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Paediatric Eye Trauma with Foreign Bodies in Ukraine

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Abstract:

Background: Traumatic eye injuries remain a significant cause of vision loss in children. The presence of ocular foreign bodies (FB) significantly aggravates the clinical picture and consequences of eye trauma.

Material and methods: Consecutive medical records of 53 children and adolescents (55 eyes) with FB injuries, who presented to the Paediatric Ophthalmopathology Department in the Filatov Institute of Eye Diseases and Tissue Therapy between 2020 and 2025, were reviewed retrospectively. The study patients were divided into 2 groups: a corneal foreign body group (CFB Group), comprising 28 patients with corneal foreign bodies (CFBs); and an intraocular foreign body (IOFB) group, comprising 25 patients with IOFBs.

Results: The investigation showed an increase in ocular trauma caused by small FBs in younger children (first years of life), entering various corneal layers, mainly the middle layer (50.0%), which were immediately removed under general anaesthesia. The analysis of IOFBs in children showed an increased number of non-metallic FBs (59.2%) located predominantly in the anterior eye segment (63%). The cornea and lens were affected most commonly (88.5% each), and the iris was quite often affected (55.5%). Given the localisation, IOFB removal in paediatric practice was performed predominantly using the anterior approach (66.7% of cases) and also through the wound channel during primary surgical care (22.2% of cases). The transvitreal approach was relatively rare (11.1%) when IOFB was localised in the posterior segment. Simultaneous and early reconstructive interventions were performed.

Conclusion: Complex reconstructive surgeries (traumatic cataract phacoaspiration with IOL implantation, iridoplasty, pars plana vitrectomy) performed simultaneously with IOFB removal or immediately after primary care allowed not only preservation of the eye globe, but also restoration of visual acuity in 96.3% of children, among them high vision (0.3–1.0) in 14.0%.

Key words: corneal foreign bodies, intraocular foreign bodies, children, primary care, foreign body removal, intraocular foreign body removal, traumatic cataract phacoaspiration, IOL implantation, pars plana vitrectomy.

Background

Traumatic eye injuries remain a significant cause of vision loss in children [1, 2].

Ocular traumas with foreign bodies (FBs) are the most severe injuries, characterised by significant damage to multiple eye structures with major complications and consequences that require complex reconstructive surgical interventions [1, 3].

Intraocular FBs (IOFBs) account for 18%–41% of all open-globe injuries in paediatric ophthalmological practice [3–5]. The number of ocular FB incidents has increased worldwide over the past decade, especially in developing countries [5]. Furthermore, predictive models indicate a substantial rise in the incidence of IOFBs among children over the next decade [6].

The study aimed to analyse the clinical features of ocular FB injuries in children.

Material and methods

It was a single-centre cohort, retrospective study, conducted with human subjects. The Institute's Bioethics Committee approved this research. Due to its retrospective nature, no informed consent forms were obtained. The study was performed following the Declaration of Helsinki.

Consecutive medical records of 53 children and adolescents (55 eyes) with FB injuries, who presented to the Paediatric Ophthalmopathology Department in the Filatov Institute of Eye Diseases and Tissue Therapy between 2020 and 2025, were reviewed retrospectively. The mean age of patients was 7.9 ± 3.8 years (range, 3 months – 16 years). Of these, there were 35 male and 18 female patients. The study patients were divided into 2 groups: a corneal foreign body group (CFB group) — those with corneal foreign bodies (CFBs); and an IOFB group — those with IOFBs. The CFB group included 28 patients (28 eyes), aged from 3 months to 15 years (mean, 6.4 ± 3.5). The IOFB group comprised 25 patients (27 eyes) aged from 3 to 16 years (mean, 9.84 ± 3.7). Two patients had both eyes injured as a result of explosive trauma.

Personal data, including age, sex, time and circumstances of injury, and time to seek medical care and FB removal, were collected and analysed. The FB location was classified into exclusively CFB and IOFB. IOFB in the anterior (anterior chamber, iris, and lens) and posterior (vitreous, retina) segments, respectively. For CFBs, the location, depth, size, and material were recorded. For IOFBs, the entry site was differentiated as zone I (corneal and limbal wound), zone II (scleral wound up to 5 mm from the limbus), and zone III (scleral wound farther than 5 mm from the limbus). In addition, the FB location, quantity, and material, as well as FB-related complications, such as vitreous prolapse, damage to the lens and iris, hemophthalmos, retinal detachment, and endophthalmitis, were recorded.

