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# Chinese Journal of Traumatology

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## Original article

# Clinical diagnosis and treatment of intraorbital wooden foreign bodies

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## ARTICLE INFO

### Article history:

Received 23 March 2016

Accepted 14 April 2016

Available online 10 November 2016

### Keywords:

Eye injuries

Wooden foreign bodies

Computed tomography

Magnetic resonance imaging

## ABSTRACT

**Purpose:** The intraorbital wooden foreign body is often misdiagnosed or missed on computed tomography (CT) scan, due to the invisible or unclear images. The residual foreign bodies often occur during surgical removal. The clinical manifestations, imaging features and treatment of intraorbital wooden foreign bodies were discussed in this study.

**Method:** We retrospectively analyzed 14 cases of intraorbital wooden foreign bodies managed at our hospital between January 2007 and May 2015. All patients underwent orbital CT examination before surgery, and surgery was performed under general anesthesia with orbital wound debridement and suture, as well as exploration and removal of wooden foreign bodies.

**Results:** At first, 11 cases underwent removal of foreign bodies, including 1 case with incomplete removal and then receiving a secondary surgery. Foreign bodies were not found in three cases with preoperative misdiagnosis and orbital MRI found residual foreign bodies in the orbit. Operations were performed via primary wound approach in eight cases, conjunctival approach in two cases, and anterior orbitotomy in four cases. Postoperatively, one case was complicated with eye injuries, three cases with ocular muscle injuries, eight cases with visual loss, and eight cases with orbital abscess. The length of foreign bodies ranged from 1.8 cm to 11.0 cm. The maximum of four foreign bodies were removed at the same time.

**Conclusion:** Because the imaging of orbital wooden foreign bodies is complex and varied, MRI should be combined when they are invisible on CT scan. At the same time injuries trajectory and clinical manifestations of patients should be taken into account. Surgical exploration should be extensive and thorough, and foreign bodies and orbital abscess must be cleared.

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## Introduction

Eye injuries are often associated with orbital foreign bodies, which are metallic (magnetic, non-magnetic) and non-metallic (plants, plastics, glass, etc). Computed tomography (CT) scan is most commonly used in orbital trauma, and the metallic foreign bodies, even those with the length of merely 2 mm, can be easily detected on CT images, as they usually exhibit high density.<sup>1,2</sup> Misdiagnosis or missed diagnosis rarely appears, nor does orbital infection, because in orbit metallic foreign bodies are often easy to be wrapped within the orbital tissue. And small metallic foreign bodies or those located at the orbital apex, if there is no intraorbital

infection or incarceration in the optic nerve, often do not need to remove, as surgery itself may cause orbital bleeding, optic nerve injuries and other serious complications. Wooden foreign bodies present low density or even are invisible on CT scan. The quantity and composition of foreign bodies are very difficult to identify, and the CT images of wooden foreign bodies will vary with time, which often leads to misdiagnosis or missed diagnosis.<sup>3–5</sup> Wooden foreign bodies due to the pore on their surface and the characteristics of organic matter, are a great bacterial growth medium, and if not promptly removed, they may lead to infection.<sup>6,7</sup> In addition, the wooden foreign bodies are fragile and difficult to remove completely; thus the procedure is much more difficult compared with metal foreign bodies. Diagnosis and treatment of wooden foreign bodies are rarely reported. In this study, we analyzed 14 cases of orbital foreign bodies managed at our hospital between January 2007 and May 2015, and summarized the clinical manifestations, imaging features and treatment of orbital foreign bodies.

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Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

## Materials and methods

### General data

All 14 cases were unilateral, including 8 in the left orbit and 6 in the right orbit. There were 11 males and 3 females with the age ranging from 2 to 65 years (average, 36 years). Among them, 5 patients (36%) were under 14 years, 6 patients (43%) 40–60 years, and 3 (21%) above 60 years.

### Injury causes and types

The main causes of trauma were sticks (2 cases), bamboos (3 cases), twigs (4 cases), wood bricks (4 cases) and corn stalks (1 case, Fig. 1). The types of injury included slip injury (6 cases), bounce injury (4 cases), and penetrating injury (4 cases).

