Effectiveness of the Goldmann Applanation Tonometer, the Dynamic Contour Tonometer, the Ocular Response Analyzer and the Corvis ST in measuring intraocular pressure following FS-LASIK

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Conflict of Interest

Professor Ahmed Elsheikh is a consultant with Oculus, who has provided financial support for research leading to the development of Corvis bIOP.

Running title

IOP measured with four tonometers following FS-LASIK

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Precis:

Among the six IOP measurements provided by four tonometers, the bIOP by the Corvis ST was the least influenced by the change in corneal biomechanical properties caused by FS-LASIK.

Abstract

Purpose: To test the performance of the four tonometers in providing IOP measurements that were free of effects of corneal biomechanics changes caused by refractive surgery.

Methods: Four tonometers were employed to provide IOP measurements for 65 participants who accepted Femtosecond laser-assisted LASIK (FS-LASIK). The measurements included GAT-IOP by the Goldmann Applanation Tonometer, DCT-IOP by the Dynamic Contour Tonometer, Goldmann-correlated IOP (ORA-IOPg) and corneal-compensated IOP (ORA-IOPcc) by the Ocular Response Analyzer, and uncorrected IOP (CVS-IOP) and biomechanically-corrected IOP (CVS-bIOP) by the Corvis ST. Statistical analyses were performed to assess the association of the differences in IOP caused by FS-LASIK with central corneal thickness (CCT), mean corneal curvature (Km), age, refractive error correction (REC), optical zone diameter (OZD), ablation zone diameter (AZD), residual stromal bed thickness (RSB) and RSB ratio (RSB/CCT). Multiple linear regression models were constructed to explore factors influencing IOP changes.

Results: All four tonometers exhibited significant differences between IOP measurements taken pre and post-surgery except for CVS-bIOP in the low to moderate myopia group ($t= 1.602$, $p= 0.12$). CVS-bIOP, followed by DCT-IOP, provided the best agreement between pre and post-FS-LASIK measurements with the lowest differences in IOP and the narrowest limits of agreement. The pre-post IOP differences were also significantly associated with the reduction in CCT in only GAT-IOP, ORA-IOPg and CVS-IOP. CVS-bIOP and ORA-IOPcc were the only measurements that were not correlated with CCT, Km or age both before and after FS-LASIK.

Conclusions: The biomechanically-corrected bIOP from the Corvis ST provided post-FS-LASIK measurements that were in closest agreement with those obtained before surgery. In comparison, GAT-IOP, ORA-IOPg, ORA-IOPcc and CVS-IOP appeared to be more influenced by the changes in corneal biomechanics caused by FS-LASIK.

Keywords: Biomechanics changes; FS-LASIK; Intraocular pressure measurements, Corvis ST, Dynamic Contour Tonometer

Introduction

Measurement of Intraocular pressure (IOP) is an important eye examination needed to risk-profile and manage glaucoma. The accuracy of current methods of IOP measurement is influenced by corneal stiffness which varies with thickness, curvature, age and medical history [1-5], and the resulting errors have been estimated to affect the accuracy of glaucoma management in more than 20% of patients [6].

Since its introduction in the 1950s, the Goldmann Applanation Tonometer (GAT, Haag-Streit AG) has become the reference standard in tonometry [7] despite the inaccuracies of its IOP measurements caused by variations in corneal parameters, most notably the central corneal thickness (CCT) [8]. Numerous studies have since been conducted to assess the effect of CCT variation on GAT-IOP and the estimates range between 0.7 and 7.1 mmHg for every 100 μm change in CCT [2,9-13]. Further studies estimated the effect of corneal curvature, on GAT-IOP to be between 0.57 and 1.14 mmHg per 1mm change in the central anterior radius [9 5,14]. The studies also reported a significant effect of the tissue's material properties on GAT-IOP, but the practical value of this observation was limited by the current inability to measure corneal material properties in vivo.

