The Nose and Associated Structures: Part III

35

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35.1 Injuries

35.1.1 Nasal Fractures

These are very common and typically seen following assaults or sports injuries. Because of their high visibility, management of these injuries must take into consideration both functional and cosmetic aspects. The nasal bones are relatively delicate and can be broken easily following low energy impacts. In some cases, impact forces as low as 30 g can be sufficient to fracture the nose, compared to the supraorbital rim which requires a force of around 200 g. Similar to the paranasal sinuses, it has been suggested that the collapsibility of the nasal bones and septum may help absorb the energy of impact and offer some protection to the brain. Higher energy impacts can result in more significant nasoethmoid fractures, or fractures that extend into the anterior cranial fossa. The mechanism of injury is therefore a key part in the initial assessment of nasal fractures. If this suggests a high energy impact, 'deeper' (occult) fractures should be considered.

Nasal fractures can involve either the bony or cartilaginous skeleton of the nose, or both. From a structural point of view, the nasal bones can be divided into a stronger upper portion and weaker lower portion, by a horizontal line passing through the canthi. Most nasal bone injuries occur in the lower part. Injuries to the upper part represent higher energy impacts and should raise concerns regarding extended or deeper injuries, notably skull base fractures. The nasal septum is also frequently injured and needs careful assessment. This supports the lower two thirds of the nose, maintaining its projection and alignment. The cartilaginous septum is an elastic structure which can absorb and recoil following minor impacts. However it can also

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fracture or dislocate, resulting in collapse of the lower part of the nose, which can slowly progress over a prolonged period of time. The turbinates provide support to the lateral nasal wall. These may also be damaged following lateral impact injuries. The type and severity of the injury therefore depends on both the magnitude and direction of the force applied. These are generally described as lateral or frontal impacts, although combinations of these and other less common vectors (such as vertical) also occur.

Not surprisingly, high energy impacts to the nose are more likely to result in extensive, comminuted and deeper fractures. In such cases it is especially important to consider the orbits and the anterior cranial fossa—the bones comprising these are very thin. Fractures of the nasal bones are almost always open fractures, although infection is quite rare. Breaches of the skin or mucosa occur in the vast majority of cases. Hence epistaxis is a common occurence. This may have ceased by the time patient arrives in the emergency department or clinic. Nevertheless it is important to be very careful when examining the injured nose as bleeding may restart. If the patient attends several days after injury the wound may have become infected and antibiotics may then be required. Otherwise antibiotics are usually not needed.

In most cases the diagnosis is self evident. In addition to a history of trauma, patients may also complain of nasal deformity, swelling, epistaxis and an obstructed nasal airway. It is important to consider the following

1. Bleeding. If ongoing, ask the patient to apply gentle finger pressure until it has settled.
2. Swelling of nose—this appears within a few hours and may make examination difficult or imprecise (notably measurements of the intercanthal distance). Swelling increases after the injury and can continue for several days before it subsides. It can be particularly severe around the eyelids, where the skin and soft tissues are very thin and easily distensible.
3. Bruising around one or both eyes. The well defined ‘Black eye” (Panda eye) indicates the presence of a fracture somewhere within the orbit. Whilst this is a common sign with fractures of the nose, its presence should also prompt careful examination of the eyes, extraocular movements and consideration of imaging.
4. Pain. All fractures are painful, however severe headaches and pain behind the eyes should be regarded with suspicion.
5. Nasal deformity. The nose may be depressed or deviated to one side. In all patients ask about whether they had any pre-existing deformity. Distinguishing this from a newer injury can sometimes be very difficult, especially if imaging has not been undertaken. However this is important, as an old injury cannot be corrected with a simple manipulation under anaesthesia (some patients may think otherwise)
6. Nasal obstruction. This may be due to swelling, septal deformity or septal haematoma. Septal haematoma requires rapid evacuation to prevent septal necrosis and subsequent collapse of the nose. A haematoma can also become infected resulting in a septal abscess. This is a serious infection, requiring urgent drainage

and intravenous antibiotics. This can also result in septal necrosis with collapse of the nose.

7. Lacerations in the overlaying skin with exposure of nasal bones and cartilage can occur. Only rarely is tissue loss significant. In such cases the wounds will need careful repair. Consider the need for antibiotics and tetanus immunisation (Figs. 35.1 and 35.2).

