Corneal Changes with Refractive Surgery

In keratorefractive surgery, 2 areas of the cornea are affected: the epithelium and stroma. As expected, the epithelium is affected primarily in surface ablation, due to its removal at the beginning of surgery. Surface ablation has been associated with epithelial hyperplasia secondary to small ablation zones, greater attempted corrections, and deeper ablations. In laser in situ keratomileusis (LASIK), there is minimal epithelial hyperplasia, but it is more prevalent in higher myopic corrections.

Stromal changes after photorefractive keratectomy (PRK) may be mild with minimal stromal response or be aggressive with stromal regrowth, myopic regression, and haze formation due to keratocyte regrowth and increased keratocyte activity. Figure 3-2 illustrates stromal haze following PRK treatment. In LASIK, there is a much lower incidence of haze, because the epithelial basement membrane is not disrupted. However, thinner flaps, and intraoperative abrasions increase the risk of haze and regression.

In keratorefractive surgery, the natural prolate asphere of the cornea is permanently altered. For myopic correction, the center is flattened compared to the periphery, creating an oblate shape, shown in Figure 3-3. Newer technologies, such as wavefront-driven lasers and advanced blend zones, try to maintain a prolate structure and have been shown to induce less higher order aberrations after surgery.

In hyperopic treatments, the periphery is flattened and the center is indirectly steepened. Although this maintains the prolate shape, more peripheral ablation causes more corneal asymmetry, as shown in Figure 3-4. Because the normal cornea has more ring-shaped fibrils in the peripheral anterior cornea, one would expect this asymmetry. The peripheral cornea also has a greater decrease in ablation depth per laser pulse than the center. In addition, hyperopic treatments have less uniform functional optical zones than myopic treatments. This is due to a less predictable release of tension on collagen after peripheral ablation and greater variation of beam contraction with the angle of incidence.

Refractive surgery, in addition to reshaping the anterior cornea, causes changes in the biomechanical properties of the posterior stroma. This is seen in the steepening of the posterior best-fit sphere (BFS) after surgery and increase in posterior corneal elevation. Miyata and colleagues investigated the amount of forward shift following LASIK in relation to residual bed thickness, preoperative pachymetry, myopic correction, intraocular pressure (IOP), and amount of ablation in 164 eyes of 85 patients. Patients were evaluated using the Orbscan II preoperatively and at 1 month. Using regression analysis, the investigators found the relevant variables to include the amount of ablated tissue and preoperative corneal thickness. Residual bed thickness was not highly correlated to a forward shift of the posterior surface.