the study aims to explore if such changes influence the long-term outcomes of LASIK surgery. To our knowledge this pilot study is the first evaluating these changes in a more significant number of patients who underwent LASIK surgery after long periods of OK treatment.

2. Methods

2.1. Inclusion criteria

This is a retrospective study in which patients undergoing LASIK surgery to correct low-to-moderate myopia, between −1.00 and −5.50D (Sph), were evaluated before and at 1 year after refractive treatment. Patients were recruited from consecutive candidates to LASIK after wearing Orthokeratology according to the inclusion criteria.

The inclusion criteria required that the subjects did not suffer from any current eye disease or injury and were not taking any ocular or systemic medication. No patient had any history of ocular disease or had undergone previous ocular surgery. Refractive error must have been stable within the last two years to be considered for surgery. A complete ocular examination was performed before surgery or contact lens fitting. All patients had satisfactory results after treatments with respect to the residual refractive error, visual acuity, regularity and centering of the treatment zone. The study followed the tenets of the Declaration of Helsinki. Measurements were obtained from sixteen subjects undergoing LASIK using non-customized corneal ablations at the Novovision Ophthalmological Clinic (Madrid, Spain).

2.2. Subjects and procedures

The 16 participants either worn daily wear hydrophilic soft contact lenses (Control group) or OK (OK group) before surgery.

OK patients underwent corneal refractive therapy with Paragon CRT® (sigmoid reverse geometry rigid gas permeable lenses - paflufocon D, Dk = 100 barrer - Paragon Vision Sciences, Mesa, AZ, USA) for an average of 3.6 ± 1.1years. OK lenses were fitted according to the manufacturer's recommendation [23] and average lens fitting parameters were as follow (BCR = 8.36 ± 0.13 mm; RZD = 531.25 ± 22.16 µm; LZA = 33.13 ± 0.64°). Contact lens wearers used conventional hydrogel monthly disposable soft contact lenses under disposable regime for 3.0 ± 0.7years. Patients in both groups discontinued CL wear 30 days before performing LASIK surgery [24]

Surgical routine for LASIK surgery was held according to international standards, and the commonly accepted criteria for refractive surgery procedures were observed regarding predictability, efficacy and safety. After creating a 120 µm, 9.5 mm diameter flap with a Hansatome microkeratome (Chiron Vision, model 2765; Bausch & Lomb, Claremont, California, USA), Standard LASIK (Munnerlyn based [25]) ablation profiles were produced using the Allegretto Wave Eye-Q-400 Hz (Wavelight, Erlangen, Germany). In all cases, a central ablation with an optic zone of 6.5 mm was produced. All surgical procedures were uneventful and successful with refractive error within ± 0.50D of spherical equivalent and no ocular complications. Only subjects with refractive, visual and topographic outcomes before and at least 1 year after surgery from the database were included.

2.3. Outcomes

For those patients who satisfied the inclusion criteria, front and back corneal surface topographies, pachymetry, corneal radius (steep and flat meridians), corneal asphericity, corneal volume and corneal aberrations (spherical and comatic) were obtained with Pentacam (Oculus, Inc. GmbH, Wetzlar, Germany) before and 1 year after LASIK surgery. Topographic data along the horizontal meridian were collected, over an 8-mm corneal diameter in 1-mm steps - in the center of corneal topography (C), 4 mm in the nasal corneal (N1, N2, N3, N4), and 4 mm in the temporal corneal (T1, T2, T3, T4) – using the elevation map from the computer display (elevation data were obtained using the Floating-Point option). Topographic data were obtained manually for each location. To improve the reliability of readings, only maps with a coverage of the central 8 mm in the horizontal meridian and with no irregularities during acquisition were considered. Our origin of measurements was the keratometric center, where the grid of the topography map has the (0;0) coordinates. Pre-treatment best fit sphere (BFS) was calculated for each cornea automatically. The same BFS was again used for each cornea after intervention to maintain the same reference surface for subsequent comparison. The BFS was fitted to the central 8 mm of the cornea. This procedure has been previously described for the evaluation of the anterior [7] and posterior cornea [26].

Subjective non-cycloplegic refraction was performed monocularly. The criterion of maximum plus for best visual acuity was used to arrive to the end point of refraction. The intraocular pressure was checked with a non-contact tonometer Nidek NT-4000 (Nidek CO, LTD, Hiroishi Gamagori, Aichi, Japan) before and after treatment [27].

