

# Comparison of Visual and Refractive Outcomes for SMILE Performed with Two Different Femtosecond Lasers



VS



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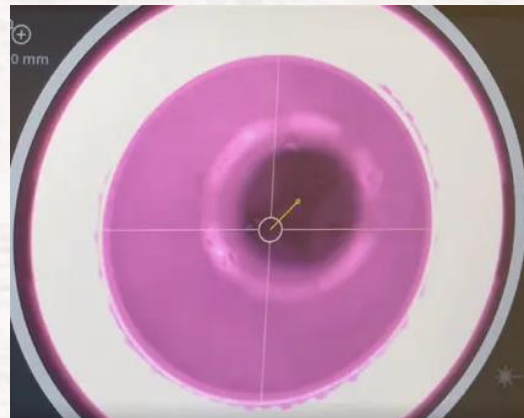
Onnuri Smile Eye Clinic, Seoul, South  
Korea

The authors have no financial interest in this presentation

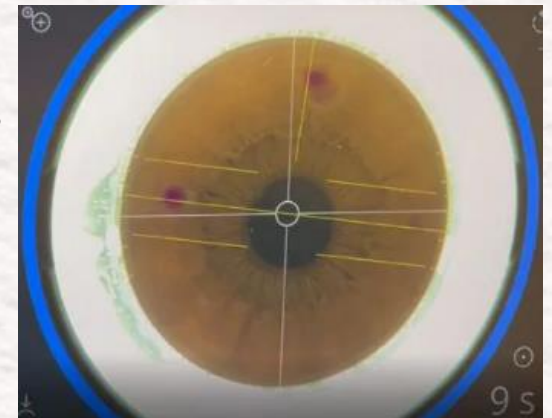
# INTRODUCTION

- Following its introduction in 2011, SMILE using the VisuMax 500 has proven to be an effective treatment for myopia and myopic astigmatism, and it has been widely used worldwide.
- However, there are some limitations of SMILE
  - Risk of suction loss
  - Decentration
  - Cyclotorsion
- VisuMax 800 (SMILE pro), a second-generation femtosecond laser, was introduced in 2021 with several improvements
  - Faster speed (about 3 times faster than VisuMax 500)

- **CentraLign®**: guides the surgeon for centration by visual overlays on the monitor to align the eye



- **OcuLign®**: control for cyclotorsion by rotation of the axis of the treatment



- **Purpose**: To compare the clinical outcomes of SMILE performed with VisuMax 800 (SMILE pro) versus VisuMax 500 (SMILE)

# METHODS

- 2023/Aug/1 ~ 2023/Oct/30
- Onnuri Smile Eye Clinic, Seoul, South Korea
- 50 patients, 100 eyes for each group
- By one experienced SMILE surgeon (KBK)
- SMILE group: VisuMax 500, manual centration
- SMILE pro group: VisuMax 800, using **CentraLign®**
- Laser settings for both groups
  - Spot distance 3.0 ~ 4.0  $\mu\text{m}$
  - Lenticule diameter 5.9 ~6.7 mm
  - Cap thickness 110 ~ 120  $\mu\text{m}$
  - Side cut thickness 15  $\mu\text{m}$
  - Incision 1.0 mm
- **Same nomogram** was applied to both groups
- Follow up: POD 1 day, 1 week, 1 month, 3 months

Table 1. Main equipment parameters of two machines

	Visumax 500	Visumax 800
Manufacturer	Carl Zeiss, Jena, Germany	Carl Zeiss, Jena, Germany
Wavelength (nm)	1043	1043
Pulse duration (fs)	220-580	220-580
<b>Laser pulse repetition rate (kHz)</b>	<b>500</b>	<b>2,000</b>
Weight (kg)	870	520
Dimensions (cm)	380 x 440 (fixed installation with patient bed)	171 x 93 (laser only)
Energy (nJ)	100-260 (personal setting possible)	75-260 (personal setting possible)
Spot distance ( $\mu\text{m}$ )	3-5	1-5
Docking method	Joystick (patient to system docking)	Joystick (system to patient docking)
Contact glass on suction system	Curved	Curved
<b>Automatic detection of pupil</b>	<b>No</b>	<b>Yes</b>
<b>Pupil central offsetting</b>	<b>No</b>	<b>Yes</b>

