EC OPHTHALMOLOGY
Research Protocol

Optimization of Simple Myopic Treatment

Jean Dominique Gueirard*

Opticien Optometriste Expert, Lunettes Pour Tous, France

***Corresponding Author:** Jean Dominique Gueirard, Opticien Optometriste Expert, Lunettes Pour Tous, France.

Received: February 04, 2019; **Publiahed:** May 23, 2019

Abstract

The concept of aberration and their correction has been questioned by many authors.

Indeed, at equal rates any aberration of small or high order does not induce the same decrease in visual acuity or sensitivity to contrasts.

For example aberrations due to astigmatisms, these being more deleterious for visual acuity when its axis is inverse or oblique.

By the same token it may be logical that some aberrations are acceptable if they follow a physiological rate or are localized in a particular way.

Changes in corneal geometry can even lead to optical improvements such as depth of field with spherical aberration (Z400) at the cost of a moderate loss of contrast perception.

We must therefore ask the question: What are the geometric elements of the cornea that induce defects to correct and what defects can be left to see amplified to improve visual function.

Keywords: *Aberration; Cornea; Asphericity; Curvature*

Geometric elements of the cornea

Corneal topography has allowed us in recent years to better understand the shape and geometric characteristics of the cornea.

The cornea is thus characterized by its diameter, thickness, curvature, asphericity and symmetry.

In our case, the thickness and the diameter do not interest us; these two parameters being only in the calculation of the shape factor of the optical assembly.

For many authors the curvature of the cornea and asphericity is related.

In reality we realize that the curvature has no relation to the slope of the cornea because they are two values without connection.

Indeed a perfect sphere has a factor of asphericity equal to zero regardless of its radius of curvature.

The variation of slope of two near points thus defines the factor Q; this is the variation of the vector tangent to the curve.

For example an asphericity of - 0.23 with a keratometry of 40 diopters.

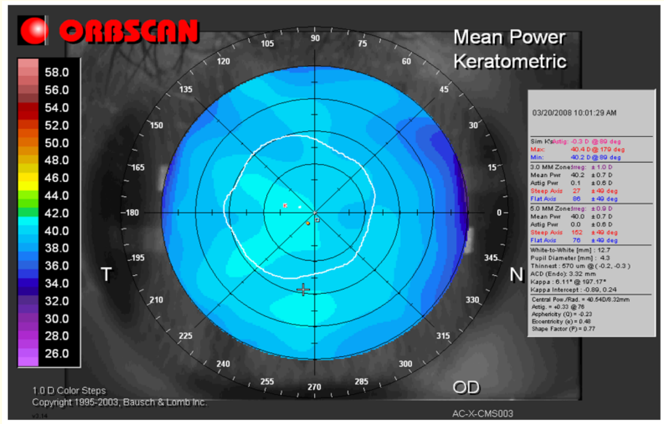

Figure 1

The radius of curvature locally only amplifies the value of this variation, giving a greater variation of the Q factor for a small variation of curvature when the radius of curvature is small and conversely requires a greater variation of curve for the same variation of Q when the radius of curvature is important.

This fact is also to be taken into account during changes in asphericity factor so to change the asphericity of a cornea plus the cornea will be arched less there will be material to remove and vice versa.

Geometrical concepts in the case of myopia

When one reads the literature on myopia correction profiles, one realizes that the axial model proposed by Munnerlyn does not take into account the asphericity of the corneal surface preoperatively.

However, the approximate profile of a cornea describes a conical section of apical radius R_1 and asphericity Q_1 giving the following relation:

$$y^2 = 2 R_1 x - (1 + Q_1) x^2$$

The postoperative corneal profile then becomes following the Munnerlyn model on a surface of diameter S:

$$x = \frac{R_1 - \sqrt{(R_1^2 - (1 + Q_1) y^2)}}{1 + Q_1} + \sqrt{R_1^2 - \left(\frac{S}{2}\right)^2} - \sqrt{R_2^2 - \left(\frac{S}{2}\right)^2} + \sqrt{R_2^2 - y^2} - \sqrt{R_1^2 - y^2}$$

With good on R_2 given by the computation of power variation in geometrical optics:

$$D = D_2 - D_1$$

So

$$D = (n - 1)\left(\frac{1}{R_2} - \frac{1}{R_1}\right)$$

With $R_2 > R_1$

We thus realize that on the principle the final asphericity is not directly related to the starting asphericity and we can only search by comparison of the different curvatures that we know to determine the most similar.