A comprehensive medical history of the injury circumstances was obtained upon admission. Diagnostic examinations included visometry, slit-lamp examination and ophthalmoscopy, A- and B-scan, X-ray with and without the Komberg-Baltin prosthesis, and computed tomography (CT).

Data collection, systematisation, and statistical analysis were performed using STATISTICA 8.0 (StatSoft Inc.) in electronic spreadsheets. The nominal data are described in terms of absolute values and percentages. Quantitative indicators were evaluated according to the normal distribution using the Shapiro-Wilk's criterion. With a normal distribution, the data on children's ages were combined into a variation series, in which the arithmetic mean (M) and standard error of the mean (m) were calculated.

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Results

The lag time, i.e. the interval between getting injured and seeking ophthalmic care, varied significantly, ranging from 2 hours to 90 days. The mean lag time was 6.2 ± 6.7 days, indicating insufficient alertness of parents and primary care providers regarding ocular trauma in childhood, insufficient medical history taking, and difficulties in performing ophthalmic examinations in children.

Corneal foreign bodies (CFBs)

CFBs in most cases (60.7%) were non-metallic and were mainly located in the peripheral zone of the cornea (71.4%) in its middle layers (50.0%) (Tab. I). All CFBs were small, ranging from 0.8 to 2.0 mm in size. Visual acuity (VA) of all eyes was higher than 0.3, except one with central CFB localisation, the VA of which was 0.2.

All CFBs were removed in the operating room, except for two 14-year-old adolescents who underwent CFB removal using a slit lamp under local anaesthesia. The surgical procedure was performed using a sterile 30G needle by scratching using an operating microscope under general anaesthesia.

Characteristics	Number of eyes 28	Percentage %
Foreign body material		
Non-metallic (glass, plastic)	17	60.7
Metallic	7	25.0
Plant origin	4	14.3
Localisation in the cornea		
Central	8	28.6
Peripheral	20	71.4
Depth of location		
Superficial	7	25.0
Medium	14	50.0
Deep	7	25.0

Tab. I. Clinical characteristics of corneal foreign bodies in children and adolescents.

Intraocular foreign bodies (IOFBs)

The circumstances of IOFB entrance included getting injured while playing games, performing "adult" work, careless behaviour with freely available pneumatic weapons, self-made device explosions, getting injured while fishing, etc.

Table II presents data on the nature, localisation, and extent of eye structure damage, specifics of reconstructive interventions, and IOFB-related complications.

Most of the IOFBs in children and adolescents were non-metallic (59.2%), including glass (Fig. 1), bullets, stones, asbestos, plastic, copper wire, etc. Casuistic, but not uncommon (14.8%), were cases of eyelashes getting into the eye during trauma, as well as such unexpected injurious objects such as a fishing hook (Fig. 2). IOFBs ranged from 5 to 10–15 mm in size.

The anterior eye segment (63.0%), particularly zone I (59.2%), was mostly damaged. Most frequently, there was damage to the cornea (81.5%), iris (55.5%), and lens (81.5%). Iris and choroid prolapse into the wound canal (26.0%) indicated the open wound depth. Among the IOFBs, posterior pole complications were hemophthalmos (18.5%) and retinal detachment (7.4%). Despite the late seeking of help, only 3 children had clinical signs of endophthalmitis (11.5%).

Characteristics	Number of eyes 27	Percentage %
Intraocular body material		
Non-metallic	16	59.2
Metallic	7	26.0
Eyelashes	4	14.8
Localisation in the eye		
Anterior segment	17	63.0
Posterior segment	10	37.0
Intraocular body entrance		
Zone I	16	59.2
Zone II	3	11.3
Zone I-II	6	22.5
Zone III	1	3.5
Zone II-III	1	3.5
Intraocular foreign body-related damage to ocular structures and complications		
Cornea	22	81.5
Iris	15	55.5
Lens	22	81.5
Vitreous	7	26.0
Retina	6	22.2
Iris and choroid prolapse	7	26.0
Hemophthalmos	5	18.5
Retinal detachment	2	7.4
Endophthalmitis	3	11.5
Foreign body removal approach		
Anterior approach	18	66.7
Through the wound channel	6	22.2
Transvitreal approach	3	11.1
Additional reconstructive interventions		
Primary surgical care	24	88.8
Cataract phacoaspiration/ lensectomy	20	74.0
Intraocular lens implantation	8	29.6
Iridoplasty	4	14.8
Anterior Chamber lavage	2	7.4
Pars plana vitrectomy	9	33.3
Retinal laser coagulation	9	33.3

Tab. II. Clinical characteristics, treatments, and complications of intraocular foreign bodies in children and adolescents.

