

## THE MOST COMMON CONTRAINDICATIONS FOR REFRACTIVE SURGERY

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The preoperative examination for refractive surgery is of extreme importance for ensuring optimal outcomes and preventing complications. Aim of this study was to point out the most common contraindications for refractive surgery, laser-assisted in situ keratomileusis (LASIK) and photorefractive keratectomy (PRK).

The study included patients in the process of preoperative examination for refractive surgery who underwent complete standard ophthalmic examinations, as well as corneal topography and ocular biometry. Additional examinations were performed in cases of suspected specific ocular or systemic disease.

Out of 1,238 patients (646 males and 592 females; mean age 32±10.4 years), refractive surgery was performed in 743 patients (60%), LASIK 367 (30%) and PRK in 376 patients (30%). Refractive surgery was contraindicated in 327 patients (26%) while 102 patients cancelled surgery. The most common reasons for not performing surgery were irregular cornea in 106 patients (32%), too steep or too flat corneal curvature in 71 patients (22%), insufficient corneal thickness in 62 patients (19%), high myopia in 28 patients (9%), high hyperopia in 19 patients (6%), dry eye in 13 patients (4%), incipient cataract in 10 patients (3%) and less common ocular and systemic diseases in 18 patients (6%).

According to obtained results, irregular corneal topography, corneal curvature and insufficient corneal thickness are the most common reasons for not performing refractive surgery. *Acta Medica Medianae* 2023;62(1):21-26.

**Key words:** corneal curvature, corneal thickness, LASIK, PRK, refractive surgery

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### Introduction

Refractive surgery has been used worldwide since 1987 and the first LASIK procedure was performed in 1990. Continuous innovations have led to great progress and improvements in refractive surgery. The satisfaction of patients after the intervention is at a high level and ranges from 82 to 98% (1–4). Patient's satisfaction after the intervention directly correlates with postoperative visual acuity and visual function, but

preoperative expectations and psychological characteristics of patients are also of great importance for successful outcome (5, 6, 7).

A thorough screening examination of patients considered for refractive surgery is of extreme importance to ensure optimal outcomes and to prevent complications (8–12). The intervention itself has resulted in time in increased safety and simplicity due to technological developments – introduction of advanced laser generations and surgical instruments. However, despite the advances in refractive surgery equipment, contraindications for the surgery have remained the same. Even though the patients are highly motivated, surgeons are experienced, and the devices and equipment are modern, many patients are not good candidates for refractive surgery, so they still have to wear glasses and contact lenses or decide on some alternative form of intraocular surgery. Contraindications for refractive surgery are numerous.

Referral corneal **thickness** is from 530 to 560 μm (13, 14). It is well known that laser ablates the cornea for about 15 μm per diopter, thus the corneal thickness plays an important role in preoperative selection of patients and in the

choice of method. In order to avoid the risk of corneal ectasia, surgeons suggest leaving a minimum residual stromal bed thickness between 250 and 300  $\mu\text{m}$ . Corneal ectasia was first described by Seiler, Koufala and Richter (15) in 1998 as a progressive steepening and thinning of the cornea that is associated with increasing myopic astigmatism and decrease in visual acuity. Risk factors for corneal ectasia include high myopia, forme fruste keratoconus, young age, thin corneas and low residual stromal bed thickness. Randleman et al. designed a scale, ectasia risk score system (ERSS), which includes preoperative parameters to rate post-LASIK ectasia (16). If the cornea is thinner than 500  $\mu\text{m}$ , then PRK is indicated.

Keratoconus or any irregularity of corneal curvature is considered to be an absolute contraindication for refractive surgery. Forme fruste keratoconus (FFK) is described as an atypical or attenuated manifestation of keratoconus, suggesting that the disease has not progressed, or has been aborted at an early stage. The clinical signs are subtle, so it may be difficult to diagnose. Risk factors for FFK include moderate astigmatism, irregular corneal topography, pachymetry less than 500  $\mu\text{m}$  and positive family history of keratoconus (16–20).

