Visual quality improvement in refractive surgery

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Patients who seek a refractive procedure are motivated to undergo an elective procedure that will enhance their vision without the need for optical correction. In the majority of cases the outcomes are acceptable to excellent, with high satisfaction in terms of improved uncorrected vision, recreation, and comfort. Side effects are well known.

Does patient satisfaction correlate with visual quality? This depends on the definition used. Visual quality and patient satisfaction depend on patient expectations, and patient experience with vision. Visual quality is determined by physical and psychological phenomena.

In the introduction, in chapter 1, the history and development of refractive surgery and some of the technologies used are described. Visual quality parameters are described together with explanations of the technologies that allow for measurement of these parameters. The relevant questions posed are whether the newer laser technologies improve visual acuity and visual quality. The effect corneal laser surgery has on straylight is introduced. Complications and safety of refractive surgery are described.

Newer wavefront guided laser nomograms, have shown a consistent improvement of outcomes in terms of target refraction and Snellen acuity. Literature on this is scant and possibly biased as it is often produced by people who are related to the companies that develop these nomograms.

Chapter 2 shows our data in the independent clinical setting, of how well this nomogram performs. In evaluating the Advanced Personalized Nomogram, we have shown that in nearly 1-in-5 patients we are able to achieve an improved uncorrected post-operative visual acuity, as compared to pre-operative best corrected visual acuity. Our findings affirm that newer laser nomograms perform better. In wavefront guided ablations, the eyes’ aberrations are treated for, but a corrective factor for the aberrations induced by the laser treatment is also accounted for. We see that enhancement rates from previous wavefront guided treatments decrease from nearly 1-in-4 eyes, to 1-in-35.7 eyes. This decrease in the rate of enhancements means a significant reduction in the most common side effect of laser refractive surgery.

Wavefront guided treatments reduce overcorrections, which are the foremost cause of retreatment and patient dissatisfaction. Retreatment is the second most common complication or side effect of refractive surgery. Reducing retreatment rates is very important in increasing safety and predictability of refractive surgery.

In chapter 3 evaluation of bioptics procedures after multifocal diffractive apodized lens implantation is shown, does it make sense to treat a mean residual refraction that is less than 1 D in spherical equivalent refraction? Our results show that it is safe and efficacious to do so, and that patient satisfaction increases. Both LASIK and LASEK can be done. The discussion that has not yet been resolved is which laser nomogram to use. In our opinion, one should treat the manifest spherocylindrical refraction. Wavefront measurements in multifocal pseudophakic eyes cannot be reliably and repeatedly done. Also most wavefront aberrometers will either measure, or extrapolate the
aberration beyond 6 mm, which is the optic diameter of the intraocular lens used. As a result one would likely correct for non-existing aberrations centrally on the cornea, and thus reduce the visual acuity or increase the manifest refractive error, or both. Another reason is that most lenses we implant have a negative spherical aberration purposely made to induce a little bit more of depth of focus. If one tries to correct this with a wavefront guided treatment, we might actually lose that benefit.

Straylight, which is by definition disability glare is an objective measure for quality of vision. It was tested in a population of myopic and hyperopic patients before and after either LASIK or LASEK.

In chapter 4 we describe the behavior of straylight in myopic laser ablations, both in LASIK and in LASEK. We found a small, but statistically significant decrease in straylight in these patients. The clinical significance is that straylight overall does not increase, which was contrary to expectations. In some eyes we could find an increase in straylight and could sometimes relate it to specific findings in the cornea. In some eyes we could not relate an increase in straylight to clinical findings. This can be explained by the fact that the slit lamp examination, which is the golden standard for ocular examination, relies on backscatter for visualization, while straylight is a function of forward scatter of light in the eye. We think that the decrease in straylight is mostly related to a central decrease in corneal thickness, following ablation. The relation between ablation depth and the reduction in straylight was a trend, but was not statistically significant.

In hyperopic ablations, as described in chapter 5, we found no change in straylight in eyes that had LASIK or LASEK. This is consistent with our findings in the myopic treatments. Again in some eyes straylight was increased, and this could, some of the time, be related to clinical findings at the slit lamp examination. In hyperopic ablations, the center of the cornea does not change very much in thickness, so these findings are again consistent with the findings that straylight decreased on average in the myopic eyes.

This is very good news for our patients, as disability glare is one of the quality of vision parameters that is potentially endangered by doing surgery. It will take more research and time before the ophthalmological community will adapt to and accept straylight as a complementary test to visual acuity testing. Early adopters, like me, have already implemented its use in daily practice. I feel this is an instrument than enhances decision making under certain circumstances.

We also looked at straylight under circumstances of a potentially serious complication, such as epithelial ingrowth. We could relate the clinical findings and improvement to straylight findings. This is just part of the research work that will need to be done – to show the clinical uses for straylight testing.

In chapter 6 we describe the treatment of epithelial ingrowth, with the ensuing improvement in visual acuity, and refractive error, but also a major improvement in straylight. The incidence and indications to treat, and techniques to treat epithelial ingrowth is reviewed.
Chapter 7 elaborates on reactivation of herpes keratitis after LASIK. Herpes reactivation is a rare post-operative complication, but needs to be diagnosed and treated in due time.

Refractive surgery is a rapidly changing and evolving subspecialty within ophthalmology. It deals with innovative technique and cutting edge surgeries. In its nature it appeals to patients who adapt rapidly and easily to new technologies and who are motivated by their wish not to wear optic aids. The practice of refractive surgery strives for exemplary accuracy in outcomes, and major efforts in reducing potential complications. The results of refractive surgery are daily being translated into improvements in cataract surgery. Patients are aware of the possibilities and have become more demanding. We experience a trend in which refractive surgery and cataract surgery as we know it converge. This exchange will undoubtedly strengthen both fields.