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Original Article

The applicability of correction factor for corneal thickness on non-contact tonometer measured intraocular pressure in LASIK treated eyes

Jitendra Jethani [a,b]; Paaraj Dave [a,*]; Monica Jethani [b]; Yogesh Desai [b]; Purvi Patel [b]

Abstract

Purpose: To determine the applicability of central corneal thickness (CCT) based correction factor for non-contact tonometer (NCT) measured intraocular pressure (IOP) readings.
Method: A prospective, non-randomized study involved 346 eyes of 173 consecutive patients with age ⩾21 years undergoing laser-assisted in situ keratomileusis (LASIK) for myopia and/or myopic astigmatism. The CCT and IOP were measured before and after the LASIK procedure. The IOP pre and post-LASIK was compared after applying the correction factor for CCT. Patients not completing the 3 month postoperative follow-up were excluded.
Results: The median spherical equivalent before undergoing LASIK was −4.25D (inter-quartile range, −3.25D). The mean preoperative CCT was 536.82 ± 33.71 μm which reduced to 477.55 ± 39.3 μm ($p < 0.01$) post-LASIK. The mean IOP reduced from a preoperative value of 14.6 ± 2.32 mmHg to 10.64 ± 2.45 mmHg postoperatively ($p < 0.01$). On applying correction for the corneal thickness, the pre and postoperative IOP was 15.14 ± 2.8 mmHg and 15.37 ± 2.65 mmHg ($p = 0.06$) respectively with a strong positive correlation ($r = 0.7$, $p < 0.01$). Three hundred eyes (86.7%) had an absolute difference in IOP of less than 3.0 mmHg post-CCT correction which is within the retest variability of NCT. Only 46 eyes (13.3%) had an absolute difference of more than 3.0 mmHg.
Conclusion: The modified Ehler's correction algorithm used in this study can be effectively applied in the normal IOP range in a majority of patients.

Keywords: NCT, CCT, LASIK, Intraocular pressure, Correction

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Introduction

Laser-assisted in situ keratomileusis (LASIK) is a commonly employed procedure for the correction of myopia.[1] Myopia is an independent risk factor for glaucoma progression.[2] The intraocular pressure (IOP) measurements following LASIK are known to be inaccurate.[3] With the IOP being the only modifiable risk factor, obtaining accurate IOP readings is essential in diagnosing and managing glaucoma.[4] It is now possible to measure corneal biomechanics in the form of corneal hysteresis. Patients with glaucoma have been repeatedly shown to have a significantly lower corneal hysteresis and central corneal thickness (CCT).[5,6] The main source of error for measuring IOP post-LASIK is the change in CCT.[7] The

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[a] Dr. T V Patel Eye Institute, Vadodara 390001, India
[b] Surat Eye Laser Centre, Adarsh Society, Athwa, Surat 395001, India

* Corresponding author at: Dr. T V Patel Eye Institute, Vinoba Bhave Road, Salatwada, Vadodara 390001, India. Tel.: +91 265 2410932; fax: +91 265 22426311.
e-mail address: paaraj@gmail.com (P. Dave).

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non-contact tonometer (NCT) is widely used as a screening tool for glaucoma because of its advantage of not requiring direct corneal contact and corneal anesthesia. Previous studies have shown that the NCT can produce accurate IOP assessment comparable to Goldmann applanation tonometer (GAT).[8–10] The CCT readings affect the NCT measurements.[11] The test–retest variability of NCT has already been reported.[12] There is little information regarding the accuracy of correction factor application on the IOP readings of NCT. The aim of our study was to apply the CCT based correction factor before and after the LASIK procedure and to ascertain whether the difference lies within the retest variability of the NCT.

Materials and methods

This was a prospective, non-randomized, interventional study done at a tertiary care center and its collaborating center where the LASIK procedure was performed. A written consent was obtained from all patients and the study was approved by the local ethics committee. The study included 180 consecutive patients undergoing LASIK for myopia and/or myopic astigmatism from February 2011 to January 2012. Patients were excluded from surgery if they were younger than 21 years or had a history of uveitis, ocular trauma, severe dry-eye syndrome, collagen disease, drug allergy, glaucoma and diabetes mellitus. Those not willing to participate or not completing the 3 month postoperative follow-up were also excluded from the study. Seven patients did not complete the last follow-up. Three hundred and forty-six eyes of 173 patients were finally included in this study.

Preoperative examination

Baseline ocular examination included anterior segment and anterior vitreous evaluation by slit lamp biomicroscopy; posterior vitreous, disk, and macula evaluation by slit lamp biomicroscopy with a 90 diopter (D) lens and peripheral retina evaluation by indirect ophthalmoscopy. Intraocular pressure measurement was done by NIDEK NT-2000 NCT (Nidek CO., LTD., Hiroishi Gamagori, Aichi, Japan). An average of four daytime IOP readings (9 am, 11 am, 1 pm and 3 pm) on the same day was taken as the preoperative IOP. The delay in the time schedule was never more than 30 min. Central corneal thickness measurements were done by an ultrasonic pachymeter (SP-3000, TOMEY Corporation, Nagoya, Japan). The pre and postoperative assessment including the IOP measurement was done by one of the authors (JJ).

LASIK procedure

An 8 to 8.5-mm diameter corneal flap, approximately 130 μm in thickness, was created using the Wave Light FS 200 femtosecond laser and Allegretto Wave Eye-Q 400 Hz (Alcon, Fort Worth, Texas, USA) excimer laser was used to ablate the corneal stromal bed. All procedures were performed by one of the authors (YD).

Postoperative regimen

The postoperative regimen included nepafenac 0.03% eyedrops 3 times a day, moxifloxacin 0.5% eyedrops 4 times a day and polyethylene glycol 0.4% + propylene glycol 0.3% eyedrops 6 times a day. These drops were continued for 6 weeks after the LASIK procedure. Repeat IOP (Average of 4 daytime readings as before) and pachymetry measurements were again taken at 3 months postoperatively.

Correction factor

The CCT based correction algorithm was based on the Ehler's correction[13] for GAT and is shown in Table 1. This correction algorithm is distributed with most pachymetry instruments and has been used and validated in previous studies.[14] The correction factor was applied depending on the closeness of the CCT values to the described category. If the CCT values were equidistant from both categories, the next category was chosen to apply the correction factor. For example, if the CCT was 480 μm, a correction factor of +4 was applied.

Statistical analysis

Descriptive and inferential statistics were performed using STATA version 12 for Windows (StataCorp LP, Texas). Normality of variables was tested by the Shapiro–Wilk test. Continuous normally distributed data were represented as mean and standard deviation. Data with non normal distribution were represented as median and quartiles. Paired *t*-test was used to compare the CCT and IOP values before and after the LASIK procedure. Multiple linear regression analysis was used to find the factors affecting the difference in IOP

Table 1. The modified Ehler's correction factor algorithm.

Central corneal thickness (μm)	Correction value (mmHg)
410	10
415	10
420	9
425	9
430	8
435	8
440	7
445	7
455	6
465	6
475	5
485	4
495	4
505	3
515	2
525	1
535	1
545	0
555	−1
565	−1
575	−2
585	−3
595	−4
605	−4
615	−5
625	−6
635	−6
645	−7

Abbreviations: μm = microns, mmHg = millimeter mercury.