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Features of The Ocular Surface Condition After Keratorefractive Surgery in Patients Previously Using Orthokeratological Lenses

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Abstract: Relevance. Myopia and myopic astigmatism remain among the most common refractive disorders in young patients. At the same time, the effect of previous orthokeratological lens wear on the ocular surface after keratorefractive surgery has not been sufficiently studied. Aim. To perform a comparative assessment of the ocular surface condition and the clinical and functional outcomes of keratorefractive surgery in patients with myopia and myopic astigmatism who had previously used orthokeratological lenses. Materials and methods. The study included 20 patients, 20 eyes, with anisometropia, mild myopia, and myopic astigmatism, with emmetropia in the fellow eye. All patients had used overnight orthokeratological lenses for up to 2 years before surgery. After standard and special ophthalmic examinations, the patients were divided into 2 groups. In group 1, LASIK was performed. In group 2, Femto-LASIK was performed. Before surgery and during the postoperative period, the Schirmer test, TFBUT, OSDI index, and axial eye length were assessed. Results. It was found that before surgery the groups were comparable in the main clinical and instrumental parameters. After LASIK, more pronounced ocular surface changes were observed, including reduced tear production, decreased tear film stability, and increased subjective complaints. After Femto-LASIK, the objective parameters remained more stable, although the OSDI index also increased. In patients who had previously used orthokeratological lenses, the axial eye length remained almost unchanged 6 months after surgery. Conclusion. Keratorefractive surgery in patients who had previously worn orthokeratological lenses is effective and predictable. Femto-LASIK has a gentler effect on the ocular surface compared with LASIK.

Keywords: Myopia, myopic astigmatism, orthokeratological lenses, keratorefractive surgery, LASIK, Femto-LASIK, ocular surface, dry eye syndrome.

Introduction: Myopia and myopic astigmatism remain among the most common refractive errors today and continue to be increasingly common, especially among young people. This trend makes the problem not only clinically significant but also socially important, as vision loss impacts patients' quality of life, academic performance, and professional capabilities [1,5,9].

Particular attention to myopia is also due to the fact that its progression, especially in more severe forms, increases the risk of changes in the retina and other ocular structures, which can lead to persistent deterioration of visual function [2,8]. Therefore, ophthalmology today is focused not only on correcting existing refractive errors but also on finding approaches to stabilize the process and ensure safe functional outcomes in the future [3].

In recent years, orthokeratology lenses have become an important part of myopia management, particularly in children and adolescents. Their use allows for the temporary discontinuation of glasses and soft contact lenses and promotes refractive stabilization. This is especially important for patients who are considered candidates for keratorefractive surgery [4,10,11].

However, the extent to which previous orthokeratology lens wear can influence corneal condition and the clinical and functional results of excimer laser correction remains understudied. Therefore, assessing the corneal surface condition after keratorefractive procedures in patients who previously wore orthokeratology lenses is of clear practical interest and requires separate analysis [6,7].

Study Objective:

To conduct a comparative assessment of corneal surface condition and the clinical and functional results of keratorefractive surgery in patients with myopia and myopic astigmatism who previously wore orthokeratology lenses.

