# Comparison of Visual Acuity, Contrast Sensitivity, Corneal Haze and Tear Break Up Time in Photorefractive Keratectomy and Laser Epithelial Keratectomy in Low to Moderate Myopes

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## ABSTRACT

**Purpose:** The purpose of this research aimed to evaluate clinical outcomes including like visual acuity, contrast sensitivity, corneal haze and tear break-up time between PRK and LASEK.

**Materials and Methods:** A comparative cross-sectional study was conducted in The Smile Laser Eye Center Multan from September 22 to May 2023. This study included 60 participants of both genders with age included from 25 to 35 years old having low to moderate myopia. The sample was divided in two groups by non-probability purposive sampling technique. Each Group had 30 patients of PRK and 30 patients of LASEK respectively. Refractive errors other then myopia was excluded from this study. Visual Acuity through LogMAR Chart at distance of 4-meter, Contrast Sensitivity through Pelli Robson Chart at distance of 1-meter, Corneal Haze through Slit Lamp and Tear breakup time through fluorescein dye strip was assessed.

**Results:** Results revealed that the mean age in group 1 and 2 was 29.52 analyzed by descriptive statistics. Results showed value of paired sample T-test over visual acuity in group 1 and group 2 was 0.21±0.32 (SD), contrast sensativity was 0.37±0.45 (SD), tear breakup time 0.76±0.71(SD) and corneal haze was 0.50±0.47 (SD) with significant value (P=0.000) in PRK and (P=0.001) in LASEK respectively. The Independent sample T-test mean and SD value of VA, CS, TBUT and corneal haze was 0.24±0.32 (SD) with

(P=0.906), -0.92±0.450 (SD) with (P=0.086), 0.8±0.714(SD) with (P=0.799) and -0.33±0.47 (SD) with (P=0.197) respectively. Results of this study concluded that between LASEK and PRK treatments, there were no significant difference in low to moderate myopes as the P-value (P=0.05).

**Conclusion**: This study concluded that there was no significant difference in visual acuity, tear breakup time, contrast sensitivity and corneal haze before and after PRK and LASEK treatments but non-significant difference was observed after results of both procedures respectively.

**Key Words:** Best Corrected Visual Acuity, Contrast Sensitivity, Corneal Haze, Laser Epithelial Keratectomy, Photorefractive Keratectomy, Tear Break-Up Time, Uncorrected Visual Acuity, Visual Acuity

## INTRODUCTION

Eye is a specialized organ that can receive light through objects and transfer it to the brain. It improves an ability to recognize objects as well as perception of light, colors, and depth. The cornea and sclera compose the outer layer. The layer in the middle which includes the choroid eye's main blood supply. The retina in the inner most layer. Eyeball contains three fluid-filled chambers. The anterior chamber, which is between iris and cornea. Vitreous chamber lies between the lens and retina. Iris and lens separated by the posterior chamber. Cornea, iris, ciliary body, pupil and crystalline lens are all parts of the eye's anterior parts of eye. Anterior chamber, the front portion of the eyes where aqueous humor enters and exits to nourish the eye. The transparent, domed surface that protects the front part of the eye called cornea. In the central opening of iris, through which light enters the back of the eye called pupil. The colored area which known as iris having a central aperture known as pupil that control amount of light allowed to enter the eye (1).