# RESULTS

Table 2. Patient demographics

	SMILE	SMILE pro	p-value
Age (years)	26.14 ± 4.27	26.24 ± 5.56	0.920*
Gender (M/F)	54/46	60/40	0.294†
Refractive errors (D)			
Spherical	-4.06 ± 1.68	-3.87 ± 1.54	0.383*
Cylindrical	-1.18 ± 0.85	-1.4 ± 0.95	0.079*
SE	-4.65 ± 1.86	-4.57 ± 1.6	0.724*
CCT (µm)	564.6 ± 31.27	562.9 ± 25.88	0.676*
Optic zone (mm)	6.42 ± 0.3	6.43 ± 0.23	0.749*
Preoperative pupillary offset (mm)			
X-axis	0.13 ± 0.1	0.13 ± 0.09	0.594*
Y-axis	0.15 ± 0.12	0.14 ± 0.11	0.445*
Pupil diameter (mm)	6.92 ± 0.52	6.75 ± 0.66	0.087*
HOAs (µm)			
Oblique trefoil	0.12 ± 0.08	0.11 ± 0.09	0.474*
Vertical coma	0.16 ± 0.1	0.17 ± 0.13	0.425*
Horizontal coma	0.15 ± 0.11	0.14 ± 0.11	0.745*
Horizontal trefoil	0.09 ± 0.07	0.11 ± 0.08	0.164*
Spherical aberration	0.2 ± 0.07	0.22 ± 0.06	0.160*
Total HOAs	0.45 ± 0.1	0.48 ± 0.14	0.082*

SMILE = small incision lenticule extraction; M/F = male/female; D = diopters; SE = spherical equivalent; CCT = central corneal thickness; HOAs = higher order aberrations.

\*Independent sample *t*-test; †chi-square test.

Table 3. Comparison of intraoperative findings between two surgeries

	SMILE	SMILE pro	p-value*
Intraoperative complication	0	0	N/A
<b>Time for lenticule creation (seconds)</b>	<b>28.27 ± 2.34</b>	<b>10.33 ± 0.82</b>	<b>&lt;0.001</b>
Time for lenticule removal (seconds)	35.33 ± 13.5	30.73 ± 9.55	0.101
<b>Decentration (mm)</b>			
<b>X-axis</b>	<b>0.21 ± 0.19</b>	<b>0.16 ± 0.15</b>	<b>0.021</b>
<b>Y-axis</b>	<b>0.32 ± 0.21</b>	<b>0.13 ± 0.1</b>	<b>&lt;0.001</b>
<b>Total</b>	<b>0.39 ± 0.26</b>	<b>0.22 ± 0.15</b>	<b>&lt;0.001</b>

SMILE = small incision lenticule extraction; N/A = non-applicable.

\*Independent sample *t*-test.

