Original article

GOLDMANN APPLANATION TONOMETRY AFTER LASER IN SITU KERATOMILEUSIS FOR MYOPIA

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Abstract Purpose: To evaluate the change of intraocular pressure (IOP) using Goldmann applanation tonometry (GAT) and to determine the relationship between IOP and the central corneal thickness (CCT) after laser in situ keratomileusis (LASIK).

Methods: Data from 65 patients, who had undergone bilateral LASIK, were included in a retrospective study. Three-month follow-up data were reviewed. IOP was measured by GAT preoperatively and 3 months after LASIK. The change from baseline (preoperative) IOP and the correlation between IOP and the central corneal thickness (CCT) were evaluated.

Results: At 3 months, the mean IOP decreased, compared to preoperative values. The significant mean change in IOP was 2.14±0.90 mm Hg (range, 0 to 5 mm Hg) (p=0.0001), and the mean reduction of CCT after LASIK was 90.46±30.62 µm (range 25 to 167 µm). There was no correlation between change in CCT (µm) and IOP (mm Hg) (r=-0.09; p=0.334).

Conclusion: LASIK lowered IOP measurement by GAT. The reduction in IOP measurement was probably caused by a change in the corneal thickness (central stromal thinning). This decrease may the delay recognition and treatment of future glaucoma that may develop after LASIK for myopia.

Refractive Surgery Center, (Chiang Mai, Thailand). The patients were randomly selected from those having a minimum of 3-months follow-up. All the cases of this study met the inclusion criteria including an age of at least 18 years, a manifest refraction spherical equivalent (MRSE) error of between −1.00 and −10.00 diopters (D), documented stable refraction for 1 year, refractive astigmatism of less than 2.00 D, central corneal thickness that permitted at least 250 µm of intact corneal tissue to remain after ablation, and realistic patient expectations concerning the outcome. The exclusion criteria included glaucoma, glaucoma suspect, ocular hypertension, previous ocular surgery, previous ocular disease, systemic diseases likely to affect corneal wound healing (e.g. systemic lupus erythematosus, rheumatoid arthritis), use of topical or systemic steroid, and enhancement procedure. Emmetropia was the refraction goal in all cases.

The following preoperative data were collected: age, sex, slit-lamp biomicroscopy, manifest refraction, Goldmann applanation tonometry, cycloplegic refraction, fundus examination, and ultrasonic pachymetry.

**Surgical Technique**

Prior to surgery, the patients received standard preoperative care with disinfection of the eyelid (providone iodine 10%) and tobramycin 0.3% for infection prophylaxis. Surgery was performed under topical anesthesia. An 8.5 to 9.5 mm diameter anterior corneal flap, approximately 160 µm in thickness, was created using the Hansatome microkeratome. This was followed by a midstromal ablation using a Technolas 217 excimer laser. After the ablation, the stromal bed and posterior surface of the flap were washed with balanced salt solution and the flap was placed in its original position. Before eye speculum removal, one drop of tobramycin 0.3% and non-preserved artificial tears (Sodium Hyaluronate 0.18%) were put in. Stable humidity and temperature were maintained in the operating room. Oral analgesics were recommended, if necessary, during the immediate postoperative time, and topical tobramycin 0.3% was prescribed 4 times daily during the first week.

Postoperatively, refraction and corneal topography were measured at 1, 3, and 12 months. IOP measurement was performed at 3 months.

**Statistical Analysis**

The paired Student’s *t* test and Pearson correlation coefficient (two-tailed) on the computer using the Statistical Package for Social Science (SPSS version 10.0.7) were used for statistical analysis of significance.

**Results**

Data from 65 patients who had undergone bilateral LASIK between January 2000 and December 2000 were suitable for analysis. Patients ranged in age from 18 to 58 years (mean±SD 35.9±9.6 yr). Of the 65 patients, 42 (64.6%) were female and 23 (35.4%) were male.

