Original Article

Variations in Intraocular Pressure Following Photorefractive Keratectomy in Different Degree of Myopia at Dr Yap Eye Hospital

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ABSTRACT

Backgorund: *To investigate the variations in intraocular pressure following PRK in different degree of myopia.*
Methods: *Restrospective cohort study of 315 patients (429 eyes) who underwent photorefractive keratectomy at Yap Eye Hospital between January 2011 and December 2012. Visual acuity, refractive status, and intraocular pressure were examined before, 2, 4, 8, 12 weeks after photorefractive keratectomy. IOP was measured directly using non-contact tonometry and calculated using Chang's formula (ΔP = -0.12 x refractive change – 1.36 mmHg). Variations in IOP were assessed comparing follow-up to baseline IOP.*
Results: *There were 225 men and 90 women with mean age 22,9 years. Overall, compared to IOP prior surgery (mean 15.6mmHg), there were significant variations in measured IOP at 2, 4, 8, and 12 weeks after the procedures (variations were -30-.6% (mean 11.0mmHg), -25.0% (11.7mmHg), -26.3 (mean 11.5mmHg), -29.5% (mean 11.0mmHg) consecutively; p for variations<0.001). However, these variations were also presents in low, moderate, and high myopia (all p for variations <0.001). However, there were almost none variations using converted IOP (overall -9.14% (14.9mmHg); low myopia -8.91% (14.3mmHg); moderate myopia -5.81% (14.6mmHg); high myopia 0% (15.5mmHg); p<0.01).*
Conclusion: *PRK caused relatively decreased variations in measured IOP, however, with converted IOP these variations are very small (relatively no difference in pre and postoperative IOP).*

Intraocular Pressure (IOP) measurement is key to glaucoma dignosis and management. In the last 15 years, it has be the target in the glaucoma management.[1] For example, lowering the pretreatment IOP by 25% or more will slow down the progression of glaucoma.[2] However, careful attention should be made regarding inaccuracy in IOP measurement which can lead to under and over diagnosis of ocular hypertension.

Evidence has demonstrated that corneal biomechanics, curvature, and thickness can significantly influence IOP measurement.[3,4] Previous study by Tranos et al, suggestes that changes in corneal curvature following cataract extraction[5] and keratoplasty[6] affected the measurement of IOP. Similarly, photorefractive keratectomy (PRK) involves corneal thickness and surface manipulation. In recent years, PRK has become

widely used for the treatment of myopia at different severity level. Theoritically, the more severe the myopia, the greater the corneal thickness reduction done by the PRK procedure, therefore the greater it affects the measured IOP.[7]

Several studies have investigated the changes in IOP measurement following PRK[8-11] particularly in myopic patients. For example, IOP readings was reduced and underestimate following corneal ablation surgery. These may provoke an important question whether the measurement of IOP following PRK should or should not rely solely on direct measurement? In line with this, there were studies showing that measurement of IOP in patients underwent PRK were different from those normal patients, and should engage specific formula.[12] However, how close the changes in measured and converted IOP following PRK remains less known. The aims of this study is to investigate changes in IOP measurement following PRK and compared these changes with those using converted IOP formula as proposed by Chang.[13]

METHODS

In this retrospective study, data from 429 eyes of 315 patients who underwent photorefractive keratectomy between January 2011 until December 2012 at dr.Yap Eye Hospital Yogyakarta were collected.

Preoperative measurements were taken as baseline values. Preoperative data included visual acuities, refraction, and IOP measurements from the central part of the cornea with noncontact tonometer. Measurements of IOP were performed 2, 4, 8, and 12 weeks postoperative. Postoperatively, all patients received 0.1% fluorometholone for 12 weeks.

Converted IOP was calculated using the following formula $\Delta P = -0.12 \times$ refractive change-1.36 mmHg

All IOP data were analysed as continuous data. Changes in IOP after PRK (both measured and converted IOP) were estimated by comparing the mean IOP values in each follow-up point baseline IOP, and assesses using Generalized Estimating Equation modelling to allow adjustment for age and gender.

RESULTS

Table 1 shows the baseline characteristics of participants in this study. Of the 315 patients (429 eyes) in this study, 225 (71.4%) were male and 90 (28.6%) were female. The mean age was 22,9 years. Before the surgery, the mean visual acuity was 0.15 mmHg, the mean IOP was 16.6mmHg, refractive error was 34.3% for low myopia, 26.4% for moderate myopia, and 32.1% for high myopia.

Table 1. Baseline characteristics of participants

	Mean (SD)
Age	22.9 (0.18)
Visual acuity	0.15 (0.18)
Intra-ocular pressure	16.6 (3.08)
Gender, % male	71.4
Refractive error	
Low myopia	34.3
Moderate myopia	26.4
High myopia	32.1

Variations in IOP following PRK in different degree of myopia are shown in Tabel 2. Overall, compared to IOP prior surgery (mean 15.6 mmHg), there were significant variations in measured IOP at 2, 4, 8, and 12 weeks after the procedures (variations were -30.6% (mean 11.0 mmHg), -25.0% (11.7 mmHg), -26.3 (mean 11.5 mmHg), -29.5% (mean 11.0 mmHg) consecutively; p for variations <0.001). In low myopia, there were -23.4% variations (mean 11.8 mmg), -22.0% (mean 12.8 mmHg), -21.9% (mean 12.6 mmHg), and -26.2% (mean 12.1 mmHg) in 2, 4, 8, 12 weeks after PRK. These variations were also present in moderate and high myopia (all p for variations <0.001).

