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Case Report

Small Incision Lenticule Extraction Using A Direct Corneal Light Reflex Marking Technique for Centration in an Eye with Corectopia Attributable to Traumatic Iridodialysis: A Case Report

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Abstract

Introduction: Small Incision Lenticule Extraction (SMILE) affords many advantages including rapid postoperative recovery and a lack of flap-related complications. However, given the lack of an eye-tracking system, centration is manually performed by the surgeon. This can be challenging if an anomaly in the pupil serves as a landmark during surgery.

Case Report: A 38-year-old man presented to our clinic for refractive correction. He had a history of blunt right eye trauma and the slit-lamp microscope revealed corectopia and temporal iridodialysis 2.4 x 4.6 mm in size. The corneal light reflex of the centration light was marked intraoperatively, and the lenticule was created via centering on the corneal marking. Three months after surgery, the uncorrected distance visual acuity was 20/20, the manifest refraction 0 D-0.75 D, and the extent of decentration 0.12 mm.

Conclusion: Myopic astigmatism in patients with corectopia attributable to traumatic iridodialysis may be successfully treated with SMILE if the corectopia is not severe and centration is appropriately performed.

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Keywords: Centration; Corectopia; Iridodialysis; Small incision lenticule extraction; SMILE

Introduction

Small Incision Lenticule Extraction (SMILE) is a form of corneal refractive surgery in which a femtosecond laser is used to create a lenticule that is manually extracted via a small, peripheral corneal incision [1]. Although SMILE is a relatively new procedure, it has been widely accepted given its good efficacy, safety, predictability, lack of flap-related complications, and rapid postoperative recovery [2,3]. However, SMILE still features certain limitations, such as the absence of an eye-tracking system. Centration during SMILE depends principally on the experience and skill of the surgeon, and may thus challenge beginner and inexperienced surgeons [4]. Decentration may cause complications including halo, glare, diplopia, and decreased vision [4]. Iridodialysis refers to tearing or localized separation of the iris from the ciliary body attachment, and is typically caused by blunt trauma [5]. If the iridodialysis is tiny, it is not a cause for concern from either a cosmetic or visual perspective [5]. However, even a small iridodialysis can affect centration during refractive surgery. We here present the case of a patient with corectopia attributable to traumatic iridodialysis who underwent SMILE, during which direct marking of the corneal light reflex (CLR) was used to ensure accurate centration.

Case Report

A 38-year-old male came to our clinic for refractive correction. He had a history of blunt trauma to his right eye when he was 8 years of age. On ocular examination, the uncorrected distance visual acuities were 20/200 and 20/400 in the right and left eyes respectively, and the corrected distance visual acuity was 20/18 in both eyes. The manifest refractions were -3 D -1.25 D x 175° and -4.75 D -0.25 D x 5° in the right and left eyes respectively. Slit-lamp microscopy revealed mild nasal decentration of the pupil and temporal iridodialysis, 2.4 x 4.6 mm in size, in the right eye (Figure 1A). The CLR was within the pupil margin during primary gaze, and the patient lacked symptoms of iridodialysis, such as glare, halo, or monocular diplopia. The Galilei dual rotating Scheimpflug analyzer (Ziemer, Port, Switzerland) revealed regularly shaped corneas in both eyes, however, given the iridodialysis, the pupil was misidentified in the right eye (Figure 1B,C). The central corneal thicknesses were 514 µm and 513 µm in the right and left eyes respectively. The intraocular pressures measured using a non-contact tonometer were 14 and 13 mmHg in the right and left eyes respectively.

