

# Topographically Directed Customized Treatment

This form of treatment can address aberrations induced by previous keratorefractive surgery.

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Correcting aberrated corneas remains difficult despite the widespread availability of wavefront-guided treatment. Topography-guided ablation is an alternative for patients with a poor quality of vision due to complications following keratorefractive surgery, asymmetric astigmatism, and keratoconus.<sup>1-4</sup> During the past few years, we have performed almost 600 topography-guided laser treatments with the Allegretto Wave T-CAT software (not available in the US; Wavelight, Inc., Sterling, VA). The goal of these treatments is twofold. First and foremost, we want to improve patients' BSCVA. Second, we want to improve their unaided distance acuity, which is the reason many of them underwent refractive surgery originally.

## METHOD

The Allegretto Wave excimer laser platform uses the Allegro Topolyzer for T-CAT treatment (all products from Wavelight, Inc.). Planning the treatment is complex, because the surgeon must make adjustments for anticipated induced refractive changes. Each case requires customization, and patients must have realistic expectations.

## WAVEFRONT- OR TOPOGRAPHY-GUIDED ABLATION?

Wavefront-guided customized treatment assumes that most of a given patient's ocular aberrations can be cor-

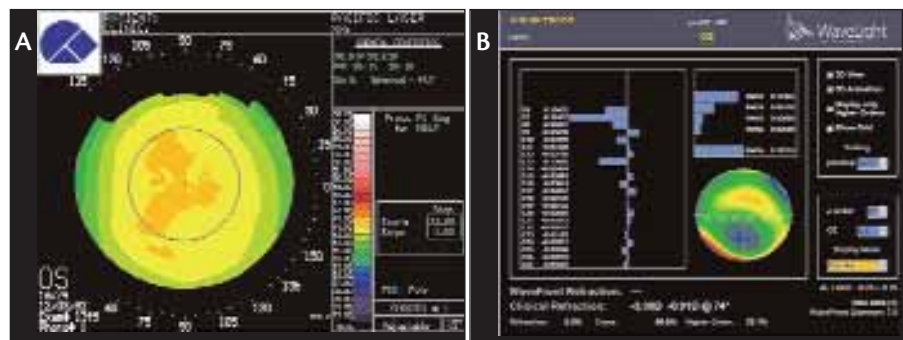


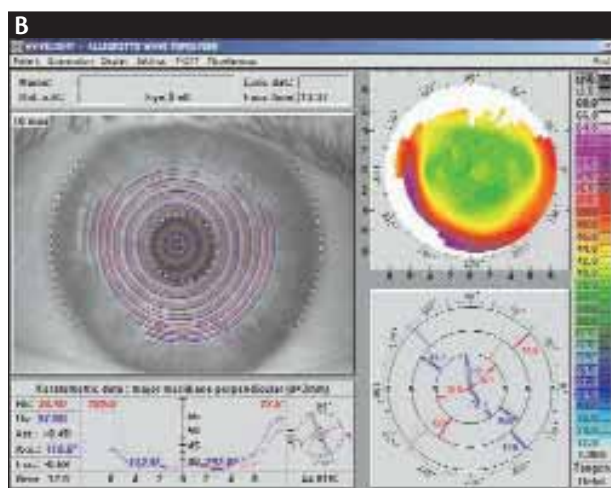
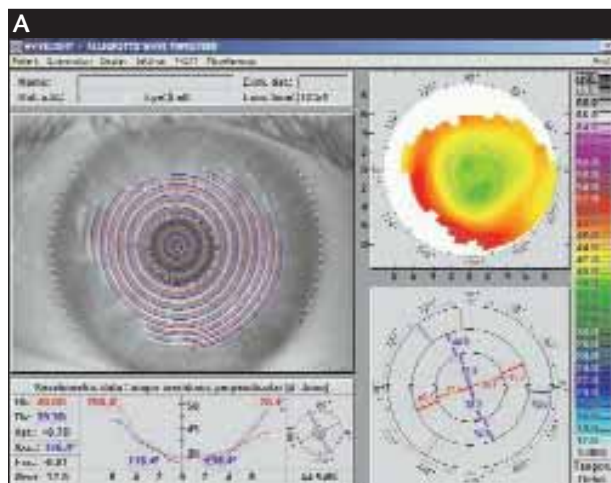
Figure 1. A patient with normal topography (A) has an abnormal wavefront measurement showing significant coma (B).

rected by reshaping the cornea. Patients may have normal topographies yet abnormal wavefront maps (Figure 1). In this situation, a wavefront-guided treatment might induce aberrations. When a patient's corneal aberrations correlate with his wavefront aberrations, either a wavefront- or topography-guided approach should yield satisfactory results.

