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Axial Length Evaluation before and after Myopic Corneal Refractive Surgery Using IOL Master

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Abstract

Purpose: To evaluate axial length before and after the photorefractive keratectomy (PRK) and laser *in situ* keratomileusis (LASIK). **Setting:** Alhokama Eye Center, Riyadh Saudi Arabia. **Design:** A cross-sectional study. **Methods:** The study sample was comprised of 106 eyes of 54 patients. Patients were divided into 2 groups based on whether they had photorefractive surgery (PRK group) or laser *in situ* keratomiluesis (LASIK group). The intra-group comparison was performed of the changes in axial length before and after surgery using IOLMaster. $P < 0.05$ was considered statistically significant. **Results:** There were 76 eyes (39 patients) in the PRK group with the mean age of 25.10 ± 3.47 years, the mean preoperative spherical equivalent of −3.16 ± 1.75 D, and the mean preoperative axial length of 24.79 ± 1.02 mm. In the LASIK group, there were 30 eyes (15 patients) with the mean age of 25.13 ± 4.91 years and the mean preoperative spherical equivalent of −5.58 ± 1.98 D and the mean preoperative axial length of 25.67 ± 1.35 mm. Postoperatively, the mean axial length was 24.70 ± 1.14 mm in the PRK group and 25.60 ± 1.33 mm in the LASIK group. The mean change between the preoperative and postoperative axial length was statically significant in both groups ($P < 0.00001$, both intra-group comparisons). **Conclusion:** There was a statically significant decrease in the axial length measurements after PRK or LASIK for myopia.

Keywords

Myopia, Axial Length (AL), LASIK, PRK, IOL Master

1. Introduction

Refractive surgery encompasses a range of procedures that aim to alter the refrac-

tive error of the eye by altering the cornea and/or crystalline lens [1]. Keratorefractive (corneal) procedures include radial keratotomy (RK), photorefractive keratectomy (PRK), laser *in situ* keratomileusis (LASIK), and laser subepithelial keratomileusis (LASEK) [2]. A 193 nm argon-fluoride excimer laser decreases refractive error by ablating the anterior corneal stroma to create a new radius of curvature. There are three major refractive surgical techniques that use excimer laser ablation. While the epithelium is debrided in photorefractive keratectomy (PRK), it is preserved as an epithelial flap in the PRK variant, laser subepithelial keratomileusis (LASEK). The excimer laser ablation is performed under a lamellar flap that is created with a microkeratome or scanning pulsed laser in laser *in situ* keratomileusis (LASIK) [2] [3]. The corneal changes after the refractive surgery have been well documented; however, there are relatively few studies on the effect of keratorefractive surgery on axial length. Previous studies evaluate the axial length after corneal refractive surgery [4] [5] [6] [7] and found conflict results, however, this study was done with larger samples and a longer follow-up period. In addition, we compare the difference in axial length before and after PRK and LASIK, and no study compares this difference between these two procedures before.

2. Materials and Methods

2.1. Subjects

This cross section study evaluated of an initial total number of 146 eyes of 74 subjects who had undergone photo refractive keratectomy (PRK) and Laser In suite Keratectomy LASIK to correct myopia were collected from ALHOKAMA eye center, Saudi Arabia, Riyadh. 40 eyes were excluded from the study because they either did not complete all the tests or did not came for the follow up. We ended with a total of 106 eyes of 54 patients who were eligible for analysis. Postoperative assessment was performed between the 6th to 9th weeks. According to the refractive surgery the subjects were divided into groups, Group 1 PRK the total number was 76 eyes of 39 subjects, Group 2 LASIK 30 eyes of 15 subjects. All subjects were free from systemic and ocular diseases, and were informed about the procedure and agreed to participate.

2.2. Inclusion Criteria

Patient with myopic refractive error who underwent refractive surgery and were at least 19 years old will be included in this study.

2.3. Exclusion Criteria

Patients with a history of ocular disease (glaucoma, cataract, retinal diseases…etc.) rather than myopia with astigmatism will be excluded.

2.4. Methods

The primary objective of the study was to evaluate the changes in axial length after PRK and LASIK. Hyperopic patients were excluded. This study was approved

by the King Saud University research ethics board. Patients were grouped according to the type of refractive surgery as follows: PRK group, those who underwent PRK for myopia; LASIK group, those who underwent myopic LASIK.

Preoperative ophthalmic examination included measurement of pupillometer, corneal topography LogMAR uncorrected (UDVA) and best corrected distance visual acuity (CDVA), manifest refraction, measurement of axial length (IOLMaster Version 5.02; Carl Zeiss AG, Jena, Germany), corneal pachymetry, Goldmann tonometry, slit lamp examination and dilated funduscopy. Subjects were examined postoperatively at regular intervals to 6 months. The 6 months postoperative examination was identical to the preoperative examination with the exception of dilated funduscopy which was performed only if clinically warranted and axial length was performed only once postoperatively between months 1 and 2.

2.5. Statistical Analyses

The paired T-test was used to determine the intra-group difference in axial length from preoperatively to postoperatively using SPSS program Version 22. $P < 0.05$ was considered statistically significant.

