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Research Article

Development of the Number of Corneal Endothelial Cells Following the Femtosecond Laser-Assisted Cataract Surgery Compared to Classical Phacoemulsification

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Abstract

Purpose: To compare the effect of cataract surgery with conventional phacoemulsification and cataract surgery performed on the cornea assisted by femtolaser with the help of contactless endothelial microscope.

Patients and Methodology: In each group there were 25 eyes (25 patients) after the cataract surgery with conventional phacoemulsification and 25 eyes (25 patients) after cataract surgery performed on the cornea assisted by femtolaser with the help of contactless endothelial microscope. The number of endothelial cells was measured preoperatively, 1 day, 1 week and 1 month after the surgery.

Results: We compared the loss of endothelial cells during 3 various periods. The first day after the surgery we noticed an average decrease in the number of endothelial cells of 1.1% in the group with femtosecond laser, in the group with conventional phacoemulsification we noticed an average decrease of 3.8%. The first week after the surgery we noticed an average decrease in the number of endothelial cells of 4.5% in the group with femtosecond laser, in the group with conventional phacoemulsification we noticed on average decrease of 6.2%. One month after surgery we noticed on average decrease in the number of endothelial cells of 5.1% in the group with femtosecond laser, in the group with conventional phacoemulsification we noticed on average decrease of 9.3%. The difference between the average values in both groups was not statistically significant at any point (indication of statistically significance was value of $P < 0.05$).

Conclusion: Cataract surgery performed on the cornea assisted by femtolaser reduces trauma of the cornea and it reduces the loss of endothelial cells in comparison to conventional phacoemulsification.

Keywords: *Femtolaser; Phacoemulsification; Endothelium; Cataract*

Introduction

Cataract surgery is today one of the most commonly used surgical procedures. More than 15 million of surgeries are done worldwide each year. Modern cataract surgery is one of the most successful surgical procedures in the field of medicine as for improvement of the quality of life. The eye surgeons have still searched and seek for best surgical procedures and better technologies to improve safety and efficiency of this procedure [4]. The method of phacoemulsification has brought tremendous progress. Using of ultrasound emulsification of the core is today a method of choice. A progress that has been provided by introduction of phacoemulsification was manifested in the preoperative and postoperative period. A significant reduction of perioperative complications, shorter healing times, and even better postoperative outcomes are associated with a shorter duration of surgery, less damage and safety of the surgery. A conventional phacoemulsification performed by an experienced surgeon with perfectly executed incisions, cantered capsulorhexis, and implantation of a premium intraocular lens is now a procedure with clear and rapid effects for patients.

Refractive intraocular surgery also develops in connection with the improvement of human lens surgery. The safety and high effectiveness of the procedures leads to development of eye surgery with a clear intraocular lens in the treatment of refractive defects, in particular presbyopia. These intraocular surgeries on otherwise healthy eyes further emphasize the need to look for safer and more accurate technologies.

Lasers have been used in various fields of ophthalmology for many years. Those whose pulse is in a matter of femtoseconds are called femtoseconds. An extremely short pulse generates plasma which expands. After cooling of plasma, the cavitation bubbles are formed and tissue photodisruption occurs in their vicinity [5,7].

The entry of femtosecond laser into ophthalmic surgery has been significant in recent years. In corneal solution of refractive defects its use in flap formation and subsequent corneal ablation with excimer laser begins to be dominant. Femtolasik is now a method of choice in corneal refractive surgery and, for example, the flap-less ReLEx smile method uses only femtolaser to correct refraction. Perforating or lamellar keratoplasty, using of different corneal implants get a completely different dimension due to femtosecond laser as far as accuracy, safety and performance of the surgeon are concerned.

It is not surprising that precise incision and tissue separation performed by the photodisruptive effect of the femtosecond laser started to be used in cataract surgery. Therefore, so called, femtosecond laser assisted cataract surgery provides further possibilities how to improve this procedure. The effect of femtosecond laser is used in this method to create corneal incisions (primary, secondary, arcuate), anterior capsulotomy and fragmentation of the lens core [1,4].

Eye trauma in cataract surgery is strongly related to the intensity and duration of the used phacoemulsifying energy. Fragmentation of the core with the femtosecond laser facilitates and accelerates its removal from the eye. Saving in the used phacoenergy undoubtedly reduces per-operative load and loss of endothelial cells [2,3].

Aim of the Study

The aim of our observation is to compare the postoperative loss of endothelial cells in the group of cataract surgery with conventional phacoemulsification and in the group with femtolaser assisted surgery.

Materials and Methods

25 eyes were evaluated in each of two groups (25 patients). In all eyes we performed uncomplicated cataract surgery with implantation of the intraocular lens in the sac. All 50 patients were operated by one surgeon. The procedures were performed using the Constellation (Alcon) device, Ozil Torsional handpiece and in the femtolaser system LenSx (Alcon).

Patients with poor cooperation, pathological findings on the cornea (scars, opacities, etc.) and poor pupil dilatation were excluded from the observation.

