Comparison of Outcomes after Wavefront-optimized and Topography-guided Transepithelial Photorefractive Keratectomy

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ABSTRACT

Purpose: To evaluate the outcomes of wavefront-optimized (WFO) and topography-guided (TG) transepithelial photorefractive keratectomy (transPRK) in the treatment of myopia and myopic astigmatism.

Methods: Patients who underwent transPRK using the WaveLight® EX500 excimer laser for the correction of myopia and myopic astigmatism between January 2022 and March 2023 were divided into the WFO transPRK (77 eyes of 36 patients) or TG transPRK (63 eyes of 31 patients) groups in this retrospective, observational cohort study. The pre- and postoperative 3-month refractive and visual outcomes of the two groups were analyzed.

Results: The uncorrected distance visual acuity was 0.0 logMAR or better in 95% of eyes 3 months postoperatively, and the mean manifest refraction spherical equivalent was within ± 1.0 diopter (D) in 90% of eyes. No significant differences were observed between the groups in terms of the UDVA or astigmatism. A significant induction of higher-order aberrations (HOAs) was observed in both groups. However, the induction of total corneal HOAs (P = .014) and spherical aberrations (P = .000) was significantly lower in the TG group than that in the WFO group.

Conclusions: WFO and TG transPRK effectively improved the visual and refractive outcomes; however, the induction of total corneal HOAs and spherical aberration was lesser following the TG ablation.

Keywords: Contoura-based topography-guided ablation, Topography-guided PRK, Transepithelial PRK, Wavefront-optimized PRK
INTRODUCTION

Keratorefractive surgeries effectively improve visual acuity by correcting lower-order aberrations; however, preexisting and surgically induced higher-order aberrations (HOAs) often lead to deterioration of vision. The inadvertent creation of HOAs following corneal ablation may result in the incidence of glare, halos, haze, or starbursts, which affect visual quality [1]. Consequently, HOAs are a significant source of concern in the field of refractive surgery.

New treatment profiles and topography-guided surgeries have been used to minimize the postoperative induction of HOAs. Several studies have investigated the clinical outcomes of wavefront-optimized (WFO) and topography-guided (TG) laser in-situ keratomileusis (LASIK) in the treatment of myopia and astigmatism [2-4]. However, studies comparing the clinical outcomes of WFO and TG transepithelial photorefractive keratectomy (transPRK) in patients with myopia and astigmatism are lacking. Therefore, this study aimed to compare the clinical outcomes, including visual and refractive outcomes, as well as corneal HOAs, after transPRK following wavefront-optimized and topography-guided algorithms.

METHODS

Patients who had undergone WFO and TG transPRK performed by two experienced surgeons (S.H.C. and S.J.N.) for the correction of myopia and myopic astigmatism between January 2022 and March 2023 were included in this retrospective observational cohort study. This study was approved by the Institutional Review Board and adhered to the tenets of the Declaration of Helsinki.

Surgical treatment-naive eyes with preoperative refractive error ranging between -0.50 and -9.50 diopters (D) of spherical myopia and between 0.00 and 4.50 D of astigmatism and distance visual acuity correctable to 0.1 logMAR or better were included in this study. Patients with a history of systemic conditions, such as autoimmune disease and pregnancy; dystrophy or herpetic eye disease; recurrent corneal erosion; keratoconus; severe dry eye; cataracts; corneal scarring; and retinal and optic nerve disease were excluded. The type of surgery was selected based on the preference of the patient. We retrospectively reviewed the medical records of 140 eyes (67 patients) satisfying the inclusion criteria.

Preoperative Assessment

Each patient underwent a comprehensive ophthalmological assessment, including measurement of the WFO and TG transPRK in Myopia Treatment.
uncorrected and corrected distance visual acuity (UDVA and CDVA, respectively), manifest refraction, slit-lamp examination of the anterior segment of the eye, fundus examination using wide-field digital imaging (Optomap, Optos Inc., USA), measurement of the intraocular pressure, keratometry, and corneal topography (Pentacam; Oculus, Wetzlar, Germany), pre-operatively. Anterior segment optical coherence tomography (Cirrus HD-OCT, Zeiss, Germany) was performed to measure the corneal epithelial thickness. Ultrasonic pachymeter (US-500, NIDEK, Japan) was used to measure the central corneal thickness (CCT), respectively.