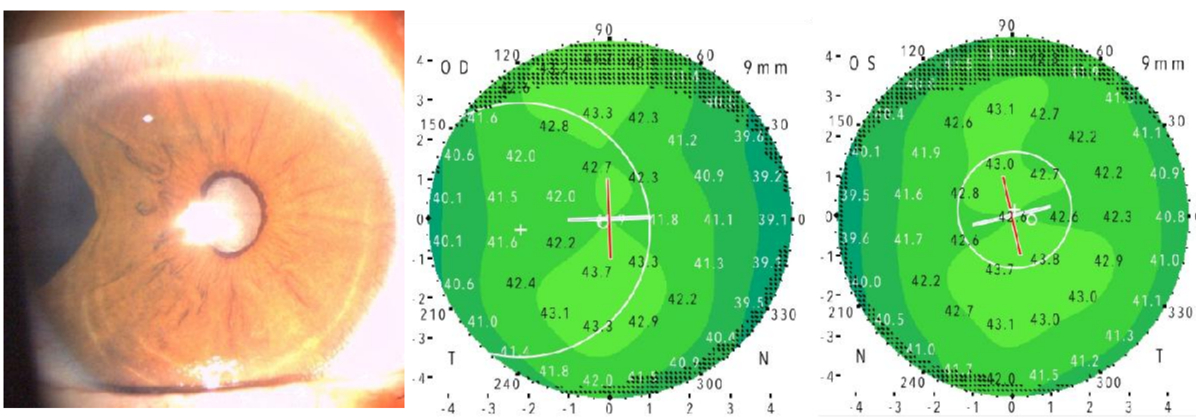

Figure 1: (A) Anterior segment photograph of the right eye. A 2.4 x 4.6-mm sized temporal iridodialysis and a nasally displaced pupil were observed. **(B)** The preoperative, anterior axial curvature map of Galilei for the right eye. **(C)** The preoperative, anterior axial curvature map of Galilei for the left eye.

An experienced surgeon (KBK) performed SMILE; the target refraction was emmetropia. SMILE employed a 500-kHz Visumax femtosecond laser (Carl Zeiss Meditec, Jena, Germany) with a lenticule diameter of 6.0 mm, a cap thickness of 110 μm, and a 2-mm incision for both eyes. To aid eye central fixation and surgical center marking, a centration light (a small blue LED) was placed at the center of the observation microscope (Figure 2). The patient was asked to watch the light and, under the microscope, the surgeon marked the CLR of the light (which was considered to be the corneal vertex) using a spatula tip dipped in surgical marker ink (Nesco Dermark, Alfresa Pharma Corporation) (Figure 3A,B). After moving the bed so that the eye moved under the curved contact glass when pushed by a joystick, the surgeon raised the bed while meticulously matching the fixation light with the corneal marking; the patient was told to watch the fixation light. When the cornea was in contact with about 80% of the contact glass and the fixation light and corneal markings coincided, suction was applied, and the lenticule was created (Figure 3C,D). The lenticule was extracted via an incision at 11 o'clock. The postoperative regimen included 0.5% moxifloxacin; 0.1% fluorometholone; and preservative-free, hyaluronic acid lubricating eyedrops.

The postoperative course was unremarkable; the patient had no complaints. On day 1 after surgery, the uncorrected distance visual acuities were 20/20 and 20/18 in the right and left eyes respectively, and no sign of infection was apparent on slit-lamp microscopy. Three months postoperatively, the uncorrected distance visual acuities were 20/20 and 20/18 in the right and left eyes respectively, and the corrected distance visual acuity was 20/18 in both eyes. The manifest refractions were 0 D -0.75 D and -0.25 D 0 D in the right and left eyes respectively. The Galilei platform revealed a post-myopic ablation pattern with good central flattening 3 months postoperatively (Figure 4). The extent of decentration revealed by a difference map based on the instantaneous curvature was 0.12 mm in the right eye and 0.14 mm in the left eye. The Galilei-measured, corneal higher-order aberrations over the 6-mm central diameters decreased from 0.89 μm to 0.75 μm in the right eye and increased from 0.39 μm to 0.71 μm in the left eye.

Figure 2: A centration light (a small blue LED) was placed at the center of the observation microscope to aid central eye fixation and surgical center marking.

