Case Report

SAND BLAST CORNEAL TRAUMA FROM TYRE EXPLOSION: ROLE OF SLIT LAMP PHOTOGRAPHY AND ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY

Rita O Momoh[1], Darlingtess A Oronsaye[2]

[1]Department of Ophthalmology, School of Medicine, College of Medical Sciences, University of Benin, Edo State, Nigeria.
[2]Department of Ophthalmology, University of Benin Teaching Hospital, Benin City, Edo State, Nigeria.

ABSTRACT

Tyre explosion injuries affecting the eyes, though rare, are usually occupational and can be debilitating, causing vision loss. This article highlights the management of this type of eye trauma and the role of imaging techniques such as slit lamp photography (SLP) and anterior segment optical coherence tomograghy (AS-OCT) in the management. A 33- year old male presented to the accident and emergency unit with gross and sudden reduction in vision in both eyes following injury from a tyre explosion which occurred as he attempted to inspect the faulty brake-pads of his vehicle on the highway. Examination showed sandblasted corneae with multiple superficial and deep foreign bodies within the anterior half of the corneae in both eyes. He was managed conservatively on medical treatment with partial restoration of vision and then referred due to proximity. Slit-lamp photography and anterior segment optical coherence tomography were used to illustrate the initial picture on presentation and helped in subsequent monitoring of the injury. Wearing of spectacles or protective goggles is advised when handling or inflating tyres.

Keywords: tyre explosion, sandblasted corneae, slit-lamp photography, anterior–segment-optical coherence tomography AS-OCT.

INTRODUCTION

Tyre explosion injuries though rare can affect the eyes, head and other parts of the body. The head and face are the most commonly affected regions (48%) followed by the upper limbs (20%).[1,2,3] Injury is caused by the pressure impact of the explosion or by direct hit of the rim of the tyre. The severity depends on the size of the tyre, the contained air pressure and the distance between the tyre and the victim.[1,4,5] Tyre explosions can occur as a result of occupational exposure or during do- it- yourself (DIY) procedures to deflate or inflate tyres especially when using air compression inflation technique.[6,7,8] It can also occur spontaneously, even with non-contact, purely as accidents, even to by-standers.[2,3] Tyre blast injuries can result in fatalities and the overall mortality is high (19%) and is mainly caused by head injuries.[1]

Correspondence: Dr Rita O Momoh,
Department of Ophthalmology, School of Medicine, College of Medical Sciences, University of Benin, Edo State, Nigeria.
E-mail: rita.momoh@uniben.edu

The material or foreign body(FB) commonly associated with such blast injuries from tyres include sand, splinters of the tyre or metallic foreign bodies from tyre parts.[4,5,8] In the eye, these foreign bodies get embedded in the conjunctiva and cornea and could be superficially or deeply located. They could penetrate even deeper, and get embedded in posterior segment structures.[8]

Deep multiple corneal foreign bodies constitute a rare occurrence compared to superficial corneal FB or deep isolated corneal FB. The management may pose a challenge as the FB may be retained for prolonged periods with the consequent sequelae of impaired vision.[4,5] Slit lamp photography (SLP) and anterior segment optical coherence tomography (AS-OCT) are very useful imaging techniques to document clinical findings and monitor the sequelae of this type of injury.[9,10]A decision may need to be taken for keratoplasty and the availability of facilities for this treatment is quite limited in low resource settings.

CASE REPORT

A 33- year old male intercity truck driver presented at our Accident and Emergency Unit with complaints of reduced vision in both eyes, ocular aches, redness, grittiness and photophobia of four hours duration, following a tyre explosion in his face at close range. He sustained the injury when he stopped to examine his brake pads which appeared to have developed a fault while on the highway. He claimed the tyre was very hot and exploded spontaneously as he bent to inspect it, before he could deflate the tyre to work on the brake pads. He was not wearing glasses or protective spectacles at the time of the incident and had good vision in both eyes (BES) prior to the trauma. First aid care which consisted essentially of irrigation of both eyes was given at a private hospital before referral to the tertiary facility.

CLINICAL FINDINGS AND MANAGEMENT

Visual acuity in each eye was Counting-Fingers (CF) at two meters. There was periorbital edema and oily debris along the lid margins on inspection. Ocular examination with the slit lamp bio-microscope showed conjunctival congestion and multiple foreign bodies (mainly sand granules and about three tiny pieces of superficial tyre splinters) embedded at various levels within the conjunctiva, corneal epithelium and stroma of both eyes. There was positive fluorescein staining surrounding the more superficial foreign bodies and negative staining overlying the deeper corneal foreign bodies in both eyes. Other anterior segment and posterior segment structures appeared normal in both eyes. He also had abrasion injuries involving the face, right forearm and left leg.

