Original Article

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Profile and Visual Outcome of Patients Following Keratorefractive Surgery at Tertiary Eye Hospital, Nepal: A Hospital-based Study

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Abstract

Background: Keratorefractive surgeries (KRS) are widely performed globally to correct refractive errors. Common options include photorefractive keratectomy (PRK), laser-assisted in situ keratomileusis (LASIK), laser-assisted subepithelial keratectomy (LASEK), small-incision lenticule extraction, and intraocular lens-based procedures. This study aimed to analyze the profile and visual outcomes of patients following keratorefractive surgery.

Methods: This hospital-based cross-sectional study was conducted at the Biratnagar Eye Hospital, Nepal, from January 2019 to December 2021. Data were collected retrospectively from medical records. Patient selection for KRS was based on predefined corneal assessment criteria. Eligible patients underwent re-evaluation by experienced optometrists trained in refractive surgery. All procedures were performed by a single experienced keratorefractive surgeon.

Results: A total of 81 eyes from 43 patients were included. LASIK was performed in 33 eyes, while TransPRK was performed in 48 eyes. The mean age of the patients was 23.05 ± 3.72 years, with a male-to-female ratio of 3:1. Compound myopic astigmatism was the most common refractive error, accounting for 47 eyes (58%). In the LASIK group, mean preoperative uncorrected visual acuity (UCVA) improved from 1.16 ± 0.19 logMAR to 0.00 ± 0.01 logMAR on postoperative day 1 and remained stable at one month. Contrast sensitivity (CS) also remained stable. In the TransPRK group, mean preoperative UCVA improved from 0.90 ± 0.37 logMAR to 0.19 ± 0.15 logMAR on day 1 and 0.01 ± 0.03 logMAR at one month, while CS showed gradual improvement over time.

Conclusion: Both LASIK and TransPRK demonstrated excellent visual outcomes and preserved contrast sensitivity, making them effective options for surgical correction of refractive errors and achieving spectacle independence.

Keywords: Contrast Sensitivity; Nepal; Refractive Errors; Refractive Surgical Procedures; Treatment Outcome

Declarations

Ethics approval and consent to participate: This study was conducted with prior ethical approval from Ethical Review Board of Biratnagar Eye Hospital (IRC-BEH -56/A).

Consent for publication: None.

Availability of data and materials: The full data set supporting this research is available with the corresponding author upon request by the readers.

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BACKGROUND

Uncorrected refractive error is one of the most widespread causes of visual impairment and the second leading cause of blindness globally [1, 2]. It is a condition of the eye in which light is not properly focused onto the retina, resulting in blurred vision. Refractive error-related blurred vision can be corrected using spectacles, contact lenses, or refractive surgery [3].

Keratorefractive Surgery (KRS) represents a transformative advancement in ophthalmology, offering a promising alternative to conventional vision correction methods such as glasses and contact lenses [4]. By modifying the corneal curvature, KRS aims to enhance visual acuity and reduce dependence on corrective eyewear [5]. As these techniques have evolved over the years, various modalities have emerged, including Laser-Assisted in Situ Keratomileusis (LASIK), Photorefractive Keratectomy (PRK), and more recently, Small Incision Lenticule Extraction (SMILE) [6, 7]. Each approach offers unique benefits and potential challenges, making it essential to thoroughly evaluate patient profiles and visual outcomes to optimize surgical strategies and patient satisfaction.

Although KRS is not a new surgical procedure for the correction of refractive errors globally, only a limited number of eye hospitals in Nepal have been performing KRS over the past decade. Patient acceptance of elective refractive surgery largely depends on its safety and effectiveness, evidence regarding surgical outcomes is essential. To the best of our knowledge, no published study from Nepal has comprehensively evaluated the outcomes of KRS. Therefore, this study aimed to analyze profile and visual outcomes of patients who underwent KRS at Biratnagar Eye Hospital, Biratnagar, Nepal. The findings of this study may also aid in counselling potential candidates considering surgical correction of refractive errors.