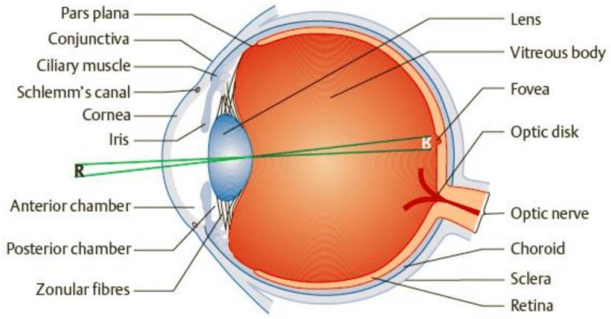


**Figure 1.1: Anatomy of Human Eye**

The process by which axial length of the eye and its refractive elements are balanced during morphogenesis to cause emmetropia known as emmetropization. According to studies the refractive state of eye changes over time depending on this model optical control of eye growth can lead to emmetropization or a gradual decline in refractive errors over time that eventually results in emmetropia. While visual conditions involve a dominance of distant work this happens. According to the study, when near work increases, myopia will become more prominent in the eye's refraction (2). The process of development that balances the unaccommodated eye's optical power to its axial length that focused at a distance is known as emmetropization (3). Surgical treatments include Radial Keratectomy (RK) making deep radial incision in peripheral part of cornea leaving the central of 4mm optical zone. It corrects (-6.00 D to -0.50 D) moderate to low myopia. Small incision lenticular extraction eye surgery (SMILE) the procedure involves removal of lenticule of tissue from the corneal stroma. Which remove by surgical instruments. It corrects low to high myopia -0.50 D to -10.00 D (16).

Photorefractive Keratectomy is a refractive surgery which involves in reshaping of cornea surface by removing of epithelium. The excimer laser is applied directly to bowmen's layer to remove anterior stroma. When eye does not properly refract light having refractive error with PRK as a result light beams are better focused on the retina. Astigmatism, hyperopia and myopia are all conditions that are treated with PRK. Treating refractive error to enhance vision is the purpose of photorefractive keratectomy. Candidate must fulfil certain conditions in order to get PRK. It can be an ideal substitute if intend to have refractive surgery but don't have dry eyes or thin corneas. The Laser Sub Epithelial Keratectomy (LASEK) is the basic idea underlying LASEK is to accurately alter the cornea's shape in order to enhance eyesight. Astigmatism, myopia, and hyperopia can be treated using

LASEK eye surgery, which is a very common type of elective vision correction surgery. Advantages of LASEK includes generally quick and painless, taking less than 5 minutes per eye. Excellent outcomes with patients frequently noticing improvements in just a few days. According to research, 97 % of LASEK patients completely satisfied themselves and attain their desired eyesight.

**METHODOLOGY**

A comparative cross-sectional study was carried out from September 2022 to May 2023 at The Smile Laser Eye Center, Multan. This study included 60 patients (N = 60) of both gander males and females of age 25 - 35 years old with low to moderate myopia divided into categories 1 and 2 each category had 30 participants. Effect over Visual Acuity, Contrast Sensitivity, Tear Breakup Time and Corneal Haze were compared in PRK and LASEK respectively. This study included patients who had stable refractive error (myopia) from two years with corneal thickness less than 500 microns and excluded high myopes who had myopia above then (-6.00 D). It also excludes those patients who had systemic and ocular disease like diabetes, hypertension and uveitis etc. Self-designed examination proforma was used to collect data LogMAR and Pelli Robson chart was used to assess visual acuity and contrast sensitivity respectively. Fluorescein dye strip were used to assess dry eye in TBUT while slit lamp was used to assess different grades of corneal haze. TBUT assessed in mild, severed and moderate rang while corneal haze assessed in different grades, 0 represent no haze, 1+ defined faint corneal haze, 2+ represent with moderate, visibility of the iris and lens is cloudy with a grade of 3+, which indicated significant inflammation, intense haze in grade 4+ might be visible at the slit lamp along with fibrin or plastic fluid.

**RESULTS AND DISCUSSION**

In this study, total sample size of 60 patients age of 25-35 years old with low to moderate myopia divided into two categories i.e (category 1 and category 2) each had 30 patients. LASEK and PRK patients were compared to check efficacy of Visual Acuity (VA), Contrast Sensitivity (CS), Tear Breakup Time (TBUT) and Corneal Haze respectively. Data was analyzed through software SPSS 22 version using the paired sample T-test and the independent sample T-test.

