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Case report

Femtosecond laser-assisted cataract surgery in a patient with posterior chamber phakic intraocular lens

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ABSTRACT

We describe a case of modified femtosecond laser settings for cataract extraction in a patient with a posterior chamber phakic intraocular lens (PIOL), to avoid incomplete treatment patterns and treatment displacement. Modification of laser settings (increased depth for the capsulotomy, increased vertical spot spacing for the capsulotomy and increased anterior and posterior capsule safety margins for lens fragmentation) seems to make femtosecond laser-assisted cataract surgery feasible in patients with posterior chamber PIOLs, as complete treatment patterns are achieved.

1. Introduction

The femtosecond laser platforms utilize imaging and software technologies in order to create a three dimensional reconstruction of the cornea and the crystalline lens [1]. After image acquisition, the treatment plan is overlaid on the three dimensional reconstruction and the surgeon may customize the corneal incisions, capsulotomy and lens fragmentation pattern [1]. After image acquisition and treatment planning, laser delivery occurs; the femtosecond laser energy is absorbed by the ocular tissues (cornea, crystalline lens and capsular bag), resulting in plasma formation. This plasma of free electrons and ionized molecules rapidly expands, creating cavitation bubbles [1]. The force of the cavitation bubble creation separates the tissue through a process known as photodisruption [1] and the resultant gas is disseminated into the anterior chamber.

The presence of a posterior chamber phakic intraocular lens (PIOL) could affect both imaging and laser delivery during femtosecond laser-assisted cataract surgery (FLACS), because of a change in the refractive index introduced by the PIOL or due to its high refractive power [2]. Furthermore, the PIOL could block gas diffusion in the anterior chamber, with subsequent accumulation of gas bubbles beneath it and gas interference with laser delivery leading to possible incomplete treatment patterns.

We describe modified laser settings in a patient with PIOL undergoing femtosecond laser assisted cataract surgery (FLACS), to avoid gas accumulation beneath the PIOL and possible treatment displacement in order to achieve complete treatment patterns and increase the safety of the procedure.

2. Materials and methods

2.1. Case report

A 69-year-old male presented to our institute complaining of decreased vision in both eyes. The patient had history of bilateral implantation of posterior chamber PIOLs, to correct high myopia eight years prior to presentation (The Visian® ICL, STAAR Surgical Company, Ca, USA). The patient's uncorrected distance visual acuity (UDVA) at presentation was 20/40 in both eyes; while the corrected distance visual acuity (CDVA) was 20/25 in both eyes with a manifest refraction of -1.25sph $+ 0.75$cyl $\times$ 2 (right eye) and -1.25sph $+ 0.75$cyl $\times$ 10 (left eye). Corneal topography keratometric (K) values of the right eye were K steep 43.89 @ 86° and K flat 42.48 @ 176° corneal cylinder of 1.41 @ 86°. Slit lamp

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examination revealed the presence of posterior chamber PIOLs, peripheral iridotomies (placed at 10 and 1 o'clock) and posterior subcapsular cataracts in both eyes; the PIOLs in both eyes were not in contact with the crystalline lenses, demonstrating a normal vault depth. The patient was informed about the risks and benefits of the procedure and after obtaining an informed consent, the patient was scheduled to undergo FLACS (Catalys platform, Abbott Medical Optics, Santa Ana, California, USA) for the right eye first, using the modified laser settings as described above.

3. Theory

The manufacturer recommended laser settings for FLACS for the Catalys platform include capsulotomy treatment height of 600 μm and vertical spot spacing 10 μm. With respect to lens fragmentation, the safety margin is 500 μm from the anterior and posterior lens capsule. The presence of an optical material between the imaging source and the targeted tissue could possibly cause inaccuracies of the lens dimensions and important crystalline lens structures (lens thickness, anterior and posterior capsule) due to its high refractive power [2]. Furthermore, the change in the refractive index and the high refractive power of the PIOL could also affect the laser beam focus position [2]. Thereby, the presence of a PIOL could result in treatment displacement and could lead to complications. Gas accumulation beneath the PIOL is another concern which could potentially block laser delivery, resulting in incomplete treatment patterns.

