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Original article

Identification of iridocorneal angle structures assessed by Fourier domain optical coherence tomography☆

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ABSTRACT

Objective: To study the structures of the iridocorneal angle using anterior segment optical coherence tomography (OCT) defining their tomographic characteristics and quantifying their identification frequency.

Material and methods: A cross-sectional study was performed on 267 right eyes of 267 consecutive healthy patients. Fourier domain OCT RTVue (Optovue Inc, CA, EE. UU.) was used to examine the iridocorneal angle in the nasal and temporal sectors. The structures evaluated were: sclerocorneal limbus, sclerocorneal transition, Schwalbe's line, trabecular meshwork, Schlemm's canal, scleral spur, and angular recess. Within and between agreements to identify structures were calculated using Cohen's kappa coefficient.

Results: The mean age was 41.3 ± 14.3 years (range 20–80), with 57% being women. The sclerocorneal limbus, sclerocorneal transition, and Schwalbe's line were identified by 98.7, 97 and 93.4% of the images, respectively, with the trabecular meshwork and Schlemm's canal being identified in 91% of cases. The scleral spur could be identified in 85.4%, and the angular recess in 74.5%. There was no difference in the identification between the temporal and nasal sectors. Within and between agreement was $k = 0.92$ and $k = 0.88$, respectively, in the identification of the structures of the total images studied.

Conclusions: Fourier domain OCT is a reliable technique for the identification of the structures of the iridocorneal angle, among which can be highlighted are, the trabecular meshwork, Schlemm's canal, scleral spur, and Schwalbe's line.

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Identificación de estructuras del ángulo iridocorneal mediante tomografía de coherencia óptica de dominio Fourier

Palabras clave:
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Tomografía de coherencia óptica
Malla trabecular
Estructuras angulares
Glaucoma

RESUMEN

Objetivo: Estudiar las estructuras que conforman el ángulo iridocorneal mediante tomografía de coherencia óptica (OCT) de segmento anterior, definiendo sus características tomográficas y cuantificando su frecuencia de identificación.

Material y métodos: Estudio transversal realizado en 267 ojos derechos de 267 pacientes consecutivos sanos. Se empleó una OCT de dominio Fourier RTVue (Optovue Inc, CA, EE. UU.) para explorar el ángulo iridocorneal en los sectores nasal y temporal. Las estructuras evaluadas fueron: el limbo externo, transición corneoescleral, línea de Schwalbe, malla trabecular, canal de Schlemm, espolón escleral y receso angular. Se calculó la concordancia intra- e interobservador para la identificación de las estructuras mediante el coeficiente kappa.

Resultados: La edad media fue 41,3 ± 14,3 años (rango 20-80); el 57% eran mujeres. El limbo externo, la transición córneo-escleral y la línea de Schwalbe se identificaron en un 98,7; 97 y 93,4%, respectivamente de las imágenes. La malla trabecular y el canal de Schlemm se identificaron en el 91% de los casos. El espolón escleral pudo ser identificado en un 85,4% y el receso angular en un 74,5%. No existió diferencia en la identificación entre el sector temporal y nasal. La concordancia intra- e interobservador fue de k = 0,92 y k = 0,88 respectivamente, en la identificación de las estructuras para el total de las imágenes estudiadas.

Conclusiones: La OCT de dominio Fourier es una técnica eficaz para la identificación de las estructuras que conforman el ángulo iridocorneal, entre las que destacan la malla trabecular, el canal de Schlemm, el espolón escleral y la línea de Schwalbe.

Introduction

Traditionally, the iridocorneal angle has been studied with gonioscopy[1] as it enables a direct visualization of its structures. However, it exhibits some disadvantages such as subjectiveness and involving uncomfortable contact for patients.

To date, the main imaging techniques used for studying the chamber angle have been ultrasound biomicroscopy (UBM)[2] and devices based on the Scheimpflug technology.[3] However, the resolution of this technology is below that of optic coherence tomography (OCT), and UBM is an invasive technique that requires longer time for exploration.[4,5]

In the past few years, OCT has arisen as an alternative for studying the iridocorneal angle.[6–8] The first OCT models, of the time domain type, allowed measuring angle opening with the main objective of identifying subjects suspicious of angle closure. However, said devices continued providing low-quality details. Subsequently, OCT evolved from time domain to spectral domain, including the Fourier domain, to offer at present higher acquisition rates yielding higher image resolutions enabling a novel description of the angle because we are able to identify and analyze the various structures it comprises.[9–12]

The first studies for identifying angle region structures focused on the scleral spur and Schwalbe's line as these were the only visible and clearly identifiable structures.[9,13,14] Subsequently, the trabecular meshwork and Schlemm's canal began to be studied. The interest in studying the iridocorneal angle has increased in recent years, not only due to its relevance in the physiopathology of the aqueous humor and the drainage pathways in glaucoma,[15–17] but also to obtain in-depth knowledge of the changes that take place after conventional glaucoma surgery as well as due to the emerging minimally invasive glaucoma surgery.[18,19]

The purpose of this study is to analyze the iridocorneal angle with OCT to identify and analyze the structures it comprises.

Subjects, material and methods

A transversal study comprising 267 right eyes of 267 consecutive healthy patients. The inclusion criteria was an age range between 18 and 25. The study excluded subjects with previously diagnosed ocular diseases or identified during the examination, with previous ocular surgery including cataract, refractive or glaucoma surgery and ocular trauma history. A complete examination was carried out which included detailed clinical record, anterior segment examination with slitlamp and posterior segment ophthalmoscopy. If the patients fulfilled the inclusion criteria, they were requested to sign an informed consent and were explored with OCT to complete the study. The protocol fulfilled the principles of the Helsinki declaration and was approved by the Ethics Committee of the hospital.

The device used for OCT exploration was RTVue® 100 (Optovue Inc., Fremont, CA, USA), the main characteristics of