

# Is wavefront-guided LASIK necessary for re-treatments? A comparison of 65 wavefront-guided enhancements to 64 asphericity-adjusted enhancements

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## Abstract:

**Purpose:** The comparison of the two techniques in efficacy and safety.  
**Methods:** 130 enhancements were evaluated for: refraction, UCVA, BSCVA, QvA, aberrations (coma) and contrast sensitivity. Follow-up was 8.5 (3-12) months.  
**Results:** QvA: Refraction spherical equivalent -0.85 to -0.24. UCVA improved from 20/25 to 20/18. BSCVA 20/28 to 20/18. QvA of +1.29 to -0.11. Aberrations decreased and CS improved 55%. When compared to the previous wavefront-guided cases, there was no statistical difference in any of the parameters studied.  
**Conclusions:** QvA with the ALLEGRETTO-WAVE system (0.9mm flying-spot and 400Hz) appear to be safe and very effective for correction of residual refractive error and cornea asphericity. When compared with the more laborious wavefront-guided experience, the parameters improved appear to be identical: UCVA, RMSH, and C12. This suggests that wavefront-guided treatments may be effective mainly through better approximation of emmetropia and better post-operative asphericity profiles and not an improvement of all Zernicke coefficients.

## Introduction:

How do we define customized laser ablation in 2006?

- Wavefront guided? Topography guided? Wavefront-optimized? Asphericity adjustment?
- Adjustment to pupil size? (example of binocular pupillometry in figure 1)
- Adjustment to angle kappa? A combination of some of the above?

Our experience with customized ablations have been:

- Wavefront-guided: 5 years, Topography-guided: 3 years, Q-value adjustment: 2 years
- At the 2004 annual AAO meeting, we presented our experience with wavefront-guided enhancements (JRS April 2006) and on topography-guided enhancements (JRS Sept/Oct 2005)

There are several technical limitations in fulfilling customized treatments such as:

- Spatial resolution, dynamic range, sensitivity, and reproducibility of the wavefront sensor; Accuracy of laser treatment and eye-tracking; Laser stability / calibration

Specifically for wavefront guided treatments, some of the limitations include:

- Registration (are we measuring a static or dynamic parameter?), Interpretation (IR visible spectrum calculations), Data transfer into treatment
- How does this theoretical model become "ablated" from a human cornea in vivo?
- Hydration state, tilt (3 axes), cyclorotation, laser decentration, patient decentration, and attenuation of laser spot energy in periphery.

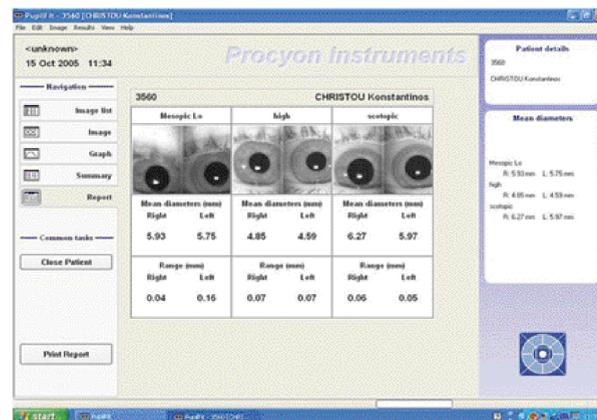
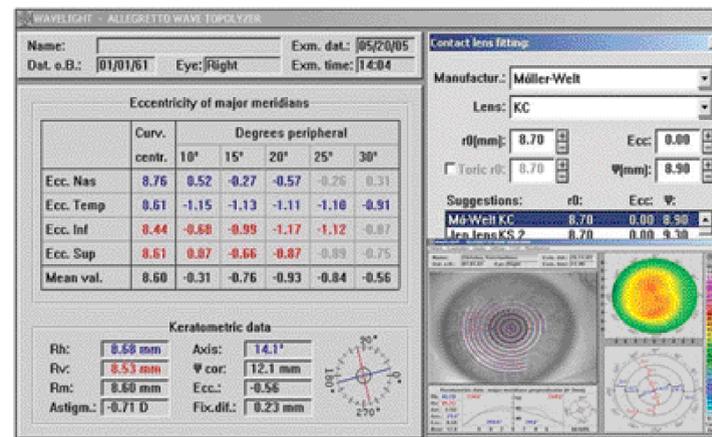


