ARTICLE

Long-term quality of life after posterior chamber phakic intraocular lens implantation and after wavefront-guided laser in situ keratomileusis for myopia

Hidenaga Kobashi, MD, PhD, Kazutaka Kamiya, MD, PhD, Akihito Igarashi, MD, PhD, Kazuhiro Matsumura, MD, Mari Komatsu, MD, PhD, Kimiya Shimizu, MD, PhD

PURPOSE: To compare the vision-related quality of life 5 years after Implantable Collamer Lens phakic intraocular lens (pIOL) implantation and after wavefront-guided laser in situ keratomileusis (LASIK) for myopia.

SETTING: Department of Ophthalmology, Kitasato University, Kanagawa, Japan.

DESIGN: Retrospective case series.

METHODS: Quality of life was measured with the National Eye Institute Refractive Error Quality of Life instrument in consecutive patients 5 years after pIOL implantation or wavefront-guided LASIK to correct myopia.

RESULTS: Phakic IOL implantation was performed in 48 patients and LASIK in 55 patients. The scores for activity limitations, symptoms, appearance, and satisfaction with correction were significantly higher in the pIOL group than in the LASIK group ($P<.05$, Mann-Whitney U test). No significant differences in other scores were observed between the 2 groups ($P\geq.05$). The scores for near vision and dependence on correction were significantly higher in the younger subgroup than in the older subgroup with both techniques.

CONCLUSIONS: Phakic IOL implantation may offer significant vision-related quality-of-life advantages (eg, fewer activity limitations and symptoms and better appearance and satisfaction with correction) over wavefront-guided LASIK for myopia in the long term. Moreover, refractive surgery may provide a better quality of life in younger patients.

Financial Disclosure: Dr. Shimizu is a consultant to Staar Surgical Co. No other author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2014; 40:2019–2024 © 2014 ASCRS and ESCRS

The Visian Implantable Collamer Lens posterior chamber phakic intraocular lens (pIOL) (Staar Surgical Co.) is reported to be effective for the correction of moderate to high ametropia.[1–4] We previously reported that pIOL implantation induces significantly fewer ocular higher-order aberrations (HOAs) than wavefront-guided laser in situ keratomileusis (LASIK).[4,5] We also showed that contrast sensitivity function was significantly improved after pIOL implantation but that it was not significantly changed after wavefront-guided LASIK for low to moderate myopia[5]; contrast sensitivity was significantly worse after wavefront-guided LASIK for moderate to high myopia.[4]

Most evaluations of visual performance after pIOL implantation focused on visual and refractive outcomes, with some testing in the contrast domain.[4–6] These objective measures are of clinical importance but fail to highlight important symptomatic or functional problems.[7] Questionnaires have been developed to provide a more direct measure of subjective visual function and quality-of-life changes associated with refractive surgery. Validated instruments include the Refractive Status and Vision Profile,[8,9] the

National Eye Institute Refractive Quality of Life (NEI-RQL),[10–12] the Canadian Refractive Surgery Research Group instrument,[13] and the Quality of life Impact of Refractive Correction (QIRC).[14–16] However, to our knowledge, comparison of refractive error–specific quality of life, which plays an important role in patient satisfaction after pIOL implantation and wavefront-guided LASIK, has not been performed. In view of the prevalence of these surgical procedures, it is essential to evaluate the long-term subjective symptoms and patient satisfaction. However, until now, no study has assessed the long-term (>6 months) vision-related quality-of-life outcomes after surgery.

The purpose of the present study was to retrospectively compare the postoperative vision-related quality of life 5 years after pIOL implantation and after wavefront-guided LASIK in patients with myopia using the NEI-RQL instrument.

PATIENTS AND METHODS

This study comprised patients who had pIOL implantation or wavefront-guided LASIK for the correction of myopia and who completed a 5-year follow-up. The retrospective review of data was approved by the Institutional Review Board (IRB), Kitasato University, and followed the tenets of the Declaration of Helsinki. The IRB waived the requirement for informed consent for this study.

