

WaveLight Plus Ray Tracing LASIK - A Revolution in Personalization

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““The main tenet of design thinking is empathy for the people you’re trying to design for.” - David Kelley

Corneal refractive surgery has entered a new era with the arrival of the first commercially available **ray-tracing-based procedure**. This represents a major breakthrough compared to traditional methods, introducing a new paradigm of personalization for correcting myopia and myopic astigmatism (spherical equivalent worse than -1 D and up to -9.0 D), and producing impressive early visual outcomes. This article delves into the evolution of ray-tracing technology and its culmination in the first U.S. system—Alcon’s Sightmap device paired with the WaveLight Plus treatment.

Although ray tracing is well established in optics and computer graphics, its application in refractive surgery is revolutionary. In ophthalmology, it simulates the path of light through the entire eye—considering not only the corneal surface but also the lens, retinal position, and full biometric profile—unlike Topography-Guided approaches that focus solely on the cornea (1). Initial concepts date back to 2008, using simulated model eyes to refine outcomes and correct higher-order aberrations (2).

Following more than a decade of R&D and the integration of advanced diagnostic tools, Alcon’s Sightmap device received CE approval in 2019. This “all-in-one” system combines Scheimpflug corneal tomography, Hartmann–Shack wavefront aberrometry, and interferometry-based biometry. It creates a fully digital 3D model of your eye, enabling simulations that predict how reshaping the cornea will impact vision (3). The outcome is a highly individualized ablation profile—the first of its kind in clinical practice.

Early Ray-Tracing Results

A European multicenter study—the first clinical evaluation of ray-trace LASIK—demonstrated safety, efficacy, and predictability comparable to or better than wavefront-optimized (WFO) and wavefront-guided (WFG) techniques (4). In a 2013 one-year comparison, eyes treated with ray tracing achieved 6/6 vision or better, with no loss in corrected distance visual acuity (CDVA); 38% gained one line and 10% more than one line of acuity (5).

Outcomes with Sightmap + WaveLight Plus

Several studies have supported the performance of the integrated Sightmap and WaveLight Plus system:

- In 2020, Kanellopoulos reported that all 50 treated eyes achieved 6/6 uncorrected vision; 65% gained one line and 38% gained two lines, with

improved contrast sensitivity at six months (6) . Two-year follow-up confirmed stable vision, reduced higher-order aberrations, and improved visual quality (7).

- Bala's 2023 report (400 eyes) showed 100% reaching 6/6, 89% attaining 6/5, 51% achieving 6/4.5, and 10% 6/3.25. No clinically meaningful rise in aberrations was found; in fact, spherical aberration decreased (3).
- Post-marketing data confirmed 98.1% of eyes achieved 6/6 or better, 82.5% reached 6/5 or better, and 99.1% of patients were satisfied (8).
- A large real-world retrospective review of 400 eyes revealed 100% achieved $\geq 20/20$ uncorrected vision, 89% $\geq 20/16$, and 51% $\geq 20/12.5$; total higher-order aberrations showed only marginal, statistically significant—but clinically negligible—increase, while spherical aberration decreased (3).
- In a 250-eye series, ocular higher-order aberrations rose only slightly (from 0.306 μm to 0.371 μm) after three months; spherical aberration decreased, and increases in coma correlated with eye movement during treatment (9).
- An international post-marketing study showed similar results with 98.1% reaching 6/6 or better, 82.5% reaching 6/5 or better, and 99.1% of patients satisfied and happy with their ray tracing femto-LASIK procedure (8). Results that show 83–89% of ray tracing eyes reaching 20/17 are impressive and compare well to other published results of wavefront optimised (72–76%), (10) wavefront guided (64–69%), (10-11) and topography-guided treatments (22–69%) (1,12).

Conclusion

Traditional LASIK—a widely successful technique—often struggles with complex aberrations and truly individualized vision correction. The **WaveLight Plus system**, powered by ray-tracing via data from the Sightmap device, addresses these limitations with unmatched precision and personalization. Early data suggest consistent, high-level visual outcomes, minimal induction of aberrations, and outstanding patient satisfaction.

While long-term and broader-market data are still forthcoming, the delivery of such concurrent biometric measurements, comprehensive modeling, and tailored ablation profiles could redefine surgical benchmarks. **WaveLight Plus** may be the cutting-edge tool refractive surgeons worldwide have awaited.

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