8. In more severe injuries there may be ocular/orbital symptoms, or a watery nasal discharge—suggestive of CSF leakage. These need urgent evaluation, including CT.

Fig. 35.1 Degloving injury nasal tip

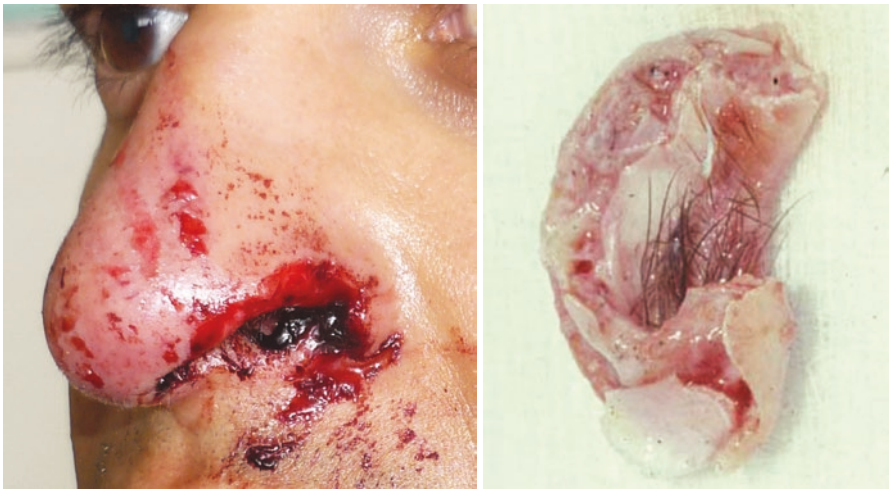

Fig. 35.2 Tissue loss following bite

When examining an injured nose, the precise sequence is not critical so long as all steps are completed. The key points to include are

1. Rapid and confident exclusion of more extensive injuries (most notably nasoethmoid (NOE), anterior cranial fossa (ACF), orbital walls and ocular injuries). Measure the intercanthal distance (ICD). Sit the patient forward and look for CSF leaks. Determine whether the patient has had epistaxis only or if it has been combined with a watery discharge (CSF). Then note the following
2. Any deviation, depression, or step deformities
3. Mobility, crepitus and specific areas of point tenderness. With questionable injuries of the nose, gently check for mobility and fracture crepitus. This can be done by placing your index finger along the dorsum of the nose, with the thumb and the middle fingers on the sides. Then gently move the nose from one side to the other. Crepitus can usually be felt and occasionally heard.
4. Note any areas of swelling, bruising and mucosal or skin lacerations
5. Carefully assess for septal fracture/haematoma/abscess/perforation
6. Infra orbital numbness—this will be due to injury to the infra orbital nerve. If this is present then the injury may be more than a simple nasal fracture.

35.2 Classification of Fractures

Many classifications have been described and include (i) Harrison (ii) Murray and (iii) Stranc Robertson. These fractures can be classified according to the mechanism of injury, or the type of fracture sustained.

35.2.1 Frontal Impact Injuries

In these fractures, the impact of injury is from the front—usually head-on trauma. Here, the fractured segments are displaced inwards and are splayed. Patients often develop saddle nose deformity.

35.2.2 Side Impact Injuries

With these injuries the fractured segments are displaced to the opposite side to the point of impact. This is the most common mechanism in adults, seen following assaults or sports related injuries.

Another simple classification, describing 3 ‘levels’ or planes of injury is also commonly used.

Level 1
Injuries that do not extend beyond a line joining the tip of the nasal bones to the anterior nasal spine. These involve the cartilaginous nasal skeleton only.

Level 2
Injuries limited to external nose which do not pass into the orbital rims.

Level 3
Injuries that extend beyond the nose and involve the orbital walls and skull base. These are termed nasoethmoidal (more precisely naso-orbital-ethmoid) fractures—NOE (Fig. 35.3).