Some patients were part of previous studies of visual acuity, HOAs, and contrast sensitivity after pIOL implantation and after wavefront-guided LASIK.[4,5,17] The preoperative manifest refraction was selected as the targeted correction in all eyes. Eyes with keratoconus were excluded from the study based on the results of a Placido-disk videokeratography keratoconus screening test (TMS-2, Tomey Corp.).

Surgical Technique

Phakic Intraocular Lens Implantation Preoperatively, 2 peripheral iridotomies were created with a neodymium:YAG laser. On the day of surgery, patients were given dilating and cycloplegic agents. Topical anesthesia was administered and sodium hyaluronate 1.0% (Opegan) placed in the anterior chamber. Next, a model V4 Implantable Collamer Lens pIOL was inserted through a 3.0 mm clear corneal incision with an injector cartridge (Staar Surgical Co.). The pIOL was placed in the posterior chamber. To control for potential cyclotorsion with the patient supine, the zero horizontal axis was marked preoperatively at the slitlamp. In addition, a Mendez ring was used for intraoperative measurement of the required rotation from the horizontal axis. After the pIOL had been placed in the posterior chamber, it was rotated by 22.5 degrees or less using the manipulator. Then, the remaining ophthalmic viscosurgical device was completely washed out of the anterior chamber with a balanced salt solution, and acetylcholine chloride (Ovisort) was instilled. Postoperatively, betamethasone 0.1% (Rinderon) and levofloxacin 0.5% (Cravit) were administered topically 4 times daily for 2 weeks; the dose was steadily reduced thereafter.

Laser in Situ Keratomileusis Wavefront-guided LASIK was performed with the Technolas 217z excimer laser system (Bausch & Lomb) using a wavefront-guided ablation algorithm (Zyoptix, version 3.1). A flying spot of 1.0 or 2.0 mm in diameter with a Gaussian profile was applied, and a 120 Hz active eye tracker was used. An LSK-1 microkeratome (Moria) was used to create a 130 µm thick hinged corneal flap. After surgery, fluorometholone 0.1% (Flumetholone) and levofloxacin 0.5% were topically administered 4 times daily for 2 weeks.

Refraction, Visual Acuity, and Vision-Related Quality of Life

The refraction, logMAR uncorrected distance visual acuity (UDVA), logMAR corrected distance visual acuity (CDVA), and vision-related quality of life 5 years postoperatively were assessed. A single examiner performed all measurements. Monocular data from the better eye was used throughout for between-group comparisons in accordance with the recommendations of Ieong et al.[15,16]

Vision-related quality of life was evaluated (with no correction) using the adapted Japanese version of the NEI-RQL instrument-42 scale. This 42-item instruments has 13 scales covering specific aspects of quality of life.[10–12] Each scale has a score from 0 to 100. A higher score indicates a higher self-reported quality of life. The linguistic translation followed the international guidelines of forward and backward translation.[18] Five years after surgery, the patients were also asked about their range of visual clarity and whether they experienced blur at any distance. Patients were also asked questions about whether they experienced any level of blur to establish whether the blur affected overall quality of vision. All patients provided written permission before completing the NEI-RQL questionnaire. To determine the effect of age on vision-related quality of life, patients were divided into 2 subgroups based on age (<40 or ≥40 years).

In addition, to assess the test–retest reliability of the adapted Japanese version of the NEI-RQL questionnaire, the patients in the pIOL group were asked to return for a second visit within 1 month. The reliability was tested by calculating the Cronbach α coefficient[19] for internal consistency and by measuring the test–retest reliability using intraclass correlation coefficients (ICCs) and their 95% confidence intervals (CIs). The recommended α values for scales to ensure internal consistency is greater than 0.70. It is also generally recommended that the ICC exceed 0.90 if an instrument is to be used for individual patients in clinical practice and that the ICC exceed 0.70 for discriminating between groups of patients in research.[20]

Submitted: February 7, 2014.
Final revision submitted: March 18, 2014.
Accepted: March 21, 2014.

From the Departments of Ophthalmology, University of Kitasato School of Medicine (Kobashi, Kamiya, Igarashi, Matsumura, Shimizu), Kanagawa, and Sanno Hospital (Komatsu), Tokyo, Japan.

