Topography-guided LASIK for Hyperopia and Hyperopic Astigmatism

PO475

AAO Chicago 2012

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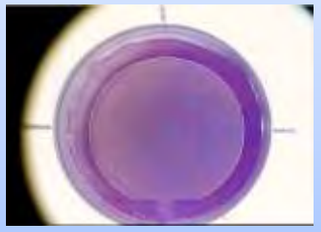
Financial Interest: Alcon/Wavelight

the Alcon/Wavelight refractive Suite: the FS200 femto and EX500 excimer

Figure 1: This is the end of flap making report generated by the FS200 femtosecond laser. The image of the flap created in this right eye (this is the surgeons view) is shown here in reference to the pupil highlighted by the red circle and shown by the red arrow. It is easy to ascertain that this flap has been created nasally in order to accommodate a similarly placed topography-guided ablation



Purpose

To evaluate the safety and efficacy of the topography guided ablation (tgLASIK) of the Alcon/Wavelight platform in LASIK for hyperopia and /or hyperopic astigmatism

Methods:

We prospectively evaluated 328 consecutive LASIK cases for hyperopia with or without astigmatism with tgLASIK. Mean preoperative sphere was +3.29 diopters (D) (+0.75 to +8.25) and mean cylinder was -1.95 (0 to -6.00). Flaps were created with the Intralase FS60 or the Wavelight FS200 femtosecond lasers. Parameters evaluated were age, pre and post-operative refractive error, UCVA, BSCVA, flap diameter and thickness, topographic changes, higher order aberration changes and low contrast sensitivity.

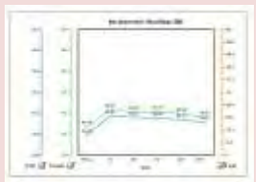


Figure 8, the keratometry readings showed an initial increase within the first month indicative of an effective hyperopic correction, but demonstrated a progressive slow decline over the first 2 years suggesting a predictable long-term regression of the initial hyperopic effect.

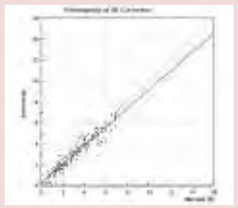


Figure 6 shows the predictability graph: red dots show overcorrection and blue under-correction, green dots are within +/- 0.5 diopters. This graph shows a slight trend for overcorrection in higher refractive errors, which was our aim pre-operative in order to compensate for long-term regression effect.

RESULTS: Two hundred two eyes were available at two years; three patients was lost to follow up and 5 eyes received enhancement procedures prior to the completion of our evaluation. The age average age was 40.4 years (+/-11.78), range of 19 to 62. Males were 54% of the cases and females 46%. Mean preoperative sphere was +3.04 diopters (+/-1.75) (range from +0.75 to +7.25) and mean cylinder was -1.24 diopters (+/- 1.41) (range from -4.75 to 0 diopters). UDVA improved from 5.5/10 to 8.2/10. At 24 months (8-37), 75.5% of the eyes were in between +/- 0.50 diopters (D) range, 94.4% were in the +/- 1.00 diopters range. of the refractive goal. Pre-operatively mean sphere values (sph) were +3.04 (+/-1.75) and mean cylinder (cyl) -1.24 (+/-1.41) and post-operatively were: sph -0.39 (+/-0.3) and cyl -0.35 (+/-0.25). There was an increase in best spectacle corrected visual acuity (CDVA) from 9.1/10 pre-op to 9.5/10 post-op. Figure 3 shows the comparison of preoperative CDVA in blue and postoperative UDVA in red, there is obvious improvement) Figure 4: shows the pre-operative cylinder distribution in red and postoperative in blue, Figure 5 is a vectogram of preoperative cylinder distribution in blue dots (distance on the y axis represents amount and on the x axis degrees, the yellow-dots represent the post-operative cylinder vectogram.

