Radiology of acute skull and facial injuries

Introduction

Facial trauma is frequently seen in day-to-day practice as a casualty doctor, often resulting from road traffic accidents, sporting injuries and assaults.

The use of skull X-rays has diminished markedly in recent years with non-contrast computed tomography now the first-line investigation for significant head injury. It is useful to have a working understanding of the National Institute for Health and Clinical Excellence (2007) guidelines on head trauma. There are still many situations when skull and facial X-rays are indicated and therefore a symptomatic approach to interpreting these is imperative.

This article discusses the fundamental anatomy required for image interpretation, basic imaging methods, and also common fracture patterns.

Anatomy

The bones of the skull and face make up the most complex area of skeleton within the body. A thorough understanding of the bones and their associated sutures is imperative for the correct interpretation of plain X-rays. There are several separate bones, which are united by fibrous sutures (*Figures 1* and *2*).

Figure 1. Lateral radiograph of a child's skull demonstrating the coronal (blue arrows), squamosal (black arrow) and lambdoid sutures (white arrow).

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Radiological assessment and classical signs

Basic assessment and classical signs

For the skull two views are used in standard practice. A lateral view is taken with the patient supine using a horizontal X-ray beam. One further view is then taken, either Towne's view for trauma to the occipital bone, or an anteroposterior frontal view for any other type of injury.

Systematic approach for examining skull X-rays

Adequacy

Check that both views demonstrate all the anatomical features required and that there is sufficient penetration.

Alignment and bones

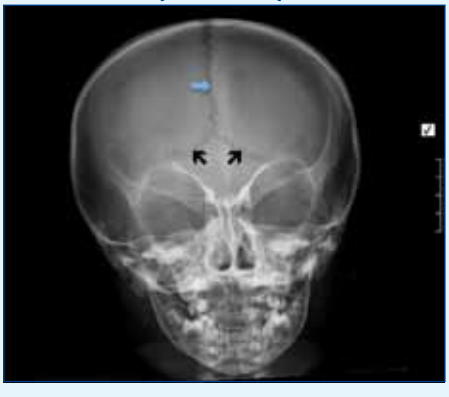
Assess all bony details focusing specifically at the site of injury. Look specifically for:

- Linear fractures. Vascular markings can make interpretation difficult. Straight black lines are more indicative of fractures, while irregular branch lines are likely to be vascular in origin (*Figure 3*)
- Depressed fractures
- Fluid levels within the sphenoid sinus
- Intracranial air. This is a rare finding but should not be missed.

Soft tissue swelling or haematoma

This often indicates the site of injury.

Figure 2. Anteroposterior radiograph of a child's skull demonstrating the sagittal (blue arrow) and lambdoid sutures (black arrows).



Basic imaging of the facial bones

To image the mandible use an orthopantomogram. This is a panoramic view of the mandible. To image the midface and orbits requires two views: the occipitomental view and the occipitomental 30° view.

Systematic approach to interpreting facial X-rays

Adequacy

Check that both views have demonstrated all the anatomical features required, and that the penetration is adequate.

Alignment

McGrigor and Campbell (1950) described three lines which help in the interpretation of the occipitomental view. They provide a systematic method of assessing the complex anatomy of the facial bones. The injured site is compared with the uninjured side, by tracing along each line separately, comparing the sides for symmetry (*Figure 4*).

Figure 3. Anteroposterior radiograph of a child's skull demonstrating a skull fracture. Note the straight black line (arrows).

Figure 4. Occipitomental view demonstrating the three McGrigor lines.

Bones
Facial fractures are often difficult to identify so look for indicators of injury such as fluid levels within the sinuses and abnormal soft tissue swelling. Facial bones have common fracture patterns. An understanding of these helps with image interpretation.

