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Management of Intraoperative Issues and Frequency of their Occurrence during Femtolaser-Assisted LASIK using The Wavelight® FS200 Laser

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Introduction

Beyond dispute, currently femtolaser-assisted LASIK is leader among all sorts of vision laser correction. For last 15th years since beginning of clinical setting of femtosecond lasers for flap creation it has been changed 5th generations of this machines, which differ each other by various technical parameters and characteristics[1]. In particularly, it is pulse energy that has been increased from 15 kHz (in 2002) until 200 kHz to 2010, etc.

Accordingly to data of multiple clinical researches there are most mentioned intraoperative complications and issues are OBL, eye anterior chamber bubbles, suction loss and vertical gas breakthrough. All of indicated above complications periodically occur in routine practice of any refractive surgeon, regardless of model and generation of femtolaser which using at the current time.

Methods

The charts of consecutive eyes that underwent femtolaser-assisted LASIK from May 2015 (it's onset date of clinical usage of femtolaser WaveLight® FS200 in our department) through December 2016 were retrospectively reviewed and analyzed. The pre- and intraoperative data, outcomes, frequency of occurrence and management features were described in subject developing opaque bubble layer, bubbles into eye anterior chamber, suction loss, vertical gas breakthrough during femtolaser-assisted flap creation procedure [1-7] (Table 1).

Opaque bubble layer

This intraoperative feature is most common issue which observed during femtolaser flap creation regardless of used model of femtolaser, their constructive properties and technical advantages [2]. Particularly, such one of them is creation of venting dissection corridor provided by the WaveLight® FS200 immediately after docking procedure within the hinge area [3]. The square and position of OBL occurrence within flap can be different in each case. The flap lifting process has been conducted by movement of the spatula (for Femto LASIK) from a hinge to lower edge of the flap without some difficulties anywhere within the flap area. We have received none of case of difficult flap lifting, formation an irregular stromal bed and flap tears in process of the management and also any issues which related with usage of eye tracking system of WaveLight® EX500 laser. The healing process was unremarkable (Figure 1 and Table 2).

Anterior chamber bubbles

The anterior chamber bubbles phenomenon was occurred in four patients (4 eyes, 1.46% from total amount of executed eyes). We postponed the stage of laser ablation on the next day in one case due to moderate anxious behavior of the patient. However, we performed the laser ablation without eye tracker in other three cases at the same day.

The anterior chamber gas bubbles were always noted closer to the end of the flap creation process. The venting canal of the flap hinge had been functioning in all four cases.

Following the registration the first incident of anterior chamber gas bubbles it was discussed with clinical experts and engineers of the company-manufacturer. After that, it was decided to reduce parameters of laser settings in next subjects: bed cut energy was decreased from 0.8 μJ to 0.7 μJ; both bed cut spot separation and bed cut line separation were reduced from 8.0 μm to 7.0 μm respectively. It was thought that such management would give us the opportunity to avoid or at least significantly diminished the frequency of these side effects by

reducing a gas formation during the flap creation procedure. Next case of anterior chamber bubbles which happened very quickly following the first incident and thus confirmed the insolvency of the suggested tactic.

However, in all aforemeantioned cases it has been reached the aimed level of UBVA without a loss of BCVA lines. The healing process was also uneventful (Figure 2 and Table 3).

Vertical gas break through

Only 1 case of gas vertical breakthrough was registered. That case was analyzed; and presumably the potential cause of the complication could be the existing preoperative irregularity of the corneal surface [1,5,6] (preoperative keratotopography pattern is shown above) in combination of flap thickness (entered value was 100 µJ, others setting parameters were similar like shown above). I have not postponed the flap lifting. It was made immediately after the end of docking and followed by transfer to excimer laser (criteria of choice of the management in this case was an existence of the injury's location). Once the lifting process started I began noticing a hard fixation of tissue between flap and surface of the bed. I had been gently using a crescent blade and forceps without appearance of button hole. After that corneal laser ablation was performed. The early healing process was complicated by moderate inflammation and scar formation (displayed on OCT scan). However, the visual acuity has been achieved up to the targeted level (at the1 month postoperatively) without loss of lines of BCVA (Figure 3 and Table 4).

Suction Loss

We have none of case of the complication until current time. Furthermore, I have reviewed results of the different similar researches during preparation time of my report and I found none of described case of suction loss which would happened while using of this model of femtosecond laser.

Medication Management

The early postoperative medication management (to all categories of patients) has included moxifloxacin was given by instillations during 5 days, dexamethasone (as 1% solution for instillations) which used for 2 weeks as well as eye solution of hyaluronic acid (within 1 month postoperatively).

Table 1: Femtosecond laser settings (recommended by the company-manufacturer)

Femto- and excimer lasers	Both bed cut energy and side cut energy	Both bed cut spot separation and bed cut line separation	Side cut spot separati on	Side Cut Line Separati on	Vent Canal Power	Vent Canal Width	Side Cut Angle
FS200	0.8 µJ	8.0 µm	5.0 µm	3.0 µm	0.85 µJ	1.7 mm	70°
EX 500							

Table 2: Statistical data in cases with Opaque Bubble Layer (OBL).