### Time of injury

The interval between injury and surgery was less than 7 days in 9 cases, 15–25 days in 2, above 50 days in 3, ranging from 3 h to 8 months.

### Clinical manifestations

Among 14 cases, 1 case presented with ocular rupture, 1 lachrymal sac injury, 6 decreased visual acuity, 5 proptosis, 6 limited eyeball movement, 2 ptosis, 3 lower eyelid ectropion, 10 increased intraorbital pressure and 11 eyelid swelling. In eye examination, foreign bodies can be found in 4 cases, skin wound in 11 and conjunctival wound in 3.

### Imageology

#### CT scan

CT scan was performed in all cases, and orbital foreign bodies were suggested in six cases. On CT images, two cases had high-density strip, two low-density strip, one irregularity, one multiple high density spots, one soft tissue shadow with uneven density and one low-density area with a density equivalent to that of air (Fig. 2).

#### MRI

Three cases were examined by magnetic resonance imaging (MRI): one case gave long T<sub>1</sub> mixed with T<sub>2</sub> mass single, and high density in medial rectus, one appeared with long T<sub>1</sub> and short T<sub>2</sub> single as pneumatosis image, and one showed normal (Fig. 3).

## Results

All the patients underwent CT examination before operation, and six cases were preoperatively diagnosed with orbital foreign bodies. All the cases underwent probing and debridement, and at first 11 cases received removal of foreign bodies, including 1 case with foreign bodies incompletely removed and receiving a secondary surgery. Foreign bodies were not found in the remaining three cases with preoperative misdiagnosis and then orbital MRI found residual foreign bodies in the orbit. Operations were performed in eight cases via primary wound approach, two conjunctival approach, and four anterior orbitotomy. In 14 cases, 1 case was complicated with eye injuries, 3 ocular muscle injuries, 8 visual loss and 8 orbital abscess. The length of foreign bodies ranged from 1.8 cm to 11.0 cm, and the maximum foreign bodies in eyes was up to 4 pieces which were removed at the same time.

## Discussion

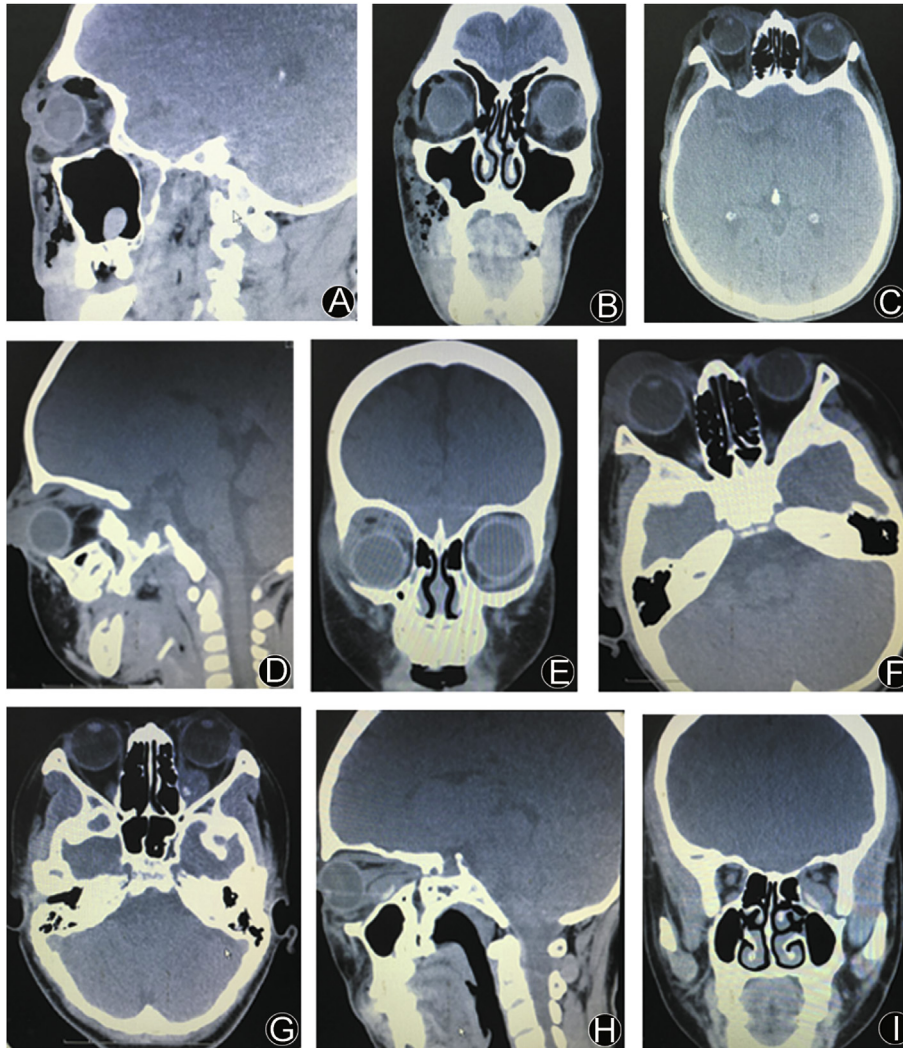
Orbital foreign bodies are common in falls (including riding), which penetrate into the orbital or facial area, and lead to foreign bodies remained. They are also can be found in bounce injury or puncture injury while people are working or playing. The foreign bodies are usually tree branches, chopsticks, corn stalks, bamboos and wood. In our study, children and young adults are more likely to get injured, while older people account for a small proportion. That is because children may easily fall down while playing, and young adults often do woodworking.

