MANAGING RETINAL DETACHMENT AFTER REFRACTIVE SURGERY

With current knowledge, we cannot determine whether prophylactic treatment is indicated in candidates for refractive surgery.

BY J. FERNANDO AREVALO, MD, FACS

Refractive surgery has become popular for correcting ametropias, but it can lead to a variety of complications (Figures 1 - 4).[1-35] Hofman et al,[2] Sanders et al,[3] and Feldman et al[4] have described retinal detachment (RD) after radial keratotomy. Rodriguez and Camacho[5] reported on 14 eyes (12 patients) that had either asymptomatic or symptomatic retinal breaks, subclinical and clinical rhegmatogenous RD (RRD), or both after corneal refractive surgery. Rodriguez et al,[6] Barraquer et al,[7] and Ripandelli et al[8] have described RDs after refractive lens exchange for myopia correction.

Ruiz-Moreno and associates reported the results of a clinically controlled study to investigate the rate of RD after implantation of phakic anterior chamber intraocular lenses.[9] In that report, there was a 4.8% incidence of RD after implantation of a phakic anterior chamber intraocular lens for the correction of severe myopia. Our own most recent series demonstrated much lower incidences of RD after implantation of a Visian implantable collamer lens (ICL; Staar Surgical, 0.7%) or an Artisan iris-fixated intraocular lens (Ophtec, 0%).[36]

Laser-assisted in situ keratomileusis (LASIK) has become one of the most popular options for the correction of low to moderate myopia worldwide.[10,11,35] Complications of LASIK that have been reported include optic neuropathy,[12] undercorrection and overcorrection,[13] flap displacement,[14] epithelial ingrowth,[15] flap melting,[16] keratitis,[17] retinal tear,[18] RD,[19] retinal phlebitis,[20] corneoscleral perforation,[21] retinal hemorrhage,[21] macular hemorrhage,[35] macular hole,[22] serous macular detachment,[23] choroidal neovascular membrane,[21] reactivation of ocular toxoplasmosis,[24] and irregular astigmatism.

This report reviews retinal complications that may occur after refractive surgery, with an emphasis on RD after LASIK.

RD AFTER LASIK

A number of studies have described the occurrence of RD after LASIK.[18,25,26] Ozdamar et al reported a case of bilateral RD associated with giant retinal tear after LASIK.[25] Stulting and associates reported a case of RRD after LASIK for the correction of myopia.[26] Faghihi et al reported an incidence of 0.082%,[27] and Ruiz-Moreno and coworkers reported an incidence of 0.25% in myopic eyes after LASIK and mean BCVA of 20/45 after retinal repair surgery.[19] Aras et al described

AT A GLANCE

- Although LASIK has become one of the most popular options for the correction of low to moderate myopia, various types of complications have been associated with the procedure.
- Because vitreoretinal surgery causes changes in corneal shape, thus damaging the refractive surgeon's results, the author suggests that cryopexy, argon laser retinopexy, pneumatic retinopexy, or vitrectomy without a scleral band be performed when appropriate because these procedures tend not to change the shape or length of the globe.
- It is very important to inform patients that LASIK corrects only the refractive aspect of myopia. Vitreoretinal complications in these eyes will occur, and only careful, large, prospective studies in patients can determine whether the procedure exacerbates myopic pathology.

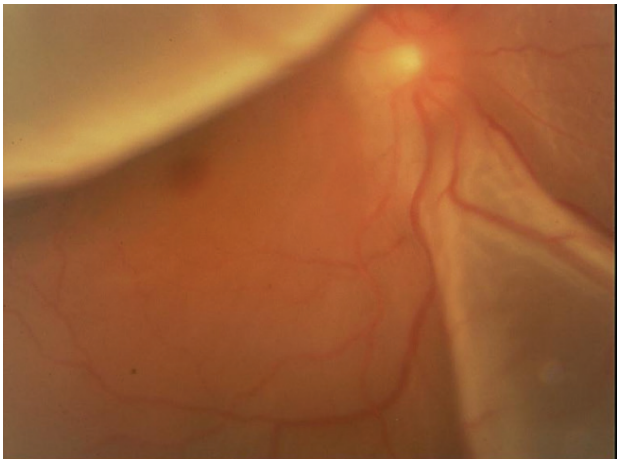

Figure 1. Fundus photo of a subtotal superotemporal and nasal macula-on RD after LASIK.