Fig. 1. Multiple glass fragments in the anterior chamber angle of a 13-year-old boy.

Fig. 2. Eye injury caused by a fishing hook in a 9-year-old boy.

IOFB ocular injuries in children caused a decrease in visual acuity (VA). Thus, VA was no light perception in one child; light sensitivity up to 0.09 in 20 children; 0.2 in 1 child; while 4 children exhibited a fairly high level from 0.6 to 1.0.

Predominantly (66.7%), IOFBs were removed by anterior approach through a corneal wound during primary surgical care or through additional limbal incisions after its implementation. In 22.2% of the cases, IOFB removal was performed through the wound corneo-scleral channel during the primary surgical care. IOFBs were mostly removed using microforceps, with only 2 metallic ones extracted by magnet.

When indicated, additional reconstructive surgery, particularly phacoaspiration or lensectomy of traumatic cataracts (74.0%), iridoplasty (14.8%), and IOL implantation (29.6%), was performed simultaneously or in the early stages.

Surgical interventions in some cases (16) were also performed at different post-injury time points, ranging from 1 to 457 days; the mean lag time was 48.5 ± 70 days. This delay in IOFB removal indicates an untimely diagnosis of IOFBs in childhood.

An anterior approach with a single-stage reconstructive intervention was the most frequently used approach for IOFB removal, which we present in the following case report.

Case report

A 13-year-old teenager, during "adult" work while cleaning rust with a special brush (Fig. 3), obtained a left eye penetrating injury with an IOFB. The patient was hospitalised on the third day after injury with complaints of pain, tearing, and decreased visual acuity of his left eye. Slit lamp examination revealed a 3-mm corneal wound at 3 o'clock paracentrally and a semi-transparent lens with a metal foreign body (metal wire). Fundus examination revealed a pale-pink optic disk with clear margins. Left eye uncorrected visual acuity (UCVA) was 0.6. The right eye was clinically healthy with a VA of 1.2. B-scan of the left eye revealed a high echogenicity IOFB in the lens at 4–5 o'clock. The IOFB passed through the entire lens and exited through the lens equator to the pars plana of the ciliary body (Fig. 4).

The patient was diagnosed with a penetrating corneal wound, IOFB in the lens, complicated cataract, and cyclitis in the left eye.

Surgical intervention included primary surgical care of the corneal wound, IOFB (metal wire) removal using an anterior approach and a magnet (Figs. 5, 6), unusual anterior capsulorhexis, and traumatic cataract phacoaspiration with cartridge endocapsular IOL implantation. The metal wire was successfully and atraumatically removed through the wound channel, passing the entire lens without vitreous loss. After traumatic cataract phacoaspiration, the posterior capsule in the visible zone was clear, and the IOL haptic was placed in the intact lens equator zones. The patient's VA was restored to 1.0.

Fig. 3. Steel brush for a grinding machine.

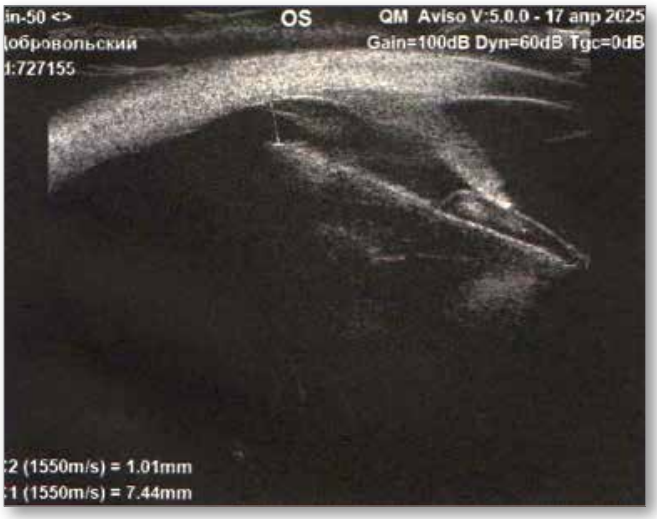

Fig. 4. Ultrasound scan of an adolescent's left eye reveals a 7.5-mm-long IOFB in the lens, with high echogenicity, approximately 0.5 mm in diameter. The IOFB ends on the pars plana of the ciliary body at a distance of 1.0 mm.

