

LASIK World Literature Review

Quality of Life and Patient Satisfaction

Kerry D. Solomon, MD,¹ Luis E. Fernández de Castro, MD,¹ Helga P. Sandoval, MD, MSCR,¹ Joseph M. Biber, MD,¹ Brian Groat, MD,¹ Kristiana D. Neff, MD,¹ Michelle S. Ying, MD, MSPH,¹ John W. French, MD,¹ Eric D. Donnenfeld, MD,² Richard L. Lindstrom, MD,³ for the Joint LASIK Study Task Force*

Purpose: To analyze the patient reported outcome of satisfaction after LASIK surgery.

Design: Systematic review.

Participants: Patient data from previously reported studies.

Methods: A literature search conducted for the years 1988 to 2008 that included pertinent LASIK surgery information from the review of 2915 retrieved citations. All abstracts from these citations were reviewed and 1581 were deemed to be relevant for review. Complete copies of each of these relevant (1581) articles were obtained, and after thorough analysis each was rated based on the strength of the study design and weight of evidence. A level I rating was assigned to properly conducted, well-designed, randomized clinical trials; a level II rating to well-designed cohort and case-control studies; and a level III rating to case series, case reports, and poorly designed prospective and retrospective studies. Level I and II rated, peer-reviewed articles were entered into a database, and level III articles were eliminated. A total of 309 articles were incorporated into this database, representing level I and level II well-controlled studies of primary LASIK surgery.

Main Outcome Measures: Patients' satisfaction rates and factors associated with dissatisfaction.

Results: Nineteen of the 309 database articles (6.1%) reported on both patient quality of life and satisfaction and together encompassed a total of 2198 subjects. The procedures from these 19 articles took place between 1995 and 2003. The overall patient satisfaction rate after primary LASIK surgery was 95.4% (2097 of 2198 subjects; range of patient satisfaction for the 19 articles was 87.2%–100%). The patient satisfaction rate after myopic LASIK was 95.3% (1811 of 1901 patients), and after hyperopic LASIK was 96.3% (286 of 297 subjects).

Conclusions: Based on this review, worldwide, an average 95.4% of patients were satisfied with their outcome after LASIK surgery. With 16.3 million procedures performed worldwide, and more than a decade of clinical studies and technological innovation, LASIK surgery should be considered among the most successful elective procedures. LASIK surgery compares more favorably with other elective surgical procedures in terms of generally higher satisfaction rates.

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*Group members listed after the references.

LASIK surgery is among the most common operations performed worldwide.^{1,2} It is estimated that almost 1 million patients undergo corneal refractive surgery each year in the United States alone.³ Refractive error affects approximately 60% of the adult population in the United States. Refractive surgery has enabled people to enter occupations previously closed to them because of their vision. It is well recognized that LASIK surgery can correct refractive error and reduce dependence on eye-glasses or contact lenses.

A meta-analysis of the US Food and Drug Administration-approved LASIK device studies found that 97% of patients achieved uncorrected visual acuity (UCVA) of 20/40, and 62% of patients achieved UCVA of 20/20.⁴ The widely accepted success of the procedure is predicated on the ease and comfort of the procedure for patients, the excellent UCVA outcome, and the relatively low compli-

cation rate, with rare complications leading to permanent visual loss.^{5,6}

The continued acceleration of health care costs and pressures on employers and the government have created a demand for value purchasing and performance measurement. One of these important measures is patient satisfaction, which has been used to rate hospitals, health plans, and individual physicians. However, it is only 1 facet of quality of care and is affected by different factors, such as discrepancy between expectations and actual outcome.⁷ Greater understanding of the reasons for dissatisfaction may provide assistance to ophthalmologists in patient selection, preoperative counseling about risk and benefits, and post-operative evaluation and management of quality of vision issues.

Heretofore, there has not been a systematic review of patient satisfaction after LASIK surgery. Thus, the purpose

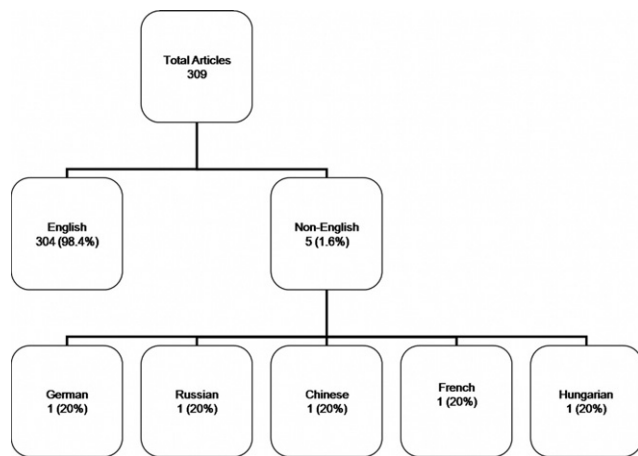


Figure 1. Level I and Level II, English and non-English articles reviewed.

of this study was to analyze patient satisfaction after LASIK surgery utilizing peer-reviewed reports from a worldwide literature review.

Sources and Methods of Literature Search

This literature review of all articles on LASIK published in the peer-reviewed journals from 1988 through 2008 was performed using a multistage, systematic approach. In the first stage, a computerized search was performed to identify all articles related to LASIK surgery using 2 databases: (1) the PubMed database (National Library of Medicine) and (2) Ovid Article Indexes from the Medical University of South Carolina Library, which included MEDLINE, CINAHL, and PsycINFO databases. The last search was done on March 1, 2008. The key words used for a broad and sensitive search included "LASIK," "laser vision correction," and "laser in situ keratomileusis." This review yielded 2915 articles.