Total of executed eyes	596	Flap size (entered value), mm	From 9,0 to 9,6 mm	Flap thickness (entered value), µm	100; 105; 110
Incidence of OBL pattern (% to total)	129 (21,64%)	Mean docking time, Mean ± SD,sec	39,91 ± 7,807 sec P<0,05	Venting canal width entered value	1,7 mm
Women **Men**	65 37	Preop cyl, Mean ± SD	-0,89D ± 1,03D (From 5,0D to +1,66D)	SE Mean ± SD	-3,62D ±2,36D (From-10,75D to +2,75D)
Age, Mean ± SD	28,42 ± 7,32 (from 17 to 53 years) P<0,005	Preop UCVA Mean ± SD	0,13 ± 0,11	Postop UCVA, mean ± SD (at the 1 month postoperatively)	0,90 ± 0,19
Mean preop keratometry Mean ± SD	43,24D ± 1,40D (from 38,5D to 47,18D) P>0,5	Preop BCVA Mean ± SD	0,91 ± 0,15	Postop BCVA, Mean ± SD (at the1 month postoperatively)	0,96 ± 0,11

Note: Statistically difference between preop BCVA and postop BCVA, preop UCVA and postop UCVA is nonsignificant (p=0,9970; p=0,9841 respectively).

Table 3: Statistical data in cases with anterior chamber bubbles.

Total amount of executed eyes	596	Flap size (entered value),mm	9,2;9,4	Flap thickness (entered value), µm	100;105
Incidence of anterior chamber bubbles	4	Mean docking time Mean ± SD,sec	35,25 ± 4,57sec	Venting canal width (entered value)	1,7 mm
Females **Males**	2 2	Mean preop cyl Mean ± SD	-0,93± 0,34D	SE, Mean ± SD	-5,27 ± 2,34D
Age, Mean ± SD	26,5 ± 8,35	Preop UCVA Mean ± SD	0,098 ± 0,073	Postop UCVA, Mean ± SD	0,9 ± 0,14
Mean preop keratometry Mean ± SD	42,36 ± 0,66D	Preop BCVA Mean ± SD	0,875 ± 0,15	Postop BCVA, Mean ± SD	0,98 ± 0,05

Table 4: Statistical data in patient with vertical gas breakthrough.

Age, years	SE	Cyl	Keratometry value, R1/R2	Preop UBVA	Postop UBVA (at 1 month postop)	Preop BCVA	Postop BCVA (at 1 month postop)
19	-7,0D	2,80 D	40,61D/43,21D	0,1	0,7	0,8	0,8

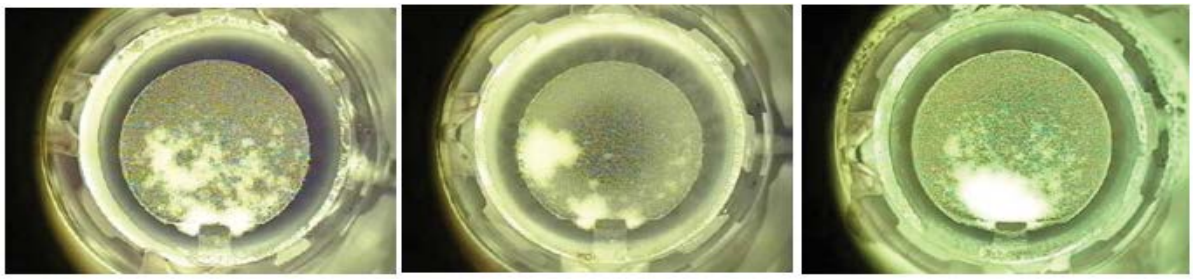

Figure 1: Opaque Bubble Layer.

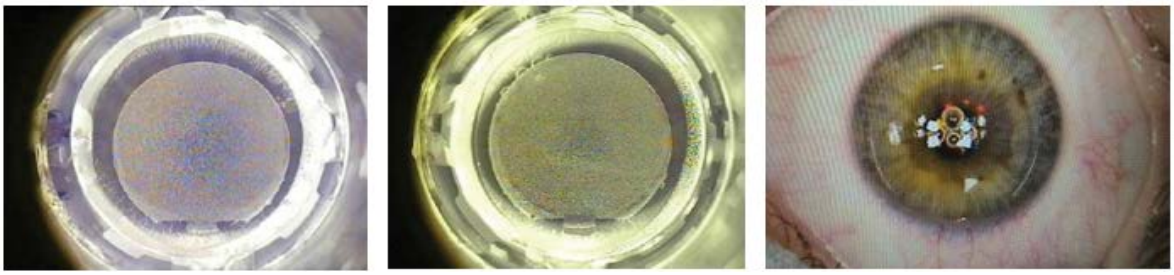

Figure 2: Anterior Chamber Bubbles.

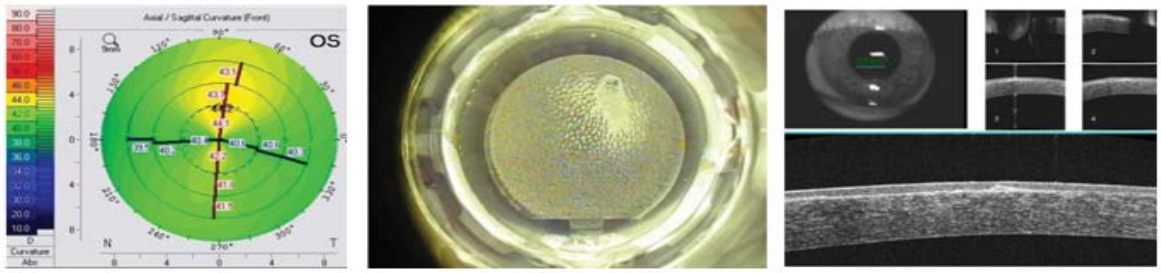

Figure 3: (from left to right): preop keratopography scan; inverted view immediately after flap creation; postop OCT scan 1 month later.

Conclusion

Currently femtolaser – assisted lasik is most predictable and precise procedure among all kinds of the laser vision correction despite existence of certain complications and issues are clearly linked with femto-assisted flap creation. However, relatively non-severe management upon complex cases allows satisfied outcomes in vast majority of incidents.

Financial disclosure

Author has no financial or proprietary interest in any material or method mentioned.

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