Original Article

Zahedan Journal of Research in Medical Sciences

Journal homepage: www.zjrms.ir

The Effect of Various Contact Lenses on Intraocular Pressure Measurement by Goldman Tonometer

Monireh Mahjoob,*[1] Abbas Azimi,[2] Hamed Momeni-Moghadam,[1] Mohammad Mohamadian,[3] Reza Yousofi[3]

1. Department of Optometry, Zahedan University of Medical Sciences, Health Promotion Center, Zahedan, Iran
2. Department of Optometry, Mashhad University of Medical Sciences, Mashhad, Iran
3. MSPH Student of Rehabilitation Management, Tehran University of Medical Sciences, Tehran, Iran

Article information

Article history:
Received: 31 Oct 2011
Accepted: 12 Jan 2012
Available online: 11 May 2013
ZJRMS 2014; 16(6): 33-35

Keywords:
Intraocular pressure
Contact lens
Goldman tonometer

*Corresponding author at:
Zahedan University of Medical Sciences, Department of Optometry, Health Promotion Center, Zahedan, Iran.
E-mail:
mahjoob_opt@yahoo.com

Abstract

***Background*:** Today, contact lenses have extensive usages. Contact lens places on cornea, so it may induce variation on cornea and these variations can influence the measurement of intraocular pressure (IOP) by Goldman tonometer. The aim of this research was to study the effect of various contact lenses on measurement of intraocular pressure by Goldman tonometer.

***Materials and Methods*:** In this study, 80 subjects aged 18-25 were selected randomly among patients of Al-Zahra ophthalmology center. None of them has any eye pathological problems. Before wearing the lens, intraocular pressure was measured, and then patients were divided into two groups of soft and hard contact lenses. Soft and hard contact lenses were placed on the eye for two hours, and the intraocular pressure was measured again.

***Results*:** The mean of IOP before wearing contact lenses and two hours later was 15.96 mmHg and 13.93, s respectively. Paired test showed a significant difference between IOP before and after wearing contact lenses (p=0.001).There was no significant differences in mean of intraocular pressure decline before and after placing the contact lens in both soft and hard lenses.

***Conclusion*:** According to this study, the intraocular pressure decreases after wearing contact lenses (CL). This decline may be due to variation in properties of cornea after wearing CL that can also affect IOP measurement.

Introduction

Nowadays, contact lenses are used for many reasons including beauty, removing any discomfort caused by glasses, vision improvement especially for patients with high ametropia, high astigmatism, keratoconus, corneal trauma and deformity as well as poor results of refractive surgery [1]. Wearing contact lens causes corneal edema after some hours, and this edema increases corneal central thickness. Results of a study carried out by Tyagi found that central and peripheral corneal thickness was increased in patients who wearing hydrogel or silicone hydrogel lenses after 8 hours; this increase in thickness more happens in toric lenses [2]. Also, Martine pointed out that extended wear rigid gas permeable (RGP) lenses increase corneal thickness and cornea edema. In a similar study he showed that the Low Dk lenses (a term describes the capability of oxygen transfer by the lens) induced significantly higher corneal swelling, as compared to the high DK lenses [3, 4]. This finding is consistent with other studies [5, 6]. In a research done by Mao to evaluate biomechanical properties of cornea by orthokeratology lenses, results indicated that cornea hysteresis (CH) and corneal resistant factor (CRF) was decreased after one week and it comes to the original level at 3-month and 6-month follow up and remains constant [7]. In a similar study, Gonzalez-Meijome pointed out that after 3 hours of contact lens wear, CH is reduced, but the corneal resistance factor change is not significant [8]. Tonometer is a very important tool for diagnosis and evaluating treatment process of glaucoma in every age. High and asymmetric intraocular pressure, daily unusual intraocular pressure differences as well as an unusual increase in intraocular pressure for a long time can be used in diagnosis and determining effectiveness of glaucoma treatment [9]. Goldman tonometer is a standard tool for measuring intraocular pressure [10].

Studies show that changes in the characteristics of the cornea such as its central thickness, curvature, hydration as well as corneal hardness may cause incorrect diagnosis and inaccuracies in the measurement of intraocular pressure [11, 12]. Corneal edema less than 8% causes errors in intraocular pressure measurement among youth and, in result, it makes wrong glaucoma diagnosis as well as eye hypertension [13, 14]. New studies indicate that changes in corneal characteristics can interfere in accuracy of intraocular pressure results measured by Goldman tonometer.