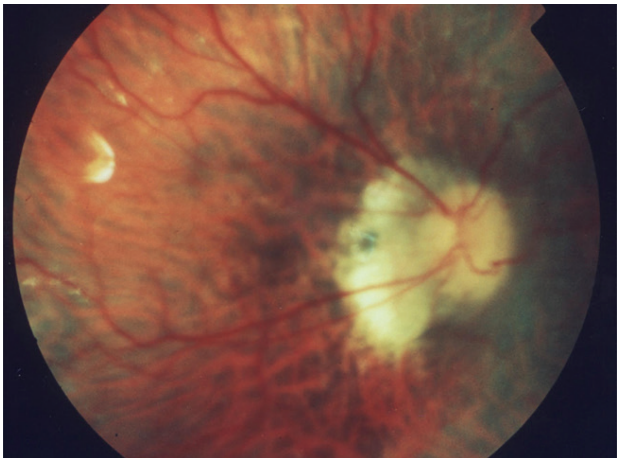

Figure 2. Postoperative fundus photo of a myopic eye that developed an RRD with PVR after LASIK. Vitrectomy and silicone oil injection were successfully performed.

10 RDs in myopic eyes after LASIK, an incidence of 0.22%.[1] Farah and colleagues reported on four eyes that had RRD within 3 months of LASIK for correction of high myopia.[28] One case report details the development of an inferior RD due to two inferior horseshoe tears diagnosed 14 hours after LASIK surgery in a patient with -13 D of myopia.[29]

No causal relationship between LASIK and RD can be stated from these studies. LASIK may be associated with RD, particularly in highly myopic eyes. In myopic eyes, the yearly incidence of RD has been estimated to range from 0.015% to 0.075%, thought to be related to premature vitreous liquefaction and early posterior vitreous detachment.[30]

Ruiz-Moreno et al studied the incidence of retinal disease observed in 9,239 consecutive eyes of 5,099 patients after refractive surgery, including LASIK.[31] RD occurred at a mean 24.6 ±20.4 months after LASIK in 11 eyes (0.36%). We have previously reported a 2-year study including 29,916 eyes after LASIK for the correction of ametropias, both myopia and hyperopia. The incidence of vitreoretinal pathology at 24 months in our study was 0.06%, including 14 RRDs (Figures 1 and 2).[21] The incidence of RRD after LASIK in our previous studies ranges between 0.04% and 0.05%.[32]

In our 10-year follow-up study including a total of 11,594 patients, 22 eyes (19 patients) developed an RRD after LASIK.[33] Patients underwent surgical correction of myopia of -1.50 to -10.00 D (mean -4.50 D). RRD occurred between 1 month and 13 years (mean 31.6 months) after LASIK, with increasing frequency at longer follow-up intervals. The frequency of RRD was 0.05% at 1 year, 0.15% at 5 years, and 0.19% at 10 years.[33] Patients were scheduled to be seen on postoperative day 1, at 3 and 12 months, and yearly thereafter. The clinical findings, frequency of RRD after LASIK, characteristics (evaluations of fundus drawings), and surgical outcomes of 22 eyes were presented in that report. Preoperative examinations included a thorough dilated funduscopy with scleral depression and treatment of any retinal lesion predisposing to the development of an RRD.