Measured IOP and calculated IOP 3 months following PRK in different degree of myopia are report in Table 3. There were almost none variations using converted IOP (overall -9.14% (14.9 mmHg); low myopia -8.91% (14.3 mmHg); moderate myopia -5.81% (14.6 mmHg); high myopia 0% (15.5 mmHg); p<0.01).

DISCUSSION

In this study, compared to preoperative IOP, there were decreased variations in IOP level measured with a noncontact tonometer in different degree of myopia. Relatively, high myopia has more decreased variations in measured IOP compared to low and moderate myopia.

Table 2. Variations in IOP following PRK in different degree of myopia

Degree of myopia	Visit	Right eye		Left eye	
		Mean (SE)	% variation	Mean (SE)	% variation
Overall		P<0.001		P<0.001	
	Pre-op	15.6 (0.18)	0	15.8 (0.19)	0
	2 weeks	11.0 (0.18)	-30.6	11.3 (0.22)	-28.5
	4 weeks	11.7 (0.21)	-25.0	11.9 (0.23)	-34.5
	8 weeks	11.5 (0.21)	-26.3	11.7 (0.22)	-34.5
	12 weeks	11.0 (0.25)	-29.5	11.1 (0.26)	-40.2
Low Myopia		P<0.001		P<0.001	
	Pre-op	15.4 (0.31)	0	16.3 (0.45)	0
	2 weeks	11.8 (0.32)	-23.4	13.5 (0.58)	-17.2
	4 weeks	12.8 (0.40)	-22.0	12.7 (0.44)	-26.7
	8 weeks	12.6 (0.37)	-21.9	12.7 (0.44)	-28.3
	12 weeks	12.1 (0.43)	-26.2	12.6 (0.88)	-29.1
Moderate myopia		P<0.001		P<0.001	
	Pre-op	15.4 (0.33)	0	16.0 (0.47)	0
	2 weeks	10.6 (0.29)	-31.2	10.5 (0.40)	-34.4
	4 weeks	11.2 (0.39)	-39.6	11.0 (0.45)	-47.6
	8 weeks	10.8 (0.28)	-41.1	11.2 (0.41)	-43.6
	12 weeks	10.5 (0.35)	-45.4	10.9 (0.40)	-45.5
High myopia		P<0.001		P<0.001	
	Pre-op	15.5 (0.37)	0	15.4 (0.56)	0
	2 weeks	9.65 (0.31)	-37.7	10.1 (0.49)	-34.4
	4 weeks	10.4 (0.37)	-52.8	10.3 (0.63)	-50.5
	8 weeks	10.3 (0.51)	-50.0	10.9 (0.97)	-43.7
	12 weeks	9.91 (0.56)	-54.3	8.36 (0.45)	-64.6

Table 3. Measured IOP and calculated IOP 3 months following PRK in different degree of myopia

Degree of myopia	Measured IOP		Calculated IOP		p-value
	Mean (95% CI)	% variation	Mean (95% CI)	% variation	
Overall	11.0 (10.5 – 11.5)	-29.5	14.9 (14.5 – 15.3)	-9.14	P<0.01
Low myopia	12.1 (11.2 – 13.2)	-26.2	14.3 (13.5 – 15.0)	-8.91	P<0.01
Moderate myopia	10.5 (9.62 – 11.3)	-45.4	14.6 (13.9 – 15.2)	-5.81	P<0.01
High myopia	9.91 (8.96 – 10.9)	-54.3	15.5 (14.8 – 16.3)	0	P<0.01

*data are adjusted for age and gender. P-values were estimated using analysis of covariates (ANCOVA)

Depth of the ablated cornea, changes in corneal curvature, and corrected refractive error have been suspected to be the major parameters that affect IOP reading.[8,17] Other studies[7,14,20-21] showed poor correlation between ablation depth and reduced IOP reading beacuse corneal ablation by refractive surgery is lenticularly shaped and not uniform. According to a report by Montés-Micó R et al, there were no statistically significant variations change in measured IOP with degree of myopia treated with PRK.[10] In contrast, this study showed variations in measured IOP.

Previous study[24] showed that the use of steroid use like fluorometholone can increased IOP readings in patients underwent PRK. Therefore, risk of steroid-induced ocular hypertension is increased and might be needed anti glaucoma therapy.[25]

Calculated IOP in this study shows very minimal and almost none variations IOP. According to other studies on comparing between measured IOP and calculated IOP[11], they did not provide a statiscally significant difference between pre and postoperative calculated IOP in patients underwent refractive surgery but there were statiscally significant difference in measured IOP. Underestimate measurement of IOP can occur in thinner cornea. Independently from refractive procedures, changes in corneal thickness are reflected in

either under or overestimation of the "true" IOP.[22] Previous study recommended used of correction formula for assess the "true" IOP after refractive surgery.[12,14-17,23]

CONCLUSION

In conclusion, there were decreased variation in measured IOP in various degree of myopia following PRK, but there were no variations in calculated IOP. In order to minimized IOP underestimation, the clinician should consider using the correction formula instead of only using direct measurements because the correction IOP readings may prevent misdiagnosis of ocular hypertension and avoid the need for further treatment.

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