# RESULTS

Table 4. Comparison of postoperative findings between two surgeries at 3 months

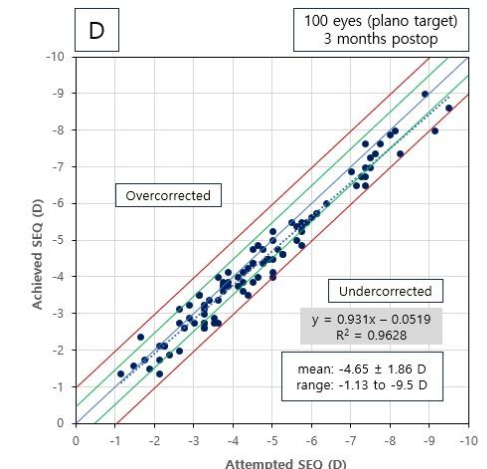
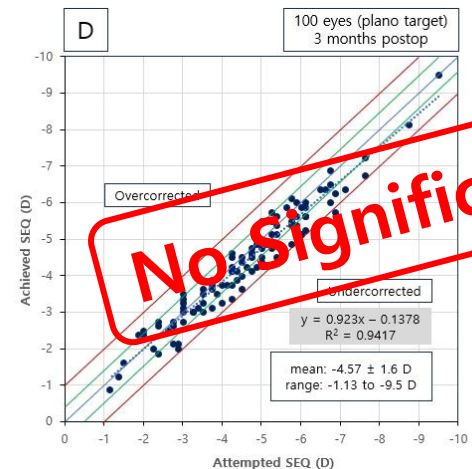
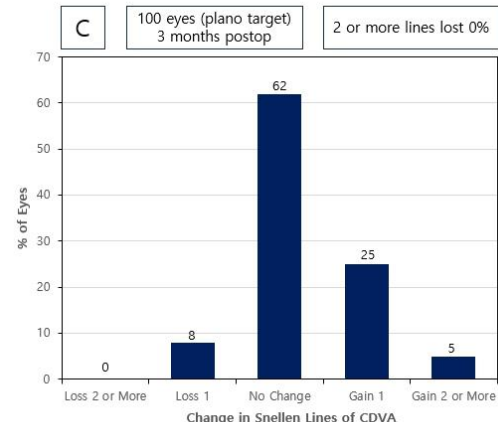
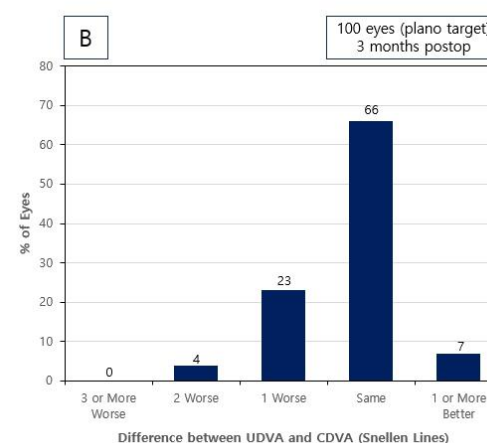
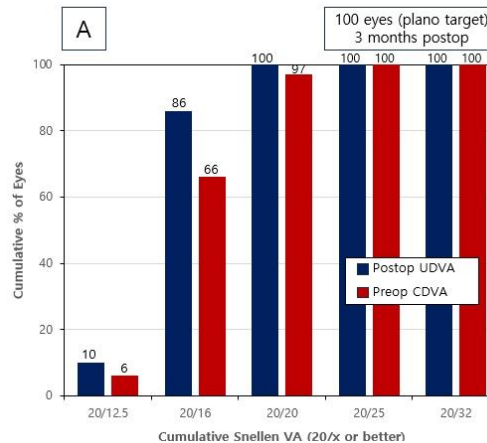
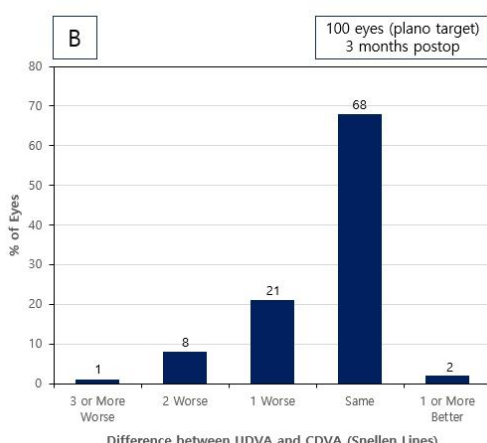
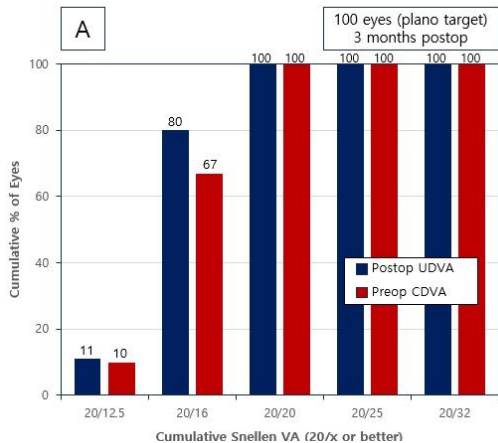
	SMILE	SMILE pro	<i>p</i> -value*
UDVA (logMAR)	-0.08 ± 0.04	-0.07 ± 0.05	0.539
CDVA (logMAR)	-0.1 ± 0.06	-0.09 ± 0.05	0.957
Refractive errors (D)			
Spherical	-0.09 ± 0.38	-0.05 ± 0.39	0.552
Cylindrical	-0.36 ± 0.23	-0.32 ± 0.23	0.250
SE	-0.27 ± 0.36	-0.21 ± 0.39	0.337
CCT (µm)	473.6 ± 35.4	469.8 ± 29.6	0.408
Efficacy index	1.06 ± 1.07	1.04 ± 0.15	0.292
Safety index	1.12 ± 0.21	1.09 ± 0.19	0.417
HOAs (µm)			
Oblique trefoil	0.16 ± 0.12	0.14 ± 0.11	0.235
Vertical coma	0.24 ± 0.18	0.2 ± 0.14	0.383
Horizontal coma	0.18 ± 0.13	0.18 ± 0.13	0.983
Horizontal trefoil	0.11 ± 0.09	0.12 ± 0.1	0.266
Spherical aberration	0.3 ± 0.16	0.29 ± 0.12	0.853
Total HOAs	0.64 ± 0.21	0.63 ± 0.17	0.766

No vision-threatening complications were detected in either group during the 3-month follow-up period.