The average age in the 19 patients with RRD after LASIK was 41.8 (range, 22-70) years, and 12 (54.5%) were male. In this series, 1.5% required treatment of predisposing retinal lesions before LASIK, but no patients who developed an RRD after LASIK had had previous prophylactic treatment of peripheral retinal lesions. No patient had a history of any ocular surgery after LASIK. RDs were managed with vitrectomy, cryoretinopexy, scleral buckling, argon laser retinopexy, and pneumatic retinopexy. Vitreoretinal surgery to repair RRD after LASIK was performed at a mean of 34.8 days (range, 7 days to 3 months) after the onset of visual symptoms. The mean follow-up after retinal surgery was 8.7 years (range, 1 month to 12 years).

Final BCVA after surgery improved by 2 or more lines from preoperative value in 57.1% of eyes. Poor visual acuity (20/200 or worse) occurred in 31.8% of eyes. Reasons for poor visual acuity included epiretinal membrane, myopic maculopathy, development of proliferative vitreoretinopathy (PVR), and optic atrophy. Anatomic success after one surgery was 100%.

CAN WE PREDICT RETINAL COMPLICATIONS?

The incidence of vitreoretinal pathology after LASIK in our study ranged from 0.05% to 0.19% (annual incidence 0.02%).[33] This number is much lower than the incidence of RRD in myopes in general.[3] This finding may be explained by the fact that refractive surgery patients in the institutions involved underwent preoperative examinations including a very thorough dilated indirect funduscopy with scleral depression and treatment of any peripheral retinal lesion predisposing for the development of an RRD before LASIK. In this study, extensive lattice degeneration, flap tears, atrophic holes, and retinal tufts were prophylactically

> "At this time, it is not possible to scientifically determine whether peripheral retinal lesions should be treated differently from standard practice in a preoperative evaluation for LASIK.

treated regardless of symptoms. Such indication is justified by the fact that vitreoretinal surgery causes changes in corneal shape, thus damaging the refractive surgeon's results. We suggest that cryopexy, argon laser retinopexy, pneumatic retinopexy, or vitrectomy without a scleral band be performed when appropriate because they tend not to change the shape or length of the globe. Another option in case of scleral buckling procedures is to remove the exoplants early, after ensuring that all breaks have sealed and that no RD is present.

Lin and Tseng recently published a study assessing the efficacy and safety of prophylactic laser photocoagulation for retinal breaks in myopic patients undergoing LASIK.[18] Retinal breaks were identified and treated in 39 eyes (2%) of 32 patients (3%). During a mean 19-month follow-up, none of the patients developed RRD except one patient without retinal breaks who sustained ocular trauma 19 months after LASIK.

Chan et al[34] suggested that pre-LASIK retinal examination might help predict locations of certain post-LASIK retinal lesions (breaks, RDs) that may develop in highly myopic eyes with pre-LASIK vitreoretinal pathology (lattice, breaks); however they also noted, prophylactic treatment of vitreoretinal pathology before LASIK does not guarantee the prevention of post-LASIK vitreoretinal complications.

Based on published data, we cannot determine whether prophylactic treatment is indicated in patients who are candidates for refractive surgery. At this time, it is not possible to scientifically determine whether peripheral retinal lesions should be treated differently from standard practice in a preoperative evaluation for LASIK. Most practitioners suggest that patients scheduled for LASIK be carefully examined with indirect ophthalmoscopy and scleral depression under pupillary dilatation to detect any myopic peripheral lesion that requires treatment before LASIK is performed. One could argue that this is prudent in myopes whether or not they undergo LASIK; given the potential of the procedure to

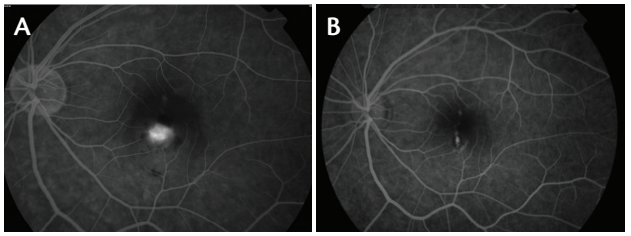

Figure 3. Subfoveal CNV after LASIK was diagnosed with fluorescein angiography (A). The CNV was treated with one intravitreal bevacizumab (Avastin, Genentech) injection. After treatment, the CNV was totally closed with a small central area of staining and no leakage (B).

exacerbate preexisting pathology, it might be wise to treat such pathology more aggressively.

