Chapter 2

Pupil Testing and Its Clinical Significance

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PUPIL SIZE GLARE

Few topics in refractive surgery are as controversial as the role of pupil size in patient selection. Some claim that with current lasers, pupil size is relatively unimportant, while others insist that patients should only be treated if the optical zone exceeds the size of the scotopic pupil. The relationship between increasing night glare, halos, and large pupil size has been studied since the days of radial keratotomy. Early photorefractive keratectomy (PRK) experience demonstrated significant night glare and halos in a high percentage of cases as the patients’ pupils dilated far beyond the optical zone. As the pupil dilates from 3 to 7 mm, spherical aberrations have been shown to increase seven-fold in normal eyes prior to PRK. After PRK, the increase in spherical aberration was 300-fold.

On the other hand, large numbers of patients have been treated successfully using optical zones smaller than their scotopic pupils, and many others have been successfully treated without accurately determining scotopic pupil size. The ability of some patients to tolerate optical zones smaller than their scotopic pupils may be partially attributable to the Stiles Crawford effect. This phenomenon refers to the ability of on-axis light to more efficiently stimulate photoreceptors as compared to peripheral oblique light. Additionally, many refractive surgery patients are former soft contact lens wearers, and they may already be accustomed to suboptimal night vision. Finally, there is undoubtedly a spectrum in the ability of patients to tolerate aberrations under scotopic and low mesopic conditions (Figure 2-1).

A variety of factors can contribute to reduced quality night vision. Frequently, more than one factor plays a role. Residual refractive error may be the most common factor causing postoperative night vision complaints. Surprisingly, small amounts of myopia and astigmatism can lead to significant difficulties at night that may be correctable with further laser treatment, spectacles, or contact lenses. Tear film abnormalities may cause fluctuation and distortion of vision that may be worse at the end of the day. Decentered or irregular ablations should be screened with topography, ideally using a difference map from preoperative measurements. Similarly, flap irregularities or striae may introduce distortion first presenting as poor night vision. The edge of small diameter or decentered flaps and epithelial in-growth may impinge on the scotopic pupil and produce glare. Finally, subtle changes in the crystalline lens should be screened for as well. Distortion from irregular astigmatism typically will improve with a pinhole or with a rigid gas permeable contact lens overrefraction, while distortion from a media opacity will not. All of these factors must be excluded before assigning night vision complaints solely to a pupil-optical zone mismatch. If these other factors are excluded, and the patient’s symptoms in a dimly lit room can be substantially reduced by constricting the pupil slightly with a penlight, then the symptoms are likely due to the pupil dilating beyond the optical zone.

In a study of pupil size and night vision in photoastigmatic refractive keratectomy, Haw and Manche used 6.5 x 5.0 mm ablations with the Summit Apex Plus laser (Alcon Surgical, Fort Worth, Tex) on 93 eyes. They followed their patients for 2 years postoperatively and found no correlation between preoperative scotopic pupil size and postoperative glare or halos. The investigators also found that higher attempted corrections resulted in more glare early in the postoperative period, but this effect was gone by 12 months. In a separate study of 400 eyes, Schallhorn found a very weak relationship between pupil size and postoperative glare after laser in-situ keratomileusis (LASIK) using a VISX 6.0-mm optical zone, but this effect was gone after 6 months. Schallhorn examined patients treated with a 6.5-mm optical zone and an 8.0-mm transition zone and found no relationship between pupil size and glare or halos postoperatively. This study also demonstrated a tendency for higher myopic