In response to the inaccuracies reported in GAT, the Dynamic Contour Tonometer (DCT, SMT Swiss Microtechnology AG, Switzerland) was designed with a tip that has a curvature, which the cornea naturally achieves when the pressure is the same on both sides [15,16]. On this basis, the DCT is reported to be much less affected by the corneal stiffness parameters than GAT [15]; a claim that has been validated in a number of clinical studies [15,17-19]. Other attempts to address the effect of corneal stiffness on tonometry results include the Ocular Response Analyzer (ORA, Reichert Ophthalmic Instruments, Depew, NY). The ORA provides the corneal-compensated IOP (IOPcc), which is intended to be less dependent on corneal thickness than applanation tonometers [20]. More recently, another non-contact tonometer, the Corvis ST, was developed by OCULUS Optikgeräte, Inc. (Wetzlar, Germany) for the same purpose. The Corvis relies on high-

precision, ultra-high-speed, Scheimpflug technology to monitor corneal deformation under air puff and produces a wide range of tomography and deformation parameters, which have the potential to enable accurate estimates of both corneal stiffness and IOP. Earlier research led to the development of a biomechanically-corrected IOP (bIOP) measurement that has been validated both experimentally and clinically and found to have lower dependence on the corneal parameters; CCT and material properties which vary with age [21], compared with the uncorrected Corvis measurement (CVS-IOP) [22,23].

This paper attempts to assess the effectiveness of the four tonometers in estimating the true value of IOP (IOP_{true}). However, since IOP_{true} cannot be determined directly (without conducting manometry), we have used the assumption that it does not change after refractive surgery, in which the tissue becomes ablated, a flap or a cap becomes separated and the cornea experiences stiffness changes due to the wound-healing effect [24,25]. Therefore, the ability of a tonometer to provide similar estimates of IOP before and after surgery is considered an indication of success in avoiding the inaccuracies caused by changes in corneal biomechanics.

Methods

Patients

65 eyes of 65 myopes, (26.32±5.96 years, range 17-40) including 32 males and 33 females who underwent Femtosecond laser-assisted LASIK (FS-LASIK) refractive surgery in the Eye Hospital of WenZhou Medical University were involved in this prospective study. The study followed the tenets of the Declaration of Helsinki and was approved by the Scientific Committee of the Eye Hospital. Surgical parameters including optical zone diameter (OZD), ablation zone diameter (AZD), residual stromal bed thickness (RSB) and refractive error correction (REC) were recorded from surgery planning/treatment printouts. REC was converted into spherical equivalent (SE). Central corneal thickness (CCT) and mean corneal keratometry (Km) were both measured with a Pentacam (OCULUS Optikgerate GmbH, Wetzlar, Germany). Km was

taken as the average of cornea's central curvature in the horizontal and vertical directions, Kh and Kv. RSB ratio was defined as RSB/CCT. According to SE measured pre-surgery, participants were divided into two groups with low to moderate myopia (-0.50D>SE≥-5.00D, 30 eyes) and high myopia (-5.00D>SE, 35 eyes). The exclusion criteria included a history of ocular disease, surgery and/or trauma, stopping use of contact lenses for less than two weeks. Those not willing to participate or not completing the 3 months postoperative follow-up were also excluded from the study.

Examinations and Measurements

Four tonometers were employed in this study to provide IOP measurements for each participant. The measurements included GAT-IOP by the Goldmann Applanation Tonometer, DCT-IOP by the Dynamic Contour Tonometer, corneal-compensated IOP (ORA-IOPcc) and Goldmann-correlated IOP (ORA-IOPg) by the Ocular Response Analyzer, and uncorrected IOP (CVS-IOP) and biomechanically-corrected IOP (CVS-bIOP) by the Corvis ST. Of these measurements, DCT-IOP, ORA-IOPcc and CVS-bIOP were designed to significantly reduce effect of corneal biomechanics on IOP estimations.

To eliminate bias, all participants underwent the following tests in a single session and in the same order: measurement of topography, IOP measurement using non-contact tonometers (ORA and CVS arranged randomly), then contact tonometers (GAT and DCT arranged randomly) as described in previous studies [26-28]. Non-contact IOP measurements were repeated in 3 minutes in between until there were 3 readings by each tonometer, in which the difference between the highest and lowest values was within 2 mmHg. Contact measurements by GAT and DCT were taken 20 minutes after completion of all non-contact measurements, and drops of topical Alcaine 0.5% (Alcon, Missisauga, Canada) were applied before taking measurements as described in previous studies [29]. Each contact tonometer was used twice with a pause of at least 5 min between

measurements [30].

Data were collected preoperatively and at 3 months postoperatively. The 3-month-postoperative time point was selected as postoperative stromal edema would have resolved by then and postoperative corneal astigmatism typically stabilized [31]. All measurements were completed in one clinic visit in the same half day session (morning 08:30-11:30 or afternoon 01:30-04:30) to improve follow-up, ensure consistency and minimize diurnal effects [32]. All measurements were taken with participants in the sitting position and with undilated pupils. They were taken by the same experienced clinician (WH) and using the same instruments to minimize potential for variability associated with either the instrument or the operator, and in line with procedures adopted in earlier studies [18,33,34]. Only one eye per patient, randomly selected, was included in the study.

