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CYTOKINE PROFILE OF TEAR FLUID AFTER LASIK AND FEMTO-LASIK

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Abstract

Relevance. Excimer laser vision correction using LASIK and Femto-LASIK is one of the most common surgical procedures for ametropia. However, despite their effectiveness, corneal regeneration processes after surgery may vary significantly depending on the method of flap formation. Cytokine balance plays a key role in modulating the inflammatory response and reparative processes, which determine the clinical outcomes of surgical intervention.

Objective. To assess the levels of cytokines (IL-1 β , TNF- α , IL-4) in the tear fluid of patients after LASIK and Femto-LASIK to analyze the inflammatory response and corneal regeneration.

Materials and methods. The study included 40 patients (80 eyes) with myopia and astigmatism. Cytokine levels were measure using the ELISA method on the third day after surgery. Results. In the LASIK group, higher levels of IL-1 β and TNF- α were detected, correlating with a pronounced inflammatory response and delayed healing (p<0.05). In the Femto-LASIK group, IL-4 levels were higher, contributing to faster corneal recovery.

Conclusions. Femto-LASIK is associated with a lower inflammatory response and accelerated epithelialization compared to LASIK, confirming its advantages in the postoperative period.

Keywords: LASIK, Femto-LASIK, cytokines, inflammation, cornea, tear fluid.





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Introduction

The relevance of the study is due to the wide use of excimer laser surgeries, such as LASIK and Femto-LASIK, in modern refractive surgery aimed at correcting ametropia. Despite their high efficiency and predictability, corneal tissue healing processes remain a complex biological mechanism that depends on many factors, including molecular and cellular regulatory systems [1,5,9,12]. In this context, the study of the role of cytokines, which act as key mediators of inflammation and regeneration, is of particular importance [2,6].

Pro-inflammatory cytokines such as IL-1 β and TNF- α initiate an inflammatory response, stimulate cell migration and tissue repair processes, but their overexpression can lead to an increased inflammatory response, cell apoptosis, and epithelialization disorders, which increases the risk of postoperative complications [8]. At the same time, anti-inflammatory cytokines, in particular IL-4, help reduce the inflammatory response, activate regeneration mechanisms and improve the restoration of nerve endings. The balance between pro- and anti-inflammatory cytokines plays a decisive role in ensuring an adequate course of regenerative processes after laser vision correction [3,4,10].

Recently, special attention has been paid to the comparison of LASIK and Femto-LASIK in terms of their effect on the biochemical parameters of lacrimal fluid, since the use of a femtosecond laser in the formation of a corneal flap is associated with less tissue trauma and, presumably, a less pronounced inflammatory response. However, the question of the comparative dynamics of cytokines in the lacrimal fluid in patients after these types of interventions remains insufficiently studied [7,11]. This study will expand the understanding of the mechanisms of corneal regeneration after LASIK and Femto-LASIK, identify differences in the cytokine profile, determine the severity of the inflammatory response and assess the impact of corneal flap formation methods on healing processes. The data obtained can contribute to the development of new approaches to individualizing postoperative patient management, improving the quality of rehabilitation and reducing the risk of inflammatory complications.

The aim of the study was to evaluate the level of cytokines IL-1 β , TNF- α and IL-4 in the lacrimal fluid in patients after LASIK and Femto-LASIK to analyze the inflammatory response and regenerative processes of the cornea, identify differences between correction methods and optimize postoperative management.

Materials and methods of research

The study was prospective and included 40 patients (80 eyes) with mild to moderate myopia and complex myopic astigmatism, who underwent excimer laser vision correction between June and August 2022 at the Department of Ophthalmology of the Innovation Clinic of Dr. Maksudova (DMC). The distribution of patients by gender was as follows: men – 17 (39.5%), women – 23 (60.4%). The age of the patients ranged from 19 to 28 years, with a mean age of 23.9 ± 1.8 years. Depending on the method of corneal flap formation, the patients were divided into two groups: the main group (n=20, 40 eyes), in which Femto-LASIK surgery was performed with flap formation with the Wavelight FS 200 femtosecond laser (Alconlab, USA) at a programmed thickness of 110





 μ m, and the comparison group (n=20, 40 eyes), in which the LASIK method using the Evolution 3E microkeratome with a 130 μ m head was used (MORIA SA, France).

Tear fluid was taken on the 3rd day after surgery in the morning without stimulation of lacrimal production. To analyze the concentration of cytokines, a biochemical study of the level of IL-1 β , TNF- α and IL-4 was carried out by enzyme-linked immunosorbent assay (ELISA). Surgical interventions were performed under local anesthesia with a 0.5% alkaine solution, using the Wavelight EX 500 excimer laser (Alconlab, USA) under the "Wavefront optimized" program.