## CHOOSING A TOPOGRAPHY-BASED TREATMENT

### Indications

The ablation profile is calculated based on the topographical height maps, which are then adjusted based on the eye's overall refraction. The greatest potential for topography-guided treatment may be in severely aberrated corneas with decreased BCVA for which even refraction is unreliable and wavefront capture is not possible. In these situations, we use the T-CAT software and advise patients that they may require a second procedure



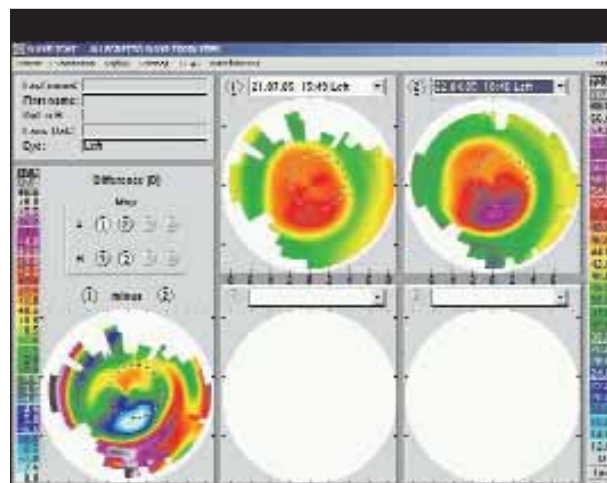
**Figure 2.** Five years after LASIK with a central monodioptric optical zone of 2.8mm, this eye had a UCVA of 20/60 and a manifest refraction of  $-1.00 -0.50 \times 125 = 20/20$  (A). Ten months after undergoing topography-guided treatment, the eye had a UCVA of 20/25, a manifest refraction of  $-0.25 -0.25 \times 90 = 20/20$ , and a central monodioptric optical zone of 4.9mm.

for successful refractive outcomes.

The indications for topography-guided treatment include decentered ablations, the enlargement of the optical zone, irregular astigmatism following penetrating keratoplasty,<sup>2,3</sup> RK, asymmetrical astigmatism, and keratoconus. We increasingly prefer PRK with mitomycin C (MMC) rather than LASIK, because the former spares tissue in eyes with thin corneas—often an issue after laser refractive surgery—and retreatments are easier. In such cases, we favor a transepithelial approach.

### Contraindications

Topography-guided ablation only uses data from the anterior corneal surface. It is therefore probably inadvisable



**Figure 3.** Ten years earlier, this patient underwent hyperopic keratomileusis with a decentered ablation. Topography-guided PRK with MMC and the T-CAT software improved his BSCVA.

to perform topography-guided ablation when the patient's manifest refraction is not consistent with the measurement obtained by the Allegro Topolyzer. This approach is also contraindicated when the topographic astigmatism does not correlate with the manifest refraction or a deep ablation is required in an eye with a thin cornea.

### ENLARGING THE OPTICAL ZONE

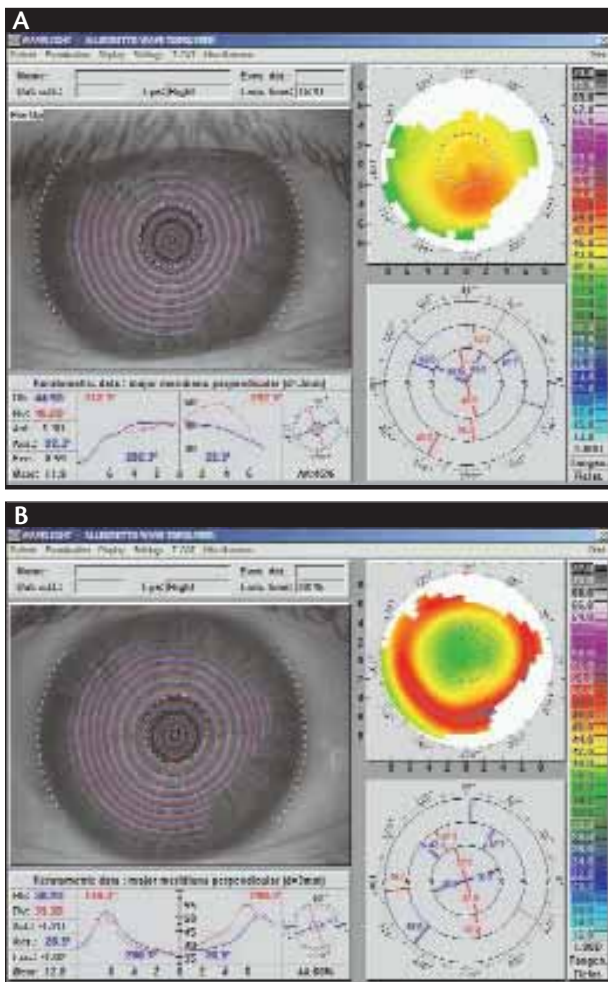
Topography-guided LASIK or PRK can readily treat the symptoms of halos and glare, particularly at night, due to a small optical zone. In one case, for example, we increased the central monodioptric optical zone from 2.8 to 4.9mm (Figure 2). The additional concentric peripheral treatment simulated a hyperopic ablation for which we compensated with a myopic treatment calculated by the topography-guided neutralization technique and included in the initial procedure.<sup>4</sup>

