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Case report

Utility of anterior segment swept-source optical coherence tomography for imaging eyes with antecedent ocular trauma

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ABSTRACT

Purpose: To evaluate the utility of swept source optical coherence tomography (SS-OCT) for the analysis of anterior segment structures in cases with previous traumatic eye injuries.

Observations: We report three eyes of three patients with anterior segment traumatic eye injury and highlight the role of SS-OCT in their evaluation and management. This technology enabled us to visualize the structural details of anterior segment of the eye and augment the clinical examination in our patients. Given that it is non-invasive and that there is no contact involved, it may be an ideal imaging modality for traumatic eye injuries for viewing the details before and after any clinical intervention especially in the sub-acute setting.

Conclusions: The anterior segment SS-OCT is a useful device allowing non-invasive, non-contact, real-time, cross-sectional anterior segment images of eyes with previous ocular trauma.

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1. Introduction

Anterior segment optical coherence tomography (ASOCT) has been shown to be a valuable tool for the evaluation and management of ocular conditions such as narrow angles and primary angle closure [1,2]. The utility of ASOCT for the assessment and management of ocular trauma has not fully been explored. Classically, ocular assessments in the setting of antecedent trauma has been performed using traditional slit lamp examination, gonioscopy and ultrasound biomicroscopy. However, traumatized ocular tissue can be fragile especially in the acute and sub-acute setting, and hence, using contact methods to assess the anterior segment may not be desired [3].

The disadvantages of contact methods, such as risk of corneal abrasions, infections due to corneal contact, and discomfort experienced by the patient, have made the noncontact ASOCT imaging devices popular [4].

In all our cases, we used the Casia SS-1000 OCT (Tomey, Nagoya, Japan), which is a commercially available swept-source OCT

specifically designed for imaging the anterior segment. The device uses 1310 nm wavelength with a scan speed of 30,000 A-scans per second, with an axial resolution of less than 10 μm . The anterior chamber angle can be imaged in 128 cross-sections (each with 512 A-scans) 360° around the anterior segment in 2.4 seconds [5].

We describe three eyes of three patients with antecedent anterior segment traumatic eye injury and highlight the role of anterior-segment SS-OCT in their evaluation and management.

2. Findings

All patients provided written consent for publication of personal information including medical record details and photographs.

2.1. Case report 1

A 76-year-old male presented to the emergency room complaining of severe pain in his left eye and headache. Patient's ocular history was significant for a traumatic eye injury that required subsequent cataract removal with no intraocular lens implantation in his left eye at 16 years of age. On examination, the patient's visual acuity was 20/20 in the right eye and light perception in the left eye. The intraocular pressure (IOP) measured 18 mm Hg in the right eye and 46 mm Hg in the left eye. Slit lamp examination of the right eye was unremarkable. Slit-lamp examination of the left eye was

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hampered by corneal edema, as well as, band keratopathy of the cornea, but appeared to have a relatively flat anterior chamber with significant peripheral iris-cornea touch and 360° peripheral anterior synechiae (PAS) (Fig. 1A). Retro-iris dense material likely from residual cortex/capsule and mild neovascularization at pupillary margin were seen. Gonioscopy was challenging due to inadequate visualization and the patient was sent for additional imaging including anterior segment SS-OCT and ultrasound biomicroscopy (UBM). Ten MHz B-scan ultrasound revealed no mass or tumor of the posterior segment. UBM showed iridocorneal contact and shallowing of the anterior chamber (Fig. 1B). The SS-OCT added value to the exam as it displayed a full 360° visualization of all iris corneal adhesions, confirmed synechial angle closure, but additionally revealed seclusio pupilla (Fig. 1C, Video 1). The patient was diagnosed with pupillary block angle closure glaucoma in the left eye with iris-lenticular adhesions revealed only by the anterior-segment SS-OCT. After treatment with topical and systemic ocular hypertensive medications, the patient underwent successful laser peripheral iridotomy (LPI) in the left eye. At one week follow-up after LPI, the patient was now asymptomatic, and repeat anterior segment SS-OCT demonstrated the formation of anterior chamber with significant reduction in iridocorneal touch (Fig. 1D).

