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Role of Anterior Segment Optical Coherence Tomography in Ocular Trauma at a Teritiary Centre

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Purpose*: To study Anterior Segment Optical Coherence Tomography in patients with Ocular Trauma*
Methods*: This study was conducted for 1 year in the outpatient department of ophthalmology and the in-patient wards of teritiary centre, Mangalore during November 2018 to December 2019. This was a hospital based Prospective Study done on 100 patients. Along with complete routine ophthalmic examination, Anterior Segment Optical Coherence Tomography was done.*
Results*: The present study was conducted among 100 patients to evaluate the anterior segment OCT changes in ocular trauma.*
Out of 100 trauma cases 28% belonged to Road Traffic Accidents, followed by industrial injuries (17%) and domestic injuries (17%).
Among 100 patients, 34% of right eyes were not injured and found to be normal. On AS-OCT corneal foreign body is seen in 43% of right eyes and 23% with no corneal changes. Anterior chamber changes were seen in 60% of right eyes. Hyphaema was found in 16% and 10% found with angle recession. On AS-OCT lens changes were seen in 81% of right eyes. Traumatic cataract in 18%, subluxated lens in 9% and dislocation in 3% of patients.
Among 100 patients, 49% of left eyes were not injured and found to be normal. On AS-OCT corneal changes were seen in 39% of left eyes and 12% with no corneal changes. Anterior chamber changes were seen in 80% of left eyes. Hyphaema was found in 28% and 3% found with angle recession. On AS-OCT lens changes were seen in 89% of left eyes. Traumatic cataract in 19%, subluxated lens in 17% and dislocation in 16% of patients.
Conclusion*: AS-OCT of cornea offers data on the position, size and depth of the foreign body. AS-OCT may also recognize unexpected lesions in cases of ocular trauma that are invisible or difficult to see through routine bio microscopic slit-lamp examination. It also demonstrated corneal wound closure and improvement in corneal edema after treatment. In addition, it presented data on correct corneal thickness and anterior chamber width. AS-OCT has been shown to be a valuable tool for the evaluation and management of ocular conditions such as narrow angles and primary angle closure. AS-OCT can also be helpful in situations where gonioscopy isn't feasible.*
Keywords*: AS-OCT, Trauma, Corneal foreign body, Traumatic cataract, Macular edema*

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I. Introduction

Ocular injury is the most common cause for emergency interventions in ophthalmology departments throughout the world, and is the second most common cause of visual loss[1]. Over 2.4 million eye injuries occur each year[2]. 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 subacute 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 AS-OCT imaging devices popular[4].

Anterior segment optical coherence tomography (AS-OCT) has been shown to be a valuable tool for the evaluation and management of ocular conditions such as narrow angles and primary angle closure[5,6]. The utility of AS-OCT for the assessment and management of ocular trauma has not fully been explored. Anterior segment optical coherence tomography (AS-OCT) is a valuable tool for the early diagnosis and monitoring the progress of treatment in cases of ocular trauma[7]. AS-OCT uses low coherence, near-infrared light to obtain detailed images of anterior segment structures, including cornea, at resolutions exceeding other available systems, including ultrasound bio microscopy and conventional ocular ultrasonography[8]. OCT for anterior segment imaging, was first reported in 1994[9]. Since then, significant technological advancements have resulted

in the development of new-generation spectral domain OCT devices, including the Cirrus spectral domain optical coherence tomography (SD-OCT) device (Carl Zeiss Meditec, Dublin CA, USA), with a resolution of 5 µm and A-scan speed of 27.000 A-scan/s and 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 mm. The anterior chamber angle can be imaged in 128 cross-sections (each with 512 A-scans) 3600 around the anterior segment in 2.4 seconds[10].

II. Methods

Objectives:

The primary objective was to study the importance of Anterior segment optical coherence tomography in patients with ocular trauma and the secondary objective was to demonstrate the clinical applications of AS-OCT in ocular trauma and various ocular conditions.

Study design

A 1-year prospective synopsis study was conducted in ophthalmology outpatient department of teritiary care centre

Study subjects

A total of 100 Patients with Ocular trauma who attended the Out Patient Department of teritiary care centre and those admitted in the Inpatient ward of the Department of Ophthalmology, between November 2018 and December 2019 were the subjects of this study

Each patient was requested to provide detailed history, followed by complete ocular examination as follows:

1. Presenting complaints and relevant history
2. Visual acuity recording using Snellen's chart.
3. Examination of anterior segment done in detail with the help of slit lamp biomicroscopy
4. Fundus examination done using direct ophthalmoscope, indirect ophthalmoscope and slit lamp bio microscopy using 90D OR 78D lens.
5. Rebound Tonometry was done to measure Intraocular pressure in both eyes
6. AS-OCT (Zeiss Primus 200) was done in the affected eye

III. Results

The present study was conducted among 100 patients to evaluate the anterior segment OCT changes in ocular trauma. Majority of study subjects belong to 21-30 years followed by 31-40 years age group and 53% of all the subjects are Males which means Male to Female ratio is 1.13.