Corresponding author: Hidenaga Kobashi, MD, PhD, Department of Ophthalmology, University of Kitasato School of Medicine, 1-15-1 Kitasato, Minami, Sagamihara, Kanagawa 252-0374, Japan. E-mail: himon@hotmail.co.jp.

Table 1. Patient demographics by group.

Characteristic	pIOL Group	LASIK Group	*P* Value
Age (y)			
Mean ± SD	38.2 ± 9.3	37.0 ± 8.5	.59
Range	22, 59	17, 53	
Preop MRSE (D)			
Mean ± SD	−9.97 ± 2.51	−6.31 ± 2.20	<.001
Range	−3.00, −14.50	−3.00, −12.88	
MRSE 5 years postop (D)			
Mean ± SD	−0.27 ± 0.44	−0.41 ± 0.61	.36
Range	−2.00, 1.00	−1.88, 0.50	
UDVA 5 years postop (logMAR)			
Mean ± SD	−0.06 ± 0.18	0.00 ± 0.21	.19
Range	−0.30, 0.70	−0.30, 0.82	
CDVA 5 years postop (logMAR)			
Mean ± SD	−0.21 ± 0.08	−0.18 ± 0.06	.12
Range	−0.30, −0.08	−0.30, 0.00	

CDVA = corrected distance visual acuity; LASIK = laser in situ keratomileusis; MRSE = manifest refraction spherical equivalent; pIOL = phakic intraocular lens; UDVA = uncorrected distance visual acuity

Table 2. The NEI-RQL scale scores 5 years postoperatively by treatment group.

Scale	Mean ± SD		*P* Value
	pIOL Group	LASIK Group	
Clarity of vision	84.72 ± 17.68	75.23 ± 25.04	.07
Expectations	57.81 ± 42.89	71.36 ± 38.91	.09
Near vision	85.55 ± 19.00	84.05 ± 20.31	.74
Far vision	83.23 ± 18.36	82.36 ± 21.12	.98
Diurnal fluctuations	79.17 ± 22.40	73.56 ± 27.75	.37
Activity limitations	98.96 ± 6.36	91.82 ± 16.62	.002
Glare	77.08 ± 21.32	77.27 ± 24.89	.60
Symptoms	89.66 ± 12.70	81.69 ± 18.11	.02
Dependence on correction	73.26 ± 29.75	75.83 ± 26.89	.78
Worry	74.48 ± 26.42	66.36 ± 33.41	.33
Suboptimal correction	100.00 ± 0.00	96.82 ± 14.68	.06
Appearance	97.92 ± 3.41	89.82 ± 20.20	.01
Satisfaction with correction	83.75 ± 16.84	74.91 ± 21.16	.03

LASIK = laser in situ keratomileusis; MRSE = manifest refraction spherical equivalent; pIOL = phakic intraocular lens

Statistical Analysis

The sample size in this study offered 92% statistical power at the 5% level to detect a 10-point difference in NEI-RQL score between the 2 groups when the standard deviation (SD) of the mean difference was 15.

All statistical analyses were performed using SPSS software (SPSS, Inc.). The Mann-Whitney *U* test was used to compare the data between the 2 groups. The results are expressed as the mean ± SD, and a *P* value less than 0.05 was considered statistically significant.

RESULTS

The pIOL group comprised 48 patients (18 men, 30 women) and the LASIK group, 55 patients (13 men, 42 women). Table 1 shows the patient demographics. In the pIOL group, a nontoric pIOL was implanted in 25 eyes (52%) with a manifest cylinder of 1.25 D or less and a toric pIOL in 23 eyes (48%) with the manifest cylinder of 1.50 D or more.

In the pIOL group, no clinically significant symptomatic cataract, pigment dispersion glaucoma, pupillary block, or other vision-threatening complication occurred in any eye over the 5-year follow-up. In the LASIK group, there were no significant complications, such as diffuse lamellar keratitis, epithelial ingrowth, severe dry eye, or keratectasia.

Table 2 shows the postoperative NEI-RQL scale scores. The scores for activity limitations, symptoms, appearance, and satisfaction with correction were statistically significantly higher in the pIOL group than in the LASIK group. There were no significant differences in clarity of vision, expectations, near vision, far vision, diurnal fluctuations, glare, dependence on correction, worry, or suboptimal correction between the 2 groups.

