ERRORS IN SUPPLEMENTARY TORIC IOL IMPLANTATION (SULCOFLEX TORIC, RAYNER)

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✧ **In the article, the results of a combined surgical treatment method of induced astigmatism in a pseudophakic eye are presented. The authors describe an initial case of "wrong" supplementary toric IOL Sulcoflex (Rayner, Great Britain) position and its influence on aberrometric parameters.**

✧ ***Keywords:*** corneal astigmatism; cataract surgery; pseudophakic supplementary IOL Rayner Sulcoflex; LRI.

ОШИБКИ ПРИ ИМПЛАНТАЦИИ ДОБАВОЧНЫХ ТОРИЧЕСКИХ ИОЛ (SULCOFLEX TORIC, RAYNER)

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✧ **В статье представлены результаты комбинированного способа хирургического лечения индуцированного астигматизма на артифакичном глазу. Авторами впервые описан случай «неправильного» положения добавочной торической ИОЛ Sulcoflex (Rayner, Великобритания) и её влияние на аберрометрические параметры.**

✧ ***Ключевые слова:*** роговичный астигматизм; хирургия катаракты; добавочная псевдофакичная ИОЛ (Sulcoflex, Rayner); лимбальные послабляющие разрезы (ЛПР).

INTRODUCTION

Supplementary toric intraocular lens (IOL) implantation is a surgical method used to correct residual astigmatism in the pseudophakic eye [1]. The first supplementary IOL implantation (so-called "piggyback" technique) was proposed by J. Gayton and V. Sanders in 1993 to correct a high degree of hyperopia and was subsequently used to correct refractive errors usually associated with erroneous IOL power calculations [2]. Conventional IOLs, which were designed for implantation in the capsular bag, were initially used for piggyback implantation; as a result, opacification between the lenses was observed in one-third of cases over a long term, and 5 % among these cases were complicated by the formation of dense fibrotic membranes [3, 4]. Furthermore, IOLs implanted in the ciliary sulcus, particularly those consisting of hydrophobic acryl and possessing a sharply edged optical component, often lead to the development of secondary glaucoma because of pigment dispersion syndrome [5, 6]. Various attempts have been made to prevent these complications, including a larger capsulorhexis diameter, the use of lenses with rounded optical component edges, and the implantation of only one or two lenses in the capsular bag [7]. In recent years, a new generation of supplementary soft IOLs intended for fixation to the ciliary sulcus appeared in the market (Sulcoflex® 653L, Rayner, Hove, East Sussex, UK). These lenses may be implanted simultaneously during cataract extraction, after monofocal IOL implantation or in a second surgery [8]. Currently, this is the most popular type of lens because of its specific design that allows implantation in the ciliary sulcus via a piggyback-IOL style to correct residual refractive errors after cataract surgery. Three types of these lenses are currently in production, namely, aspherical, toric, and multifocal.

Supplementary IOLs consist of hydrophilic acryl (Rayacryl®) [9]. These lenses include a number of design features to avoid complications associated with implantation in the ciliary sulcus. The large optical diameter (6.5 mm) and rounded edges reduce the risk of seizure between the IOL and iris. Undulating haptics, which feature a large diameter (14 mm), circular edges, and 10° angulation, minimize the risk of contact with the pigment epithelium of the iris to prevent the development of pigment dispersion syndrome and ensure central positioning and rotational stability of the IOL. Research conducted by McIntyres et al. on cadaver eyes demonstrated that for haptics, a 10° angulation helps to maintain necessary distance between the front surface of the IOL and the posterior surface of the iris, even if the supplementary IOL haptic shifts forward consequent to excessive proliferation in the capsular bag (Soemmerring's ring formation) [10].

Haptic design features allow the implantation of this IOL even in the presence of zonule defects in up to one quadrant. In such cases, the IOL should be oriented such that the haptics are placed 90° to the defect zone. These recommendations are primarily intended for ordinary aspheric IOLs and have some limitations in cases of toric IOLs that require the precise localization of the lens toward the astigmatism axis. Trans-scleral suture fixation of these lenses could be possible in cases involving unstable supplementary IOL position because of zonule defects or other causes [11].