METHODS

The hospital-based cross-sectional study was conducted at the Refractive Surgery Unit of Biratnagar Eye Hospital (BEH), Biratnagar, Nepal. The data were collected retrospectively from hospital records of patients who underwent keratorefractive surgery (KRS), either LASIK or TransPRK, between January 2019 and December 2021. Ethical clearance was obtained from the Institutional Review Committee (IRC) of BEH (IRC approval number: BEH-IRC-56/A; dated 28/09/2022). Approximately 300–400 patients underwent refractive surgery screening annually, and many were deemed unsuitable for surgery for various reasons. During the study period, the COVID-19 pandemic affected routine services, and complete screening records were not available. Therefore, it was estimated that approximately 500–600 patients were screened for KRS during the study period.

Before undergoing KRS, patients underwent a comprehensive ophthalmic examination, including assessment of uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), objective and manifest subjective refraction, slit-lamp examination, contrast sensitivity measurement, corneal curvature assessment, central corneal thickness measurement, fundus evaluation, intraocular pressure measurement, and dry eye evaluation. The duration of spectacle use was also documented, and the planned refractive surgical procedure (LASIK or TransPRK) was recorded in the patient's examination chart. Demographic data, including age, gender, and nationality, were also collected.

The decision regarding the type of KRS was based on predefined corneal assessment parameters. During the examination, UCVA and BCVA were measured in logarithm of the Minimum Angle of Resolution (logMAR) units using the Compact Acuity Tester (CAT) Vision Liquid Crystal Display (LCD) chart (Aurolab, India). Contrast sensitivity was measured in decimal units using an LCD vision chart. Dry eye evaluation was performed using the Schirmer test and tear break-up time (TBUT).

Corneal thickness (pachymetry) was measured both invasively using a NIDEK Pachymeter (US-500, Japan) and non-invasively using the Bon Sirius topographer. Corneal curvature (keratometry) was assessed using the Bon Sirius topographer, Zeiss Atlas topographer, and Zeiss IOLMaster 700.

All suitable patients were re-evaluated by experienced optometrists trained in refractive surgery, and the final decision regarding surgery was made by an experienced keratorefractive surgeon. All surgeries were performed by a single experienced keratorefractive surgeon. Patients who did not meet the selection criteria were excluded from surgery.

The criteria used for selecting suitable candidates for keratorefractive surgery are presented in **(Table 1)**.

Table 1: Inclusion criteria for patient selection for KRS (LASIK/ TransPRK)

Criteria for keratorefractive surgery	For LASIK	For TransPRK
Age	>18 years	>18 years
Myopia	Up to -8.00 Diopter	Up to -8.00 Diopter
Hypermetropia	Up to 3.00 Diopter	Up to 3.00 iopter
Astigmatism	Up to ±3.00 Diopter	Up to ±3.00 Diopter
Central corneal thickness	> 500 micron	> 480 micron
Residual stromal bed thickness	>350 micron	>350 micron
Remaining corneal thickness		>400 micron
Stable refraction	No change in sphere or cylinder in past one year	No change in sphere or cylinder in past one year
Keratoconus	KCI > 5%	KCI>5%

KCI: Keratoconus Classification Index

A) Procedure for LASIK

Topical anesthesia was achieved using 0.5% proparacaine hydrochloride, instilled two to three times before surgery. The periocular area was cleaned with 5% povidone-iodine, and a sterile drape and lid speculum were applied. Corneal flaps were created using a mechanical microkeratome (Moria M2 90-µm One Use Plus SBK Head). The suction ring and flap stop were selected according to the manufacturer's guidelines based on corneal diameter and horizontal keratometry to maximize flap diameter. The microkeratome was manually centered on the cornea, and a single-pass technique was employed. Flap integrity was assessed after lifting, and the stromal bed was examined for uniformity and the absence of debris or striae.

The Zeiss MEL 90 excimer laser was used for stromal ablation, utilizing the Triple-A ablation profile and a 500 Hz repetition rate. The optical zone was typically set between 6.0 and 6.5 mm, with a transition zone of 1.0–1.25 mm, adjusted according to mesopic pupil size. The system's active eye-tracking feature with cyclotorsional compensation was engaged throughout the procedure. Following laser ablation, the stromal bed was gently irrigated with balanced salt solution (BSS) to remove residual particles, and the corneal flap was carefully repositioned using a blunt spatula. The flap was allowed to re-adhere for one to two minutes, and its alignment was confirmed visually under the operating microscope.