Surgical Technique

In the FS-LASIK procedure, a 100-110 μm thick, 8.0-9.0 mm diameter flap with a superior hinge was created using femtosecond laser (Ziemer Ophthalmic Systems AG, Port, Switzerland), followed by tissue ablation using the Amaris 750 excimer laser (Schwind eye-tech-solutions, Kleinostheim, Germany). Postoperatively, 1 drop of tobramycin/dexamethasone (Tobradex; Alcon, TX, USA) was instilled at the surgical site and a bandage contact lens (Acuvue Oasys; Johnson & Johnson, FL, USA) was placed on the cornea and removed 1 day later. After surgery, fluorometholone 0.1% (Flumetholon; Santen, Osaka, Japan) and topical levofloxacin 0.5% (Cravit; Santen, Osaka, Japan) were applied 4 times a day for 1 week, then the dosage was tapered each subsequent week until it was stopped 1 month post-operation.

Statistical analyses

The Statistical analyses were performed using SPSS (version 20.0, IBM, Inc.). The difference between pre- and post-surgery IOP values was analyzed using paired-sample T test, while the comparison between low-to-moderate myopia group and high myopia group was assessed through independent-samples T test. MANOVA of repeated

measurements was employed in the analysis of the difference between DCT-IOP and the other five IOP measurements. The level of agreement between the IOP measurements obtained by GAT, DCT, ORA and CVS pre and post-FS-LASIK was evaluated using Bland-Altman plots. The relationship between each of the IOP measurements (DCT-IOP, GAT-IOP, ORA-IOPg, ORA-IOPcc, CVS-IOP and CVS-bIOP) and each of age, Km and CCT was assessed using the Pearson's or Spearman linear correlation factor according to a normal distribution test. Multiple linear regression analyses with the stepwise method were used to identify significant associations of ΔCCT, ΔKm, age, REC, OZD, AZD, RSB and RSB ratio with the IOP differences between pre and post-FS-LASIK. p values less than 0.05 were considered statistically significant.

Results

The mean preoperative CCT was 550.7±22.6 μm, which reduced to 460.9±37.1 μm ($p< 0.01$) post-FS-LASIK, and the mean REC, OZD and AZD were -5.38±1.90 D, 6.70±0.36 mm and 7.77±0.33 mm, respectively. At the pre-surgery stage, the low-to-moderate myopia group and high myopia group were closely matched in age (26.61±6.61 years vs 26.07±5.43, t= 0.361, p= 0.720), gender ratio (Male/Female: 16/14 vs 16/19, χ^2=0.375, p= 0.622), Km (43.34±1.63 D vs 43.30±1.16 D, t= 0.103, p= 0.918), CCT (551.2±25.3 μm vs 550.3±20.6 μm, t= 0.150, p= 0.881) and GAT-IOP (13.06±2.13 mmHg vs 13.18±1.96 mmHg, t= -0.246, p= 0.807).

Table 1 showed the mean preoperative and postoperative IOP measurements for all patients. The results showed significant differences between the IOP measurements taken pre and post-surgery in DCT-IOP, GAT-IOP, ORA-IOPg, ORA-IOPcc and CVS-IOP in both myopia groups (all $p< 0.05$). On the other hand, CVS-bIOP decreased significantly after FS-LASIK only in the high myopia group (t= 4.232, p= 0.000), but not in the low-to-moderate myopia group (t= 1.602, p= 0.12).

DCT-IOP was higher than the other five IOP measurements both before and after FS-LASIK ($p< 0.01$). IOP differences between pre and post-FS-LASIK in the low-to-moderate myopia group were lower than in the high myopia group for DCT-IOP and CVS-IOP ($t= -2.804$, $p=0.007$ for DCT-IOP; $t= -3.195$, $p= 0.002$ for CVS-IOP) but not in GAT-IOP, ORA-IOPg and ORA-IOPcc and CVS-bIOP ($p> 0.05$).

Using Bland-Altman plots, the agreement between pre and post-operative IOP measurements by DCT, GAT, ORA and CVS were evaluated in Figure 1 (low to moderate myopia group) and Figure 2 (high myopia group) where the mean difference was the estimated bias, and the standard deviation (SD) of the differences measured the random fluctuations. Both Figures 1 and 2 showed that CVS-bIOP, followed by DCT-IOP, provided the best agreement between pre and post-FS-LASIK measurements with the mean differences in IOP being closest to zero and the data showing the smallest ranges of limits of agreement (LoA) in both low to moderate myopia group and high myopia group.