**Table 1: 4.1: Age Distribution**

Total 60 patients (N = 60) of age 25-35 years old with low to moderate myopia were selected for study. 29.52 and 2.819 were mean and standard deviation (SD) values respectively.

**Table 4.1: Descriptive Statistics for Age**

| Values | N | Mean | Std. deviation |
|---|---|---|---|
| **Age** | 60 | 29.52 | 2.819 |

## 4.2: Paired Sample T-Test for Visual Acuity, Contrast Sensitivity, Corneal Haze and Tear Breakup Time on Photorefractive Keratectomy

selecting the participants according to inclusion criteria visual acuity, contrast sensitivity, tear breakup time and corneal haze values before and after PRK was measured. Pre and post mean and SD values of VA, CS, TBUT and corneal haze was 0.56 ± 0.26, with 0.21 (SD) 0.21 ± 1.27, with 0.37 (SD) 9.13 ± 8.50 with 0.76 (SD) and 0.00 ± 0.50 with 0.50 (SD) respectively with the significant value (P = 0.00) respectively.

**Table 4.2: Descriptive statistics for Visual Acuity, Contrast Sensitivity, Tear Break Up Time and Corneal Haze of Photorefractive Keratectomy**

| | Values | Mean | N | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | **Pre PRK visual acuity** | 0.5613 | 30 | 0.23133 | 0.04224 |
| | **Post PRK visual acuity** | 0.2627 | 30 | 0.28307 | 0.05168 |
| **Pair 2** | **Pre PRK contrast sensitivity** | 0.2100 | 30 | 0.29896 | 0.5458 |
| | **Post PRK contrast sensitivity** | 1.2733 | 30 | 0.28458 | 0.5196 |

| | | | | | |
|---|---|---|---|---|---|
| **Pair 3** | **Pre PRK tear breakup time** | 9.13 | 30 | 0.900 | 0.164 |
| | **Post PRK tear breakup time** | 8.50 | 30 | 1.009 | 0.184 |
| **Pair 4** | **Pre PRK corneal haze** | 0.00 | 30 | 0.00 | 0.00 |
| | **Post PRK corneal haze** | 0.50 | 30 | 0.509 | 0.93 |

**Table 4.2.1: Paired Sample T-Test for PRK Surgery**

| | **Values** | **Mean difference** | **Std. Deviation** | **Std. Error Mean** | **T** | **Df** | **Sig. (2-tailed)** |
|---|---|---|---|---|---|---|---|
| **Pair 1** | **Pre PRK visual acuity - Post PRK visual acuity** | 0.2987 | 0.21896 | 0.0398 | 7.471 | 29 | 0.00 |
| **Pair 2** | **Pre PRK contrast sensitivity - Post PRK contrast sensitivity** | 1.06333 | 0.37782 | 0.06898 | 15.415 | 29 | 0.00 |
| **Pair 3** | **Pre PRK tear breakup time - Post PRK tear breakup time** | 0.633 | 0.765 | 0.14 | 4.535 | 29 | 0.00 |
| **Pair 4** | **Pre PRK corneal haze – Post PRK corneal haze** | -0.5 | 0.509 | 0.093 | -5.385 | 29 | 0.00 |

## 4.3: Pair Sample T-Test for Visual Acuity, Contrast Sensitivity, Corneal Haze and Tear Breakup Time for Laser Sub Epithelial Keratectomy

The mean and SD value of VA, CS, TBUT and corneal haze was 0.51 ± 0.26 with 0.32 (SD), 0.17 ± 1.09 with 0.08 (SD), 9.23 ± 8.43 with 0.13 (SD) and 0.00 ± 0.33 with 0.47 (SD) respectively with significant value (P = 0.001) respectively.