A more comprehensive anatomically based classification includes

A. **Fractures that are confined to the nose**
- Fractures involving the nasal bones only. Only the dorsum of nose is deformed. Depending upon the displacement of the segment it can be either depressed (more common) or elevated. This can happen in both frontal and lateral impact injuries.
- Unilateral fractures involving the nasal bones and frontal process of maxilla. In addition to depression of the dorsum, the lateral wall of nose is depressed to the opposite side of the impact. Disfigurement here is more significant than isolated dorsal injuries. This usually happens following side impact injuries. There is often mild haematoma in the eyelids of the involved side.
- Bilateral fractures involving the nasal bones and frontal process of maxilla. This is usually seen following frontal impacts. Disfigurement can be

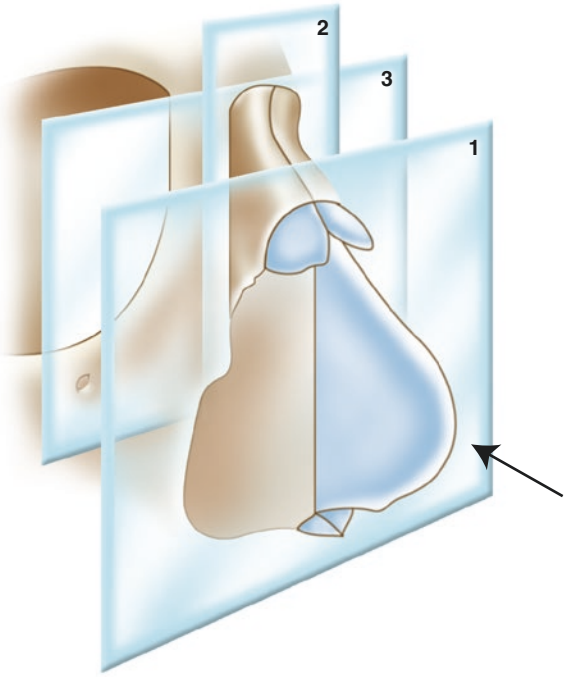

Fig. 35.3 Three levels of nasal trauma

extensive. Most of the entire nose appears depressed. There is usually significant swelling and haematoma in the eyelids on both sides.

B. **Fractures extending beyond the nose**

- Bilateral fractures involving the nasal bones, ethmoids and frontal process of maxilla. In these injuries the entire nose is depressed and sunken into the face. Telecanthus may be present. There is usually significant swelling and haematoma in the eyelids on both sides. These injuries are often associated with other facial fractures, notably the orbits.
- Fractures of the nose extending into the orbits and the ethmoids—Nasoorbitalethmoidal—NOE fractures. These are severe injuries and ocular problems are likely to be present. NOE fractures are commonly classified according to the attachment of the medial canthus to the bone (Markowitz classification)
- Fractures of the nose extending into the anterior cranial fossa, orbits and ethmoids. These are the most severe types of fractures. In the first instance they should be considered as head injuries and assessed and referred accordingly. The nasal fractures are a lower priority during this time.

C. **Fractures of the septum**

Septal fractures can occur with any of the above fractures. However it is important to note that septal fractures can also occur in the absence of nasal bone fractures. This usually happens following frontal and below-upwards impact injuries. Common septal fractures associated with isolated fractures of the nasal bone include

Chevrolet fracture. This is a vertical fracture of the septum which occurs when the direction of impact on the nose is from below upwards

Jarjavay fractures are a horizontal fracture of nasal septum. These occur when the direction of blow on the nose is from the front.

Crushed septum. This occurs when the impact force is significantly more and directed from the front. The septum is often crushed and highly comminuted. The mucosa is also frequently shredded.

Mucosal tears are common and must be looked for in all cases. If not identified infection and necrosis can develop in the septum. Fortunately this is rare. Nevertheless, failure to manage the septum correctly will result in residual deformity. Deviation may not always be immediately apparent in septal fractures. This is because of the elastic nature of the septum—hence the absence of deviation does not rule out a fracture. Septal fractures tend to release 'interlocked stresses' over a prolonged period of time. These are intrinsic forces which are normally confined within the structure of the cartilage. Following fracture they can result in buckling of the septum (often C-shaped, S-shaped), or the development of septal spurs. Septal fractures can also result in "telescoping" of the fractured edges, causing retrusion of the nose and a depressed dorsum. It is therefore important to always assess the septum carefully. If not, many patients may subsequently develop deformity, nasal obstruction or sinusitis.

From an emergency perspective a simple classification is to consider the fractures in terms of comminution and extension beyond the nose. This can help in referral and treatment planning

1. Type1 'En bloc' fractures with minimal comminution
2. Type 2 Moderately comminuted
3. Type 3 Severely comminuted
4. Type 4 Any of the above with extension beyond the nose.

