



# Fourier-domain optical coherence tomography evaluation of clear corneal incision structure according to blade material

Hun Lee, MD, Eung Kweon Kim, MD, PhD, Hong Seok Kim, MD, Tae-im Kim, MD, PhD

**PURPOSE:** To use Fourier-domain optical coherence tomography (OCT) to evaluate the wound characteristics of clear corneal incisions (CCIs) created with a metal or diamond blade in cataract surgery.

**SETTING:** Department of Ophthalmology, Institute of Vision Research, Yonsei University College of Medicine, Seoul, South Korea.

**DESIGN:** Prospective comparative observational study.

**METHODS:** Patients who had cataract surgery were randomized into 2 groups based on whether a metal blade (Group 1, 37 eyes) or diamond blade (Group 2, 33 eyes) was used to create a 2.8 mm temporal CCI. One day, 1 week, and 1 month postoperatively, structural characteristics of the CCI were analyzed using RTVue-100 Fourier-domain OCT. Parameters included incision angle, corneal thickness, epithelial or endothelial gaps, and Descemet membrane detachment. Visual acuity, surgically induced astigmatism (SIA), and ocular aberrations were evaluated.

**RESULTS:** There was a significant difference in corneal thickness at the 1.0 mm temporal side from midpoint. The mean uncorrected distance visual acuity in Group 2 (33 eyes) improved significantly over time. In both groups, corneal thickness at the midpoint, 1.0 mm temporal side, and 1.0 mm nasal side from the midpoint of the incision significantly decreased over time. At all timepoints, temporal and nasal thickness in Group 2 was significantly greater than in Group 1 (37 eyes), with the exception of temporal thickness at 1 month. In both groups, wound healing was reliable over time. There were no significant between-group differences in SIA or changes in aberrations.

**CONCLUSIONS:** Corneal thickness at the incision site showed a significant difference between the 2 groups. Both groups achieved structural stabilization.

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Sutureless clear corneal incisions (CCIs) are the most popular incision method in current phacoemulsification cataract surgery.<sup>1</sup> If constructed properly, the incisions can be effectively sealed without a suture, resulting in minimum iatrogenic astigmatism.<sup>2</sup> The CCI also provides higher structural stability of the anterior chamber and fast recovery of visual acuity with a high degree of patient satisfaction.<sup>2,3</sup> Although still controversial, several authors suggest that the CCI may be associated with an increased risk for endophthalmitis after cataract surgery and speculate that the

complication may be attributable to the relatively weak sealing force of the CCI.<sup>4,5</sup>

With the development of new surgical advances, such improved phaco machines and advanced intraocular lenses (IOLs), the size of the incision is progressively decreasing. The advantages of the small incision, such as reduced postoperative inflammation and less surgically induced astigmatism (SIA), are well known. However, when an incision is too small in phacoemulsification, surgeons inevitably encounter complications, including thermal corneal injury, wound distortion, and corneal hydration, unless they

are equipped with compatible instruments and IOL delivery systems.

Recently, anterior segment optical coherence tomography (AS-OCT) has allowed in vivo evaluation of the CCI structure.<sup>6-9</sup> Using this technology, cataract surgeons can not only evaluate additional details about CCI architecture but can also analyze the relationship between incision integrity and postoperative clinical outcomes.<sup>10</sup> Furthermore, Fourier-domain OCT technology, a more sophisticated method, has been reported to produce images with higher resolution and fewer artifacts.<sup>11</sup>

The RTVue-100 Fourier-domain OCT system (Optovue, Inc.) uses a rapid imaging speed (within 0.04 seconds) that can overcome the effects of eye movements; it has an axial resolution of 5  $\mu\text{m}$  and produces high magnification of the cornea.<sup>11</sup> The high-measurement velocity of this instrument is achieved with a stationary reference mirror. In time-domain OCT systems, the scan speed is limited because of the mechanical movement of the reference mirror over a range of several millimeters.<sup>12</sup> In contrast, Fourier-domain OCT eliminates this mechanical restraint on speed by simultaneously collecting signals from the entire range of interest and analyzing data using the spectral interferogram and rapid Fourier transform.<sup>11</sup>

The first step in cataract surgery is to create an incision to enable access to the anterior chamber. At present, there are 2 blade materials for creating the CCI; that is, diamond and metal. The important structural differences when creating the CCI depend on the

corneal tunnel construction made by metal blades and diamond blades. Likewise, enhanced surgical control of the corneal tunnel construction could augment the quality of cataract surgery. Metal blades are not as sharp as diamond blades,<sup>13</sup> and once metal blades are used, they lose a significant amount of their original sharpness. In contrast, diamond blades are very sharp and durable<sup>13</sup> and create more accurate incisions. However, the cost of purchasing and maintaining diamond blades is quite high compared with the cost and maintenance of metal blades.

Reducing SIA is crucial to delivering excellent postoperative uncorrected distance visual acuity (UDVA) and increased patient satisfaction. Several factors, such as incision size, incision location, incision distortion, and incision healing, can affect SIA. Among these factors, a smaller incision is especially associated with lower degrees of SIA. Considering the characteristics of blade materials, the degree of SIA may be affected by the blade material. Assuming that the type of blade material affects CCI structure and wound healing, changes in ocular aberrations might also be affected. However, to our knowledge, no studies in the literature have assessed the effects of blade materials on the SIA and corneal aberrations.

To our knowledge, there have been no studies using the Fourier-domain OCT to evaluate the structural analysis of the CCI based on the type of blade materials. Therefore, using RTVue-100 Fourier-domain OCT, we sought to determine whether there are differences in architectural features and healing processes of the corneal wound created using a metal blade and a diamond blade. We also characterized the effects of blade materials on the SIA and on corneal aberrations. The primary outcome involved the structural components of the CCI, and the secondary outcomes were visual acuity, SIA, and ocular aberrations.

## PATIENTS AND METHODS

This prospective observational study evaluated the CCIs in adult eyes having cataract surgery. The study was approved prospectively by the Institutional Review Board, Severance Hospital, Seoul, South Korea, and performed according to the tenets of the Declaration of Helsinki and Good Clinical Practices. All patients gave informed consent for participation in the study.

Patients having nuclear or corticonuclear cataracts of grade 2 to 5 according to the Lens Opacities Classification System III<sup>14</sup> were included. Exclusion criteria included previous ocular or intraocular surgery, evidence of trauma on biomicroscopic examination, evidence of acute or chronic corneal infection, inflammatory conditions of the cornea, corneal opacity, contact lens wear during the preceding 6 months, preoperative astigmatism of more than 2.00 diopters (D), posterior capsule rupture during surgery, or IOL decentration of more than 0.5 mm; decentration after cataract

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From the Department of Ophthalmology (Lee, E.K. Kim, H.S. Kim, T-i. Kim), Institute of Vision Research, the Brain Korea 21 Project for Medical Science (E.K. Kim), Yonsei University College of Medicine, and the Department of Ophthalmology (E.K. Kim), Cornea Dystrophy Research Institute, Severance Biomedical Science Institute, Seoul, South Korea.

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Corresponding author: Tae-im Kim, MD, PhD, Department of Ophthalmology, Yonsei University College of Medicine, 250 Seongsanno, Seodaemun-gu, Seoul 120-752, South Korea. E-mail: [tikim@yuhs.ac](mailto:tikum@yuhs.ac).

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