• Letter to the Editor •

Periocular skin "tattooing" caused by gel pen pigment mistaken for periorbital bruising: a case of missed diagnosis of traumatic intraorbital pen core foreign body

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Dear Editor,

We are writing this letter to report a special missed diagnosis case of pediatric ocular trauma with intraorbital pencil core foreign body. When an eye trauma occurs, orbital foreign bodies are widespread. The most common types of foreign bodies are metal, followed by plant foreign bodies, while oil foreign bodies are rare. Owing to variations in the size and composition of orbital foreign bodies, certain patients may exhibit no apparent clinical symptoms in the initial stages, leading to potential instances of missed diagnosis and misdiagnosis[1-3]. Here, we report a case of misdiagnosis of periorbital bruising caused by the tip of a blue gel pen core. It can easily be misinterpreted as subcutaneous congestion since it causes the skin to become blue, which can result in the orbital foreign bodies being ignored. Our report for the blue gel pen orbital foreign bodies can provide some reference for the diagnosis and treatment experience.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The informed consent was obtained from her guardians.

CASE PRESENTATION

A 3-year-old female patient was admitted to the hospital presenting with periorbital bruising of the left eye persisting for over 4mo following trauma. According to the family, the child had sustained an accidental injury from a pen, resulting in a skin tear of approximately 5 mm in length at the medial 1/3 of the left eyebrow arch. The initial medical intervention at a local hospital involved wound closure without sutures, accompanied by local wound cleaning and disinfection. At that time, the light blue discoloration surrounding the wound was initially regarded as subcutaneous congestion. Following debridement two days later, the eyelid laceration had apparently healed, and the child resumed regular activities with only mild eyelid swelling and no specific complaints (Figure 1A). However, the observed "bruising" did not diminish and, in fact, slightly expanded. After a few days of monitoring, the family noticed that the "bruising" on the left eyelid persisted (Figure 1B). More than 20d post-injury, the patient sought care at another local third-class A hospital's ophthalmology department, where the condition was still attributed to subcutaneous congestion. The recommendation was for continued observation. Over two months post-injury, the child sought consultation at the ophthalmology department of a third local Class III Grade A hospital, where the diagnosis remained consistent with subcutaneous congestion, prompting a suggestion for hot compress treatment. Despite more than a month of local hot compresses, there was no improvement in the bruising. After four months, the parents noted a gradual widening and slight deepening of the periorbital "bruised" area, leading them to seek treatment at our hospital's outpatient clinic. A computed tomography (CT) scan revealed the presence of an orbital foreign body, leading to the immediate hospitalization of the patient. The infant was born at term and had a history of breastfeeding. There was no reported general medical history, and both personal and family histories were unremarkable. The patient's ophthalmic specialty examination is shown in Table 1.

Table 1 Patients with eye specialist checklist

Items	Right eye	Left eye
Uncorrected visual acuity	0.8	0.8
Corrected visual acuity	+0.75 DS=0.9	+0.50 DS=0.8
Intraocular pressure	12 mm Hg	12 mm Hg
Periorbital skin and eyelids	Normal	The skin of the left eye and the nasal side of the eyelid showed a pale blue bruise shape change, normal skin temperature, pain, no pressure, and the eyelids were open/nearly normal (Figures 2A, 2B)
Cornea	Transparent	Transparent
Anterior chamber	Medium	Medium
Aqueous humor flash	(-)	(-)
Iris texture	Clear	Clear
Pupil	Round, 3 mm in diameter	Round, 3 mm in diameter
Direct and indirect light reflex	Present	Present
Lens	Transparent	Transparent
Vitreous	Transparent	Transparent
Fundus	Retinal flat under small pupil	Retinal flat under small pupil

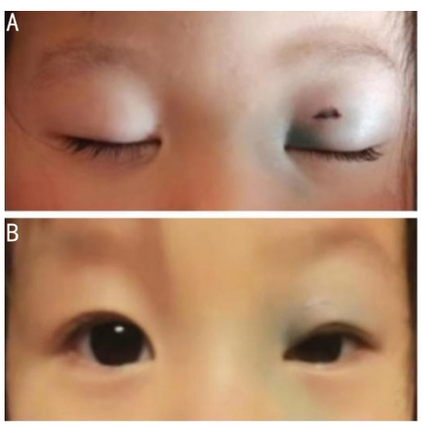

Figure 1 Photos after injury in children A: 2d after injury, the upper eyelid skin wound is scabby, left eye week is blue; B: 1wk after injury, the left eye visible upper eyelid skin scar dice, slightly swollen eyelids, peri-orbit "bruised" did not fade.