Statistical processing of data was carried out using descriptive statistics methods. To assess the differences between the groups, the Student's test (t-test) was used for independent samples. The statistical significance of the differences between the mean values of the indicators was considered significant at p<0.05.

Results of the study

In the course of the study, a comparative analysis of the levels of pro-inflammatory (IL-1 β , TNF- α) and anti-inflammatory (IL-4) cytokines in the lacrimal fluid of patients on the 3rd day after LASIK and Femto-LASIK surgery was carried out. The data obtained made it possible to identify the features of the inflammatory response and regenerative processes in the cornea, depending on the method of corneal flap formation.

IL-1 β is a key pro-inflammatory cytokine that activates the immune response and regulates tissue repair processes. According to the results of the study, in the study group (Femto-LASIK), the detection rate of IL-1 β was 80%, while in the comparison group (LASIK), this cytokine was found in 90% of tear fluid samples. Mean IL-1 β concentrations were statistically significantly higher in the LASIK control group (p<0.05), suggesting a more pronounced inflammatory response when using a microkeratome to form a flap. It is important to note that in the control group (healthy patients), IL-1 β was detected only in 25% of cases, which confirms its role in the development of the inflammatory process after surgery.

α tumor necrosis factor (TNF-α) is a pro-inflammatory cytokine and plays an important role in the mechanisms of inflammation and apoptosis. The incidence of detection of TNF-α in lacrimal fluid was 75% in the study group (Femto-LASIK) and 95% in the comparison group (LASIK). The mean concentration of TNF-α was significantly higher (p<0.05) in the comparison group, which confirms a more pronounced inflammatory response after LASIK compared to Femto-LASIK. In the control group, TNF-α was detected in only 25% of the samples, indicating its activation in response to surgical trauma. The findings suggest a milder inflammatory response when using a femtosecond laser.

IL-4 is a key anti-inflammatory cytokine that suppresses the inflammatory response and promotes tissue repair. Analysis of the concentration of IL-4 showed that in the study group (Femto-LASIK) the frequency of its detection was 95%, in the comparison group (LASIK) – 75%. The average concentration of IL-4 was the highest in the Femto-LASIK group, which indicates the predominance of anti-inflammatory mechanisms and a more favorable course of regeneration. In the control group, IL-4 was detected in only 10% of cases, which confirms its participation in recovery processes.

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Based on the data obtained, it can be concluded that there is a more pronounced inflammatory response after LASIK, which is confirmed by higher levels of IL-1 β and TNF- α . At the same time, in the Femto-LASIK group, the level of these cytokines was significantly lower, which correlated with a higher level of anti-inflammatory IL-4, which provides faster regeneration of corneal tissues.

In addition, the analysis of the terms of corneal recovery in patients of both groups was carried out. Table 1 shows the average values of the key parameters of the postoperative period.

Table 1

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Comparative dynamics of corneal reconstruction in patients after LASIK and Femto-LASIK

Parameter	Basic group (Femto- LASIK)	Comparison Group (LASIK)
Pain relief time, hours	2,4±0,4	3,6±0,5
Epithelialization completion time, hours	3,5±0,3	4,3±0,4
Refractive Topographic Recovery Time (RTSP), days	10,2±1,2	14,4±1,3

As can be seen from the presented data, the time of pain relief, completion of epithelialization and corneal repair was significantly shorter in the Femto-LASIK group compared to LASIK (p<0.05). This indicates that the femtosecond laser is less traumatic and the regenerative process is more favorable.

The results obtained confirm that the method of forming the corneal flap has a significant impact on the intensity of the inflammatory response and the rate of corneal recovery after surgery. The higher activity of pro-inflammatory cytokines (IL-1 β , TNF- α) after LASIK may be due to the mechanical action of the microkeratome, whereas the use of a femtosecond laser in the Femto-LASIK method provides a lower degree of tissue damage, resulting in a more moderate inflammatory response and faster healing.

The revealed differences in the cytokine profile are also clinically significant: increased levels of IL-1 β and TNF- α may be associated with delayed epithelialization, increased pain, and the risk of postoperative complications such as diffuse lamellar keratitis (DLK), epitheliopathy, and subepithelial fibrosis. At the same time, the high concentration of IL-4 after Femto-LASIK contributes to more effective tissue repair, reducing the likelihood of adverse outcomes.

Conclusion

The results of the study confirmed that the level of pro-inflammatory (IL-1 β , TNF- α) and antiinflammatory (IL-4) cytokines in the lacrimal fluid in patients after excimer laser vision correction directly depends on the method of formation of the corneal flap. It has been established that after LASIK there is a more pronounced inflammatory response, accompanied by increased levels of IL-1 β and TNF- α , which may be associated with delayed healing of corneal tissue, increased duration of pain syndrome and potential risk of postoperative complications. In the Femto-LASIK group, there was a significant decrease in the concentration of pro-inflammatory cytokines and a





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significant increase in the level of IL-4, which correlated with less inflammation, faster completion of epithelialization, and a decrease in pain in the early postoperative period.

