

# Improving outcomes of Laser Vision Correction: The potential power of a personalized nomogram

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Patients who undergo a laser vision correction (LVC) procedure have high expectations for their outcome. Achieving accurate results and patient satisfaction benefits the practice in several ways. It leads to word-of-mouth referrals, limits chair time spent in postoperative visits, and reduces the need for enhancement procedures. Thanks to ongoing advances in techniques and technologies, outcomes of laser corneal refractive surgery have continued to improve so that today, most patients see 20/20 or better uncorrected for distance after their procedure.<sup>1,2</sup>

However, the results of refractive surgery are influenced by a variety of issues that can differ between surgery sites, including subjective refraction protocol, surgical technique, and laser room environment. Standardization of these factors is crucial in achieving good outcomes and must be implemented before embarking on nomogram development, as without their standardization, nomograms will not be effective. Once that is done, a personal nomogram created using a regression analysis of the intended correction on the laser and achieved refractive outcomes from a series of consecutive patients can refine accuracy. The optimal goal is to improve the refractive outcomes of individual patients. That is achieved by a sophisticated analysis that takes into account various factors and reflects the approach available through the ZEISS User Nomogram Service.

A personal nomogram is a proven method for improving clinical results with LVC.<sup>3-6</sup> The ZEISS User Nomogram Service, which uses statistical methods to create personal nomograms for PRK, LASIK or Lenticule Extraction procedures performed with ZEISS refractive laser devices and applications such as PRESBYOND (Carl Zeiss Meditec AG, Jena, Germany) and SMILE (Carl Zeiss Meditec AG, Jena, Germany), makes nomogram personalization readily accessible for refractive surgeons whose goal is to deliver patients the best possible results.

## LVC NOMOGRAMS

Nomograms in LVC can be look-up tables that guide adjustments for programming laser parameters to optimize results. They take into account a range of patient variables that contribute to outcome variability and are derived using mathematical equations that statistically analyse preoperative and postoperative data as well as the data entered on the laser from a series of previously operated patients.

Each ZEISS refractive laser has an internal nomogram built into its software that is derived from data collected in extensive clinical studies with use of the internal nomogram. Satisfactory clinical results are typically achieved in the earliest procedures that are performed using the laser “right out of the box”.

## NOMOGRAM DEVELOPMENT IN OUR CLINIC

ZEISS offers the nomogram service at every clinic with refractive laser installations. We recently took advantage of this opportunity to develop a personal nomogram for Lenticule Extraction with SMILE on the VisuMax femtosecond laser (Carl Zeiss Meditec AG, Jena, Germany) and LASIK on the MEL 90 excimer laser (Carl Zeiss Meditec AG, Jena, Germany). In the initial SMILE cases performed our postoperative day 1 results were good. Yet, we were interested in seeing if they could be improved. Our local ZEISS Clinical Applications Specialist (CAS) worked closely with us to address the situation, and based on their review made recommendations for refinements to the laser energy level and settings that improved our postop day 1 results. However, we were still interested in seeing if it would be possible to reach an even higher bar – long term.

Therefore, we started collecting data to submit to the ZEISS User Nomogram Service. First, we conferred with our local CAS, who explained the process, provided training on the requirements and data needed, and offered tips to facilitate data collection.

To optimize nomogram performance, ZEISS recommends collecting data on at least 60 eyes. The data needed include anonymous patient identification and demographic information, preoperative refractive (sphere cylinder, axis) and visual acuity (UDVA and CDVA) measurements, the clinical refractive target and laser corrections for sphere cylinder, and axis, and the postoperative refractive and visual acuity results with the date of examination. A dedicated spreadsheet file (Microsoft Excel) provided by ZEISS serves as a template for data collection and simplifies the process.

Once completed, the spreadsheet is submitted to ZEISS headquarters where it first undergoes review for data consistency. Turnaround time to receiving the recommended nomogram is just two weeks. Once the practice has had a chance to review the information, an anal-

ysis debriefing conference is scheduled to discuss the results. ZEISS support does not stop at that point, however. The ZEISS CAS will provide ongoing follow-up onsite and through remote consultation while surgeons continue to review their outcomes to verify the accuracy of the nomogram and determine the need for further refinement either in the short-term, which was done for our clinic, or looking ahead if updating is needed because of changes in equipment, surgeons, or techniques.