Table 3 shows the NEI-RQL scale scores in the pIOL group divided into 2 subgroups based on age. The scores for near vision, dependence on correction, worry, appearance, and satisfaction with correction were statistically significantly higher in the younger subgroup than in the older subgroup. There were no significant differences in clarity of vision, expectations, far vision, diurnal fluctuations, activity limitations, glare, or symptoms between the 2 subgroups.

Table 4 shows the NEI-RQL scale scores in the wavefront-guided LASIK group divided into 2 subgroups based on age. The scores for near vision, diurnal fluctuations, and dependence on correction were statistically significantly higher in the younger subgroup than in the older subgroup. There were no significant differences in clarity of vision, expectations, far vision, activity limitations, glare, symptoms, worry, suboptimal correction, appearance, or satisfaction with correction between the 2 subgroups.

Table 5 shows the reliability estimates for the NEI-RQL. The internal consistency of the NEI-RQL scales was generally high. Two scales—glare (Cronbach $\alpha = 0.61$) and appearance (Cronbach $\alpha = 0.67$)

Table 3. The NEI-RQL scale scores 5 years after pIOL implantation by age subgroup.

Scale	Mean ± SD		*P* Value
	Younger (n = 28)*	Older (n = 20)†	
Age (y)	31.8 ± 5.2	47.3 ± 4.9	<.001
Clarity of vision	86.98 ± 12.96	81.69 ± 23.35	.63
Expectations	62.50 ± 42.22	48.68 ± 43.68	.35
Near vision	94.42 ± 8.56	73.46 ± 23.16	<.001
Far vision	86.67 ± 15.75	77.28 ± 20.89	.26
Diurnal fluctuations	82.29 ± 19.79	74.12 ± 26.01	.38
Activity limitations	99.78 ± 1.18	97.70 ± 10.04	.79
Glare	76.79 ± 18.54	77.63 ± 25.88	.55
Symptoms	90.43 ± 8.36	88.35 ± 17.69	.43
Dependence on correction	86.31 ± 22.59	55.26 ± 30.14	<.001
Worry	80.80 ± 22.69	66.45 ± 29.77	.04
Suboptimal correction	100.00 ± 0.00	100.00 ± 0.00	NA
Appearance	98.81 ± 2.60	96.49 ± 4.08	.04
Satisfaction with correction	89.29 ± 12.74	75.79 ± 19.53	.008

NA = not available
*Range 28 to 39 years
†Range 40 to 59 years

Table 4. The NEI-RQL scale scores 5 years after wavefront-guided LASIK by age subgroup.

Scale	Mean ± SD		*P* Value
	Younger (n = 35)*	Older (n = 20)†	
Age (y)	31.9 ± 5.6	46.1 ± 3.9	<.001
Clarity of vision	74.94 ± 25.44	75.73 ± 24.97	.85
Expectations	77.14 ± 35.03	61.25 ± 44.04	.17
Near vision	89.11 ± 17.76	75.21 ± 21.88	.006
Far vision	84.29 ± 21.15	79.00 ± 21.17	.23
Diurnal fluctuations	78.45 ± 27.54	65.00 ± 26.64	.03
Activity limitations	90.54 ± 18.96	94.06 ± 11.56	.99
Glare	78.93 ± 24.02	74.38 ± 26.74	.46
Symptoms	82.14 ± 19.31	80.89 ± 16.23	.54
Dependence on correction	82.26 ± 24.32	64.58 ± 28.05	.03
Worry	66.79 ± 35.48	65.63 ± 30.31	.69
Suboptimal correction	95.36 ± 18.21	99.38 ± 2.80	.59
Appearance	89.14 ± 22.58	91.00 ± 15.64	.42
Satisfaction with correction	76.57 ± 21.95	72.00 ± 19.89	.35

*Range 17 to 38 years
†Range 40 to 53 years

—had internal consistencies of less than 0.70. The overall test–retest reliability of the NEI-RQL was excellent, with an ICC of 0.94 (95% CI, 0.90-0.96). No NEI-RQL scale had an ICC value less than 0.70.