Orbital CT (horizontal+coronal) showed (Figure 2C, 2D): a fusiform high-density shadow with a size of about 1.1×0.8 cm and a CT value of about 2840 HU was seen in the medial rectus muscle of the left eye, and a few metal radial artifacts were seen around it. Clinical diagnosis: left orbital foreign body (old).

A definitive history of trauma was evident, accompanied by a visible surface wound subsequent to the injury. However, an orbital CT examination was not conducted immediately post-injury. Prolonged persistence of a blue hue in the skin around the wound, coupled with a deepening of color and an expansion in scope over time, raised suspicions of a potential overlooked diagnosis of an orbital foreign body. To substantiate this suspicion, an orbital CT examination was performed, conclusively confirming the clinical diagnosis of an old left orbital foreign body.

Preoperative antibiotics were administered to forestall infection. Under general anesthesia, the removal of the left orbital foreign body was executed through the superior fornix conjunctival approach. The intraoperative extraction unveiled a roughly 2 cm ballpoint pen tip (Figure 3A), distinguished by wet blue ink (Figure 3B) that permeated the surrounding

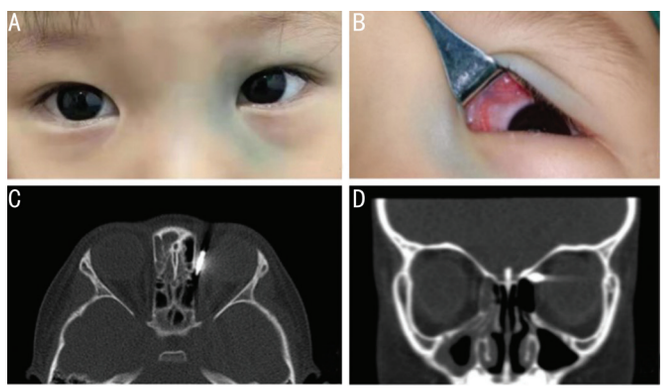

Figure 2 Children with preoperative check the photos A: Appearance in addition to the upper eyelid and inner canthus of peri-orbit skin cyan without other symptoms; B: The eyelid retractor opened the upper eyelid, and the blue conjunctiva was seen in the fornix region above the nose. C: Orbital CT scan preoperatively, left eye close orbital wall is seen here in a rod-shaped high-density shadow, visible around the metal radial artifacts; D: Preoperative orbital CT coronal scan, oval high-density shadow was seen above the medial rectus muscle at the equator of the eyeball. CT: Computed tomography.

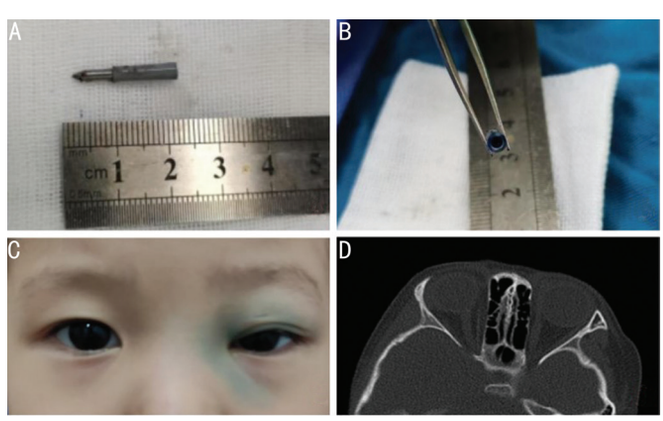

Figure 3 Intraoperative and postoperative pictures A: Intraoperative remove foreign bodies to neutral pen lead head end, measuring length is 22 mm; B: Wet blue ink cartridge inside is still visible; C: Appearance photo 1d after operation, the left eyelid was slightly swollen, and the range of periorbital "bruising" was the same as that before operation; D: Postoperative orbital CT showed no foreign body in the orbit. CT: Computed tomography.

tissue. Despite multiple irrigations with copious amounts of normal saline and iodophor during the procedure, the blue discoloration proved resistant to elimination through washing. Post-surgery, the child's appearance remained unchanged one day later (Figure 3C), and a follow-up CT scan (Figure 3D) confirmed the successful removal of the orbital foreign body. The child has been followed up for two years, and has received local pulsed laser treatment for several times in the cosmetologically department within two years. Now the blue marks are slightly lighter and the size range is basically the same as that at the first visit.