Supplementary video related to this article can be found at <http://dx.doi.org/10.1016/j.ajoc.2016.03.004>.

2.2. Case report 2

A 48-year-old male presented to the ER complaining of a pain in his left eye after having blunt ocular trauma to that eye and was then referred to ophthalmology clinic. The history revealed that the patient had had a LASIK surgery in 2009. On exam, the patient's best corrected visual acuity was 20/20 in the right eye and 20/30 in the left eye. Left pupil was unreactive to direct and indirect

pupillary light reflex. IOP was 19 mm Hg in the right eye and 5 mm Hg in the left eye. Slit lamp examination revealed central corneal opacity throughout the stroma, 2 (+) shallow anterior chamber, iridodialysis extending from 6:30 to 9:30 o'clock, mid dilated pupil and nuclear sclerotic cataract (Fig. 2). Choroidal folds and cystoid macular edema were seen in fundus examination. Due to corneal edema and the shallow anterior chamber, gonioscopy did not afford a clear view of the anterior chamber angle recess. Anterior segment SS-OCT was performed and confirmed a large iridodialysis in 4 clock hours, and revealed a very-large area of cyclodialysis in 7 clock hours (extending from 5:30 to 12:30) (Fig. 3, Video 2). The SS-OCT results allowed a more thorough evaluation of the anterior segment and proper planning for surgical repair of the iridodialysis, as well as, the cyclodialysis.

Supplementary video related to this article can be found at <http://dx.doi.org/10.1016/j.ajoc.2016.03.004>.



Fig. 2. Case 2: Slit lamp examination revealing iridodialysis extending from 6.30 to 9.30 o'clock.

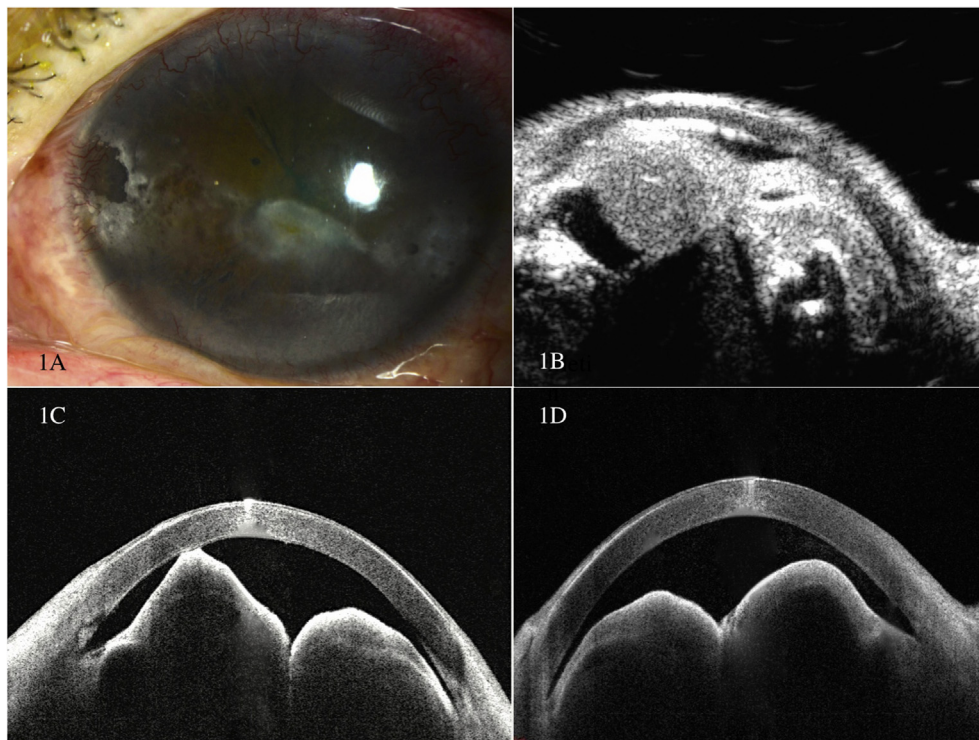


Fig. 1. Case 1: Slit lamp examination (1A), Ultrasound biomicroscopy showing iris bulge and shallow anterior chamber (1B), Swept source AS-OCT imaging before laser peripheral iridotomy showing iris corneal touch (1C), Swept source AS-OCT imaging after laser peripheral iridotomy with the iris falling away from the cornea and deepening the anterior chamber (1D).