METHODS

The study was conducted at the innovative DMC Clinic. Twenty patients (20 eyes) with anisometropia, mild myopia, and myopic astigmatism were observed, with emmetropia remaining in the fellow eye. All patients had been wearing orthokeratology lenses in night mode for up to two years prior to surgery. The study included individuals with stable myopia without signs of progression for one year, a central corneal thickness of at least 490 µm, and no corneal pathologies or chronic inflammatory eye diseases. The subjects were aged 18 to 20 years, including 11 women and 9 men. Patients discontinued orthokeratology lens wear for two months before surgery. All patients underwent a standard and specialized ophthalmological examination. It included visometry, corneal topography, A-scan, corneal optical coherence tomography, B-scan, Schirmer's test, and Norn's test. Keratotopography was performed on a WaveLight Oculyzer II, A-scan on a Tomey OA-2000, and corneal optical coherence tomography on an Optopol Revo. Patients were divided into two groups. Group 1 included patients who underwent excimer laser correction using the LASIK technique. Group 2 included patients who underwent Femto-LASIK. In Group 1, the corneal flap was created using an Evolution 3E microkeratome with a 90-µm head manufactured by MORIA SA, France. In Group 2, the flap was created using a WaveLight FS 200 femtosecond laser (Alcon, USA) with a programmed thickness of 100 µm. Postoperative outcomes were assessed at the following follow-up points: 1 day, 7 days, 1 month, and 6 months after surgery. The OSDI scale, Schirmer's test, and Norn's test were used to assess the condition of the corneal interface and the severity of dry eye syndrome. Additionally, the axial length of the eye was determined preoperatively and 6 months after the procedure to assess the stability of the result.

RESULTS

According to Table 1, both study groups were generally comparable preoperatively in terms of key clinical and instrumental parameters. This allows them to be considered sufficiently homogeneous for subsequent comparison of LASIK and Femto-LASIK results. No significant baseline imbalance was observed between the groups.

The spherical equivalent in the LASIK group was -2.85 ± 0.8 D, while in the Femto-LASIK group it was -2.67 ± 0.5 D. This indicates similar degrees of myopic refraction in the patients examined. The cylindrical component was also similar, amounting to -1.56 ± 0.4 D and -1.39 ± 0.6 D, respectively. Consequently, the severity of the astigmatic component was approximately the same in both groups.

Table 1.

General clinical and instrumental characteristics of the groups preoperatively (M ± δ)

Indicator	**LASIK, n=10**	**Femto-LASIK, n=10**
Spherical equivalent, diopters	-2,85±0,8	-2,67±0,5
Cylindrical component, diopters	-1,56±0,4	-1,39±0,6
Axial length of the eye, mm	24,99±0,09	25,01±0,08
Keratometry K1, diopters	43,4±0,7	43,0±0,8
Keratometry K2, diopters	46,2±0,8	45,8±0,7
Central corneal thickness, µm	537,4±8,1	528,0±7,2

The axial length of the eye showed virtually no difference. It was 24.99±0.09 mm in the LASIK group and 25.01±0.08 mm in the Femto-LASIK group. These values confirm the similarity in the anatomical characteristics of the eyeball in patients in both groups. A similar pattern was observed in the analysis of keratometric parameters. K1 values were 43.4±0.7 D in the LASIK group and 43.0±0.8 D in the Femto-LASIK group, while K2 values were 46.2±0.8 D and 45.8±0.7 D, respectively. This indicates comparable anterior corneal surface condition before surgery.

The central corneal thickness in both groups remained within limits sufficient for planning keratorefractive surgery. In the LASIK group, this indicator was slightly higher, at 537.4±8.1 µm, while in the Femto-LASIK group, it was 528.0±7.2 µm. However, even accounting for this difference, the overall baseline structure of corneal parameters remained similar.

Table 2.

Dynamics of ocular surface parameters after keratorefractive surgery in the LASIK group (M±δ)

Parameter	Before surgery	After 1 month	After 6 months
Schirmer’s test	14,8±0,08	12,9±0,08*	13,9±0,09
TFBUT	19,1±0,04	16,3±0,07*	17,1±0,05
OSDI, balls	20,5±1,51	33,1±1,23*	30,2±1,55*

Note: * - statistically significant results in relation to pre-operative data (p<0.05)

Preoperative data show that the LASIK and Femto-LASIK groups were comparable in refractive, anatomical, and keratometric characteristics. This provides a reliable basis for further evaluation of postoperative results and allows for a more objective interpretation of the differences identified between treatment methods.