In the second stage, all 2915 abstracts of the retrieved articles were obtained and were analyzed. The articles that met all the following criteria were selected for further review: (1) human clinical trials of LASIK surgery; (2) primary procedures (not enhancement); (3) the reporting of visual outcomes; (4) the reporting of night vision symptoms (glare, halos, etc); (5) the reporting of dry eye symptoms; and (6) the reporting of patient satisfaction after the procedure. This second stage narrowed the 2915 to 1581 abstracts that met all these criteria. Case reports were excluded from this second stage. The articles were reviewed by a panel composed of 2 ophthalmologists and 5 ophthalmology residents at the Storm Eye Institute, Medical University of South Carolina, Charleston, South Carolina.

Next, each article from the 1581 abstracts was retrieved in its entirety. A total of 1461 of these articles were in English; the remaining 120 were non-English. These articles were geographically representative of the world in a variety of languages, including Chinese, Czechoslovakian, Danish, Finnish, French, German, Hebrew, Hungarian, Japanese, Norwegian, Polish, Portuguese, Romanian, Russian, and Spanish. The English abstract of the 120 non-English articles were re-revised and 60 were excluded. With the assistance of the American Society of Cataract and Refractive Surgery, all pertinent non-English articles ($n = 60$) were translated and have been included in this review. Additionally, bibliographies of the retrieved 1581 articles were manually searched with the use of the same search guidelines, and any additional articles that were

felt to be relevant and within the guidelines were obtained and reviewed.

In a third stage, all 1521 articles were reviewed by the same panel and the articles were rated according to the strength of the evidence. This rating system has been previously established and described in the literature.^{6,8} A level I rating was assigned to properly conducted, well-designed, randomized clinical trials; a level II rating to well-designed cohort and case-control studies; and a level III rating to case series, case reports, and poorly designed prospective and retrospective studies.

In the final stage, 1213 articles were excluded because of a level III rating. Other factors that excluded these articles included LASIK procedure after other surgical procedures (e.g., photorefractive keratectomy, radial keratotomy, penetrating keratoplasty), LASIK in children, presbyopic LASIK treatment, enhancements or retreatments, review of the literature (which provided no new information), editorials, and/or letters or comments to the editor. This left 309 articles in the level I and level II rating categories. All 309 articles represented peer-reviewed, well-designed, properly conducted, randomized clinical trials or case-control and cohort studies. A total of 98.3% (304 of 309 articles) were in English and 1.7% (5 of 309 were non-English; these articles were translated by the American Society of Cataract and Refractive Surgery; Fig 1). These articles comprised the database for further analyses. Although this database also includes information on visual outcomes, night vision symptoms, and dry eyes, for the purpose of this paper, the analysis of the database focuses specifically on patient satisfaction and quality of life. A complete listing of the 309 articles is available from the corresponding author via e-mail.

Statistical analysis was conducted using Chi-square (StatView 5.0.1, SAS, Cary, NC). $P < 0.05$ was considered significant.

Results

A total of 309 peer-reviewed articles published in a variety of peer-reviewed journals from 1994 to 2008 (Fig 2) with a clinical focus on primary LASIK surgery were identified. These articles represent studies which took place from all around the world.

The study design of the 309 articles is shown in Figure 3. A total of 54.7% (169/309 articles) represent prospective studies, and the remaining 45.3% (140/309 articles) represent retrospective or case-controlled studies. Follow-up in these studies ranged from 1 month to 10 years. These articles included patients with simple myopia, simple hyperopia, myopic and hyperopic astigmatism, and mixed astigmatism. Treatment ranges (spherical equivalent) were from -29.00 to $+10.00$ diopters.

The articles were then divided into 5 categories, which included measurement of visual outcomes, night vision symptoms (glare and halos), patient satisfaction/quality of life, dry eyes, and "combined." The combined group represented those articles that measured ≥ 2 of these 4 categories. The majority of the articles (56.8%) identified in this literature review reported on visual outcomes; night visual symptoms, 11.3% (35/309); and dry eyes, 7.1% (22/309). A total of 4.5% (14/309) reported on patient satisfaction and quality of life. When analyzing the combined group, an additional 5 articles evaluated patient satisfaction and quality of life, the main purpose of this review. Therefore, a total of 6.2% (19/309) articles were identified that reported on patient satisfaction; this paper focuses on patient satisfaction and quality of life.^{2,9-26}

These 19 studies were conducted in Egypt, France, India, Iran, Ireland, The Netherlands, Scotland, South Africa, Spain, Turkey, the United Arab Emirates, the United Kingdom, and the United States. These articles were published from 1996 to 2007, representing

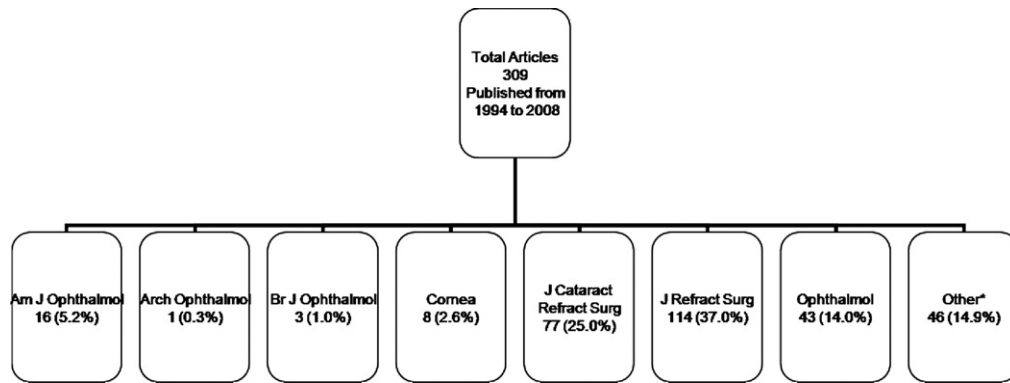


Figure 2. The assortment of peer-reviewed journals for the LASIK literature review.