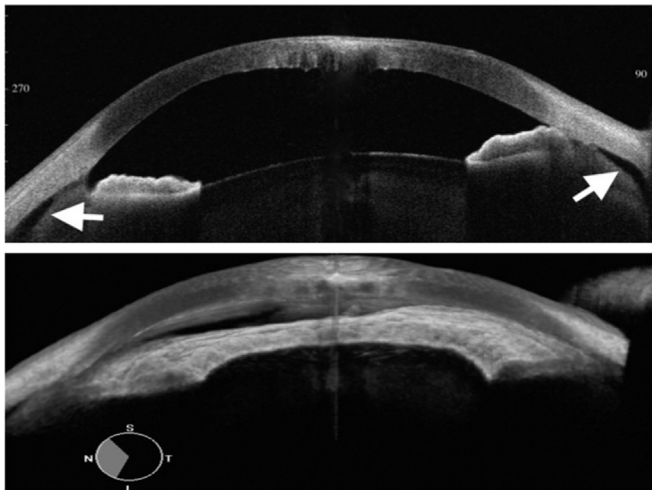


Fig. 3. Case 2: Swept source AS-OCT showing the iridodialysis in 4 clock hours and cyclodialysis in 7 clock hours.

2.3. Case report 3

A 33-year-old male was referred to our clinic because of elevated intraocular pressure in his left eye. The patient has a remote history of a left-eye penetrating ocular injury at the age of 3, followed by several ocular surgeries including trabeculectomy. On exam, the patient's best corrected visual acuity was 20/20 in the right eye and 20/400 in the left eye. Left pupil was unreactive to direct and indirect pupillary light reflex. IOP was 15 mm Hg in the right eye and 27 mm Hg in the left eye. Slit lamp and gonioscopic examinations revealed no pathology in the right eye, but showed a trabeculectomy bleb, areas of peripheral anterior synechia, two peripheral iridectomies at 7 o'clock and at 12 o'clock, large Soemmering's ring tracking to the nasal corneal wound and aphakia in the left eye. Optic atrophy and vitreous strands were seen on fundus

examination. Anterior-segment SS-OCT revealed significant PAS – much more extensive than that noted on gonioscopy which was hampered by the presence of vitreous-iris-corneal attachments. We also were able to see the vitreous-corneal attachment at the iridectomy site at 7 o'clock through a membrane (Fig. 4, Video 3). The patient was diagnosed with uncontrolled chronic angle closure glaucoma with extensive synechia demonstrated by the anterior segment SS-OCT and was scheduled for appropriate surgical intervention.

Supplementary video related to this article can be found at <http://dx.doi.org/10.1016/j.ajoc.2016.03.004>.

3. Discussion

Our small case series of 3 eyes with ocular trauma revealed the added utility of imaging the anterior segment using SS-OCT in addition to the clinical exam. Although we used it primarily in the sub-acute and chronic settings of eyes with antecedent ocular trauma, the anterior segment OCT may prove to have utility in the acute setting as well. Even in cases with clinical visualization, it provides a 360° view of the angle in a non-contact manner in a very quick fashion (few seconds) for initial assessment and then provides the capability of monitoring the effectiveness of treatment with sequential scans. In our cases, it afforded the ability to visualize the chamber deepening after laser PI in the 1st case; allowed visualization and quantification of the cyclodialysis in addition to iridodialysis in our 2nd case before surgical repair, and document resolution after surgery; and finally, allowed complete visualization of the anterior segment to augment clinical exam and aid with surgical planning in our 3rd case.