DISCUSSION

In the current study, several scales on the NEI-RQL instrument were statistically significantly higher 5 years after pIOL implantation than 5 years after wavefront-guided LASIK for myopia. Although we found no

Table 5. Internal consistency and test–retest reliability of the NEI-RQL scales.

Subscale (# of Items)	Internal Consistency (Cronbach α)	Test–Retest Reliability	
		ICC	95% CI
Clarity of vision (4)	0.75	0.82	0.73, 0.89
Expectations (2)	0.90	0.90	0.81, 0.96
Near vision (4)	0.88	0.90	0.85, 0.93
Far vision (5)	0.79	0.89	0.81, 0.93
Diurnal fluctuations (2)	0.83	0.79	0.64, 0.89
Activity limitations (4)	0.74	0.82	0.73, 0.90
Glare (2)	0.61	0.73	0.60, 0.85
Symptoms (7)	0.76	0.84	0.78, 0.90
Dependence on correction (4)	0.85	0.88	0.83, 0.92
Worry (2)	0.77	0.79	0.65, 0.89
Suboptimal correction (2)	0.71	0.74	0.55, 0.87
Appearance (3)	0.67	0.77	0.60, 0.89
Satisfaction with correction (1)	*	0.92	0.90, 0.94
Overall (42)	0.90	0.94	0.90, 0.96

CI = confidence interval; ICC = intraclass correlation coefficients
*Undefined

significant differences in UDVA or CDVA between the 2 groups, pIOL implantation improved several areas of visual function relevant to quality of life, such as activity limitations, symptoms, appearance, and satisfaction with correction. The primary goal of this study was to clinically compare the long-term subjective symptoms and patient satisfaction between the 2 surgical techniques, which are based on fundamentally different indications, especially preoperative MRSE. As far as we can ascertain, this is the first published study to compare vision-related quality of life, which plays an important role in patient satisfaction, after pIOL implantation and wavefront-guided LASIK. There have been several published studies of the quality of life after refractive surgery.[8–16] However, these studies did not compare the 2 surgical techniques. To our knowledge, this is also the first study to assess the long-term quality-of-life outcomes after pIOL implantation and wavefront-guided LASIK. We believe that long-term assessment of vision-related quality of life after these 2 types of refractive surgery is clinically helpful given their popularity.

With regard to activity limitations, we asked whether the patients had difficulty taking part in active sports or other outdoor activities, such as hiking, swimming, aerobics, team sports, or jogging. In the current study, the scores show that these activities were more difficult for patients who had wavefront-guided LASIK than for patients who had pIOL implantation. A reason for this finding might be that the deterioration in visual performance after wavefront-guided LASIK restricts performance of these activities.

The symptoms of dryness, pain, or discomfort occurred with greater frequency in patients who had wavefront-guided LASIK than in those who had pIOL implantation. Dry-eye symptoms are a common complaint after LASIK, with the incidence ranging from 3% to 59%.[21,22] Corneal flap creation and ablation of the stroma during LASIK interrupts the afferent sensory nerve fibers, which can induce dry eyes by altering blink rates, decreasing tear production, or increasing neurotrophic effects on the epithelium.[23] Our findings suggest that pIOL implantation may be less stressful than LASIK to the ocular surface.

The scores for appearance and satisfaction with correction were also better in the pIOL group than in the LASIK group. Preoperatively, patients with higher refractive errors have more lifestyle limitations[24] and they may correct their refraction using a higher power of spectacle or contact lens. We believe that the preoperative refractive status may have affected our vision-related quality-of-life results.

In addition, the scores for the near vision and dependence on correction scales were significantly different between the younger subgroup and the older subgroup with both surgical techniques. It is reasonable that it is more difficult for older patients than for younger patients to obtain good uncorrected near visual acuity because of the presence of presbyopia in the former group. This suggests that refractive surgery, such as pIOL implantation and LASIK, may provide a higher quality of life in younger patients.