surgeries that were performed from 1995 to 2003. Follow-up of the patients from these studies ranged from 1 month to 5 years. The age of the subjects reported in these articles ranged from 18 to 67 years of age. The spherical equivalent treated in these articles ranged from -22.75 to $+7.00$ diopters. A total of 63.2% (12/19) were prospective, and 36.8% (7/19) were retrospective. A summary of the articles is presented in Table 1.

The overall patient satisfaction rate for all the available, peer-reviewed, Level I and Level II studies was determined to be 95.4% (2097/2198 subjects; range of patient satisfaction for the 19 articles was 87.2% to 100%). This represented patient reported outcomes of satisfaction rates across all ranges of treatment, myopic to hyperopic with and without astigmatism. The overall dissatisfaction rate was 4.6% (101/2198 patients; range for the 19 articles, 0%–12.8%).

A total of 84.2% (16/19) articles used questionnaires that were nonvalidated whereas 15.8% (3/19) used validated questionnaires. The overall satisfaction rate for articles using nonvalidated questionnaires was 95.6% (1844/1928 subjects; range for the 16 articles, 87.2%–100%); the overall dissatisfaction rate was 4.4% (84/1928 subjects; range for the 16 articles, 0%–12.8%). The overall satisfaction rate for articles using validated questionnaires was 93.7% (253/270 subjects; range for the 3 articles, 92.2%–96.8%); the overall dissatisfaction rate was 6.3% (17/270 subjects; range for the 3 articles, 3.2%–7.8%). A total of 15.8% (3/19) studies used questionnaires that were administered anonymously, 73.7% (14/19) were not administered anonymously, and in 10.5% (2/19) of

the articles the method of administration of the questionnaire was not reported. The overall satisfaction rate for articles using anonymous questionnaires was 98.8% (334/338 subjects; range for the 3 articles, 97.8%–99.5%); the overall dissatisfaction rate was 1.2% (4/338 subjects; range for the 3 articles, 0.5%–2.2%). The overall satisfaction rate for articles using nonanonymous questionnaires was 94.8% (1560/1645 subjects; range for the 14 articles, 87.2%–100%); the overall dissatisfaction rate was 5.2% (85/1645 subjects; range for the 14 articles, 0%–12.8%). The overall satisfaction rate for articles using unknown method of questionnaire administration was 94.4% (203/215 subjects; range for the 2 articles, 92.0%–95.0%); the overall dissatisfaction rate was 5.6% (12/215 subjects; range for the 2 articles, 5.0%–8.0%).

Articles were analyzed to determine whether patient satisfaction after LASIK surgery can change depending on the postoperative time the questionnaire was administered. Patient satisfaction rates were compared for questionnaires completed within 6 months of the LASIK surgery with questionnaires completed at ≥ 7 months. A total of 16 articles reported at what postoperative period was the questionnaire administered. Ten articles (1459 subjects) reported on questionnaires that were completed within 6 months of the LASIK surgery. The satisfaction rate results found in these articles was 94.8% (range, 91.4%–100%). Six articles (477 subjects) reported on questionnaires that were completed at ≥ 7 months. The satisfaction rate was 98.5% (96.0%–100%).

In general, the patient satisfaction questionnaires summarized in the 19 articles used scale or objective scores ranging from 1 (very dissatisfied or very unhappy) to 5 (very satisfied or very happy). Categories such as dissatisfied or unhappy, somewhat dissatisfied or somewhat unhappy, somewhat satisfied or somewhat happy, and satisfied or happy, were also reported in the 19 articles. All levels ranging from “very” to “somewhat” were grouped and reported as either “satisfied” or “dissatisfied” patients. Only 5 articles included an “undecided,” “not sure,” or “neutral” category. Because this category is neither satisfied nor dissatisfied, the subjects were removed and the total number of subjects for each study was recalculated.^{18–20,23,26} All the questionnaires inquired about a specific aspect of patient satisfaction (i.e., global satisfaction/quality of vision, quality of night vision).

Articles were then analyzed to determine whether the patient satisfaction after LASIK can change over time. Patient satisfaction rates were compared for surgeries performed in the 1990s with surgeries performed in 2001 and after. A total of 13 articles reported surgery dates. Eight articles (1112 subjects) reported surgeries that took place from 1995 to 2000. The satisfaction rate results found in these articles was 96.0% (range, 93.8%–100%). Five articles (511 subjects) reported surgeries that took place from

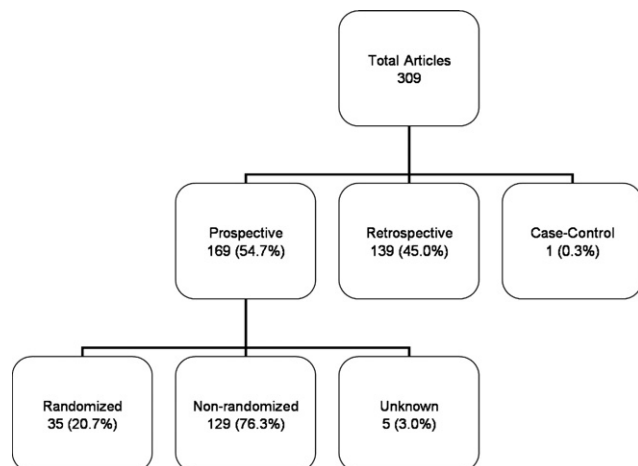


Figure 3. The study design for review of the 309 included articles.