In this situation, thin corneas produced underestimations of the intraocular pressure, whereas thick corneas produced overestimations [15, 16]. Also, researches have shown that biomechanical characteristics of cornea, compared to its thickness, play important and vital role in

intraocular pressure changes measured by Goldman tonometer. If corneal biomechanical features remain constant but its thickness changes, it causes measurement error of about 2-3 mmHg in intraocular pressure, but changes in corneal biomechanical properties alone, can cause measurement error of 17 mm Hg form real intraocular pressure [17-18]. Considering the importance of careful measurement of intraocular pressure and the effect of contact lenses on corneal parameters, this study was aimed to evaluate the effects of contact lenses on intraocular pressures evaluated by Goldman tonometer.

Materials and Methods

In this interventional study, 80 patients with an average age of 21.49±3.73 years were selected using simple non-probability method from those who referred to Al- Zahra ophthalmology center in Zahedan in order to receive contact lenses. Selected patients lacked eye diseases such as glaucoma, inflammation of the cornea and conjunctiva, and were allowed to participate in study if they were medically competent to receive contact lenses. Then, curvature radius of the anterior corneal surface was measured as well as checking lacrimal system and doing slit lamp examinations. Prior to wearing the contact lenses, intraocular pressure was measured with Goldman tonometer. Measurements of IOP were performed under topical anesthesia (amethocaine hydrochloride 2%) and with the use of fluorescein staining.

The tonometer tip was cleaned with dry cotton followed by swabbing the tips thoroughly with an alcohol prep pad and allowing it to dry for 10 minutes to reduce the risk of cross-infection. Then tonometer tip was slightly put in contact with cornea and when seeing upper and lower semicircular in the correct position, recorded number was noted as intraocular pressure before putting contact lenses. Next, patients were divided into two groups. Patients competent to receive soft contact lenses were given air optix CIBA vision with 14.2 diameters and curvature radius of 8.6 and 110 DK. The second group received RGP lens. After two hours wearing of contact Lenses intraocular pressure was measured without contact lenses immediately. Data were entered SPSS. 13 and were analyzed using *t*-test and paired *t*-test with 95% confidence interval.

Results

In this study, 80 patients (44 females and 36 males) aged 18-25 were participated. Patients were divided into two groups. First group (40 patients) was given RGP, and the second (40 patients) was given soft contact lens. Table 1 shows average intraocular pressure before and after wearing contact lens. Paired *t*-test showed significant difference between intraocular pressure before and after wearing contact lens (p=0.001), moreover, it indicated a significant difference between intraocular pressure before and after wearing soft contact lenses and also for hard contact lenses (p=0.001 for both groups). Also, independent *t*-test found no significant differences between intraocular pressure before wearing contact lenses in soft and hard contact lenses wearer groups. Furthermore, based on this test, there wasn't significant difference between intraocular pressures after wearing contact lenses in 2 groups of contact lenses wearers. The mean decrease in intraocular pressure in soft and hard contact lenses wearers was measured 1.8±1.32 and 1.72±2.05 mm Hg, respectively after wearing contact lens. Moreover, independent *t*-test did not show any significant difference between intraocular pressure reductions with wearing contact lenses for both groups.

Table 1. Intraocular pressure mean before and after using contact lens

	Before	After	*p*-Value
Soft contact lens	15.95±2.09	14.15±1.95	0.001
Hard contact lens	15.44±2.02	13.71±2.79	0.001
Both lenses	15.96±2.06	13.93±2.40	0.001

Discussion

According to the results of this study, the mean of intraocular pressure was 15.96 mmHg before wearing contact lens, but it decreased to 13.93 two hours after wearing contact lens. This decrease was also found by Oh et al. In a study on 20 normal subjects, they concluded that wearing soft contact lens for two hours can increase corneal thickness as well as 0.43+1.95 decrease in intraocular pressure [19]. Furthermore, Hamilton et al. conducted a study on 25 young patients. They used two kinds of soft lenses having 0.7 and 0.3 mm thickness for two hours. Their results indicated an increase in corneal thickness after wearing contact lens. This increase was clearly significant in 0.3 mm rather than 0.7 [13]. In another study carried out with Hamilton, he found an increase in intraocular pressure while measuring it with Goldman tonometer, but it decreases when measuring with Pascal DCT [20].

These results clarify the importance of the difference in intraocular pressure measurement with contact lens should be considered in clinical area. Contact lenses can affect tonometer results due to changes in corneal parameters such as changes in corneal hydration. The effect of these changes on intraocular pressure is dependent on type of tonometer, lens-induced edema, type of contact lens and changes in biomechanical properties of cornea [18].

On the other hand, researchers have found paradoxical results regarding the relationship between corneal thicknesses with tonometer results so that in corneas with increased central thickness due to increase in corneal hydration, sometimes tonometer results showed decrease in intraocular pressure [22, 23].

Therefore, it is proposed to use different tonometer for evaluating the effects of contact lenses as well as measuring corneal thickness, hydration and biomechanical properties of cornea before and after wearing contact lens. Also it is recommended testing both lenses on one subject in order to keep cornea and tear-related factors constant.