The psychometric properties of the Japanese NEI-RQL are similar to those of the original NEI-RQL. In terms of reliability, except for 2 subscales, the calculated Cronbach α coefficients were high. In agreement with results in a previous study,[12] the glare and appearance scales had an internal consistency of less than 0.70. The Japanese version of the NEI-RQL performed better in terms of test–retest reliability, which is consistent with results in previous studies.[12,25] The Japanese version of the NEI-RQL appears to be a reliable and effective instrument to assess subjective outcomes after pIOL implantation.

This study has at least 3 limitations. First, we did not completely match the preoperative MRSE and other preoperative factors between the 2 groups. We believe that the postoperative clinical outcomes were influenced mainly by the preoperative refraction. However, the higher myopic refraction in the pIOL group tended to bias the data in favor of the wavefront-guided LASIK group because it was often associated with poor safety, efficacy, predictability, and stability of the procedure. We believe that this information is meaningful to compare 2 surgical procedures in a clinical setting. Second, we did not assess the preoperative quality of vision in all eyes. In studies using the QIRC instrument,[16,26] significant improvements in quality of life were found not only after pIOL implantation but also after LASIK for myopia. Although it remains unclear whether our results using the NEI-RQL questionnaire are on a par with those using the QIRC questionnaire, our patients in both groups would have also shown significant gains in quality of life using the QIRC instrument. Third, this study was performed in a retrospective fashion. A prospective study is needed to compare the vision-related quality of life between the 2 techniques.

In conclusion, pIOL implantation may offer significant vision-related quality-of-life advantages over wavefront-guided LASIK for myopia in the long term. Advantages include less activity limitations, fewer symptoms, better appearance, and better satisfaction with correction. Moreover, for each technique, the near vision and dependence on correction scores were significantly higher in the younger subgroup than in the older subgroup, indicating that refractive surgery yields a higher quality of life in younger patients.

WHAT WAS KNOWN

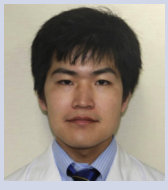
- Most evaluations of visual performance after pIOL implantation or wavefront-guided LASIK focused on visual and refractive outcomes, with some testing in the contrast domain.

WHAT THIS PAPER ADDS

- Phakic IOL implantation offered significant vision-related quality-of-life advantages over wavefront-guided LASIK for myopia 5 years postoperatively.