His eyes were irrigated copiously with normal saline and the lids were everted and particulate matter removed. Slit lamp photography of the external ocular surface was achieved with a mobile smartphone, the Lenovo Vibe K-5 with its 13-megapixel camera. The camera was placed against the eyepiece of the slit-lamp and pictures of the magnified view of each eye were taken both at presentation (fig.1) and on follow-up visit (fig.3). Another easily reproducible document, an AS-OCT (using the anterior segment mode of a TOPCON OCT machine) was also performed to determine the depth of the foreign bodies in the corneae and the presence of foreign bodies in the anterior segment, especially the iris, anterior chamber angles and lens. This initial AS-OCT (fig.2) served as baseline and enabled us monitor the migration and location of these foreign bodies subsequently (fig. 4). The initial AS-OCT (longitudinal section) showed sand granules embedded at various levels within the anterior half of the corneal thickness. Gonioscopy and dilated fundoscopy revealed no intraocular foreign bodies or other abnormality in both eyes. The most superficial of the foreign bodies were removed from both corneae and conjunctivae under topical anaesthesia, with the bent tip of a 26-guage needle using the binocular and magnified view of the slit lamp biomicroscope. Siedel test done after the procedure was negative. The eyes were padded for 24 hours and the patient was placed on ointment chloramphenicol, guttae moxifloxacin, a cycloplegic agent, tablets of ascorbic acid and non-steroidal anti-inflammatory drugs (NSAIDS). Intramuscular tetanus toxoid (booster dose) was also given and the abrasions on the face and limbs were cleaned and dressed.

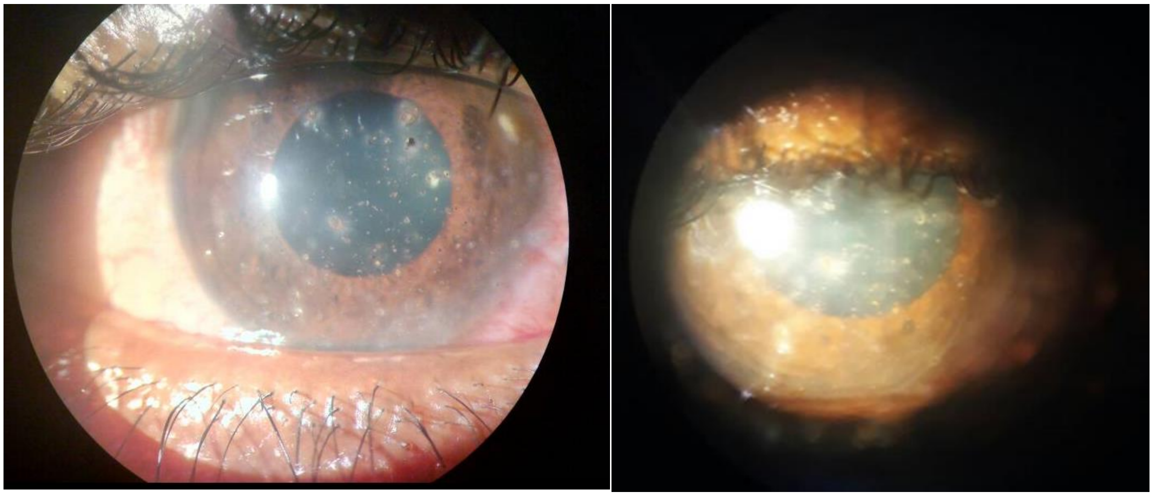

Fig.1: Slit lamp photograph of RE and LE respectively, showing multiple foreign bodies (sand granules) in the cornea at presentation after irrigation.

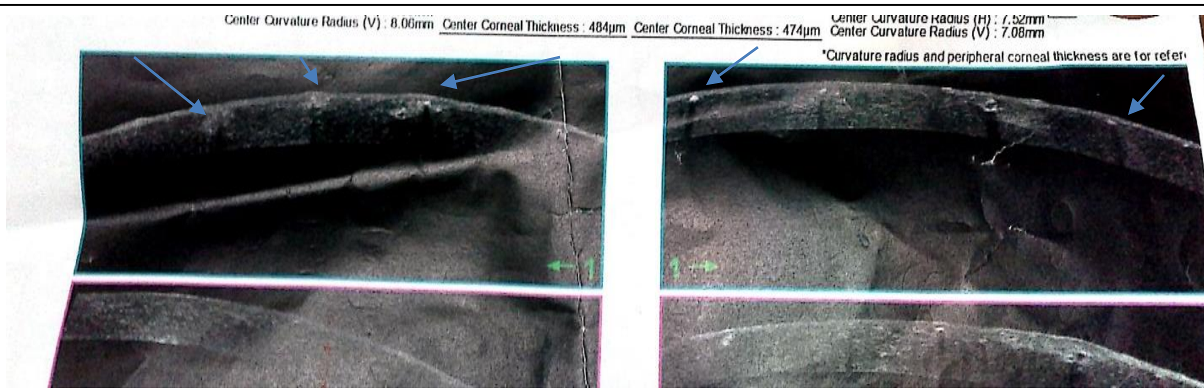

Fig.2. AS- OCT in RE and LE respectively at presentation showing multiple, widespread corneal foreign bodies embedded at different depths in the anterior half of the cornea, more superficial in LE.

