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Posterior Corneal Ectasia following LASIK

Ektazja rogówki jako powikłanie operacji LASIK

Rasik B. Vajpayee (MS, FRCSEd), Rajesh Sinha (MD, FRCS), Namrata Sharma (MD), Jeewan S. Titiyal (MD), Radhika Tandon (MD, FRCS, FRCOphth)

Rajendra Prasad Centre for Ophthalmic Sciences
All India Institute of Medical Sciences, New Delhi

Summary: Purpose: To evaluate the cases of posterior corneal ectasia following laser in situ keratomileusis.
Material and methods: Thirteen eyes of 7 patients, that were diagnosed to have posterior corneal ectasia (ł0.060mm) on Orbscan topographic system following LASIK, were identified. The parameters evaluated were uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), refraction, contrast sensitivity, glare, corneal topography, keratometry and pachymetry. The preoperative and postoperative data at day 1, 1 week, 1 month, 3 months, 6 months and 1year were retrospectively analyzed.
Results: The mean UCVA of the patients before LASIK surgery was 0.032 ± 0.04. It was 0.320 ± 0.159 in follow-up of LASIK surgery after 1 year. The mean Pre-LASIK BCVA was 0.59 ± 0.11. There was no change in mean BCVA at 1 year. The mean preoperative spherical equivalent was -14.25 ± 2.91 D except in 2 hyperopic eyes in which the mean spherical equivalent preoperatively was +5.75 ± 0.35 D. The mean postoperative spherical equivalent after 1 year of LASIK surgery in last follow-up (± enhancement) was - 3.45 ± 2.08 in the myopic eyes and +1.0 ± 0.70 in the two hyperopic eyes. The mean preoperative posterior corneal elevation was 0.022 ± 0.011mm, which at the end of 1 week following LASIK was 0.067 ± 0.009 and at 1 year/ last follow-up following LASIK, it was 0.068 ± 0.006mm.
Conclusions: Higher amplitudes of refractive correction may lead to the occurrence of posterior corneal ectasia.
Słowa kluczowe: tylna rogówkowa ektazja, keratoektazja, powikłania po operacjach LASIK.
Key words: posterior corneal ectasia, keratectasia, LASIK complications.

Laser in situ keratomileusis (LASIK) is the commonest refractive procedure performed in most part of the world. Although claims have been made to correct upto -26.0 diopters (D) (1), it is being realized that LASIK works best for low to moderate myopia (2). As the attempted correction correlates linearly with the depth of keratectomy (3), the biomechanical stability of residual stromal bed is a matter of major concern, especially in those with high refractive correction. Cases with sight threatening corneal ectasia have been reported in the literature (2,4-10). In this study, we retrospectively evaluated cases with posterior corneal ectasia following an uneventful LASIK procedure.

Material and methods

A retrospective analysis was performed of 8 eyes of 4 patients, which were diagnosed to have posterior corneal ectasia (posterior corneal elevation ≥0,060 mm) on Orbscan topographic system following LASIK, were evaluated. These patients were identified during routine follow-up in our LASIK clinic and the data were analyzed on a chart review. Eleven eyes of 6 patients had myopia while one patient had undergone LASIK for hyperopia in both the eyes.

Surgery was performed under topical anesthesia (0,5% proparacaine). A superiorly hinged flap was created by Hansatome microkeratome (Bausch and Lomb, Salt Lake City, Utah). For these eyes, an 8,5-mm suction ring was used in 6 eyes and 9,5 mm suction ring had been used in 2 eyes in which hyperopic LASIK was performed. Hansatome heads of 180-micron and 160-micron flap were used in these eyes. Laser ablation was performed by standard technique using Chiron Technolas 217 excimer laser (Chiron Vision, Claremont, CA). A minimum residual stromal bed thickness of 250 μm was planned after the ablation. The flap was reposited in place after the ablation. The undersurface was irrigated and merocel sponge was used to wipe off excess fluid. An adherence time of 2 minutes was allowed.