35.3 Imaging and Management

The indications for X-rays of the fractured nose are controversial and whilst some clinicians will request imaging, others will not. In the UK for example, X-rays of suspected isolated nasal fractures are almost never requested. However in other countries they are (commonly plain lateral nasal bone views, or a lateral skull X-ray). CT is of value in high energy injuries, not only to determine the extent of the nasal fracture but also to exclude fractures involving the skull base and orbits. Fine cut CT will clearly show all the fractures including the ethmoids, orbits and anterior cranial fossa. CT is also very helpful in diagnosing septal and turbinate fractures, although it can not predict the severity of the injury or the likelihood of residual deformity. In some countries ultrasound is being studied as a tool for investigating nasal fractures. This has been reported to give a clear view of the nasal bones allowing easy identification of fractures. However, the sensitivity and specificity of ultrasonography has not yet been fully tested in this area.

Management of nasal fractures varies considerably. Although these may be considered relatively 'trivial' injuries, it is still important to take basic of observations, notably blood pressure and pulse and document findings carefully. In the elderly, significant bleeding can compromise their cardiovascular reserve. A full blood count and coagulation screen may be required to rule out anaemia and clotting disorders. If the nose is actively bleeding, gentle pinching and light cold compress will usually arrest haemorrhage and help reduce swelling. Anterior or posterior nasal packing may occasionally be required. However this must be done with care to avoid displacing fractures. If packing is required, prescribe antibiotics. Any attempts to 'tweak' the nose in the emergency department must be resisted, unless the clinician is very experienced and confident of the fracture pattern. Patients must be selected carefully as manipulation may restart bleeding.

Definitive treatment is usually delayed for 5–10 days to allow the swelling to subside and enable more detailed clinical assessment. Swelling masks injuries and can make the nose appear initially worse than it is. Indications for treatment include (i) nasal deviation, (ii) nasal obstruction with difficulty in breathing and (iii) cosmetic deformity. Manipulation under anaesthesia is possible under both local or general anaesthetic. This may be achieved digitally with simple en block fractures.

However the septum needs to be carefully assessed and if this is not addressed the nose will drift over time. Waltham's forceps allows precise manipulation of the bones, but usually requires general anaesthesia. They come in pairs which gently grip the nasal bones allowing manipulation in three dimensions. However they can crush the soft tissues and so skin protection is needed. They have a rounded end which passes into the nose and a flatter beak which passes on the outside. Ashes forceps help straighten the septum. These have matching beaks. Both CSF leakage and blindness have been reported as complications following manipulation of the nasal bones. This is very rare but does emphasise the need for careful assessment, including imaging when necessary, as well as consenting patients fully. Most cases probably occur because deeper fractures extend to the skull base and orbital apices. During forceful manipulation of the nose, they can also be agitated.

Primary open septoplasty via an intranasal incision and ORIF of the nasal bones though overlaying lacerations are also undertaken in selected cases, normally under general anaesthesia. Following manipulation, the nose is supported with a temporary splint. Care is required if plaster of Paris is used. The wetting water produces a caustic solution which can cause irritation to any unprotected eyes. The use of nasal packs is controversial. Patients should be advised no nose blowing for 2 weeks and prescribed nasal decongestants and analgesia.

35.4 Septal Haematoma

This is a collection of blood between the septal cartilage and the overlying perichondrium. This must be considered in every nasal injury although it is rare. If it is missed it can have disastrous consequences. Timely management prevents abscess formation, septal perforation and a 'saddle-nose' deformity. The haematoma appears as a dark swelling on the septum bulging into the nasal airway. It usually appears within the first 24 to 72 h. If left untreated this can go onto form a septal abscess within a few days. Septal abscess can also give rise intracranial complications and avascular necrosis of the cartilage, with eventual perforation and loss of structural support. Patients then develop nasal whistling, crusting and recurrent epistaxis. Larger septal defects can result in near complete collapse of the septum resulting in a 'saddle nose' defect.

In most cases haematomas can be aspirated or drained under local anaesthetic. An incision is placed over the area of greatest fluctuation without incising the cartilage. Bilateral haematomas should not have incisions placed opposite each other. This helps to avoid septal perforation. Gentle suction with saline irrigation can usually evacuate the clot. Some specialists recommend excising a small segment of mucoperichondrium to prevent premature closure of the incision. This will prevent re-accumulation of blood. Occasionally a corrugated drain may be necessary or quilting sutures. The nose can be then packed. Whilst packs are in situ, broad spectrum antibiotics are usually prescribed to cover Staphylococcus aureus, Haemophilus influenza and Streptococcus pneumoniae. Any specimens should be sent for microscopy, culture and sensitivity.