Another method would be to use Taylor's limited development which gives us the approximate value of Q_2 by the relation:

$Q_2 = Q_1 - 8(D_1 - D_2)\, R_1\, Q_1$

The consideration of corneal asphericity is necessary to establish a profile intended to correct an ametropia while minimizing the magnitude of spherical aberrations postoperatively.

The initial preoperative and postoperative corneal surface is modeled by conical sections of apical curvature R_1 and R_2 and asphericity Q_1 and Q_2 (taking into account a meridian) over a diameter S.

The maximum central ablation will then be established according to the following equation:

$$Abl = \frac{R_1 - \sqrt{R_1^2 - (1+Q_1)\left(\frac{S}{2}\right)^2}}{(1+Q_1)} - \frac{R_2 - \sqrt{R_2^2 - (1+Q_2)\left(\frac{S}{2}\right)^2}}{(1+Q_2)}$$

This allows us to determine what is the true value of the central ablation to aim at in order to obtain the optimum myopic correction.

Many calculations are based on an empirical approach based on the fact that ablation of a standardized treatment should be equal to a treatment with a specific asphericity.

This type of reasoning creates an overcorrection of the myopic because of the lesser regression of an aspherical treatment the distribution of the corneal efforts being better distributed.

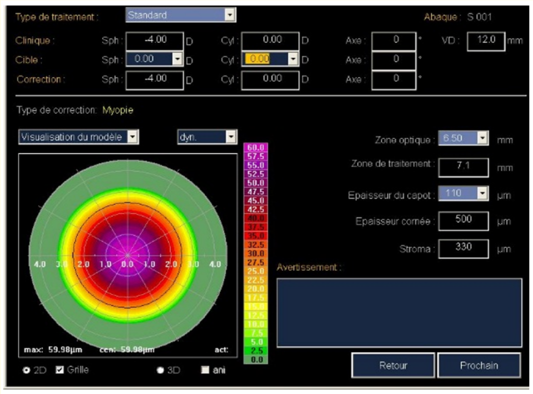

Figure 2

In our example we see that the preservation of asphericity requires less ablation than a standardized treatment.

In reality, we see that the final asphericity is not the one expected because it is due to the myopic correction.

We thus obtain an oblation of the final geometry that is less marked, but significant.

In order to maintain the initial asphericity, it is necessary to compensate for the asphericity induced by the change in curvature of the cornea and thus to aim for a more prolific asphericity than the initial one.

For this we remember the formula Taylor $Q_2 = Q_1 - 8\,(D_1 - D_2)\, R_1\, Q_1$ which allows us to understand the corrective to bring to maintain the asphericity of departure.

