

Vitreoretinal complications in Yemeni patients with keratorefractive surgery

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ABSTRACT

الأهداف: دراسة مضاعفات الشبكية والسائل الزجاجي لمرضى تصحيح النظر بالليزر والليزر السطحي.

الطريقة: خلال الفترة من يونيو 2005م إلى مارس 2008م تم إجراء 4691 عملية تصحيح النظر بالليزر، والليزر السطحي في 2480 مريض وتم إجرائها في مستشفى مغربي - صنعاء - اليمن. تعتبر هذه الدراسة الاستيعادية دراسة ملاحظة غير مقارنة. تم متابعة المرضى لمدة تتراوح بين 12 إلى 36 شهر. تم فحص جميع المرضى وشمل الفحص على مقاسات النظارة قبل وبعد قطرة توسيع حدقة العين، حدة الإبصار بالنظارة وبدون نظارة، فحص المنظار الشقي وفحص الشبكية بعد توسعة حدقة العين. تم تسجيل جميع التغيرات في الشبكية وتم تحليلها قبل وبعد عملية تصحيح النظر.

النتائج: كانت هناك 65 (1.4%) عين من 4691 لديها مضاعفات في الشبكية والسائل الزجاجي احتاجت إلى تدخل الليزر أو الجراحة. تم علاج 57 عين خلال الفحص ما قبل العملية بالليزر لثقب في الشبكية. حدث انفصال في السائل الزجاجي لدى 7 حالات بعد عملية تصحيح النظر احتاج 4 منهم إلى ليزر للشبكية للحام ثقب في أطراف الشبكية. حدث انفصال في الشبكية في 2 مريض (0.04%)، واحتاج إلى تدخل جراحي لإرجاع الشبكية إلى مكانها. حدث وذمة، وتسرب سوائل في البقعة الصفراء لعين مريض واحد.

خاتمة: معظم مضاعفات عملية الليزر، والليزر السطحي لتصحيح النظر لها علاقة بتصحيح النظر، أو في القرنية، والجزء الأمامي للعين. تعد مشاكل الجزء الخلفي للعين وخاصة الشبكية نادرة الحدوث ولكن فحص الشبكية قبل وبعد عملية تصحيح النظر بالليزر مهمة جدا. يجب تحويل المرضى الذين لديهم مشاكل في الشبكية لاختصاصي الشبكية لإجراء فحص شامل للشبكية.

Objectives: To evaluate vitreoretinal complications in patients undergoing laser keratorefractive surgery.

Methods: This retrospective observational non-comparative clinical study was carried out between June 2005 and March 2008, and included 4691 consecutive

laser keratorefractive surgery procedures for 2480 patients performed in the Department of Refractive Surgery, Yemen Magrabi Hospital, Sana'a, Yemen. Patients were followed up for 12-36 months. The preoperative patient evaluation included manifest and cycloplegic refractions, uncorrected visual acuity, best spectacle-corrected visual acuity, slit-lamp biomicroscopy, and dilated vitreoretinal assessment. Retinal diseases were recorded and analyzed during the preoperative and postoperative care.

Results: Sixty-five (1.4%) of the 4691 eyes had posterior segment pathology requiring intervention. In the preoperative assessment, 57 eyes had prophylactic laser photocoagulation for retinal lesions. Seven eyes developed posterior vitreous detachment postoperatively, and 4 of these required prophylactic laser therapy for lattice degeneration and retinal breaks. Two eyes (0.04%) developed rhegmatogenous retinal detachment, which occurred spontaneously. One patient developed cystoid macular edema in both eyes.

Conclusion: Most complications are related to the refractive outcome or to corneal and anterior segment injury. Posterior segment complications are rare, but dilated vitreoretinal assessment is important before and after laser keratorefractive procedures. Patients with suspicious retinal lesions need a comprehensive vitreoretinal evaluation by a retinal specialist.

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Laser in situ keratomileusis (LASIK) and photorefractive keratectomy (PRK) are popular laser keratorefractive procedures for the correction of myopia, hyperopia, and astigmatism.¹ Most published studies have shown good efficacy, high levels of safety, and low complication rates for LASIK and PRK.^{1,2} However, the increasing number of patients undergoing these procedures has led to awareness of the potential hazards and complications of these surgeries. Most of these reported complications are related to the refractive outcome or to corneal and anterior segment injury.^{3,4} Refractive surgery candidates, particularly those with moderate to high myopia, have an inherently increased risk of peripheral retinal degeneration, such as lattice degeneration and retinal break, which render the patient more susceptible to rhegmatogenous retinal detachment (RRD).^{5,6} Information concerning posterior segment complications after keratorefractive surgery (LASIK or PRK) are rare and the possible effect of both techniques on the posterior segment of the eye are also not well known. Case reports of RRD after PRK,⁷ and after LASIK,^{8,9} have been published. There are also reports of choroidal neovascularization,¹⁰ macular hemorrhage,¹¹ macular hole,¹² and macular detachment¹³ following LASIK and PRK. These reports propose a relationship between keratorefractive surgery and posterior segment complications in myopic eyes. Posterior segment complications are rarely reported, and this study was performed to retrospectively evaluate the preoperative and postoperative vitreoretinal complications of 4691 eyes following keratorefractive surgery (LASIK or PRK) for myopia, hypermetropia, and astigmatism.

