An Unexpected Complication in Femtosecond Laser-Assisted Capsulotomy: Endothelial Hit and Cut

Femtosaniye Lazer Kapsülotomide Beklenmeyen Bir Komplikasyon: Endotel Kesisi

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ABSTRACT

Femtosecond laser–assisted cataract surgery (FLACS) has become the safer surgical intervention in creation of precise anterior capsulotomy compared to the manual capsulorhexis by ophthalmologists in the past years. Herein, we report a corneal endothelial hit and cut complication during femtosecond laser–assisted capsulotomy. During the laser procedure the suction ring lost adhesion, but the laser continued to firing causing misaligned cut at the corneal endothelial layer. The cataract surgery was performed manually and an intraocular lens was implanted without any complication. The misaligned cuts along the inner layer of the cornea were visible at the postoperative period, but there were no visual consequences. The surgeon should be cautious in this unexpected and undesired complication at all critical steps during FLACS.

Key Words: Femtosecond laser-assisted cataract surgery, FLACS capsulotomy complications, Corneal endothelial cut.

ÖZ

Femtosaniye lazer katarakt cerrahisi (FLACS), geçtiğimiz yıllarda cerrah tarafından yapılan manuel kapsüloreksis ile karşılaştırıldığında, kusursuz ön kapsülotominin oluşturulmasında daha güvenli bir cerrahi girişim haline gelmiştir. Bu olgu sunumunda femtosaniye lazer kapsülotomi sırasında korneal endotelyal kesi komplikasyonunun geliştiğini bildirmekteyiz. Lazer işlemi sırasında vakum halkası gevşedi, buna rağmen lazer atış yapmaya devam ederek ve yanlış yönlenerek kornea endotel tabakasında kesiye neden oldu. Katarakt cerrahisi manuel olarak gerçekleştirildi ve intraoküler lens komplikasyonsuz implante edildi. Korneanın iç tabakasındaki kesi hattı ameliyat sonrası dönemde görülmeye devam etse de görme keskinliğini etkilemedi. Cerrah, femtosaniye lazer kapsülotomi sırasında tüm kritik aşamalarda bu beklenmedik ve istenmeyen komplikasyona dikkat etmelidir.

Anahtar Kelimeler: Femtosaniye lazer katarakt cerrahisi, FLACS kapsülotomi komplikasyonları, Korneal endotelyal kesi.

INTRODUCTION

Femtosecond laser-assisted cataract surgery (FLACS) has become increasingly common since it was firstly introduced in 2008 with promising treatment outcomes in terms of creation of precise anterior capsulotomy, sparing of phacoemulsification energy, creation of corneal incision in desired position and size, and treatment of preoperative astigmatism. Suction break, conjunctival redness or hemorrhage, capsule tags and bridges, anterior capsule tear, capsular blockage syndrome, posterior capsule rupture, miosis, elevated intraocular pressure (IOP) are well known complications and during FLACS.[1,2]

Herein, we reported an unexpected corneal complication during FLACS capsulotomy creation with optic coherence tomography (OCT) integrated femtolaser device.

CASE REPORT

79-year-old male patient presented to our clinic with grade 3 nuclear cataract according to the LOCS III criteria. The

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routine cataract surgery by FLACS with the LensAR® laser system (LENSAR® Inc., Orlando, Florida, US) and multifocal intraocular lens (IOL) implantation was planned. Best corrected visual acuity was 3/10 according to Snellen. Other than cataract formation, IOP, anterior and posterior segment findings, including axial length (23.15 mm) and anterior chamber (AC) depth (2.69 mm) were all in normal range.