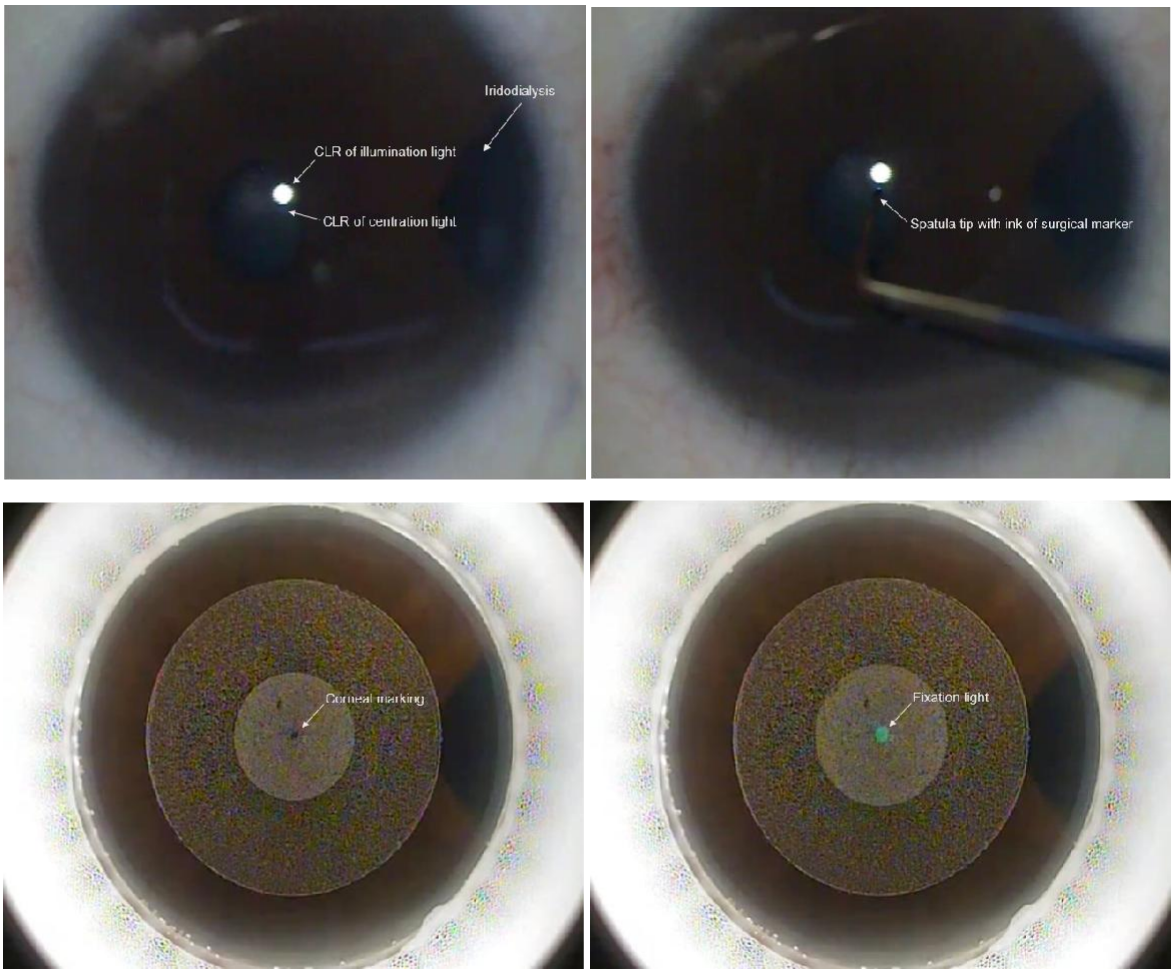

Figure 3: (A) The cornea was placed under the observation microscope before laser treatment. The corneal light reflexes (CLRs) to a large, white illumination light and a small, blue centration light were observed. Iridodialysis was apparent. **(B)** The surgical center was marked on the cornea using the CLR to the centration light employing a spatula tip dipped in surgical ink. **(C,D)** The positions of the corneal marking and fixation lights coincided during laser treatment.

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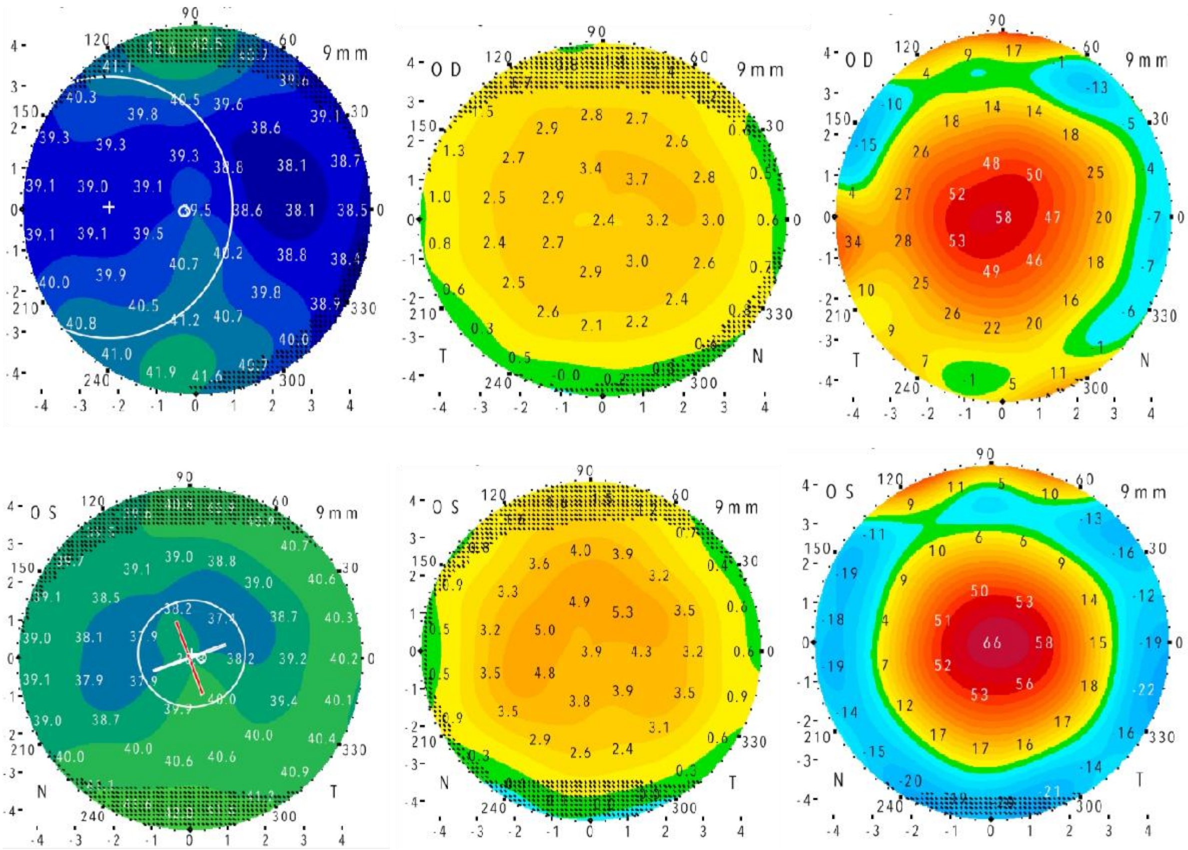

