Comparison of Corneal and Total Ocular High-Order Optical Aberrations Before and After Myopic Laser in situ Keratomileusis


**Purpose:** To evaluate the changes in total and corneal aberrations and the compensation of aberrations within the human eye after conventional myopic laser in situ keratomileusis (LASIK).

**Methods:** Total and corneal aberrations were measured preoperatively and 3 months postoperatively for 57 eyes. The NIDEK EC 5000 excimer laser was used for all treatments. Total and corneal ablations root-mean-square (RMS) values were calculated out to the 6th Zernike orders for a 6.00 mm pupil diameter. The percentage of increase after surgery was defined by the ratio between the RMS values pre- and postoperatively for each of the corneal and total eye aberration groups. The compensation between corneal and internal aberrations for a given ablation group was defined by the ratio (corneal aberration group RMS)/ (total eye aberration group RMS).

**Results:** Postoperatively, higher order aberrations showed a statistically significant increase after myopic LASIK by a factor of 1.77±0.26 (total) and 2.47±2.5 (corranel) (p <0.05). Coma aberration increased by a factor of 2.43±2.61 (total) and 2.56±2.66 (corneal). Spherical aberration increased by a factor of 1.61±0.83 (total) and 2.64±2.24 (corneal). The values of the ratio of compensation did not show statistically significant differences before and after LASIK for individual aberrations (p>0.05).

**Conclusions:** Although myopic LASIK induced significant corneal aberrations, the level of partial compensation of corneal aberrations by internal structures remained unchanged. These results may suggest that a previously described emmetropization that is effective not only with developmental factors but also with acquired variations in corneal shape.

**CR:** D. Gatlinel, None; P. Adam, None; S. Chaabouni, None; J. Munck, None; M. Thévenot, None; T. Hoang-Xuan, None; H. Bains, None.

**Support:** None

---

Multizone Model for Post-surgical Corneas. Analysis of Standard and Custom LASIK Outcomes


**Purpose:** To develop a model of post-surgical corneas and its application to analyze the outcomes of standard and custom myopic LASIK treatments.

**Methods:** The optical zone (OZ), transition zone (TZ) and periphery are segmented automatically by a clustering algorithm. For each point, we compute three physical magnitudes: Gauss curvature, root-mean-square (RMS) fit error, and distance to the vertex, which are then used as local descriptors in the segmentation. Both pre-surgical and post-LASIK corneal topographies were compared using monozone and multizone models. Three groups of patients (31 eyes) were studied according to the treatments applied: Allegretto (custom), Zyoptix (custom) and Planofac (standard).

**Results:** The multizone model improved the goodness of fit from 2.4±0.7 to 1.2±0.4 μm (post-LASK). The segmentation permitted us to estimate the diameter, shape and decentration of the different zones. The estimated central ablation (OZ) area was always lower than nominal value (average diameter 6.6±0.3 mm versus 5.5±0.4 mm) and showed elliptical shape (average ε = 0.27). In the OZ, curvature radii increased after surgery, and conic constants (con) increased. No significant differences were found between Zyoptix and Planofac: Corneal HOA increased by a factor of 2; for Allegretto HOA increased by 3.

**Conclusions:** The analysis of the three different LASIK treatments showed no improvement of custom over standard treatments. The multizone model shows a higher fidelity representation of the corneal topography and permits a deeper understanding of the post-surgical cornea.

**CR:** L.M. González, None; J.L. Hernández-Matamoros, None; R. Navarro, None.

**Support:** None

---

Early Refractive Outcomes of Wave-Front Guided Sub-Bowman’s Keratomileusis (SBK) With 110µm and 90µm Femtosecond Flaps

K.A. Kerna, B.H. Jeng, R.R. Kruger, A.S. Roth, W.J. Dupps, Jr., PhD. Cole Eye Institute, Cleveland, OH; The Department of Biomedical Engineering, Lerner Research Institute, Cleveland Clinic, Cleveland, OH.

**Purpose:** To compare the refractive outcomes of thin-flap LASIK with 90µm and 110µm femtosecond flaps to determine if surgeons need to account for their choice of flap thickness in the treatment offset.

**Methods:** We performed a retrospective, IRB-approved chart review of 178 consecutive patients who had CustomCornea LASIK for myopia (Alcon LADARVision 6000) with femtosecond flaps (IntraLase fs 60) performed by two surgeons (RK and WD). Eyes with 3-5 month follow-up were divided into 2 groups: 88 eyes with 90µm flaps and 90 eyes with 110µm flaps. Preoperative and surgical variables in each group were compared using student t-test with a p value <.05 indicating significance.

