Anterior Gas Breakthrough During Femtosecond Intrastromal Astigmatic Keratotomy (FISK)

Femtosecond laser technology has provided a new surgical modality in corneal surgery. The accuracy, safety, and efficacy of this technology have been reported for several corneal refractive procedures. Recently, femtosecond lasers have been used for the creation of arcuate femtosecond intrastromal keratotomy (FISK) incisions to treat small to mild corneal astigmatism by taking advantage of the femtosecond laser’s intrastromal photodisruption capability. We report a case of inadvertent anterior breakthrough as a complication of FISK, leading to refractive overcorrection, irregular astigmatism, and loss of corrected distance visual acuity.

A 74-year-old man presented to our institution for consultation for surgical refractive correction. His uncorrected distance visual acuity was 20/40 in both eyes, which improved to a corrected distance visual acuity of 20/20 in both eyes with a manifest refraction of -0.50 +1.50@10 and -0.50 +1.25@5 in the right and left eye, respectively. The patient was diagnosed as having pseudophakia in both eyes, with no intraocular lens tilt and open posterior capsulotomies. Corneal topography demonstrated against-the-rule regular corneal astigmatism with a steep keratometry value of 42.87 diopters (D) @4 and a flat keratometry value of 41.86 D @94 (corneal cylinder: 1.01 D) in right eye. The left eye demonstrated a steep keratometry value of 42.80 D @176 and a flat keratometry value of 41.96 D @86 (corneal cylinder: 0.84 D) (Figure 1A).

Because of the mild mixed corneal astigmatism, the option of minimally invasive FISK was offered to the patient. The left eye first underwent paired symmetric FISK incisions (using the Catalys precision laser system [Abbott Medical Optics, Inc., Santa Ana, CA] with a repetition rate of 60 kHz) with the following settings: 7.0-mm optical zone, 70° incision length at the 176 and 356 axes, a 135° side-cut angle, and uncut zones 100 µm anteriorly and posteriorly (pulse energy 5 µJ, horizontal and vertical spot spacing 5 and 10 µm, respectively). However, inadvertent anterior gas breakthrough was noticed intraoperatively in the left eye in only the nasal intrastromal arcuate incision (Figure 2). To avoid a similar event in the right eye, the anterior uncut zone was increased to 150 µm instead of 100 µm. The right eye underwent uneventful FISK with the following settings: 7.0-mm optical zone, 70° incision length at the 4 and 184 axes, a 135° side-cut angle, and uncut zones 150 µm anteriorly and 100 µm posteriorly.

Postoperatively, the patient demonstrated more discomfort in the left eye compared to the right eye. At the 1-month postoperative follow-up examination, the patient had significant reduction in astigmatism in his right eye (42.70 D @148 and 42.27 D @58; cylinder: 0.44 D), resulting in improvement in uncorrected distance visual acuity from 20/40 to 20/20−1 (corrected distance visual acuity of 20/20 with +0.25 @150 correction). In comparison, the left eye demonstrated postoperative
refractive overcorrection (44.47 D @70 and 39.50 D @160; cylinder: 4.97 D) (Figure 1B), induced irregu-
lar corneal astigmatism, and loss of both uncorrected
distance visual acuity (20/40 to 20/60-) and corrected
distance visual acuity (20/20 to 20/30 with -1.0 -3.50@
75 correction).

FISK is a promising, new, minimally invasive proce-
dure to correct mild to moderate corneal astigmatism.
However, intraoperative complications can still occur
in the form of vertical gas breakthrough and anterior
penetration, resulting in significant refractive overcor-
rection. Careful operative planning and modification
in the laser settings may avoid similar complications,
resulting in optimum postoperative outcomes. Nomo-
grams need to be developed for improving the efficacy
and predictability of this novel application of femto-
second technology.

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