35.5 Nasoethmoid (Naso-Orbital-Ethmoid, NOE) Fractures

The naso-orbital-ethmoidal (NOE) complex is a very delicate and complicated three dimensional structure, involving four key bony regions (cranium, orbits, nose and maxilla) and multiple cavities (anterior cranial fossa, orbits, nasal cavity and the sinuses). Fractures in this region extend beyond the nose, involving the orbits and ethmoidal sinuses to varying degrees. They may vary from minor cracks (many of which probably go undiagnosed) to collapse of the entire region with obvious deformity. Collapse of the ethmoid air cells also impairs free drainage of mucus from the frontal sinus through the "Frontal Sinus Drainage Pathways (FSDP)". This can result in mucocoele formation in the frontal sinus months or even years later. Secondary infection of the mucocele from nasal organisms can also occur, resulting in a frontal sinus empyema. NOE fractures are most likely following high energy impacts directly to the bridge of the nose. The ethmoidal sinus acts as a crumple zone which results in a 'pushed-in' look to the bridge of the nose, with an upturned nasal tip, sometimes referred to as a "Miss Piggy" nose (Fig. 35.4).

When examining these injuries it is important to determine whether there is any orbital involvement, canthal displacement or CSF rhinorrhoea. There may be associated head and cervical spine injuries. These take priority over the facial injury (in the absence of major facial haemorrhage). Symptoms of NOE fractures include a "Miss Piggy" nose and significant swelling, which usually develops quickly.

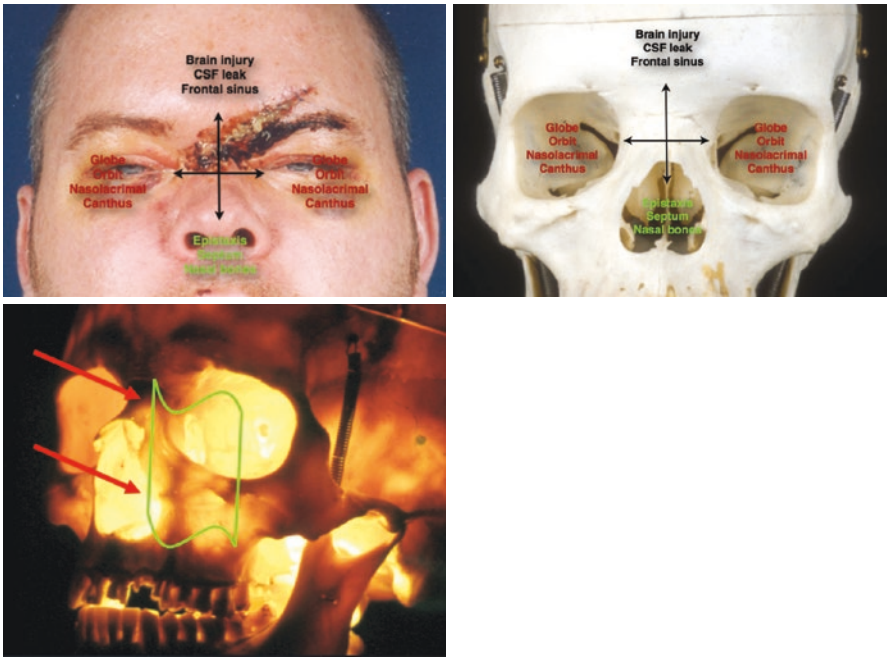

Fig. 35.4 Nasoethmoid fractures occur at a critical anatomical junction

Ophthalmic and orbital symptoms include diplopia, telecanthus, enophthalmos, epiphora and a shortened palpebral fissure (as a result of medial orbit wall or medial canthal tendon displacement). Nasal symptoms include collapse of the nasal bridge, anosmia (caused by damage to the olfactory nerve) and nasal congestion (secondary to swelling, septal haematoma or bony/cartilaginous deformity). More specifically, key clinical features include

