Surgically induced astigmatism after 3.0 mm temporal and nasal clear corneal incisions in bilateral cataract surgery

Je Hwan Yoon, Kyun-Hyung Kim, Jong Yeon Lee, Dong Heun Nam

Aims: To compare the corneal refractive changes induced after 3.0 mm temporal and nasal corneal incisions in bilateral cataract surgery. Materials and Methods: This prospective study comprised a consecutive case series of 60 eyes from 30 patients with bilateral phacoemulsification that were implanted with a 6.0 mm foldable intraocular lens through a 3.0 mm horizontal clear corneal incision (temporal in the right eyes, nasal in the left eyes). The outcome measures were surgically induced astigmatism (SIA) and uncorrected visual acuity (UCVA) 1 and 3 months, post-operatively. Results: At 1 month, the mean SIA was 0.81 diopter (D) for the temporal incisions and 0.92 D for nasal incisions (P = 0.139). At 3 months, the mean SIA were 0.53 D for temporal incisions and 0.62 D for nasal incisions (P = 0.309). The UCVA was similar in the 2 incision groups before surgery, and at 1 and 3 months post-operatively. Conclusion: After bilateral cataract surgery using 3.0 mm temporal and nasal horizontal corneal incisions, the induced corneal astigmatic change was similar in both incision groups. Especially in Asian eyes, both temporal and nasal incisions (3.0 mm or less) would be favorable for astigmatism-neutral cataract surgery.

Key words: Nasal incision, surgically induced astigmatism, temporal incision

The aims of modern cataract surgery are rapid visual rehabilitation and the best uncorrected visual acuity (UCVA) possible with minimal post-operative astigmatism. Modern cataract surgery techniques allow rapid visual recovery but surgically induced astigmatism (SIA) remains a common obstacle to achieving an excellent UCVA. SIA is related to the type, length and location of the incision, and the suture closure technique.

Previous studies examined the astigmatism induced after an incision in various locations including the superior, superotemporal, superonasal, temporal, and nasal. These studies on the use of ranges from 3.5 mm to 4.0 mm corneal incisions in phacoemulsification concluded that nasal locations induced greater refractive changes than temporal regions, and temporal incisions induced the smallest SIA. Therefore, a temporal incision in a temporal position has been a popular method in modern phacoemulsification cataract surgery (temporal approach). On the other hand, recent evidence suggests that a small (ranges from 2.8 mm to 3.0 mm) clear corneal incisions (CCIs) induce little refractive change. Furthermore, locating the incision temporally in the right eye and nasally in the left eye might be comfortable for a right-handed cataract surgeon, who prefers to work from the 12 o’clock position relative to the patient (superior approach). This study compared the effect of 3.0 mm temporal and nasal CCIs on SIA in bilateral cataract surgery using the superior approach.

Materials and Methods
This prospective study included 60 eyes of 30 consecutive patients with bilateral senile cataract. The patients were scheduled to undergo separate bilateral cataract surgery with an interval of 1 day between procedures. None of the patients had a history of previous ocular surgery or diseases that would affect the corneal refraction. Written informed consent was obtained from each patient.

All eyes underwent a complete ophthalmological examination pre-operatively and post-operatively at 1 month and 3 month, including a manifest refraction using a refractometer and snellen projector chart. Astigmatism was measured from the keratometry readings. Data on gender, age, UCVA, manifest refraction, and automatic keratometry (ARK-510A, NIDEK) were collected.

All operations were performed by a single experienced surgeon using the same technique and sub-tenon anesthesia in all cases. The surgeon sat in the superior position. Three-step, CCIs were made with a 3.0 mm disposable blade. Temporal CCIs and nasal CCIs were used in all right and left eyes, respectively. The depth of the first cut, a precut, was approximately one third of the corneal depth; the tunnel length was 1.50 mm to 1.75 mm. After injecting sodium hyaluronate (Hyal plus®), capsulorhexis (approximately 5.0 mm in diameter), a side port incision and hydrodissection were performed. After phacoemulsification and cortex removal, a 1-piece foldable acrylic intraocular lens (TECNIS® 1-Piece intraocular lens (IOL), AMO) was then inserted. At the conclusion of surgery, a single, radial, 10-0 Nylon suture was passed across the wound in the center of the incision and closed to achieve simple apposition of the wound without tension or gape. The suture was removed 7 days after surgery.

SIA was calculated by vector analysis using the Holladay-Carvy-Koch formula. A paired Wilcoxon test was performed to determine if there was a significant effect on induced astigmatism depending on the incision location (temporal or nasal). An intra-individual comparison of the 2 groups was considered significant if P < 0.05.

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Results

Each group contained 30 bilateral cases. The mean age of the patients at the time of the baseline was 66.2 ± 7.6 years; there were 17 men and 13 women. The pre-operative corneal astigmatism in both groups ranged from 0.0 to 2.58 diopter (D). The level of pre-operative astigmatism was similar in the two groups (0.71 ± 0.43 in temporal incision group, 0.58 ± 0.53 in nasal incision group, \( P = 0.100 \)).