Another important factor to take into consideration when we evaluate our state of knowledge in this area is the duration of follow-up. In our 10-year follow-up study, the incidence of RRD increased with time, with an annual incidence of 0.02%. It is possible that LASIK-induced trauma might accelerate vitreous liquefaction and that, over the years, these patients might have a higher incidence of RDs and other vitreoretinal problems. It is equally likely that, with the current practice patterns of shorter periods of follow-up, ophthalmologists may be unaware of this.

Macular diseases may be a relative contraindication to LASIK. Patients with high myopia and lacquer cracks in the

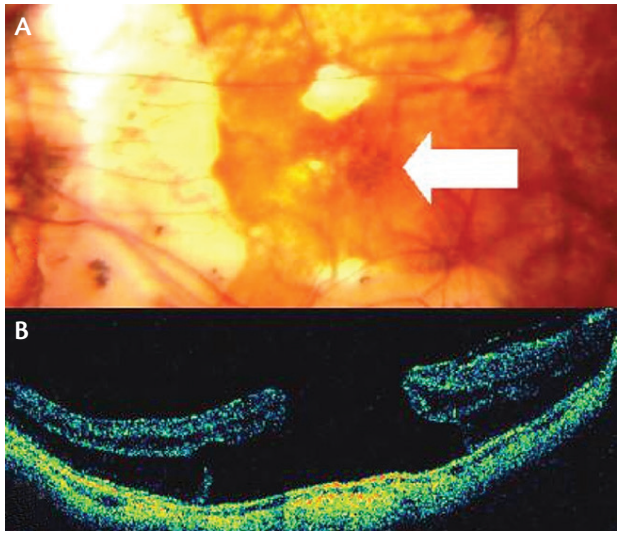

Figure 4. Fundus photography shows a stage 4 macular hole (arrow) associated with an RD localized to the posterior fundus and BCVA of counting fingers. Posterior staphyloma and myopic chorioretinal and retinal pigment epithelium (RPE) atrophy are seen (A). OCT image shows features of RD and retinoschisis. High reflectivity of the RPE-choriocapillaris complex is due to atrophy and choroidal backscatter (B).

> **"Patients with high myopia and lacquer cracks in the macula are at high risk to develop macular hemorrhage or CNV after intraocular pressure is raised with application of the suction ring during the procedure.**

macula are at high risk to develop macular hemorrhage or choroidal neovascularization (CNV) after intraocular pressure is raised with application of the suction ring during the procedure. Patients with angioid streaks and traumatic choroidal ruptures are in the same category of risk. Stage 1 macular holes may progress due to traction in the posterior pole during LASIK. In addition, eyes that are at risk of needing vitreoretinal surgery in the future are relatively contraindicated for LASIK. On the other hand, in eyes with stable macular disease (scars), LASIK may be performed, depending on the refractive surgeon's criteria, if the patient is aware of and accepts his or her visual acuity limitations.

CONCLUSIONS

Serious complications after LASIK are infrequent. It is very important to inform patients that LASIK corrects only the refractive aspect of myopia. Vitreoretinal complications in these eyes will occur, and only careful, large, prospective studies in patients can determine whether the procedure exacerbates myopic pathology. Such studies must be performed using careful prospective examinations including determination of risk factors, echography of the vitreous, indirect ophthalmoscopy with scleral depression, and possibly photography and angiography of the macular region to determine whether the LASIK procedure can exacerbate pathologic changes in the myopic eye.

