



ORIGINAL ARTICLE

Aspheric photorefractive keratectomy for myopia and myopic astigmatism with the SCHWIND AMARIS laser: 2 years postoperative outcomes

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KEYWORDS

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Abstract

Purpose: To evaluate mid-term refractive outcomes and higher order aberrations of aspheric PRK for low, moderate and high myopia and myopic astigmatism with the AMARIS excimer laser system (SCHWIND eye-tech-solutions GmbH, Kleinostheim, Germany).

Methods: This prospective longitudinal study evaluated 80 eyes of 40 subjects who underwent aspheric PRK. Manifest refractive spherical equivalent (MRSE) of up to -10.00 diopters (D) at the spectacle plane with cylinder up to 3.25 was treated. Refractive outcomes and corneal wavefront data (6 mm pupil to the 7th Zernike order) were evaluated out to 2 years postoperatively. Statistical significance was indicated by $P < 0.05$.

Results: The mean manifest spherical equivalent refraction (MRSE) was -4.77 ± 2.45 (range, -10.00 D to -0.75 D) preoperatively and -0.12 ± 0.35 D (range, -1.87 D to $+0.75$ D) postoperatively ($P < 0.0001$). Postoperatively, 91% (73/80) of eyes had an MRSE within ± 0.50 D of the attempted. No eyes lost one or more lines of corrected distance visual acuity (CDVA) and CDVA increased by one or more lines in 26% (21/80) of eyes. Corneal trefoil and corneal higher order aberration root mean square did not statistically change postoperatively compared to preoperatively ($P > 0.05$, both cases). There was a statistical increase in postoperative coma ($+0.12 \mu\text{m}$) and spherical aberration ($+0.14 \mu\text{m}$) compared to preoperatively ($P < 0.001$, both cases).

Conclusion: Aspheric PRK provides excellent visual and refractive outcomes with induction in individual corneal aberrations but not overall corneal aberrations.

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PALABRAS CLAVE

Aberraciones;
Asférico;
PRK;
Miopía;
Astigmatismo

Queratectomía fotorrefractiva (PRK) para miopía y astigmatismo miópico con el láser SCHWIND AMARIS: resultados postoperatorios a los 2 años

Resumen

Objetivo: Evaluar los resultados refractivos a medio plazo así como de aberraciones de alto orden corneales de la técnica PRK asférica para miopía baja, moderada y alta y astigmatismo miópico con el sistema de láser excímero AMARIS (SCHWIND eye-tech-solutions GmbH, Kleinostheim, Alemania).

Métodos: En este estudio longitudinal prospectivo se evaluaron 80 ojos de 40 sujetos que se sometieron a PRK asférica. Se trató un equivalente esférico de la refracción manifiesta (EERM) de hasta $-10,00$ dioptrías (D) en el plano de la gafa con un máximo de $3,25$ D de cilindro. Se evaluaron los resultados refractivos y los datos de frente de onda (*wavefront*) corneal (pupila de 6 mm hasta el orden 7 de Zernike) durante 2 años tras la cirugía. La significación estadística fue indicada por $P < 0,05$.

Resultados: La media del equivalente esférico de la refracción manifiesta (EERM) fue de $-4,77 \pm 2,45$ (intervalo: de $-10,00$ D a $-0,75$ D) en el preoperatorio y de $-0,12 \pm 0,35$ D (intervalo: de $-1,87$ D hasta $+0,75$ D) en el postoperatorio ($P < 0,0001$). En el postoperatorio, el 91% (73/80) de los ojos presentaron un EERM dentro de un intervalo $\pm 0,50$ D respecto al objetivo. Ningún ojo perdió una o más líneas de agudeza visual mejor corregida y ésta aumentó en una o más líneas en el 26% (21/80) de los ojos. El valor cuadrático medio de las aberraciones de alto orden y el defecto trefoil corneal no cambiaron estadísticamente en el postoperatorio en comparación con el preoperatorio ($P > 0,05$ en ambos casos). Se observó un aumento estadístico en el coma a nivel postoperatorio ($+0,12 \mu\text{m}$) y en la aberración esférica ($+0,14 \mu\text{m}$) en comparación con el preoperatorio ($P < 0,001$ en ambos casos).

Conclusión: La PRK asférica proporciona unos resultados refractivos y visuales excelentes, con inducción de algún tipo específico de aberración corneal, pero sin afectación global de las aberraciones corneales.

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Photorefractive keratectomy (PRK) is a surgical procedure for the treatment of refractive error and higher order wavefront aberrations.¹⁻³ PRK for myopia is a surface ablation procedure that flattens the cornea by removing corneal tissue centrally, thereby changing the refractive power of the cornea and reducing myopia and may be combined with a reduction of the higher order aberrations specific to the eye.

Postoperative regression, haze and the introduction of laser in situ keratomileusis lead to reduced demand for PRK with a conventional ablation profile within a decade after introduction. However, wavefront and aspheric ablation algorithms, larger optical zones, the incorporation of transition zones and the treatment of higher order aberrations have improved its safety and accuracy over the last two decades.²⁻⁵ The ablation algorithm, named "Aberration-Free™", which is available in the SCHWIND AMARIS platform, aims at maintaining the preoperative levels of higher order aberrations by planning the optimal ablation pattern for each individual eye. Other aspheric approaches include "customized",⁶ ocular wavefront,⁶ corneal wavefront, topography-guided,⁷ wavefront-optimized,⁸ asphericity preserving,⁹ or Q-factor profiles.¹⁰

Thanks to the SCHWIND CAM software, aspheric ablation profiles are integrated in order to compensate for the peripheral loss of energy which occurs during the LASIK. In addition, the same software, in order to keep stable the

preoperative corneal higher order aberrations, changed the postoperative corneal curvature using ablation algorithms that take into account the stigmatic condition, the spot overlapping and the tissue remodeling.¹¹

The increased safety combined with the incorporation of mitomycin C to mitigate corneal haze has led to a resurgence of PRK.¹² However, the long-term outcomes of PRK remain largely undocumented.

The current study prospectively evaluated the refractive outcomes and higher order aberrations of aspheric PRK for low, moderate and high myopia and myopic astigmatism with the AMARIS excimer laser system (SCHWIND eye-tech-solutions GmbH, Kleinostheim, Germany) at 2 years postoperatively.

Subjects and methods

Subject population and baseline examinations

In this prospective study a total of 80 eyes of 40 subjects were treated with aspheric PRK for spherical myopia and myopic astigmatism. Manifest refractive spherical equivalent (MRSE) of up to -10.00 diopters (D) at the spectacle plane with cylinder up to 3.25 was treated. Subjects were enrolled in the study if they were 18 years of age or older, had a stable refraction for 1 year prior to the study and discontinued contact lenses for at least 2 weeks

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