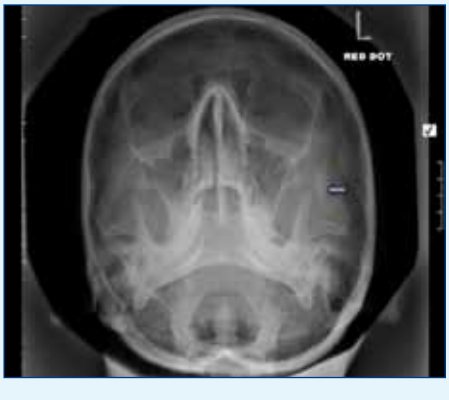
Common facial fractures

Zygomaticomaxillary complex, i.e. tripod fracture
This is the most common mid-face fracture (*Figure 5*), involving three separate fractures which disrupt the major attachments of the zygoma to the face. A tripod fracture will generally disturb all three lines of McGrigor.

Isolated fracture of the zygomatic arch
The patient presents with flatness of the lateral cheek area and often an inability to open his/her mouth, as a result of impingement of the fracture fragment on the coronoid process of the mandible (*Figure 6*).

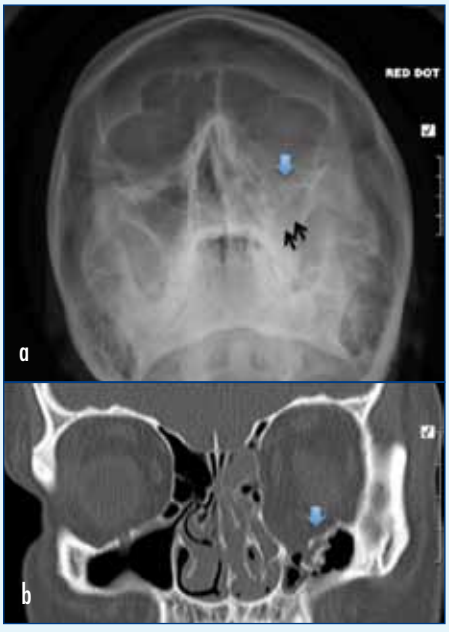
Figure 5. Occipitomental view demonstrating a tripod fracture. 1. Fracture through the body of the zygoma (black arrow). 2. Widening of the zygomatico-frontal suture (white arrow). 3. Fracture of the zygomatic arch (blue arrow).

Figure 6. Occipitomental view demonstrating a fracture of the zygomatic arch (blue arrow).



Orbital blow-out fracture
Look carefully at the orbits, as 60–70% of all facial fractures involve the orbit in some way (*Figures 7a* and *b*). Patients often present with either enophthalmos or diplopia. The usual mechanism is a direct blow to the eye. Forces transmit through the soft tissues of the eye into the orbit causing fractures at the path of least resistance. This is usually through the roof of the maxillary sinus or the medial orbital wall or lateral wall of the ethmoid sinus.

Figure 7. a. Occipitomental X-ray demonstrating an orbital blow-out fracture through the floor of the orbit (blue arrow) and fluid within the left maxillary sinus (black arrows). b. Coronal computed tomography slice demonstrating an orbital blow-out fracture. Note the fracture through the floor of the orbit (blue arrow).



Mandible fractures
The mandible is a bone which is covered by the 'ring bone rule'. Therefore if one fracture is seen, always look for a second (*Figure 8*). Careful evaluation of the body, angle and condyle of the mandible is especially important, as these account for between 70 and 90% of all mandible fractures. BJHM

Conflict of interest: none.

McGrigor DB, Campbell W (1950) The radiology of war injuries. Part VI. Wounds of the face and jaw. *Br J Radiol* **23**: 685–96

National Institute for Health and Clinical Excellence (2007) *Head injury: triage, assessment, investigation and early management of head injury in infants, children and adults.* National Institute for Health and Clinical Excellence, London

Further reading

Raby N, Berman L, de Lacey G (2005) *Accident and Emergency Radiology: A survival guide.* 2nd edn. Elsevier Saunders, Philadelphia, PA

KEY POINTS

- Look for secondary signs of injury including fluid levels and soft tissue swelling.
- Trace all three McGrigor lines comparing both sides for asymmetry.
- Look for common injury patterns including tripod fractures, zygomatic arch fractures, orbital fractures and mandible fractures.
- Treat the mandible as a ring, looking for more than one fracture line.
- Computed tomography is the first-line investigation for most head trauma so be aware of the National Institute for Health and Clinical Excellence head injury guidelines.

Figure 8. Orthopantomogram demonstrating a fracture through the left angle and right body of mandible (blue arrows).