Pre-operatively, DCT-IOP, ORA-IOPg and CVS-IOP were correlated with CCT ($p< 0.05$), while only ORA-IOPg and CVS-IOP were correlated with CCT ($p< 0.01$) in the post-operative stage. Further, none of the six IOP measurements taken pre-surgery was correlated with Km or age ($p> 0.05$), while only GAT-IOP and CVS-IOP were correlated with Km post-operatively ($p< 0.05$, Table 2).

Table 3 summarizes the results of multiple linear regression analyses in the study group. The analysis shows that, only ΔDCT-IOP and ΔCVS-bIOP were correlated with age (all $p< 0.05$), while only ΔGAT-IOP, ΔORA-IOPg and ΔCVS-IOP were associated with ΔCCT (all $p< 0.01$). Further, both ΔDCT-IOP and ΔGAT-IOP seemed to be significantly affected by the RSB ratio ($p< 0.05$). However, ΔORA-IOPcc seemed to be the least affected by these parameters, followed by ΔCVS-bIOP. None of the pre-post FS-LASIK IOP differences showed significant association with ΔKm, REC, OZD, AZD or RSB.

Discussion

Laser-assisted in situ keratomileusis (LASIK) is the most common refractive procedure used to change anterior corneal shape and enable the eye's optical system to focus light on the retina [35]. As the procedure involves separating an anterior flap and ablating a layer of corneal tissue, it leads to considerable reductions in overall corneal stiffness, which may lead to underestimations in intraocular pressure (IOP) measurements. Three tonometers have been developed to overcome this problem and produce IOP estimations that are less affected by corneal biomechanics than GAT, the reference standard in tonometry. These tonometers, the Dynamic Contour Tonometer (DCT), the Ocular Response Analyzer (ORA) and the Corvis ST (CVS), were assessed in this study in their ability to produce consistent IOP measurements pre and post-FS-LASIK, and compare this performance to that of GAT.

Among all IOP measurements, the biomechanically-corrected IOP obtained by CVS (CVS-bIOP) produced the smallest difference between pre and post-surgery estimations (0.78±1.52 mmHg) followed by DCT-IOP (1.58±2.06 mmHg). Other measurements produced consistently larger differences with means of 2.85±2.22 mmHg by GAT-IOP, 3.11±1.77 mmHg by CVS-IOP, 3.56±1.72 mmHg by ORA-IOPcc and 6.15±2.01 mmHg by ORA-IOPg.

Earlier studies have questioned the validity of GAT following corneal refractive surgeries [36] and reported significant differences in IOP measurements before and after LASIK including 3.4±2.5 mmHg [37]; 3.8±2.2 mmHg [38]; 5.4±3.0 mmHg [39] and 1.8±2.8 mmHg [40], some of which are close to the mean difference recorded in our study (2.85±2.22 mmHg). While most relevant studies on GAT concentrated on the biomechanical effect of refractive surgery, further insight was provided by a study by Chang and Stulting linking the change in measured IOP to the change in refraction in over 8,000 subjects after a myopic refractive procedure [41]. Subsequently, and in order to avoid the dependence of GAT on corneal biomechanics, several formulas were

produced to correct GAT-IOP based on CCT, keratometry and age [42,43].

The DCT, proposed as a possible solution for the error measurement caused by GAT, has a concave tip that is designed to be closely adapted to the mean curvature of the cornea when subjected to equal pressure on both sides (IOP on the posterior surface and tonometric pressure on the anterior surface) [15,16,44]. While most studies reported that DCT measurements did not change significantly after LASIK [15,45], we obtained lower results in the low-to-moderate myopia group (0.81±1.97 mmHg, $p< 0.05$), but found a significant mean reduction post-surgery in the high myopia group (2.22±1.94 mmHg, $p< 0.01$), which was the second lowest difference after CVS-bIOP. The results also showed ΔDCT-IOP was influenced by factors including age ($\beta= -0.402$) and RSB ratio ($\beta= -0.29$). Further, the tendency of DCT to give higher IOP measurements compared with other tonometers was also evident in both pre and post-surgery results, which was similar to the findings of earlier studies [29,39,46,47]. DCT showed good concordance with intracameral IOP [44], while GAT tended to give lower IOP values [17,48]. The fact that tonometers are commonly calibrated against the GAT presents a possible explanation for this underestimation.

