

CHAPTER 17

Photorefractive Keratectomy for the Correction of Corneal Irregular Astigmatism

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The most common corneal complication that significantly affects visual function following keratorefractive surgery is corneal irregular astigmatism (IA). This chapter will discuss the correction of corneal irregular astigmatism by means of myopic photorefractive keratectomy (M-PRK) as practiced successfully by the authors on more than 1000 patients during the past 15 years. The pathophysiology of IA, the rationale for using M-PRK, the past controversy concerning this treatment, and the clinical limitations of such surgery will be presented.

Irregular astigmatism is often defined as astigmatism of an optical surface caused by meridians of curvature that are not orthogonal to each other. Such astigmatism cannot be neutralized by a correcting lens with orthogonal axes of curvature. A more illustrative definition is to picture a tortilla chip and consider that its variable surface and shape will not focus all incoming light at the same point (Figure 17-1). This optical imperfection at the air-cornea interface creates the clinical conditions of glare and reduced contrast, as a result of the nonfocused light making the image and background appear similar to one another.

Corneal irregular astigmatism occurs at the corneal surface where the tear film and the corneal epithelium meet the air. However, the physical source of the IA may be found at the level of the corneal epithelium, Bowman's membrane (subepithelial), or within the corneal stroma. At the level of the corneal epithelium, superficial punctate keratitis (SPK) (Figure 17-2), which is often associated with topical antibiotics or allergy, may cause IA with reduced visual acuity, even to the level of 20/200. The treatment for SPK involves use of a topical steroid, liberal lubrication with artificial tears, or a combination

of the two. Pathology of the corneal epithelium may be documented by observing the mires using a manual keratometer. For example, significant SPK results in distortion of the reflected mires. When viewing an irregular cornea through a keratometer, the mires are of good quality, but the multiple images cannot be superimposed upon each other. This indicates that the cornea is irregular in shape, but the reflecting surface of the epithelium is undisturbed.

At the level of Bowman's membrane, IA may be caused by wrinkles that are greater than about 10 μm high. This problem may result from an irregular, variably thin, or decentered laser in situ keratomileusis (LASIK) flap, typically following high myopic treatment. For example, following laser ablation of a -12.00-D eye, Bowman's membrane notably wrinkles because the surface area of the flap is greater than the surface area of the residual corneal bed.

A concentric wrinkling phenomenon involving Bowman's membrane occurs after successful myopic LASIK for -5.00 D and greater, but can be visualized only if the epithelium is removed by debridement over the center of the flap. The height of the wrinkles is low enough such that the epithelium can fill in between them, thereby forming a smooth optical surface. In these cases, visual function remains unaffected. When the pattern of wrinkles is cross-hatched rather than concentric, IA results (Figure 17-3).

Hyperopic LASIK rarely creates central corneal IA because the area of disparity between flap and ablated surface is opposite that of the myopic case, allowing the flap to be draped smoothly over the central cornea. However, this reduction in IA for hyperopic LASIK is counterbalanced