Table 1: Subjects by Age

Age (years)	Frequency	Percentage
11-20	12	12
21-30	32	32
31-40	28	28
41-50	21	21
51-60	7	7
TOTAL	**100**	**100**

Table 2 : Subjects by Gender

SEX	Frequency	Percentage
MALE	63	63
FEMALE	47	47
TOTAL	**100**	**100**

Table 3 : DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO CONJUNCTIVAL FINDINGS ON ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY (ASOCT)

CONJUCTIVAL FINDINGS	RT EYE		LT EYE	
	Freq	%	Freq	%
YES	48	48	44	44
NO	18	18	5	5
NO TRAUMA	34	34	49	49
TOTAL	**100**	**100**	**100**	**100**

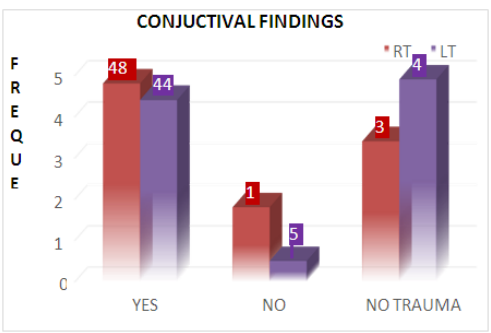
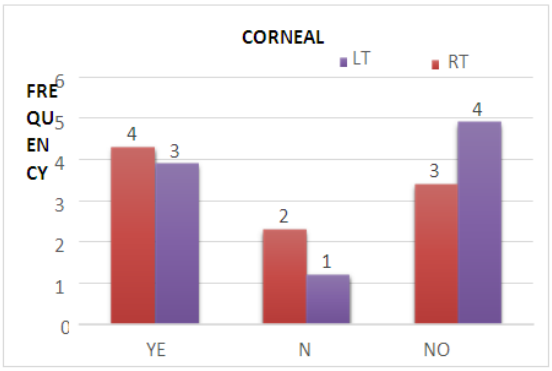


Table 4 : DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO CORNEAL FINDINGS ON ASOCT

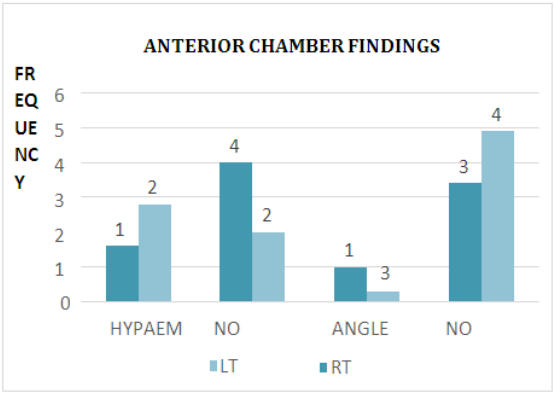
CORNEAL CHANGES	RT EYE		LT EYE	
	Freq	%	Freq	%
YES	43	43	39	39
NO	23	23	12	12
NO TRAUMA	34	34	49	49
TOTAL	100	100	100	100



Among 100 patients, 34% of right eyes were not injured and found to be normal. On ASOCT corneal foreign body is seen in 43% of right eyes and 23% with no corneal changes.
Among 100 patients, 49% of left eyes were not injured and found to be normal. On ASOCT corneal changes were seen in 39% of left eyes and 12% with no corneal changes.
AS -OCT is helpful in detection **in type of foreign body**

Table 5 : SLIT-LAMP ANTERIOR CHAMBER FINDINGS

ANTERIOR CHAMBER	RT EYE		LT EYE	
	Freq	%	Freq	%
DECEMENT MEMBRANE TEAR	3	3	2	2
FOREIGN BODY	40	40	37	37
ANGLE RECESSION	3	3	3	3
NO CHANGES	54	54	58	58
TOTAL	100	100	100	100



AS-OCT showed corneal wound closure and improvement in the corneal edema with treatment on follow up. Furthermore, it supplied information on accurate corneal thickness and anterior chamber depth. AS-OCT was a valuable tool to noninvasively observe wound shape and detect the presence of intracorneal foreign bodies

Among 100 patients, 34% of right eyes were not injured and found to be normal. Anterior chamber changes were seen in 60% of right eyes. Hyphaema was found in 16% and 10% found with angle recession.

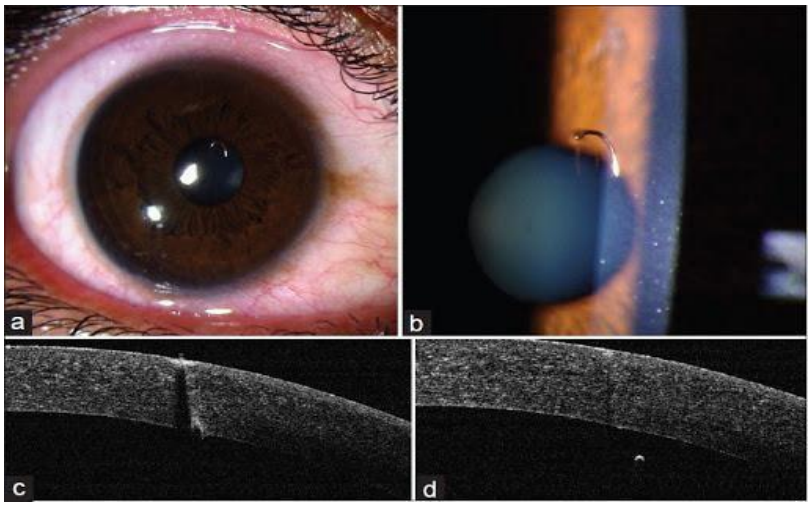
Among 100 patients, 49% of left eyes were not injured and found to be normal. Anterior chamber changes were seen in 20% of left eyes. Hyphaema was found in 28% and 3% found with angle recession.