Methods. Between June 2005 and March 2008, 4691 laser keratorefractive procedures were carried out for 2480 patients, 2211 patients had the procedure to both eyes and 269 had it to one eye. The medical records were retrospectively studied in the Refractive Surgery Unit, Yemen Magrabi Hospital, Sana'a, Republic of Yemen. All patients who had LASIK or PRK during the study period were included, and patients who had other refractive procedures were excluded. The Research and Ethics Committee of Yemen Magrabi Hospital approved the study, and the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. Patients' age ranged from 18-53 years with a minimum follow-up period of one year, and ranging from 12-36 months. Three hundred and fifty-one patients were lost to follow-up before the first months visit. Most of these patients live in the Gulf countries, coming to Yemen to visit their relatives. At the initial examination, all patients received complete

ophthalmic examination, including manifest and cycloplegic refraction, uncorrected visual acuity (UCVA), best spectacle-corrected visual acuity (BSCVA), slit-lamp biomicroscopy of the anterior segment, central corneal thickness, corneal videokeratography, and dilated vitreoretinal assessment. Cases with suspicious retinal lesions, lattice degeneration, retinal break or tear, or those with high myopia were referred for a thorough comprehensive retinal examination with scleral depression by 2 experienced vitreoretinal surgeons. Patients presenting with postoperative retinal complications or complaining of floaters, flashes of light and/or ectopias were also referred to the vitreoretinal unit. Documented information included detailed descriptions or fundus drawings of retinal lesions in all 4 quadrants of the globe. Although most patients with lattice or retinal breaks in this series were asymptomatic, they all underwent immediate prophylactic argon laser photocoagulation to seal the retinal lesion. The laser was applied by the 2 retinal specialists treating any peripheral retinal lesions predisposing to the development of RRD, such as lattice degeneration, atrophic holes, or flap tears. The breaks were surrounded completely with the photocoagulation treatment for at least 3-5 rows of photocoagulation marks or U-shaped photocoagulation for breaks extending anteriorly far to the ora serrata. Those who had photocoagulation had the keratorefractive procedure at least one week later after re-examination by the retinal surgeon to check the effect of the laser on the retina. The keratorefractive surgeries (LASIK or PRK) were carried out by 3 experienced refractive surgeons. The laser was performed with the NIDEK EC-5000 excimer laser (Nidek Co., Gamagori, Japan) and the LASIK flaps were created with the Moria M2 automated microkeratome (Moria Co., Antony, France) and all procedures were carried out under topical anesthesia. The time of vacuum suction in the LASIK patients was approximately 20-30 seconds. All patients who had preoperative and posttreatment prophylactic retinal laser photocoagulation and patients who presented with postoperative vitreoretinal complaints and complications were included in the study.

Descriptive analysis was performed on the data collected using Microsoft Excel® spreadsheet 2003 (Microsoft Corporation, Seattle, USA).

Results. A total of 4691 eyes were treated for myopia, hypermetropia, and astigmatism by laser keratorefractive surgery. Most of the patients underwent LASIK, and were females. Table 1 summarizes the patients' characteristics. In the preoperative retinal assessment, 57 eyes (1.2%) had retinal holes or breaks and required prophylactic retinal laser photocoagulation. Of these breaks, 24 were identified as atrophic holes, 21 as flap

tears, and 12 lattice degenerations. Prophylactic argon laser photocoagulation was performed in all cases before LASIK or PRK. The refractive procedure was performed at least one week later. In the postoperative follow-up period, 7 eyes developed posterior vitreous detachment (PVD). Four of these cases had lattice degeneration and retinal holes at the peripheral area of the retina, and needed prophylactic laser therapy to seal the breaks. Two eyes of post-LASIK patients developed RRD. The first was the right eye of a 27-year-old male who had moderate myopia, and the second was the left eye of a 29-year-old female with high myopia. The overall RRD rate post laser refractive surgery was 0.04%. The RRD developed spontaneously 22 months post-LASIK in the male patient, and 32 months post-LASIK in the female patient. Retinal detachment surgery was carried out and achieved anatomic success after one surgery in both cases. Final visual acuity was 20/200, in the male patient and 20/40 in the female patient. Both cases had documented pre-LASIK retinal examination by the anterior segment surgeon and were not seen by the retinal surgeon. The 4 eyes that had laser photocoagulation after LASIK

or PRK also had documented retinal examination by the anterior segment surgeon, but were not seen by the retinal specialist. Two eyes of a post-LASIK male patient developed cystoid macular edema (CME). Table 2 shows the eyes that had laser photocoagulation, CME, and RRD.

