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The Measurement of Intra-Ocular Pressure Over Low Minus Soft Contact Lens by Air Puff Non-Contact Tonometer

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ABSTRACT:

The measurement of intraocular pressure (IOP) over silicone hydrogel contact lenses by non-contact tonometer (NCT) could be applied in ophthalmologic practice but the accuracy of the measurement is still controversial. Previous research has proven that power and material of contact lenses being the factors that influence the values of IOP. The aim of this study is to evaluate the effect of low power spherically designed silicone hydrogel contact lenses on values of IOP measured by NCT. We measured IOP with and without silicone hydrogel contact lenses on 38 subjects (16 male and 22 female) who did not have any ocular or systemic diseases. The One-way repeated measures ANOVA showed statistically significant higher values of IOP measurement over contact lenses immediately after wearing (13.19 ± 2.47 mmHg) and two hours after wearing (13.26 ± 2.48 mmHg) compared to those measured without contact lenses (13.03 ± 2.56 mmHg), $p = 0.041$ and $p = 0.028$ respectively. There was no significant difference on IOP measurement between immediately and after two hours of contact lens wear, $p = 1.000$. Independent t-test showed there was no significant difference between male and female IOP, $p = 0.206$. In conclusion, silicone hydrogel contact lenses give significant changes in IOP measurement thus need to be removed for IOP measurement.

Keywords: Intraocular pressure; tonometry, ocular; contact lenses

INTRODUCTION:

Intraocular pressure (IOP) is the tissue pressure of the intraocular contents that can be measured by using contact and non-contact tonometer (NCT). The normal range for IOP is 10-21 mmHg. Thickness of central cornea playing the main role in getting accurate IOP as it is one of the factors that contributing to error measurement of IOP. The most accurate IOP obtained when the central thickness of cornea is 550 µm. Thicker than that, would lead to overestimate of IOP while thinner than that would give the opposite effect (Bikas, 2009). Contact lens wear believed to be one of the things that can contribute to inaccurate of IOP measurement as it can cause changes in corneal thickness due to hypoxia. In order to avoid error in IOP measurement, contact lens wearers need to take off their contact lenses before taking IOP measurement. However, frequent removal of contact lenses used for therapeutic purposes in types of corneal diseases affects epithelization and the recovery process negatively (Firat et al, 2012). Besides that, frequent removal of contact lens could increase the risk of infection in case patient does not apply proper care and hygiene during removal and insertion process. Therefore, it would be better if IOP measurement can be taken without taking off contact lens. Previous

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studies showed that IOP measurements over a soft contact lens with NCT depend on the lens power and material (Patel et al, 2009). So, the aim of this study is to verify the measurement of IOP over the low minus power of soft contact lens (-0.25 Ds to -2.75 Ds) by Air puff NCT (Huvitz HNT-7000).

Methods

An experimental study design was used to conduct this research project. We involved randomization principle to ensure groups being compared are similar apart from the treatment and control.

This research study was conducted at Management & Science University (MSU) Eye Center, Selangor, Malaysia with the total sample were 38 (16 male, 22 female) students which consist of 19 to 29 years old of contact lens wearer. Consent forms were distributed before the experiment conducted among the students. Before the examination starts, history taking was carried out for essential information. Examination was divided into four which were preliminary examination, refraction, anterior and posterior assessment as all of these parts were necessary in order to screen patient's general and ocular health status, obtaining actual refractive power and to confirm either patient is suitability to be the subject. Once eligible, IOP were directly measured using air puff NCT. Soon after that, subjects were fitted with spherical design silicone hydrogel contact lens on both eyes and again IOP measurement was done over the contact lens. The subjects were released for two hours of rest time before the final IOP measurement repeated over the contact lens.

Results

The Statistical Package for the Social Sciences (SPSS) version 22 was used to analyse the data of this study. The One-way repeated measures ANOVA showed statistically significant higher values of IOP measured over contact lenses immediately after wearing (13.19 ± 2.47 mmHg) and two hours after wearing (13.26 ± 2.48 mmHg) compared to those measured without contact lenses (13.03 ± 2.56 mmHg), p = 0.041 and 0.028 respectively. There was an increasing pattern of IOP reading across time. The increment of IOP from base line to immediately after contact lens wear was 0.16 mmHg or 1.23% and from base line to after two hours of contact lens wear was 0.23 mmHg or 1.77%. There was an increment of 0.07mmHg between immediately after contact lens and after two hour of contact lens wear and the difference was not significant, p = 1.000 . For comparison of male and female IOP changes after two hours of contact lens wear, independent t-test showed there was no significant difference, p = 0.206 where male IOP was greater by 0.22 mmHg compared to female.

Table 1: Pairwise comparison of IOP between without contact lens (1), immediately after contact lens wear (2), and after two hour of contact lens wear (3).

