Wavefront Optomized vs. Topography-Guided Corneal Ablations with WAVELIGHT Platform: A Summary of Visual Outcomes


BY KARL G. STONECIPHER, MD, AND JESSICA MATHEW, OD, PHD, FAAO

INTRODUCTION

Two corneal refractive ablation procedures that have been widely adopted and compared are wavefront optimized (WFO) treatments and topography-guided treatments. Some surgeons have generally preferred the ease of WFO compared to newer, more advanced laser refractive treatment options, and while WFO generally provides good vision for most patients, topography-guided ablation has shown visual acuity advantages. The WAVELIGHT Excimer Laser Platform (Alcon) was originally approved for WFO treatments[1-4] and was later approved for use for topography-guided treatments.[5]

VISUAL OUTCOMES

The prospective FDA study on normal eyes showed excellent visual outcomes after CONTOURA Vision (Alcon), with uncorrected distance visual acuity (UDVA) of 20/20 or better in 92.6% of eyes, 20/16 or better in 64.8% of eyes, 20/12.5 or better in 34.4% of eyes, and 20/10 or better in 15.7% of eyes (at 12 months) (Figure 1). These results were achieved when the manifest refraction was used, as well as in eyes where the difference between the topographic astigmatism and manifest refractive cylinder were nominal. Additionally, 30.9% of eyes gained one or more lines of UDVA compared with preoperative corrected distance visual acuity (CDVA). Visual acuity improvement from 3 to 12 months was also shown.[5]

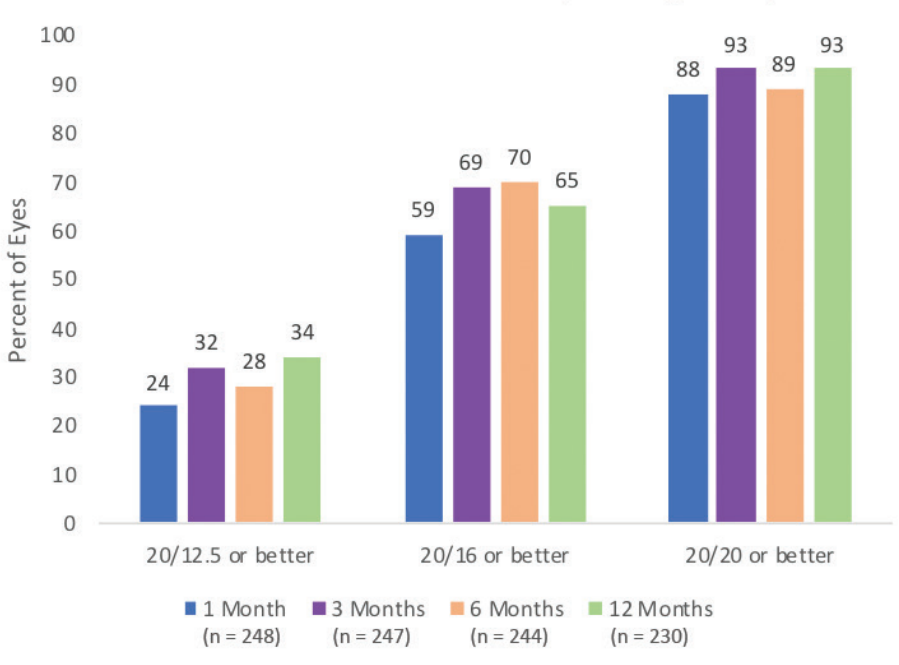

Figure 1. FDA clinical trial showing UDVA at each postoperative visit following CONTOURA Vision treatment.[5]

Study results listed below include only those studies where CONTOURA Vision was used consistently with the approved FDA indications for use, the manifest refraction was used for the surgical planning, and 20/15 visual outcomes were provided. In general, all treatments were equally effective at the 20/20 level, but differences at 20/15 and 20/10 were shown. Additionally, residual refractive error among all treatments was similar across the studies mentioned unless stated otherwise.