Some of our patients suffered eyelid laceration, and a few had conjunctival laceration. The surface of wooden foreign bodies is rough, as well as bacteria and parasites can easily attach to them. If foreign bodies penetrate into the orbit or remain and are not removed timely, acute inflammatory reaction will occur.<sup>8</sup> Wooden foreign bodies will be calcified and organized, and inflammatory granuloma can grow in the surrounding. In addition, wooden foreign bodies are fragile, which may get fractured and broken in the orbit during injury, resulting in incomplete removal or misdiagnosis. The foreign bodies are not found in the wound, that is one of the reasons for the misdiagnosis. In 12 cases with foreign bodies fracture in orbit, 1 case underwent incomplete removal, a secondary surgery was performed to remove the remaining three pieces of foreign bodies and finally the patient got postoperative orbital infection.

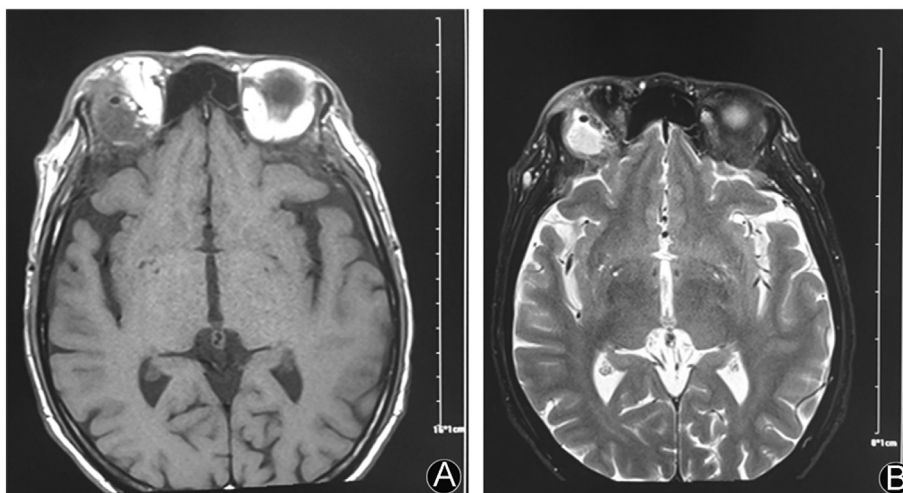
In most cases, the foreign bodies are metal, plastic, or glass, which can be easily detected by ordinary X-rays. However, wooden foreign bodies are uncommon and are difficult to be found in ordinary X-ray images; therefore their diagnosis is often missed or delayed. A CT scan is usually performed in cases where foreign bodies are suspected. But it is well known that a wooden foreign



**Fig. 1.** A: Wooden sticks in the orbit; B: Swelling in the right upper eyelid without skin wound; C: Swelling in the left upper eyelid with skin wound; D: Foreign bodies moved intraoperatively.



