A Guide to Facial Fractures

G.D.Wood
MSc, MDS, FDSRCPS

Dr RICHARD A PEARSON
17 Shillingford Drive
Trentham
Stoke-on-Trent
ST4 8YG

Independent Publishing, Windy Knowe, Wood Lane, Parkgate, Wirral, Cheshire L64 6RA

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PREFACE

This book is intended as a guide to those involved with the diagnosis and treatment of facial fractures and not as a comprehensive text. Hospital Accident and Emergency doctors and other medical practitioners have to make the preliminary assessment of facial trauma prior to referral of the patient to the Oral and Maxillofacial surgeon for definitive treatment. Diagnosis is often difficult and if incorrect can cause suffering to the patient as well as risking litigation for the doctor.

Hopefully this compact book can sit on a desk or in a pocket and provide a readily available source of reference.

Nasal fractures are common and are treated by either Ear, Nose and Throat or Oral and Maxillofacial specialists. The initial diagnosis of these injuries is straightforward and thus is not included in the text. Injuries to the teeth although common are quickly sent to the appropriate dental specialist and thus are not described.

About the Author

The author is a Consultant Oral and Maxillofacial Surgeon with extensive first hand experience in treating fractures of the facial skeleton. He has undertaken original research on various aspects of the subject and published numerous articles in the scientific literature on diagnosis, treatment and consequence of facial trauma.

CONTENTS

THE FRACTURED ZYGOMATIC BONE

The zygomatic bone is situated in the upper and lateral part of the face. It forms the prominence of the cheek and contributes to the formation of the lateral wall and floor of the orbit and to the walls of the temporal and infratemporal fossa (Figure 1).

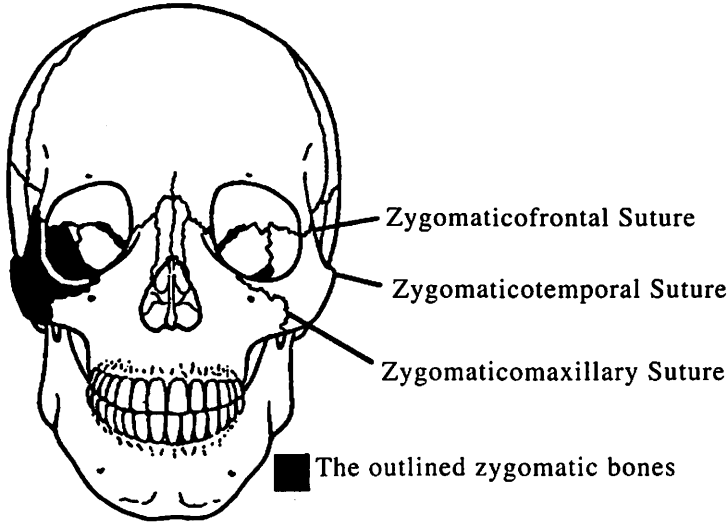


Figure 1
The position and relations of the zygomatic bone.

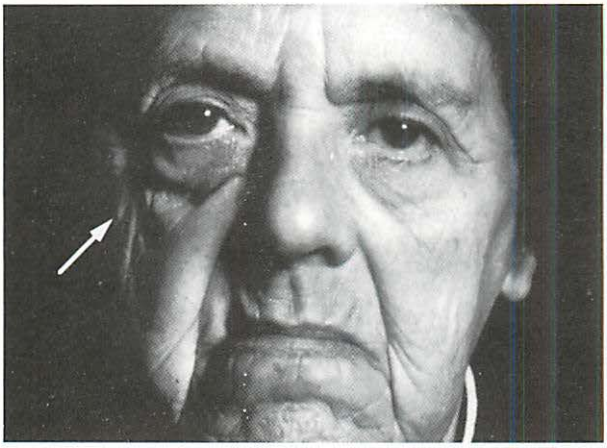
Fracture of the zygomatic complex is a common injury; it usually fractures along the zygomaticofrontal, zygomaticotemporal and zygomaticomaxillary sutures. Rarely the zygomatic bone itself fractures, but when this occurs it is usually severely comminuted.

Aetiology

The zygomatic bone can be fractured from a violent blow to the side of the face. In the 1960's road traffic accidents were the most common cause, with sporting injuries a close second, with assaults and industrial accidents a minority. More recently interpersonal violence is the most common cause. Seat belt legislation has reduced the road traffic accident related injuries and sport and industry now play a lesser role.