In our case D_1 - D_2 = - 4.00 Dc = 43.00 R_1 = 7.85 10-2 Q_1 = - 0.25

Q_2 is therefore - 0.25 - 8 (4.00) 7.85 10-2 X - 0.25 = + 0.38

We must aim a Q_2 of - 0.25 - 0.38 = - 0.63

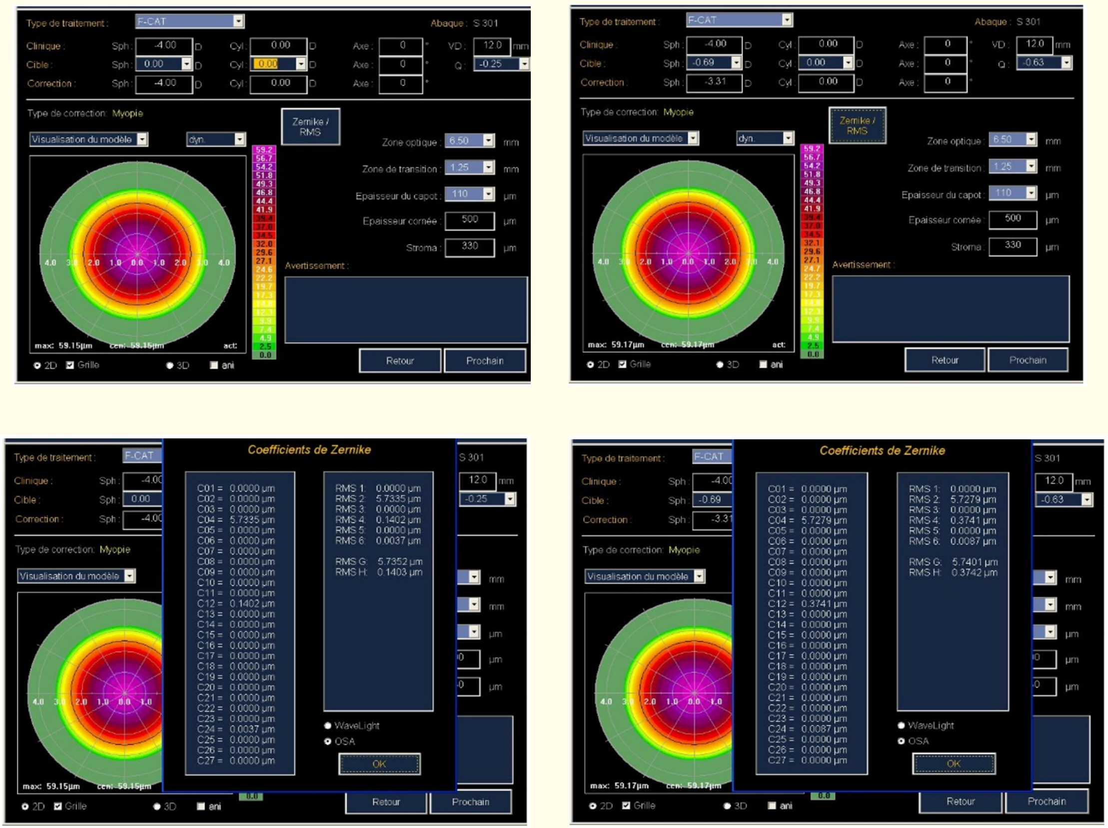

Figure 3

For the operator, he must therefore no longer think of power, but in geometry we can see that the correction displayed is no more than - 3.31 diopter for an effective correction of - 4.00.

We also note that the C12 which corresponds to the Z400 aberration is more than doubled, thus preserving the prolate geometry of departure.

Practical example

I will present here a case that shows the interest of such an approach.

The patient was operated on a keratotomy radial of an eye a few years ago and healing did not proceed as planned he has a significant ametropia on his eye operated.

The second eye was not operated because of the result of the first.

Today we are left with both eyes having a similar correction but with very different geometric and optical characteristics.

The patient wishing to no longer wear glasses - 4.00 (- 2.00) for each eye the question arises: What will be the final visual result in view of the initial asphericity, the genes and the quality of the contrasts.

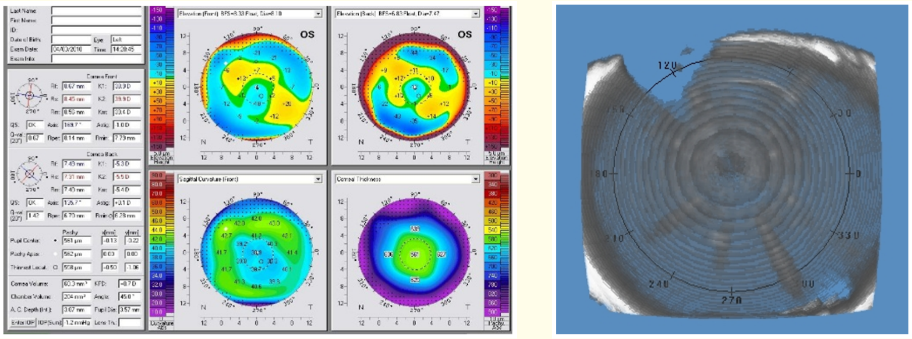

Figure 4

In our case it is therefore necessary to obtain a similar quality of contrasts on both eyes in order to maintain a good binocular vision and not to amplify a gene at night already present.