There were no cases of epithelial ingrowth, severe diffuse lamellar keratitis, or keratectasia.

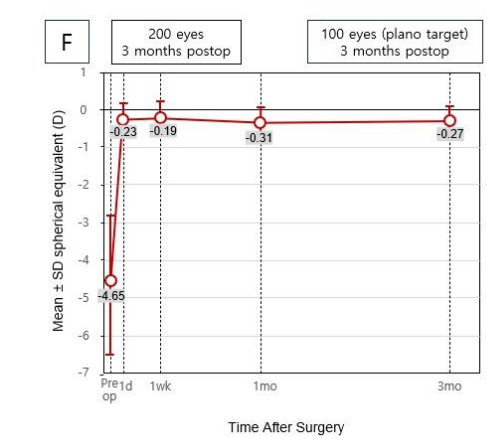
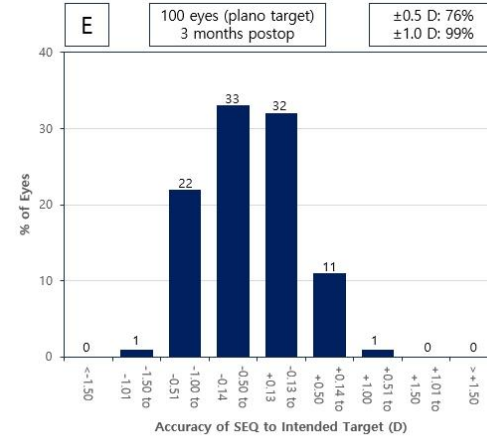
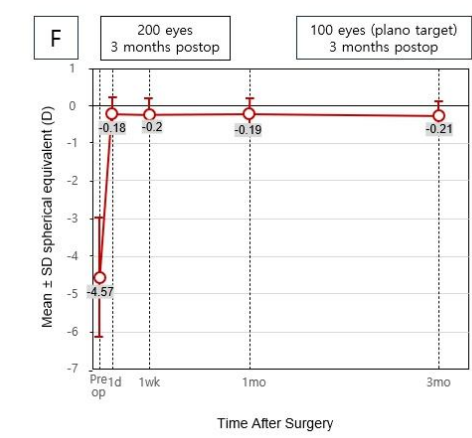
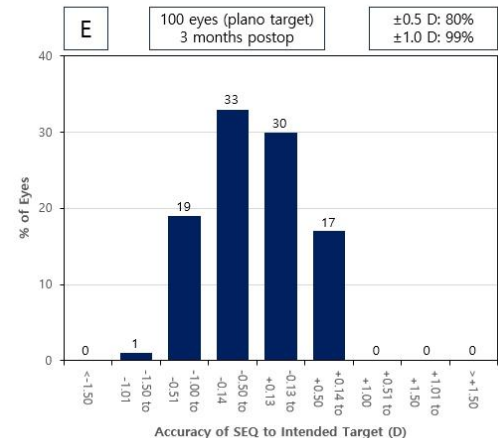
SMILE = small incision lenticule extraction; UDVA = uncorrected distance visual acuity; logMAR = logarithm of the minimum angle of resolution; CDVA = corrected distance visual acuity; D = diopters; SE = spherical equivalent; CCT = central corneal thickness; HOAs = higher order aberrations.

\*Independent sample *t*-test.