WFO VS TOPOGRAPHY-GUIDED ABLATION

Stonecipher et al[6] conducted a large prospective study on 846 eyes comparing WFO (n = 430) to topography-guided CONTOURA Vision (n = 416) using manifest refraction for treatment planning (Figure 2). The study showed that more patients achieved better than 20/20 vision with CONTOURA Vision than with WFO: 54.6% versus 45.0% had UDVA of 20/15 or better. These visual acuity percentages did not reach the levels seen in the FDA study. However, this study included all

Note: Those with missing 20/10 or 20/15 were not provided within the manuscript.

Figure 2. Visual acuity percentages among multiple studies where the manifest refraction was used for CONTOURA Vision. Postoperative UDVA: Stulting at 3 months;[5] Stonecipher at 1 day;[6] Kim at 3 months;[7] Lobanoff at 2-5 months;[9] Stonecipher at 1 day;[8] Stonecipher at 1 day.[8]

patients with normal corneal parameters and was not restricted by differences in corneal and refractive astigmatism, as was the case in the FDA study. They also found in this study that the postoperative spherical equivalent refraction and the residual cylinder were slightly worse in the wavefront-optimized group.

One study by Kim et al[7] showed that the number of patients with postoperative UDVA was numerically higher at 20/16 with WFO (versus CONTOURA Vision); however, this difference was reported as not statistically significant. The study also showed that topography-guided LASIK with CONTOURA Vision induced fewer total corneal HOAs ($P = .013$) and less coma ($P = .003$). Notably, this study was substantially smaller (n = 86 eyes) than the other studies reported here.

CONTOURA VISION: MANIFEST REFRACTION VERSUS PHORCIDES

Several retrospective analyses on CONTOURA Vision using manifest refraction versus the PHORCIDES Analytic Engine software (Alcon) for treatment planning have recently been published. These studies show that the two treatment profiles are equivalent at 20/20. However, more patients are able to achieve 20/15 and 20/10 acuities with the use of PHORCIDES.[8,9] Lobanoff et al[9] showed that a significantly higher percentage of patients reached 20/16 vision with PHORCIDES (n = 323 eyes) versus manifest refraction-based (n = 317 eyes) CONTOURA Vision (62.5% vs. 41.3%; $P < .001$). The number of patients in this study with UDVA better than their preoperative CDVA was significantly higher in the PHORCIDES group (36.5% vs. 23.0%; $P < .001$), and significantly more eyes in the PHORCIDES group gained 1 or more lines of CDVA (42.7% vs. 30.3%; $P = .001$). Importantly, these studies showed 20/20, 20/15, and 20/10 results that are very similar to the percentages in the FDA study results, which selected for eyes with tight agreement between the manifest astigmatism and the measured anterior corneal astigmatism, whereas these studies were not selective in this way and better represented the true clinical population.[8,9]

In addition to the studies already presented, there are several publications by Wallerstein et al and others using a manifest refraction-based nomogram that also show that CONTOURA Vision treatment can be highly effective.[10-13] However, these studies did not provide direct head-to-head comparisons of their approaches to either WFO or PHORCIDES.

WHICH TREATMENT IS RIGHT?

WAVELIGHT WFO and CONTOURA Vision treatments both provide excellent visual outcomes especially at the 20/20 level. While both treatments can also deliver 20/15 visual acuity, CONTOURA Vision has shown, overall, that a higher number of patients can achieve 20/15 or better.[8,9] Further, the use of the PHORCIDES Analytic Engine software has consistently delivered higher percentages of 20/15 over the standard manifest refraction-based CONTOURA Vision planning, even in patients whose manifest and topography astigmatism do not match.[8,9]

While CONTOURA Vision has the potential for better visual outcomes and has been used successfully on a wide range of patients, there are a few instances where WFO treatments would be preferred.