Table 1. Summary of Articles, Organized

Reference	County/Year of Publication	Sample Size	% Patient Satisfaction	% Patient Dissatisfaction
Twa ²⁰	USA/2005	26	100 (26 of 26)	0 (0 of 26)
Uçakhan ²⁴	Turkey/2003	42	100 (42 of 42)	0 (0 of 42)
Hill ¹⁵	South Africa/2002	200	99.5 (199 of 200)	0.5 (1 of 200)
Miller ¹⁸	USA/2001	82	98.8 (81 of 82)	1.2 (1 of 82)
McGhee ¹⁴	Scotland/2000	48	97.9 (47 of 48)	2.1 (1 of 48)
Saragoussi ¹³	France/2004	90	97.8 (88 of 90)	2.2 (2 of 90)
Jabbur ¹⁹	USA/2005	252	97.6 (246 of 252)	2.4 (6 of 252)
Payvar ²⁶	Iran/2002	31	96.8 (30 of 31)	3.2 (1 of 31)
el Danasoury MA ¹⁷	United Arab Emirates/1997	56	96.1 (54 of 56)	3.9 (2 of 56)
O'Doherty ²	Ireland/2006	49	96.0 (47 of 49)	4.0 (2 of 49)
Soroka ⁹	USA/2005	165	95.0 (157 of 165)	5.0 (8 of 165)
Schmidt ²²	USA/2007	97	94.8 (92 of 97)	5.2 (5 of 97)
Akhaury ²¹	India/2004	88	94.6 (83 of 88)	5.4 (5 of 88)
Pérez-Santonja ¹²	Spain/1997	94	94.0 (88 of 94)	6.0 (6 of 94)
Bailey ¹⁰	USA/2003	604	93.8 (567 of 604)	6.2 (37 of 604)
Tahzib ¹¹	The Netherlands/2005	142	92.2 (131 of 142)	7.8 (11 of 142)
Ibrahim ²³	Egypt/1998	50	92 (46 of 50)	8.0 (4 of 50)
Slade ²⁵	USA/2004	35	91.4 (32 of 35)	8.6 (3 of 35)
Jaycock ¹⁶	UK/2005	47	87.2 (41 of 47)	12.8 (6 of 47)

D = diopters; NA = not available; UK = United Kingdom; USA = United States of America.

2001 to 2003. The satisfaction rate was 94.6% (range, 92.2%–100%). LASIK has provided consistently high rates of patient satisfaction, regardless of when the surgery was performed ($P = 0.857$).

Overall satisfaction of patients whose surgery was performed in the United States (1261 subjects) was compared with that in patients having surgery outside the United States (937 subjects). In United States' reports, a total of 95.2% of subjects were satisfied (1201/1261; range, 91.4%–100% for the 19 articles), and 4.8% subjects were dissatisfied (60/1261 patients; range, 0%–6.2% for the 19 articles). When surgery was performed outside the United States, a total of 95.6% of subjects were satisfied (896/937 subjects; range, 87.2%–100% for the 19 articles), and 4.4% of patients were dissatisfied (41/937 patients; range, 0%–7.8% for the 19 articles). No significant differences in satisfaction were found ($P = 0.689$).

The majority of the patient satisfaction articles reported on myopic treatment (84.2%; 16/19 articles). Figure 4 shows patient satisfaction from the articles that reported only myopic LASIK. These studies took place in 10 countries: France, India, Iran, Ireland, The Netherlands, Scotland, Spain, Turkey, the United Arab Emirates, and the United States. The myopic LASIK surgeries took place from 1995 to 2003. A total of 86.5% (1901/2198

subjects) were myopic eyes. The overall satisfaction rate for patients undergoing myopic LASIK surgery was 95.3% (1811/1901 subjects; range for the 16 articles, 91.4%–100%); the overall dissatisfaction rate was 4.7% (90/1901 subjects; range for the 16 articles, 0%–8.6%).

Three articles reported patient satisfaction for hyperopic treatment (15.8%). Figure 4 demonstrated patient satisfaction from the articles that reported hyperopic LASIK. These studies took place in 3 countries: Egypt, South Africa, and the United Kingdom. The hyperopic LASIK surgeries took place from 1997 to 1998. The overall satisfaction rate for patients undergoing hyperopic LASIK surgery was reported to be 96.3% (286/297 subjects; range, 87.2%–99.5% for the 3 articles); the overall dissatisfaction rate was 3.7% (11/297 subjects; range, 0.5%–12.8% for the 3 articles). Patient satisfaction is comparable in myopes and hyperopes ($P = 0.431$).