Surgical technique - a group with conventional phacoemulsification: Under topical anaesthesia corneal incision 2.2 mm from the temporal side, 2 service paracenteses, anterior capsulorhexis with tweezers, phacoemulsification of the core, bimanual irrigation of aspiration, implantation of the foldable IOL into the sac, hydration of the paracenteses.

Surgical technique - a group with the femtolaser-assisted surgery: Under local anaesthesia docking of laser via a single-piece interface, performing of all pre-selected procedures - primary incision of the cornea 2.3mm, 2 secondary incisions, or arcuate incision, capsulotomy 4.8 - 5.0 mm, fragmentation of the core of the lens to 4 quadrants with one circular cylinder (Figure 1). Opening of the incision using a hook, phacoemulsification of the core, bimanual irrigation aspiration, implantation of a foldable IOL into the sac, hydration of paracenteses.

In all 50 eyes we measured the number of endothelial cells (cells/mm2) prior to the surgery, 1 day, 1 week and 1 month following the surgery. Measurement was performed on a contactless specular endothelial microscope EM3000 (Tomey).

Results

The monitored parameters were measured in each group in total in 25 patients. The group with femtosecond laser assisted cataract surgeries included 15 females and 10 males. The mean age was 61 ± 5 years.

The group with conventional phacoemulsification of the core included 13 females and 12 males. The mean age was 64 ± 7 years (see Table 1).

The patients were not differentiated with regard to hardness of the core. We evaluated the density of nuclear opacification using the Scheimpflug camera on the Pentacam device. The degree of core maturity varied only insignificantly in both groups (see Table 1).

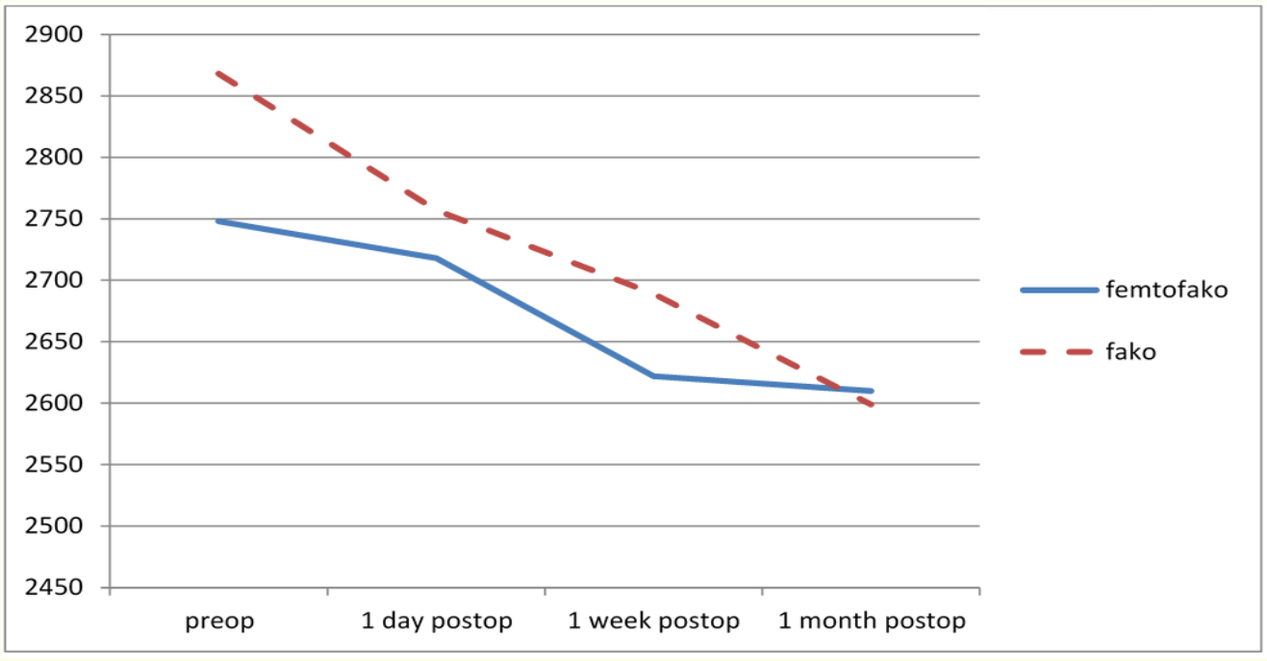
Value	Femtolaser group	Group without femtolaser
Number of endothelial cells (cells/)	2748 ± 314	2868 ± 290
ACD (mm)	2.59 ± 0.51	2.67 ± 0.39
Axial diameter of the bulb (mm)	23.8 ± 3.5	24.1 ± 2.8
Pre-operative IOP (mmHg)	15.0 ± 4. 1	16.5 ± 3.9
Core density (Pentacam)	2.12 ± 0.9	2.24 ± 1.1
Age of the patients	61 ± 5	64 ± 7

Table 1: *Parameters of the eyes in both observed groups.*

Comparison of the number of endothelial cells between 2 groups in all stated observed periods is described in table 2. Decrease in the number of cells is higher in the group with conventional phacoemulsification in all postoperative observed periods (Graph 1). The difference was not statistically significant possibly due to standard variance in the values of the number of cells in both groups. The absolute difference compared to the baseline values and the difference in the percentages in both groups are described in table 3.