B) Procedure for TransPRK

In the first step, epithelial removal was performed using the Zeiss MEL 90 excimer laser set at a 250 Hz repetition rate. The laser ablated the corneal epithelium in a precise and uniform manner to a depth of approximately 55 µm centrally over the eight mm treatment zone. After complete epithelial removal, stromal refractive ablation was performed. This was also carried out at a 250 Hz repetition rate, with the laser reshaping the corneal stroma according to the patient's refractive error.

The treatment zone was generally set between 6.0 and 6.5 mm, with a transition zone of 1.0–1.25 mm, adjusted according to mesopic pupil size. The laser incorporated active eye tracking and cyclotorsional compensation throughout both phases of the procedure to ensure precise alignment with the visual axis.

Data Entry and Analysis

All data were retrieved from the examination records of individual patients and entered into a Microsoft Excel spreadsheet. Data entry, editing, and coding were performed using Microsoft Excel, and statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS), version 25. Demographic variables, including age, gender, type of refractive error, and type of surgery performed, were presented in tabular form.

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages.

RESULTS

During the study period, a total of 81 eyes from 43 patients were included. The mean age ± SD of the patients was 23.05 ± 3.72 years. Two thirds of the patients were male (32, 74.4%). The majority of patients belonged to the 18–25 years age group (36, 83.7%). More than half of the eyes had compound myopic astigmatism (47, 58.0%), and TransPRK was the most commonly performed procedure, accounting for 48 eyes (59.3%) **(Table 2)**.

Table 2: Demographic and Clinical Profile of the study population

Mean age(± SD) (years)	23.05 (± 3.72) (LASIK = 23.7 and PRK = 22.54)
Gender (n = 43)	**N (%)**
Male	32 (74.4)
Female	11 (24.6)
Age group (Years) (n = 43)	
18-25	36 (83.7)
26-36	7 (16.3)
Types of refractive error (Eyes) (n = 81)	
Myopia	29 (35.8)
SMA	5 (6.2)
CMA	47 (58.0)
Types of surgery performed (Eyes) (n = 81)	
LASIK	33 (40.7)
TransPRK	48 (59.3)

SMA: Simple Myopic Astigmatism; CMA: Compound Myopic Astigmatism; LASIK: Laser-Assisted in Situ Keratomileusis; PRK: Photorefractive Keratectomy

The patients had myopia up to –6.50 diopters (D) spherical equivalent and hypermetropia up to +4.50 D, with a mean duration of spectacle use of 6.5 years. The mean ± SD central corneal thickness (CCT) was 533.68 ± 31.0 µm and 530.42 ± 30.4 µm, as measured by manual pachymetry and Bon Sirius topography, respectively. The mean ± SD keratometry (K) values were 43.52 ± 1.20 D, 43.48 ± 1.21 D, and 43.51 ± 1.21 D, as measured by the Bon Sirius topographer, Atlas topographer, and IOLMaster 700, respectively **(Table 3)**.

Table 3: Mean comparison of clinical findings with different instruments (n = 81 eyes of 43 patients)

Clinical findings	Mean (± SD) (Range)
CCT Manual (micron)	533.68 (± 31) (476 - 623)
CCT Bon Sirius (micron)	530.42 (± 0.4) (474 - 606)
KM Bon Sirius (Diopter)	43.52 (± 1.2) (40.65 - 45.96)
KM Atlas (Diopter)	43.48 (± 1.23) (40.65 - 45.92)
KM IOL Master 700 (Diopter)	43.51 (± 1.21) (40.46 - 46.04)
MRSE (Diopter)	-3.20 (± 1.9) (-0.50 to -6.50)
Duration of using glass (years)	6.5 (± 2.96) (1 - 15)

CCT: Central corneal thickness; MRSE: Manifest refractive spherical equivalent

In the LASIK group, the mean preoperative uncorrected visual acuity (UCVA) was 1.16 ± 0.19 logMAR. It improved to 0.01 ± 0.05 logMAR on postoperative day 1 and remained stable at 0.01 ± 0.03 logMAR after 1 month. No significant changes were observed in mean contrast sensitivity (CS), which was 1.61 ± 0.09 before surgery, 1.63 ± 0.09 on day 1, and 1.63 ± 0.08 after 1 month **(Table 4).**

Table 4: Uncorrected visual acuity (UCVA) and Contrast Sensitivity (CS) before and after LASIK