**Surgical Procedure**

Corneal elevation data were obtained using Topolyzer Vario (Alcon, USA) and transmitted to EX500 via an intranet for TG ablation. The target refraction was determined using the protocol by the U.S. Food and Drug Administration. The optical diameter was set as 6.5 mm for all eyes, and the residual corneal stroma thickness was maintained at ≥300 µm. The thickest epithelial measurement within the central 7 mm region of the cornea obtained via OCT was used to determine the corneal epithelial thickness. A value <5 µm beyond this measurement was used in the transPRK program.

The surgical procedure was performed under topical anesthesia (Alcaine eye drops 0.5%, Alcon, USA). Two-step ablation was performed in the TG group. Removal of the epithelium and correction of -0.25D of the cylinder were performed using the transPRK mode (StreamLight®, Wavelight, USA) as the first step. The topography-guided custom ablation treatment (TCAT) mode was used to eliminate the remaining errors and corneal HOAs. WFO transPRK was performed only in the transPRK mode.

Mitomycin C (0.02%) was applied for 40 s in all cases, and copious irrigation with cold BSS was performed subsequently. A bandage contact lens (Acuvue® 1 week, Johnson & Johnson, USA) was applied for 4–5 days. The postoperative medication regimen comprised the instillation of moxifloxacin and fluorometholone eye drops four times daily for 2 weeks and 3 months, respectively. In addition, sodium hyaluronate eye drops were instilled every 2 h for 3 months.

**Vector Analysis of Refractive Astigmatism**

Alpine vector analysis was performed to determine the changes in astigmatism [5]. The values calculated included target-induced astigmatism (TIA), defined as the change in astigmatism that the surgery was expected to induce; surgically induced astigmatism (SIA), defined as the actual change in astigmatism achieved postoperatively; difference vector (DV), defined as the disparity between the attained astigmatism and the WFO and TG transPRK in Myopia Treatment.
desired astigmatism; correction index (CI), calculated by dividing SIA by TIA; and index of success (IOS),
determined by dividing DV by TIA. Microsoft Excel (Microsoft Corp., Redmond, WA, USA) was used to
perform all calculations.

**Statistical Analysis**

Continuous data are presented as standard deviation (SD). The normality of the data was assessed using the
Kolmogorov–Smirnov test. An independent t-test was performed to determine the intergroup differences. A
paired t-test was performed to compare the preoperative and postoperative values within the group that were
normally distributed. Statistical significance was set at p < 0.05. IBM SPSS Statistics, version 20.0 (IBM Corp.,
Armonk, NY, USA) was used to perform all statistical analyses.

**RESULTS**

Overall, 77 eyes of 36 patients and 63 eyes of 31 patients were included in the TG and WFO groups,
respectively. Table 1 presents the results of the comparison between the preoperative characteristics and
parameters of the WFO and TG groups. No statistically significant differences were observed between the two
groups in terms of the preoperative characteristics (Table 1).

**Refraction and Visual Acuity**

A UDVA of 0.0 logMAR or better was achieved by 133 eyes (95%) in both groups at 3 months
postoperatively (Figs. 1a). A significant improvement in the mean manifest refractive spherical equivalent
(MRSE) was observed in both groups after transPRK (Fig. 1b). The accuracy of the refractive correction was
excellent (Fig. 1c, d). The MRSEs in the WFO and TG groups were 0.13 ± 0.53 D and 0.42 ± 0.65 D,
respectively (P = .004). The MRSE was within ±1.0 D of emmetropia in 126 cases (90%) in both cases.

**Vector Analysis of Astigmatism**

All parameters were comparable between the two groups (Table 2). The IOS was <1 in both groups, indicating
a reduction in astigmatism compared with that preoperatively. However, the correction index and magnitude of
error in both groups were <1 and <0, respectively, indicating a slight undercorrection of astigmatism.