Descriptive statistics (mean ± SD) were obtained for the refraction vector components M, J0 and J45 according to Fourier analysis, as recommended by Thibos [28].

2.4. Statistical analysis

The SPSS software package v.21 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Shapiro-Wilk Test was applied to evaluate the normality of the data distribution. When normality could not be assumed, the Mann-Whitney U Test was used for paired comparison between baseline and post-treatment values; reversely Independent sample *t*-test was used in cases that normality could be assumed. P-values lower than 0.05 (or value corrected for multiple comparisons) were considered statistically significant.

3. Results

For the control group, 8 subjects (4 female and 4 male) with a mean age of 25.75 ± 4.80 years (ranging from 21 to 32) were recruited and the measurements made on the right eyes. The average spherical equivalent before LASIK intervention was −3.33 ± 1.35D (Table 1) ranging from −1.75 to −5.50D and the mean pre-LASIK CCT (central corneal thickness) was 540.38 ± 30.05 μm. Age and pre-operative refractive data of the control group and comparison with the clinical group are shown in Table 1.

Measurements in the OK group were made on the right eyes of 8 subjects with a mean age of 22.75 ± 5.78 years (ranging from 18 to 31years), of which two were female (25%) and six were male (75%). Average pre-OK treatment spherical equivalent was −2.61 ± 1.16D ranging from −1.50 to −6.00D. OK subjects stop the treatment at least one month before LASIK treatment (−3.27 ± 1.80D). Stability after recovery was confirmed by consecutive weekly refraction within ± 0.50D, apical and keratometric curvature readings below ± 0.05 mm and anterior and posterior elevation data changes below ± 2 μm. In 2 patients the topography readings were not of enough quality to be analyzed so we conducted a comparison of corneal parameters before OK wear and after OK (prior LASIK surgery) in 6 patients. There were not differences in any of the parameters analyzed (Wilcoxon, p > 0.050 for all parameters, Table 2).

The pre-LASIK refractive error in vector components (M, J0 and J45) from both Control and OK groups are presented in Table 1. The table show low and non-significant differences (p > 0.050, Independent sample *t*-test) between the two groups study for the age, components of the refractive error, CCT and corneal curvature. The mean CCT was 540.38 ± 30.05 μm for the Control group and 550.25 ± 43.84 μm for the OK group, with no statistically significant differences (*p* = 0.308, Independent Sample Test).

Fig. 1 shows the change in corneal thickness observed in each group across the central 8 mm of the treatment zone with the LASIK. Changes in corneal thickness at corresponding points in the nasal and temporal semi-meridians of the cornea across the 8 mm chord were not significantly different (p > 0.050, Mann-Whitney U test) between both groups.

Analyzing the anterior and posterior corneal elevation for pre-LASIK (p > 0.050, Independent Sample Test) and post-LASIK (p > 0.050, Independent Sample Test) conditions, the two study groups did not show statistically significant differences. Fig. 2 represents the difference (post-pre) elevation of the anterior (A) and posterior (B) corneal surfaces for both refractive surgery conditions. The graphical profile of the difference for the anterior corneal elevation (Fig. 2A) of the two groups is quite similar, have not been observed significantly differences changes (p > 0.050, Mann-Whitney U test, corrected for multiple comparisons) at corresponding points in the nasal and temporal semi-meridians of the cornea cross the 8 mm chord. The elevation pattern of the posterior corneal elevation changes (Fig. 2B) showed to be similar too, although the Control group seemed to have a more symmetric profile than the OK group. Changes in posterior corneal elevation at corresponding points in the nasal and temporal semi-meridians of the cornea cross the 8 mm chord were not significantly different (p > 0.050, Mann-Whitney U test).

After LASIK treatment, another relevant aspect is the change in HOA expression influencing the optical quality. Fig. 3 shows the amount of pre and post-LASIK total RMS, spherical-like (4th and 6th order) and coma-like (3rd and 5th order) RMS HOA of the two study groups. In general, it was observed that post-LASIK total RMS decrease significantly while spherical and comatic HOA tended to increase in both groups (p < 0.050, Paired *t*-test). When compared both groups, there were no differences (p > 0.050, Independent sample *t*-test) for the HOA RMS (Fig. 3), which means that both groups showed similar amounts of total RMS, spherical and coma-like HOA before and after LASIK treatment.