It is not always possible to evaluate the safety of zonules in a pseudophakic eye. Biomicroscopy may reveal some relative signs of zonule defects, including pseudophakodonesis, iridodonesis, pseudoexfoliative syndrome, and uneven optic distance of the IOL from the iris (beam parallax). Ultrasound biomicroscopy (UBM) can reveal extensive zonule defects complicated by "hidden" vitreous hernias and can evaluate increases and irregularities in the irido-lental space. Evaluation of the primary position of an implanted IOL may be hampered by inadequate mydriasis, including the presence of planar posterior synechia (irido-capsular adhesions). Together with an incomplete medical history (e.g., IOL model, presence of intraoperative complications), surgeons may be faced with unexpected situations during supplementary IOL implantation. Therefore, a careful medical history with a discharge summary review, anterior segment examination with an adequately dilated pupil, and UBM are essential when making decisions regarding supplementary IOL implantation with fixation in the ciliary sulcus. When collecting medical history, it is necessary to note the remoteness of the primary operation, both the type and optical power of the IOL, and peculiarities of the intra- and postoperative periods. Examination with a dilated pupil allows estimation of position of the IOL and its centration, anterior capsulorhexis diameter, and signs of zonule defects. UBM may be recommended both before the operation (particularly with suspected zonule damage) and during the postoperative period to assess IOL positioning.

Particular design features of supplementary IOLs (such as lens size, haptic design, inclination towards the optical area) require extra precautions during implantation. IOL thinness and elasticity of the polymer comprising the IOL optic portion allow lens implantation in the anterior chamber through a 2.6-mm incision with a special cartridge, according to the manufacturer's recommendations. The process of lens "unfolding" in the anterior chamber requires precise control during the implantation to achieve proper correction. A 180° overturn of IOL during implantation could introduce difficulties while rotating the lens to the correct position, considering the large optical (6.5 mm) and haptic (14 mm) diameters. This rotation may be particularly difficult in the shallow anterior chamber (high hyperopia) and with the intraoperative detection of zonule defects or capsular bag. Restoring the correct position of the IOL in such cases may adversely affect the state of the endothelium or exacerbate zonule conditions and may result in an inability to implant the lens and the need for suture fixation of the primarily implanted IOL. A surgeon must assess the individual risk of IOL rotation in each case. In this article, we present our experience in resolving this problem. To date, no similar descriptions have been published to the best of our knowledge.

CLINICAL CASE

Patient K., aged 77 years, was admitted to the ophthalmology department in October 2012 with a diagnosis of OS pseudophakia. Secondary diagnoses included high-degree mixed astigmatism without the rule and OD pseudophakia. Extracapsular cataract extraction and monofocal IOL implantation had been performed in the left eye in 2003. Upon clinical examination, an old postoperative scar was detected in the upper part of the cornea, the anterior chamber was determined to be regular but deeper than its average depth, and aqueous humor was transparent. The iris was atrophic with soli-

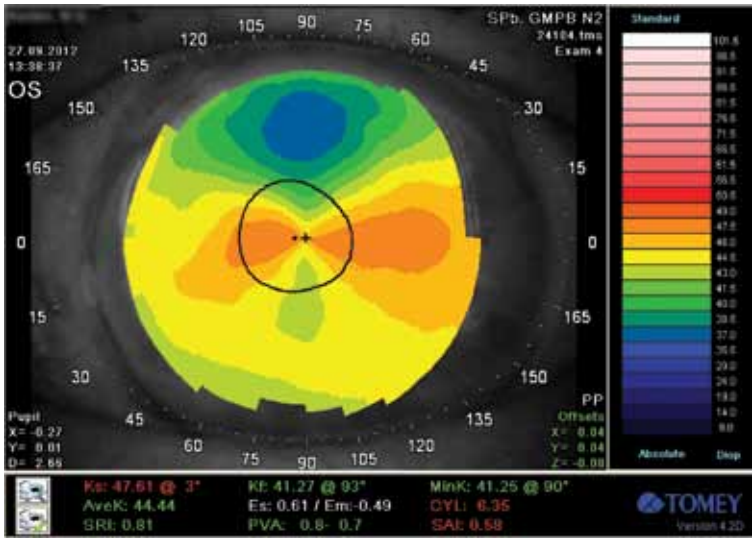

Fig. 1. Corneal topography data of the left eye of patient K. (age: 77 years) before limbal relaxing incisions

