Comparison of Visual Aberrations After SMILE and LASEK for Myopia

I read with interest the article of Yu et al.[1] about the "Comparison of Visual Quality After SMILE and LASEK for Mild to Moderate Myopia." The authors compared the aberrations of the small incision lenticule extraction (SMILE) technique versus eyes treated with laser-assisted sub-epithelial keratectomy (LASEK), measuring the aberrations with a dilated pupil at 6 mm. After 3 months of the treatment, the aberrations were higher in the LASEK group. But if we look at the induced aberrations in the LASEK group, most of them were due to the spherical aberrations (SMILE: 0.26 µm, LASEK: 0.57 µm).

The cause of this could be due to effective smaller optical zone. The authors used an optical zone from 6.5 to 6.6 mm in the SMILE group and 6.25 to 6.75 mm in the LASEK group. That means that the VisuMax (Carl Zeiss Meditec, Jena, Germany) has an effective larger zone than the MEL 80 (Carl Zeiss Meditec), but this is not due to the technique itself. In our opinion, the spherical aberrations can be reduced by targeting a larger optical zone or by optimizing the laser energy at the periphery.[2] The spherical aberrations can be reduced if the excimer platform optimizes the laser energy at the periphery, considering the keratometry data.

On the other hand, if we observe all other aberrations induced after the refractive surgery, the LASEK group had less vertical coma (0.4 µm) than the SMILE group (0.56 µm), in addition to less coma (0.81 and 0.69 µm, respectively) and vertical trefoil (-0.037 and -0.017 µm, respectively) or horizontal trefoil (-0.15 and -0.11 µm, respectively); these types of aberrations are due to centration. The authors do not mention where they centered the ablation; if this point is different from the center of measurement, there will be aberrations in the measurement. This problem is greater if we choose a small optical zone of 6.25 mm and measure the aberrations at 6 mm; if we have some shift of the treated versus centered point, this will again cause aberrations. The total ablation zone was larger than the flap created (9 mm vs 9.25 to 9.75 mm) in the LASEK group and the authors used a hinge so the total zone was definitively too small. LASEK or other surface techniques have the advantage of ablating less tissue than with SMILE. This allows us to choose larger optical zones and the ablation is still less deep than with the SMILE technique.

I cannot understand why the total higher order aberrations are smaller than the spherical aberrations in Yu et al.'s study. It also would have been more interesting to compare the difference postoperatively versus preoperatively than preoperatively versus postoperatively.

REFERENCES

1. Yu M, Chen M, Wang B, et al. Comparison of visual quality after SMILE and LASEK for mild to moderate myopia. *J Refract Surg.* 2015;31:795-800. doi:10.3928/1081597X-20151111-02
2. Arba-Mosquera S, de Ortueta D. Geometrical analysis of the loss of ablation efficiency at non-normal incidence. *Opt Express.* 2008;16:3877-3895.

Diego de Ortueta, MD, PhD, FEBO
Recklinghausen, Germany

Dr. de Ortueta is a consultant for Schwind eye-tech Solutions, Kleinhostheim, Germany.

Reply

We thank Dr. de Ortueta for his letter regarding our article "Comparison of Visual Quality After SMILE and LASEK for Mild to Moderate Myopia."[1]

The first concern raised is that the spherical aberration in small incision lenticule extraction (SMILE) is less than in laser-assisted sub-epithelial keratectomy (LASEK), and the cause can be due to a larger effective optical zone in SMILE. In the current study, the effective optical zone was set to 6.5 or 6.6 mm in SMILE, averaging 6.58 ± 0.04 mm, and to 6.25 to 6.75 mm in LASEK, averaging 6.51 ± 0.09 mm, which had a significant difference ($t = 5.969$, $P < .001$). There was a 1.5-mm transition zone in LASEK, so the total ablation diameter was larger than in SMILE. Both of the ablation diameters were larger than the aberration measurement diameter (6 mm), so the aberrations within 6 mm were comparable between SMILE and LASEK. In addition, spherical aberrations can be reduced by optimizing the laser energy at the periphery[2] (ie, the transition zone). Why are spherical aberrations larger in LASEK than in SMILE? In our study, we observed that patients had a more uniform and smoother corneal anterior surface after SMILE than after LASEK, despite more tissue removed with SMILE, indicating that the difference in surgery working pattern might be an explanation for the better quality of vision and less introduction of higher order aberrations (HOAs) after SMILE.

The second point raised was the centration method we used in SMILE and that the aberration would be increased by decentration. The laser was centered on the visual axis for LASEK. For SMILE, the patient was asked to gaze at the target light, which was coaxial with the femtosecond laser ray. As the cornea approached the cone, the surgeon observed the pupil and the "touch zone." Once the ring of the touch zone was

concentric with the margin of the suction cone, the surgeon accepted the centration and started the femtosecond laser.[3] The centration in SMILE is therefore largely dependent on the experience of the surgeon, who decided the centration according to visual axis, corneal apex in Pentacam (Oculus Optikgeräte, Wetzlar, Germany), and pupil center. In our study, all surgical procedures were performed by the same experienced surgeon and the aberration was measured by another surgeon. It is known that the centration of LASEK is based on the ray tracing, which provides an accurate centration. According to the study by Li et al.,[3] SMILE can achieve accurate centration and good visual quality. If we observed other aberrations induced after surgery, the LASEK group had less coma and trefoil, but the differences were not significant.

The other concern raised was that the HOAs in our study were smaller than the spherical aberration, which can be explained as follows: HOAs have positive and negative values and when we calculated the average of the HOA among all patients, the value was small. But we compared the spherical aberration by the absolute value of the Z^4_0 from the Wavefront Aberration Supported Cornea Ablation method, so the average of the spherical aberration was greater than the HOAs.[4] With regard to the preoperative and postoperative HOAs, as we mentioned in the article, HOAs and coma increased significantly (paired *t* test; SMILE group: HOA: $t = -3.934$, $P < .001$; coma: $t = -3.576$, $P = .001$; LASEK group: HOA: $t = -5.491$, $P < .001$; coma: $t = -2.151$, $P = .04$) in both groups, whereas spherical aberrations increased significantly (paired *t* test; $t = -5.461$, $P < .001$) in the LASEK group only.

We appreciate the opportunity to clarify the above questions about our study methodology and results.

REFERENCES

1. Yu M, Chen M, Wang B, et al. Comparison of visual quality after SMILE and LASEK for mild to moderate myopia. *J Refract Surg.* 2015;31:795-800. doi:10.3928/1081597X-20151111-02
2. Arba-Mosquera S, de Ortueta D. Geometrical analysis of the loss of ablation efficiency at non-normal incidence. *Opt Express.* 2008;16:3877-3895.
3. Li M, Zhao J, Miao H, et al. Mild decentration measured by a Scheimpflug camera and its impact on visual quality following SMILE in the early learning curve. *Invest Ophthalmol Vis Sci.* 2014;55:3886-3892.
4. Lin FY, Xu YS, Yang YB. Comparison of the visual results after SMILE and femtosecond laser-assisted LASIK for myopia. *J Refract Surg.* 2014;30:248-254.

Manrong Yu, MM
Minjie Chen, PhD
Bingjie Wang, MM
Leilei Zou, MD
Xiaoyu Zhu, MD
Jinhui Dai, PhD
Shanghai, People's Republic of China

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