11.2 EFFECTIVE OPTICAL ZONE AND VISUAL FUNCTION

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The process of corneal refractive surgery modifies the natural prolate corneal asphericity. When treating myopia the resulting trend towards an oblate profile, where the cornea is flatter centrally and relatively steeper peripherally, induces changes to the optical properties of the eye. An oblate cornea causes the steeper periphery to bend the light rays too strongly, potentially leading to excess spherical aberration and a consequent reduction in image quality. As the amount of refractive correction in both myopic and hyperopic treatments increases, there is a coincident increase in the undesirable asphericity created and a consequent reduction in the effective optical zone.[1] Advantages can be derived from maintaining a shape closer to the pre-operative prolate form, to lessen the impact of the refractive change. The difficulty lies in the increased proportion of ablation necessary in the peripheral corneal regions to achieve this, which itself becomes a limiting factor in higher corrections.

Although, visual acuity can be easily measured and found to be adequate, it is more difficult to accurately quantify the functional quality of vision, particularly the subjective appreciation of glare, ghosting and halos. Under photopic conditions there is little evidence available to associate altered corneal asphericity with diminished visual function.[1] This may be firstly attributed to the defocussed peripheral rays being physically blocked by the normally constricted state of the pupil.[1] Secondly, para-central rays are likely to converge perpendicular to the retina leading to greater photoreceptor stimulation as described by the Stiles-Crawford Effect. It seems likely, however, that as the pupil dilates, and more peripheral rays are able to traverse the pupil, that contrast sensitivity is impeded and may begin to express itself as complaints of poorer night vision and halos.[2]

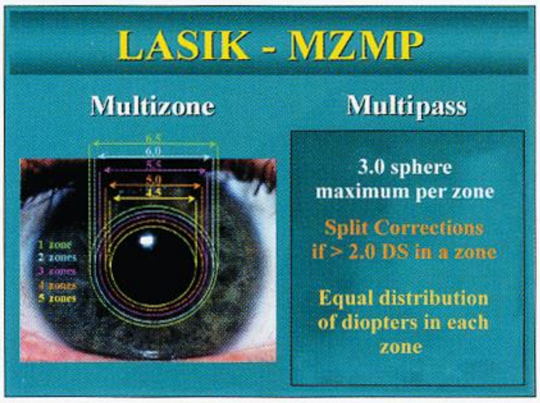

Figure 11.2-1
Multizone multipass ablation profile for the treatment of myopia, with equal dioptric correction in all zones. Two passes, equally divided, are employed in any zone of 2.00 dioptres or more.

The delivery of the laser over a wider treatment diameter may assist in expanding the effective optical zone. The degree to which this is possible is limited for high myopic treatments by the intrinsic corneal thickness and the goal of maintaining corneal integrity. The application of a multizone multipass ablation profile enables an increase in the ablation zone diameter while limiting the central ablation depth. Further advantages are gained by algorithms with equal dioptric correction apportioned to all treatment zones and passes.[3] These apply an even spread of treatment across the treated region, achieving benefits in visual outcomes above those with a greater proportion of correction applied to the inner zones.[3] Such techniques can also assist the creation of a gradual peripheral transition zone by smoothing and minimising the rate of change of shape over the ablated surface. The division of the treatment into smaller segments allows for more efficient maintenance of centration throughout the treatment.[3] Decentration itself has been associated with an increased likelihood of night vision problems, reduced contrast and post-operative visual acuity.[4]

When performing corneal refractive surgery the ultimate goal is to provide the patient with the best possible refractive result in all ambient light conditions. However, when designing the treatment, consideration should be given to the profile of the ablation slope, the relationship between the effective optical zone to the pupil size, and the implications of these on long-term visual functionality.

References

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