**Results:** Preoperative central corneal thickness (CCT) differed between the 90µm (543.0±22μm) and 110µm groups (557.3±33μm, p=0.002), while attempted correction, simulated keratometry and patient age did not (p>0.09). Surgeon offsets differed between the 90µm (0.3±0.28D) and 110µm groups (0.12±0.3D, p<0.001). Regression analysis demonstrated no correlation between postoperative spherical equivalent (SE) refractive error and CCT. Visual acuity outcomes were no different in the 2 groups. Actual postoperative SE was no different between the 90µm (0.09±0.39D) and 110µm (0.10±0.36D) groups (p=0.9) but differed slightly after adjustment for the offset (p=0.1). Intended and measured flap thickness (by intraoperative subtractive pachymetry) were poor predictors of adjusted SE refractive error in single predictor and multivariate analyses, and surgeon offset only explained a small portion of the variance in refractive outcome (R²=4.8%, p=0.003).

**Conclusions:** The choice of a 90µm vs.110µm femtosecond flap had no measurable effect on early refractive outcomes in custom myopia treatments. Though surgeons tended to treat thinner corneas with 90µm flaps and apply slightly larger positive SE offsets in this group, intended flap thickness never demonstrated significance as a predictor of refractive outcome. Offset adjustments on the basis of intended flap thickness in the 90-110µm range do not appear to be necessary.

**CR:** K.A. Kerna, None; B.H. Jeng, None; R.R. Kruger, Alcon & IntraLase consultant and travel funds, F. A.S. Roth, None; W.J. Dupps, None.

**Support:** Research to Prevent Blindness, NIH grant 1KL2RR024990 (BHJ and WJD)
Contralateral Comparison of WASCA versus Iris Recognition Guided WASCA Using MEL80 Excimer Laser System

F. Wu, Y. Yang. Ophthalmology, the second Hospital Affiliated to Zhejiang University, Hangzhou, China.

Purpose: To verify whether there is any difference in visual outcome after performing WASCA (wavefront supported corneal ablation) and iris recognition guided WASCA (IR-WASCA) of the same patient 3 month after surgery.

Methods: This was a prospective randomized study of 104 myopic eyes (52 patients) that had LASIK using the MEL80 excimer laser system. IR-WASCA was used in the first eye of the patient (study group) and the other eye of the same patient was operated with WASCA surgery (control group). Mean refractive error was similar between left and right eyes of the same patient. Higher order aberration (HOAs), Contrast sensitivity function (CSF), UCVA and BCVA were recorded preoperative and 1-month, 3-month postoperative. Corneal topographic maps were performed preoperative and 3-month postoperative.

Results: The mean cyclorotation of IR-WASCA group was -2.0°±4.2°, and 0.6°±1.2°. At 3 month after surgery, UCVA was 20/20 or better in 96.2% of IR-WASCA group and 90.5% of WASCA group. A significant difference in CSF was found between the two groups at 2.5, 1.6, 1.0 degree.

Conclusions: IR-WASCA provides a better quality of vision as they detect and compensate cyclorotation to give a more precise ablation profile.
Conclusions: change in refraction was observed. 

P noted (trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were after the procedure significant decreases in total, tilt, high order aberrations, total root-mean-square (RMS) wavefront aberration was 4.39 ± 2.79 μm. All Zernike modes total coma, total trefoil, total tetrafoil, total spherical and total high astigmatism measured using the Nidek-OPD scan aberrometer. Total, tilt, high order aberrations, eyes of 20 patients before and 1 month after Nd:YAG laser posterior capsulotomy were.

Methods: The Artisan hyperopic PIOL is fabricated from ultraviolet-absorbing polymethylmethacrylate. It was implanted in 95 eyes of 60 subjects at 13 participating trial sites located throughout the United States. Inclusion criteria included endothelial cell counts (ICC) of at least 2000 cells/mm² and anterior chamber depth (ACD) of at least 3.2 mm. The goal of all surgeries was emmetropia. 46 eyes were followed for 3 years.

Results: Implant diastere strength averaged 7.55 ± 2.04 D (range ±0.1 to +12.0 D). Pre-operative ACD averaged 3.40 ± 0.17 mm. The pre-operative mean spherical equivalent (MSE) averaged ±5.47 ± 1.45 D, while the third post-operative year MSE averaged ±0.56 ± 0.65 D. By this third post-operative year, 65.5% of eyes were within ±0.5 D and 96.2% were within ±1.0 D of the intended correction. Pre-operative best corrected visual acuity (BCVA) was 20/20 or better for 75.8% of eyes and 20/40 or better for all eyes, while at the third post-operative year, 21.4% of eyes achieved uncorrected visual acuity (UCVA) of 20/20 or better, and 85.5% of eyes achieved 20/40 or better. By the third post-operative year, 72.7% of eyes achieved a BCVA of 20/20 or better with all eyes achieving a UCVA of 20/40 or better. ECC decreased by 4.3% over three years from 2588 to 2400 cell/mm² (p < 0.01).

