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Temporal Evolution of Ocular and Corneal Aberrations Following LASIK Refractive Surgery

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Abstract

Purpose: To explore how ocular and corneal aberrations evolve over time after standard LASIK refractive surgery. The changes of both corneal and ocular aberrations measured at different times from the surgery serve to better understand the nature and evolution of the optical aberrations after LASIK.

Methods: We measured both ocular and corneal wave-front aberrations for a 5 mm pupil diameter in a group of patients that underwent standard LASIK myopic/astigmatic refractive surgery. Every patient was measured prior to the surgery and at least 1, 4 and 18 weeks after the surgery. The ocular aberrations were measured using our own research prototype near-infrared Hartmann-Shack wave-front sensor adapted to the clinical environment. This system is robust, since it has more than 220 microlenses over a 5 mm pupil area, it has a high-dynamic range allowing to measure large aberrations with enough accuracy. The corneal aberrations were obtained by using a custom ray-tracing procedure from the corneal elevation maps provided by videokeratography. A group of 10 patients (20 eyes) was studied, with mean age of 29.5 ± 3.9 years old; and mean pre-operative refraction: defocus -3.4 ± 2.1 D and astigmatism -1.6 ± 1.3 D.

Results: The RMS of the higher order ocular aberrations (third to sixth order) increased from an average preoperative value of 0.21 ± 0.07 microns to 0.38 ± 0.12 microns one week after the surgery (this represents an increase by 1.8 fold). Four and eighteen weeks after the surgery, the RMS was reduced to average values of 0.32 ± 0.12 and 0.27 ± 0.08 respectively. This last value represents an increment of 1.3 compared to the pre-operative value. We found a similar trend in the temporal evolution of the RMS of the corneal aberrations: 0.19 ± 0.06 microns before surgery, and 0.39 ± 0.13 , 0.36 ± 0.09 and 0.30 ± 0.03 microns at 1, 4 and 18 weeks after surgery. Analysis of how individual aberration terms changed over time revealed a

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large variability in the kind of aberration induced or either if it remained stable or changed after the first week from surgery.

Conclusions: The changes in ocular and corneal aberration during the first 18 weeks after standard LASIK were followed. The highest amount of aberrations appeared just one week after the surgery. After that, in most eyes, we found a continuous reduction of the RMS following an exponential decay with time. The nature of the actual mechanisms responsible of the reported aberration changes require further investigations.

Keywords: refractive surgery: optical quality • refractive surgery: LASIK • physiological optics



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