3. Results

3.1. PRK Group

There were 76 eyes of 39 patients in the PRK group with mean age of 25.10 ± 3.47 years (range, 19 to 32 years) and 53.8% were female and 46.1% were male. Preoperative mean spherical equivalent was −3.16 D ± 1.75 D (range, −1.00 D to −8.25 D) in the PRK group. The mean preoperative keratometry was 43.50 ± 1.61 D (range, 40.43 to 48.8 D). The mean axial length was 24.79 ± 1.02 mm (range, 22.50 to 28.24 mm) preoperative and 24.70 ± 1.14 mm (range, 22.43 to 28.28 mm) postoperatively. The main difference in axial length was statistically significant at 0.09 ± 0.02 mm ($P < 0.00001$).

3.2. LASIK Group

There were 30 eyes of 15 patients in the LASIK group, 60% were female and 40%

Table 1. Pre and post-operative parameters in both groups.

Means ± SD Range	PRK			LASIK		
	Pre-operative	**Post-operative**	***P* value**	**Pre-operative**	**Post-operative**	***P* value**
Spherical equivalent (D)	−3.16 ± 1.75 −1.0 to −8.25	+0.02 ± 0.37 −2.0 to+1.25	***	−5.58 ± 1.98 −2.0 to −10.0	+0.04 ± 0.33 −0.5 to +1.0	***
Visual acuity (decimal)	0.13 ± 0.11	1.02 ± 0.2	***	0.06 ± 0.049	0.96 ± 0.15	***
Axial length (mm)	24.79 ± 1.02 22.5 to 28.36	24.70 ± 0.1 22.43 to 28.28	***	25.67 ± 1.35 23.03 to 28.37	25.60 ± 1.33 23.0 to 28.32	***
K reading (D)	43.50 ± 1.61 40.43 to 48.8	40.26 ± 2.09 31.87 to 45.94	***	43.36 ± 1.46 40.35 to 46.61	38.26 ± 2.94 31.9 to 41.95	***

***p value of paired t test; <0.00001.

were male. Preoperatively, the mean age was 25.13 ± 4.91 years (range, 18 to 36 years), the mean spherical equivalent was −5.58 ± 1.98 D (range, −2.0 to −10.0 D), and the mean keratometry was 43.36 ± 1.46 D (range, 40.35 to 46.61 D). The mean axial length was 25.67 ± 1.35 mm (range, 23.03 to 28.36 mm) preoperatively and 25.60 ± 1.33 mm (range, 23.03 to 28.36 mm) postoperatively. The difference in axial length was statistically significant at 0.07 ± 0.92 mm ($P < 0.00001$) (**Table 1**).

4. Discussion

There is a relative paucity of studies that evaluate the difference in axial length before and after refractive surgery. Von Mohrenfels *et al.* [4] published the first study on this topic and measured the axial eye length before and after Laser-Assisted Sub-Epithelial Keratectomy (LASEK) with the IOLMaster and reported no statistically significant difference from preoperatively to 1 month postoperatively. Subsequently, Rosa *et al.* [5] evaluated the accuracy of the IOLMaster in detecting axial length changes after photorefractive keratectomy (PRK) and rejected von Mohrenfels *et al.* [4] observation of a lack of a significant difference between preoperative and postoperative axial length measurements.

The outcomes of the current study indicate a highly statically significant difference in the axial length before and after the surgery in both groups. However the differences were slightly larger in the PRK group compared to the LASIK. This difference can be explained by the larger number of subjects in the first group. Our outcomes concur with those reported by Chalkiadkis *et al.* [6] and Tay *et al.* [8] who reported that IOLMaster can accurately detect variations in the axial length after a photorefractive operation especially, LASIK.

LASIK involves greater changes to the corneal stroma compared to PRK due to creation of a 130 to 160 μm flap and laser delivery directly to the deeper stromal layers. The corneal stroma is contained more than two hundred lamellae, which are 1 to 2 μm thick each, which are strongly crammed and coordinate collagen fibrils 36 nm in diameter [9]. The lamellae are composed of collagen fibrils that are about 30 nm in diameter, with center-to-center spacing of about 60 nm [10]. However, PRK involves broad injury and removal of the epithelium, epithelial basement membrane, Bowman's layer and a portion of the anterior stroma, whereas LASIK leaves these structures relatively undisturbed except at the flap margin by virtue of a stromal-epithelial flap. This difference in the degree of central epithelial trauma is a major factor in the clinical and histological differences noted after LASIK and PRK. Differences in the level of peripheral epithelial injury, depending on side-cut energies, is also likely an important determinant of the difference in healing between LASIK performed with femtosecond laser compared to LASIK performed with a microkeratome [11].

Although the changes in axial length were statistically significant after both refractive procedures, these changes are likely not clinically significant. For example, a change of less than 0.10 mm as reported in the current study is likely to lead

to approximately 0.2 D error for a 24.00 mm eye.

5. Conclusion

The outcomes of the current study indicate that there are variations in the axial length of the eye after PRK and LASIK, resulting in a statistically significant decrease in axial length measurements.

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Limitation of This Study

There are some drawbacks to our study including the small sample size the lower number of patients in the LASIK group. Ideally, a prospective, randomized study enrolling larger sample sizes in both groups would allow more definitive conclusions.

Presented

This article has not been presented in a meeting.

Conflicts of Interest

The authors have no financial or proprietary interest in a product, method, or material described herein.

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