DOI: 10.4274/tjo.galenos.2020.42223
Turk J Ophthalmol 2021;51:265-268

Original Article

Retrospective Evaluation of Corneal Foreign Bodies with Anterior Segment Optical Coherence Tomography

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Abstract

Objectives: To assess the anterior segment optical coherence tomography (AS-OCT) findings of various types of corneal foreign bodies.
Materials and Methods: The medical records of patients with corneal foreign body were retrospectively analyzed. Patients who underwent anterior segment photography and Spectralis AS-OCT (Heidelberg Engineering GmbH, Germany) imaging were included.
Results: The AS-OCT findings of 22 eyes of 20 patients with corneal foreign body were reviewed. The mean age was 34.9±14.98 years (range, 15-71) with a female/male ratio of 4/16. The mean best corrected visual acuity at presentation was 0±0 LogMAR (range, 0-0). There were 18 metallic, 3 organic (chestnut burr), and 1 chemical clay foreign bodies. The metal materials demonstrated hyperreflectivity with a mirror effect. Chemical clay, which is an opaque material, had a hyperreflective appearance. Chestnut burr is an organic foreign body with a feather-like pattern and was not detected with AS-OCT.
Conclusion: AS-OCT is a valuable non-invasive tool to define the characteristics of foreign bodies, as well as decide the proper treatment method and monitor patients with corneal foreign bodies.
Keywords: Cornea, anterior segment optical coherence tomography, trauma, foreign body

Introduction

Ocular injuries are one of the most important eye-related emergencies.[1] Although they can often be prevented with the use of safety glasses, the conscious use of such equipment is still uncommon.[2,3] Ocular injuries are more common among males and are usually a result of work or home accidents.[4] Most ocular injuries are mild in nature (e.g., corneal abrasions, periorbital contusions, and lacerations) and do not lead to permanent visual impairment.[5,6] The majority of emergency admissions for ocular injury are due to corneal foreign bodies, which are characteristically painful.[6,7] In addition to pain, corneal foreign body should be considered in every patient with a history of trauma associated with eye redness, watering, decreased visual acuity, photophobia, and foreign body sensation.[8] A meticulous slit-lamp examination together with a thorough clinical history including risk factors and exposure are important for accurate diagnosis and treatment.[8]

While superficial corneal foreign bodies present a low risk of complications and sequelae, the risk with deeply embedded foreign bodies varies depending on factors such as the size, depth, and type of foreign body.[9] Deep corneal foreign bodies require more careful handling due to the risk of perforation in particular.[10] Under certain conditions, foreign body type and depth cannot be clearly discerned on slit-lamp examination, and inappropriate interventions to remove deep corneal foreign bodies may result in corneal perforation.[11]

With the rapid technological advancement in ophthalmology, optical coherence tomography (OCT) has become routinely used in most clinics. Anterior segment OCT (AS-OCT) allows the detailed objective evaluation of the anterior segment (angle, cornea, sclera).[10] AS-OCT examination of a healthy cornea shows

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Received: 15.06.2020 **Accepted:** 24.11.2020

Cite this article as: Akbaş E, Barut Selver Ö, Palamar M. Retrospective Evaluation of Corneal Foreign Bodies with Anterior Segment Optical Coherence Tomography. Turk J Ophthalmol 2021;51:265-268

all layers of the cornea with a highly reflective tear film over the epithelium.[12]

There are few studies in the literature reporting on the AS-OCT imaging of corneal foreign bodies.[13,14,15,16,17] In this study, we aimed to evaluate corneal foreign bodies with different characteristics using AS-OCT and to investigate their characteristic findings.

Materials and Methods

The medical records of patients with corneal foreign bodies who presented to our center in 2019 were reviewed retrospectively. Patients who were diagnosed as having a corneal foreign bodies but whose records did not include anterior segment photographs and AS-OCT (Heidelberg Engineering GmbH, Germany) imaging were excluded. The study was approved by the Ege University Faculty of Medicine Ethics Committee and conducted in accordance with the Declaration of Helsinki.

The patients' medical records were examined in detail, including their best corrected visual acuity (BCVA), anterior and posterior segment examination findings, anterior segment photographs, and AS-OCT imaging. The AS-OCT device used provides high-resolution anterior segment imaging, with 16 mm spectral-domain OCT scanning for dual-angle imaging.

Statistical Analysis

Descriptive statistical analysis of the study data was performed using SPSS 21.0 software (IBM Corp, Armonk, NY, USA).

Results

The study included 20 eyes of 20 patients with corneal foreign body who underwent anterior segment photography and anterior segment optical coherence tomography. All of the patients were admitted within 72 hours of the incident.