RE=Right eye, LE=left eye, AS-OCT=Anterior Segment Optical coherence tomograph.

At a follow-up visit, 2- weeks post trauma, grittiness had reduced markedly, visual acuity had improved to 6/12 in either eye and there were fewer but relatively widespread, multiple embedded sub-epithelial sand granules in the conjunctiva and cornea. Fluorescein test was negative in both eyes. Two embedded but more superficial sand granules were also removed while deeper ones were left behind to avoid perforation, ulceration and minimize inflammation and scarring. He was asked to continue topical medications and booked for short follow- up visits for re-evaluation and further treatments as necessary. The follow up visits were declined as patient was resident in another state, hence he was referred to an eye care facility in his state of residence for further management.

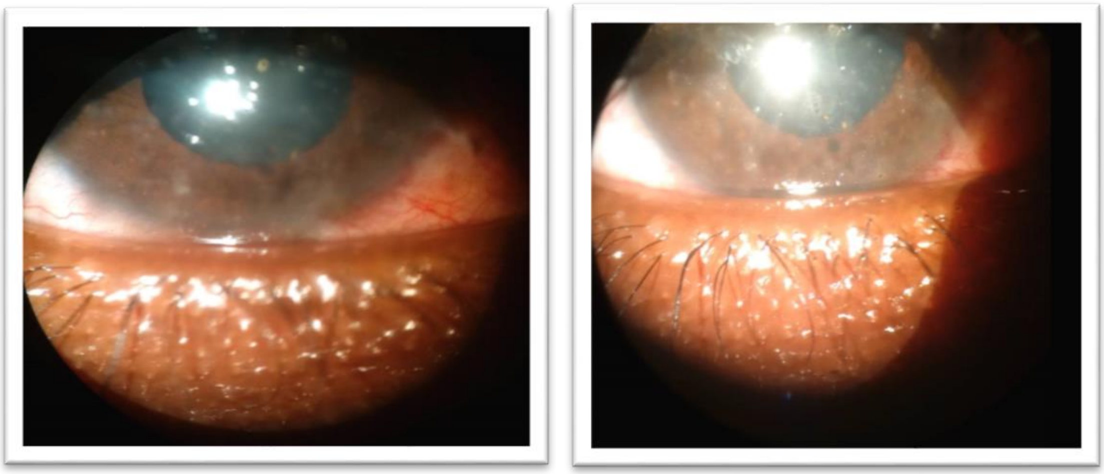

Fig.3: Slit lamp photograph of RE and LE respectively at 2 weeks post-trauma: showing fewer intra-corneal foreign bodies.

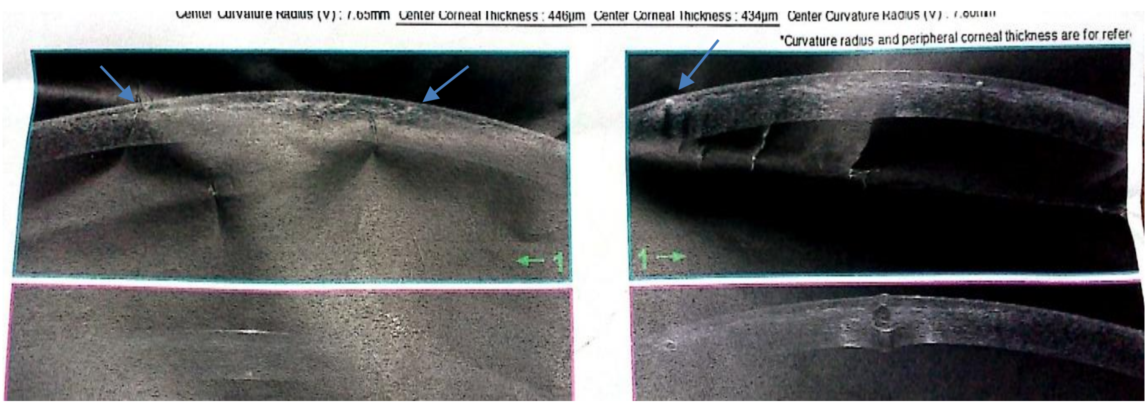

Fig.4: repeat AS-OCT of RE and LE at 2 weeks post-trauma) showing fewer Foreign bodies and position of FB