REFERENCES

1. Sanders DR, Brown DC, Martin RG, Shepherd J, Deitz MR, DeLuca M. Implantable contact lens for moderate to high myopia: phase 1 FDA clinical study with 6-month follow-up. J Cataract Refract Surg 1998; 24:607–611
2. Uusitalo RJ, Aine E, Sen NH, Laatikainen L. Implantable contact lens for high myopia. J Cataract Refract Surg 2002; 28:29–36
3. Lackner B, Pieh S, Schmidinger G, Hanselmayer G, Dejaco-Ruhswurm I, Funovics MA, Skorpik C. Outcome after treatment of ametropia with implantable contact lenses. Ophthalmology 2003; 110:2153–2161
4. Igarashi A, Kamiya K, Shimizu K, Komatsu M. Visual performance after implantable collamer lens implantation and wavefront-guided laser in situ keratomileusis for high myopia. Am J Ophthalmol 2009; 148:164–170
5. Kamiya K, Igarashi A, Shimizu K, Matsumura K, Komatsu M. Visual performance after posterior chamber phakic intraocular lens implantation and wavefront-guided laser in situ keratomileusis for low to moderate myopia. Am J Ophthalmol 2012; 153:1178–1186
6. Jiménez-Alfaro I, Gómez-Tellería G, Bueno JL, Puy P. Contrast sensitivity after posterior chamber phakic intraocular lens implantation for high myopia. J Refract Surg 2001; 17:641–645
7. Massof RW, Rubin GS. Visual function assessment questionnaires. Surv Ophthalmol 2001; 45:531–548
8. Schein OD, Vitale S, Cassard SD, Steinberg EP. Patient outcomes of refractive surgery; the Refractive Status and Vision Profile. J Cataract Refract Surg 2001; 27:665–673
9. Vitale S, Schein OD, Meinert CL, Steinberg EP. The Refractive Status and Vision Profile; a questionnaire to measure vision-related quality of life in persons with refractive error. Ophthalmology 2000; 107:1529–1539
10. Hays RD, Mangione CM, Ellwein L, Lindblad AS, Spritzer KL, McDonnell PJ; for the NEI-RQL Research Group. Psychometric properties of the National Eye Institute-Refractive Error Quality of Life instrument. Ophthalmology 2003; 110:2292–2301
11. McDonnell PJ, Mangione C, Lee P, Lindblad AS, Spritzer KL, Berry S, Hays RD; for the NEI-RQL Research Group. Responsiveness of the National Eye Institute Refractive Error Quality of Life instrument to surgical correction of refractive error. Ophthalmology 2003; 110:2302–2309
12. Nichols JJ, Mitchell GL, Saracino M, Zadik F. Reliability and validity of refractive error-specific quality-of-life instruments. Arch Ophthalmol 2003; 121:1289–1296. Available at: http://archopht.jamanetwork.com/data/Journals/OPHTH/9912/EEB20032.pdf. Accessed September 1, 2014
13. Brunette I, Gresset J, Boivin J-F, Boisjoly H, Makni H; the Canadian Refractive Surgery Research Group. Functional outcome and satisfaction after photorefractive keratectomy. Part 1: development and validation of a survey questionnaire. Ophthalmology 2000; 107:1783–1789
14. Pesudovs K, Garamendi E, Elliott DB. The Quality of Life Impact of Refractive Correction (QIRC) Questionnaire: development and validation. Optom Vis Sci 2004; 81:769–777. Available at: http://journals.lww.com/optvissci/Fulltext/2004/10000/The_Quality_of_Life_Impact_of_Refractive.9.aspx. Accessed September 1, 2014
15. Ieong A, Rubin GS, Allan BDS. Quality of life in high myopia; implantable Collamer lens implantation versus contact lens wear. Ophthalmology 2009; 116:275–280
16. Ieong A, Hau SCH, Rubin GS, Allan BDS. Quality of life in high myopia before and after implantable collamer lens implantation. Ophthalmology 2010; 117:2295–2300
17. Kamiya K, Shimizu K, Igarashi A, Komatsu M. Comparison of Collamer toric contact lens implantation and wavefront-guided laser in situ keratomileusis for high myopic astigmatism. J Cataract Refract Surg 2008; 34:1687–1693; erratum, 2011
18. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol 1993; 46:1417–1432
19. Bland JM, Altman DG. Cronbach's alpha [Statistical notes]. BMJ 1997; 314:572. Available at: http://www.bmj.com/content/bmj/314/7080/572.full.pdf. Accessed September 1, 2014
20. Fayers P, Machin D. Quality of Life: Assessment, Analysis, and Interpretation. New York, NY, John Wiley & Sons, 2000
21. Yu EYW, Leung A, Rao S, Lam DSC. Effect of laser in situ keratomileusis on tear stability. Ophthalmology 2000; 107:2131–2135
22. Jabbur NS, Sakatani K, O'Brien TP. Survey of complications and recommendations for management in dissatisfied patients seeking a consultation after refractive surgery. J Cataract Refract Surg 2004; 30:1867–1874
23. Vroman DT, Sandoval HP, Fernández de Castro LE, Kasper TJ, Holzer MP, Solomon KD. Effect of hinge location on corneal sensation and dry eye after laser in situ keratomileusis for myopia. J Cataract Refract Surg 2005; 31:1881–1887
24. Zaldivar R, Oscherow S, Piezzi V. Bioptics in phakic and pseudophakic intraocular lens with the Nidek EC-5000 excimer laser. J Refract Surg 2002; 18:S336–S339
25. Toker E, Onal S, Eraslan M, Eyriparmak M. The Turkish version of the National Eye Institute Refractive Error Quality of Life instrument: translation, validity and reliability. Qual Life Res 2008; 17:1269–1276
26. Garamendi E, Pesudovs K, Elliott DB. Changes in quality of life after laser in situ keratomileusis for myopia. J Cataract Refract Surg 2005; 31:1537–1543



First author:
Hidenaga Kobashi, MD, PhD

Department of Ophthalmology, University of Kitasato School of Medicine, Kanagawa, Japan