IOP (I)	IOP (J)	Mean ± SD	Mean difference (I)-(J)	P value
1	2	13.03 ± 2.56	-0.16	0.041
	3		-0.23	0.028
2	1	13.19 ± 2.47	0.16	0.041
	3		-0.07	1.000
3	1	13.26 ± 2.48	0.23	0.028
	2		0.07	1.000

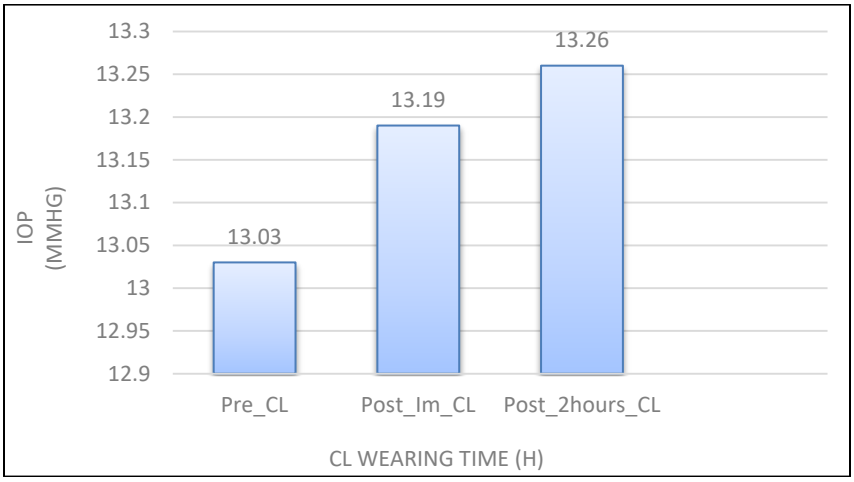

Figure 1: Changes of IOP between without contact lens (Pre_CL), immediately afte contact lens wear (Post_Im_CL), and after two hours of contact lens wear (Post_2hours_CL).

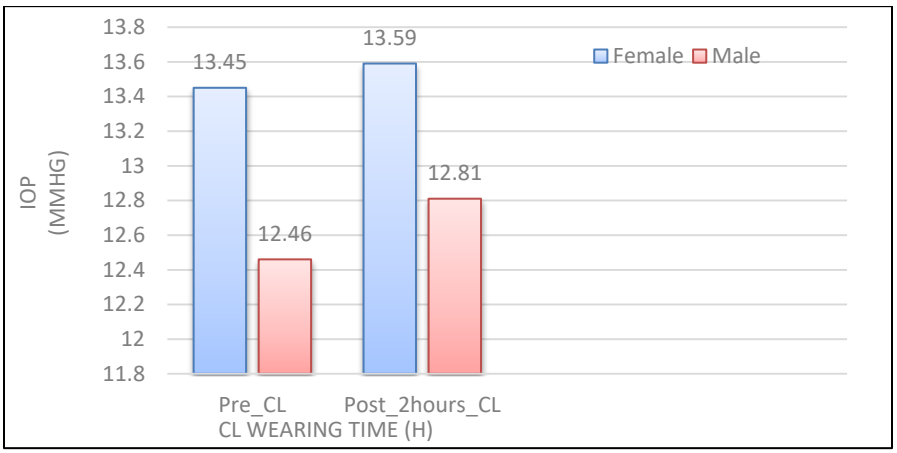

Figure 2: IOP changes without contact lens (Pre_CL) and after two hours of contact lens wear (Post_2hours_CL) between male and female.

Discussion

According to results obtained, we found that spherical design silicone hydrogel contact lens significantly affect the IOP measurement by air puff NCT. Material of contact lens used in our research high probably become the main reason why result obtained was not the same as most of the previous related study. Most of the previous study were using hydrogel contact lens which has lower modulus than silicone hydrogel that we used in our study. High modulus of silicone hydrogel has high resistance toward deformation and this characteristic increase the central resistance of the cornea as it attached to the cornea. Combination of cornea and contact lens will doubling the central resistance which may lead to overestimation of IOP as cornea itself has its own central resistance. Combination of contact lens and cornea had been called as "new body" formation (Zeri et al, 2011). In addition, there were few research obtained no significant difference of IOP over contact lens if compared to without contact lens even though they were using silicone hydrogel soft contact lens. This is because contact lens they used was the third generation silicone hydrogel which has lower modulus while in our study, we were using the second generation of silicone hydrogel which has higher modulus. The increment of IOP also due to increase of corneal thickness after wearing contact lens for certain period. This is because of lack of oxygen supplied to cornea thus lead to corneal edema or swelling which then cause changing in corneal thickness. Based on study conducted in 2014 by Monireh et al, wearing soft contact lens for 2 hour can induce corneal swelling. However, the level of increment in corneal thickness is depends on severity of

corneal swelling whereas, corneal swelling are depend on contact lens wearing time and level of oxygen transmit into cornea. The only efficient way to avoid severe corneal swelling under long contact lens wearing time is by wearing high oxygen permeability contact lens which is silicone hydrogel material. This had been proven in our study as increment of IOP over contact lens for immediately to two hour after contact lens wear was not significant.

In summary, the accuracy of IOP measurement over soft contact lens by non- contact tonometry is depends on several factors such as material (Patel, 2009), power, central thickness of contact lens (Patel & Illahi, 2004) and method of IOP measurement. As the result we obtained in our study showed a significant increment of IOP over soft contact lens, we can concluded that IOP measurement over soft contact lens by non-contact tonometry is not accurate, thus contact lens must be removed in order to get accurate IOP reading.

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