On the other hand, ORA provides two measurements of IOP that serve different purposes. While ORA-IOP_g simulates GAT-IOP, the ORA-IOP_{cc} aims to correct for variations in corneal biomechanics. In our study, ORA-IOP_g underwent significant and large reductions (6.15±2.01 mmHg) following FS-LASIK, which were similar to the values reported in earlier studies for ORA-IOP_g (mean 6.2 mmHg [49], 3.9±2.19 mmHg [50]) and the values obtained for GAT-IOP (2.85±2.22 mmHg), which ORA-IOP_g was intended to simulate. Our results also found ΔORA-IOP_g to be dependent on ΔCCT ($\beta= 0.523$).

In comparison with ORA-IOP_g, ORA-IOP_{cc} performed better with a smaller mean of difference between pre and post-surgery stages of 3.56±1.72 mmHg, which was still significant ($p< 0.01$) and higher than the results of earlier studies (mean 2.57 mmHg [49],

0.67±2.07 mmHg [50]). ORA-IOP_{cc} was also not dependent on ΔCCT, ΔKm, Age, REC, OZD, AZD, RSB or RSB ratio ($p > 0.05$). These results, combined, present evidence that ORA-IOP_{cc} was less influenced by corneal parameters such as CCT and Km than ORA-IOP_g [51].

Similar to the ORA, the Corvis ST provides two IOP measurements, the uncorrected CVS-IOP and the biomechanically-corrected CVS-bIOP. The uncorrected CVS-IOP showed large and significant differences between the pre and post-surgery stages of 3.11±1.77 mmHg ($p < 0.01$) and was dependent on ΔCCT ($\beta = 0.516$). In comparison, the CVS-bIOP provided the most stable measurements before and after FS-LASIK; the differences were statistically insignificant in the low-to-moderate myopia group (0.47±1.56 mmHg, $p > 0.05$), which were slightly higher than those reported earlier (0.1±2.1 mmHg [52] and 0.26±1.41 mmHg [53]). However, the differences were larger in the high myopia group (1.04±1.46 mmHg, $p < 0.01$), possibly due to the higher refractive error correction (-5.38±1.9 D in our study, -3.65±1.12 D [52], -4.28±1.36 D [53]). Our study also showed dependence of ΔCVS-bIOP on age only ($r = -0.266$).

In our study, multiple linear regression analysis showed that ΔORA-IOPcc seemed to be the least affected by ΔCCT, ΔKm, age, REC, OZD, AZD, RSB and RSB ratio, followed by ΔCVS-bIOP. The magnitude of effect of ΔCCT on IOP measurements varied widely (ΔGAT-IOP > ΔORA-IOPg ≈ ΔCVS-IOP). Interestingly, when all corneal factors were modeled (Table 3), ΔKm, REC, OZD, AZD and RSB were found to have no significant effect on all IOP measurements.

In conclusion, among the six IOP values measured by the DCT, GAT, ORA and CVS, the biomechanically-corrected bIOP by the Corvis ST was the most successful in providing post-surgery measurements that were in close agreement with those obtained pre-surgery, and this was followed closely by the DCT-IOP. Measurements by the GAT, IOPg and IOPcc by ORA, and the uncorrected IOP by the Corvis all provided estimations with similar results that appear to be more influenced by variations in

corneal biomechanics caused by FS-LASIK.

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Table Captions:

Table 1 Six IOP measurements obtained by DCT, GAT, ORA and CVS in pre and post FS-LASIK stages

Table 2 Correlation of CCT, Km and Age with six IOP measurements made by DCT, GAT, ORA and CVS in pre and post FS-LASIK stages

Table 3 Correlation of ΔCCT, ΔKm, Age, REC, AZD, RSB and RSB ratio with the differences between IOP measurements obtained pre and post-surgery by GAT, DCT, ORA and CVS

Table 1 Six IOP measurements obtained by DCT, GAT, ORA and CVS in pre and post FS-LASIK stages