Apart from corneal thickness, **corneal curvature** is also an important parameter to consider before the intervention. Correction of myopia requires preoperatively a steeper curvature of the cornea, unlike hyperopia correction where a flat cornea is more desirable. Of course, the degree of the curvature change depends on the diopter magnitude to be corrected. Quite often patients have satisfactory corneal thickness, but suboptimal curvature.

"**Dry eye**" is a common postoperative complication, but it decreases over the first year following refractive surgery. Many conditions may contribute to dry eye. They may include postoperative neurotrophic eye disease, tear film instability, local inflammation and corneal exposure (21, 22). Typical symptoms are irritation, pain, and photophobia and visual acuity fluctuations. It is crucial to identify the potential patients at risk of dry eye symptoms in preoperative preparation to ensure postoperative comfort. The results of different studies are controversial regarding the risk factors (depth of ablation, flap thickness, hinge location and size) for postoperative dry eye (23). Most surgeons choose PRK method as a safer procedure in preoperative dry eye, although some studies suggest no postoperative difference in patients regarding different surgical methods (24, 25).

Particular attention at screening should be paid to the most common vision-threatening **systemic diseases** that include systemic lupus erythematosus, rheumatoid arthritis, Sjögren's syndrome, Grave's disease and Crohn's disease. Nevertheless, refractive surgery may be

performed in patients with controlled systemic disease and without ocular involvement (26, 27, 28)

Less common reasons during the screening to refuse patients for refractive surgery include the history of cataract, unstable refraction, amblyopia (not accepting the fact that the intervention could not achieve 100% visual acuity) and immunodeficiency.

The aim was to identify the most common ophthalmic conditions that are contraindication to refractive surgery.

## Methods

This retrospective observational study included 646 male and 592 female candidates for refractive surgery (LASIK or PRK) examined at the Special Hospital for Ophthalmology "Maja Clinic", Niš, Serbia in the period from March 2013 to April 2022. Potential candidates were provided an educational booklet followed by a consultation with the surgeon to discuss any further questions or concerns.

Apart from complete standard ophthalmic examination, all patients underwent refractive error determination (subjective and cycloplegic), best corrected visual acuity in eyes with constricted and dilated pupils, intraocular pressure measurements, examination of anterior and posterior eye segment, determination of tear volume by Schirmer's test, corneal topography using Wavelight Oculyzer® and axial length measurements provided by Wavelight Biograph®. Additional examinations were performed in cases of suspected specific ocular or systemic diseases. Both personal and family medical histories regarding ocular and systemic diseases were noted.

Patients with topographic signs of keratoconus, forme-fruste keratoconus or pellucid marginal degeneration in one eye were excluded from the surgery.

If the preoperative CCT was  $>500 \mu\text{m}$  and the residual stromal bed thickness was higher than 300  $\mu\text{m}$ , the patient was considered a candidate for LASIK. In cases where the preoperative CCT was lower than 500  $\mu\text{m}$  or the residual stromal bed thickness was lower than 300  $\mu\text{m}$ , the patient was advised to undergo PRK and not LASIK. In cases where the corneal thickness was  $<450 \mu\text{m}$  or the refractive error precluded safe residual corneal thickness, phakic intraocular lens implantation or clear lens extraction was recommended if the corneal topography was normal or had very mild asymmetry.

One or two drops of tropicamide 1% were instilled for mydriasis and cycloplegia. Cataract was detected by slit lamp examination after pupil dilation and any lens opacity was a contraindication for keratorefractive surgery.

## Results

The study enrolled 1,238 patients, 646 male and 592 female, with a mean age of  $32 \pm 10.4$  years. Out of the total of 1,238 patients, refractive surgery was performed in 743 patients (60%). LASIK was done in 367 (30%) and PRK in 376 patients (30%).