Table 2 shows that, following LASIK, predictable postoperative changes develop in the ocular surface, most pronounced during the first month of observation. All three indicators showed adverse changes. This indicates the development of functional tear film disorders and an increase in subjective complaints in the early postoperative period.

The Schirmer test before surgery was 14.8±0.08. After one month, it decreased to 12.9±0.08, a difference that was statistically significant at $p<0.05$. This decrease reflects a decrease in tear production after surgery. Such a change is expected after LASIK, as corneal flap formation is accompanied by a temporary disruption of innervation of the anterior corneal surface. This leads to a decrease in reflex tear secretion. After six months, the Schirmer test increased to 13.9±0.09, indicating a partial restoration of tear production. However, even with this positive change, the test did not return to baseline, suggesting that residual changes persisted in some patients.

A similar pattern was observed when assessing the TFBUT. Before surgery, this test was 19.1±0.04. After 1 month, it decreased to 16.3±0.07, with the difference also being statistically significant at $p<0.05$. This indicates a deterioration in tear film stability early after surgery. A decrease in TFBUT is of significant clinical importance, as tear film instability largely determines the occurrence of burning, dryness, visual fluctuations, and visual discomfort. After 6 months, the indicator increased to 17.1±0.05. Therefore, tear film condition partially improved over time. However, a complete return to preoperative values was not observed, confirming the continued functional vulnerability of the ocular surface even in the late period.

The OSDI index most clearly reflects the severity of postoperative discomfort. Before surgery, its value was 20.5±1.51 points. After 1 month, it increased to 33.1±1.23 points, which was statistically significant at $p<0.05$. This change indicates that subjective manifestations of dry eye after LASIK become more pronounced. During this period, patients likely more frequently reported a sensation of dryness, foreign body sensation, rapid visual fatigue, and unstable vision. After 6 months, the OSDI decreased to 30.2±1.55 points, but this indicator still remained statistically significantly higher than the baseline level. This is particularly important because, even with some recovery in objective tests, subjective discomfort may persist longer.

Considering all the indicators together, several consistent patterns emerge. First, a clear deterioration in both objective and subjective ocular surface parameters is observed as early as the first month after LASIK. Second, by the sixth month, positive dynamics are observed. This indicates a gradual restoration of tear film function and ocular surface adaptation. Third, recovery is incomplete. Some indicators remain worse than preoperative levels, especially based on patient complaints.

From a clinical perspective, these data confirm that LASIK is associated with the development of transient but significant dry eye syndrome. The first month after surgery is the most sensitive period. It is during this period that particularly careful patient monitoring and active support of the ocular surface are required. Later, the condition improves, but not everyone achieves complete normalization. Therefore, the results in the table emphasize the need not only for a technically successful surgery but also for thoughtful postoperative care aimed at stabilizing the tear film and reducing patient complaints.

The data show that after Femto-LASIK, changes in the ocular surface were milder than typically observed after mechanical flap formation. When analyzing the obtained results, it is noteworthy that objective indicators of tear production and tear film stability remained relatively stable throughout the entire observation period. At the same time, subjective patient complaints did increase after surgery, which is reflected in the OSDI index dynamics (see Table 3). The Schirmer test before surgery was 14.9 ± 0.10. After one month, the value decreased slightly to 14.0 ± 0.8, and after six months it was 14.2 ± 0.07. Despite a slight decrease compared to baseline, no significant drop in tear production was observed. Importantly, the table does not show a statistically significant difference for this parameter. This suggests that basal tear secretion generally remained fairly stable after Femto-LASIK. This finding is of practical significance, as it indicates a lesser damaging effect of the procedure on tear production mechanisms.

Table 3.

