Effect of biaxial versus coaxial microincision cataract surgery on optical quality of the cornea

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Context: Visual function is determined by a combination of the cornea, which has a larger effect and internal aberrations generated by the intraocular lens and those induced by the surgery. These corneal refractive changes are related to the location and size of the corneal incision. The smaller the incision, the lower the aberrations and the better the optical quality. Aims: To compare the effect of uneventful coaxial versus biaxial microincision cataract surgery (MICS) on the corneal aberrations. Settings and Design: Retrospective interventional nonrandomized comparative case study comprised 40 eyes of 36 patients with primary senile cataract. Subjects and Methods: They were divided into two groups: Group I (20 eyes) had operated by biaxial MICS and Group II (20 eyes) had operated by coaxial MICS. Each group were assessed by corneal topography and wavefront analysis over 6 mm pupil size preoperatively and 1-month postoperatively. Statistical Analysis Used: Statistical analysis was performed using SPSS for Windows (version 17.0.1, SPSS, Inc.). The paired t-test was used to compare the mean values of corneal aberrations preoperatively and 1-month postoperatively in each group. Results: There was a significant increase in trefoil and quatrefoil in biaxial MICS (P = 0.063, 0.032 respectively) while other aberrations insignificantly changed. The coaxial MICS showed a significant increase in root mean square (RMS) of total high order aberrations (HOAs) (P = 0.02) and coma (0.028), but not the others. In comparison to each other, there was the insignificant difference as regards astigmatism, RMS of individual and total HOAs. Conclusions: Coaxial and biaxial MICS are neutral on corneal astigmatism and aberrations.

Key words: Cataract surgery, corneal aberrations, corneal astigmatism, high order aberrations, microincision cataract surgery

Today with the era of the premium intraocular lens (IOLs) including aspherical monofocal and multifocal IOLs, which aim to reduce the positive spherical aberrations of the cornea to improve the retinal image.[1] This necessitates an insignificant change in the optics of the cornea as the quantity (astigmatism) and quality (high order aberration [HOA]).[2] However, several studies reported that cataract surgery degrades the optical quality and quantity of the cornea, which is related to corneal incision size.[3-5] The aim of this study was to determine whether microincision cataract surgery (MICS) effectively decreases corneal HOAs during cataract surgery.

Subjects and Methods
Retrospective cumulative interventional nonrandomized comparative case study comprised 40 eyes of 36 patients with visual significant primary senile cataract (graded according to Lens Opacities Classification System III for grading cataract as regards to nuclear color, nuclear opalescence, cortical, and posterior subcapsular cataract).

Inclusion criteria included age between 48 years and 81 years, clear cornea, no history of previous ocular surgery, or glaucoma, central corneal thickness (CCT) < 600 µm and pupil sized > 5 mm. Diseases known to decrease contrast sensitivity function (e.g., macular disorders or ocular surface disease) as well as diseases that affect IOL centration (e.g., subluxated lens or pseudoexfoliation) were excluded from this study.

The routine complete ophthalmic examination was performed for every case preoperatively and 1-month postoperatively. The corneal astigmatism, corneal topography and wave front analysis were measured (Optikon corneal topographer) for a 6.0 mm aperture diameter pre- and post-operatively at 1-month interval for total HOA, coma Z (3, +1), spherical Z (4, +0) (reported with its sign), trefoil, quatrefoil, and secondary astigmatism.

All patients gave adequate informed consent.

Peribulbar anesthesia (lidocaine 2% + bubicain + hyalaze of 15 IU/ml) associated with mild sedation with midazolam was used in all cases.

The same surgeon (I.H.) did biaxial MICS for 20 cases. Two clear corneal incisions (of 1.4 mm) were made superiorly by Alcon 19G MVR with 90º apart. He did also coaxial MICS for
Results
Forty eyes of 36 patients were enrolled in this study. The mean age of the patients was 58.73 years (range 48–81 years). The biaxial group comprised 20 eyes of 17 patients and the coaxial MICS group, 20 eyes of 19 patients. Table 1 shows the patients’ characteristics.