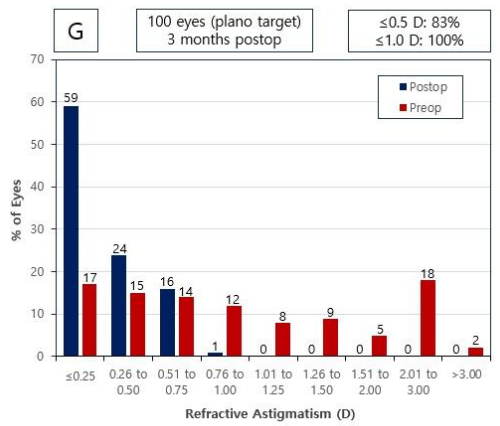
No Significant Differences

VS

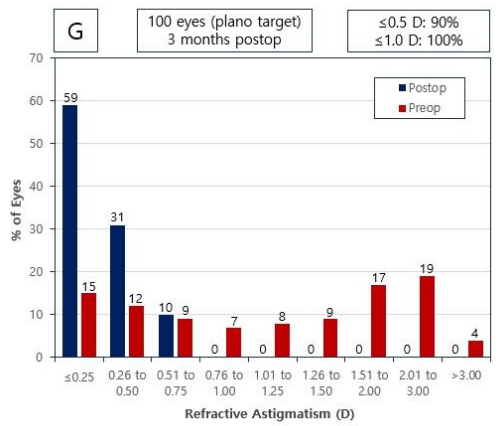


# Astigmatism

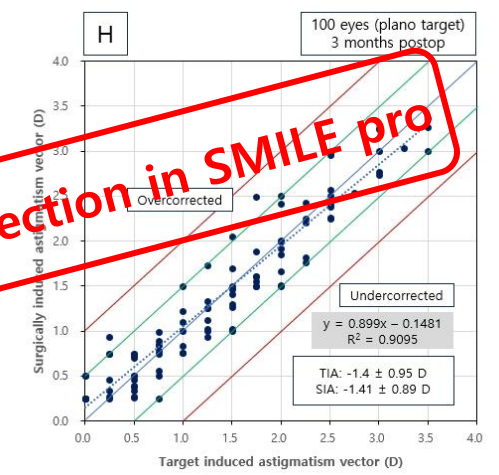
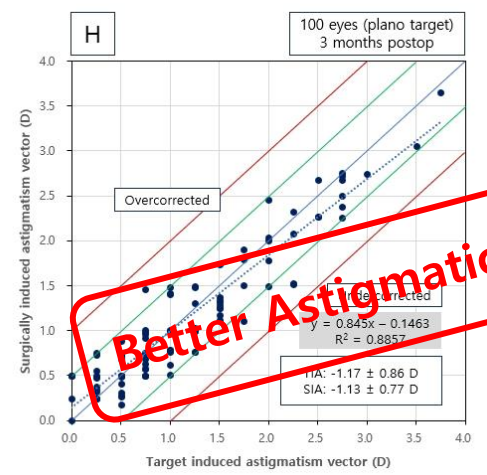
SMILE



SMILE pro



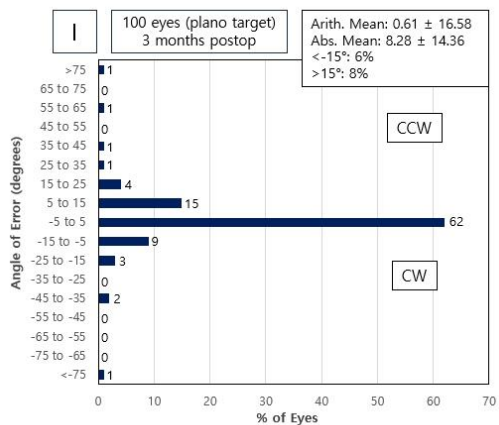
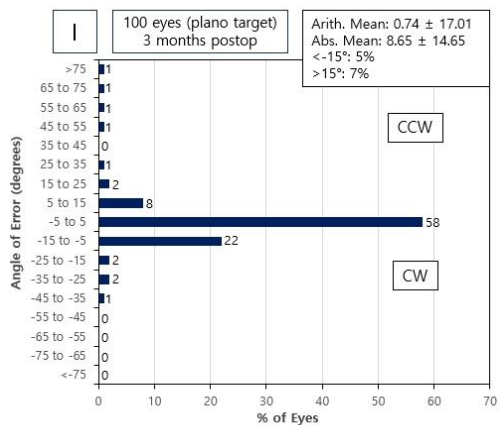
Residual astigmatism ≤0.5 D: 83% vs 90%