1. Nasal fractures. These are often comminuted. They will almost certainly be associated with extensive septal deformity or fractures. Look for an upturned "Miss Piggy" nose. This is highly suggestive of a NOE fracture.
2. Overlaying lacerations. If present the soft tissues are usually split open. Fragments of bone maybe visible. These will need to be temporarily dressed or closed prior to definitive treatment. Resist any temptation to pick out small fragments of exposed bone.
3. Telecanthus—this is an increase in the intercanthal distance as a result of separation of medial canthal attachments. This can be tested for, using the 'bow-string' test—the lateral canthus is pulled laterally. If there is detachment of the medial canthus, this will also move laterally. Repair of the medial canthus is a key part in the treatment of these injuries. Any residual deformity will be very noticeable and very difficult to correct secondarily.
4. Anterior cranial fossa fractures with associated CSF leakage. These may not be immediately apparent, particularly if the patient is supine and awake. CSF may trickle down the back of the throat and be swallowed.
5. Frontal sinus fractures—if these are present, this represent a very high energy injury. In the first instance regard these as head injuries rather than facial injuries.
6. Globe injuries. With high energy injuries globe rupture can occur. The eyes therefore need careful assessment. This is discussed in the chapter on the eye.
7. Nasolacrimal apparatus damage. A common problem following these injuries is persistent watering of the eye (epiphora) as a result of damage to the lacrimal drainage apparatus. Always consider this with any penetrating injury around the inner corner of the eye (Figs. 35.5 and 35.6).

