The Pseudoaccommodative Cornea Multifocal Ablation With a Center-distance Pattern: A Review

Alain Telandro, MD

ABSTRACT

PURPOSE: To describe an excimer laser ablation architecture called the pseudoaccommodative cornea (PAC) that uses ocular aberrometry and aspheric ablation profiles to create a multifocal cornea.

METHODS: A descriptive article outlining the theory of the PAC algorithm.

RESULTS: The topographic changes induced by PAC produce corneal multifocality.

CONCLUSIONS: PAC-treated eyes have progressive concentric rings of center-distance and midperipheral-near power that enable functional vision at near, intermediate, and distance. [J Refract Surg. 2009;25:S156-S159.]
NIDEK Co Ltd resulted in the incorporation of these algorithms into the treatment to replace the conventional algorithms.

Currently, the Final Fit software (NIDEK Co Ltd) is used to deliver the myopic corrections using the OPDCAT algorithm along with the treatment of pre-existing ocular higher order aberrations. All treatments are centered on the visual axis. The manifest refraction values are obtained using a thorough red/green balance; the lowest value for myopia and the highest for hyperopia are used for data input during treatment planning. Due to the incorporation of OPD-CAT algorithms, the OPD-Scan II data must be free of artifacts measured with a pupil size ≥6 mm. In some cases, pupil dilation is warranted.

The correction algorithm first performs the distance correction based on manifest refractive error using large optical and transition zones. Subsequently, the required near add is delivered using optical and transition zones that treat the midperipheral cornea followed by a “demyopization” treatment using optical zones between 4 and 5 mm to ensure the center of the cornea is corrected for distance and the midperiphery for near (Fig 1).

The postoperative result creates differing refractive zones for distance vision centrally and near vision mid-peripherally (see Fig 1). Successful refractive results have been reported. A significant concern about corneal multifocality is the reduction in visual quality due to the light scatter introduced by the varying refractive powers on the cornea. The induction of significant aberrations may further degrade visual performance. However, two published studies on PAC have reported maintenance of preoperative contrast sensitivity. This is due to the age-related pupillary miosis of the population age 40 years and older. In normal day-to-day activities, the reduced pupil diameter with age mitigates the effect of the induced aberrations on optical quality. For example, a 1-mm reduction in pupil diameter in older patients results in objective visual quality similar to that of younger individuals. In addition, Stiles-Crawford apodization reduces the effect of peripheral light rays.

Using an aspheric algorithm with large treatment zones to create a midperipheral steepening (similar to hyperopic ablations) results in inducing spherical aberrations.

**Figure 1.** Corneal topography and wavefront measurement of an eye that underwent PAC treatment for presbyopia. The refractive wavefront map (OPD) shows a central mildly hyperopic area (light blue denoting +0.50 D), surrounded by increasing myopia in concentric circles (yellow color denoting −1.50 D myopia). In this case, the eye is corrected for distance centrally and near peripherally. The eye has increasing positive spherical aberration peripherally.
aberration similar to accommodation. This induced spherical aberration increases depth of focus, allowing better near vision. The distance-center technique is advantageous because in bright light, the pupil is small; in a center-near technique, a central myopic island is created and distance vision is compromised due to the pupillary constriction. Center-near techniques create more pupil dependency.

The PAC ablation profile creates a progressive change in refractive power from center to periphery due to the use of multiple aspheric treatment zones that create smooth junctions between the central and peripheral cornea. This creates concentric central distance and midperipheral near vision zones. An added advantage of this ablation architecture is a large concentric region for intermediate vision between the central and midperipheral corneal regions (Fig 2). This is in contrast to diffractive IOLs, which create a large peripheral near zone, a thin intermediate reading zone, and a small central-far zone (see Fig 2). This progressive change in refractive power within the pupil may be more physiologic than the result of diffractive IOLs because of the quality of the progression between distance and near and a real intermediate focus. Comparative studies between PAC and diffractive IOLs testing reading speed at intermediate distance and contrast sensitivity are needed to determine whether this is the case.

With the current ablation architecture that incorporates OPDCAT and reduces preoperative higher order aberrations (irregularity treatments), the PAC treatment can be used on myopic, hyperopic, and emmetropic patients with presbyopia. Proper patient counseling and realistic expectations are fundamental for success with any presbyopic surgery. This is no different for PAC treatments. First, one must be cognizant that patients with myopia and emmetropia are accustomed to crisp vision at near and far and will have a greater tendency to be unsatisfied. Patients with hyperopia will be more readily satisfied because both their hyperopic and near symptoms will be alleviated. Second, patients must be counseled to expect functional vision, ie, vision that allows them to perform their daily routines without spectacles, with certain situations requiring optical compensation. Third, patients with unrealistic expectations or demands should be dissuaded from presbyopic surgery. Although definitive treatments for presbyopia are still being debated, the distance-center PAC treatment represents a treatment therapy for presbyopia.

REFERENCES


