Of significance is the difference in the context of "steep" and "flat" corneas mentioned above. On average, the deviation of the central lenticular thickness with Femto-LASIK is 12.3 µm, compared with 27.8 µm with the mechanically generated flap. In the case of "normal" corneas, i.e., those with a radius of between 7.5 mm and 8.0 mm, the difference is smaller. The femtosecond laser fares even better in terms of the variation in lenticular diameter (flap) and hinge length. Having measured corneal flaps in 50 eyes, we determined the average to be 0.2 mm for the flap diameter (1.2 mm mechanically) and 0.2 mm for the hinge (0.8 mm mechanically). The flap thickness is routinely determined sonographically with all LASIK procedures. However, the reason for the enhanced precision of the femtosecond laser in flap generation is the applanation technique that the laser adopts, which is independent of the corneal radius and diameter. During the laser process, virtually the entire cornea is applanated. There are no frictional errors of the type found with mechanical keratotomy, where the applanation plate progressively flattens the cornea and can lead to biomechanically related wavelike distortions.

This freedom from friction also means that other problems that we see quite frequently with the mechanical technique are no longer an issue with the laser technique. Epithelial lesions generally do not affect the subsequent progress of visual recovery, at least if they do not occur in the centre of the cornea. With mechanical keratotomy, according to our investigations, peripheral epithelial lesions occur in 5.6% of the cases. The incidence is probably even higher, because we only document such lesions statistically when a therapeutic contact lens is being fitted. Although the clinical relevance of peripheral epithelial lesions can be overlooked, occasionally extensive central epithelial dehiscences can occur that can also result in a delay of visual rehabilitation that should not be underestimated. Since we have been using the femtosecond laser, we have not had to fit a single therapeutic contact lens. The friction-free laser technique has an advantage here in terms of the integrity of the cornea being operated on.

Getting the position right

A further advantage that has become apparent from the applanation technique used with Femto-LASIK is the ability to re-centre the desired flap position in relation to the centre of the pupil. Hyperopic eyes in particular, frequently demonstrate an eccentric position of the pupil. The mechanical microkeratome must be centred in the middle of the cornea, regardless of the position of the pupil. In hyperopic eyes with eccentric pupils and a nasally eccentric visual axis (positive angle kappa), the available ablation zone can, in certain circumstances, be critically reduced. With Femto-LASIK, the position of the flap can be changed and optimized on the control interface (screen), even after applanation. The position of the flap hinge can also be custom-adjusted. If the astigmatism is with the rule, then the 12-o'clock position is selected for the hinge. If the astigmatism is against-the-rule, then a nasally oriented hinge is selected. The ablation zone can always be used to best effect.

Is the incision free of complications?

During the October 2004–2005 period, we have seen no incision-related complications in patients treated with Femto-LASIK. In actual fact, the complication rate in relation to incision errors is 0.0%. We have, however, seen some complications with the Femto-LASIK procedure. Folds in the flaps, sterile interface irritations, refractory sicca syndromes and ablation errors are just some examples. The frequency of these types of complications, which, in the long-term, do not affect the vision after treatment, stands at 3% for all cases attending our centre.

The frequency of irreversible, vision-affecting, incision-related complications from the traditional LASIK procedure stands at an average of 0.5%. Of note are incomplete incisions, button-holes, irregular incisions, decentred incisions and lenticular amputations. Half a per cent is really not much, one might argue. But when there are a thousand LASIK treatments per year in our eye laser clinic, 0.5% is still five eyes. And this is in just one year and just in our centre. Even based on conservative estimates, out of approximately 100,000 treatments in Germany per year, this would equate to five hundred eyes of around five hundred patients who would see worse after LASIK than before it. For an elective procedure that essentially is based on functional indications, this is a lot. It is therefore worthwhile to make efforts towards making this method safer. Femto-LASIK, in my opinion, is a step in this direction.

What about TLS?

But advances in medicine always have their price. There are new, different problems that did not affect us with conventional LASIK.

Transient light sensitivity (TLS), for example, is a syndrome that leads to varying degrees of photophobia developing days or weeks after treatment with Femto-LASIK. So far, I have only seen congress reports on this. The LASIK interface demonstrates no significant activity. In some cases, cells were also found in the anterior chamber but the retina is unremarkable, at least from an ophthalmoscopic perspective. Photophobia, on the other hand, and accompanying dysesthesia, can be very marked. There are no reliable figures on the incidence of this syndrome, which is probably a mild and transient anterior uveitis. Over the past year, we have seen two such cases. Although patients can generally be successfully treated for TLS with intensive topical treatment of prednisolone, with symptoms passing within a few days, it has been postulated that this irritated state is the consequence of a phototoxic insult. Phototoxic effects, however, are only described in the event of exposure to ultraviolet light (UV-B and UV-C). Short-wave UV light may interact with the intracellular structures and influence the reproductive and transcription activity of the affected cells. With Femto-LASIK, on the other hand, an infrared laser is used. In fact, the radiant beam that diverges behind the focus of the femtosecond laser is high in energy. So the only insult can be a thermal effect, rather than a toxic one. The path from the cornea to the retina is long and the diameter of the radiant