	Stages	DCT-IOP	GAT-IOP	ORA-IOP$_g$	ORA-IOP$_{cc}$	CVS-IOP	CVS-bIOP
Low to Moderate Myopia Group (-3.70±0.91 D)	Pre-operation	16.57±2.87	13.06±2.13	14.88±3.06	15.37±2.65	13.72±2.13	13.35±1.99
	Post-operation	15.60±2.26	10.35±1.94	9.12±2.21	11.61±1.74	11.33±1.8	12.86±1.87
	Difference between pre and post-operation stages	0.81±1.97	2.60±2.37	5.76±2.53	3.76±2.09	2.39±1.82	0.47±1.56
	t value	2.186*	5.917**	12.465**	9.837**	7.071**	1.602
High Myopia Group (-6.83±1.22 D)	Pre-operation	17.89±2.39	13.18±1.96	14.68±2.41	15.41±2.06	13.89±1.87	13.52±1.57
	Post-operation	15.65±2.32	10.09±2.14	8.20±2.04	12.01±1.56	10.18±1.83	12.48±1.72
	Difference between pre and post-operation stages	2.22±1.94	3.07±2.1	6.48±1.39	3.39±1.34	3.71±1.5	1.04±1.46
	t value	6.566**	8.506**	27.599**	14.966**	14.624**	4.232**
Both groups combined (-5.38±1.90 D)	Pre-operation	17.27±2.69	13.13±2.02	14.77±2.71	15.39±2.33	13.82±1.98	13.44±1.76
	Post-operation	15.62±2.27	10.21±2.04	8.63±2.16	11.83±1.65	10.71±1.89	12.66±1.79
	Difference between pre and post-operation stages	1.58±2.06	2.85±2.22	6.15±2.01	3.56±1.72	3.11±1.77	0.78±1.52
	t value	5.961**	10.188**	24.603**	16.653**	14.073**	4.106**

DCT-IOP and GAT-IOP mean the IOP value provided by DCT and Goldmann, respectively; ORA-IOP_g and ORA-IOP_{cc} mean the Goldmann-correlated IOP and corneal compensated IOP provided by ORA; CVS-IOP and CVS-bIOP mean the uncorrected IOP and the biomechanically-corrected IOP provided by Corvis ST (CVS); * means $p< 0.05$, ** means $p< 0.01$.

Table 2 Correlation of CCT, Km and Age with six IOP measurements made by DCT, GAT, ORA and CVS in pre and post FS-LASIK stages

Parameters	Stages	DCT-IOP	GAT-IOP	ORA-IOP_g	ORA-IOP_{cc}	CVS-IOP	CVS-bIOP
Age	Pre-operation	-0.191	-0.105	-0.110	-0.129	-0.138	-0.184
	Post-operation	0.065	0.154	0.107	-0.165	0.183	0.045
Km	Pre-operation	-0.041	0.082	0.094	-0.047	0.096	0.066
	Post-operation	-0.025	0.249*	0.229	-0.167	0.369**	0.163
CCT	Pre-operation	0.258*	0.141	0.315*	0.139	0.284*	-0.027
	Post-operation	0.187	0.159	0.465**	0.030	0.385**	0.069

Km means the mean corneal keratometry; CCT means central corneal thickness; DCT-IOP and GAT-IOP mean IOP provided by DCT and Goldmann, respectively; ORA-IOP_g and ORA-IOP_{cc} mean the Goldmann-correlated IOP and corneal compensated IOP provided by ORA; CVS-IOP and CVS-bIOP mean the uncorrected IOP and the biomechanically-corrected IOP provided by Corvis ST (CVS); * means $p< 0.05$, ** means $p< 0.01$.

Table 3 The stepwise multiple linear regression models for IOP differences between pre and post-FS-LASIK

Dependent Variables	Parameters	B [a]	P value	Regression Equation	Adjusted R^2	F [b]	P value
ΔDCT-IOP	Age	-0.402	0.001	ΔDCT-IOP(mmHg) = -0.136 x Age(year) - 13.09 x RSB Ratio + 13.70(mmHg)	0.263	11.682	0.000
	RSB ratio	-0.29	0.013				
ΔGAT-IOP	ΔCCT	0.742	0.002	ΔGAT-IOP(mmHg) = 0.058 x ΔCCT(μm) + 23.77 x RSB Ratio - 18.01(mmHg)	0.145	6.166	0.004
	RSB ratio	0.489	0.033				
$\Delta ORA\text{-}IOP_g$	ΔCCT	0.523	0.00	ΔORA-IOPg(mmHg) = 0.036 x ΔCCT(μm) + 2.84(mmHg)	0.262	23.318	0.000
ΔORA-IOPcc	-	-	-	-	-		-
ΔCVS-IOP	ΔCCT	0.516	0.000	ΔCVS-IOP(mmHg) = 0.033 x ΔCCT(μm) + 0.132(mmHg)	0.254	22.111	0.000
ΔCVS-bIOP	Age	-0.26	0.04	ΔCVS-IOP(mmHg) = -0.065 x Age(year) + 2.46(mmHg)	0.052	4.424	0.04

Δ means the difference between pre and post FS-LASIK stages; CCT means central corneal thickness; RSB means residual stromal bed thickness, RSB ratio = RSB/CCT; DCT-IOP and GAT-IOP mean the IOP value provided by DCT and Goldmann, respectively; $ORA\text{-}IOP_g$ and $ORA\text{-}IOP_{cc}$ mean the Goldmann-correlated IOP and corneal compensated IOP provided by ORA; CVS-IOP and CVS-bIOP mean the uncorrected IOP and the biomechanically-corrected IOP provided by Corvis ST (CVS); a means Standardized Coefficients (Beta); b means Multiple Linear Regression Model (Stepwise).