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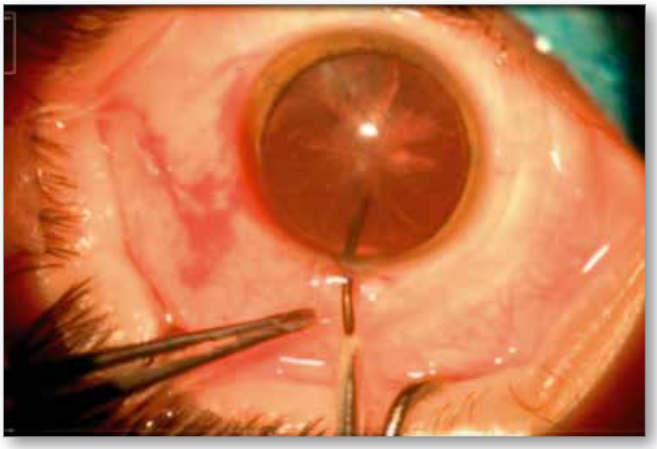

Fig. 5. In an adolescent, the IOFB, a metal wire, is removed from the lens using the tip of a permanent samarium cobalt magnet.

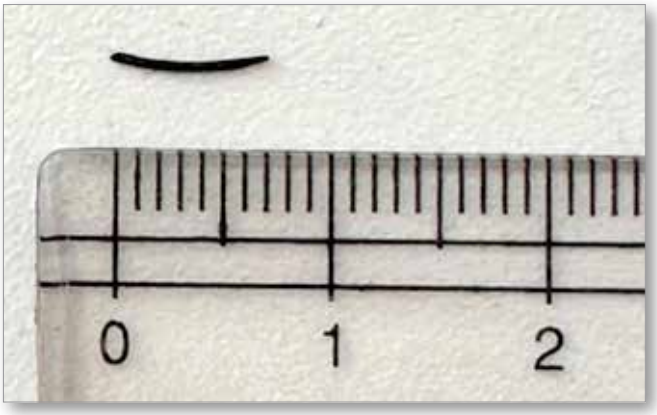

Fig. 6. The removed IOFB is an 8.0-mm piece of metal wire.

Discussion

Ocular trauma with foreign bodies, as well as paediatric ocular trauma in general, is characterised by a significantly higher proportion of boys, who are prone to dangerous games and the creation of self-made devices, which was also noted in our observations [1]. However, in the present paper, gender differences were not as pronounced (35 boys versus 18 girls).

Collecting medical history in children is not always possible. Parents often are absent when an injury occurs, and adolescents may deliberately hide the injury details. In cases where a foreign body is suspected in the eye, the first step is to detect and localise it. In cases of CFBs, examination can be performed clinically using biomicroscopy, whereas IOFB cases require imaging methods such as X-ray, CT, and A- and B-scans.

Patel et al. [7] reported that clinical examination of the eye can reveal IOFBs in 55% of adult patients, and it is clear that this proportion is much lower in children due to their behavioural characteristics. X-ray examination is required in all paediatric penetrating eye injuries and even in cases of suspicion in unclear trauma history. Bobrova [1] describes a casuistic example of unsuccessful conservative treatment, for 4.5 months, of left eye traumatic uveitis in a 6-year-old child, who underwent primary surgical treatment of the corneal wound without X-ray examination. After admission to the Paediatric Ophthalmopathology Department in the Filatov Institute with painful, developed left-eye subatrophy, X-ray revealed a massive shadow of a metallic foreign body, 22 × 2 mm in size, throughout the entire length of the left eye (Fig. 7). Enucleation of the left eye showed the presence of a 22 mm metal nail in the eye, located from the cornea to the optic nerve head with adhesion to all intraocular structures (Fig. 8).

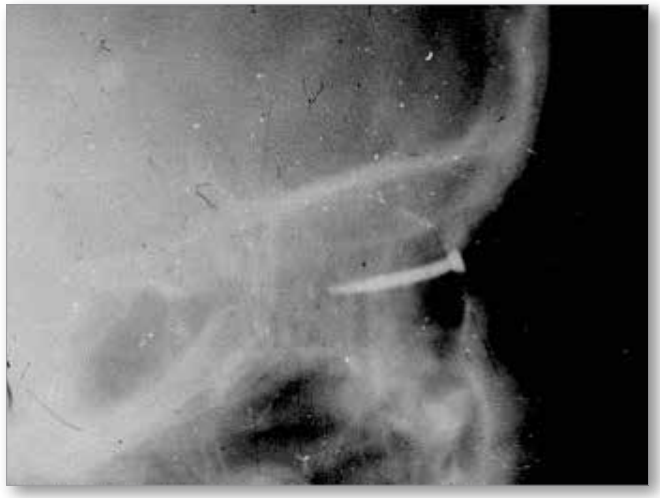

Fig. 7. X-ray of the left orbit in lateral projection. A massive shadow of a foreign body is visible, almost equal in length to the anterior-posterior size of the eyeball [1].

