THE SWEET SPOT

Corneal vertex wins out for centring refractive procedures. Roibeard O'hEineachain reports



The ideal optical outcome and the means of achieving it with cataract and refractive surgery remain a source of heated debate, but there is a growing consensus that the ideal axis on which to base refractive procedures is a point close to the corneal vertex, said Damien Gatinel

MD (pictured above), Fondation Rothschild, Paris, France, at the XXXII Congress of the ESCRS in London.

He noted that there is a growing body of evidence suggesting that refractive procedures should be centred on an axis somewhere between the centre of the entrance pupil and the corneal vertex, which is closer to the visual axis.

Furthermore, research also suggests that the larger the angle of the line of sight to the pupillary axis, the closer to the corneal vertex the refractive treatment axis should be. The corneal vertex is visually evident in clinical photography as the projection of the centre of the first Purkinje image when a patient fixates on a light source that is coaxial with the camera.

"Because by construction the nodal point is close to the centre of curvature of the cornea, you may assume that the visual axis is probably very close to the vertex," he added.

FINDING THE LANDMARKS

There are several types of diagnostic instruments available for determining the position of the corneal vertex, and other corneal anatomical landmarks important to vision, Dr Gatinel said. The iTrace* (Tracey), the OPD scan (Nidek) and the

Acutarget[™] (Acufocus) provide a measurement of distance between the pupil centre and the first Purkinje image.

The Orbscan (Bausch and Lomb) provides measurement of the angle lambda, which is the angle of the line

of sight - which extends from the fixation point to centre of the entrance pupil - to the pupillary axis, which is the line perpendicular to the cornea which passes through the centre of the entrance pupil. The Orbscan readings incorrectly refer to this angle as the angle kappa, which more correctly refers to the angle between the visual axis and the pupillary axis.

Studies performed with these devices indicate



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Damien Gatinel MD

that the centre of the entrance pupil is temporal in relation to the corneal vertex. The average angle lambda is 5.5° which correlates well with the average distance from the first Purkinje image to the centre of the entrance pupil, which is 300 microns. The studies also show that myopic eyes tend to have

a lower angle kappa than hyperopic eyes, and that the position of the centre of the entrance pupil moves by about 100 microns as the pupil dilates and constricts.

Furthermore, the pupil is not concentric with the limbus, and its centre is more nasal and superior and becomes even more so when the pupil constricts under high illumination.

"However, there are eyes where the vertex is close to the pupil centre but there is a nasal pupil centre and other eyes where the corneal vertex is nasal but the pupil centre is close to the limbal centre, all of this is important for cataract and refractive surgeons," Dr Gatinel pointed out.

CLINICAL IMPLICATIONS

Knowing the position of the corneal vertex in an individual patient can be helpful not only for planning cataract and refractive treatments but also for correcting induced refractive errors after surgery.

As an example, he described the case of a patient he had who developed visually disturbing symptoms such as ghosting and double-images after undergoing implantation of a Kamra inlay. Using Acutarget measurements he was able to determine that the implant was placed too far in the nasal direction with respect to the corneal vertex. When they accordingly re-centred the inlay the visual symptoms disappeared.

In laser refractive surgery there is one inherent problem in centring treatments on the corneal vertex, and that is the intraoperative loss of specularity of ablated corneal surface, which means that there is no first Purkinje image to use as a reference for the corneal vertex.

The laser system must therefore use other anatomical landmarks such as the pupil and the limbus and their relationship to the corneal vertex as determined by preoperative measurements. It is recommended to centre the photoablation midway or two thirds of the way between the pupil centre and the vertex.

"It is very important to try to match your pupil diameter with what you recorded with the topography system and pupillometry. Then you can take into account any pupil centre shift which is assessed from the limbus, and add this X and Y shift to locate the intended laser centration. Then you can select the distance you want between pupil centre and the vertex and fire your laser," Dr Gatinel added.

Dr Gatinel noted that when performing cataract surgery, and especially when implanting intraocular lenses (IOLs) with complex geometry such as multifocal IOLs, he creates a temporally centred capsulorhexis. That seems counterintuitive, but it leaves a fairly large nasal capsule remnant allowing a nasal positioning of the IOL with good postoperative stability.

Damien Gatinel: gatinel@gmail.com