Conclusions: The Artisan PIOL provides effective and predictable correction of hyperopia up to +12.0 D.

Conclusions:

CR: R.U. Desai, None; A. Jain, None; E.E. Manche, is a stock holder of Calboun Vision, I; received some travel support from VISX, AMO, and IntraLase, R.
Support: Optitec

The Effect of Nd:YAG Laser Posterior Capsulotomy on Ocular Wavefront Aberrations


Purpose: To assess the effect of Nd:YAG laser posterior capsulotomy on ocular wavefront aberrations.

Methods: The wavefront aberrations of the entire optical path of 24 pseudophakic eyes of 20 patients before and 1 month after Nd:YAG laser posterior capsulotomy were measured using a wavefront OD scan aberrometer. Total, tilt, high order aberrations, total coma, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were analyzed statistically. Secondary measures included changes in visual acuity and refraction.

Results: Before Nd:YAG laser posterior capsulotomy, the total higher-order aberrations root-mean-square (RMS) wavefront aberration was 4.39 ± 2.79 μm. All Zernike modes were elevated, with total trefoil being a major contributor 1.19 ± 1.2 μm. One month after the procedure significant decreases in total, tilt, high order aberrations, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were noted (P < 0.05). No significant changes in total coma aberrations were found (P > 0.05). Additionally, significant improvement in visual acuity without significant change in refraction was observed.

Conclusions: Before Nd:YAG laser posterior capsulotomy causes significant decrease in ocular wavefront aberrations which can explain a better optical quality after the procedure. Further research to examine the impact of wavefront aberrations in visual function after Nd:YAG laser posterior capsulotomy is needed.

CR: J. Levy, None; I. Kleinperer, None; Z. Ashkenazy, None; N. Belfair, None; A. Kratz, None; T. Lifshitz, None.
Support: None

The Effect of Nd:YAG Laser Posterior Capsulotomy on Ocular Wavefront Aberrations


Purpose: To assess the effect of Nd:YAG laser posterior capsulotomy on ocular wavefront aberrations.

Methods: The wavefront aberrations of the entire optical path of 24 pseudophakic eyes of 20 patients before and 1 month after Nd:YAG laser posterior capsulotomy were measured using a wavefront OD scan aberrometer. Total, tilt, high order aberrations, total coma, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were analyzed statistically. Secondary measures included changes in visual acuity and refraction.

Results: Before Nd:YAG laser posterior capsulotomy, the total higher-order aberrations root-mean-square (RMS) wavefront aberration was 4.39 ± 2.79 μm. All Zernike modes were elevated, with total trefoil being a major contributor 1.19 ± 1.2 μm. One month after the procedure significant decreases in total, tilt, high order aberrations, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were noted (P < 0.05). No significant changes in total coma aberrations were found (P > 0.05). Additionally, significant improvement in visual acuity without significant change in refraction was observed.

Conclusions: Before Nd:YAG laser posterior capsulotomy causes significant decrease in ocular wavefront aberrations which can explain a better optical quality after the procedure. Further research to examine the impact of wavefront aberrations in visual function after Nd:YAG laser posterior capsulotomy is needed.

CR: J. Levy, None; I. Kleinperer, None; Z. Ashkenazy, None; N. Belfair, None; A. Kratz, None; T. Lifshitz, None.
Support: None

The Effect of Nd:YAG Laser Posterior Capsulotomy on Ocular Wavefront Aberrations


Purpose: To assess the effect of Nd:YAG laser posterior capsulotomy on ocular wavefront aberrations.

Methods: The wavefront aberrations of the entire optical path of 24 pseudophakic eyes of 20 patients before and 1 month after Nd:YAG laser posterior capsulotomy were measured using a wavefront OD scan aberrometer. Total, tilt, high order aberrations, total coma, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were analyzed statistically. Secondary measures included changes in visual acuity and refraction.

Results: Before Nd:YAG laser posterior capsulotomy, the total higher-order aberrations root-mean-square (RMS) wavefront aberration was 4.39 ± 2.79 μm. All Zernike modes were elevated, with total trefoil being a major contributor 1.19 ± 1.2 μm. One month after the procedure significant decreases in total, tilt, high order aberrations, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were noted (P < 0.05). No significant changes in total coma aberrations were found (P > 0.05). Additionally, significant improvement in visual acuity without significant change in refraction was observed.

Conclusions: Before Nd:YAG laser posterior capsulotomy causes significant decrease in ocular wavefront aberrations which can explain a better optical quality after the procedure. Further research to examine the impact of wavefront aberrations in visual function after Nd:YAG laser posterior capsulotomy is needed.