In addition, our most recent study shows that results may not be as good as expected after RRD surgery. Despite high anatomic success with one surgery, reasons for poor visual acuity included the development of epiretinal membrane, PVR, myopic maculopathy, and optic atrophy. Final visual acuity may be limited by myopic degeneration, amblyopia, or delayed referral to a vitreoretinal specialist. ■

1. Aras C, Ozdamar A, Karacorlu M, Sener B, Bahcecioglu H. Retinal detachment following laser in situ keratomileusis. *Ophthalmic Surg Lasers*. 2000. 31(2):121-125.
2. Hofmann R, Starling JC, Hovland KR. Case report: retinal detachment after radial keratotomy surgery. *J Refract Surg*. 1985;1:226-230.
3. Sanders DR, Hoffman RF, Salz JJ. *Refractive Corneal Surgery*. Thorofare, NJ: Slack; 1986.
4. Feldman RM, Crapotta JA, Feldman ST, Goldbaum MH. Retinal detachment following radial and astigmatic keratotomy. *Refract Corneal Surg*. 1991;7(3):252-253.
5. Rodriguez A, Camacho H. Retinal detachment after refractive surgery for myopia. *Retina*. 1992;12(3 Suppl):S46-50.
6. Rodriguez A, Gutierrez E, Alvira G. Complications of clear lens extraction in axial myopia. *Arch Ophthalmol*. 1987;105(11):1522-1523.
7. Barraquer C, Cavelier C, Mejia LF. Incidence of retinal detachment following clear-lens extraction in myopic patients. Retrospective analysis. *Arch Ophthalmol*. 1994;112(3):336-339.
8. Ripandelli G, Billi B, Fedeli R, Stirpe M. Retinal detachment after clear lens extraction in 41 eyes with high axial myopia. *Retina*. 1996;16(1):3-6.
9. Ruiz-Moreno JM, Alió JL, Pérez-Santonja JJ, de la Hoz F. Retinal detachment in phakic eyes with anterior chamber intraocular lenses to correct severe myopia. *Am J Ophthalmol*. 1999;127(3):270-275.
10. Pallikaris IG, Papatzanaki ME, Siganos DS, Tsilimbaris MK. A corneal flap technique for laser in situ keratomileusis. Human studies. *Arch Ophthalmol*. 1991;109(12):1699-1702.
11. Pallikaris IG, Siganos DS. Excimer laser in situ keratomileusis and photorefractive keratectomy for correction of high myopia. *J Refract Corneal Surg*. 1994;10(5):498-510.
12. Bushley DM, Parmley VC, Paglen P. Visual field defect associated with laser in situ keratomileusis. *Am J Ophthalmol*. 2000;129(5):668-671.
13. Barequet IS, Levy J, Klemperer I, et al. Laser in situ keratomileusis for correction of myopia in eyes after retinal detachment surgery. *J Refract Surg*. 2005;21(2):191-193.
14. Lee AG. LASIK-induced optic neuropathy. *Ophthalmology*. 2002;109(5):817; author reply 817.
15. Najman-Vainer J, Smith RJ, Maloney RK. Interface fluid after LASIK: misleading tonometry can lead to end-stage glaucoma. *J Cataract Refract Surg*. 2000;26(4):471-472.
16. Arevalo JF, Ramirez E, Suarez E, et al. Rhegmatogenous retinal detachment in myopic eyes after laser in situ keratomileusis. Frequency, characteristics, and mechanism. *J Cataract Refract Surg*. 2001;27(5):674-680.
17. Perez-Santonja JJ, Sakla HF, Abad JL, Zorraquino A, Esteban J, Alió JL. Nocardial keratitis after laser in situ keratomileusis. *J Refract Surg*. 1997;13(3):314-317.
18. Lin SC, Tseng SH. Prophylactic laser photocoagulation for retinal breaks before laser in situ keratomileusis. *J Refract Surg*. 2003;19(6):661-665.