The differences of the anterior and posterior corneal curvature, asphericity and volume between the Control and OK groups for pre and post-LASIK measures are presented in Table 3. All these parameters did not show statistically significant differences between the two study groups for both anterior and posterior corneal surfaces (p > 0.050, Independent sample *t*-test or Mann-Whitney U test, depending on the normality of the variables).

4. Discussion

The present study shows that morphological changes induced by LASIK to the cornea are not different in patients who previously undergone orthokeratology. The changes in the corneal shape and thickness induced by LASIK have been well documented previously. However, considering the biochemical and histological changes associated with OK treatment it is important to demonstrate that they do not affect the outcomes of subsequent LASIK procedures.

OK has demonstrated to be a reversible and alternative to surgical corneal reshaping while criteria of age or refractive stability are met. Nowadays, there is evidence of its benefits over myopia control during the active progression of the refractive condition, reducing the elongation of the eye by approximately 50% [29]. However, after several years of OK wear, some patients decide to eliminate definitively their dependency on visual correction [21] undergoing LASIK. Indeed, the myopic control must also represent an additional benefit in case of future surgery as LASIK visual outcomes are expected to be better for lower refractive corrections.

However, LASIK corneal surgery after long-term wear of OK lenses has been under scrutiny for two reasons: the stability of corneal topography before surgery and potential influence in outcomes after surgery. The preliminary results presented in this paper are relevant at least in three dimensions. First, before LASIK surgery contact lens wearers need to stop wearing them till stability of the anterior corneal

Table 1
Descriptive Statistics (Mean ± SD) for the two groups before LASIK surgery.

	Control LASIK	OK Group	*p-value*[*]
Age (years)	25.75 ± 4.80	22.75 ± 5.78	0.278
M (D)	−3.33 ± 1.35	−3.27 ± 1.80	0.938
J0 (D)	0.09 ± 0.26	0.13 ± 0.32	0.799
J45(D)	0.01 ± 0.10	−0.05 ± 0.17	0.396
CCT (μm)	540.38 ± 30.05	550.25 ± 43.84	0.308

* Independent Samples Test.

Table 2
Statistical significance of the details on corneal parameters in the OK Group before OK treatment and before LASIK after 1 month of OK treatment discontinuation (only the data of 6 subjects were analyzed, Wilcoxon test).

	Central Corneal Thickness (μm)			Anterior Corneal Elevation (mm)			Posterior Corneal Elevation (mm)		
	Pre-OK	Pre-Lasik	p	Pre-OK	Pre-Lasik	p	Pre-OK	Pre-Lasik	p
K_{steep}	—	—		7.76 ± 0.08	7.79 ± 0.11	0.273	6.22 ± 0.13	6.20 ± 0.12	0.343
K_{flat}	—	—		7.86 ± 0.05	7.90 ± 0.07	0.058	6.45 ± 0.15	6.44 ± 0.15	0.276
T4	715 ± 80	718 ± 81	0.140	7.67 ± 6.71	9.17 ± 6.74	0.416	22.33 ± 6.65	20.33 ± 8.31	0.057
T3	644 ± 69	645 ± 69	0.752	−0.83 ± 1.17	0.33 ± 1.51	0.084	2.50 ± 2.17	1.33 ± 4.03	0.518
T2	590 ± 58	591 ± 60	0.596	−0.67 ± 1.03	−0.17 ± 2.04	0.408	1.50 ± 3.02	1.17 ± 3.37	0.516
T1	559 ± 58	562 ± 54	0.141	1.00 ± 2.10	1.50 ± 1.05	0.453	2.50 ± 3.78	2.83 ± 2.86	0.892
C	551 ± 58	553 ± 51	0.462	2.33 ± 1.63	2.33 ± 0.52	1.000	0.50 ± 1.76	2.00 ± 0.89	0.066
N1	559 ± 59	561 ± 52	0.463	2.33 ± 2.16	1.67 ± 1.21	0.336	4.83 ± 2.14	2.67 ± 2.42	0.112
N2	584 ± 59	589 ± 56	0.093	0.50 ± 3.27	0.50 ± 2.07	1.000	3.00 ± 1.79	1.67 ± 3.27	0.084
N3	638 ± 64	641 ± 62	0.115	0.00 ± 2.61	0.67 ± 3.27	0.157	1.00 ± 4.38	0.33 ± 6.65	0.674
N4	711 ± 67	715 ± 68	0.116	5.83 ± 4.31	7.00 ± 5.66	0.197	15.00 ± 5.44	16.33 ± 6.65	0.686