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New York University School of Medicine

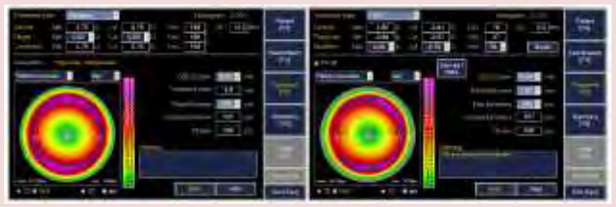
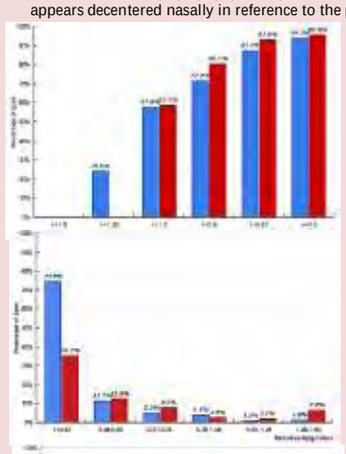


Figure 2 This Figure demonstrates the topography-guided ablation concept
The image on the left shows the relative centration to the pupil image of a standard ablation for +3 diopters in the right eye of a patient. The image on the right shows the exact same correction planned with the topography-guided platform. It is obvious that the ablation here appears decentered nasally in reference to the pupillary image (circle)



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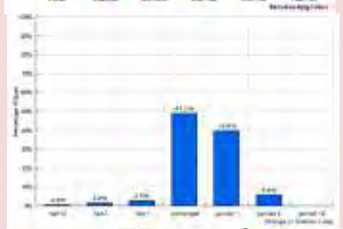

Figure 7 is the safety graph with lines gained and lost, revealing a great safety record with this technique and an impressive 46,6% of cases gaining at least 1 line of acuity postoperatively

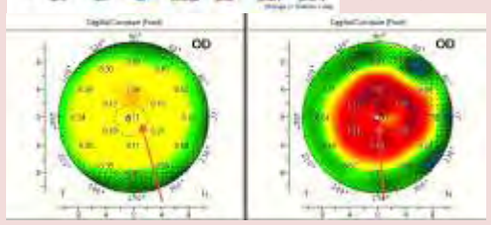

Figure 9 shows a pre and postoperative Scheimflug generated tomography. The red arrows point to the visual axis and line of sight. It is obvious that when one evaluates the centration of the achieved hyperopic ablation in this hyperopic eye the optical zone appears nessaly decentered in reference to the pupillary image (dotted circle). It is nevertheless centered on the visual axis of this eye with significant angle kappa.

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Flap diameter: 8.9 mm, with a standard deviation of +/- 0.2 mm, flap thickness 135 (+/-8) um calculated by subtraction ultrasonic pachymetry.

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The higher order aberrations as measured by the RMSH increased by 15% from a pre-operative of 0.2um to 0. to a post-operative value of 0.23um at the 12month of follow up. There were no epithelial downgrowth or any other significant complications noted in this limited group.

Low contrast sensitivity scores results at 12 cycles/degree (column C on the chart) improved from an average preoperative of 6.4 to 6.8.

Conclusions/Discussion:

Hyperopic and mixed astigmatism LASIK utilizing the topography-guided 400Hz eye-Q excimer laser and the Intralase FS-60 and Alcon FS200 Femtosecond lasers appears to be safe and very effective in the correction of hyperopia and hyperopic astigmatism. The post-operative results at 1 and 2 years are impressive for hyperopic and astigmatic refractive error correction, improvement in both UDVA and CDVA, with minimal regression and need for enhancement. At twenty four months follow up our mean refraction spherical equivalent was +/- 0.50 Diopters of the intended post-operative refraction in over 80% of cases, which is comparable or even better than other published results achieved with other similar systems for the correction of hyperopic refractive errors[1-11].

This efficacy also extends to the treatment of mixed hyperopic and astigmatic refractive errors; which we theorize may be in part, because of the positive cylinder conversion and treatment of the astigmatism on the steep meridian as well as addressing angle kappa. We consider centering hyperopic ablations in the pupil center an error, as it will invariably decenter the actual ablation in regard to the visual axis and line of sight, and potentially inducing astigmatism. This principle leaves the central optical zone in these treatments non-treated by the excimer as both the hyperopia and cylinder are treated is the theoretical peripheral ring of 6.5 to 9.5 mm from the center of the visual axis.

The keratometric regression though noted over the average 2 year follow-up suggest an intrinsic biomechanical mechanism in hyperopic LASIK: The "expansion" of the ablated mid-peripheral cornea that has been ablated, resulting in progressive flattening of the steepened central cornea. We are currently working with adjunct collagen cross-linking techniques as a means of reducing and/or eradicating this effect.