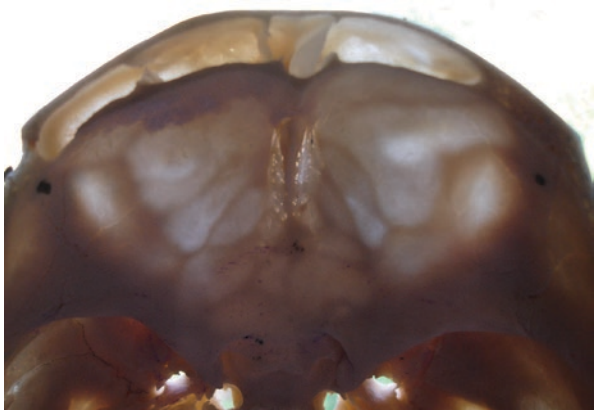

Fig. 35.5 "*Wafer-thin*" anterior skull base

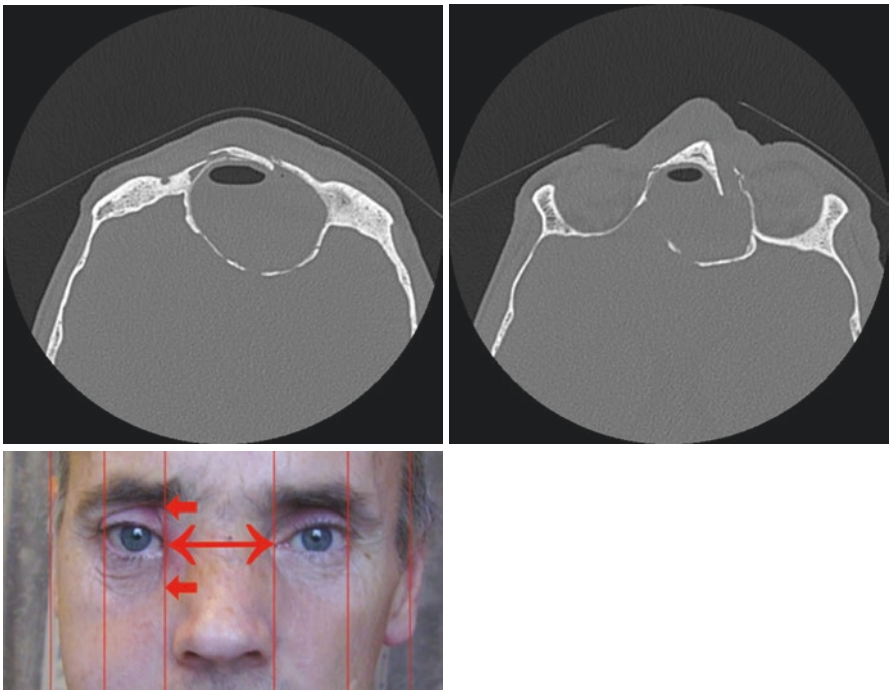

Fig. 35.6 Unilateral NOE fracture secondary to pre-existing frontal mucocele

With obvious injuries, initial clinical examination should focus on excluding the presence of active haemorrhage and cervical spine, head and ocular injuries. There is no need to elicit crepitus and movement—these injuries will require CT assessment. If the patient has a significant watery rhinorhoea he/she should be assumed to have a cerebrospinal fluid (CSF) leak. Remember this may be difficult to recognise if the patient is supine from spinal immobilisation. CSF leakage is confirmed by either performing a bedside test ("Halo sign"), or by testing fluid levels for either glucose or β- transferrin. This is discussed in the chapter on head injuries. The Halo or "double-ring" sign uses the principle of chromatography: different components of a fluid mixture will separate as they travel through a material. However it is not 100% reliable. Filter paper, paper towels, coffee filters and linen can all be used to show a ring. Laboratory testing for B- Transferrin is the most reliable method, but takes times to get results (Figs. 35.7, 35.8, and 35.9).

35.6 Classification and Mangement

The most widely accepted classification is that of Markowitz, who described 3 types based on whether the medial canthal tendons were attached to a central fragment. With type A injury the tendon attaches a large single central fragment. In type B fractures the central fragment is comminuted with the medial canthal tendon

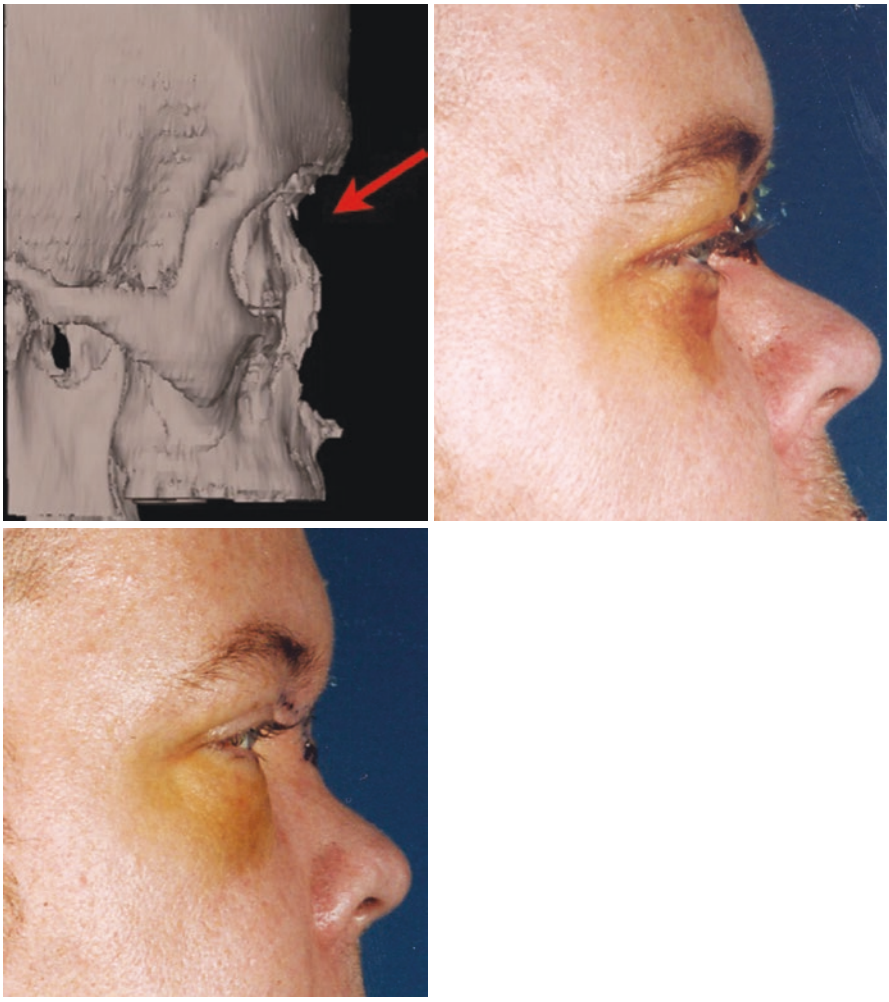

Fig. 35.7 "Miss Piggy" nasal deformity

attached. In type C the medial canthal tendon is separated from the communicated central fragment.