Period of observation	Femtolaser	Phacoemulsification	P value
Preoperatively	2748 ± 314	2868 ± 290	> 0.05
1 day after the surgery	2718 ± 290	2757 ± 320	> 0.05
1 week after the surgery	2622 ± 278	2689 ± 367	> 0.05
1 month after the surgery	2610 ± 245	2599 ± 380	> 0.05

Table 2: *Comparison of the number of endothelial cells (cells/ in the single periods of observation.*



Graph 1: *Development of the number of endothelial cells in the defined periods of observation.*

Group	1 day after the surgery	1 week after the surgery	1 month after the surgery
Femtolaser	30 cells/ 1.1%	126 cells/	138 cells/5.1%
Phacoemulsification	111 cells/3.8%	179 cells/6.2%	269 cells/9.3%

Table 3: *Comparison of the decrease in the number of endothelial cells compared to the baseline values.*

Discussion

The post-operative corneal oedema and loss of epithelial cells are one of the most common early complications of cataract surgery. Incidence of this complication is affected by many factors such as duration of phacoemulsification, phacoenergy, density of the lens, pathology of the cornea, depth of the anterior chamber, axial diameter of the eyeball, mechanical and heat traumatization, technique of phacoemulsification, experience of a surgeon and the used type of viscoelastic material [8-12].

In our study we focused on the effect of preoperative fragmentation of the core using the femtosecond laser and the impact on the change of the number of corneal endothelial cells compared to conventional phacoemulsification. We used the system of Scheimpflug camera using the Pentacam device for determination of density of the operated lenses. It is an objective method that correlates with classification systems to determine opacification of the lens. The difference in core densities between both groups was not significant.

The effect of phacotime and phacoenergy on the post-operative loss of endothelial cells by comparison of the phaco prechop technique and the divide and conquer technique was already observed in the era of conventional phacoemulsification [13].

Our study proved that decrease in the number of endothelial cells was higher in the group with conventional phacoemulsification in all post-operative measurements.

The observation correlates with the results of the published studies which provide evidence of the effects of laser fragmentation of the core on decrease of phacoenergy, effective phacotime and decrease of the loss of endothelial cells compared to the surgeries in which the femtosecond laser is not used [6].

Bibliography

1. Kent Ch. "Laser cataract: better outcomes may follow". *Review of Ophtalmology* (2012): 54-70.
2. Nagy Z. "Intraocular femtosecond laser applications in cataract surgery". *Cataract and Refractive Surgery Today* (2009): 79-82.
3. Nagy Z., *et al*. "Initial clinical evaluation of an intraocular femtosecond laser in cataract surgery". *Journal of Refractive Surgery* 25.12 (2009): 1053-1060.
4. Probst Louis E and Clara C Chan. "Femtosecond cataract surgery a primer, USA". Slack Incoporated (2012): 1-3, 21-36.
5. Soong HK and Malta JB. "Femtosecond lasers in ophthalmology". *American Journal of Ophthalmology* 147.2 (2009): 189-197.
6. Takacs A., *et al*. "Central corneal volume and endothelial cell count following femtosecond laser-assisted refractive cataract surgery compared to conventional phacoemulsification". *Journal of Refractive Surgery* 28.6 (2012): 381-391.
7. Vogel A., *et al*. "Mechanisms of intraocular photodisruption with picoseconds and nanosecond laser pulses". *Lasers in Surgery and Medicine* 15.1 (1994): 32-43.
8. Baradaran-Rafii A., *et al*. "Effect of hydrodynamic parameters on corneal endothelial cell loss after phacoemulsification". *Journal of Cataract and Refractive Surgery* 35.4 (2009): 732-737.

9. Yeniad B., *et al*. "The effects of blunt trauma and cataract surgery on corneal endothelial cell density". *Middle East African Journal of Ophthalmology* 17.4 (2010): 354-358.

10. Richard J., *et al*. "Corneal endothelial cell loss after cataract extraction by using ultrasound phacoemulsification versus a fluid- bases system". *Cornea* 27.1 (2008): 17-21.

11. Suzuki H., *et al*. "Phacoemulsification associated corneal damage evaluated by corneal volume". *American Journal of Ophthalmology* 142.3 (2006): 5256-528.

12. Suzuki H., *et al*. "Functional evaluation of corneal endothelium by combined measurement of corneal volume alteration and cell density after phacoemulsification". *Journal of Cataract and Refractive Surgery* 33.12 (2007): 2077-2082.

13. Elnaby EA., *et al*. "Phaco prechop versus divide and conquer phacoemulsification: a prospective comparative interventional study". *Middle East African Journal of Ophthalmology* 15.3 (2008): 1323-1327.

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