It has been previously shown that ASOCT provides quick evaluation of structural details so it may be ideal for viewing the cross-section of the cornea, anterior chamber and angle, and anterior portion of the iris. However, it must be noted that one of the major limitations of ASOCT is that visualization is typically limited to details anterior to the iris, and structures posterior to the iris are

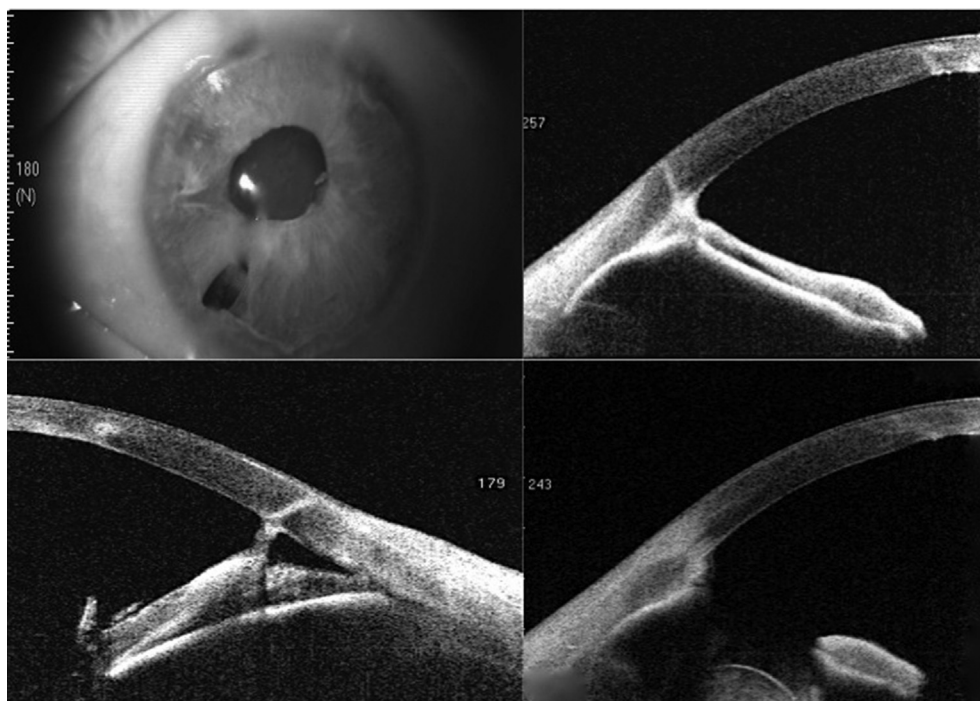


Fig. 4. Case 3: Swept source AS-OCT showing peripheral anterior synechia, vitreous-iris-corneal attachments and iridectomy site.

typically not well visualized due to blocked signals and shadowing artifacts. This limitation was especially true with older devices but have shown some improvement with recent ASOCT devices [5–7]. ASOCT is generally considered analogous to ultrasound imaging except that it uses infrared light rather than sound; therefore, it does not require fluid immersion or probe contact. This not only makes it easier to obtain images but also results in less discomfort for the patients than ultrasound imaging modality [4].

Classically, gonioscopy is the most common method (especially in clinical practices without the availability of UBM) for investigating iridocorneal angle abnormalities such as cyclodialysis clefts. However, gonioscopy can be quite challenging in patients with hypotony related to cyclodialysis cleft since the anterior chamber is typically quite shallow and visualization of the iridocorneal angle is often severely compromised. Furthermore, gonioscopy is often not useful in cases with corneal opacities/edema which often can accompany ocular trauma. In such cases, non-contact ASOCT may be a viable alternative or adjunctive modality to evaluate the angle anatomy [8].

4. Conclusion

To summarize, we successfully used the anterior segment SS-OCT to obtain high-resolution images of anterior chamber

anatomy in eyes with antecedent ocular trauma, and it was useful in providing assessment and planning management of these cases.

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