tary planar posterior irido-capsular synechia that prevented pupil dilation and evaluation of IOL position abnormalities. The posterior lens capsule had no visible signs of damage. A fundus examination revealed a clearly defined pale pink optic disc and an excavation to disk ratio of 0.3. The arteries were moderately narrowed, and the macular region and periphery lacked focal lesions. The irido-corneal angle was opened and slightly pigmented. The patient's visual acuity at admission was as follows: OS of 0.06 with sph +2.0 D, cyl-6.0 D, and axis 85° = 0.8; OD of 0.8 with sph −0.5 D = 1.0. According to OSV corneal topography (TMS-4 keratotopograph; Tomey, Nagoya, Japan), the corneal astigmatism was 6.35 D (Fig. 1). In both eyes, IOP was 20 mmHg, according to Maklakov tonometer. The length of the anterior–posterior axis in the left eye was 22.72 mm. The anterior chamber depth in the left eye was 3.87 mm. The number of endothelial cells was within normal range for the patient's age.

Considering the high degree of corneal astigmatism (6.35 D), a combined method was selected for induced astigmatism correction. A one-time surgical procedure, including limbal relaxing incisions (LRIs) in combination with toric pseudophakic IOL (Sulcoflex Toric, Rayner) implantation, was performed after preliminary calculations. Two arcuate limbal incisions with a depth of 600 μm and length of 90° were made in the projection of the most optically powerful astigmatism meridian (the 0°–180° axis) at a distance of 0.5 mm from the limbus (Donnenfeld's nomogram was used for the calculations; Fig. 2). The anterior chamber was

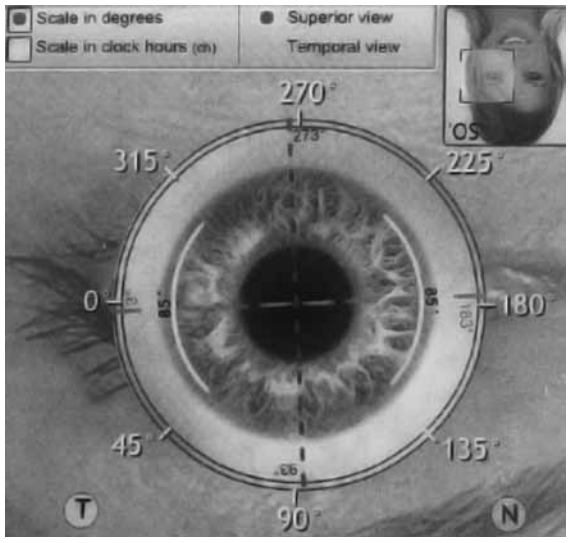

Fig. 2. Scheme of the limbal relaxing incisions accor ding to Donnenfeld's nomogram

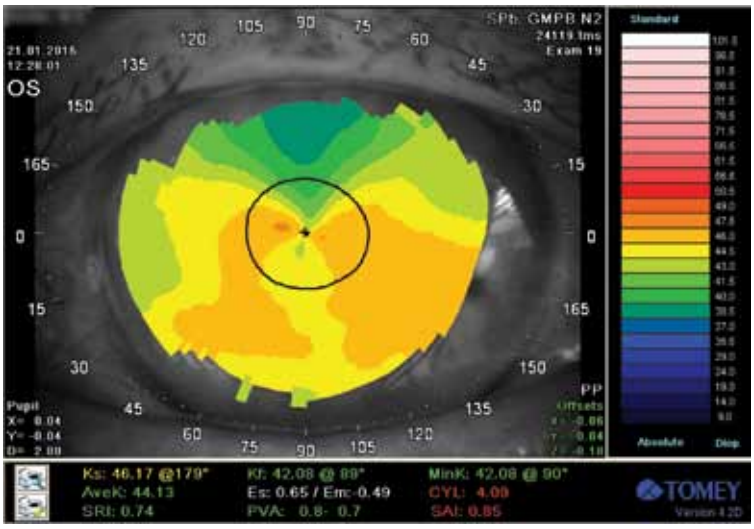

Fig. 3. Corneal topography data of patient K., 3 years after limbal relaxing incisions