Acknowledgements

This article is resulted from a research project supported by student committee of Zahedan University of medical sciences with 1081 code. The project was done by Mohammad Mohammadian, Reza Yousefi and Monireh Mahjoub, and was financially supported by student committee of school of allied health at Zahedan University.

Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

Funding/Support

Zahedan university of Medical Sciences.

References

1. Bennett ES, Vinita Allee H. Clinical manual of contact lenses. 2rd ed. Philadelphia: Lippincott Williams & Wilkins; 2000: 310-3.
2. Tyagi G, Collins M, Read S and Davis B. Regional changes in corneal thickness and shape with soft contact lenses. Optom Vis Sci 2010; 87(8): 567-75.
3. Martin R, Izquierdo M, Saber A. Investigation of posterior corneal curvature in CL-induced corneal swelling. Cont Lens Anterior Eye 2009; 32(6): 288-93.
4. Martin R, de Juan V, Rodriguez G, et al. Contact lens-induced corneal peripheral swelling: Orbscan repeatability. Optom Vis Sci 2009; 86(4): 340-9.
5. Teo L, Lim L, Tan DT, et al. A survey of contact lens complications in Singapore. Eye Contact Lens 2011; 37(1): 16-9.
6. Orucov F, Frucht-Pery J, Raiskup FD, et al. Quantitative assessment of bandage soft contact lens wear immediately after LASIK. J Refract Surg 2010; 26(10): 744-8.
7. Mao XJ, Huang CC, Chen L and Lu F. [A study on the effect of the corneal biomechanical properties undergoing overnight orthokeratology] Chinese [Abstract]. Zhonghua Yan Ke Za Zhi 2010; 46(3): 209-13.
8. Gonzalez-Meijome JM, Villa-Collar C, et al. Pilot study on the influence of corneal biomechanical properties over the short term in response to corneal refractive therapy for myopia. Cornea 2008; 27(4): 421-6.
9. Eskridge B, Amos JF, Bartlatt JD. Clinical procedures in optometry. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 1991: 221-225
10. Wessels IF, Oh Y. Tonometer utilization, accuracy, and calibration under field conditions. Arch Ophthalmol 1990; 108(12): 1709-12.
11. Brooks AM, Robertson IF, Mahoney A-M. Ocular rigidity and intraocular pressure in keratoconus. Aust J Ophthalmol 1984; 12(4): 317-24.
12. Doughty MJ, Zaman ML. Human corneal thickness and its impact on intraocular pressure measures: A review and meta-analysis approach. Surv Ophthalmol 2000; 44(5): 367-408.
13. Hamilton KE, Pye DC, Hali A, et al. The effect of contact lens induced corneal edema on Goldmann applanation tonometry measurements. J Glaucoma 2007; 16(1): 153-8.
14. Argus WA. Ocular hypertension and central corneal thickness. Ophthalmology 1995; 102(12): 1810-12.
15. Whitacre MM, Stein RA, Hassanein K. The effect of corneal thickness on applanation tonometry. Am J Ophthalmol 1993; 115(5): 592-596.
16. Orssengo GJ, Pye DC. Determination of the true intraocular pressure and modulus of elasticity of the human cornea in vivo. Bull Math Biol 1999; 61(3): 551-572.
17. Brandt JD. Central corneal thickness, tonometry, and glaucoma risk: A guide for the perplexed. Can J Ophthalmol 2007; 42(4): 562-566.
18. Manni G, Oddone F, Parisi V, et al. Intraocular pressure and central corneal thickness. Prog Brain Res 2008; 173: 25-30.
19. Oh JH, Yoo C, Kim YY, et al. Effect of contact lens-induced corneal edema on Goldmann applanation tonometry and dynamic contour tonometry. Graefes Arch Clin Exp Ophthalmol 2009; 247(3): 371-5.
20. Hamilton KE, Pye DC, Kao L, et al. The effect of corneal edema on dynamic contour and Goldmann tonometry. Optom Vis Sci 2008; 85(6): 451-6.
21. Holden BA, Mertz GW. Critical oxygen levels to avoid corneal edema for daily and extended wear contact lenses. Invest Ophthalmol Vis Sci 1984; 25: 1161-1167.
22. Simon G, Small RH, Ren Q, et al. Effect of corneal hydration on Goldmann applanation tonometry and corneal topography. Refract Corneal Surg 1993; 9: 110-117.
23. Whitacre MM, Stein RA. Sources of error with use of Goldmanntype tonometers. Surv Ophthalmol 1993; 38: 1-30.

Please cite this article as: Mahjoob M, Azimi A, Momeni-Moghadam H, Mohamadian M, Yousofi R. The effect of various contact lenses on intraocular pressure measurement by Goldman tonometer. Zahedan J Res Med Sci (ZJRMS) 2014; 16(6): 33-35.