CR: J. Levy, None; I. Kleinperer, None; Z. Ashkenazy, None; N. Belfair, None; A. Kratz, None; T. Lifshitz, None.
Support: None

The Effect of Nd:YAG Laser Posterior Capsulotomy on Ocular Wavefront Aberrations


Purpose: To assess the effect of Nd:YAG laser posterior capsulotomy on ocular wavefront aberrations.

Methods: The wavefront aberrations of the entire optical path of 24 pseudophakic eyes of 20 patients before and 1 month after Nd:YAG laser posterior capsulotomy were measured using a wavefront OD scan aberrometer. Total, tilt, high order aberrations, total coma, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were analyzed statistically. Secondary measures included changes in visual acuity and refraction.

Results: Before Nd:YAG laser posterior capsulotomy, the total higher-order aberrations root-mean-square (RMS) wavefront aberration was 4.39 ± 2.79 μm. All Zernike modes were elevated, with total trefoil being a major contributor 1.19 ± 1.2 μm. One month after the procedure significant decreases in total, tilt, high order aberrations, total trefoil, total tetrafoil, total spherical and total high astigmatism aberrations were noted (P < 0.05). No significant changes in total coma aberrations were found (P > 0.05). Additionally, significant improvement in visual acuity without significant change in refraction was observed.

Conclusions: Before Nd:YAG laser posterior capsulotomy causes significant decrease in ocular wavefront aberrations which can explain a better optical quality after the procedure. Further research to examine the impact of wavefront aberrations in visual function after Nd:YAG laser posterior capsulotomy is needed.

CR: J. Levy, None; I. Kleinperer, None; Z. Ashkenazy, None; N. Belfair, None; A. Kratz, None; T. Lifshitz, None.
Support: None
A Comparative Study of Visual Perceptions and Pain Scores in Vitreo-Retinal and Cataract Surgery Under Local Anesthesia

U.K. Bhatt, M. Gregory, S. Benskin, S. Jain, S. Banerjee, University Hospital of Leicester, Leicester, United Kingdom; Ophthalmology, Gartnavel General Hospital, Glasgow, United Kingdom; Ophthalmology, Queen Elizabeth Hospital, St Michael, Barbados.

Purpose: To compare subjective visual perceptions and pain during vitreo-retinal (VR) and cataract surgery under local anesthesia (LA).

Methods: Sixty-eight patients undergoing VR surgery under LA in a teaching hospital VR unit were included (Group A). Age and sex matched controls were selected from patients undergoing cataract surgery under LA (Group B). Visual perceptions and pain scores (during anesthesia and the VR procedure separately) were compared in the two groups. Statistical analysis was performed using Microsoft Excel® software.

Results: Patients’ experiences of seeing colour and light and also pain scores were significantly different between the two groups (p<0.001 for colour and light sensations, Fisher’s exact test (FE-test); p<0.001 for pain sensation, t-test) but perception of movement was not significantly different (p=0.36, FE-test). See table).

Among the patients in the vitreoretinal group, pain scores were higher with duration of surgery (p<0.005, t test), history of previous ocular surgery under LA (p=0.03, FE-test) and the type (e.g. scleral buckling) of surgery (p=0.004, Chi-square test). There was no correlation between the intra-operative pain scores and visual perceptions (p>0.05, Spearman’s correlation).

Conclusions: Subjective visual perceptions and also pain scores during vitreo-retinal surgery under LA are different from those in cataract surgery. With an increasing proportion of the VR procedures done under LA, this information can be useful in better pre-operative counselling of such patients.

Summary of comparison of visual perceptions and pain in vitreoretinal and cataract surgery groups

<table>
<thead>
<tr>
<th>Different Modalities</th>
<th>VR Surgery</th>
<th>Cataract Surgery</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colors</td>
<td>75% (51/68)</td>
<td>35.29% (24/68)</td>
<td>0.0001 (F. E. Test)</td>
</tr>
<tr>
<td>Lights</td>
<td>88.23% (60/68)</td>
<td>60.29% (41/68)</td>
<td>0.0001 (F. E. Test)</td>
</tr>
<tr>
<td>Movements</td>
<td>45.59% (31/68)</td>
<td>41.18% (28/68)</td>
<td>0.36 (F. E. Test)</td>
</tr>
<tr>
<td>Mean anesthetic pain (Scores)</td>
<td>2.54</td>
<td>2.57</td>
<td>0.4677 (t-test)</td>
</tr>
<tr>
<td>Mean surgery pain (Scores)</td>
<td>2.59</td>
<td>1.42</td>
<td>0.00002 (t-test)</td>
</tr>
</tbody>
</table>

CR: U.K. Bhatt, None; M. Gregory, None; S. Benskin, None; S. Jain, None; S. Banerjee, None.
Support: None.