DISCUSSION

A corneal foreign body is an object that is either superficially adherent to the cornea or embedded in it. These objects include metal, glass, wood, dirt, dust, insect, plant particles and sand (as in the case presented). It accounts for approximately 35% of all eye injuries.[11] Majority of ocular foreign body require prompt removal in the clinic or theatre.[11] The incidence is higher in males usually in the second decade and generally occur in people younger than 40 years, likely due to higher occupational exposure.[8,11]

The cornea is about 540- 570µm thick and is comprised of five layers namely the Epithelium, Bowman's membrane, Stroma, Descemet's membrane and Endothelium. Corneal foreign body may be within the epithelium (superficial) or may breach the Bowman's membrane (deep).

Many foreign bodies are diverted from the surface of the eye by the rapid blinking action of the eyelids and eyelashes. They may also be washed to the inner canthus and sometimes the lacrimal ducts by a combination of blinking and tear flow. Depending on the nature of the FB, it's presence may set off an inflammatory cascade resulting in edema of the eyelids, conjunctiva and cornea, corneal infiltrates and anterior chamber reaction. Organic matter may quickly result in suppurative inflammation while materials such as glass, plastic and sand are relatively inert. The presence of a metallic foreign body in the cornea can result in a rust ring, identified as a brownish ring imprint left on the cornea from oxidation of an iron-containing FB. The common sequelae following intra-corneal foreign bodies include; corneal ulcer, perforation, scarring, rust ring formation, dry eye, endophthalmitis and loss of vision.

Slit-lamp photography affords an opportunity to obtain real time pictures of the eyes through the magnified view of a microscope and document same for record purposes and for monitoring.[9,12] Traditionally, magnified view pictures of the eyes are obtainable with high technology cameras mounted on the slit lamp, but these are relatively expensive and immobile. Several smartphones have been reported to be useful when manually adapted, to achieve relatively good views of the anterior and posterior segments of the eyes through the eyepiece of the slit-lamp bio-microscope.[9] When smartphones are used with specially designed adapters, it can allow a hands-free advantage for easy manipulation of the slit-lamp to achieve desired high quality images.[12] In the absence of special adapters, we attempted to manually adapt the investigator's regular smartphone and were successful at producing pictures of sufficient quality, which also helped in monitoring this patient on follow up. Anterior segment optical coherence tomography is another non-contact method of anterior segment imaging. In ocular trauma, AS-OCT results can be used to support diagnosis of ocular surface injuries, monitor the healing process after surgical repair and can reveal unexpected lesions that are invisible or difficult to recognize in routine slit-lamp examination.[8,10]

Three cases of retained foreign body following tyre blast injuries similar to ours have been reported in literature.[4,5,8] Rathi and colleagues[4] reported that foreign body such as sand granules can be left in the cornea, particularly if deeply embedded, as they are inert and do not cause any long term damage to the eye. Anterior segment OCT was not used in two of the cases reported[4,5]but in the latter case,[8] AS-OCT helped detect embedded metal foreign bodies in both the anterior segment and posterior segment (lens and retina), even when patient remained asymptomatic and vision was normal. In our case, AS-OCT helped to localize the sand granules within the cornea and the most superficial ones were removed. Deep foreign bodies can remain in the cornea for prolonged periods of several years and may not get extruded superficially.[4] The major consequence is the impaired vision the patient suffers, particularly where both eyes are affected. A successful corneal transplant or keratoplasty can help restore vision but the decision to undertake this treatment is influenced by its availability and affordability. In settings such as ours, the patient may need to be monitored for a prolonged period. Vision may be optimized with readily available options such as refraction, prescription of photochromic or tinted lenses to reduce the incidence of glare, and in the worst case scenario, low vision aids may be given.

CONCLUSION AND RECOMMENDATION

Corneal foreign bodies can occur following blast injuries from tyre explosion and the management may be challenging. A complete history and physical examination of the eye is important with proper illustrations. AS-OCT is quite useful in determining location and subsequent monitoring and management. Commonly, superficial corneal FBs are easy to remove but deep corneal FBs should be carefully monitored and may require a keratoplasty when severely vision disabling.

It is important to educate people about the hazards associated with handling tyres and encourage the wearing of protective eyewear when handling tyres or checking vehicle brake pads. Confinement of tyres within purpose-built cages during compression-inflation of tyres is common protective measure employed in developed countries[8] and should also be encouraged in our clime.

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