Figure Captions:

Figure 1 Bland Altmann analysis of six IOP measurements made by DCT (a), GAT (b), ORA (c, d) and CVS (E, f) in pre and post FS-LASIK stages in low to moderate myopia group

Figure 2 Bland Altmann analysis of six IOP measurements made by DCT (a), GAT (b), ORA (c, d) and CVS (E, f) in pre and post FS-LASIK stages in high myopia group

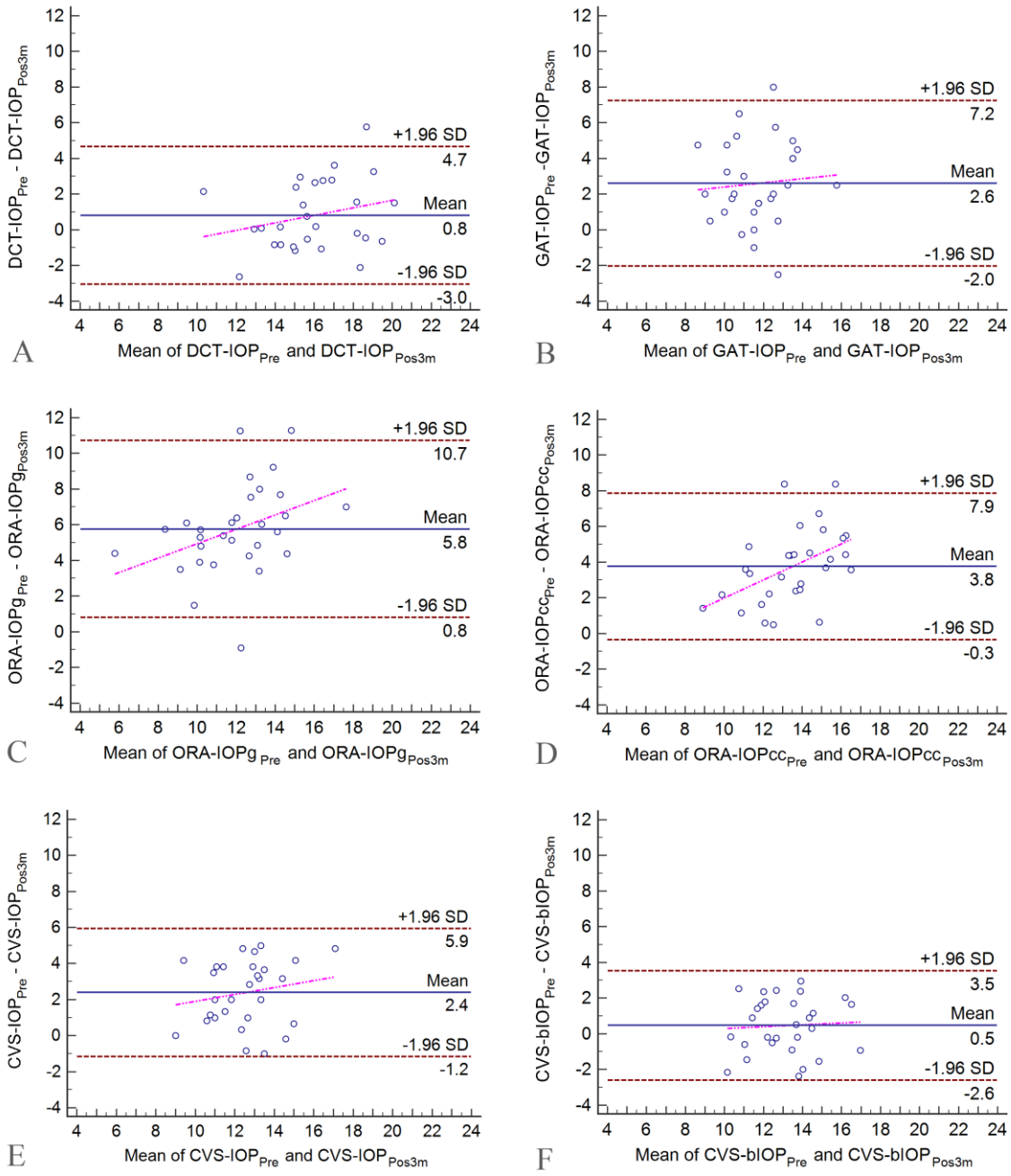

Figure 1 Bland Altmann analysis of six IOP measurements made by DCT (a), GAT (b), ORA (c, d) and CVS (E, f) in pre and post FS-LASIK stages in low to moderate myopia group