Taking these factors into consideration we performed FLACS after modifying 3 laser settings, aiming for accurate laser delivery and minimal gas release. We increased the capsulotomy treatment height to 800 μm (from the standard 600 μm) and we also increased the vertical spot spacing by a factor of two (from the standard 10 μm–20 μm) (aiming for a 33% decrease of laser spots when compared to the standard settings and less gas formation) (Video 1). Treatment height was increased in order to compensate for possible laser focus displacement and to achieve a complete capsulotomy treatment. Finally, we increased safety margins from the anterior and posterior capsule to 1000 μm (from the standard 500 μm) for lens fragmentation, to compensate for possible laser focus displacement that could violate the lens capsule (Video 1). The crystalline lens fragmentation pattern included, segmentation in 4 quadrants using a cross pattern and softening using a grid pattern (cubes) (Video 1).

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4. Results

The treatment patterns were complete for both capsulotomy and lens fragmentation. Extraction of the PIOL along with phacoemulsification and intracapsular implantation of a toric intraocular lens was achieved without any complications in our patient. One month after FLACS the UDVA of the right eye was 20/25, while CDVA of the right eye was $20/25^{+}$ (manifest refraction: -0.25sph + 0.75cyl × 10); no late postoperative complications were evident.

5. Discussion

Femtosecond (FS) laser technology advancements and its integration with high-resolution anterior segment imaging have led to evolution of FLACS [3]. FS lasers are used in performing various steps of the cataract procedure as a pre-treatment to traditional phacoemulsification, including clear corneal incisions, arcuate keratotomies, anterior capsulotomies and phacofragmentation. The limitations of utilizing FS technology in cataract surgery may be categorized into inability to either achieve anterior segment imaging (due to corneal opacities and small pupils [4]) and/or FS laser delivery (corneal opacities) [5].

Even though, there is no available literature about FLACS in patients with posterior chamber PIOLs, there have been anecdotal reports about cases with excessive gas accumulation beneath the PIOL that blocked laser delivery and resulted in incomplete capsulotomy treatment patterns (Video 2). Furthermore, there have been concerns about image acquisition and laser delivery, when a refractive material is placed between the laser and imaging sources and the targeted tissue [2].

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Taking in account the above, we modified the laser settings in our patient with the rationale to minimize gas accumulation under the PIOL that could block complete lasing of the capsule. Furthermore, we increased the safety margins for crystalline lens fragmentation to compensate possible laser focus displacement anteriorly or posteriorly that could violate the lens capsule [5]. This approach was selected to increase treatment safety and avoid possible complications.

The suggested method may not be optimal and it is not certain that the laser modifications of the routine settings are actually necessary. Furthermore, we cannot comment about the optimal settings required for other laser platforms. In conclusion, FLACS seems feasible in patients with posterior chamber PIOL. Concerns for imaging acquisition and laser delivery should be studied in the future in order to optimally modify FLACS settings if necessary.

6. Conclusions

In conclusion, FLACS seems feasible in patients with posterior chamber PIOL. Concerns for imaging acquisition and laser delivery should be studied in the future in order to optimally modify FLACS settings if necessary.

Conflict of interest

None declared.

References

[1] K.E. Donaldson, R. Braga-Mele, F. Cabot, R. Davidson, D.K. Dhaliwal, R. Hamilton, M. Jackson, L. Patterson, K. Stonecipher, S.H. Yoo, ASCRS refractive cataract surgery subcommittee. Femtosecond laser-assisted cataract surgery, J. Cataract Refract. Surg. 39 (2013) 1753–1763.
[2] C.P. de Freitas, F. Cabot, F. Manns, W. Culbertson, S.H. Yoo, J.M. Parel, Calculation of ophthalmic viscoelastic device-induced focus shift during femtosecond laser-assisted cataract surgery, Investig. Ophthalmol. Vis. Sci. 56 (2015) 1222–1227.
[3] D.V. Palanker, M.S. Blumenkranz, D. Andersen, M. Wiltberger, G. Marcellino, P. Gooding, D. Angeley, G. Schuele, B. Woodley, M. Simoneau, N.J. Friedman, B. Seibel, J. Batlle, R. Feliz, J. Talamo, W. Culbertson, Femtosecond laser-assisted cataract surgery with integrated optical coherence tomography, Sci. Transl. Med. 17 (2010), 58ra85.
[4] V.P. Kankariya, V.F. Diakonis, S.H. Yoo, G.D. Kymionis, W.W. Culbertson, Management of small pupils in femtosecond-assisted cataract surgery pretreatment, Ophthalmology 120 (2013) 2359–2360.
[5] L. He, K. Sheehy, W. Culbertson, Femtosecond laser-assisted cataract surgery, Curr. Opin. Ophthalmol. 22 (2011) 43–52.