surface is achieved. This might take up to 1 month as the present pilot study shows that both, soft contact lens wearers and OK wearers achieve comparable anterior corneal surface topography within this period, in agreement with the results of Hiraoka et al. [16] Previous studies considered longer time for recovery before undergoing LASIK surgery after a period of OK use [22,30]. However, the medical criteria in our patients considered stability of refraction, topography and wavefront aberrations as required criteria which was achieved within the timeframe between OK discontinuation and LASIK intervention. As said Soni et al. found a stabilization of refractive correction after OK discontinuation within a period of 2 weeks [24]. Regarding the second concern related with eventual histological changes that might compromise the corneal response to the LASIK treatment. The present study shows that changes induced by the LASIK for similar refractive corrections are the same in terms of corneal thickness ablation and resultant anterior elevation topography what suggests that LASIK ablation affects identically the corneal stroma that undergone SCL or OK for long periods of time. It can be indirectly hypothesized that the stromal properties are very similar between both groups after 1 month of discontinuation of both contact lens modalities. Finally, the present results suggest that stability of the corneal structure is not different between patients that have been under OK treatment and subjects that have been wearing soft contact lenses before surgery. Apparently, the molecular changes detected in the tear film in OK lens wearers [13,14] are not associated with any definitive change related with corneal reshaping that could place a higher risk of corneal complications after those eyes underwent LASIK surgery. However, this conclusion is derived simply from morphological data, future studies could evaluate the histology of the cornea in both situations using confocal microscopy [31]. Additional information might be obtained measuring molecular biomarkers [13,14] or eventually by biomechanical analysis of the cornea [18,32,33].

Results from the present pilot study suggest that OK does not behave differently in the short-to-medium term after LASIK, irrespective of being worn soft contact lenses or OK before the surgery. Results from previous studies on molecular biomarkers expression in the tear film showed to be different between soft lenses wear and OK with higher levels of EGF and MMP-9 in OK, both potentially associated with myopic regression or ectasia after corneal surgery [14]. This does not seem to play an effect on the outcomes of the surgery after a period of discontinuation before the surgery.

Corneal biomechanical parameters of hysteresis and resistance have demonstrated to be reduced transiently in OK patients [18] recovering to normal values after lens wear discontinuation [19]. Therefore, changes potentially induced by OK in biomechanical response of the cornea seem to be unrelated to any different response to LASIK surgery after OK lens wear discontinuation prior to surgery. Although a link between lower hysteresis or resistance factor has not been established as a risk factor of ectasia or myopic regression, our results also suggest that corneal response to LASIK surgery should not be expected to be different between OK and soft contact lens wearers. However, this should be further investigated in larger samples.

These results are not surprising if considered the reversible nature of corneal changes induced by OK. Soni et al. (2004) have demonstrated that after lens wear cessation, refractive error recovers to pre-treatment values within several days to some weeks depending on the treatment correction achieved [24]. This is related to the recovery of corneal topographic parameters and thickness parameters soon after lens wear

