

Original Article

Assessment of the macula and choroid in pediatric keratoconus patients

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Abstract

Purpose: To present choroidal and macular thickness measurements in pediatric patients with keratoconus and to evaluate a possible correlation between anterior and posterior segment parameters.

Methods: 50 eyes of 50 patients and 50 eyes of 50 age-matched controls were included in this cross-sectional comparative study. The participants underwent ophthalmologic examination including; refraction, visual acuity, biomicroscopy, corneal topography and optical coherence tomography. The choroidal thickness (CT) was measured at subfoveal area and at 500 microns intervals to the nasal and temporal to the fovea up to 1500 microns.

Results: The mean age of the patients and controls were 12.4 ± 1.9 and 12.0 ± 2.1 years. The mean thinnest corneal pachimetry was $456 \pm 57 \mu\text{m}$, the mean central macular thickness (CMT) was $258 \pm 24 \mu\text{m}$ and the mean subfoveal choroidal thickness was $342 \pm 30 \mu\text{m}$ for the patients. There was no significant difference between the patients and controls in regards of CMT and CT at any measured points ($p > 0.05$ for all). There was no correlation between anterior segment parameters and CMT. There was no correlation between anterior segment parameters and subfoveal choroidal thickness.

Conclusions: We may conclude that keratoconus does not affect the CMT and CT of pediatric keratoconus patients, and we may propose that we do not need a correction for this group of patients when we need to evaluate the CMT and CT.

Keywords: Choroidal thickness, Keratoconus, Macular thickness, Optical coherence tomography

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Introduction

Keratoconus is characterized by progressive corneal protrusion and thinning, leading to irregular astigmatism and impairment in visual function.¹ It has been shown that keratoconus progression is more frequent and faster in patients under 18 years of age, with a seven-fold higher risk of requiring corneal transplantation.²

For the diagnosis and management of anterior segment disease like keratoconus, corneal topography devices has been commonly used.³ Some devices combine a rotating

Scheimpflug camera with a Placido disc and allow physicians to detect even the small irregularities on the cornea.⁴ Similarly, optical coherence tomography (OCT) devices has been commonly used for the diagnosis and management of posterior segment disease. OCT scans allow physicians to measure the thickness of the retina and choroid at various locations.⁵

In literature, there are some studies which present OCT measurements in patients with keratoconus.^{6,7} Moschos et al. presented central foveal thickness of 32 patients with keratoconus and they reported that a macular dysfunction which is not visible ophthalmoscopically may coexist in some cases

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and the low visual acuity could be due not only to the corneal abnormality, but also to the retinal dysfunction.⁶ Cankaya et al. presented optic disc and retinal nerve fiber layer (RNFL) measurements in 46 patients with keratoconus and they reported a significance difference of optic disc parameters in keratoconic patients compared to normal subjects.⁷ However, the choroidal thickness of pediatric patients with keratoconus has not been established yet. In this study, we aimed to present choroidal and macular thickness measurements in pediatric patients with keratoconus.

Methods

Study design

This cross-sectional observational study was performed between May 2014 and March 2015. The research followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all participants' guardians. Beyoglu Eye Training and Research Hospital Local Ethics Committee approved the study.

Examination

The participants underwent full ophthalmologic examination; including refraction, visual acuity, slit-lamp biomicroscopy and dilated fundoscopy. Before the pupil dilation corneal topography scan via Sirius (Schwind eye-tech-solutions GmbH & Co. KG, Kleinostheim, Germany) and optical coherence tomography (OCT) scan via Spectralis (Heidelberg Engineering, Heidelberg, Germany) were obtained.

Eligibility criteria

Inclusion criteria were; being under 15 years of age and having keratoconus in least one eye. The diagnosis of keratoconus was based on clinical examination and confirmed by corneal topographer. The eye with a higher mean corneal power of each patient was included in the study.

Exclusion criteria were; history of any ocular disease other than keratoconus, having any systemic disease or history of previous intraocular surgery including corneal cross linking or laser therapy, presence of any corneal scarring/opacity which may influence OCT imaging, and contact lens wearing at last month.

We recruited the age-matched controls from subjects who visited our clinic and have no ocular and systemic disease, and also had 20/20 or better visual acuity in both eyes. The right eye was designated as the study eye for subjects with an even birth month number, and the left eye was selected for those with an odd birth month number.

Instruments

Sirius corneal topography device was used for measuring the anterior segment parameters. All images were taken and assessed by an experienced refractive surgeon (AA) at the same time of the day, between 9 and 10 am. The Sirius use of Scheimpflug camera and a Placido disk to measure and image the anterior eye segment; including the cornea, anterior chamber, iris, pupil, and lens.⁸ The device can acquire 25 Scheimpflug frames and 1 keratometry reading

in less than 1 second.⁹ It is capable of measuring anterior and posterior tangential curvature, sagittal curvature altime-try and refractive power, equivalent refractive power, corneal thickness, and visual quality (spot diagram, point-spread function and optical transfer function).⁹ Previous studies showed that good agreement between repeated measurement obtained in the same subjects (repeatability) via Sirius device.^{4,8}

Spectralis OCT device was used for measuring the posterior segment parameters. Central macular thickness (CMT), which is define as the distance between the vitreoretinal interface and the anterior surface of the retinal pigment epithelium, was automatically calculated by OCT mapping software. All OCT images were taken and assessed by an experienced retinal specialist (IY), who was masked, at the same time of the day, between 9 and 10 am. The choroid was visualized by standard EDI technique.¹⁰ A single line of 6 mm length centered horizontally on the fovea was used for the visualization of the choroid. Automatic real time (ART) mean function was set for a hundred frames and the images were acquired in high-resolution protocol. CT was measured as the vertical distance from outer surface of the retinal pigment epithelium to the inner surface of the sclera.¹¹ CT was measured at subfoveal and 500 microns interval to the nasal and temporal to the fovea up to 2000 microns. Previous studies showed that good agreement between repeated measurement obtained in the same subjects (repeatability) via Spectralis OCT device.^{5,12}

Statistical analysis

The results are expressed as the means \pm standard deviation (SD). The demographic characteristics of the patient and control groups and the OCT measurements of the eyes were compared using an independent *t*-test. Pearson's correlation analysis was used to evaluate the possible correlation between anterior and posterior segment parameters. Statistical Package for the Social Sciences (Version 20.0, SPSS, Chicago, IL, USA) was used for data analysis and values of $p < 0.05$ were considered statistically significant.

Results

Demographic characteristics

The study included 50 eyes of 50 patients (22 female, 28 male) and 50 eyes of 50 age-matched controls (24 female, 26 male). All participants were Caucasians. Clinical characteristics of the all participants are demonstrated in [Table 1](#).

Anterior segment parameters

Anterior segment parameters of the patients are demonstrated in [Table 2](#).

Macular and choroidal thickness

Sufficient image quality from OCT scans was obtained in all participants. The mean central macular thickness (CMT) measurement and the mean CT measurements are demonstrated in [Table 3](#).

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