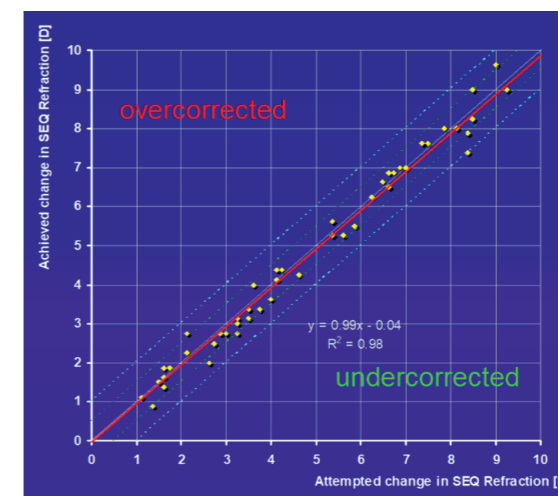
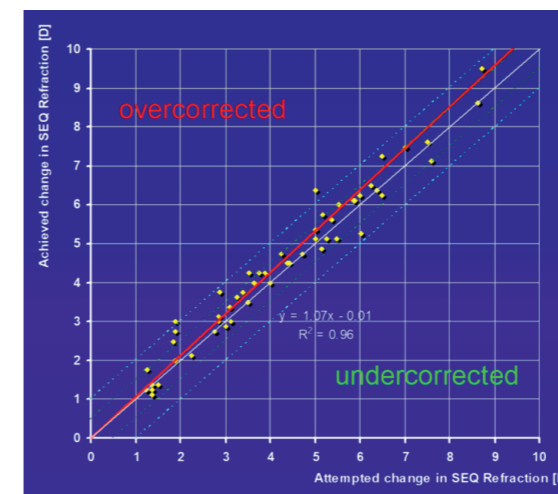


Figure 1. Scatter plot and linear regression analysis between achieved (postop month 1) and attempted spherical equivalent (SEQ) refractive correction for SMILE in the initial cohort of 58 eyes (top) and after refinement of a personal nomogram showing 47 eyes (bottom).

After implementing the refined personal nomogram, it was our clinical impression that our SMILE patients were happier on postoperative day 1 and that our re-treatment rates had decreased. To confirm these anecdotal observations, we undertook an analysis of month 1 data from a series of 47 post-nomogram eyes and compared the outcomes with those achieved in a group of 58 eyes treated initially with the nonuser-specific nomogram. The results showed implementation of the

personalized nomogram increased outcome predictability, reduced scatter, and minimized a tendency to over-correction that was seen in our first cohort of SMILE patients (Figure 1). In addition, we saw increases in the percentage of eyes achieving a spherical equivalent outcome within  $\pm 0.5$  D and  $\pm 1.0$  D of the attempted target. In the initial cohort of eyes treated before nomogram personalization, 78% had a refractive outcome within  $\pm 0.5$  D of the attempted target and 92% were within  $\pm 1.0$  D of the targeted refraction. Using the refined personalized nomogram the achieved refractive outcome was within  $\pm 0.5$  D of attempted in 89% of eyes, and 98% of eyes were within  $\pm 1.0$  D of the target.

## A CLINICAL TIP

Obtaining reliable refractive data is essential for achieving optimal surgical results. These data are also the core element for developing an accurate personal nomogram. These considerations speak to the importance of following a standardized approach for measuring manifest refraction. In our practice, all refractions are done by our two optometrists, Oliver Bowen-Thomas and Jeri Young, using a standardized protocol. Guidance on technique is also available from ZEISS and can be requested from the CAS.

## CONCLUSION

Attaining targeted refractive outcomes and excellent levels of uncorrected visual acuity is the basis for achieving satisfied patients who will help build a refractive surgery practice. A personal nomogram is one of the adjusting screws that can help to improve clinical results, and the ZEISS User Nomogram Service facilitates implementation of a personal nomogram for all ZEISS refractive laser users. When patient outcomes are optimized, surgeons will find they are spending less time with postoperative consultations and enhancement procedures. Therefore, they will be well situated to accommodate a growing influx of refractive surgery patients.

Mr Morris specializes in cataract and refractive surgery and is in private practice at Optegra Hampshire Private Eye Hospital, Whiteley, England.  
FINANCIAL DISCLOSURE: Dr. Morris is a consultant for the Carl Zeiss Meditec AG



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