Table 6 : DILATED FUNDUS EXAMINATION REPORT

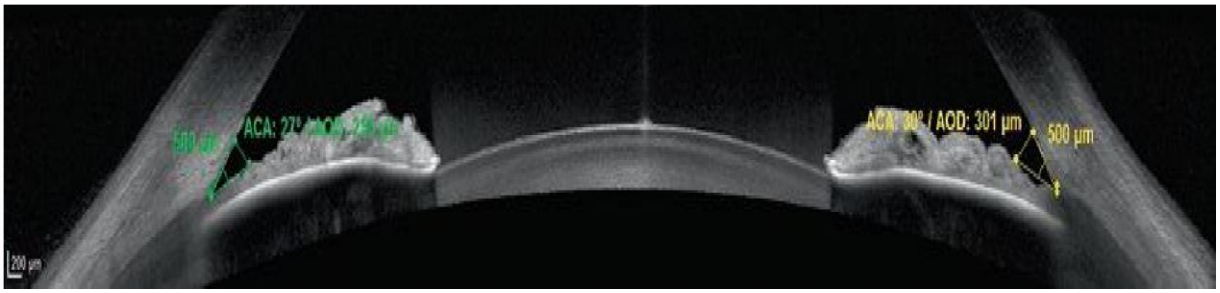
DILATED FUNDUS EXAMINATION	RT EYE		LT EYE	
	Freq	%	Freq	%
RETINAL DETACHMENT	7	7	6	6
MACULAR EDEMA	12	12	1	1
MACULAR HOLE	4	4	8	8
VITRUS HEMORRHAGE	1	1	1	1
No CHANGES	9	9	19	19
NO TRAUMA	34	34	49	49
TOTAL	100	100	100	100

Among 100 patients, 34% of right eyes were found to be normal. On dilated fundus examination macular edema observed in 12% followed by retinal detachment in 7%, macular hole in 4% & vitreous hemorrhage in 1% .

Among 100 patients, 49% of left eyes were not injured and found to be normal. On dilated fundus examination macular hole observed in 8% , followed by retinal detachment in 6%, macular edema and vitreous haemorrhage in 1%.



AS-OCT showing FB in cornea extending into anterior chamber



AS-OCT showing anterior chamber angle measuring tools. ACA and AOD

IV. Discussion

In clinical practice the cornea is routinely examined using slit-lamp bio microscopy at magnification of 10×, 25× (and up to 100×). Recent advances in ocular imaging include high-resolution techniques for visualizing cornea. Intrastromal corneal foreign bodies can be accurately viewed using the AS-OCT. The advantages of AS-OCT are that it is a non-contact imaging system associated with minimal discomfort in trauma patients and that it can be used to obtain high-resolution cross sectional images of the anterior segment, including the cornea.

In this study preoperative AS-OCT confirmed that the foreign body did not completely penetrate the cornea, which was not clearly observed via slit-lamp bio microscopy because of image overlap.

AS-OCT findings helped us choose the most appropriate technique for corneal foreign body removal.

AS-OCT provides vital details about Descemet's membrane integrity and the point of entry of a foreign body, which can be utilized to plan surgical removal

- *OCT can help to determine the cause of the angle closure.*

OCT is useful for identifying the mechanism(s) behind the angle closure. OCT can also reveal causes of secondary angle closure, such as supraciliary fluid that's pushing the iris-lens diaphragm forward. It's important to know this because the appropriate treatment varies depending upon the cause of the problem.

- *OCT can be helpful in situations where gonioscopy isn't feasible.*

Occasionally a patient will present with a hazy cornea, making angle visualization difficult or impossible; OCT can still provide a view of the angle. Also, some patients are unable to tolerate a contact lens placed on the eye. OCT can allow angle evaluation without touching the eye.

V. Conclusion

AS-OCT can be widely applicable in ocular trauma.
AS-OCT is a non-invasive method for rapid imaging of ocular tissue of various depths, which provides accurate localization of foreign bodies and the status of surrounding ocular structures, facilitating pre-operative surgical planning.
In patients who present with a hazy cornea ,making angle visualization difficult or impossible; AS-OCT can still provide a view of the angle.
AS-OCT can be helpful in situations where gonioscopy isn't feasible.
This noncontact-type technology with a high resolution and high reproducibility provides comprehensive and quantitative information.
It has been previously shown that AS-OCT 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.
It is useful in providing assessment and planning management of these cases.
It is useful in providing documentation ,assessment and planning management of ocular trauma cases.

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