WFO and TG transPRK in Myopia Treatment
Higher-order Aberrations

No significant differences were observed between the two groups in terms of the preoperative corneal HOAs with 6.0-mm pupil diameter (Table 3). The postoperative total corneal HOAs and spherical aberration were significantly higher than the preoperative values in both groups (P<0.001) (Table 4 and Fig. 2). Compared with WFO transPRK, TG transPRK resulted in significantly lower induction of total HOAs (P = .014) and spherical aberration (P = .000) at 3 months postoperatively (Table 5).

DISCUSSION

The requirement for consistent, repeatable, and secure postoperative outcomes has led to the development of numerous advanced laser platforms. The classical two-step transPRK, which comprises phototherapeutic keratectomy (PTK) followed by PRK, was first documented in 1999 [6]. An excimer laser is used instead of mechanical or chemical debridement techniques to ablate the corneal epithelium and stroma in transPRK, which can mitigate the complications associated with epithelial debridement in conventional PRK and corneal flap-related complications in LASIK. However, the integration of transPRK into mainstream refractive surgery is limited as a standardized procedure remains to be established. The planning required for the division into the PTK and PRK modes results in loss of time and potential corneal dehydration [7]. Subsequently, with a refined plan, improvements have been applied to the existing transPRK laser platform resulting in unified and advanced surgical techniques that reduce corneal dehydration due to shortened surgical times, while also enhancing both lower- and higher-order aberrations.

The postoperative outcomes of two ablation profiles following myopic transPRK were evaluated in the present study. The wavefront-optimized ablation profile was developed as a straightforward approach to pre-compensate for the anticipated HOAs, particularly the spherical aberration in the typical eye, which is often caused by the commonly used laser platforms [8]. The wavefront-optimized ablation profile incorporates a non-adjustable aspheric target, along with addressing the refractive error [9]. In contrast, topography-guided treatments overlook the HOAs of the internal structures of the eye and rely solely on information acquired from the corneal front surface topographic height maps as a reference [11]. The ablation profiles can be determined by matching the current corneal height map with an ideal rotationally symmetric shape and adjusting for existing refractive spherocylindrical errors [10]. Conceivably, addressing corneal irregularities using corneal surface mapping may enhance visual function in cases of highly irregular corneas (such as those with severe WFO and TG transPRK in Myopia Treatment

WFO and TG transPRK in Myopia Treatment
decentration), a very small optical zone due to prior refractive surgery, or corneal scars [11].

TG transPRK induced fewer total corneal HOAs and spherical aberrations in the present study. However, the refractive and visual outcomes of the TG transPRK group were comparable to those of the WFO group. No significant differences in terms of the proportion of patients who achieved a postoperative UDVA of -0.1 logMAR and 0.0 logMAR were observed between the WFO (31.2% and 96.1%, respectively) and TG (39.7% and 98.4%, respectively) groups. Furthermore, no significant discrepancy was observed between the groups in terms of the proportion of patients who achieved postoperative refractive astigmatism of <1.0 D (83.1% vs. 74.6%). The comparable visual and refractive outcomes may be attributed to the same correction target based on the manifest sphere and cylinder being used for both groups.

The visual outcomes observed in the present study are consistent with those observed in the study by Falavarjani et al. [11], wherein a contralateral eye comparison of 40 eyes was performed using the WaveLight excimer laser platform. No statistically significant differences were observed between the treatment methods in terms of the UDVA and contrast sensitivity outcomes at 3 and 6 months postoperatively in their study (P=.4 and .3, respectively). However, a previous version of the EX500 excimer laser system (ALLEGRETTO WAVE Eye-Q 400; Alcon Laboratories, Inc.) was used in their study. Moreover, they did not clarify the method used to remove the epithelium or the protocol used to plan the ablation. Faria-Correia et al. analyzed the results from the fellow eyes of myopic patients undergoing WFO and TG alcohol-assisted PRK using the EX500 excimer laser [12]. No notable differences were observed between the two groups in terms of the UDVA, MRSE, sphere, and cylinder 1 year postoperatively (P>.05). These findings suggest that visual acuity outcomes cannot be attributed solely to the ablation profile and that both profiles demonstrate similar efficacy and safety. The results of the present study are consistent with those of other studies comparing different ablation profiles in LASIK [13-16]. However, visual acuity measurements were conducted using a Snellen chart with 100% contrast and in well-lit conditions in the present study. Therefore, the results of the two surgeries may differ in everyday environments, such as indoor settings where low-contrast images are viewed or during nighttime driving. This discrepancy can be attributed to the differences in corneal HOAs [17-19].