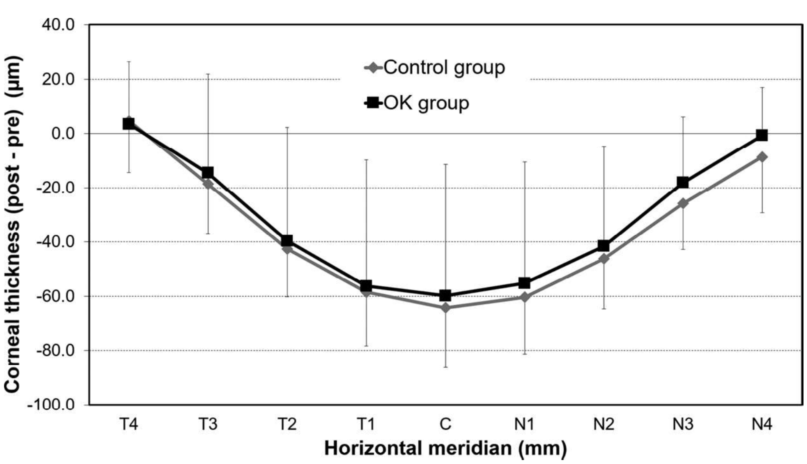

Fig. 1. Views of corneal thickness as a function of the horizontal meridian of the Control (grey) and OK (black) groups after LASIK surgery for center of corneal topography (C), 4 mm in the nasal corneal (N1, N2, N3, N4), and 4 mm in the temporal corneal (T1, T2, T3, T4) – using the elevation map from the computer display. The two groups did not show to differ between them at both pre- and post-LASIK.

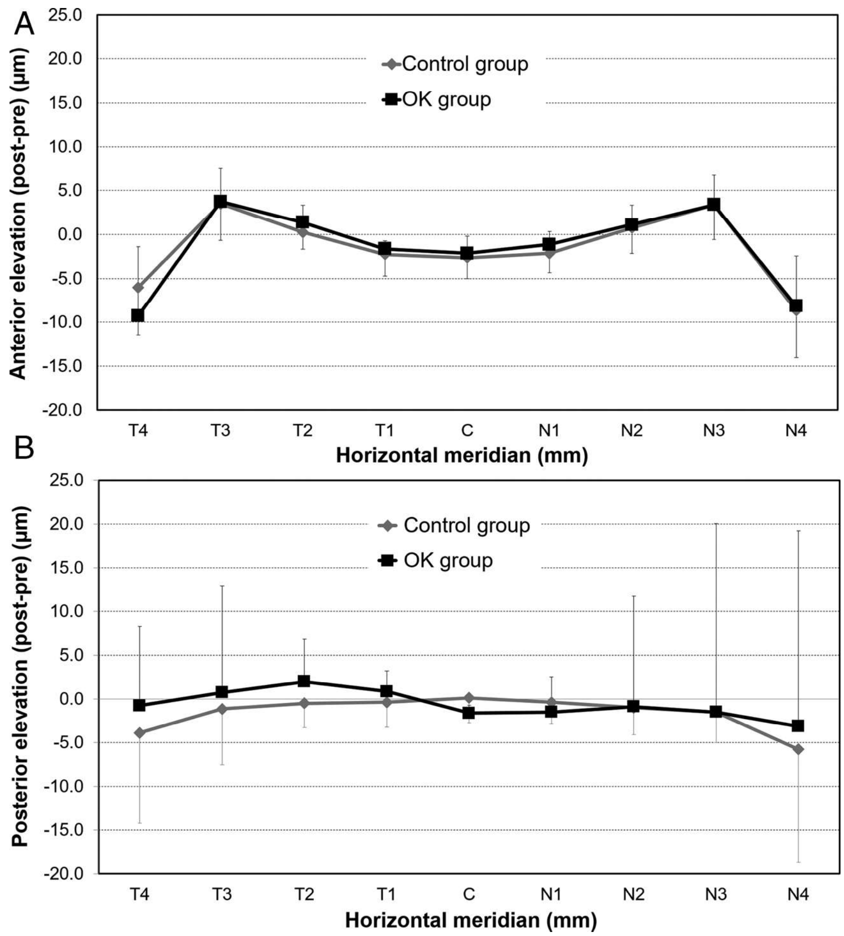

Fig. 2. Corneal elevation of the anterior **(A)** and posterior **(B)** surfaces for the two study groups (Control – grey, OK – black) post minus pre LASIK surgery. Differences between the two groups did not show to be significant.

discontinuation. Regarding histological changes, several authors have investigated the effects of overnight lens wear and mechanical pressure under the corneal reshaping lenses on epithelium, stroma and endothelium and confirmed the transient nature of these changes [11,34,35]. The changes consisted of flattening and enlarging of the epithelial cells, changes to the sub-basal nerve plexus and minor or no changes in stroma and endothelium, respectively have been identified as reversible and have been resolved within a short period of time after treatment. Therefore, the behavior of the corneal tissue and particularly the stromal tissue in response to laser ablation is not expected to be different in eyes that previously undergone reshaping treatments compared to those undergoing daily wear soft contact lenses.