**Table 4.3: Descriptive statistics for Visual Acuity, Contrast Sensitivity, Tear Break Up Time and Corneal Haze of Laser Sub Epithelial Keratectomy**

| | Values | Mean | N | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| Pair 5 | Pre LASEK visual acuity | 0.5107 | 30 | 0.27031 | 0.04935 |
| | Post LASEK visual acuity | 0.2627 | 30 | 0.30647 | 0.05595 |
| Pair 6 | Pre LASEK contrast sensitivity | 0.1750 | 30 | 0.26741 | 0.04882 |
| | Post LASEK contrast sensitivity | 1.0950 | 30 | 0.44244 | 0.08078 |
| Pair 7 | Pre LASEK tear breakup time | 9.23 | 30 | 0.971 | 0.177 |
| | Post LASEK tear breakup time | 8.43 | 30 | 1.006 | 0.184 |
| Pair 8 | Pre LASEK corneal haze | 0.00 | 30 | 0.00 | 0.00 |
| | Post LASEK corneal haze | 0.33 | 30 | 0.479 | 0.088 |

**Table 4.3.1: Paired Sample T-Test for LASEK Surgery**

| | Value | Mean difference | Std. Deviation | Std. Error Mean | T | Df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|
| **Pair 5** | **Pre LASEK visual acuity - post LASEK visual acuity** | 0.248 | 0.32583 | 0.05949 | 4.169 | 29 | 0.00 |
| **Pair 6** | **Pre LASEK contrast sensitivity - post LASEK contrast sensitivity** | -0.92 | 0.4504 | 0.08223 | -11.188 | 29 | 0.00 |
| **Pair 7** | **Pre LASEK tear breakup time - post LASEK tear breakup time** | 0.8 | 0.714 | 0.13 | 6.134 | 29 | 0.00 |
| **Pair 8** | **Pre LASEK corneal haze - post LASEK corneal haze** | -0.333 | 0.479 | 0.088 | -3.808 | 29 | 0.001 |

## 4.4: Independent Sample T-Test for PRK and LASEK Surgery for Corneal Haze

The post operative results of both methods PRK and LASEK on group 1 and group 2 were compared to check which methods was more effective. The corneal haze in PRK and LASEK had mean and SD value 0.50 ± 0.33 with 0.50 (SD) respectively. Results showed that there was no discernible distinction between PRK and LASEK (P = 0.197) over corneal haze respectively.

**Table 4.4: Descriptive statistics of Post PRK and LASEK Corneal Haze**

| | Refractive Surgery | N | Mean | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| Corneal Haze | PRK | 30 | 0.5000 | 0.50855 | 0.09285 |
| | LASEK | 30 | 0.333 | 0.47946 | 0.08754 |

**Table 4.4.1: Independent Sample T-Test for Post PRK and LASEK Corneal Haze**

| Mean Value | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Corneal Haze | Equal variances assumed | 3.625 | 0.062 | 1.306 | 58 | 0.197 | 0.16667 | 0.12761 |
| | Equal variances not assumed | | | 1.306 | 57.8 | 0.197 | 0.16667 | 0.12761 |

## 4.5: Independent Sample T-Test for Visual Acuity in PRK and LASEK

The post operative results of both methods PRK and LASEK over group 1 and group 2 were compared to check which methods was more effective regarding enhancement of visual Acuity. The mean and SD value was 0.26 ± 0.27 with 0.61 (SD) significant difference as with (P = 0.906**)** respectively.

**Table 4.5: Descriptive of Post PRK and LASEK for Visual Acuity**

| | Refractive Surgery | N | Mean | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| **Visual Acuity** | **PRK** | 30 | 0.2627 | 0.28307 | 0.05168 |
| | **LASEK** | 30 | 0.2720 | 0.32567 | 0.05946 |

**Table 4.5.1: Independent Sample T-Test for Visual Acuity in PRK and LASEK**

| Mean Value | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| **Visual Acuity** | **Equal variances assumed** | 0.182 | 0.671 | -0.118 | 58 | 0.906 | -0.00933 | 0.07878 |
| | **Equal variances not assumed** | | | -0.118 | 56.897 | 0.906 | -0.00933 | 0.07878 |

## 4.6: Independent Sample T-Test for Contrast Sensitivity on PRK and LASEK

Results of contrast sensitivity after PRK and LASEK procedure in (Group 1 and Group 2) of mild and moderate myopia showed mean and standard deviation values 1.2733 ± 1.0950 with 0.09 (SD) respectively with no significant difference as (P = 0.086) respectively.