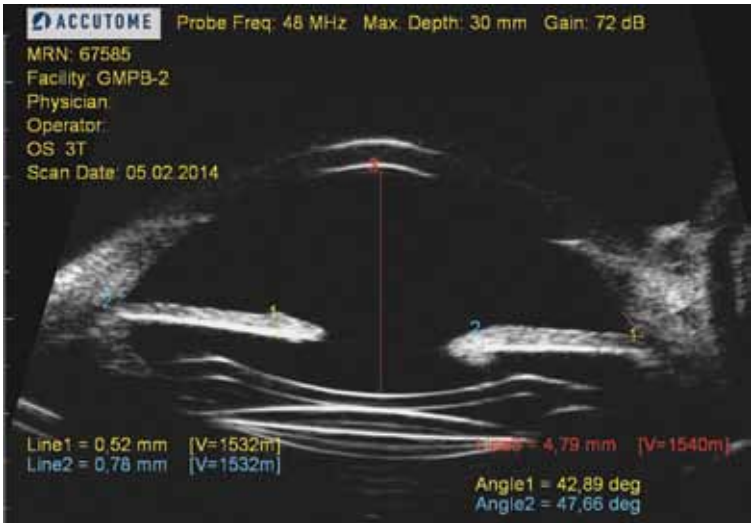

Fig. 4. Results of ultrasound biomicroscopy of the anterior segment of the bipseudophakic eye; the first intraocular lens (IOL) is fixed in the capsular bag, and the supplementary IOL Sulcoflex (Rayner) is located upside down between the front surface of the capsular bag and the iris

accessed using a 2.75-mm keratome along one of the incisions (at 3 o'clock position). The pre-calculated implantation (using the online calculator) of a supplementary toric IOL (Sulcoflex Toric 653T, sph — 2.5 D/cyl3.0 D) was performed after filling the anterior chamber with a viscoelastic substance (Provisc®, Alcon, Hünenberg, Switzerland) and separating the irido-capsular adhesions. Upon leaving the cartridge, the IOL had rotated around its axis by 180°. Attempts to rotate the lens to the correct position were complicated by the presence of a vitreous hernia, which was detected during rotation. Careful examination revealed an old detachment of the capsular bag with herniation of the vitreous body between the 10 to 11 o'clock positions. Considering the possibility of an increase in zonule defects during rotation, a decision was made to leave the lens in the "upside-down" position. After the anterior vitrectomy, an extra toric IOL was set in the 0°—180° axis in accordance with calculated data.

The postoperative period was unremarkable. OS visual acuity was 0.9 sph + 0.5 D = 1.0. IOP was 20 mmHg, according to Maklakov tonometer. The patient was followed for 3 years, with a follow-up visit every 3 months. Visual acuity, IOP, and statuses of the anterior eye and irido-corneal angle were assessed during each visit. UBM was performed to assess the IOL position every 6 months. Aberrometric data changes were monitored annually.

Corneal flattening with a corresponding reduction in the degree of astigmatism of more than 2.0 D (up to 4.09 D) in response to LRI was noted during the early postoperative period; this remained stable over the follow-up period (Fig. 3).

The "wrong" position of the supplementary toric IOL remained stable during the observation period, although this led to a slight deviation from the "target refraction"; specifically, a slight hyperopic shift of 0.5—0.75 D was recorded. Episodes of increased IOP and signs of pigment dispersion were absent (Fig. 4).

