

Excimer Laser Treatment after Corneal Graft Surgery

Causes and types of optical defect

Optical defects of the eye are caused by abnormalities in the cornea, the lens, or in the overall length of the eyeball.

When the cornea is not spherical in shape there will typically be an astigmatic optical defect in the eye. Most astigmatism is regular and symmetrical, and this type of astigmatism can be corrected by spectacles, toric or rigid contact lenses, or conventional astigmatic laser surgery. However, sometimes corneal astigmatism is irregular and asymmetrical, and this type of optical defect cannot be corrected with spectacles. Following corneal transplantation, it is not surprising that both regular and irregular astigmatism are often present in variable degrees, and are often a limiting factor in the visual recovery following such surgery.

Correction of irregular astigmatism

Because irregular astigmatism is almost always due to abnormalities in the shape of the corneal surface, it can usually be corrected by fitting rigid gas-permeable contact lenses. These work by masking the corneal irregularity behind the smooth surface of the contact lens. Alternatively these corneal irregularities can now be permanently corrected by custom excimer laser treatment.

Measurement of corneal surface irregularities can be made with a corneal topography device, and this information can be used to programme an excimer laser to re-profile the cornea with a topography-guided treatment (Topography-guided Custom Ablation Treatment:- 'T-CAT').

For many patients who require such treatment, the amount of irregular astigmatism is the predominant factor in their overall optical defect. In this situation, if one attempts to measure the *overall* optical state of the eye by wave-front aberrometry, the result may be unreliable since the deviations in the optical path may be out of the range that the instrument can measure, so wave-front-guided treatment may not be appropriate.

In addition, when patients undergo topography-guided laser treatment, correction of the irregular astigmatism may result in a substantial change in the corneal shape, which in turn is likely to have a significant effect on the conventional optical power of the cornea and hence the overall optical state of the eye.

For both these aforementioned reasons, it is generally not possible to correct both the irregular astigmatism and the overall optical defect of the eye in a single treatment, and the treatment is best broken down into parts. The initial topography-guided treatment uses only the surface topography data to achieve the most symmetrically shaped corneal profile, and then the whole eye is measured again to determine its regular spherical and astigmatic optical components, which can be treated by further laser (if there is enough corneal thickness), or by lens implant surgery.

Methods of laser treatment application:

After corneal grafting, the manner in which the laser is applied can be either surface laser ablation (e.g. epi-LASIK / LASEK / PRK), or alternatively LASIK with a microkeratome or femto-second laser-cut flap.

LASIK: laser treatment beneath a flap.

The wound healing is faster after LASIK and there is less post-operative inflammation compared to surface based treatments. This may be an important consideration in patients who have had penetrating grafts or lamellar grafts with living tissue, as further surgery in these eyes carries a small risk of precipitating graft rejection. However, in eyes which have had lamellar grafting with freeze-dried tissue there is no risk of rejection.

For all cases that have had previous grafting, the creation of a flap for LASIK will often result in some change in the pattern of astigmatism, due to release of irregular tension in the graft wound. For this reason it may be preferable to create the flap as a separate operation initially, and then measure the topography and refraction a few weeks later, before actually proceeding to the laser treatment.

For those having LASIK rather than surface-based treatment, the process may thus involve three stages: firstly flap formation without laser application, secondly T-CAT treatment to improve corneal symmetry, and finally conventional LASIK to correct any residual optical defect. There is usually a gap of a month or two between each treatment step to ensure refractive stabilisation, so the whole treatment programme can take six or more months to complete.

Surfaced based treatments: epi-LASIK / LASEK / PRK

Some patients have such a high degree of ametropia after corneal grafting that correction of this by laser is out of the question due to limitations of corneal thickness. For them a single surface-based T-CAT treatment can help improve corneal symmetry and best corrected acuity, and the remaining optical defect can then be corrected with spectacles, contact lenses, or lens implants.