

Quality of vision following refractive surgery



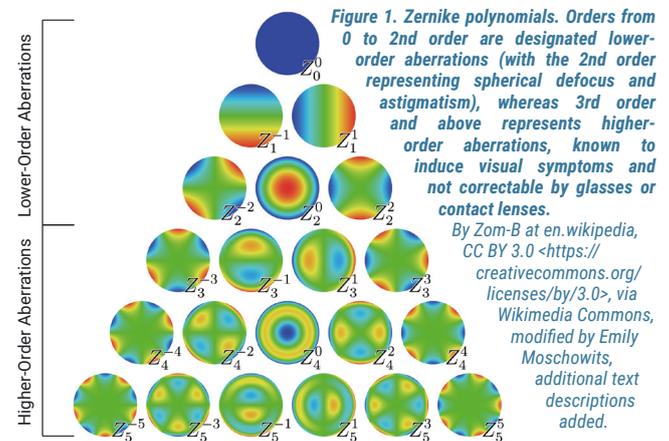
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On January 15, 2021, Anders Gyldenkerne defended his thesis titled "The quality of vision following small-incision lenticule extraction for myopia" for the degree of PhD at the Department of Clinical Medicine, Faculty of Health, Aarhus University, Denmark. The project was conducted at the Department of Ophthalmology, Aarhus University Hospital, with Professor Jesper Hjortdal as main supervisor and Anders Ivarsen and Ivan Nisted as co-supervisors.

Since its introduction in 2011, small incision lenticule extraction (SMILE) has been established as a safe, effective, and predictable corneal refractive surgical procedure for the correction of myopia and myopic astigmatism. However, as with other types of refractive surgery, some SMILE patients report bothersome postoperative visual symptoms such as halos, glare, and starbursts; these symptoms are widely believed to be caused by a surgically induced increase in higher-order aberrations (HOAs). Interestingly, there is a complex relation between HOAs and visual function, as (1) not all HOAs are of equal visual importance, and (2) HOAs interact in a complex manner. Therefore, the interpretation of how HOAs impact vision is not straightforward. Furthermore, several important aspects concerning the visual function, including the binocular visual function, have scarcely been examined in the literature concerning refractive surgery.

The overall purpose of this PhD project was to assess the influence of SMILE for high myopia on aspects of visual function influenced by optics, including visual acuity, contrast sensitivity, binocular visual function, and subjective visual symptoms. Finally, we also investigated the specific effect of surgically induced HOAs on patients' postoperative vision by calculating visual image quality metrics. Assessments were made before surgery and three months afterward.

Our studies revealed that patients were, on average, very satisfied with the surgical results. Interestingly, patients' scores of the prevalence and severity of their visual symptoms were essentially equal before and after the SMILE procedure. Furthermore, different levels of objective optical parameters (including HOAs) did not prove to have any statistically significant relations to patients' subjective visual scores. Our studies also revealed that the binocular visual function (including stereopsis) was not affected by undergoing SMILE. Finally, HOAs increased,



as expected, following SMILE; however, calculation of visual image quality metrics revealed that the average amount of blur caused by the surgical increase in HOAs was less than half a diopter of spherical defocus.

In conclusion, the results of this PhD project show that the number and severity of visual symptoms following SMILE are insignificant, the binocular visual function is maintained, and the average number of induced HOAs caused only a negligible amount of blur. However, the interaction between subjective visual symptoms and objective parameters, such as HOAs, is complex and needs to be further examined in future studies with longer follow-up.

Key points:

- There is not a strong relationship between subjective visual quality and HOAs following SMILE for myopia.
- The binocular visual function is preserved after SMILE; patients can be informed that their perceived binocular vision is maintained after surgery (even if each eye separately might have slightly less visual performance than before surgery).
- The impact of SMILE-induced HOAs on vision is negligible.

Articles in the dissertation

1. Gyldenkerne A, et al. Optical and visual quality after small-incision lenticule extraction. *J Cataract Refract Surg.* 2019;45(1):54-61.
2. Gyldenkerne A, et al. Impact on binocular visual function of small-incision lenticule extraction for high myopia. *J Cataract Refract Surg.* 2021;47(4):430-438.
3. Gyldenkerne A, et al. Visual image quality after small-incision lenticule extraction compared with that of spectacles and contact lenses. *J Cataract Refract Surg.* 2021;47(6):731-740.