The induction of total corneal HOAs and spherical aberrations was significantly lower after topography-guided ablation in the present study. HOAs degrade the quality of images on the retina and distort retinal images more than low-order aberrations [20, 21]. Spherical aberration and coma are the main HOAs that increase after laser refractive surgery, and this increase is attributed to the changes in the nonsphericity of the corneal anterior surface due to laser ablation [22, 23]. An increase in the spherical aberration leads to a decrease in night and WFO and TG transPRK in Myopia Treatment
indoor vision in large pupils. Furthermore, given the close relationship between coma and astigmatism [2], it is anticipated that coma would increase concomitantly with the postoperative increase in astigmatism. Faria-Correia et al. also reported lower postoperative HOAs and spherical aberration in the TG group; however, this difference was not statistically significant (P=.51 and .32, respectively) [12]. The markedly lower total corneal HOAs and spherical aberration observed in the present study compared with those of previous studies can be attributed to various factors. The data originated from different corneal topography devices. In addition, apart from the difference in population size, the preoperative data were not equivalent, and the present study targeted moderate to high myopia unlike previous studies, which focused on low to moderate myopia. Moreover, distinct excimer laser correction procedures and protocols were used to design the ablation in these studies. Topography-guided treatment was performed using the TCAT mode of EX500 in the present study, and the correction target was based on the manifest refraction adjusted using the FDA and Alcon’s nomograms for TG transPRK and WFO transPRK, respectively. TG-LASIK facilitated a significant reduction in the incidence of HOAs in previous studies that evaluated HOAs after LASIK using the same TCAT mode of EX 500 and the FDA and Alcon’s nomograms [2, 3].

Differences between the epithelial removal methods may also have led to the significantly lower induction of total HOAs and spherical aberrations in the present study. An excimer laser, rather than mechanical or chemical debridement methods, is used to remove the corneal epithelium and stroma in transPRK. Compared with other modalities using brushes or alcohol-assisted surgeries, transPRK facilitates a reduction in postoperative pain and the incidence of haze, dry eye, and quicker postoperative re-epithelialization [24]. The formation of a corneal flap, consistent delivery of laser energy during surgery, minimal intraoperative eye movements, tear film quality, and corneal healing may have attributed to the increase in HOAs [25].

Significant residual astigmatism was observed in the TG LASIK group in our previous comparative study of TG LASIK and WFO LASIK [2, 3]. However, in the present study, no significant differences were observed between the two groups regarding the postoperative astigmatism. The difference in the correction effect of astigmatism observed in the present study may be attributed to the discrepancy in astigmatism between the epithelial and Bowman's layers. The differences in epithelial thickness contribute to astigmatism. Thus, removal of the epithelium results in changes in the extent and direction of astigmatism. The differences in postoperative astigmatism depend on the epithelial removal method. The epithelial layer is removed in alcohol-assisted PRK, leading to the creation of different astigmatism patterns by the Bowman's layer. In contrast, sequential removal of the epithelium and stroma is performed during TG transPRK; thus, the stromal bed maintains the shape of the WFO and TG transPRK in Myopia Treatment
corneal epithelial surface during ablation [26]. TG transPRK yields a better HOAs correction effect than mechanical removal of the epithelium in terms of preserving the anterior corneal shape [27-29].

Analysis of the refractive astigmatic changes using vector analysis revealed a notable reduction in astigmatism in the WFO and TG groups in the present study. A slight undercorrection of pre-existing astigmatism was observed in both groups, indicating the requirement for collecting supplementary data to develop a more individualized and reliable nomogram for the WaveLight EX500 excimer laser.