Dynamics of ocular surface parameters after keratorefractive surgery in the Femto-LASIK group (M ± δ)

Parameter	Before surgery	After 1 month	After 6 months
Schirmer's test	14,9±0,10	14,0±0,8	14,2±0,07
TFBUT	18,8±0,06	18,9±0,04	19,0±0,05
OSDI, balls	21,5±1,12	31,5±1,22*	29,1±1,25*

Note: * - statistically significant results in relation to pre-operative data (p<0.05)

The TFBUT dynamics deserve special attention. Preoperatively, the value was 18.8±0.06, after one month it was 18.9±0.04, and after six months it was 19.0±0.05. In fact, throughout the entire observation period, it not only remained stable but even showed a minimal trend toward improvement. No statistically significant adverse changes were detected. This suggests that tear film stability did not significantly deteriorate after Femto-LASIK. From a clinical perspective, this is an important result, as TFBUT reflects the functional state of the precorneal tear film and largely determines patient comfort, vision quality, and the stability of the ocular optical surface.

Against this background, the OSDI dynamics appear somewhat different. Preoperatively, the index was 21.5±1.12 points. After one month, it increased to 31.5±1.22 points, and after six months, it remained at 29.1±1.25 points. Both postoperative values were statistically significantly higher than baseline at p<0.05. This indicates that the subjective sensation of discomfort after Femto-LASIK did increase and persist even at the long-term follow-up period. However, it is important to emphasize that this increase in complaints occurred despite relatively stable objective test results. In other words, patients could experience dryness, irritation, or visual discomfort even when standard tests did not show a significant decrease in tear production or tear film breakup.

This discrepancy between objective and subjective parameters is of particular clinical interest. It demonstrates that functional test results alone cannot be relied upon in the postoperative period. Patient complaints also have independent significance. After Femto-LASIK, the ocular surface appears to retain greater morphofunctional stability. However, neurosensory adaptation processes, changes in corneal sensitivity, and individual perception of symptoms may maintain a subjective feeling of dryness or discomfort.

Looking at the results as a whole, several important patterns emerge. First, Femto-LASIK was not associated with a significant or statistically significant deterioration in the Schirmer test or TFBUT. This suggests a more gentle effect of the method on the ocular surface. Second, even with the preservation of objective parameters, the OSDI index significantly increased at both one and six months. This indicates the need to consider not only instrumental data but also the patient's subjective status. Third, by the sixth month, complaints had somewhat decreased compared to the first month, but had not fully returned to baseline levels.

The results demonstrate that after Femto-LASIK, the ocular surface overall maintains a more stable functional state. Tear production and tear film stability remain virtually unchanged. However, subjective discomfort after surgery still increases, although its severity gradually decreases during follow-up. These data suggest that Femto-LASIK may be a more gentle keratorefractive surgery option for the ocular surface, especially when assessed using objective clinical and functional tests (see Table 4).

According to Table 4, 6 months after excimer laser correction, the study groups showed different changes in axial length. The most stable values were recorded in patients who had previously used orthokeratology lenses. In this group, the axial length preoperatively was 25.04 ± 0.02 mm, and after 6 months, it was 25.05 ± 0.02 mm. In fact, the change was minimal. This allows us to interpret this result as a sign of high stability of the anatomical parameters of the eye in the postoperative period. It should be emphasized that axial length of the eye is one of the most important objective indicators in assessing the progression of myopia. An increase in the anteroposterior diameter of the eye is considered one of the main morphological signs of myopia progression. Therefore, the lack of significant changes in this parameter in patients who previously used orthokeratology lenses has not only quantitative but also clinical significance. These data indirectly indicate that the preoperative phase with orthokeratology may have contributed to the stabilization of the myopic process and the formation of a more stable refractive background by the time of surgical treatment.

Table 4.

Change in axial length of the eye 6 months after excimer laser correction (M±δ)

Observation group	**Before surgery, mm**	**After 6 months, mm**	**Dynamics**
Patients with previous orthokeratology lens use, n=20	25,04±0,02	25,05±0,02	Virtually unchanged
Patients without previous orthokeratology lens use, n=20	24,99±0,03	25,09±0,03	Slight increase

A different picture was observed in patients who had not worn orthokeratology lenses before surgery. In this group, axial length increased from 24.99±0.03 mm to 25.09±0.03 mm. Although the absolute difference appeared small, the direction of the changes is noteworthy. Even a slight increase in axial length over time may reflect less stable anatomical conditions of the eye. Against this background, the group with prior orthokeratology lens use appears more favorable.

