Diabetes Mellitus: Evaluation of Cornea Biomechanics with Corvis-ST

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ABSTRACT

Objective: We conducted the present work to evaluate cornea biomechanics, using Corvis-ST device parameters amongst patients with diabetes mellitus.
Methods: In this cross-sectional study, 62 type II diabetic patients and 28 non-diabetic individuals were recruited. Following slit-lamp examination, the participants were further assessed and compared with Corvis-ST device (OCULUS Germany) in order to evaluate the cornea biomechanical response.
Result: The Applanation 2 Velocity variable was significantly different between the diabetic and non-diabetic patients (-0.3±0.04, respectively) (P value=0.02).
Conclusion: This study revealed an increased corneal biomechanical strength amongst diabetic patients.

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INTRODUCTION

Diabetes mellitus (DM) is a well-known cause of vision alteration, affecting nearly 240 million people worldwide.(1) DM can cause delay in cornea wound healing, neuropathy, reduced cornea sensitivity, alteration in stability and production of the tear film, edema, and recurrent erosion, which could influence a patient's vision quality.(2) It can even increase central corneal thickness and affect intraocular pressure measures. (3) The biomechanical characteristic of cornea can help diagnose ocular diseases, such as glaucoma, ectasia, and keratoconus.(5)
Corvis ST (CST) is a novel non-contact device that can evaluate the biomechanical properties of cornea, based on the dynamic changes of the cornea, employing high-speed Scheimpflug-camera. It has been proven that this device can measure intraocular pressure (IOP)(4), central corneal thickness (CCT), Deformation amplitude (DA) with acceptable accuracy, repeatability, and reproducibility. Corvis can help us screen the ketratoconic corneas using shape and biomechanical variables (6).Measuring the impact of DM on the cornea biomechanics using Corvis ST has recently attracted a great deal of scientific attention . Therefore we used Corvis-ST to evaluate cornea of diabetic and non-diabetic patients.

METHODS AND MATERIALS

In this cross-sectional study, we assessed 28 diabetic patients(type II under treatment) vs. 62 non-diabetic control participants. Inclusion criteria were intra-ocular pressure < 21 mmHg with applantation tonometry, best-corrected visual acuity (BCVA) of 20/40 or better, and refractive error of <5 diopters of spherical equivalent and less than 3 diopters of astigmatism. History of the corneal disorder or systemic collagen diseases, wearing contact lens within 2 weeks prior to their enrollment in the study, irregular astigmatism, prior refractive surgery or any ocular surgery, glaucoma and/or chronic use of topical IOP-lowering medication were considered as exclusion criteria. The sampling method was simple and non-random. Patients visual acuity was measured using Topcon KR800 automatic refractometer, refined by manual retinoscopy and subjective phoropter refraction, were used to assess the patients' refraction. After ophthalmic slit lamp biomicroscopy, corneal biomechanical evaluation was performed, using the OCULUS Corvis-ST device.
The following parameters are measured by Corvis-ST:
1)Deformation amplitude (DA)- Maximum amplitude at the highest concavity. 2)A1&A2 length (mm)- Length of the flattened cornea at the first and second applanation. 3)A1&A2 velocity (m/s)- Speed of the corneal apex at the first and second applanation. 4)velocity (m/s)- Speed of the corneal apex at the second applanation..
5)Highest concavity-time (HC-time) (ms)- Time from the start until HC is reached 5)Peak distance (PD) (mm)- Distance between the two peaks of the cornea at HC.
7)SPA 1: stiffness parameter at first applanation 1. 8)ARTH: Ambrosio relational thickness to the horizontal profile. 9)CBI: Corvis biomechanical index. 10)integrR: integrated radius.

RESULTS

Considering age, IOP, gender and CCT as confounders, and controling these variables by using statistics, our results indicated that Applanation 2 Velocity was significantly different between the two groups at -0.3±0.04 (P value=0.02).

Parameter	Diabetes group (n = 62)	Control group (n = 28)	P-value
Sex			0.4***
Male	24(38.7)	8(28.6)	
Female	38(61.3)	20(71.4)	
Age	59.8±9.3	36.6±4.5	<0.0001***
Refraction	-0.8±1.7	-1.1±0.7	0.2+
years of diabetes	8.5±3.5	0	-
IOP	17.1±3.3	16.4±2.6	0.8**
Thickness	520.2±32.3	531.9±29.5	0.4*
Applanation 1 Lenghth	2.3±0.3	2.3±0.3	0.5*
Applanation 2 Lenghth	1.6±0.5	1.7±0.4	0.8*
Applanation 1 Velocity	0.1±0.04	0.1±0.02	0.6*
Applanation 2 Velocity	-0.3±0.04	-0.3±0.04	0.1**
Highest Concavity	7.8±1.2	7.7±0.6	0.7**
DA	1.07±0.1	1.03±0.08	0.4**
PD	4.9±0.3	4.9±0.2	0.4**
SPA	108.6±17.7	101.9±15.2	0.6**
ARTH	486±162.8	485.3±81.3	0.7*
DA ratio	4.2±0.6	4.2±0.4	0.02*
Integr R	7.1±1.2	7.4±0.9	0.5*
CBI	0.1±0.3	0.09±0.2	0.2*

*** Generalized Estimating Equations**
**** linear mixed-effects model (MIXED)**
*****Mann-Whitney Test**
+ Independent Samples t Test

Hence, having diabetes affects the Applanation 2 Velocity.
Other Corvis variables were of no significant differences between the two groups.

CONCLUSION

In conclusion, A2 velocity was significantly different between the diabetic patients and non-diabetic patients, which is an indication of increased corneal biomechanics amongst diabetic patients.
Hun Lee et al. proved that corneal biomechanical parameters are correlated with IOP regardless of subjects' age. Therefore, after considering IOP as a confounder, we can assume that the significant difference of Applanation 2 velocity between two groups is due to diabetes mellitus and age difference did not affected the outcome.(7)
The average age of the control group was lower than that of the diabetic patients, which is due to the prevalence of the type 2 diabetes in the elderly.
The cornea's thickness and structure were almost the same in the two groups; hence, the amount of internal pressure in the eye, which is confounded by the thickness of the cornea, did not significantly differ between the two groups.

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