Variables	Before surgery	After surgery	
		Day 1	After 1 month
UCVA (logMAR)	1.16 ± 0.19	0.01 ± 0.05	0.01 ± 0.03
CS (logMAR)	1.61 ± 0.09	1.63 ± 0.09	1.63 ± 0.08

In the TransPRK group, the mean preoperative UCVA was 0.90 ± 0.37 logMAR, which improved to 0.19 ± 0.15 logMAR on postoperative day 1 and 0.01 ± 0.03 logMAR after 1 month. Mean contrast sensitivity showed a slight improvement over time, increasing from 1.56 ± 0.23 before surgery to 1.60 ± 0.27 on day 1 and 1.62 ± 0.37 after 1 month **(Table 5).**

Table 5: Uncorrected visual acuity (UCVA) and Contrast Sensitivity (CS) before and after TransPRK surgery

Variables	Before surgery	After surgery	
		Day 1	After 1 month
UCVA (log MAR)	0.9 ± 0.37	0.19 ± 0.15	0.01 ± 0.03
CS (log MAR)	1.56 ± 0.23	1.60 ± 0.27	1.62 ± 0.37

Only 14 patients attended the 3-month follow-up visit. Among these patients, the mean UCVA ± SD was 0.01 ± 0.04 logMAR, while the mean contrast sensitivity ± SD was 1.62 ± 0.08.

DISCUSSION

Biratnagar Eye Hospital is a tertiary eye care hospital and referral center in eastern Nepal, managed by the Lahan Eye and Ear Care System (LEECS) under the aegis of Nepal Netra Jyoti Sangh (NNJS). The hospital provides a range of subspecialty services, including a dedicated refractive surgery unit. More than 500,000 patients are examined and over 70,000 surgeries are performed annually at the hospital [8].

In this study, 81 eyes of 43 patients underwent keratorefractive surgery, including 33 (40.7%) LASIK procedures and 48 (59.3%) TransPRK procedures. The mean uncorrected visual acuity improved significantly following both procedures, with no decline in contrast sensitivity observed during the follow-up period.

Furthermore, no patients reported symptomatic dry eye following surgery.

Individuals seek refractive surgery primarily to achieve freedom from spectacles and for cosmetic reasons, particularly those with moderate to high refractive errors [9]. Typically, candidates suitable for KRS are older than 18 years, have stable refractive status, and are free from ocular diseases such as cataract, glaucoma, and retinal disorders [10]. Refractive surgery may also contribute to improved self-confidence and quality of life by reducing dependence on corrective eyewear. Both LASIK and PRK are widely used procedures for refractive correction, with reported high success rates and excellent visual outcomes [11]. Our findings are consistent with these reports and demonstrate favorable visual outcomes following both procedures.

In the present study, male patients outnumbered female patients, and compound myopic astigmatism was the most common refractive error treated with KRS. These findings differed from those reported by Ang et al. The mean manifest refractive spherical equivalent (MRSE) among myopic patients was -3.20 ± 1.9 D, and the mean age of the patients was 23.05 ± 3.72 years, which was lower than that reported by Ang et al. The mean pachymetry value was 533.68 ± 31 μm, which was comparable to their findings [10].

For contrast sensitivity assessment, measurements were performed only under photopic conditions. In terms of visual outcomes, LASIK and TransPRK produced comparable results. Our findings demonstrated that the visual outcomes of KRS were consistent with expectations and similar to those reported by Ang et al [10] and Salah-Mabed et al [12]. We also observed a slight improvement in contrast sensitivity following surgery, which is in agreement with the findings of Pradhan et al [7] and Salah-Mabed et al [12]. In contrast, Perez-Santonja et al [13] reported a slight reduction in contrast sensitivity one month after surgery, with recovery to preoperative levels by three months. This finding differs from the results of the present study.

No other postoperative symptoms or complications were systematically recorded, and patient-reported postoperative quality of life was not assessed, which may be considered a limitation of the study. Furthermore, follow-up beyond the first postoperative month was inconsistent, resulting in limited long-term outcome data. Therefore, the long-term effectiveness of these procedures could not be adequately evaluated.

CONCLUSION

Both LASIK and TransPRK demonstrated good visual outcomes and are viable options for individuals seeking surgical correction of refractive errors and spectacle independence, without significant changes in contrast sensitivity between the preoperative and postoperative periods.

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