In addition to direct patient satisfaction, a number of these articles also reported a variety of other indices indirectly related to outcome (Table 2; i.e., in a study from the United States, although the overall satisfaction rate was 93.6%, 97.0% would recommend LASIK to a friend¹⁰; or in the study performed in Ireland, although

According to Percentage Patient Satisfaction

Laser Used	Treatment Range (D)	Questionnaire
Technolas 217A; VISX S3	-1.00 to -7.00	Eye-specific questionnaires (3 questions about quality of vision and satisfaction); 6-month data were used.
MEL 70 G-Scan	-4.50 to -9.88	Patients were asked to complete a satisfaction questionnaire 12 mos after surgery relating to their level of satisfaction with surgery.
Nidek EC-5000	-13.00 to +4.50	Telephone survey; all patients had their treatment ≥ 1 year before the survey was undertaken.
VISX Star	-0.75 to -15.75	Mailed survey consisted of yes/no and multiple choice questions; patients were 6-18 mos post-LASIK.
Chiron-Technolas 117; Technolas 217	-1.75 to -22.75	An anonymous 34-item questionnaire was mailed; patients were 9.6 ± 5.2 mos post-LASIK.
Technolas 217Z	-1.00 to -9.25	An anonymous questionnaire was mailed; patients were 6.3 ± 3.3 mos post-LASIK.
CustomVue	-0.50 to -6.00	Patients were asked about 6 categories: sharpness and clarity, overall visual discomfort, consistency of vision, daylight vision, night vision, and night vision with glare; 6-month data were used.
Nidek EC-5000	-1.38 to -21.00	Patients completed the satisfaction questionnaire, pilot-studied and peer-reviewed; questionnaire was administered at 6 mos post-LASIK.
Nidek EC-5000	-2.25 to -15.5	A 3-question patient satisfaction questionnaire was given to all patients 12 mos after surgery.
Technolas 217	-1.50 to -13.00	Patients received a questionnaire at their last follow-up visit; mean follow-up was 62 mos (range, 57-72).
NA	NA	20-question survey.
VISX Star S2 and S3; Nidek EC-5000	-1.00 to -11.50	The National Eye Institute Refractive Error Quality of Life Instrument was mailed to patients who had undergone LASIK with ≥ 6 mos of follow-up.
Nidek EC-5000	-1.00 to -17.00	At 1 mo after surgery, an informal questionnaire was administered.
VISX 20/20	-3.50 to -19.75	Patients completed a satisfaction questionnaire at the 6-month follow-up visit.
Summit Apex Plus; VISX StarS2	NA	The questionnaire used for this study was mailed and designed to assess the visual symptoms post-LASIK patients (using a visual analog scale); participants were from patients who underwent LASIK ≥ 6 mos before completing the questionnaire.
PlanoScan; Zyoptix	-0.50 to -9.13	A validated questionnaire consisting of 66 items was self-administered; Patients with ≥ 4 mos of follow-up and a stable postoperative refraction were included.
Nidek EC-5000	+1.00 to +6.00	It is not specified type of survey or at what postoperative time was administered.
CustomCornea; CustomVue	-0.75 to -7.00	All patients completed a subjective questionnaire 1 month postoperative.
Summit SVS Apex Plus fitted with an Axicon	+0.75 to +7.00	The study used a simplified 5 question survey; it is not specified at what postoperative time was administered.

the overall satisfaction rate was 96.0%, 100% would recommend LASIK to a friend²).

Discussion

This article represents a review of the world's literature involving LASIK surgery. This review was conducted in a systematic, transparent, methodical, and comprehensive manner to ascertain the level of satisfaction reported in the LASIK literature. This study considered the methodology of the review, as well as the reported outcomes of reported patient satisfaction. Data acquired via this systematic world literature review demonstrated that the vast majority of patients having undergone LASIK surgery were satisfied with their results (95.4%). This satisfaction rate was consistent when differentiating the type of questionnaire used (nonvalidated and validated), if it was administered anonymously or not, and the time after surgery when completed (≤ 6 months vs ≥ 7 months postoperative). This satisfaction

rate seems to be fairly consistent from 1995 to 2003. Myopic and hyperopic subjects appeared to be equally satisfied with their operative outcomes. Patient satisfaction appears to be similar whether the surgeries and studies were conducted in the United States or from around the world. Although the majority of the articles may have been written in English, translated into English, or conducted in English-speaking countries, this review includes worldwide data. Perhaps more English-speaking countries are coincidentally publishing more articles on satisfaction and quality of life.

The measurement of patient satisfaction is an index of the efficacy of a refractive operative procedure. Patient satisfaction can also be considered a multidimensional reflection of whether surgery has met the patient's physical, emotional, and financial expectations and whether the patient has benefitted physically and/or psychosocially from the procedure.²⁷ When evaluating refractive surgery, ophthalmologists are traditionally concerned with postoperative visual acuity and a complication-free result. However, the measurement of visual acuity alone does not adequately

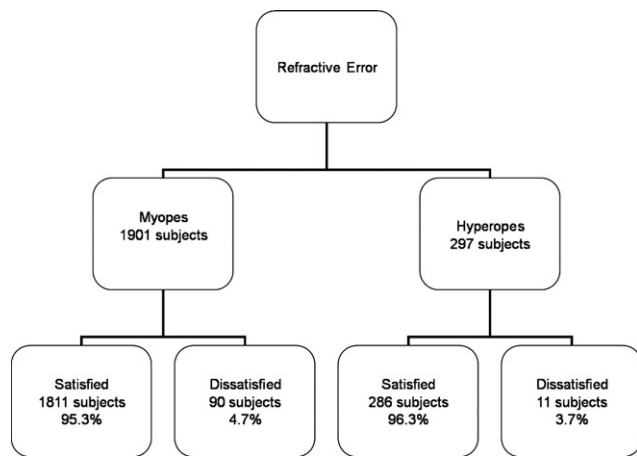


Figure 4. Patient satisfaction divided by refractive error.

illustrate the magnitude of the changes that occur after refractive surgery. Patients are interested in the effect of surgery on their vision.^{28,29} Perhaps even more important to the patients is the manner in which their improved UCVA impacts their overall quality of life. Previous studies of refractive surgery have documented increased confidence in appearance and reduction in fear and embarrassment in day-to-day activities.^{30,31}

One would expect that satisfaction rates would be even higher with current advanced LASIK surgery for a variety of reasons. This literature review encompassed patient treatments ranging from -22.75 to $+7.00$ diopters, ranges that most would consider in excess of currently accepted standard ranges. It is possible that satisfaction may be even higher when considering the more restrictive treatment ranges now typically utilized. Because the level of satisfaction and the degree of myopia/hyperopia was not detailed in the articles, this study cannot limit or subdivide the satisfaction data to modern treatment limits.