Refractive surgery was not performed in 495 patients (40%) who were candidates for the correction of refractive error. Among them 327 (26%) had absolute and relative ophthalmic contraindications for the intervention. In remaining 168 patients, there were no contraindications but they have not had the surgery for personal reasons (want to be sure they are appropriate for refractive surgery and/or plan the intervention according to their schedule). The most common contraindication for the procedure performance was irregular corneal topography in 106 patients (32%), steep or flat corneal curvature in 71 patients (22%), insufficient corneal thickness in 62 patients (19%), high myopia in 28 patients (9%), high hyperopia in 19 patients (6%), dry eye in 13 patients (4%), incipient cataract in 10 patients (3%) and less common ocular and systemic diseases as contraindications in 18 patients (6%) (Table 1).

Less common ophthalmic and systemic diseases included unstable refraction, history of viral herpetic keratitis, corneal dystrophy, uncontrolled glaucoma, diabetes, immunodeficiency disorders and ocular manifestations of rheumatoid diseases.

Corneal curvature as a contraindication to refractive surgery implies too flat cornea in myopia or too steep cornea in hyperopia. Measurements of the corneal curvature after surgery should not be below 36D and above 48D.

Insufficient corneal thickness means that tissue to be removed to treat the diopter at hand will remove more than the allowable removal of corneal tissue. Namely, it is well known that laser ablates the cornea for about  $15 \mu\text{m}$  per diopter, thus the corneal thickness plays an important role in preoperative selection of the patients and in the choice of method. In order to avoid the risk of corneal ectasia surgeons suggest leaving a minimum residual stromal bed thickness between 250 and  $300 \mu\text{m}$ .

High myopia was defined as myopia over -10 Dpt, and high hyperopia as hyperopia greater than +6.0 Dpt.

**Table 1.** The most common contraindications for refractive surgery

Contraindication	Number of patients (%)
Irregular corneal topography	106 (32%)
Corneal curvature	71 (22%)
Insufficient corneal thickness	62 (19%)
High myopia	28 (9%)
High hyperopia	19 (6%)
Dry eye	13 (4%)
Incipient cataract	10 (3%)
Less common ophthalmic and systemic diseases	18 (6%)

## Discussion

A thorough screening of patients considered for refractive surgery is of extreme importance to ensure optimal outcomes. According to the results of previous studies, the prevalence of intervention rejection rates after screening is between 25 and 38% (29, 30). Out of all the patients who required the surgery in our sample, 40% of them were contraindicated for refractive surgery.

The main contraindication for the intervention is definitely corneal pathology, namely irregular cornea, too thin cornea, too steep or too flat cornea. It is also important to note that screening for refractive surgery is also the screening process for keratoconus, especially among the populations lacking awareness of this corneal disease. In our sample of patients, corneal irregularity was detected in even 106 patients (32%) and the incidence is far higher than in published results of other studies so far. Regular

monitoring of these patients is crucial, since most of them are of young age and progression monitoring is important for timely use of cross-linking method to strengthen the cornea.

Xu et al. studied the sample of 552 patients considered for LASIK in the period from 2005 to 2010 and obtained the following results: 31.7% did not get the intervention, and the most common reasons were low corneal thickness (28.6%), high myopia (15.4%), large pupils (8.0%) and keratoconus (7.4%). The prevalence of rejections of patients decreased from 44.1% in the period from 2005 to 2006 to 3.5% in the period from 2009 to 2010. It is primarily explained by improvements in technology (modern laser eye-tracking system, wave front-guided and femtosecond LASIK technology). This study paid a great deal of attention to consultations with surgeons prior the intervention, 21% of patients changed their minds and refused the surgery after

detailed consultation with the surgeon on possible risks and real postoperative results (29).