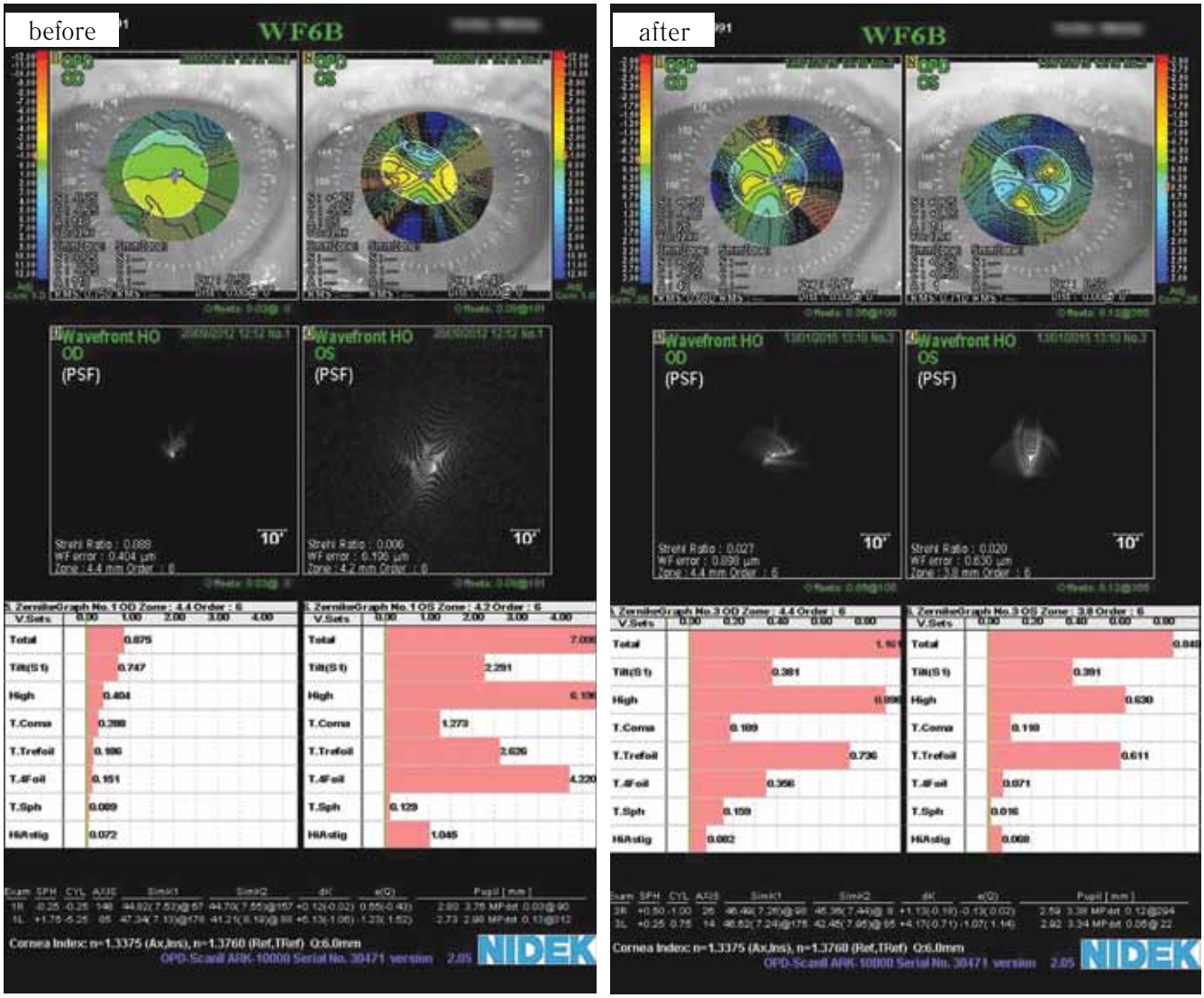

Fig. 5. Aberrometrical data before and after the correction of induced astigmatism

An earlier study by Findl et al. described cases involving optical aberrations (multifocal effect) and deviations from target refraction involving contact between the optical surfaces of the two IOLs after "piggyback" implantation [12]. The anterior surface of the Sulcoflex IOL optical component features a curved profile and concave posterior surface, minimizing the possibility of contact with the lens implanted in the capsular bag. Such design features are believed to reduce the likelihood of refractive errors and optical aberrations. In the present case, the inverted supplementary IOL position did not increased high-order aberrations as well as significantly improved overall aberrometric characteristics (Fig. 5). The levels of total aberrations and higher order aberrations were 7.098 and 0.849 μm, respectively, before supplementary IOL implantation, and 6.196 and 0.630 microns, respectively, after implantation (OPD-Scan II; Nidek, Gamagori, Japan). The Strehl ratio, which describes the function of point scattering, increased almost 10 times (from 0.006 to 0.051). It should be noted that the aberrometrical values obtained from the bipseudophakic eye were comparable to those obtained from the second pseudophakic eye. Objective data were confirmed by the subjective feelings of the patient, who did not experience a difference in the vision quality of both eyes.

CONCLUSION

Proper supplementary IOL implantation provides a high level of visual function and an opportunity to avoid complications during the postoperative period. Cases involving inverted positioning of the IOL can also achieve high-quality vision but require constant follow-up monitoring during the postoperative period.

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