**Table 4.6: Descriptive of Post PRK and LASEK for Contrast Sensitivity**

| | Refractive Surgery | N | Mean | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| Contrast Sensitivity | PRK | 30 | 1.2733 | 0.28458 | 0.05196 |
| | LASEK | 30 | 1.0950 | 0.44244 | 0.08078 |

**Table 4.6.1: Independent Sample T-Test for Contrast Sensitivity on PRK and LASEK**

| Mean Value | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Contrast Sensitivity | Equal variances assumed | 3.049 | 0.086 | 1.857 | 58 | 0.068 | 0.17833 | 0.09604 |
| | Equal variances not assumed | | | 1.857 | 49.489 | 0.069 | 0.17833 | 0.09604 |

## 4.7: Independent Sample T-Test for Tear Breakup Time on PRK and LASEK

The mean and std. value of Tear Breakup Time after PRK and LASEK of group 1 and group 2 was 8.50 ± 8.43 with 0.09 (SD) respectively. Results showed no significant difference between PRK and LASEK as (P = 0.799) respectively.

**Table 4.7: Descriptive of Post PRK and LASEK for Tear Breakup Time**

| | Refractive Surgery | N | Mean | Std. Deviation | Std Error Mean |
|---|---|---|---|---|---|
| **Tear Break-Up Time** | **PRK** | 30 | 8.5000 | 1.00858 | 0.18414 |
| | **LASEK** | 30 | 8.4333 | 1.00630 | 0.18372 |

**Table 4.7.1: Independent Sample T-Test for Tear Breakup Time on PRK and LASEK**

| Mean Value | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| TBUT | Equal variances assumed | 0.004 | 0.95 | 0.256 | 58 | 0.799 | 0.06667 | 0.26012 |
| | Equal variances not assumed | | | 0.256 | 58 | 0.799 | 0.06667 | 0.26012 |

## DISCUSSION

The purpose of this research aimed to evaluate clinical outcomes including like visual acuity, contrast sensitivity, corneal haze and tear break-up time between PRK and LASEK.[1] In this study 60 patients (N = 60), age of 25-35 years old with low to moderate myopia separated into two categories i.e. (category 1 and category 2) each had 30 patients. Effect over Visual Acuity, Contrast Sensitivity, Tear Breakup Time and Corneal Haze were compared in PRK and LASEK respectively. Data was analyzed by software SPSS version 22. The Independent Sample T-test and Paired Sample T-test were applied to compare the effects of both treatments.[2]

In 2013 kaya conducted a comparative cross-sectional study on low to moderate myopes. 32 individuals were involved in this study. Individual were informedly allocated to had one eye LASEK and other LASIK, if they had low myopia and a higher difference between their both eyes of 1 D. No statistically significant difference in groups spherical and cylindrical refractive error, tear break-up time or schirmer test after 6 months following surgery. The contrast sensitivity measurements in LASIK eyes were decreased than pre-operative measurements, however the LASEK group showed no change. Based on 6-month outcomes LASEK was considered to be an acceptable alternative to LASIK for low myopia since it was safe provides predictable results offers early refractive stability (69). Similarly, current comparative cross-sectional study conducted at The Smile Laser Eye Center Multan from September 2022 to May 2023, included 60 patients of age 25 – 35 years old having low to moderate myopia. The Patients were divided in two categories, (category 1 and category 2) each had 30 participants respectively. Statical analyzed was done by the independent sample T-test and paired sample T-test. Results of this study showed pre and post mean values of paired sample T test for VA, CS, TBUT and corneal haze were 0.26 ± 0.26, 0.21 ± 1.09, 8.50 ± 8.43 and 0.50 ± 0.33 respectively with significant value (P = 0.00) and the mean values of independent sample T-test for post PRK and LASEK over VA, CS, TBUT and corneal haze were 0.26 ± 0.27 with (P = 0.67) 1.27 ± 1.09 with (P = 0.08), 8.50 ± 8.43 with (P = 0.95) and 0.50 ± 0.33 (P = 0.62) respectively. Post results showed no statically change in both categories respectively.