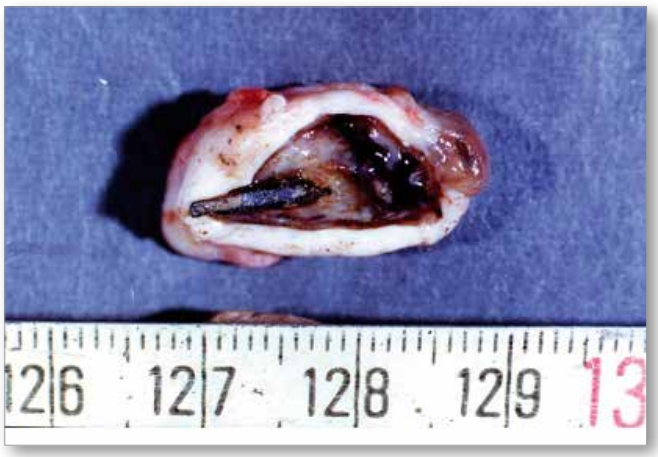

Fig. 8. Macropreparation of an enucleated eye. A nail up to 22 mm in size is visible in the cavity [1].

In recent years, spiral CT has been used more often, because its reliability for identifying IOFBs reaches 95–100% according to various authors [7–10]. Cavaillé et al. insist that a CT scan is mandatory, especially in children [8]. However, Liuet et al. [11] revealed possible inaccuracies in the localisation of IOFBs when using CT. Misleading appearance of intraocular glass foreign bodies on orbital CT has also been reported [12]. B-scan is effective for identifying foreign bodies in the anterior and posterior eye segments in 52–87.5% of patients [1, 2, 10].

Our previous studies [13] and other authors' observations [3, 14–17] have shown that the circumstances and clinical features of paediatric ocular trauma with IOFBs differ from those in adults. Thus, while adult patients are more likely to suffer injuries related to work activities and, currently, military service [18], children are more commonly injured in everyday situations like those involving fireworks or homemade explosive devices, and while playing with metal objects or tree branches. The age of patients in the CFB group ranged from 3 months to 15 years (mean, 6.42 ± 3.5 years), which correlates with literature data on the increased susceptibility of younger children to eye injuries during everyday activities or games. IOFB was observed in older children and adolescents. The mean age in the IOFB group was 9.84 ± 3.7 years, which corresponds to the mean age of the injured patients reported by Yang et al., at 10.12 ± 4.54 years old [15], and Cavaillé, at 10.3 years old [7]. This indicates a greater tendency among adolescents toward dangerous behaviour,

and, currently, injuries related to gunshot wounds and homemade explosive devices. Unfortunately, children and adolescents find instructions for creating such homemade items on social media.

Compared with previous data [1], this study showed that non-metallic foreign bodies were more frequently found in the eye (59.2%), whereas the size of the foreign bodies in children remained rather large (2.5–15.0 mm).

To restore visual acuity in our research, the IOFB removal required additional reconstructive surgery, such as traumatic cataract removal by phacoaspiration and lensectomy (74.0%) with simultaneous IOL implantation (29.6%) and iridoplasty (14.8%), anterior chamber lavage (7.4%), and pars plana vitrectomy (33.3%) with endotamponade and laser coagulation.

Conclusion

Paediatric ocular trauma involving foreign bodies is characterised by delayed primary treatment and a lack of reliable medical history. Injured eye with a foreign body in children can be challenging due to pain syndrome and the child's personality and behaviour. Various anaesthesia methods are required for biomicroscopy and ophthalmoscopy, as well as additional techniques such as X-ray and A- and B-scan, which should be performed in all cases of penetrating trauma, and even if it is suspected, in the presence of corneal scars, iris damage, traumatic cataracts, and other "incomprehensible" manifestations.

The investigation showed an increase in ocular trauma caused by small foreign bodies entering various corneal layers, mainly the middle layer, in children in their first years of life. There were also isolated cases of explosive injuries caused by homemade devices in adolescents.

The analysis of IOFBs in children showed an increased number of non-metallic foreign bodies located predominantly in the anterior eye segment. The cornea and lens were most commonly affected, and the iris was quite often affected.

IOFB removal in paediatric practice was mainly performed using the anterior approach, and somewhat less frequently through the wound channel during primary surgical care. The transvitreal approach was used relatively rarely. In general, simultaneous or early reconstructive interventions were necessary to eliminate ocular structure damage caused by IOFBs in paediatric cases.

Disclosure
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