We assert that our study represents a pioneering endeavor utilizing the WaveLight EX500 excimer laser in conjunction with the Contoura system to compare surgical outcomes between WFO and TG transPRK. Previous investigations contrasting outcomes between WFO and TG PRK relied on outdated laser platforms or surgical method. By adopting this methodology, we aimed to mitigate potential confounding variables, including biomechanical characteristics and corneal dehydration. Other parameters related to visual quality (such as contrast sensitivity) and symptoms that impact vision quality (such as glare, haze, and halo) are necessary for a more comprehensive evaluation of vision quality. Several previous studies have shown that correcting HOAs has improved contrast sensitivity [30-31]. Although contrast sensitivity was not measured in this paper, we examined corneal HOAs, and considering the results of previous studies [30-31], it can be speculated that TG transPRK result in improvements in the high contrast sensitivity performance. Subsequent studies are warranted to conduct a more thorough assessment of visual quality.

Thus, although no significant differences were observed between the topography-guided and wavefront-optimized ablation profiles in terms of refractive and visual results, the induction of HOAs in patients who underwent topography-guided transPRK performed using the TCAT mode of the WaveLight EX500 excimer laser was lesser. Further studies with longer follow-up periods and larger sample sizes must be conducted in the future to analyze the corneal responses to customized ablations and identify the superior ablation profile to develop a more robust customized transPRK technique. This could contribute to enhancing the results of topography-guided transPRK.

**Conflict of Interest**

None

**Acknowledgments**

WFO and TG transPRK in Myopia Treatment
None

**Funding**

None
REFERENCES


**Fig 1.** Refractive and visual outcomes after WFO and TG transPRK. (a) Cumulative distribution of Snellen UDCA compared with that of the preoperative CDVA. (b) Accuracy of MRSE compared with that of the intended target (D). (c) Scatter plots of attempted versus achieved MRSE. (d) Cumulative distribution of refractive astigmatism (RA) compared with the preoperative value. Data are presented as mean ± standard deviation. WFO, wavefront-optimized; TG, topography-guided; transPRK, transepithelial photorefractive keratectomy.

**Fig 2.** Changes in HOAs 3 months after WFO and TG transPRK

HOAs, higher-order aberrations; WFO, wavefront-optimized; TG, topography-guided; transPRK, transepithelial photorefractive keratectomy.
Table 1. Preoperative parameters

<table>
<thead>
<tr>
<th>Parameter (mean±SD)</th>
<th>Wavefront Group</th>
<th>Topography Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDVA (logMAR)</td>
<td>-0.11 ± 0.07</td>
<td>-0.11 ± 0.07</td>
<td>0.945</td>
</tr>
<tr>
<td>Sphere (D)</td>
<td>-4.63 ± 2.13</td>
<td>-5.06 ± 2.24</td>
<td>0.243</td>
</tr>
<tr>
<td>Cylinder (D)</td>
<td>-1.43 ± 1.13</td>
<td>-1.50 ± 0.96</td>
<td>0.662</td>
</tr>
<tr>
<td>MRSE (D)</td>
<td>-5.34 ± 2.16</td>
<td>-5.81 ± 2.28</td>
<td>0.211</td>
</tr>
<tr>
<td>Flat Keratometry (D)</td>
<td>42.78 ± 1.59</td>
<td>42.73 ± 1.11</td>
<td>0.830</td>
</tr>
<tr>
<td>Steep Keratometry (D)</td>
<td>44.71 ± 2.05</td>
<td>44.68 ± 0.98</td>
<td>0.893</td>
</tr>
<tr>
<td>CA (D)</td>
<td>1.94 ± 1.03</td>
<td>1.95 ± 0.79</td>
<td>0.935</td>
</tr>
</tbody>
</table>

CA, corneal astigmatism; CDVA, corrected distance visual acuity; MRSE, manifest refraction spherical equivalent
Table 2. Comparison of the change in astigmatism based on the Alpins vector analysis method

<table>
<thead>
<tr>
<th>Parameter (mean±SD)</th>
<th>Wavefront Group</th>
<th>Topography Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIA</td>
<td>1.94 ± 1.03</td>
<td>1.95 ± 0.79</td>
<td>0.935</td>
</tr>
<tr>
<td>SIA</td>
<td>1.44 ± 0.97</td>
<td>1.49 ± 0.82</td>
<td>0.770</td>
</tr>
<tr>
<td>DV</td>
<td>0.80 ± 0.41</td>
<td>0.84 ± 0.43</td>
<td>0.584</td>
</tr>
<tr>
<td>ME</td>
<td>-0.46 ± 0.59</td>
<td>-0.48 ± 0.50</td>
<td>0.821</td>
</tr>
<tr>
<td>CI</td>
<td>0.77 ± 0.42</td>
<td>0.74 ± 0.25</td>
<td>0.601</td>
</tr>
<tr>
<td>IOS</td>
<td>0.51 ± 0.33</td>
<td>0.51 ± 0.35</td>
<td>0.948</td>
</tr>
</tbody>
</table>