A comparative analysis of corneal recovery indicators showed that the time of pain relief, completion of epithelialization, and restoration of refractive topographic parameters was significantly shorter after Femto-LASIK compared to LASIK (p<0.05), which confirms a more favorable course of regenerative processes when using a femtosecond laser. This is due to the fact that the mechanical action of the microkeratome in LASIK causes more significant trauma to the corneal tissues, which leads to an increased inflammatory response. In contrast, a femtosecond laser provides a more uniform and atraumatic incision, which helps to reduce inflammation, accelerate repair processes, and reduce the risk of complications.

Thus, the data obtained confirm that the method of corneal flap formation has a significant impact on the intensity of the inflammatory response and the dynamics of healing after excimer laser vision correction. The use of Femto-LASIK is associated with a lower inflammatory response, faster recovery of the corneal epithelium and better rehabilitation of patients, which makes this method preferable in clinical practice to ensure minimal trauma and optimal postoperative course. The results of the study can be used to optimize postoperative patient management, develop personalized strategies for drug support, and develop new approaches to controlling the inflammatory response aimed at accelerating regeneration and reducing the risk of complications after LASIK and Femto-LASIK.

Findings

After LASIK, there is a more pronounced inflammatory response, as evidenced by higher levels of IL-1 β and TNF- α in the tear fluid.

After Femto-LASIK, the concentration of pro-inflammatory cytokines was significantly lower, and the level of anti-inflammatory IL-4 was higher, which indicates less trauma of the method and more favorable healing of the cornea.

Clinical indicators (time to relieve pain, complete epithelialization and repair of the cornea) confirm the advantages of Femto-LASIK over LASIK in terms of the speed of regeneration and the severity of the inflammatory process.

Thus, the results of the study confirm that the use of Femto-LASIK is associated with less pronounced inflammation and faster corneal recovery compared to LASIK, which makes this method the preferred choice for patients requiring minimal trauma and a quick rehabilitation period.

References

- Arifovna, Bakhritdinova Fazilat, et al. "Biochemical evaluation of the efficacy of complex treatment of eye burn." International Journal of Medical Sciences And Clinical Research 3.01 (2023): 33-37.
- 2. Bakhritdinova, F. A., et al. "The assessment of lacrimal film condition in patients with dry eye syndrome during therapy." Russian ophthalmological journal 12.4 (2019): 13-18.
- 3. Bakhritdinova, Fazilat A., et al. "Reparative and antioxidant therapy of chemical eye burns." Russian Ophthalmological Journal 14.4 (2021): 31-37.

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- Bashir ZS, Ali MH, Anwar A, Ayub MH, Butt NH. Femto-lasik: The recent innovation in laser assisted refractive surgery. J Pak Med Assoc. 2017 Apr; 67(4):609-615.
- Moshirfar M, Jehangir N, Fenzl CR, McCaughey M. LASIK Enhancement: Clinical and Surgical Management. J Refract Surg. 2017 Feb 1; 33(2):116-127. doi: 10.3928/1081597X-20161202-01.
- Perez-Straziota C, Randleman JB. Femtosecond-assisted LASIK: Complications and Management. Int Ophthalmol Clin. 2016 Spring; 56(2):59-66. doi: 10.1097/IIO.00000000000105. PMID: 26938338.
- Shah R. History and Results; Indications and Contraindications of SMILE Compared With LASIK. Asia Pac J Ophthalmol (Phila). 2019 Sep-Oct; 8(5):371-376. doi: 10.1097/01.APO.0000580132.98159.fa. PMID: 31567264;
- Toda I. Dry Eye After LASIK. Invest Ophthalmol Vis Sci. 2018 Nov 1; 59(14):DES109-DES115. doi: 10.1167/iovs.17-23538.
- 9. Tse SM, Farley ND, Tomasko KR, Amin SR. Intraoperative LASIK Complications. Int Ophthalmol Clin. 2016 Spring; 56(2):47-57. doi: 10.1097/IIO.00000000000110.
- 10. Venugopal A, Ghorpade AS, Ravindran M. Post LASIK interface infection: What NEXT? Indian J Ophthalmol. 2023 Nov; 71(11):3446. doi: 10.4103/IJO. IJO_6_23.
- 11. Wilson SE. Biology of keratorefractive surgery- PRK, PTK, LASIK, SMILE, inlays and other refractive procedures. Exp Eye Res. 2020 Sep;198:108136. doi: 10.1016/j.exer.2020.108136.
- 12. Woreta FA, Davis GW, Bower KS. LASIK and surface ablation in corneal dystrophies. Surv Ophthalmol. 2015 Mar-Apr; 60(2):115-22. doi: 10.1016/j.survophthal.2014.08.003.

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