DISCUSSION

Foreign bodies can be divided into metal foreign bodies and non-metallic foreign bodies according to types, the latter can be divided into irritating foreign bodies and non-irritating foreign bodies[3]. Irritating foreign bodies are substances with unstable physical and chemical properties, such as plant bodies, gunpowder, oils and waxes, *etc*. which can cause serious tissue reactions or infection and inflammation[3]. Non-irritating foreign bodies, such as glass, gravel, and plastic, do not cause serious complications other than mechanical damage[3-5]. The tip of the pen refill can be roughly divided into three types of substances, the tip metal is made of copper alloy or stainless steel, the shell is made of plastic material, the internal ink is the pigment of Waterlow carbon alcohol suspension and a variety of additives. The properties of the tip metal and the shell plastic are relatively stable for tissue tolerance foreign bodies, that is, inert foreign bodies[6]. The nature of neutral pen ink is between water-based pen and oil-based pen, and its main component is pigment ink. Water-based inks mainly use organic dyes to color. In addition to being 60%-80% water, gel inks contain special pigments (usually copper phthalocyanine for blue inks) as well as resins, solvents (such as ethylene glycol), non-ionic surfactants, and additives that give gel inks their unique properties[7]. The foreign body remained in the child for 4mo, except for the local subcutaneous tissue staining cyan and other asymptomatic, it can be judged that the neutral pen ink is a non-irritating foreign body. Therefore, it misled many ophthalmologists who received follow-up treatment. After 1mo of follow-up observation, the cyan range of periorbital skin was equal. There was no significant change in color depth. Whether the neutral pen dye is eventually metabolized by the body and the skin stain gradually fades, it still needs to continue long-term observation and follow-up of patients.

The judgment of orbital foreign body should be considered from various aspects[3]. Orbital foreign body is usually associated with high-speed trauma, and the specific process of injury should be carefully questioned[8], and the integrity of the injury object must be confirmed with the scene witness. When receiving patients, careful observation of clinical symptoms is very important. First, in appearance[2], obvious or hidden scars can be left on the eyelid or periorbital skin after injury, such as subcutaneous bruising, eyelid swelling, and exophthalmos. Because of the small wound and mild appearance symptoms, the possibility of foreign body entry into the orbit should not be ignored. Second, the visual acuity is often affected after injury[9]. Orbital foreign body accompanied by optic nerve injury or eyeball rupture injury, trauma, penetrating injury, and intraocular foreign body can almost cause different degrees of visual impairment. Trauma is often accompanied by eye movement disorders[10], which are limited in eye movement (strabismus, diplopia) and eyelid opening and closing (ptosis) due to foreign body stimulation, scar formation, foreign body injury, extraocular muscles, levator muscle or nerve tissue. Finally, patients often feel uncomfortable[3]. When the foreign body is located in the orbit, some patients may feel resistance during eye movement. The inflammatory response to an active foreign body can produce pain and irritation.

For ocular trauma caused by foreign bodies, regardless of the size of the wound, whether bleeding has stopped or initial healing, orbital foreign bodies should be excluded in all orbital trauma[1-2]. Early and timely diagnosis, accurate localization and targeted treatment are the keys to the prognosis of orbital foreign body[3,9,11]. The most common examination method is orbital CT[4,10,12]. As early as 1977, Kollarits *et al*[13] first used CT to detect intraorbital foreign bodies. Conventional thin layer axial scanning and coronal and sagittal image reconstruction should be used for CT examination. Considering orbital craniomaxillofacial fractures, three-dimensional bone window imaging should be performed. Orbital CT allows the doctor to fully and clearly grasp the relationship between ocular foreign bodies and related structures such as extraocular muscle, ocular wall, and optic nerve. It is recommended that the radiographers and receiving physicians should be careful when reading the radiographs. It is recommended to read the radiographs continuously by computer rather than by intermittent film. If the presence of metal foreign bodies is ruled out by orbital CT examination, the presence of low-density shadows like bubbles in the orbit or intracranial, and the presence of low-density foreign bodies or vegetative foreign bodies is suspected, the orbital and craniocerebral MRI examination can be performed[14-15].

This case has certain reference significance for our future treatment of children with ocular trauma. First, pen pigment can be released slowly and stay under the skin, showing as "bruising". If it does not disappear for a long time after trauma, the possibility of foreign body should be considered. Second, children with orbital foreign body injury must find all foreign bodies completely. If foreign bodies are missing, they must

be highly suspected of having intraorbital foreign bodies. Finally, for ocular foreign body injuries, no matter the size of the wound, whether the bleeding has stopped or the wound has healed initially, routine imaging examination is required to rule out foreign bodies.

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