Discussion. Laser keratorefractive surgery for the correction of myopia, astigmatism, and hyperopia are increasing in popularity in Yemen, particularly since the introduction of laser refractive surgery in 2005 to Yemen Magrabi Hospital in the capital Sana'a.¹⁴ Both LASIK and PRK are the most common surgical procedures for the treatment of refractive errors worldwide. Most of their complications are related to the refractive outcome or to anterior segment complications, which are well documented.^{1,2} Myopia is the main refractive error to be treated by refractive surgeons and these eyes are vulnerable to retinal problems. Myopia is a recognized predisposing factor for vitreoretinal complications, regardless of any surgical procedure.^{15,16} Although several hypotheses have been proposed to explain the effect of LASIK and PRK on the posterior segment, the rarity of these events makes it difficult to examine the exact incidence and risk factors of vitreoretinal complications. Posterior segment complications including RRD after keratorefractive surgery is infrequent yet it is a serious complication. A possible association between RRD occurrence and keratorefractive procedures has been reported by some authors. There has been no definitive proof of a causal link between keratorefractive procedures and vitreoretinal complications.^{17,18} Arevalo and coworkers⁶ in a retrospective study reported 0.06% incidence of RRD in 24,890 myopic eyes during a mean follow-up of 36 months after surgery. Ruiz-Moreno and Alió⁸ reported that RRD occurred in 0.15% of 5,936 PRK cases, and 0.25% of 3,009 LASIK eyes. Our rate of 0.02% is less than this reported range. A possible explanation is that highly myopic eyes are routinely referred to the retinal specialist and these eyes are often not treated by LASIK or PRK because of the keratorefractive procedure limitations in such cases. These patients are offered phakic intraocular lens implantation or refractive lens exchange. It must be noted, however, that these rates depend on the duration of follow-up after the laser refractive procedure, the type of procedure, the age of patients, and the severity of myopia. Overall, LASIK and PRK are associated with a low incidence of RRD.¹⁶ This is probably explained by the fact that refractive surgery patients have preoperative examination that includes dilated fundus examination, and in suspicious cases referral to the vitreoretinal surgeon. These cases usually receive treatment for any

Table 1 - Characteristics of patients underwent keratorefractive surgery in Yemen (2005-2008) (4691 eyes).

Variable	Total	LASIK n (%)	PRK
No. of patients	2480	2227 (89.8)	253 (10.2)
<i>Gender</i>			
Male	1125 (45.4)	1009 (45.3)	116 (45.8)
Female	1355 (54.6)	1218 (54.7)	137 (54.2)
<i>Procedure performed</i>			
To both eyes	2211 (8.9)	1990 (89.3)	221 (87.3)
To one eye	269 (10.8)	237 (10.7)	32 (12.6)
<i>Preoperative spherical equivalent (diopeters)</i>			
Low myopia: <-4.75	3206 (68.3)	2732 (64.8)	474 (100)
Moderate myopia: -5.00 - -8.50	1416 (30.2)	1416 (33.6)	-
High Myopia: >-8.50	37 (0.8)	37 (0.9)	-
Hyperopia: +0.25 - +4.00	32 (0.7)	32 (0.7)	-

LASIK - laser in situ keratomileusis, PRK - photorefractive keratectomy

Table 2 - Eyes that had retinal lesions in patients treated with laser keratorefractive procedures in Yemen (2005-2008).

Treatment	Preoperative laser photocoagulation	Postoperative laser photocoagulation	CME	RRD	Total
PRK	18	1	0	0	19
LASIK	39	3	2	2	46
Total	57	4	2	2	65

PRK - photorefractive keratectomy, LASIK - laser in situ keratomileusis, CME - cystoid macular edema, RRD - rhegmatogenous retinal detachment

retinal lesion that can be a predisposing factor to the development of RRD.