One of the most common reasons for dissatisfaction is a reduced postoperative UCVA because of residual refractive error.^{16,22} Similar results were observed by Levinson et al.,³² who reviewed patient referrals after LASIK and their reason for dissatisfaction. They concluded that poor distance vision, dry eye, redness/pain, and glare and halos were the most common chief complaints. Many of the results documented in these studies were before enhancement surgery to improve residual refractive error. Therefore, actual patient satisfaction is possibly higher than the results we have reported. When performing surgery with modern treatment limits for both myopia and hyperopia, the predictability of the refractive target improves and residual refractive error is generally less. Therefore, one would expect satisfaction rates to be higher. Additionally, more information is known about LASIK surgery today than previously understood. An increasing number of ophthalmologists and surgeons have a variety of tools at their disposal, such as refractive lens exchange or phakic intraocular lenses. Finally, technology has advanced significantly with the advent of customized corneal surgery, personalized nomograms, and the use of more precise microkeratomes and/or femto-

second lasers for safer flap creation. With all of these improvements in technology, one would expect higher patient satisfaction rates. As the accuracy and safety of laser vision correction continues to improve, patient satisfaction, although already high, may continue to increase along with patient expectations. In fact, data from TLC Laser Vision Centers, demonstrates patient satisfaction with current technology and patient selection criteria approaches 99% (Lindstrom, personal communication, 2008).

LASIK surgery is the most commonly performed elective procedure in medicine.³³ A comparison of the self-reported satisfaction rates published in peer-reviewed journals for other elective surgical procedures was made (Fig 5). Of the wide range of elective operative procedures, cosmetic surgery was found to be most relevant for comparison. Elective surgical procedures that occurred after injury or in response to medical illness symptoms were excluded (e.g., orthopedics knee or back surgery or esophageal reflux surgery). When reviewing patient satisfaction rates for other common cosmetic procedures we found 80% to 95% after treatment with botulinum toxin,^{34,35} 67% to 97% after breast reduction,³⁶⁻⁴¹ 70% to 98% after breast augmentation,⁴²⁻⁵⁰ 75% to 93.8% after rhinoplasty,^{51,52} 94% after revision rhinoplasty,⁵³ 94% after monopolar radiofrequency facial skin tightening,⁵⁴ 74% to 84% after brow lift,^{55,56} 80% to 85% after liposuction,⁵⁷⁻⁵⁹ and 77% to 90% after abdominoplasty.⁶⁰⁻⁶² These comparisons with the range of patient satisfaction rates after LASIK surgery of 87.2% to 100% indicate that LASIK surgery is associated with higher level of patient satisfaction when compared with other elective procedures.

Quality of life after LASIK surgery is another aspect that has been documented in the literature.^{9-11,14,15,18,22,63,64} Quality of life refers to the impact that LASIK refractive surgery can have on patients' lives. Pesudovs et al.⁶³ compared the visual quality of life of people wearing eyeglasses or contact lenses with those patients having undergone refractive surgery. In this prospective study, the validated Quality of Life Impact of Refractive Correction questionnaire⁶⁵ was administered to 312 subjects as follows: 104 spectacle wearers, 104 contact lens wearers, and 104 individuals who underwent refractive surgery. In this study, the self-reported quality-of-life scores differed significantly between the 3 groups. Specifically, refractive surgery patients scored higher in terms of their quality of life compared with patients who wore contact lenses or eyeglasses. This indicates that the outcome of refractive surgery was beneficial to these patients and significantly improved their quality of life compared with those patients who wore contact lenses or eyeglasses and did not choose to undergo refractive surgery. The improved well-being after LASIK surgery suggests that there is a positive global impact of removing the handicap of poor UCVA. Of note, poor quality of life scores after refractive surgery were associated with regression, dry eye, poor vision in low light, and halos at night. Chen et al.⁶⁴ compared the vision-related quality of life among emmetropes, myopes who had refractive surgery, and myopes who wore eyeglasses and/or contact lenses. The Vision Quality of Life questionnaire was administered to a total of 195 subjects: 64 emmetropes, 66 myopes who wore

Table 2. Summary of Pertinent Satisfaction Results Gleaned from the Articles Reviewed, Organized According to Percentage Patient Satisfaction

