More on Peripheral PresbyLASIK as a Center-distance Technique

Reply:
We thank Dr de Ortueta for his interest and comments,1 which appeared in the June 2008 issue of the Journal of Refractive Surgery, regarding our article published in the May 2008 issue.2

We would like to comment on some additional factors pointed out by de Ortueta that were not addressed in the initial response to his letter. First, our curve, termed PML™ (Presbyopic Multifocal LASIK), induces negative spherical aberrations and this is a key factor.

de Ortueta hypothesized that “a myopic central part of the cornea will help reading ability and can be compensated with negative spherical aberration to approach emmetropia at the periphery.”1 Our curve is not myopic in the center, but emmetropic; in fact, autorefractometry shows emmetropia in the center, not myopia. Central presbyLASIK and peripheral presbyLASIK are only abstract ways of thinking. The problem is and the solution will be an aspheric prolate curve, not multifocal curve, as this is the last generation of curve in our research and development department, which began with multifocal PML™ presented in our article. Therefore, a discussion about central and peripheral is not warranted in this case. The true interpretation of this curve will be based on its results, development, and evolution in the customized treatment we obtain over the next few months.

As far as the surgical timing of our procedure, this is a preliminary procedure without any standardization. Customization of the curve will be undertaken and consequently the timing will be reduced.

The purpose of our application was to show the methods, results, and topographies to the scientific world to introduce and present a new approach to presbyopic LASIK or presbyopic surface cornea surgery. All interpretations, theories, hypotheses, names, and nominations of the technique have not been established as fundamental at this time.

As this technique continues to evolve, we speculate that the curve will fix far and near smoothly and will probably be aspheric and not multifocal.

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REFERENCES

Comparing Anterior and Posterior Piggyback IOL Power Calculations in 2-optics and 3-optics Systems

To the Editor:

The classical formulas originally developed by Fyodorov et al1 for aphakic intraocular lenses (IOLs) or a 2-optics system have been widely used for decades without improvement.2 Most efforts have emphasized the accuracy and customized aspects of the estimated lens position (ELP). One of the important issues is the validity of the classical 2-optics formula used as the basis for the calculations of piggyback IOL power in phakic and pseudophakic eyes, which, strictly speaking, are 3-optics system.3

The major error source of the classical formula is due to the ignorance of the roles of the natural lens (for phakic IOL) or the primary IOL (for piggyback IOL) power and their separation distance.

This letter intends to resolve the above-described intrinsic error by using a 3-ops new formula and also provide the conditions for 2-ops approximation. An analytic formula for the conversion of spectacle power to the piggyback IOL power is also presented.

In a 3-optics system, the piggyback IOL (p-IOL) power (P) may be calculated by the new formula shown in the Table.

The 3-ops formula reduces to that of a 2-ops aphakic IOL when d=0, that is, only when the piggyback IOL is virtually attached to the primary IOL. However, for typical d=1.0 to 3.0 mm, two factors must be considered: 1) Z’<1 due to the finite d, and 2) the shifted X=xo−gd and S=d’+gd, with g being a geometry factor given by g=1/(1+Z’(P/Pn))

Therefore, the 2-ops approximation (assuming d=0) underestimates the piggyback IOL power by an amount defined as Delta=P(3-ops)−P(2-ops) shown in the following examples (for Pn=20.00 diopters [D] and P’=43.00 D as typical values) for two piggyback IOL positions and power range of −5.00, −10.00, −15.00, +5.00, and +10.00 D, respectively.

Case (a). Anteriorly implanted (with d’=d=3.0 mm):
Delta = 5.50, 6.30, 8.10, −6.00, −6.20 D.

Case (b). Posteriorly implanted (with d’=5.0 and d=1.0 mm):
Delta = 1.80, 1.70, 1.80, −2.00, −2.10 D.

The above examples demonstrate that the error of 2-ops formula (Delta) is a linearly increasing function of the IOL separation (d). Therefore, the commonly used 2-ops formula can be applied to phakic or piggyback
IOLs when the implanted IOL is virtually attached to the natural lens or the primary IOL, or when their separation \(d\) is less than 0.2 mm. For typical ranges of \(d=1.0\) to 3.0 mm, errors (underestimated) of approximately 1.80 to 6.00 D are expected.

One may further find the piggyback IOL power \(P\) without knowing the axial length but if the refractive error \(D\) is measured. This can be calculated by a conversion function defined by the “derivative” (or change) ratio of \(CF=dDe/dP=(CF1)(CF2)\), where \(CF1=dDe/dPo=Z^2\) (as \(dPo=dP')\), and \(CF2=dPo/dP\) may be derived from the formula given in the Table as follows

\[
CF2 = (1-b)^2 + 2Z'[A/(1-A)]^2 \tag{1}
\]

Furthermore, by knowing the refractive error \(De\) on the spectacle plane \(Ds\) related by \(Ds=(CF3)De\), with \(CF3=1.001(VDs)\) and \(V\) being the vertex distance having a typical value of \(V=12\) mm, one may calculate the piggyback IOL power by \(P=(TF)Ds\), with \(TF=1/(CF1CF2CF3)\). For example, for minus spectacle power of \(Ds=-10.00\) D, \(TF(-)=112\%\) and 130\%, respectively, for anterior IOL \((d=3.0\) mm\) and posterior IOL \((d=1.0\) mm\). In comparison, \(TF(+)=147\%\) and 166\% for plus IOL to correct \(Ds=+10.00\) D. These TF\((+, -)\) values are different from the commonly accepted values of TF\((-)=100\%\) (1-for-1) and TF\((+)=150\%\) (1.5-for-1) based on a fixed mean value of \(CF=80\%\), as opposed to the new formula for CF, which is determined by the corneal power \(P\) and the piggyback IOL position shown by Eq(1).

Finally, it would be interesting to compare the new analytic formulas presented herein with further study using a numerical ray-tracing method.*

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### REFERENCES


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