19. Ruiz-Moreno JM, Perez-Santonja JJ, Alio JL. Retinal detachment in myopic eyes after laser in situ keratomileusis. *Am J Ophthalmol*. 1999;128(5):588-594.
20. Lin JM, Tsai YY. Retinal phlebitis after LASIK. *J Refract Surg*. 2005;21(5):501-504.
21. Arevalo JF, Ramirez E, Suarez E, et al. Incidence of vitreoretinal pathologic conditions within 24 months after laser in situ keratomileusis. *Ophthalmology*. 2000;107(2):258-262.
22. Chan CK, Lawrence FC. Macular hole after laser in situ keratomileusis and photorefractive keratectomy. *Am J Ophthalmol*. 2001;131(5):666-667.
23. Singhvi A, Dutta M, Sharma N, Pal N, Vajpayee RB. Bilateral serous macular detachment following laser in situ keratomileusis. *Am J Ophthalmol*. 2004;138(6):1069-1071.
24. Barbara A, Shehadeh-Masha'our R, Sartani G, Garzozi HJ. Reactivation of ocular toxoplasmosis after LASIK. *J Refract Surg*. 2005;21(6):759-761.
25. Ozdamar A, Aras C, Sener B, Oncel M, Karacorlu M. Bilateral retinal detachment associated with giant retinal tear after laser-assisted in situ keratomileusis. *Retina*. 1998;18(2):176-177.
26. Stulting RD, Carr JD, Thompson KP, Waring GO 3rd, Wiley WM, Walker JG. Complications of laser in situ keratomileusis for the correction of myopia. *Ophthalmology*. 1999;106(1):13-20.
27. Faghihi H, Jalali KH, Amini A, Hashemi H, Fotouhi A, Esfahani MR. Rhegmatogenous retinal detachment after LASIK for myopia. *J Refract Surg*. 2006;22(5):448-452.
28. Farah ME, Hofling-Lima AL, Nascimento E. Early rhegmatogenous retinal detachment following laser in situ keratomileusis for high myopia. *J Refract Surg*. 2000;16(6):739-743.
29. Reviglio VE, Kuo IC, Gramajo L, Olmedo MA, Falco M, Juarez CP. Acute rhegmatogenous retinal detachment immediately following laser in situ keratomileusis. *J Cataract Refract Surg*. 2007;33(3):536-539.
30. Michels RG, Wilkinson CP, Rice TA. *Retinal Detachment*. St. Louis: Mosby; 1990: 1138.
31. Ruiz-Moreno JM, Alio JL. Incidence of retinal disease following refractive surgery in 9,239 eyes. *J Refract Surg*. 2003;19(5):534-547.
32. Arevalo JF, Ramirez E, Suarez E, et al. Rhegmatogenous retinal detachment after laser-assisted in situ keratomileusis (LASIK) for the correction of myopia. *Retina*. 2000;20(4):338-341.
33. Arevalo JF, Lasave AF, Torres F, Suarez E. Rhegmatogenous retinal detachment after LASIK for myopia of up to -10 diopters: 10 years of follow-up. *Graefes Arch Clin Exp Ophthalmol*. 2012;250(7):963-970.
34. Chan CK, Tarasewicz DG, Lin SG. Relation of pre-LASIK and post-LASIK retinal lesions and retinal examination for LASIK eyes. *Br J Ophthalmol*. 2005;89(3):299-301.
35. Zaldivar R, Davidorf JM, Oscherow S. Laser in situ keratomileusis for myopia from -5.50 to -11.50 diopters with astigmatism. *J Refract Surg*. 1998;14(1):19-25.
36. Al-Abdullah AA, Al-Falah MA, Al-Rashaed S, Khandekar R, Suarez E, Arevalo JF. Retinal complications after anterior versus posterior chamber phakic intraocular lens implantation in a myopic cohort. *J Refract Surg*. 2015;31(12):814-819.
37. Cameron BD, Saffra NA, Strominger MB. Laser in situ keratomileusis-induced optic neuropathy. *Ophthalmology*. 2001;108(4):660-665.

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