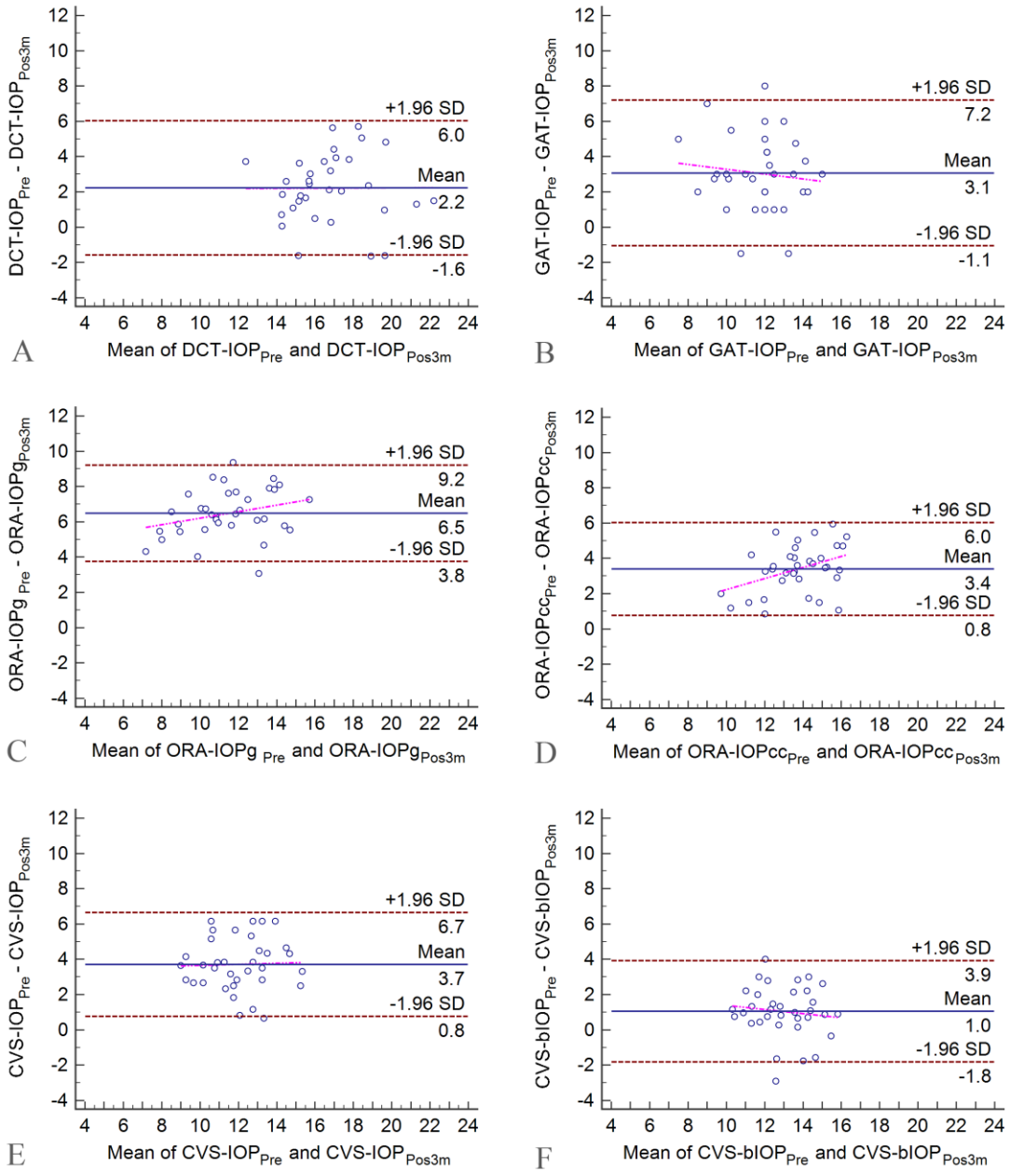

Figure 2 Bland Altmann analysis of six IOP measurements made by DCT (a), GAT (b), ORA (c, d) and CVS (E, f) in pre and post FS-LASIK stages in high myopia group