Fig. 1 binocular pupillometry

On the other hand, we have been challenged by the question of which is the most important target in a wavefront-guided treatment:

- Supervision > 20/20? 3rd order: Coma (C7, C8)? 4th order: spherical aberration (C12)? Total high order aberrations (RMSH)? Larger effective optical zones? Tissue-saving properties?

Can alternative STANDARD laser features do the same thing? We feel that the answer is yes: It can be achieved by Wavefront optimized ablation profiles which can be refined in a customized way by Asphericity adjustment (reduction of induced spherical aberrations).



## Methods:

In this study we evaluated the safety and efficacy of asphericity-adjusted LASIK enhancements in comparison to our previously reported wavefront-guided experience, utilizing the Allegretto-Wave 400 Hz system. 64 consecutive LASIK enhancement cases underwent re-treatment with treatment of residual refractive error and asphericity adjustment to the Q value of -0.50, based on 20 degrees topographic measurement. All procedures were re-lifts of flaps and performed with the Allegretto EyeQ 400 Hz excimer laser platform. We evaluated pre- and post-operative refraction, asphericity (Q value), total high order aberrations (RMSH), the subset of Zernicke coefficients C7, C8 (both representing coma), C12 (representing spherical aberrations), contrast sensitivity, and possible complications. Follow-up was 3-17 months (8.5). These data were compared with the same values recovered retrospectively from our previously reported experience with wavefront-guided LASIK enhancements.

## Results:

122 eyes were included. In the asphericity adjusted group: The mean values were: refractive error: sphere: -0.80D (-0.50 – 1.75) and cylinder: -0.55D (0 to -0.75). UCVA improved from 20/25 to 20/18. At 3 months 92% of the eyes were 20/20, 57% 20/15, and 34% 20/10. 100% of eyes were within +/- 0.5D of the refractive goal at 3 months. Q value changed from a mean of +1.29 to -0.11. There was a positive shift of Q value proportionate to the amount of refractive error corrected. The mean RMSH decreased from 0.25 to 0.10; C7 0.34 to 0.32, C8 0.55 to 0.54, and C12 +1.11 to +0.03. CS showed a 35% improvement.

## Conclusion:

- When compared to the previous wavefront-guided cases, there was no statistical difference in any of the parameters studied.
- Asphericity adjusted LASIK enhancements with the ALLEGRETTO-WAVE system (0.9mm flying-spot and 400Hz) appear to be safe and very effective for correction of residual refractive error and cornea asphericity.
- When compared with the more laborious wavefront-guided experience, the parameters that showed the largest improvement appear to be similar: UCVA, RMSH, and C12 (spherical aberration).
- This in our opinion strongly suggests that wavefront-guided treatments may be effective mainly through better approximation of emmetropia and better post-operative asphericity profiles and not an improvement of all Zernicke coefficients.
- Another significant point is that when reviewing the tissue demand for each treatment, Q adjustment may be an effective and tissue sparing primary treatment and re-treatment approach. Other potential advantages are:
- It may not change "unwanted" Zernickes as in wavefront-guided
- It appears to improve the most predictable factor in night vision problems: Cornea asphericity or spherical aberration C12
- It appears to optimize mesopic and scotopic visual quality

- Our current protocol in laser vision correction is:
- Myopia: 85% F-CAT with the Eye-Q 400Hz, (Q-value adjustment customized treatment )
- RMSH>0.4: Wavefront-guided
- High cylinder: topo-guided
- Hyperopia: 100% topo-guided with q-value adjustment (adjust for angle kappa)
- Enhancements: 100% customized (wave-, topo-, or asphericity adjusted)