Reference	County/Year(s) of Surgeries	Sample Size	% Patient Satisfaction	Additional Results from Studies Reviewed
Twa ²⁰	USA/2002	26	100	Based on outcomes, patients will have LASIK surgery again. Four patients reported as “neutral” were subtracted from the total number of subjects (30) and the percentage recalculated.
Uçakhan ÖÖ ²⁴ Hill JC ¹⁵	Turkey/1999–2000 South Africa/1997–1998	42 200	100 99.5	No additional data was obtained from the article. 97% of patients will recommend LASIK. 99% of patients would have surgery again. One patient “slightly unhappy” with his results. 98% will recommend LASIK to a friend or loved one. 97% would have surgery again. Younger patients seem to be more satisfied. One patient reported as “neither pleased nor displeased”, it was subtracted from the total number of subjects (83) and the percentage recalculated.
Miller AE ¹⁸	USA/1997–1998	82	98.8	94% achieved surgical goal. 97.9% understood procedure before surgery. 97.8% recommend LASIK to a friend or family. No factors were associated with dissatisfaction. Only LASIK patients were included.
McGhee CN ¹⁴	Scotland/1996–1998	48	97.9	At 6 mos, 2.4% dissatisfied patients (4 patients “somewhat dissatisfied” and 2 patients “very dissatisfied”). Authors do not mention why patients were dissatisfied. Six patients reported as “not sure”, they were subtracted from the total number of subjects (258) and the percentage recalculated.
Saragoussi D ¹³	France/2001–2002	90	97.8	92.6% “little”, 3.7% “sometimes”, and 3.7% “much”; response of patients for a question about the need for glasses in everyday life.
Jabbur NS ¹⁹	USA/NA	252	97.6	94% reported that based on experience they would have surgery again.
Payvar S ²⁶	Iran/1999	31	96.8	All patients will recommend LASIK to a friend. 92% reported surgery changed life significantly.
el Danasoury MA ¹⁷	United Arab Emirates/1995	56	96.1	98% reported improvement in overall performance after surgery. Who recommended surgery? 68% family, 11% media, 5% ophthalmologist, 3% ODs, and 9% others.
O’Doherty ²	Ireland/1998–1999	49	96.0	One “very dissatisfied” patient with correction, primarily because of symptoms of glare, dryness, and blurry vision. Uncorrected visual acuity is a strong predictor of patient satisfaction.
Soroka M ⁹	USA/2002–2003	165	95.0	97.6% of patients improved quality of life. 97.6% expressed satisfaction with preoperative counseling. 95% would have the surgery again.
Schmidt GW ²²	USA/1999–2002	97	94.8	97% will recommend LASIK to a friend. Increased age, flat preoperative Ks, and patients with smaller pupil size are associated with dissatisfaction.
Akhaury RK ²¹	India/2002–2003	88	94.6	93.6% achieved surgical goal. 92.3% would chose to have LASIK again. Global satisfaction did not show a correlation with patient age.
Pérez-Santonja JJ ¹² Bailey MD ¹⁰	Spain/NA USA/1999–2000	94 604	94.0 93.8	Patients were highly satisfied although many remained undercorrected.
Tahzib NG ¹¹	The Netherlands/2001–2003	142	92.2	Subjective satisfaction is highly correlated to postoperative uncorrected visual acuity. Nomogram was intentionally not adjusted.
Ibrahim O ²³	Egypt/NA	50	92	All dissatisfied patients (n = 6) were due to undercorrection.
Slade S ²⁵	USA/NA	35	91.4	
Jaycock PD ¹⁶	UK/NA	47	87.2	

NA = not available; OD = Doctor of Optometry; UK = United Kingdom; USA = United States of America.

eyeglasses and/or or contact lenses, and 65 myopes after refractive surgery. The self-assessed visual quality of life in patients after LASIK refractive surgery was similar to emmetropic patients. The quality of life measured by the Vi-

sion Quality of Life questionnaire in myopes (patients using eyeglasses or contact lenses) was lower compared with both the emmetropic patients and the patients who had undergone LASIK refractive surgery.

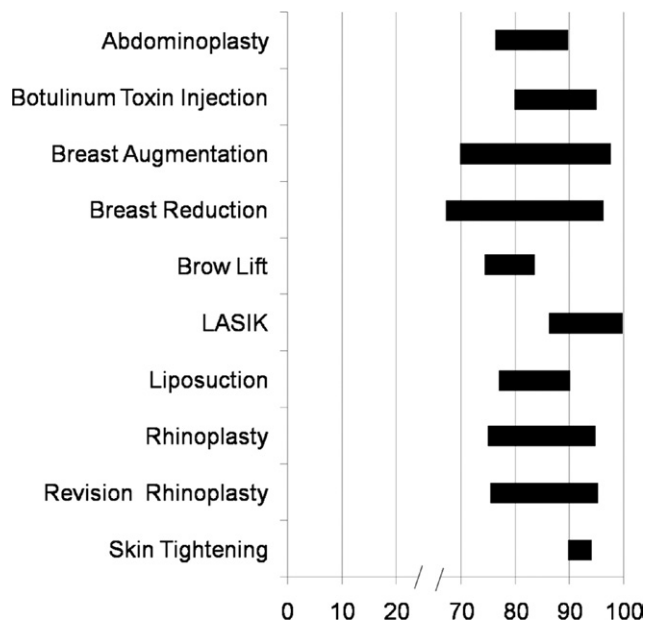


Figure 5. Percentage of patient satisfaction after different elective surgical procedures.

These studies have demonstrated that the quality of life reported by patients who have undergone LASIK refractive surgery is higher compared with patients who choose to wear eyeglasses or contact lenses. Significantly, the quality of life in patients after LASIK surgery was similar to emmetropic patients. This demonstrates that the improved visual quality of life was a result of the LASIK procedure.