**Fig. 2.** Multiple intraocular foreign bodies (A–C). CT scan showing the strip low-density shadow in the lateral orbit, multiple small flake low-density shadow around foreign bodies, compressed globe and surrounding soft tissue swelling. A low-density shadow seen outside muscle cone of the upper orbit, closely correlated with superior rectus muscle (A: sagittal plane, B: coronal plane, C: transverse). CT images showing the foreign body with a length of 3.2 cm in the upper orbit and low-density strip shadow, around which the inflammatory liquid leaked. Superior rectus muscle not shown clearly (D: sagittal plane, E: coronal plane, F: transverse). CT scan showing the lesion in muscle cone behind left eyeball with uneven density (G: transverse, H: sagittal plane, I: coronal plane).



**Fig. 3.** The foreign body outside muscle cone of the upper orbit, with long T<sub>1</sub> and T<sub>2</sub> signals and the size about 0.4 × 0.3 cm, around which there was the abscess showing the flake long T<sub>1</sub> and T<sub>2</sub> signals. Right superior rectus muscle moved down by compression (A: T<sub>1</sub>W<sub>1</sub>, B: T<sub>2</sub>W<sub>1</sub>).

body initially appears with low-density signal on CT scan, which mimics air bubbles.<sup>9–11</sup> However the application of MRI in open injury is controversial, and we cannot completely exclude the possibility of metal foreign bodies. Despite the CT combined with MRI examination, the preoperative diagnosis rate of wooden foreign bodies is still low.<sup>12,13</sup> Our data show only six cases diagnosed as orbital foreign bodies by CT scan within a week post injury, including three cases with a clear history of foreign body injuries (two cases by chopsticks and one case by corn stalks). The other three cases were injured more than 20 days, and one of them was injured up to 8 months. This suggests that the diagnosis rate of wooden foreign bodies is associated with time of injury. The density of intraorbital wooden foreign bodies may vary with time.

In our cases, nine patients were injured in a week, three of whom appeared with a very low density on CT scan, and four had invisible images, just like the images of orbital pneumatosis. Wooden foreign bodies are difficult to distinguish from air bubbles by density on images, but easy by shape. The “air” like images of wooden foreign bodies are irregular or specific, and orbital pneumatosis has no such performance. Two patients were admitted three weeks after injury, because for a long time acute inflammatory reaction around the wooden foreign body makes the surrounding soft tissue thicken and edema. The CT images presented low density, around which there was a moderate density wrapped by inflammatory soft tissue. With the surrounding fat density increased, the boundary is not clear and it is easier to diagnose. There were three cases with the injury time more than one month, and the skin wound healed; manifest as orbital cellulites, and patients may ignore the history of trauma, that would cause deviation to our diagnosis; thus patients' history is very important. In these patients the foreign body in CT presented a rod like high-density shadow, which may be related to the calcium salt deposition after the foreign body inflammatory reaction, making the low-density shadow manifest as high-density shadow. Wrapped around by medium-density soft tissue shadow, its boundary is relatively clear, and inflammatory granuloma was formed.

Once the diagnosis of orbital wooden foreign bodies is definite, they should be timely treated.<sup>14</sup> It is better to chose the original wound approach based on the principle of safety, less injury and near the wound. There are eight cases via the primary wound approach directly. In the late stage of two cases, fistula tracts were formed, and the surgery was performed not only to remove foreign bodies through the stoma incision, but also to remove fistula. If the wound has closed completely, the surgical approach will be chosen according to the injured area, foreign body size and location. There was one case via the fornix conjunctival approach, one case via

eyebrow approach and one case via the lower eyelid skin approach. Wooden foreign body in orbit is fragile. In order to avoid wooden foreign bodies remained, surgeons should completely remove them, and use antibiotics to repeatedly rinse orbit cavity when removing the foreign bodies. The wooden foreign body broke into multiple pieces in one case due to an overtime remain. We removed a total of 18 pieces, after thoroughly remove the foreign bodies, necrotic tissue and scar tissue, and place a drainage strip at the end of the operation. Moreover, intraoperative orbital secretion culture must be made, and sensitive drugs must be chosen according to the antimicrobial susceptibility.

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