Table 1 shows the preoperative and 3-month postoperative data.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Preoperative</th>
<th>At 3 months after LASIK</th>
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<tbody>
<tr>
<td>Manifestation refraction spherical equivalent (D)</td>
<td>-4.71±2.34 [-1]−[-10]</td>
<td>N/A*</td>
</tr>
<tr>
<td>Central corneal thickness (µm)</td>
<td>555.20±26.00 (496-631)</td>
<td>464.80±34.52 (400-583)</td>
</tr>
<tr>
<td>Intraocular pressure (mm Hg)</td>
<td>15.61±1.48 (11-19)</td>
<td>13.48±1.60 (10-17)</td>
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</tbody>
</table>

*; not available
90.46±30.62 µm (range 25 to 167 µm).

There was no correlation between change in CCT (µm) and IOP (mm Hg) (r=-0.09; p=0.334).

Discussion

LASIK is a refractive procedure developed by Pallikaris et al.\(^\text{1}\) and has been popularized by Ruiz et al.\(^\text{15}\). It uses a suction ring to increase the IOP to more than 65 mm Hg for the lamellar corneal cut by microkeratome. The flap is reflected to one side, and photokeratectomy with an excimer laser is applied to the bed of the cornea. The flap is then placed back on the treated cornea.

As LASIK becomes more popular, refractive surgeons are beginning to take a greater interest in its efficacy, predictability, and side effects. One of the risk factors in the development of glaucoma is myopia.\(^\text{16,25}\) Preoperative evaluation for glaucoma is necessary for all cases that receive LASIK. The measurement of IOP is a cornerstone in the diagnosis and management of many ophthalmic diseases. Although many devices have been used to evaluate IOP, Goldmann applanation tonometry has proven to be the most accurate, and it is considered the "gold standard" for measuring IOP.\(^\text{17}\)

Ehlers et al.\(^\text{3}\) found a mean error of approximately 5 mm Hg for each 70 µm change in corneal thickness, with thinner corneas causing underestimations while thicker ones caused overestimations. Whitacre et al.\(^\text{4}\) predicted a smaller mean error of 3.5 mm Hg for a decrease in corneal thickness of 70 µm. Thin corneas produced underestimations of the IOP by as much as 4.9 mm Hg.

A reduction in IOP measured by GAT after refractive surgery has been reported by other investigators. Schipper et al.\(^\text{18}\) measured applanation IOP in the central and temporal aspects of the cornea in 64 eyes before and after photorefractive keratectomy (PRK) and demonstrated that central and temporal IOP measurements were identical before treatment. However, they were 2 to 3 mm Hg lower in the central cornea after PRK. Kohlhaas et al.\(^\text{19}\) evaluated the effect of IOP by in situ keratomileusis and cryokeratomileusis, when both procedures led to a significant decrease (4.5 mm Hg). Chatterjee et al.\(^\text{20}\) showed that IOP in the eye after PRK treatment is significantly lower than in the untreated eye and it was found to be related to the degree of myopia treated. The findings of Faucher et al.\(^\text{21}\) were similar, with a mean drop in IOP of 2.4 mm Hg in 824 eyes after PRK. Many studies also demonstrated IOP change after radial keratotomy (RK).\(^\text{19,21}\) Mendez\(^\text{22}\) found a more than 7.0 mm Hg decrease in IOP after RK in six patients with primary-angle glaucoma. Perez-Santonja et al.\(^\text{23}\) also found a decrease in IOP of 3 mm Hg as measured by GAT after LASIK.

In this study, IOP measured by GAT was significantly lower at 3 months after LASIK than at the preoperative period (p=0.0001). This reinforces the results of the previous studies.\(^\text{17,24}\) This study’s outcome may be partially explained by the assumption that a thinned cornea after LASIK may require less force to create the same amount of surface applanation than would be required when the same cornea was thicker. There was no correlation between change in CCT (µm) and IOP (mm Hg) (r=-0.09; p=0.334).

Although the decrease in IOP after PRK has already been explained as the result of an absent Bowman’s layer by Schipper et al.\(^\text{18}\) and Chatterjee et al.\(^\text{20}\) the cause of IOP reduction after LASIK has not been clearly understood.

In conclusion, this study confirmed that an iatrogenic decrease in CCT by LASIK produces a decrease in mean applanation tonometry reading, and this change should be taken into consideration in order to avoid a missed diagnosis of early glaucoma in a patient who has received LASIK.
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References