Their mean age was 34.9±14.98 years (range, 15-71) and the female/male ratio was 4/16. Corneal foreign bodies were unilateral in 18 patients and bilateral in 2 patients. The mean baseline BCVA of the eyes in the study sample was 0±0 LogMAR (range, 0-0). In terms of their type, 18 of the corneal foreign bodies were metallic, 3 were organic (hairy chestnut spines), and 1 was a chemical clay substance.

In our evaluation of the AS-OCT results, we observed that metal foreign bodies had hyperreflective properties and caused a mirroring effect (Figure 1). The opaque chemical clay material also had a hyperreflective appearance like the metal objects (Figure 2). However, the chestnut spines were hair-like in nature and were not detected on AS-OCT or have any characteristic AS-OCT findings (Table 1).

Discussion

Corneal foreign bodies constitute a significant portion of ocular injuries, which are the leading emergencies of the eye.[1,6,7] A detailed history including risk factors and thorough examination are important in the diagnosis of corneal foreign bodies.[8] Ocular injuries, including corneal foreign bodies, are generally more common in young males.[4] Corneal foreign body injuries were also more frequent in young adults and males in this study, consistent with the literature.

Slit-lamp examination of corneal foreign bodies cannot be performed properly in various situations, such as the presence of a transparent foreign body, corneal turbidity, or anterior chamber hyphema.[13] Deeply embedded transparent corneal foreign bodies are particularly difficult to assess.[13] Furthermore, in areas with corneal opacity, small corneal foreign bodies may be missed in microscopic examination.[14] Determining the type of corneal foreign body is important in determining the urgency of its removal.[15] In cases of injury with better tolerated inert substances such glass and plastic, emergency intervention can be postponed if necessary.[15] In clinical situations where it is difficult to understand how deep into the cornea the foreign body has penetrated and whether or not there is full-thickness penetration, imaging modalities that facilitate determination of the type, size, and location of the corneal foreign body may be guiding in treatment, especially in cases that require surgery.[11]

AS-OCT, a non-invasive method that provides high-resolution images from various depths of the ocular anterior segment, offers an advantage in the examination of corneal

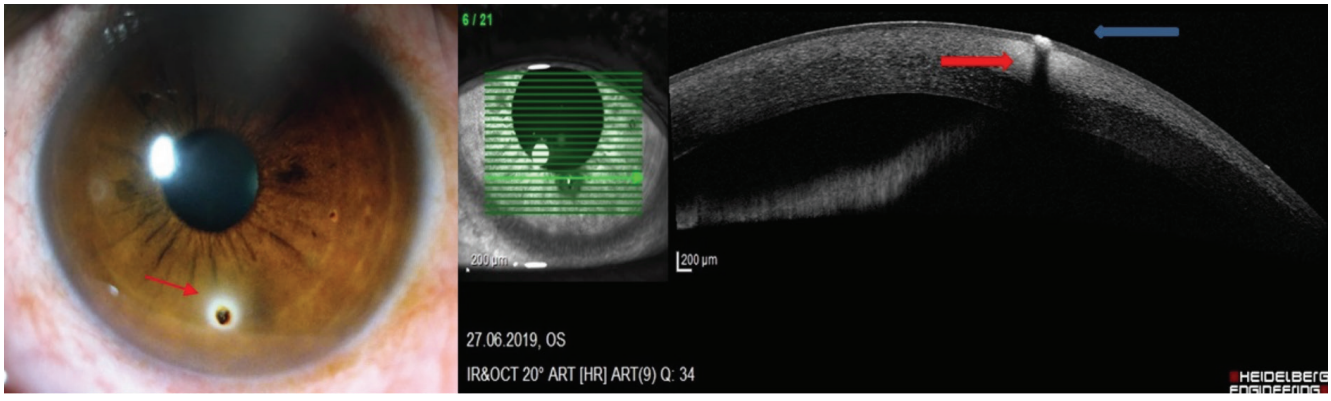

Figure 1. Anterior segment photograph of metallic corneal foreign body (red arrow) (a). On anterior segment optical coherence tomography, the metallic foreign body is hyperreflective (blue arrow) and causes a mirror effect (red arrow) (b)