Table 1 lists the change in the mean corneal astigmatism over time. Total astigmatism between temporal and nasal incision group was not different. Corneal astigmatism of the temporal incision group was unchanged, whereas, corneal astigmatism of the nasal incision group increased slightly, but the change in the nasal group was not significant.

Table 2 and Fig. 1 show the surgically-induced astigmatic change at 1 and 3 months post-operatively calculated by vector analysis using the Holladay-Cravy-Koch method. The mean SIA in the temporal and nasal CCI groups at 1 month was 0.81 ± 0.64 and 0.92 ± 0.53, respectively. The SIA of the temporal and nasal groups decreased to 0.53 ± 0.39 and 0.62 ± 0.48 at 3 months, respectively, but the difference in SIA between the groups was not significant.

Table 3 shows the mean UCVA over time. The UCVA of both groups at 1 and 3 month was higher than that before surgery, and there was no significant difference between the groups. Nevertheless, the UCVA of the nasal incision was slightly better than that of the temporal incision.

Table 1: Mean preoperative and postoperative corneal astigmatism

<table>
<thead>
<tr>
<th></th>
<th>Total astigmatism (mean±SD) (n=30)</th>
<th>P value*</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Temporal incision</td>
<td>Nasal incision</td>
</tr>
<tr>
<td>Pre-operative</td>
<td>0.71±0.43</td>
<td>0.58±0.53</td>
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<tr>
<td>Post-operative</td>
<td></td>
<td></td>
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<tr>
<td>1 month</td>
<td>0.78±0.67</td>
<td>0.88±0.52</td>
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<tr>
<td>3 month</td>
<td>0.64±0.44</td>
<td>0.78±0.64</td>
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</tbody>
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*Wilcoxon signed ranked test, \(^1\)SD: Standard deviation

Table 2: Surgically-induced mean astigmatic change by vector analysis using the Holladay-Cravy-Koch formula

<table>
<thead>
<tr>
<th></th>
<th>Surgical induced astigmatism (mean±SD) (n=30)</th>
<th>P value*</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Temporal incision</td>
<td>Nasal incision</td>
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<tr>
<td>Post-operative</td>
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<tr>
<td>1 month</td>
<td>0.81±0.64</td>
<td>0.92±0.53</td>
</tr>
<tr>
<td>3 month</td>
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<td>0.62±0.48</td>
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Discussion

Most modern cataract surgeons sit at the temporal aspect of the patient and use temporal CCLs (temporal approach). On the other hand, some cataract surgeons prefer to sit at the superior aspect of the patient and use horizontal CCLs (superior approach). Superior approach cataract surgery has several potential advantages over the temporal approach. The surgeon always operates from the head of the table and does not need to change position during the procedure. Therefore, for a right-handed surgeon, the horizontal incision at 180° is temporal in the right eye and nasal in the left. The advantage of a horizontal incision at 180° is that the surgical technique is identical for the right and left eyes. The surgeon operates from the top of the operating table in both cases. In addition, cataract surgery using the superior approach is advantageous to combined operations with pars plana vitrectomy, trabeculectomy, and simultaneous bilateral cataract surgery. In the temporal approach, the surgeons and assistants need to arrange the situation with the operating table and move their operating position. Most operating tables are not constructed for a surgeon sitting at the side of the patient.

In horizontal incisions, however, the nasal incision has several potential disadvantages over a temporal incision. First, horizontal, CCL phacoemulsification induces with-the-rule astigmatism of a larger magnitude in the left eyes (nasal incision) than in the right eyes (temporal incision). The optical center of the cornea is not identical to the geometrical center; the optical center is located somewhat more nasally and
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The differences in SIA between a nasal incision and temporal wound stress and stretching can make a smaller SIA. Therefore, operators can ease surgical manipulations. Decreased stress and stretching of the corneal tissue might be decreased, surgery have been advanced gradually. Therefore, wound temporally or nasally.

Currently, surgical complications and biometry prediction errors are rather low. Induced astigmatism shows a diminishing tendency. In the present study, the SIAs following both 3.0 mm temporal and nasal CCIs were similar, approximately 0.50 D. The induced corneal astigmatic change would be minimal with the introduction of micro-incision cataract surgery. Therefore, induced astigmatism may not be a limiting factor for an improved UCVA. Both temporal and nasal horizontal incisions (3.0 mm or less) are suitable for astigmatism-neutral cataract surgery, especially in Asian eyes.

Acknowledgment

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References

13. Kohnen T, Dick B, Jacobi KW. Comparison of the induced incision in the present study could be smaller than in previous studies. In this study, the amounts of SIA were similar in temporal and nasal CCIs.

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