Despite a successful vision correction, there will always be patients who are dissatisfied. In our literature review, approximately 4.6% of patients after LASIK surgery were dissatisfied. The most common reasons and associations reported for dissatisfaction included residual refractive error, dry eyes, older age, or night vision symptoms (Table 1). With improvements in technology, specifically, improvements in eye tracking devices, smoother corneal ablations, and customized ablations, residual refractive error and the need for enhancements have decreased over the last few years.^{66,67}

Night vision symptoms, typically glare and halos, have been a source of patient dissatisfaction.^{15,22,63} Improved ablation profiles, such as wavefront-guided, aspheric, and larger treatment zones, have been shown to reduce night vision glare and halo issues.¹⁹ Studies from the military^{3,68} have demonstrated improved night vision using advanced laser vision correction technology. All branches of the U.S. military have now embraced laser vision correction as a way to improve performance. It is now an acceptable procedure for Navy and Air Force pilots, and it was most recently approved by NASA.⁶⁹

Finally, dry eye is another possible reason for patient dissatisfaction, despite successful vision correction. Careful attention to detail with medical and ocular history preoperatively, thorough preoperative screening, and preemptive therapy to bring dysfunctional tear states under control

preoperatively can avoid postoperative exacerbations of dry eye. Although laser vision correction can induce temporary dry eye, modern, thin-flap, LASIK surgery has been associated with a reduced incidence of long-term dry eye.⁷⁰ Additionally, there are newer treatment options for patients who suffer from dry eye.⁷¹ The use of contemporary therapeutic modalities, new artificial tear preparations, the use of immunomodulation with low-dose corticosteroids, immunomodulation with topical cyclosporine, newer anti-inflammatory drugs, and attention to conditions such as blepharitis, most patients with dry eye are becoming more comfortable and less symptomatic over time.^{71,72}

Limitations of this review are consistent with limitations for any systematic literature review. These limitations include difficulty in combining the results of the articles owing to the heterogeneity of patient satisfaction measurements. Many of the satisfaction questionnaires used were nonstandardized and have not undergone independent critical assessment of their content validity or reliability. Some of the studies had low response rates and 36.8% (7/19) were retrospective. We assessed the methodologic quality of these studies using accepted criteria. There might be reasons for the overestimation for dissatisfaction rates, as mentioned. There are also possible reasons for underestimation of the rate of dissatisfaction. For example, patients may rate their level of satisfaction higher in an effort to please their physician (Hawthorne effect). Low response rates can result in possible bias, because the articles might report increased satisfied happy patients, who may be more prone to fill out a questionnaire. By accepting these limitations, we were able to combine data from these different trials and perform an analysis on the results based on available evidence. These same limitations existed in the cosmetic surgery literature review.⁷³ As with all systematic reviews, the strength of our conclusions is influenced by the quality of primary studies.

In summary, this analysis of the world's literature demonstrates that LASIK surgery, one of the most common elective surgery procedures performed in medicine,³² has a higher satisfaction rate compared with several other elective procedures. More than 95% of patients who undergo LASIK surgery, as consistently reported in the world's literature, are satisfied with their result. With better recognition and treatment of preexisting dry eye both before and after LASIK treatment, better patient selection including appreciation for the upper limits of myopic and hyperopic treatments, and improved technology, it would be expected that the satisfaction rate could be even higher with more modern surgery. As with any operative procedure, there will always be dissatisfied patients. Common reasons and associations for dissatisfaction in the literature include residual refractive error, dry eyes, older age, and night visual symptoms. Research using contemporary surgical techniques and evaluation of patient satisfaction and quality of life outcomes is being conducted. This review showed that LASIK surgery can influence one's quality of life. However, this statement is based in 2 articles that were identified in the world literature review. Additional studies evaluating quality of life after LASIK surgery may provide more answers to better understand, provide assistance to, and reduce the

incidence of patient dissatisfaction. Psychological factors and realistic goals and expectations preoperatively may also play a role.

Patient satisfaction is becoming more important in the health care environment. It has been used as a measure to rate hospitals, health plans, and individual physicians. Patient satisfaction is an important "litmus test" to carefully evaluate the success of elective surgical procedures. This worldwide literature review demonstrates that LASIK surgery is not only one of the most commonly performed elective procedures, but it is also associated with a very high level of patient satisfaction.³²⁻⁶¹

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¹ Magill Research Center for Vision Correction, Storm Eye Institute, Medical University of South Carolina, Charleston, South Carolina.

² Ophthalmic Consultants of Long Island, New York.

³ Minnesota Eye Consultants, P.A., Minneapolis, Minnesota.

The Joint LASIK Study Task Force Members:

Richard L. Abbott, MD, Flora Lum, MD, Samuel Masket, MD, Jennifer Morse, MD, Terrence P. O'Brien, MD, Konrad Pesudovs, OD, PhD, Steven C. Schallhorn, MD, Heather, M. Skeens, MD.

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Lindstrom is a consultant for AcuFocus Inc, Advanced Medical Optics, Advanced Refractive Technologies, Alcon Laboratories, AVS, Bausch and Lomb, Inc, BioSyntx, Clarity Ophthalmics, Clear Sight, CoDa Therapeutics, EBV Partners, Egg Factory, Encore, Eyemaginations, Inc, Glaukos Corporation, High Performance Optics, Improve Your Vision, I-Therapeutix, Lensar, LenSX, S.V.L. Sciences, Midwest Surgical Services, Minnesota Eye Consultants, P.A., Neurovision, NuLens, OccuLogix, Ocular Surgery News/Slack, Omeros Corporation, Pixel Optics, Quest, Refractec, RXVP, Supply Eye, 3-D Vision Systems, TCL Vision, Tracey Technologies, Versant, and Vision Solutions Technologies.

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Correspondence:

Kerry D. Solomon, MD, Magill Research Center for Vision Correction, MUSC-Storm Eye Institute, 167 Ashley Avenue, Charleston, SC 29425; E-mail: solomonk@musc.edu.