There is no statistically difference between 2 groups as regards preoperative corneal power, astigmatism, RMS of total and individual HOA. In biaxial MICS group, the mean corneal power was 43.13D ± 2.39 (SD) preoperatively and 43.03D ± 2.17 (SD) 1-month postoperatively, there was no statistically significant difference in corneal power (P = 0.16). While in coaxial MICS group, the mean corneal power was 43.09D ± 1.14 (SD) preoperatively and changed statistically insignificantly (P = 0.58) to 43.09D ± 0.96 (SD) 1-month postoperatively. The mean corneal astigmatism did not show statistically significant changes in both groups (biaxial MICS increased from 0.55D ± 0.25 preoperatively to 0.68D ± 0.28 at 1-month postoperatively, while coaxial MICS astigmatism changed from 1.1D ± 1.0 preoperatively to 1.1D ± 0.049 m postoperatively).

The RMS value of the total corneal aberrations increased insignificantly and slightly after biaxial MICS (0.5 μm ± 0.09 preoperatively to 0.57 μm ± 0.23 postoperatively) (P = 0.49), but coaxial MICS show significant increase of total RMS from 0.49 ± 0.21 μm –0.67 ± 0.31 μm preoperatively and postoperatively respectively (P = 0.02).

Analysis of individual Zernike terms showed mean astigmatism and spherical aberration did not change significantly in both groups. On the other hand, trefoil and quadruplet increased significantly in biaxial (P = 0.036, 0.032 respectively) and not in coaxial MICS (P = 0.21, 0.16 respectively), while coma increased significantly in coaxial MICS (P = 0.028) but not in biaxial MICS (P = 0.78) as shown in Table 2. Figs. 1 and 2 show pre- and post-operative wave front analysis of a case in each group as an example.

Table 3 and Fig. 3 show the insignificant difference in corneal astigmatism and aberrations between 2 groups. The RMS values for corneal astigmatism and most of HOA were slightly better, but not significant in coaxial MICS group than in the biaxial MICS group except coma and total HOA which were increasing more in coaxial.

Discussion
Recently, the cataract surgery is considered as refractive procedure aiming high patient satisfaction with better
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In our study, corneal power and astigmatism slightly, but not significantly, reduced in coaxial than biaxial MICS. Thus in agreement with Alio’s study. When the aberrations were evaluated by Zernike analysis in this study, we found the biaxial MICS significantly changed the trefoil and quatrefoil (P = 0.036 and 0.032 respectively), which is most probably related to corneal incisions. While other aberration changed insignificantly. This agrees with results of Elkady et al. Coaxial MICs significantly increased the coma and RMS of total HOA (P = 0.028 and 0.02, respectively). This finding is in agreement with other studies as regards coma but not total HOA.

In comparison the both groups, the individual corneal aberrations except coma and RMS of total aberration was slightly, but not significantly, changed in the coaxial MICs than biaxial MICs. This agrees with other studies.

Conclusion

Microincision cataract surgery (either biaxial [1.4 mm] or coaxial [2.2 mm]) was able to provide an astigmatically neutral incision. It was effective in maintaining normal corneal asphericity with respect of corneal prolateness in addition to other aberrations. These findings confirm that using the
The mean change in different corneal aberration and total RMS in both groups

| Mean change          | Biaxial group (mean±SD) | Coaxial group (mean±SD) | P    |
|----------------------|-------------------------|-------------------------|------|
| Corneal power        | −0.094±0.64             | −0.004±0.34             | 0.73 |
| Astigmatism          | 0.17±0.38               | 0.05±0.54               | 0.56 |
| Spherical            | −0.017±0.09             | 0.02±0.07               | 0.41 |
| Coma                 | 0.03±0.15               | 0.12±0.13               | 0.17 |
| Trefoil              | 0.22±0.26               | 0.13±0.23               | 0.53 |
| Trefoil              | 0.12±0.11               | 0.05±0.07               | 0.41 |
| Secondary astigmatism| 0.09±0.18               | −0.03±0.06              | 0.17 |
| Total RMS            | 0.07±0.18               | 0.18±0.17               | 0.35 |

SD: Standard deviation, RMS: Root mean square

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Conflicts of interest
There are no conflicts of interest.

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