Initial management of NOE fractures should follow the ATLS algorithm as described in the chapter on the injured patient. It might be useful to consider these injuries from a 'regional' perspetive, that is from a neurosurgical (Head injury), ophthalmic (ocular and lacrimal injuries) and facial perspective. Remember also that these high energy injuries might also have cervical spine problems. Whilst the

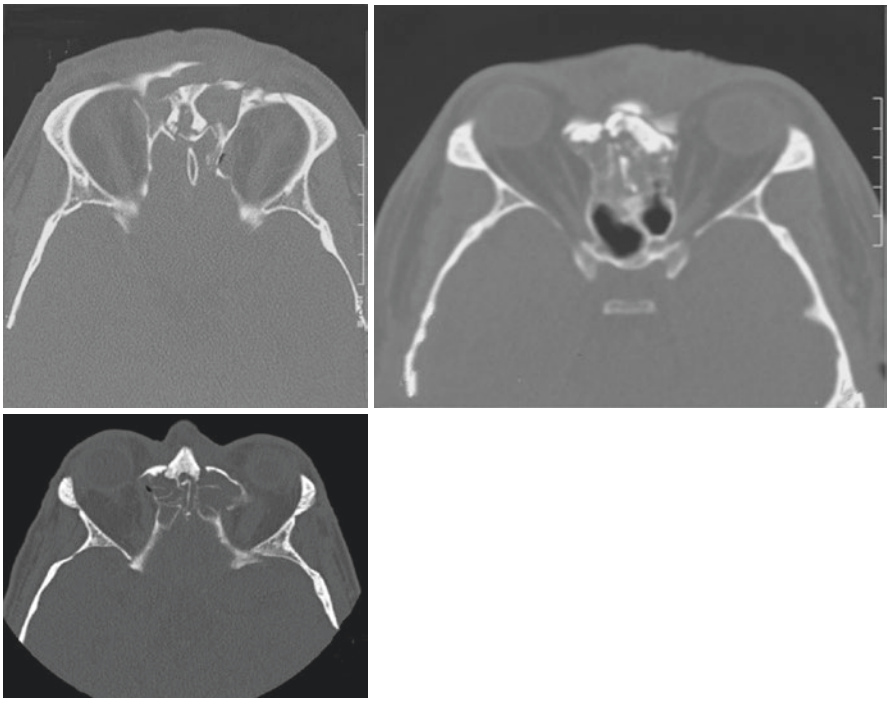

Fig. 35.8 NOE fractures with telecanthus

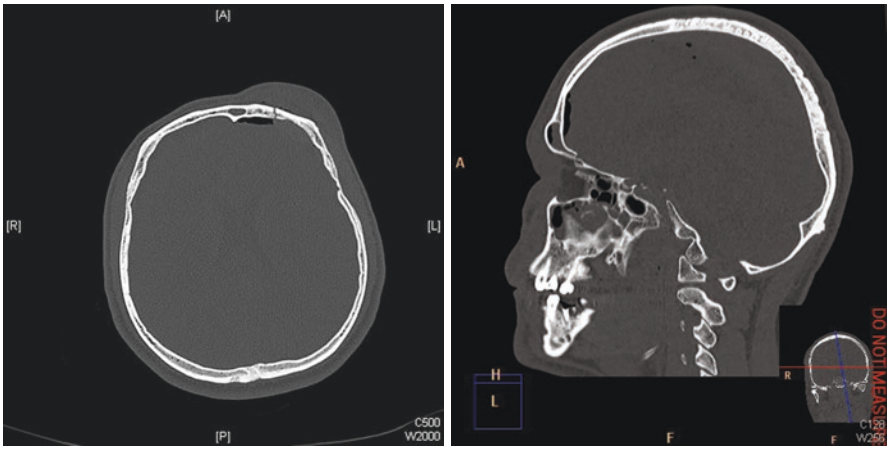

Fig. 35.9 Intracranial air

most obvious part of the injury is the depressed nose, this does not require immediate attention unless the patient is haemorrhaging significantly. Surgical repair of these injuries is often deferred 7 to 10 days as necessary, depending on the patient's general condition, other injuries which may take priority and the presence of swelling. Generally speaking, open reduction and internal fixation with accurate repositioning of the canthal ligaments is undertaken. This is often via a coronal flap which allows access to the frontal sinus too. Other approaches include using pre-existing lacerations and other local incisions.