SIA – TIA

Slope of trend line: 0.845 vs 0.899

R<sup>2</sup>: 0.8857 vs 0.9095



Angle of error

Arith. mean: 0.75 vs 0.61

≤5°: 58% vs 62%

# RESULTS

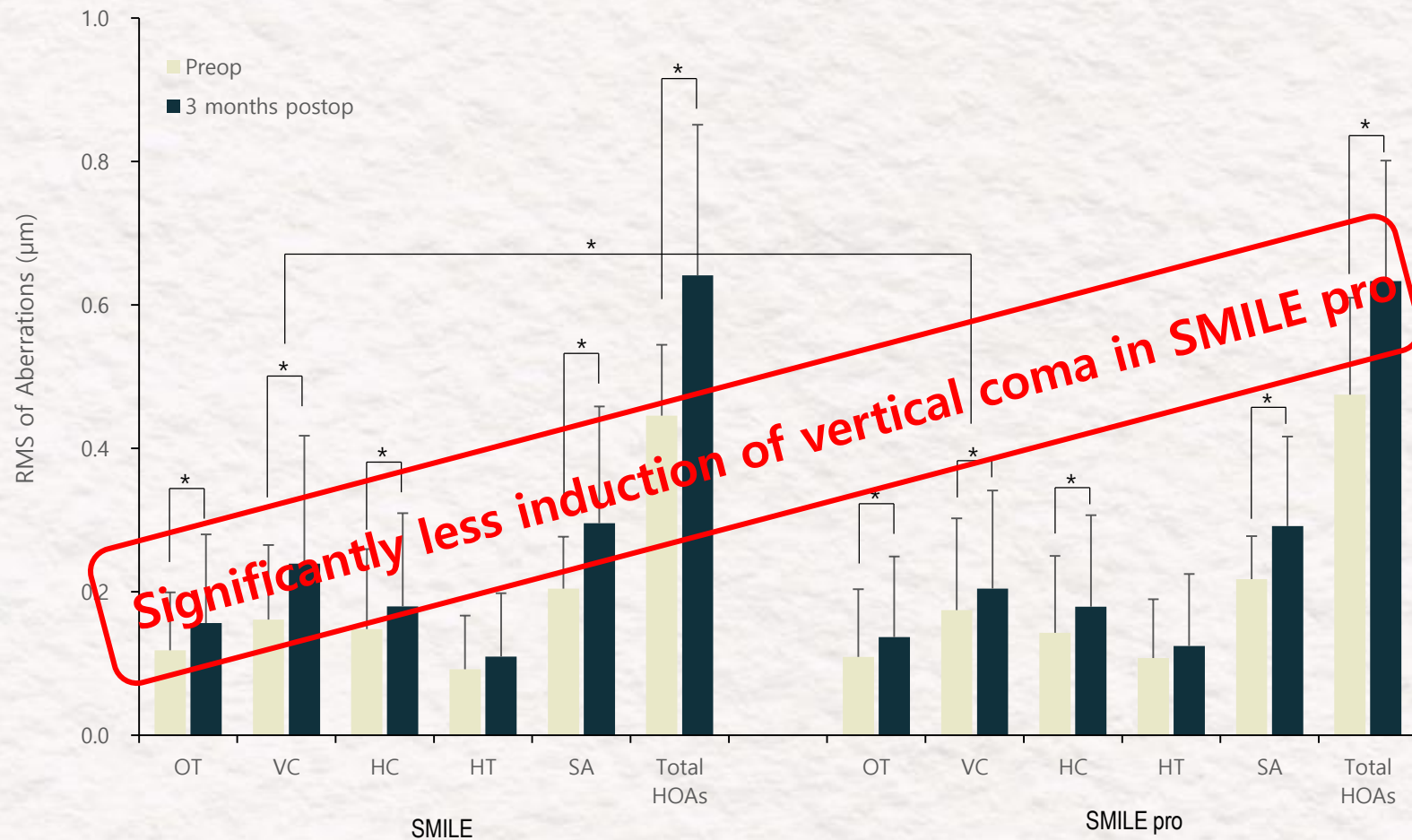


Figure 3. RMS of total HOAs and individual Zernike coefficients in the SMILE and SMILE pro groups 3 months postoperatively. Error bars indicate standard errors and \* indicates  $P < .05$ . HOAs = higher order aberrations; HC = horizontal coma; HT = horizontal trefoil; OT = oblique trefoil; SA = spherical aberration; VC = vertical coma.

Changes after the surgery by paired  $t$ -test.

Inter-group difference of change by independent sample  $t$ -test.



# CONCLUSIONS

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- Both SMILE procedures performed with VisuMax 500 and VisuMax 800 are comparable in efficacy, safety, and predictability for correcting myopia.
- There were no significant differences in postoperative visual acuity, residual refractive errors, central corneal thickness, and corneal higher-order aberrations.
- **Decentration** was significantly lower in SMILE with VisuMax 800 than in SMILE with VisuMax 500.
- **Astigmatic correction** tended to be better in SMILE with VisuMax 800 than in SMILE with VisuMax 500.
- SMILE with VisuMax 800 induced significantly less **vertical coma** than SMILE with VisuMax 500.