### CORRECTING DECENTERED ABLATIONS

Dcentered ablations following laser refractive surgery require complex calculations to estimate the degree of refractive change induced by the topographical treatment. One of our patients had undergone a decentered hyperopic keratomileusis 10 years earlier and was contact lens intolerant. After MMC-assisted, topography-guided PRK using the T-CAT software, his BSCVA improved from 20/50 to 20/30 (Figure 3).

### ADDRESSING KERATOCONUS

Topography-guided PRK may speed the progression of keratoconus. The procedure may have a place, however, in the treatment of highly symptomatic patients who are



**Figure 4.** Preoperatively, this patient's manifest refraction was  $-8.25 -0.25 \times 30 = 20/20$ . He was told he would be accepted into the police force despite his keratoconus if his UCVA met requirements. To neutralize his astigmatism, the authors performed topography-guided PRK for  $-6.67 -1.25 \times 30$  (A). Eight months postoperatively, the patient had a UCVA of 20/20- and a BSCVA of  $+0.50 -0.50 \times 180 = 20/20$ .

contact lens intolerant and are considering penetrating keratoplasty but are hesitant to proceed with this option. We have operated on 41 such eyes and have 1 year's follow-up on 15. None lost more than one line of BSCVA, with predictability of 73% within 1.00D.<sup>5</sup>

**TREATING ASYMMETRIC ASTIGMATISM**

Most patients with irregular and asymmetric astigmatism who are undergoing keratorefractive surgery in the US are now probably treated with a wavefront-guided laser. Such was our practice until the introduction of topography-guided techniques with the Allegretto Wave T-CAT software (Figure 4). Subsequently, we switched

“Topography-guided ablation with the T-CAT software is a new option for patients with severely aberrated corneas.”

almost all of our cases (n = 59 as of December 2006) to topography-guided ablations for their predictable outcomes and ease. Long-term studies are required to determine the indications of the two approaches.

**CONCLUSION**

Topography-guided ablation with the T-CAT software is a new option for patients with severely aberrated corneas. Recent reports have demonstrated the safety and efficacy of this approach at improving patients' BSCVA, contrast sensitivity, and aberrations.<sup>4</sup> In our experience, the more difficult cases involve patients with highly irregular corneas from previous photorefractive surgery. We usually elect to proceed with PRK but must educate patients that they are likely to require a retreatment to resolve residual lower-order ametropia. Each case requires an individualized approach, and the development of nomograms is difficult. Refinements of the technique will improve its predictability and minimize the need for retreatments. ■

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1. Lee DH, Seo SJ, Shin SC. Topography-guided excimer laser ablation of irregular cornea resulting from penetrating injury. *J Cataract Refract Surg.* 2002;28:186-188.
2. Mularoni A, Laffi GL, Bassein L, et al. Two-step LASIK with topography-guided ablation to correct astigmatism after penetrating keratoplasty. *J Refract Surg.* 2006;22:67-74.
3. Rajan MS, O'Brart DPS, Patel P, et al. Topography-guided customized laser-assisted subepithelial keratectomy for the treatment of postkeratoplasty astigmatism. *J Cataract Refract Surg.* 2006;32:949-957.
4. Spadea L, Di Gregorio A. Enhancement outcomes after photorefractive keratectomy and laser in situ keratomileusis using topographically guided excimer laser photoablation. *J Cataract Refract Surg.* 2005;31:2306-2312.
5. Holland SP, Lin D. Topographically-directed PRK for irregular astigmatism following penetrating keratoplasty. Poster presented at: The 2006 AAO Annual Meeting; November 13-14, 2006; Las Vegas, NV.