1. When several high-quality topography images are not obtainable, as this will limit the ability to accurately define the anterior corneal elevations.
2. When the clinical refraction is outside of the FDA-approved parameters for CONTOURA Vision (e.g. Hyperopia, myopia > -8.00 D, cylinder > 3.00 D, MRSE > -9.00 D)

CONCLUSION

WFO treatments and CONTOURA

Vision are both effective at the 20/20 level, however, CONTOURA Vision, and specifically the use of the PHORCIDES Analytic Engine software, can provide even better visual outcomes overall, with more patients reaching 20/15 and 20/10. The PHORCIDES software helps surgeons avoid the subjective nature of determining the right balance of cylinder magnitude and axis when manually planning CONTOURA Vision treatments, and it provides a more objective, user-friendly approach that makes it more appealing to surgeons. ■

1. Stonecipher KG, Kezirian GM. Wavefront-optimized versus wavefront-guided LASIK for myopic astigmatism with the ALLEGRETTO WAVE: three-month results of a prospective FDA trial. *J Refract Surg*. 2008;24(4):S424-S430.
2. Kezirian GM, Moore CR, Stonecipher KG, SurgiVision Consultants Inc WaveLight Investigator Group. Four-year postoperative results of the US ALLEGRETTO WAVE clinical trial for the treatment of hyperopia. *J Refract Surg*. 2008;24(4):S431-S438.
3. Stonecipher KG, Kezirian GM, Stonecipher M. LASIK for -6.00 to -12.00 D of myopia with up to 3.00 D of cylinder using the ALLEGRETTO WAVE: 3- and 6-month results with the 200- and 400-Hz platforms. *J Refract Surg*. 2010;26(10):S814-S818.
4. Stonecipher KG, Kezirian GM, Stonecipher K. LASIK for mixed astigmatism using the AL-LEGRETTO WAVE: 3- and 6-month results with the 200- and 400-Hz platforms. *J Refract Surg*. 2010;26(10):S819-S823.
5. Stulting RD, Fant BS, Bond W, et al. Results of topography-guided laser in situ keratomileusis custom ablation treatment with a refractive excimer laser. *J Cataract Refract Surg*. 2016;42(1):11-18.
6. Stonecipher K, Parrish J, Stonecipher M. Comparing wavefront-optimized, wavefront-guided and topography-guided laser vision correction: clinical outcomes using an objective decision tree. *Curr Opin Ophthalmol*. 2018;29(4):277-285.
7. Kim J, Choi S-H, Lim DH, et al. Topography-guided versus wavefront-optimized laser in situ keratomileusis for myopia: surgical outcomes. *J Cataract Refract Surg*. 2019;45(7):959-965.
8. Stonecipher K, Tooma T, Lobanoff M, et al. Outcomes of planning topography-guided LASIK with new analytic software vs. planning with manifest refraction in eyes with T-CAT parameters. Presented at: ASCRS. 2020.
9. Lobanoff M, Stonecipher K, Tooma T, et al. Clinical outcomes after topography-guided LASIK: comparing results based on a new topography analysis algorithm to those based on the manifest refraction. *J Cataract Refract Surg*. 2020;46(6):814-819.
10. Wallerstein A, Gauvin M, Cohen M. WaveLight Contoura topography-guided planning: contribution of anterior corneal higher-order aberrations and posterior corneal astigmatism to manifest refractive astigmatism. *Clin Ophthalmol*. 2018;12:1423-1426.
11. Wallerstein A, Gauvin M, Qi SR, et al. Primary topography-guided LASIK: treating manifest refractive astigmatism versus topography-measured anterior corneal astigmatism. *J Refract Surg*. 2019;35(1):15-23.
12. Kanellopoulos AJ. Topography-modified refraction (TMR): adjustment of treated cylinder amount and axis to the topography versus standard clinical refraction in myopic topography-guided LASIK. *Clin Ophthalmol*. 2016;10:2213-2221.
13. Stulting RD, Durrie DS, Potvin RJ, et al. Topography-guided refractive astigmatism outcomes: predictions comparing three different programming methods. *Clin Ophthalmol*. 2020;14:1091-1100.

KARL G. STONECHIPHER, MD

- Clinical Associate Professor of Ophthalmology, University of North Carolina, Chapel Hill, North Carolina
- Director of Refractive Surgery, TLC Laser Eye Centers Greensboro, NC
- Member, *CRST* Executive Advisory Board
- stonenc@aol.com
- Financial disclosure: Consultant (Alcon)

JESSICA MATHEW, OD, PHD, FAAO

- Alcon, North America, Fort Worth, Texas
- jessica.mathew@alcon.com
- Financial disclosure: Employee of Alcon