All patients received ciprofloxacin (0.3% QID) and fluorometholone (0.1% QID) eye drops for 2 weeks and tear supplements for 4 weeks in the postoperative period. Routine postoperative follow-up was scheduled at day 1, 1 week, 1 month, 3 months, 6 months and 1year and annually after that. The uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), refraction, contrast sensitivity, glare, corneal topography on Orbscan topography system (Bausch and Lomb, Salt Lake City, Utah), keratometry and pachymetry were performed at each follow up visit and any postoperative complications were noted.

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Sl No	A/S	OZ	Abln depth	Sph. Equivalent			UCVA			Pachymetry			Post. corn. elev		
				Preop	1 wk	1 yr*	Preop	1 wk	1 yr*	Preop	1 wk	1 yr*	Preop	1 wk	1 yr*
1	30/F	5.5	6 μ	6.0	3.0	1.5	0.1	0.25	0.25	498	434	458	0.015	.050	.060
2	30/F	5.5	7 μ	5.5	0.5	0.5	0.1	0.5	0.5	504	451	450	0.030	.075	.075
3	27/M	4.5	146 μ	-17.0	-2.25 (α)	-1.0	0.01-	. 06--	.66--. 33	512	327 (α) 308$^{\$}$	329	.015	.075 (α). 075$^{\$}$	.075
4	27/M	4.5	146 μ	-18.0	-2.0 (α)	-1.75	0.01-	. 25	--0.5--0.5	506	319 (α) 312$^{\$}$	315	.015	.070 (α). 045$^{\$}$	.070
5	29/M	4.8	198 μ	-12.5	-0.5	-3.75	0.01	0.33	0.16	560	392 (α_1) -306$^{\$}$	348	.015	.060 (α_1) -. 075$^{\$}$	.065
6	29/M	4.8	195 μ	-12.5	0	-3.75	0.01	0.33	0.16	560	435 (α_1) -302$^{\$}$	398	.015	.075 (α_1) ->. 075$^{\$}$	.065
7	18/M	5	133 μ	-10.5	-0,25	-7.0	0.01	0.66	0.16	516	334	345	.030	.075	>.075
8	18/M	4.5	141 μ	-15.0	-0,5	-3.5	0.01	0.66	0.5	520	359	381	0.045	.060	.060

Preop. – Preoperative
1 yr* – 1 year follow up/ last follow-up following LASIK
(α) – relasik after 4 months of the 1st procedure
(α_1) – relasik after 11 months of the 1st procedure
$ – complete data not available as surgery not performed at our centre
NA – Not available
M – Male
F – Female
Sl No – Serial Number
A/S – Age/ Sex
Sph. Equival. – Spherical Equivalent
Post. corn. elev. – Posterior Corneal Elevation

Result

Eight eyes of 4 patients demonstrating posterior corneal ectasia (posterior corneal elevation ≥0.060 mm) were included in the study. The mean age of the patients was 26,00 ± 5,47. Three (75%) patients were males and 1 (25%) female.

The mean preoperative UCVA of the patients was 0.032 ± 0.04. It was 0.320 ± 0.159 at 1 year follow-up following LASIK. The mean BCVA before LASIK was 0.59 ± 0.11. There was no change in mean BCVA at I year/ last follow-up after LASIK. The mean preoperative spherical equivalent was -14.25 ± 2.91 D except in 2 hyperopic eyes in which the mean preoperative spherical equivalent was 5.75 ± 0.35 D. The mean postoperative spherical equivalent at 1 year/ last follow-up following LASIK (± enhancement) surgery was -3.45 ± 2.08 in the myopic eyes and 1.0 ± 0.70 in the two hyperopic eyes. The mean preoperative corneal thickness in the myopic eyes was 529,00 μm ± 24,45 μm which changed to 352.66 μm ± 32.36 μm at 1 year/ last follow-up following LASIK. The average preoperative corneal thickness in the hyperopic eyes was 501 μm ± 4.24 μm. It was 454 μm ± 5.65 μm at 1 year/ last follow-up following LASIK. Four eyes underwent enhancement procedure to correct the residual refractive error. The mean preoperative keratometry in myopic cases was 44.17 ± 1.11 D and the same at 1 year/ last follow-up following LASIK was 41.42 ± 6.15 D while in the hyperopic eyes the mean keratometry was 44.25 ± 0.49 D and 47.37 ± 4.06 D preoperatively and at 1 year follow-up respectively. The mean preoperative contrast sensitivity on Cambridge low contrast gratings was 137.55 ± 39.29, which at 1 year/ last follow-up postoperative was 63.33 ± 18.66. The mean preoperative glare acuity on IRASGT glare tester was 0.74 ± 0.19, which at 1 year/ last follow-up postoperative was 0.25 ± 0.09. Corneal topography performed on Orbscan topographic system (Bausch and Lomb, Salt Lake City, Utah) revealed a mean preoperative posterior corneal elevation of 0.022 ± 0.011 mm. The mean posterior corneal elevation at the end of 1 week following LASIK was 0.067 ± 0.009. The average posterior corneal elevation at 1 year/ last follow-up following LASIK was 0.068 ± 0.006 mm.