A comparative analysis reveals that the difference between the groups is due less to the baseline values than to the nature of subsequent changes. Before surgery, both values were similar. The difference between the groups was only 0.05 mm. After 6 months, it reached 0.04 mm, favoring greater stability in patients who had previously worn orthokeratology lenses. This suggests that prior orthokeratology treatment itself may be important for maintaining the achieved result after excimer laser correction.

From a practical perspective, these data are of particular interest. Excimerase correction eliminates the refractive effects of myopia but does not directly affect the biological mechanisms of axial growth. Therefore, maintaining stable axial length after surgery can be considered an important criterion for the long-term predictability of the outcome. In this regard, patients with prior orthokeratology lens wear demonstrate a more favorable follow-up profile. The results in Table 4 show that patients who had previously worn orthokeratology lenses maintained almost complete stability of axial length after excimer laser correction. Patients without such a history showed a slight increase in this indicator. These data suggest that prior use of orthokeratology lenses may be associated with better stabilization of the myopic process and, consequently, with greater stability of the postoperative result.

This study demonstrated that keratorefractive surgery is an effective and clinically justified correction method for patients with myopia and myopic astigmatism who previously used orthokeratology lenses. Both groups were comparable preoperatively in terms of key refractive, anatomical, and keratometric parameters. This allowed for an accurate assessment of the postoperative course of LASIK and Femto-LASIK.

The results confirmed that both technologies can achieve a stable clinical and functional effect. However, the nature of changes in the ocular surface was different. After LASIK, signs of tear film disruption were more pronounced. In the first month after surgery, decreased tear production, decreased tear film stability, and increased complaints related to dry eye were noted. By the sixth month, partial recovery of these parameters was observed, but a full return to baseline was not achieved. This indicates a more pronounced ocular surface response after mechanical flap formation. The postoperative course was more favorable after Femto-LASIK. Objective ocular surface parameters remained relatively stable. No significant deterioration was observed in the Schirmer test or TFBUT. However, subjective complaints also increased postoperatively, as evidenced by an increase in the OSDI index. However, the severity of these changes was milder, and the ocular surface itself retained greater functional stability. This suggests that Femto-LASIK is a more gentle surgical correction option for this patient population.

Analysis of the axial length of the eye deserves special attention. In patients who had previously worn orthokeratology lenses, this parameter remained virtually unchanged six months postoperatively. This stability is clinically significant, as it indicates a more stable myopic process. In patients without prior orthokeratology lens use, a slight increase in axial length was noted. This suggests that prior use of orthokeratology lenses may contribute to better myopia stabilization and improve the predictability of postoperative outcomes.

Therefore, prior use of orthokeratology lenses does not impair the results of excimer laser correction; instead, it can be considered a favorable prerequisite for subsequent surgical treatment. In this context, Femto-LASIK demonstrates a more gentle effect on the ocular surface and a lower risk of functional impairment in the postoperative period. These findings highlight the importance of an individualized approach to choosing a keratorefractive surgery method and confirm the need for a comprehensive assessment of the ocular surface in myopic patients who have previously worn orthokeratology lenses.

CONCLUSIONS

1. In patients who had previously used orthokeratology lenses, keratorefractive surgery demonstrated high clinical efficacy and good tolerability. Before surgery, the LASIK and Femto-LASIK groups were comparable in key refractive, anatomical, and keratometric parameters, allowing for an objective assessment of treatment results.