Figure 4: (A) The 3-month postoperative, anterior axial curvature map of the right eye. **(B)** The instantaneous curvature difference map of the right eye. **(C)** The pachymetry difference map of the right eye. **(D)** The 3-month postoperative, anterior axial curvature map of the left eye. **(E)** The instantaneous curvature difference map of the left eye. **(F)** The pachymetry difference map of the left eye.

Discussion

During refractive surgery, the pupil plays an important part, serving as the reference point for centration. Eye-tracking systems follow pupil movement during ablation of the corneal center. Therefore, refractive surgery may be difficult if the pupil features an abnormality. Some reports on refractive surgery for patients with corectopia have appeared. Milea and Burillon described successful photorefractive keratectomy on high myopic eyes with corectopia [6]. Liang et al. reported good results using SMILE to treat eyes with corectopia after cataract surgery [7]. However, to the best of our knowledge, this is the first use of SMILE to treat an eye with corectopia attributable to iridodialysis. It is widely accepted that centration with respect to the visual axis is key in terms of optimal visual outcomes with maintenance of functional corneal morphology after refractive surgeries [4]. Centration can occur at the pupil or corneal vertex, although the latter is not affected by the kappa angle and is closest to the ideal visual axis [8]. Several studies have reported that centration based on the corneal vertex is associated with less irregular astigmatism, and with fewer higher-order aberrations, glares, halos, and ghostings after surgery than when centration is based on the pupil center [9,10].

As the surgeon must manually perform centration during SMILE, various techniques are used for centration on the corneal vertex. These include a topographic map comparison, tear film marking, and triple marking centration methods [11]. All effectively achieve centration on the corneal vertex; however, in our present case, the topographic map comparison method using the pupil center was impossible because of the iridodialysis. As it was also important to confirm that the lenticule center lay inside the pupil, we decided to mark directly the first Purkinje image. We intraoperatively accurately marked the CLR; to this end, we placed a small LED at the center of the observation microscope. Using this method, the surgeon aligned the fixation light while looking directly at the corneal mark. The method may thus be optimal when corectopia requires very accurate centration. The decentration of the right eye was 0.12 mm, thus less than the 0.14

mm of the left eye, which lacked any pupillary abnormality, using the same surgical method, and less than the previously reported decentrations of 0.17 mm to 0.36 mm after SMILE [12]. Liang et al. used the tear film marking method when treating an eye with corectopia; the decentration was 0.46 mm, thus greater than in our case [7]. Considering that the decentration of the opposite eye lacking any pupil abnormality was 0.18 mm in work of Liang et al., it seems that there could be a difficulty in centration in the eye with corectopia using the tear film mark method. Notably, the corneal higher-order aberration decreased from 0.89 μm to 0.75 μm in the eye with corectopia after SMILE, similar to the decrease from 2.64 μm to 1.36 μm after SMILE in eyes with corectopia reported by Liang et al [7]. Higher-order aberrations generally increase after SMILE. In our case and that of Liang et al., higher-order aberrations increased in eyes without corectopia. The reason is unclear, further research is needed.

We report good results using SMILE to treat a patient with corectopia attributable to iridodialysis. However, surgery should be avoided if monocular diplopia caused by iridodialysis is evident or if the corectopia is so severe that the visual axis is obscured. In addition, CLR marking must be extremely delicate; only a tiny spot of ink is applied to the corneal epithelium.

Conclusions

Our case suggests that myopic astigmatism in patients with corectopia attributable to traumatic iridodialysis may be successfully treated with SMILE. However careful preoperative evaluation and accurate centration during surgery are essential.

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