TIA, target-induced astigmatism; SIA, surgically induced astigmatism; DV, difference vector; ME, magnitude of error; CI, correction index; IOS, index of success. *Statistically significant (P < .05)
Table 3. Comparison of the preoperative corneal HOAs with 6.0-mm diameter

<table>
<thead>
<tr>
<th>Parameter (mean±SD)</th>
<th>Wavefront Group</th>
<th>Topography Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total HOAs (μm)</td>
<td>0.42 ± 0.10</td>
<td>0.45 ± 0.09</td>
<td>.520</td>
</tr>
<tr>
<td>Coma (μm)</td>
<td>0.16 ± 0.08</td>
<td>0.18 ± 0.09</td>
<td>.151</td>
</tr>
<tr>
<td>Trefoil (μm)</td>
<td>0.12 ± 0.06</td>
<td>0.12 ± 0.06</td>
<td>.813</td>
</tr>
<tr>
<td>Spherical aberration (μm)</td>
<td>0.20 ± 0.09</td>
<td>0.20 ± 0.11</td>
<td>.908</td>
</tr>
</tbody>
</table>

HOA, higher-order aberrations
Table 4. Comparison of the preoperative and 3-month postoperative corneal HOAs with 6.0-mm diameter.

<table>
<thead>
<tr>
<th>parameter (mean±SD)</th>
<th>Preop</th>
<th>Postop</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wavefront Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total HOAs (μm)</td>
<td>0.42 ± 0.10</td>
<td>0.84 ± 0.29</td>
<td>.000</td>
</tr>
<tr>
<td>Coma (μm)</td>
<td>0.16 ± 0.08</td>
<td>0.32 ± 0.22</td>
<td>.000</td>
</tr>
<tr>
<td>Trefoil (μm)</td>
<td>0.12 ± 0.06</td>
<td>0.13 ± 0.08</td>
<td>.129</td>
</tr>
<tr>
<td>Spherical aberration (μm)</td>
<td>0.20 ± 0.09</td>
<td>0.49 ± 0.22</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Topography Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total HOAs (μm)</td>
<td>0.45 ± 0.09</td>
<td>0.74 ± 0.29</td>
<td>.000</td>
</tr>
<tr>
<td>Coma (μm)</td>
<td>0.18 ± 0.09</td>
<td>0.30 ± 0.24</td>
<td>.001</td>
</tr>
<tr>
<td>Trefoil (μm)</td>
<td>0.12 ± 0.06</td>
<td>0.14 ± 0.09</td>
<td>.100</td>
</tr>
<tr>
<td>Spherical aberration (μm)</td>
<td>0.20 ± 0.11</td>
<td>0.34 ± 0.16</td>
<td>.000</td>
</tr>
</tbody>
</table>

HOA, higher-order aberrations
Table 5. Comparison of the magnitude of surgically induced corneal aberrations with 6.0-mm diameter

<table>
<thead>
<tr>
<th>Parameter (mean±SD)</th>
<th>Wavefront Group</th>
<th>Topography Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total HOAs (μm)</td>
<td>0.42 ± 0.27</td>
<td>0.29 ± 0.33</td>
<td>.014</td>
</tr>
<tr>
<td>Coma (μm)</td>
<td>0.16 ± 0.21</td>
<td>0.12 ± 0.27</td>
<td>.361</td>
</tr>
<tr>
<td>Trefoil (μm)</td>
<td>0.02± 0.10</td>
<td>0.02 ± 0.10</td>
<td>.845</td>
</tr>
<tr>
<td>Spherical aberration (μm)</td>
<td>0.30 ± 0.22</td>
<td>0.15 ± 0.17</td>
<td>.000</td>
</tr>
</tbody>
</table>

HOA, higher-order aberrations