We therefore have an average keratometry of 39.40 and an asperity factor of + 0.67 for a correction of - 4.00 (- 2.00) 135.

As we saw above with a standard treatment we would have an increase in the asher-ness factor of 2.29 bringing us to an asphericity of 2.96.

For the other eye the increase in asphericity would be only 0.86, a resultant of 0.61.

Why so much difference? the starting radius is much flatter and above all the asphericity factor is already positive both brings us together to very important values.

It is therefore in this case to treat the unoperated eye in standard version and the operated eye by aiming at a hyper prolate value to compensate for the increase in oblacity.

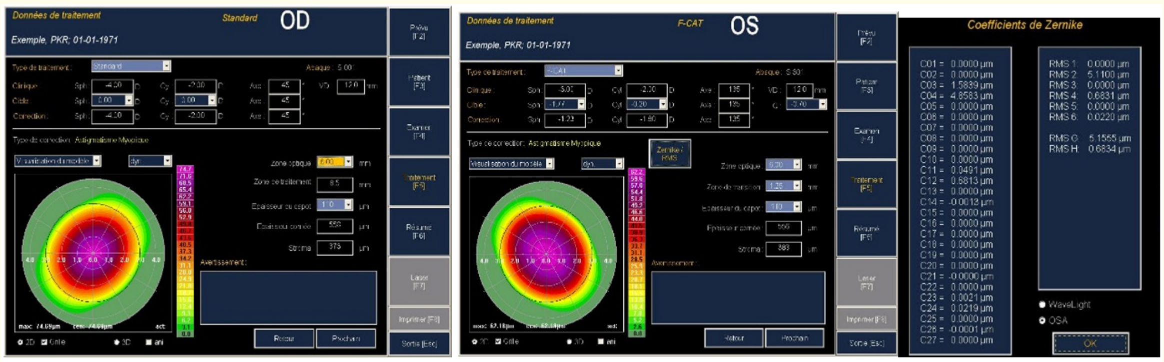

Figure 5

Note that we are aiming for a correction of - 1.00 in view of presbyopia, the final result being a lesser difference in perception between the right eye and the left eye.

In our case the right eye will be at + 0.61 the left eye at 1.81 or 1.15 less than the expected result [1-6].

True knowledge is knowing the limits of one's knowledge.

"Empiricism is a narrow and abject dungeon from which the imprisoned spirit can only escape on the wings of a hypothesis".

Bibliography

1. Gatinel D. "Principes et intérêt de la modélisation cornéenne en chirurgie refractive". In: "Chirurgie refractive". Saragoussi JJ, Arné JL, Colin J, Montard M, Société Française d'Ophtalmologie et Masson (2001): 84-95.

2. Hersh PS., *et al*. "Spherical aberration after laser in situ keratomileusis and photorefractive keratectomy. Clinical results and theoretical models of etiology". *Journal of Cataract and Refractive Surgery* 29.11 (2003): 2096-2104.

3. Artal P., *et al*. "Compensation of corneal aberration by internal optics in the human eye". *Journal of Vision* 1.1 (2001): 1-8.

4. Hollasday J and James J. "Topographic changes in corneal asphericity and effective optical zone after laser in situ keratomileusis". *Journal of Cataract and Refractive Surgery* 28.6 (2002): 942-947.

5. Calossi A. "Corneal asphericity and spherical aberration. Journal of refractive surgery". *Journal of Refractive Surgery* 23.5 (2007): 505-514.

6. Jiménez JR., *et al*. "Equation after corneal refractive surgery for corneal asphericity". *Journal of Refractive Surgery* 19.1 (2003): 65-69.

Volume 10 Issue 6 June 2019