A comparative cross-sectional study was done by Ganesh in 2017 included 60 participants had bilateral small incision lenticule extraction SMILE or PRK surgery to treat their low

myopia (4 D SE) to assessed the differences between PRK and small incision lenticule extraction SMILE for low myopia in terms of objective and the subjective quality of vision At three months, the SMILE group significantly bettered the PRK group in terms of both corrected and uncorrected distant visual acuity (CDVA) (P = 0.01). Furthermore, SMILE group showed slightly improved contrast sensitivity (P = 0.03). Due to mild haze, 4 eyes in PRK group reduced CDVA by one line. Both SMILE and PRK were effective treatments for low myopia. As a result of greater postoperative comfort and a reduction in aberration induction at three months, SMILE specified better visual quality and patient satisfaction (69). Similarly, current study included 60 patients between the ages of 25 and 35 with mild to moderate myopia were included in comparative cross-sectional research at The Smile Laser Eye Centre in Multan from September 2022 to May 2023. Two groups of patients were formed, each with 30 patients (Group 1 and Group 2). The mean and SD value of VA and CS was 0.26 and 0.50 with (P = 0.67) respectively. Results showed there was significant difference in both treatments. VA and CS equally improved after PRK and LASEK.

Reilly conducted comparative study between PRK and LASEK in moderate to high myopes included 100 patients of PRK and LASEK in each to assess corneal haze and visual acuity data which was analyzed and recorded at post-operatively. Visual acuity was recovered in PRK group after 1 week of surgery as compare of LASEK group to corneal haze was similar as fourth week of surgery in both groups. PRK had a modest advantage over LASEK in post-operative course regarding haze score and visual recovery was similar by 4 week and batter with PRK (70). In present study 60 patients between the ages of 25 and 35 with mild to moderate myopia were included in comparative cross-sectional research at The Smile Laser Eye Centre in Multan. Results showed mean value of VA and corneal haze was 0.26 and 1.27 with the p value of 0.67 and 0.08 respectively. VA and corneal equally improved after PRK and LASEK. Results of this study showed there was no significant difference in both treatments.

In 2017 Kong conducted research to comparing laser epithelial keratomileusis (LASEK) with photorefractive keratectomy (PRK) for low to moderate myopia with the objective to determine whether procedure is more successful, safe, and stable. 27 individuals who had evident refractions between -3.00 D and -6.50 D received treatment and underwent three

months of follow-up. Both times, one eye had PRK while the other underwented LASEK. The order between the eyes and the surgical technique were both random. Following the procedure, the postoperative discomfort, epithelial healing time, uncorrected visual acuity, manifest refraction, corneal haze, and surgical preference were assessed. Epithelial healing time, uncorrected visual acuity, and refractive error remained similar after a 3-month follow-up. However, compared to PRK treated eyes, LASEK treated eyes exhibited reduced postoperative pain levels (P=0.047) and corneal haze scores (P=0.02 after 1 month). 17 patients (or 63%) indicated they preferred the LASEK surgery. LASEK and PRK both effectively correct myopia, but LASEK had a lower incidence of postoperative discomfort and early postoperative corneal haze. This implied that LASEK could be a different method for correcting mild to moderate myopia (71). In the current research, 60 patients with mild to moderate myopia between the ages of 25 and 35 were enrolled in a comparative cross-sectional study at The Smile Laser Eye Centre in Multan. Result of current study showed mean value of VA after PRK and LASEK was 0.26 and 0.27 (p=0.67) respectively .VA improved equally after PRK and LASEK.

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