2. After LASIK, more pronounced changes in the ocular surface were observed in the early postoperative period. Decreased tear production, decreased tear film stability, and increased subjective complaints were observed. By the sixth month, these parameters had partially improved but had not fully returned to baseline levels.

3. After Femto-LASIK, ocular surface condition remained more stable. Objective parameters of tear production and tear film stability did not significantly worsen. Subjective discomfort after surgery persisted but was generally less severe than after LASIK.

4. In patients who previously wore orthokeratology lenses, axial ocular length remained virtually unchanged 6 months after excimer laser correction. This indirectly indicates stabilization of the myopic process and suggests that previous use of orthokeratology lenses may be a favorable factor for maintaining a stable postoperative result.

REFERENCES

1. Erdinest N, London N, Lavy I, Berkow D, Landau D, Morad Y, Levinger N. Peripheral Defocus and Myopia Management: A Mini-Review. Korean J Ophthalmol. 2023 Feb;37(1):70-81. doi: 10.3341/kjo.2022.0125.
2. Garner LF, Owens H. The relationship between the sagitta of the anterior corneal surface and refractive error of the eye. Optom Vis Sci. 2004 Aug;81(8):636-9. doi: 10.1097/01.opx.0000141798.41340.8b.
3. Ghemame M, Charpentier P, Mouriaux F. Corneal topography in clinical practice. J Fr Ophtalmol. 2019 Dec;42(10):e439-e451. doi: 10.1016/j.jfo.2019.09.001.
4. González-Pérez J, Villa-Collar C, González-Méijome JM, Porta NG, Parafita MÁ. Long-term changes in corneal structure and tear inflammatory mediators after orthokeratology and LASIK. Invest Ophthalmol Vis Sci. 2012 Aug 7;53(9):5301-11. doi: 10.1167/iovs.11-9155.
5. Park YM, Park YK, Lee JE, Lee JS. Effect of orthokeratology in patients with myopic regression after refractive surgery. Cont Lens Anterior Eye. 2016 Apr;39(2):167-71. doi: 10.1016/j.clae.2015.10.003.
6. Queirós A, Villa-Collar C, Amorim-de-Sousa A, Gargallo-Martinez B, Gutiérrez-Ortega R, González-Pérez J, González-Méijome JM. Corneal morphology and visual outcomes in LASIK patients after orthokeratology: A pilot study. Cont Lens Anterior Eye. 2018 Dec;41(6):507-512. doi: 10.1016/j.clae.2018.09.001.
7. Queirós A, Villa-Collar C, Gutiérrez ÁR, Jorge J, Ribeiro-Queirós MS, Peixoto-de-Matos SC, González-Méijome JM. Anterior and posterior corneal elevation after orthokeratology and standard and customized LASIK surgery. Eye Contact Lens. 2011 Nov;37(6):354-8. doi: 10.1097/ICL.0b013e318232e32d.
8. Ring-Mangold T, Emminger R. Die moderne Orthokeratologie – scharf sehen über Nacht [Orthokeratology - a Perfect Vision Overnight - An Update and Overview]. Klin Monbl Augenheilkd. 2021 Aug;238(8):913-931. German. doi: 10.1055/a-

1472-0517.

9. Swarbrick HA. Orthokeratology (corneal refractive therapy): what is it and how does it work? Eye Contact Lens. 2004 Oct;30(4):181-5; discussion 205-6. doi: 10.1097/01.icl.0000140221.41806.6e.

10. Wang VM, Moin KA, Hoopes PC, Moshirfar M. Corneal Refractive Surgery Considerations in Patients With History of Orthokeratology. Eye Contact Lens. 2025 Feb 1;51(2):98-105. doi: 10.1097/ICL.0000000000001138.

11. Xu HY, Lang SK, Jiang H. Risk factors and nomogram-based prediction of dry eye disease following intraocular lens implantation in cataract patients. BMC Ophthalmol. 2025 Oct 1;25(1):533. doi: 10.1186/s12886-025-04369-1.