

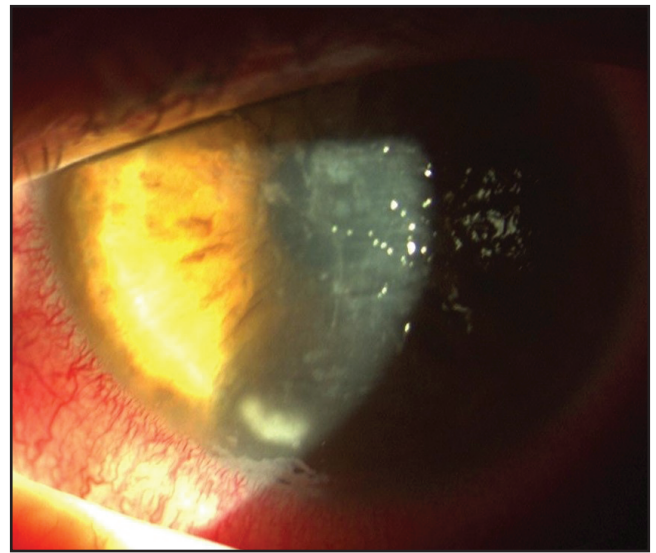
**Figure 11-3.** Ten-year follow-up after CXL. The cornea shows increasing flattening continuing for more than 10 years.

of the cornea. This slow, long-term flattening has to be distinguished from an early flattening of the cornea due to stromal scar formation. This early flattening occurs in up to 4% of cases,<sup>22</sup> and a flattening of 5 D is not uncommon.

## COMPLICATIONS OF CROSS-LINKING

The loss in BSCVA of 2 or more Snellen lines is a good indicator of the complications after CXL. In our prospective study in Zurich (n=100), we had a complication rate of approximately 3%,<sup>19</sup> which is very similar to the findings of a French retrospective study.<sup>23</sup> Odds ratio analysis identified the following 2 risk factors: age over 35 years and preoperative BSCVA equal or better to 20/25.<sup>19</sup> If we would have treated only patients younger than 35 years, the complication rate would have been down to 1%. The complication rate ranges in the literature from 0%<sup>24</sup> up to 15.5%.<sup>25</sup> In addition to this general estimation of the safety of cross-linking, special complications need to be addressed. Many of those special complications are not vision-threatening, but they do require special therapy.

The most frequent complication in the early postoperative period is the sterile infiltrate (Figure 11-4), which is visible usually at the day 1 inspection. Adding steroid drops (3 times per day) to the antibiotic therapy resolve the steroid infiltrates within 1 or 2 weeks. Infiltrates are mostly located in the periphery of the cornea and, as they occur within one



**Figure 11-4.** Sterile infiltrate 1 day after CXL. Because of the short interval of less than 24 hours after surgery, an infectious infiltrate is highly unlikely.

day, they are easily distinguished from infectious infiltrates that may occur in the de-epithelialized area. Also, infectious infiltrates do not occur within one day. Nevertheless, it is necessary to follow the patient with steroid infiltrates on a daily basis to not to miss a deterioration.

The next most frequent complication is delayed epithelial healing. In prospective studies, we found an average epithelialization time of 3.1 days (starting from a circular de-epithelialization at a diameter of 9 mm). In up to 5% of the cases, the epithelialization time takes one week or longer. In those cases, frequent change of bandage lenses and antibiotic ointment under the contact lens is necessary because the de-epithelialized cornea is vulnerable regarding superinfections.

Stromal scars can result in a condensation of extracellular matrix, which goes along with opacity and flattening of the cornea. A perfect example in refractive surgery is diffuse lamellar keratitis III (toxic SOS) after LASIK or small incision lenticule extraction, where a substantial flattening of up to 10 D may occur partially reversible within 1 year. Such lamellar scars may also occur after CLX, and the prevalence in our series in Zurich is approximately 4%. Figure 11-5 shows such an example. Most of these lamellar scars occur in the area of the cone and, therefore, this corneal flattening is beneficial for the regularization of the cornea. In the case presented in Figure 11-5, the unaided visual acuity improved from 20/80 to 20/25. The initial strong flattening infect degrades with time, and the time course of one year is a typical value to stabilize.

On other complications such as activation of herpes keratitis, secondary bacterial and fungal keratitis, endothelial cell damage due to improper procedure settings, and