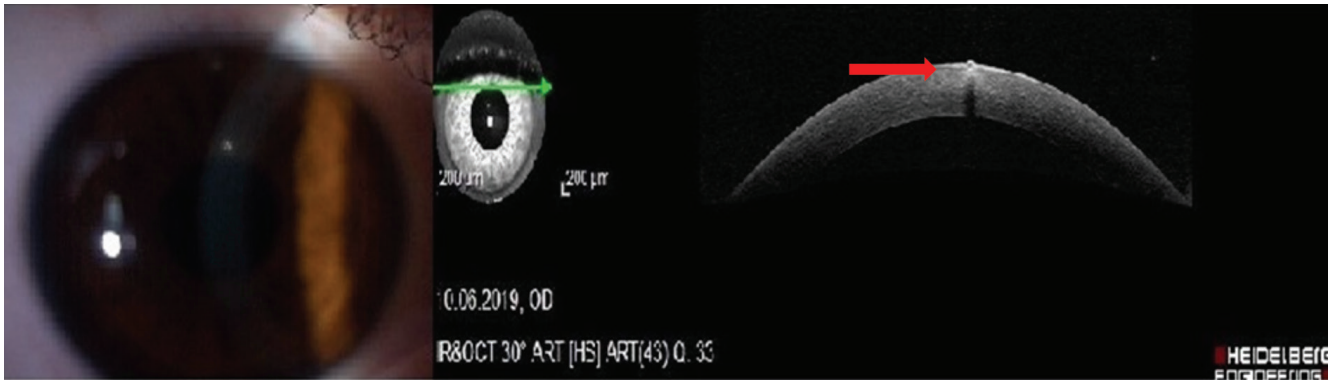

Figure 2. Anterior segment photograph of a chemical clay substance in the cornea (a). On anterior segment optical coherence tomography, the chemical clay substance appears hyperreflective (red arrow)

Table 1. The patients' demographic characteristics and optical coherence tomography findings

Patient	Gender	Age, years	Eye	FB type	OCT results
1	Male	24	Left	Metal	Hyperreflective, mirror effect
2	Male	30	Right	Metal	Hyperreflective, mirror effect
3	Male	28	Right	Metal	Hyperreflective, mirror effect
4	Male	29	Right	Metal	Hyperreflective, mirror effect
5	Male	37	Right	Metal	Hyperreflective, mirror effect
6	Male	19	Right	Metal	Hyperreflective, mirror effect
7	Male	50	Bilateral	Metal	Hyperreflective, mirror effect
8	Female	37	Right	Chestnut	Not detected on OCT
9	Female	32	Right	Chestnut	Not detected on OCT
10	Female	15	Left	Chestnut	Not detected on OCT
11	Male	51	Right	Metal	Hyperreflective, mirror effect
12	Male	50	Left	Metal	Hyperreflective, mirror effect
13	Male	55	Left	Metal	Hyperreflective, mirror effect
14	Male	27	Right	Metal	Hyperreflective, mirror effect
15	Male	24	Left	Metal	Hyperreflective, mirror effect
16	Male	34	Right	Metal	Hyperreflective, mirror effect
17	Male	71	Bilateral	Metal	Hyperreflective, mirror effect
18	Female	18	Right	Clay	Hyperreflective, no mirror effect
19	Male	49	Left	Metal	Hyperreflective, mirror effect
20	Male	18	Right	Metal	Hyperreflective, mirror effect

FB: Foreign body, OCT: Optical coherence tomography

foreign bodies because it is reliable and reproducible, has rapid image acquisition, and enables the depth of the foreign body to be determined.[11] There are few studies and case reports in the literature related to determining the details of corneal foreign body location and characteristics by AS-OCT. In an experimental study by Armarnik et al.[11], opaque objects (metal, wood, pencil graphite) were found to be hyperreflective in AS-OCT, and a mirror effect was observed with metal and pencil graphite. Transparent foreign bodies (glass and plastic) were reported to be hyperreflective with areas of hyporeflectivity.[11] Goel et al.[16] showed in a case report that a metallic corneal foreign body was hyperreflective on AS-OCT. In another case report by Celebi et al.[17], a metallic foreign body appeared hyperreflective with shadowing on AS-OCT. We also observed hyperreflectivity and the mirroring effect with the metallic corneal foreign bodies in this study, consistent with the literature. Although the foreign

body made of the opaque chemical clay substance exhibited hyperreflectivity, no mirror effect was observed. Organic foreign bodies from hairy chestnut spines were not detectable on AS-OCT.

Conclusion

In light of the limited literature information, it has been shown that there are characteristic links between the type of foreign body and their OCT findings on AS-OCT. This study contributes to the literature related to the description of foreign body materials and their OCT findings and is also important in highlighting the value of OCT in the diagnosis and follow-up of these patients. In the coming years, with corroboration by controlled prospective studies including larger case series, AS-OCT will likely play a more important role in determining the location, depth, and nature of foreign bodies and making treatment decisions accordingly.

Ethics

Ethics Committee Approval: The study was approved by the Ege University Faculty of Medicine Ethics Committee and conducted in accordance with the Declaration of Helsinki.

Informed Consent: Obtained.

Peer-review: Externally peer reviewed.

Authorship Contributions

Concept: Ö.B.S., M.P., Design: Ö.B.S., M.P., Data Collection or Processing: E.A., Ö.B.S., Analysis or Interpretation: E.A., Ö.B.S., M.P., Literature Search: E.A., Ö.B.S., M.P., Writing: E.A., Ö.B.S., M.P.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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