Toricelli et al. studied twice as large number of patients where 38.4% of all screened patients did not have the intervention and 12.6% had some contraindication to surgery. The most common reasons to exclude patients were abnormal corneal topography (34.3%) and low corneal thickness (23.1%) followed by high myopia (10.5%), incipient cataract (9.7%), high hyperopia (3.7%), need for wearing reading glasses after the intervention (3.7%), and severe signs of dry eye (3.7%) (30).

A study conducted in India reported suboptimal corneal thickness (55.1%), high myopia (18.4%), keratoconus (9.6%) and high hyperopia (5.9%) as the most common contraindications for LASIK (31). Bamashmus et al. studied the sample of 1,596 examined patients, out of which 405 (25.4%) did not have refractive surgery due to following reasons: suboptimal corneal thickness (25.9%), high myopia (17.0%), keratoconus (15.5%), cataract (11.4%), and suspicious corneal topography (9.4%) (32).

Unfortunately, the number of studies dealing with preoperative screening of patients who request refractive surgery that cannot be performed due to the above mentioned

contraindications is scarce. Contraindications are definitely numerous, but adherence to standardized protocols is of utmost importance in performing the intervention. Even though the patients are highly motivated, surgeons are experienced, devices and equipment are highly advanced, still many patients are not appropriate candidates for refractive surgery, so glasses and contact lenses are reasonable alternatives to refractive surgery, or patients may decide on some alternative form of intraocular surgery.

### Conclusion

Contraindications for refractive surgery are diverse. The most common ones include corneal irregularity, corneal curvature and insufficient corneal thickness. Despite highly motivated patients, surgeon's experience and modern devices, a great number of patients have been refused from surgery, so glasses and/or contact lenses appear to be reasonable alternatives for these patients.

The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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## NAJČEŠĆE KONTRAINDIKACIJE ZA IZVOĐENJE REFRAKTIVNE HIRURGIJE

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Preoperativni pregled za refraktivnu hirurgiju izuzetno je važan za osiguranje optimalnog ishoda i sprečavanje komplikacija.

Cilj rada jeste da navede najčešće kontraindikacije za refraktivnu hirurgiju, laser-in-situ keratomileuzis (LASIK) i fotorefraktivnu keratektomiju (PRK).

U studiji su obuhvaćeni bolesnici u procesu preoperativnog pregleda za refraktivnu hirurgiju. Svi bolesnici prošli su kompletan oftalmološki pregled, kao i topografiju rožnjače i biometriju oka. Dodatni pregledi izvedeni su u slučajevima sumnje na specifičnu očnu ili sistemsku bolest.

Od 1238 bolesnika (646 muškaraca i 592 žene, srednja starost 32 godine  $\pm$  10,4 godine), operacija refraktivne hirurgije obavljena je kod 743 bolesnika (60%), LASIK kod 367 (30%) i PRK kod 376 bolesnika (30%). Refraktivna hirurgija bila je kontraindikovana kod 327 bolesnika (26%), dok su 102 bolesnika otkazala operaciju. Najčešće kontraindikacije za operaciju bile su: nepravilna rožnjača kod 106 bolesnika (32%), previše strma ili suviše ravna zakrivljenost rožnjače kod 71 bolesnika (22%), nedovoljna debljina rožnjače kod 62 bolesnika (19%), visoka miopija kod 28 bolesnika (9%), visoka hipermetropija kod 19 bolesnika (6%), suvo oko kod 13 bolesnika (4%), početna katarakta kod 10 bolesnika (3%) i manje česte očne i sistemske bolesti kod 18 bolesnika (6%).

Na osnovu dobijenih rezultata može se zaključiti da su neregularna topografija rožnjače, zakrivljenost rožnjače i nedovoljna debljina rožnjače najčešće kontraindikacije za refraktivnu hirurgiju. *Acta Medica Medianae 2023;62(1): 21-26.*

**Ključne reči:** zakrivljenost rožnjače, debljina rožnjače, LASIK, PRK, refraktivna hirurgija

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