Discussion

Occurrence of keratectasia following LASIK surgery can be linked to surgery in eyes with forme fruste keratoconus, suboptimal residual stromal bed thickness and possibly individual variation in the strength of corneal stromal collagen. The contention that the flap does not add to the biomechanical stability of the cornea is corroborated by the fact that upto more than 1 year after LASIK, the flap can be lifted without recutting if retreatment are required (11).

It is known that due to mechanical weakness and associated loss of tensile strength of the corneal stroma due to ablation, there is risk of keratectasia following LASIK both in presence or absence of forme-fruste keratoconus (3,4,6-10,12,13,14). Eyes with forme-fruste keratoconus undergoing LASIK surgery are very prone to development of keratectasia. Posterior corneal curvature changes following LASIK have been studied and it was found that increased negative keratometric diopters and oblate asphericity of the posterior corneal curvature indicated towards a mild keratectasia early after LASIK (15). If on Orbscan II the preoperative posterior corneal elevation is higher than 0.040 mm, there is higher risk of development of posterior corneal ectasia (16) and the patient should be demotivated for LASIK surgery. In our study all but one patient had preoperative posterior corneal elevation of <0.040 mm.

Higher amount of refractive correction requires greater amount of stromal ablation thereby resulting in lesser residual bed thickness. Most of the studies reporting keratectasia following LASIK include eyes with either forme fruste keratoconus (4,6,8,10) or in high myopia requiring great amount of stromal ablation resulting in a residual bed thickness of less than 250 μm (2,9). In our study, the mean preoperative spherical equivalent was -14.25 ± 2.91 D except in 2 hyperopic eyes in which it

was +5.75 ± 0.35 D. No eye in our study had forme fruste keratoconus. We observed that high posterior corneal elevation was detected in the immediate postoperative period i. e. at 1 week follow-up. There was minimal change in the amount of posterior corneal elevation in subsequent follow-up. In a recent study calculating the elevations of the posterior surface against the best-fit sphere using slit scanning topography, it was found that the posterior corneal bulge was correlated with the residual bed thickness and that the risk of ectasia may be increased if the residual bed thickness is less than 250 μm (17). Progressive keratectasia finally requiring a penetrating keratoplasty has been reported despite a residual bed thickness of presumably 289 μm (18). This suggests that the safety limit of residual stromal bed thickness has not been determined fully.

Individual variation in the strength of corneal stromal collagen is another important factor for the development of keratectasia. Two eyes of different individuals with similar residual bed thickness behave differently in terms of anterior and posterior corneal elevation following LASIK surgery.

In the present study we also report 2 eyes in which posterior corneal ectasia occurred after LASIK surgery for hyperopia. To the best of our knowledge posterior keratectasia following hyperopic LASIK has not been reported in the literature. Perhaps the creation of the corneal flap and the resulting loss of structural integrity of Bowman's membrane is partly responsible for the posterior corneal curvature changes following LASIK (16).

Conclusion

Our study demonstrates that higher amplitudes of refractive correction with LASIK may give rise to development of posterior corneal ectasia. LASIK surgery should preferably be performed in eyes with low or moderate amount of refractive error.

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Address for Correspondence:
Rasik B. Vajpayee, MS, FRCSEd
492, R. P. Centre for Ophthalmic Science
All India Institute of Medical Sciences
New Delhi – 110029

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