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Original Communication

The CT characteristics of orbital blowout fracture and its medicolegal expertise

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Abstract

To explore the CT characteristics of orbital blowout fracture, we reviewed 76 cases with orbital blowout fracture and analyzed their clinical forensic characteristics. The missed diagnosis rate of cranial CT was 26.3%, and plain X-ray was 47.4%. The orbital CT examination has advantages in diagnosing orbital blowout fracture. In 42 cases fractures were simple medial orbital wall fracture, 30 cases were inferior orbital fractures. Loss of clinical signs included local haematoma, bone continuity, and displacement of bone fragments were mostly seen in CT image. Clinical signs and symptoms included local haematoma, whilst diplopia as the most common clinical symptom. Visual acuity was rarely affected after fracture. It is concluded that orbital blowout fracture may be misdiagnosed if only cranial CT and plain X-ray are used. Diagnose the orbital blowout fracture only by craniocerebral CT and head X-ray. Orbital CT should be done if the clinical signs are suggestive of orbital blowout fracture Visual acuity was affected and diplopia may be present.

Keywords: Orbital blowout fracture; CT; Diplopia; Clinical forensic medicine

1. Introduction

Orbital blowout fracture refers to the fracture of orbital wall without damage to orbital margin resulting from external force on the eye.[1] The rate of missed diagnosis of this kind of fracture is high. In Liu Jun's study 42.6% of fractures were missed.[2] This study reviews retrospectivley 76 case of orbital fracture emphasising the problems of diagnosis and medicolegal appraisal.

2. Methods

The materials of orbital blowout fracture are based on forensic appraisal cases of living body from this department, the Beilin branch and the Chang'an branch of public security bureau of Xi'an city from 1992 to 2004. The total cases amount to 76. All the materials of medical history and identification data were classified and counted according to age, sex, the object that caused injury and the type of trauma. Moreover, they were further analyzed and arranged in order.

3. Results

1. *General status*: Male:n = 63, female:n = 13; ages range from 18 to 62y, mean–35y; occupation: agricultural worker [???]: 28, worker: 23, student: 12, other: 13 cases. Injuries were sustained to the left eye – $n = 52$ and the right – $n = 24$.
2. *Cause of injury*: Injury by fist and foot: 59 cases, by brick and stone: 10 cases, by cudgel: 7 cases.
3. *Image examination*: A total of 76 cases all received CT examination on the head and eye. Of 57 cases, which had immediate head CT after the injury, 42 cases were

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reported to suffer from the fracture of orbital wall; of 19 cases, which had plain skull X-ray examination after the injury, 10 cases were reported to have the fracture of orbital wall; of 19 cases, which first had X-ray examination and then received orbital CT examination, 19 cases were reported to get the fracture of orbital wall.

4. *Sites of fracture*: There were 42 cases (55.2%), which had medial orbital wall fracture, 30 cases (39.5%), which had inferior orbital inferior wall fracture, 3 cases (4.0%), which had lateral wall fracture, and 1 case (1.3%), which had orbital superior wall fracture.
5. *Clinical manifestation*: Discoloration around the eye, decreased visual acuity and diplopia are the main clinical symptoms (see Table 1).
6. *Visual acuity changes*: Table 2 shows the eyesight condition of injured eyes after orbital blowout fracture.
7. *CT characteristics*: The direct CT image mostly displayed the breaking off of bone substance continuity of orbital wall, displacement of bone fragments and abnormal curvature of orbital wall. Additionally the indirect signs included haematoma at the site of fracture, ocular muscle thickening and intraorbital (see Figs. 1 and 2). The details are seen in Table 3.
8. *Results of medicolegal investigation*: The results of clinical medicolegal investigation for all 76 cases of orbital blowout fracture are shown in Table 4, according to the Human Slight Injury Identification Standard (PR China) and Human Severe Injury Identification Standard (PR China).

4. Discussion

1. The orbit contains or is bounded by the orbital superior wall, orbital medial wall, orbital lateral wall, orbital inferior wall, optic canal, optic foramen and orbital margin. The orbital margin is composed of frontal bone, zygomatic bone and maxillary bone, and is more solid than orbital wall. Therefore, when the globe sustains external force, fracture of orbital wall will frequently occur, but the orbital margin remains intact. The orbital superior wall is made up of the frontal bone and the lesser wing of sphenoid bone. The lesser wing of the sphenoid bone is about 3 mm thick, so the orbital superior wall easily fractures easily. If a fracture occurs of the orbital inferior wall, the orbital cavity becomes larger, the orbital contents descend. As a result, diplopia and endophthalmos arise. When the orbital medial wall gets fracture, diplopia tends to occur. Orbital lateral wall consists of orbital process of zygomatic bone and orbital surface of the greater wing of the sphenoid bone. Fracture of the orbital lateral wall usually leads to backward, downward and outward displacement of the zygomatic bone. Consequently, the orbital cavity enlarges and diplopia develops. In addition, if the fracture is near the superior orbital fissure, the oculomotor nerve may be injured, which will bring about external ophthalmoplegia and possible diplopia.[3] Data from this study show that the fracture of the orbital medial wall and inferior wall accounted for the majority (55.2% and 39.5%, respectively). Fracture of orbital lateral wall and superior wall was only, respectively (4.0% and 1.3%), which was basically same with literature reports. The cause of fracture bears relation to weakness of bone substance of orbital medial wall and inferior wall in anatomy, which have poor ability to bear external force.
2. The mechanism of orbital blowout fracture is still not clear. Generally one Hydraulic pressure transfer action is one possible mechanism. That is, when the outside force acts on the orbit, it transmits through orbital content making intraorbital pressure rise sharply. As a result, the weak place of orbital wall gets fracture. A further possibility is that of orbital wall flexion. Namely, it is believed that the external force acting on orbital margin causes the whole orbital wall to have transient deformation, resulting fracture. The authors of this study consider that orbital blowout fracture may involve both mechanisms. Because of special anatomical structure of pyramid with four sides of the orbit and particularity of the content, as external force acted on the orbit, there would be a steep rise in the intra-ocular pressure; simultaneously the orbital wall underwent a transient deformation due to the effect of external force. This leads to the fracture of thin orbital wall. It was demonstrated and proved the cases under study that fracture lines in the fracture of the orbital medial wall shifted inwards (Fig. 1). Additionally the case of the orbital wall fracture by contrecoup effect reported in the literature was not seen in this group.[5]
3. Orbital CT is examination means of first choice to diagnose orbital wall fracture. The accuracy of CT is much higher than that of X-ray. In this group 19 cases had X-ray examination after the injury, and only 10 of them

Table 1
Clinical manifestation of orbital blowout fracture

Clinical manifestation	Number of cases (%)
Periocular petechia and reduced visual acuity	76 (100%)
Reduced visual acuity	28 (36.8%)
Diplopia	17 (22.3%)
Abnormal eye movement	9 (11.8%)
Exophthalmos	2 (2.6%)
Depression of eyeball	5 (6.6%)
Injury of optic nerve	6 (7.9%)

Table 2
Vision diminution of injured eye after orbital blowout fracture

Eyesight after injury	Number of cases (%)
0.8	48 (63.2%)
0.7	12 (15.8%)
0.6	7 (9.2%)
0.5	4 (5.3%)
0.4	4 (5.3%)
0.3	1 (1.3%)