The present study has some limitations. The first one is related to the reduced sample size and this should be addressed in future studies. However, the directions pointed in the present study are clear and the statistical analysis took such limitation into consideration. "A posteriori" sample size calculation predicts that the 8 subjects included in each group warrant enough statistical power to test our hypothesis that no differences result in anterior corneal elevation, as a fine measurement of post-surgical effects, if such differences exceed 10 µm.

LASIK surgery produced the same results for myopia treatment in both soft contact lens and OK users and these results are equally stable

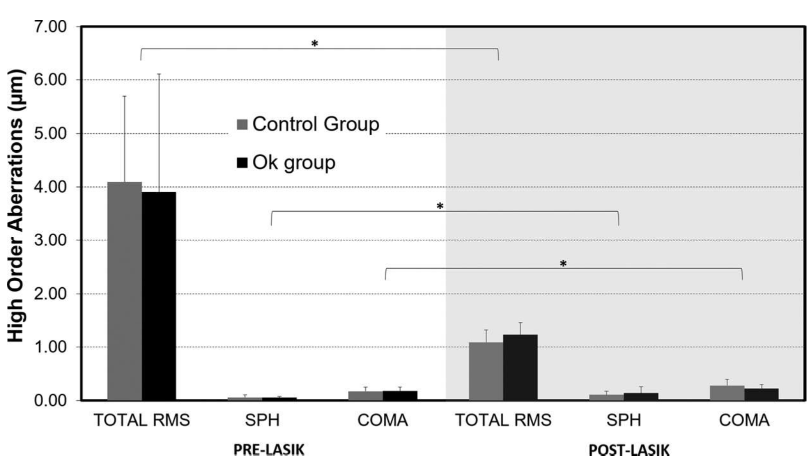

Fig. 3. Magnitude of the HOA RMS of the Control and OK groups (green and red, respectively) for pre- and post-LASIK situations. The HOA RMS evaluated were total RMS, spherical RMS (SPH) from 4th and 6th order and coma RMS (COMA) from 3rd and 5th order. Statistically significant differences are represented with the (*) symbol.

Table 3
Statistical significance of the details on corneal parameters before and after LASIK in the two groups (Control and OK).

Corneal topographic parameters		Control group	OK Group	*p*-value
Pre-LASIK				
Anterior surface	K_{steep} (mm)	7.67 ± 0.15	7.68 ± 0.22	0.713¥
	K_{flat} (mm)	7.84 ± 0.12	7.80 ± 0.19	0.641*
	Q	−0.29 ± 0.09	−0.24 ± 0.07	0.256*
Posterior surface	K_{steep} (mm)	6.09 ± 0.23	6.14 ± 0.16	0.661*
	K_{flat} (mm)	6.50 ± 0.17	6.39 ± 0.17	0.189*
	Q	−0.16 ± 0.07	−0.20 ± 0.11	0.400*
Volume (mm^2)		62.21 ± 5.22	62.49 ± 4.97	0.916*
Post-LASIK				
Anterior surface	K_{steep} (mm)	8.18 ± 0.11	8.22 ± 0.17	0.556*
	K_{flat} (mm)	8.31 ± 0.09	8.36 ± 0.19	0.531*
	Q	0.21 ± 0.28	0.33 ± 0.38	0.488*
Posterior surface	K_{steep} (mm)	6.09 ± 0.23	6.17 ± 0.24	0.502*
	K_{flat} (mm)	6.49 ± 0.21	6.63 ± 0.41	0.409*
	Q	−0.16 ± 0.16	0.07 ± 0.41	0.164*
Volume (mm^2)		59.11 ± 3.45	60.83 ± 4.47	0.406*

*Independent sample *t*-test; ¥ Mann-Whitney U test.

between the groups after one year of laser intervention. Although it is necessary to evolve these studies to a larger subject sample, these preliminary results show that the wear of OK lens for 3–4 years does not interpose the results and the stability of refractive treatment with LASIK surgery.

In general, our results showed that there were no differences on post-LASIK corneal topography on subjects with previously OK treatment compared with subjects wearing usual soft contact lens which might suggest that OK is not a contraindication for laser refractive surgery.

Disclosure

The authors have no proprietary interest in any of the instruments or materials mentioned in this article.

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