The suction ring was placed on the sclera, upon the vacuum was activated, docking procedure was completed. Than Scheimpflug system assisted scanning of the anterior segment was initiated and the treatment and safety zones were identified by the system. The capsulotomy diameter was set at 5 mm and the treatment started. As soon as the laser was fired, the suction ring adhesion to the sclera was loosened without any reason. In spite of this, the laser continued firing as planned for capsulotomy for a fraction of a second. The fluid loss at the interface caused change in OCT defined AC structures and parameters which resulted in misaligned treatment. The laser beams was misdirected to the corneal endothelium instead of the lens anterior capsule. The surgeon stopped the procedure as soon as he noticed the endothelial cut. (Figure 1 A, B)

At this step it was expected that the system must be stopped automatically, but as we understand the femtolaser we used is incapable of evaluating the AC depth parameters after changing biometry with the leakage of immersion fluid. The patient was successfully treated with manual capsulorhexis, phacoemulsification, and IOL implantation as planned. At the postoperative period, no visual complications were developed. The only consequence of this complication was the persistent endothelial incision line observed in slit lamp examination and anterior segment OCT images. (Figure 1 C, D)

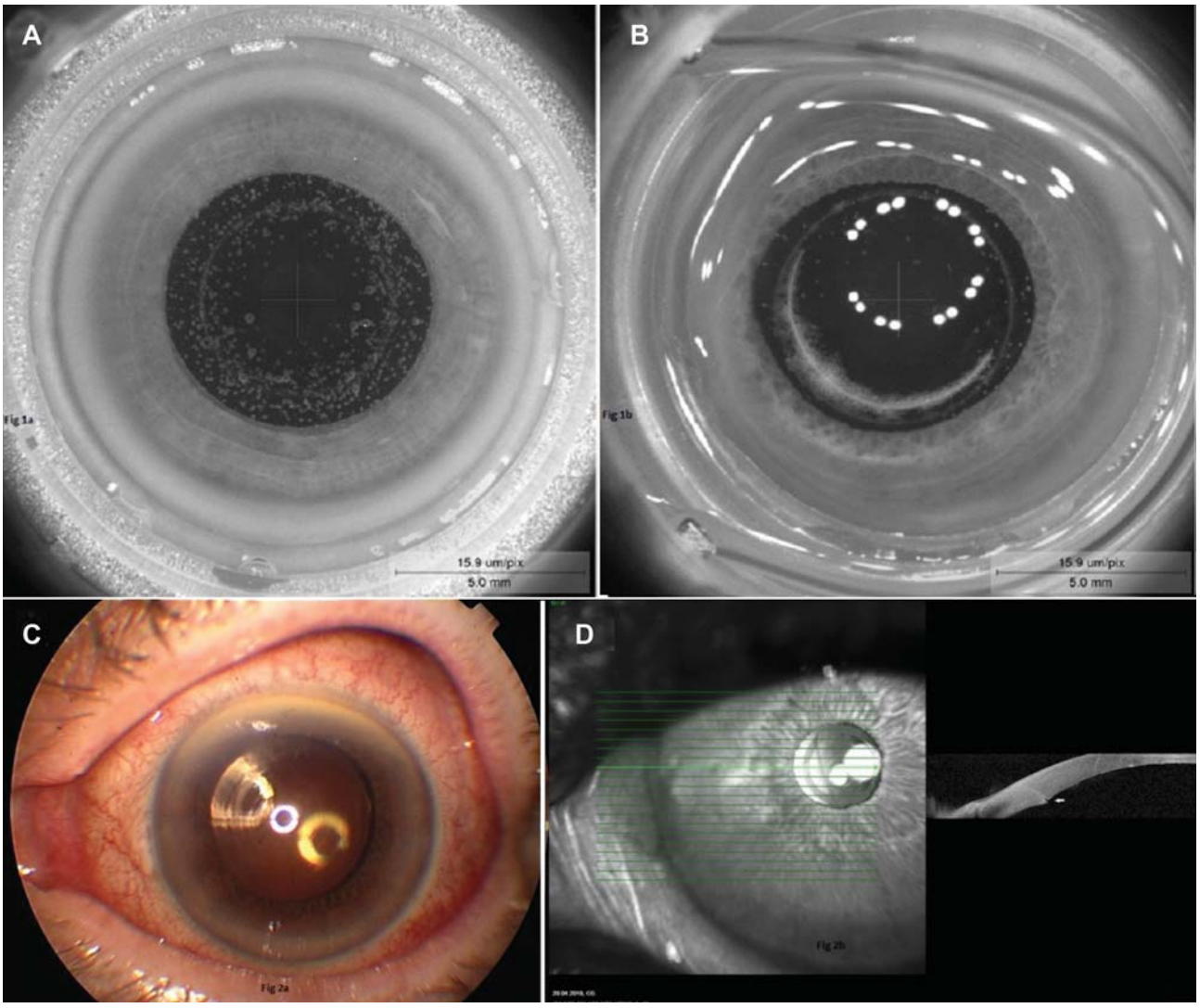

Figure 1. (A) *Normal capsulorhexis during FLACS just before nucleofracture,* **(B)** *Corneal endothelial hit and cut during FLACS stopped by the surgeon.* **(C)** *Slit lamp appearance and* **(D)** *anterior segment OCT image of the patient in postoperative period.*