Age and myopia are risk factors for RRD after laser refractive surgery.¹⁹ It is known that the vitreous undergoes syneresis between 40-60 years of age, and occurs earlier in myopic eyes, and a syneretic vitreous is a prerequisite for the occurrence of PVD and subsequent retinal breaks and retinal detachment. Arevalo and colleagues¹⁷ suggested that the excessive mechanical stress and the eye changes during the application of the suction ring to fixate the globe during the creation of the corneal flap might be an etiological factor for the development of vitreoretinal pathologies. The sudden increase and decrease in intraocular pressure during vacuum suction may exert a mechanical stretch on the vitreous base and posterior pole and induce retinal break. The underlying mechanism could involve anterior-posterior elongation and horizontal contraction and when suction stops and the suction ring released, decompression may lead to a dynamic overshoot with equatorial elongation and anterior-posterior contraction.²⁰ Mirshahi et al²⁰ performed ultrasonographic measurements of the axial length of the eye (A-scan) before and during the application of the suction ring for LASIK, and found no significant changes in axial length. The lens thickness decreased during the suction period, and in younger patients, where the anterior hyaloid is adherent to the posterior capsule of the lens, would lead to an anterior power vector in the vitreous body. This induced traction produces PVD or retinal tears, and current studies show that a PVD may occur after LASIK with the degree of myopia being a risk factor. No long-term follow-up is available on eyes that experienced LASIK-associated PVD.^{21,22}

The number of published vitreoretinal complications has not risen proportionately to the increase in the total number of LASIKs performed worldwide. Many suggest that the improved microkeratomes reduced the suction times and eventually decreased the above-mentioned complications.²³ The shock wave transmission of the excimer laser may also play an important role in the development of PVD, but this theory appears negligible.^{22,24} There is no reported case of such complication after LASIK enhancement with flap re-lifting without using a microkeratome, however, there are reports on retinal tears and detachments after PRK where no suction ring is applied.⁷ Thus, the pathogenetic role of the excimer laser shock wave cannot be ruled out with certainty.

In our series, 57 eyes (1.2%) required some form of treatment by prophylactic laser photocoagulation preoperatively due to evidence of pathology predisposing to the development of retinal lesions. Four eyes had treatment postoperatively to seal retinal breaks or treat

weak areas in the peripheral retina after presenting with PVD. We prefer that prophylactic laser photocoagulation is performed before the keratorefractive surgery. If photocoagulation is performed later for retinal breaks, the corneal flap might become displaced or damaged when performing the laser treatment with a contact lens.²⁵ A safer alternative is to carry out the laser treatment with the indirect ophthalmoscope or non-contact lenses to avoid placing a contact lens on the corneal flap. Retinal detachment surgery should be performed with care to avoid flap dehiscence during retinal detachment surgery. It has been reported that the LASIK flap can be displaced during retinal detachment surgery and surgeons should manipulate the cornea carefully and be cautious not to cause corneal trauma even if a long time has passed since the LASIK procedure.²⁵

The occurrence of RRD in 2 eyes in our series can be partly attributed to the presence of small atrophic holes or retinal tears that were missed during the preoperative examination by the refractive surgeon. Referring all cases to the retinal surgeon is also unrealistic and adds more expenses to the patient and hospital. Patients admitted for LASIK or PRK should be informed that the refractive procedure is to correct the refractive power of the corneal surface, and the inherent nature of retinal degeneration due to posterior pole elongation in patients with myopia remains unchanged. One patient in our series developed bilateral cystoid macular edema, and this patient traveled abroad and was lost to follow-up, and we do not have any documentation of his final visual acuity. In the literature, one case was reported to have developed cystoid macular edema and retinal phlebitis, although an association remains unclear.²⁶ A careful examination of the macula should be conducted before performing keratorefractive procedures in myopic and hypermetropic eyes. Pre-existing macular pathology, such as retinal pigment epithelium atrophy, may be a relative contraindication to LASIK and PRK.²⁷ Certain refractive surgeons routinely perform pre-keratorefractive dilated fundus examinations, whereas others do not. Even in the same center some surgeons routinely dilate, and others do not.

The main limitations of this study were the underestimation of vitreoretinal complications due to many reasons. A large number of patients (351) were lost to follow up after the first month, and these might have developed vitreoretinal complications, but did not come back to our unit. Also, a number of patients live in different governorates of Yemen and might have developed complications and were treated locally.

In conclusion, LASIK and PRK are the most the most common surgical procedures for treatment of refractive errors worldwide. Most of their complications are related to the refractive outcome or to corneal and

anterior segment injury. Posterior segment complications are very rare, but dilated vitreoretinal assessment is important before and after laser keratorefractive procedures. Patients with suspicious retinal lesions need comprehensive vitreoretinal evaluation by a retinal specialist. If a patient develops floaters or blurriness of vision posttreatment he/she needs detailed assessment to exclude retinal tears or detachment. Further studies are required to confirm whether aggressive prophylactic retinal therapy is indicated in myopic eyes seeking refractive surgery.

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