CONCLUSION

Cataract is the leading cause of reversible blindness worldwide, especially in developed countries, and it can be effectively and safely treated with phacoemulsification surgery with excellent visual outcomes.[3-5] Although conventional phacoemulsification surgery provides good visual acuity and rarely causes complications, patients expectations regarding to more accurate postoperative refractive outcomes leaded to the use of femtosecond lasers in cataract surgery and FLACS has recently become popular with improved outcomes.[6] The FLACS was introduced by Naggy and this technology was used for performing anterior capsulotomy, lens fragmentation, limbal relaxing incisions and self-sealing corneal incisions.[7] FLACS capsulotomy provides the IOL is contained in the capsular bag close to the effective lens position, thus the refractive outcome of the surgery will be both precise and predictable.[8]

Although there are many advantages obtained by FLACS, the procedure is not free of complications. These are capsule tags and bridges, suction break, conjunctival redness or hemorrhage, intraoperative miosis, anterior or posterior lens capsule tear, endothelial cut, descemet membrane detachment elevated IOP, macular edema, corneal endothelial cell loss, AC hemorrhage, vitreous loss, zonular dehiscence, lens material in the vitreous and corneal abrasions. [1,2,9,10]

The endothelial cell layer cut during FLACS capsulotomy creation were reported by Naggy in 3 highly hyperopic eyes with a shallow AC with the first femtolaser which is lack of an integrated OCT system. The authors concluded that the integration of the OCT device will lead no further occurrence of this complication.[2] An integrated OCT-guided femtosecond laser system provides precise cutting of the lens anterior capsule creating continuous sharp-edged anterior capsulotomies of exact size, shape, and position.[11] The occurrence of misaligned laser hits in spite of integrated OCT systems denotes that the factors other than OCT has critical roles for perfect FLACS function. Schultz et al., reported that a fraction of second after suction loss is sufficient time for displaced laser shots.[12] The factors that could lead to suction loss are the narrow lid margin, abrupt head movement of the patient, chemotic conjunctiva or excessive pressing of the eyelids.[12]

Proper docking is the main step in FLACS treatment. There are two docking systems during FLACS with a curved contact lens interface (CCL) or a noncontact liquid optical immersion interface (LOI). Fluid-filled non-applanating patient interface docking system is integrated to reconstructed 3D view of the anterior segment FLACS technology using the LensAR® with the additional advantages over CCL like lower IOP rise, corneal folds and postoperative subconjunctival hemorrhage occurrence. It is assumed that damage to the endothelial layer can be avoided using the integrated intraoperative biometry, confocal structured Scheimpflug based OCT to the LensAR®. This OCT system that uses ray tracing for identification of ocular parameters matches the refractive index of the cornea to optimize beam targeting accuracy, and theoretically images from the anterior corneal surface to the posterior lens capsule in a single view, so no further adjustment of the treatment parameters is necessary even in the presence of lens tilt. LOI has a standard suction ring outside the limbus, so anatomical variations like palpebral fissure width could limit accommodation of the ring.[2,12-14]

We reported an inadvertent, unexpected complication, the suction loss encountered during FLACS which was resulted in undesirable hit and cuts in untargeted anatomical structures by biometrical changes. Although, higher predictability and precisely determination the distances to, and dimensions of, structures to be treated by the FLACS, surgeon must control all critical steps for uncomplicated surgery.

List of abbreviations:

Anterior chamber: AC

Curved contact lens interface: CCL

Femtosecond laser-assisted cataract surgery: FLACS

Intraocular pressure: IOP

Liquid optical immersion interface: LOI

Optic coherence tomography: OCT

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