Clinical Diagnosis

Figure 2
Loss of right cheek prominence from a fractured right zygomatic bone.



Diagnosis and treatment of the injury is principally on clinical evidence supported by radiographic confirmation. Many fractures remain undiagnosed by inexperienced clinicians who examine the patient first and rely on radiographic reports made on inadequate films.

The clinical signs and symptoms of fracture are closely related to the surgical anatomy. Most commonly, the zygomatic bone is fractured and displaced medially such that the cheek prominence is lost (Figure 2) which is often masked by oedema of the soft tissues resulting from the fracturing force. The facial disfigurement is more obvious in certain ethnic groups, such as the Chinese, irrespective of the amount of bony displacement.

Palpation of the infraorbital rim may demonstrate a painful step deformity over the fractured area, while comparison of the infraorbital level with that on the opposite side may show two different levels.

The inevitable damage to the lateral wall of the maxillary antrum results in it filling with blood, and usually produces a unilateral epistaxis. In addition traumatic emphysema can often be detected in the infraorbital region if air escapes into the tissues from the maxillary sinus. An 'egg-shell cracking' sensation on palpation confirms the presence of air. Emphysema will be more abundant if the patient inadvertently blows the nose and it can close the eye on the fractured side.

Circumorbital bruising (limited by the attachments of the obicularis occuli) occurs in all cases while subconjunctival bruising which is not limited posteriorly occurs in most cases.

Blurred vision from receipt of injury can persist for up to 24 hours and is a common feature. Rarely, untreated injuries and even cases that have sustained minimal displacement may result in persistent blurred vision for some weeks.

Diplopia is a common symptom in the early stages of the injury which is caused by oedema and effusion in the region of the extraocular muscles. It can be caused by enophthalmos, which results when the orbital fat herniates through the fractured orbital floor into the maxillary antrum. A fracture of the orbital floor in isolation is termed a blow-out fracture. Diplopia at the time of injury is therefore not necessarily reason for concern, but must be followed closely.

Diplopia resulting from damage to the extraocular muscles or their nerves is more serious. The extraocular muscles can become trapped within the bone fragments of the floor of the orbit and the inferior oblique muscle is the most commonly affected. Ocular muscle dysfunction can be related to nerve damage. Examination of the eye should include testing the fundus for evidence of oedema and haemorrhage and testing the extraocular muscle function. The result of the examination should be clearly noted so that progress can be objectively assessed.

Neuropraxia or neurotmesis of the infraorbital nerve occurs when the displaced bone presses on it but usually resolves completely in time, with or without treatment. The patient thus complains of numbness/"pins and needles" of the cheek and side of the nose, depending on the degree of damage.

Damage to the anterior, middle and posterior dental nerves can lead to a change in sensation of the teeth and gums, which can be troublesome to the patient for some months following the injury.

Medial displacement of the zygomatic bone and/or arch can impinge on the coronoid process of the mandible depending on the position of the mandible at the time of the blow. This can result in the patient being unable to open the mouth to its full extent or, if the blow was received with the mouth open being unable to close it.

Radiographic Examination

The standard views for radiographic investigation of the zygomatic bone are the occipitomental (Figures 3 and 4) and submentovertex (Figure 5). Visualizing the fractures on the occipitomental views relies on comparison with the undamaged bone and the radiographs must therefore be properly centred.

The frontozygomatic suture, the infraorbital area of the floor of the orbit and the lateral wall of the maxillary antrum should be visualised and are potential sites for finding the fracture on 15° or 30° occipitomental views.

The submentovertex view will clearly demonstrate the zygomatic arch and, to some degree, the amount of displacement of the body of the zygomatic bone.

Tomography of the orbital floor or computerised axial tomograph (CAT) scan is useful when a fracture of the orbital floor alone or trapping of the extraocular muscles is suspected. The correct interpretation of radiographs is an essential part of diagnosis and treatment is based on their interpretation. Facial radiographs are often taken when the patient has received multiple injuries and/or is unable to cooperate fully. The result is a plethora of unnecessary radiographs which are inadequate for diagnosis. The standard of the radiographs must be high, as superimposition of bony structures can easily mask a fracture. The clinician must be persistent until adequate radiographs are produced for accurate diagnosis.

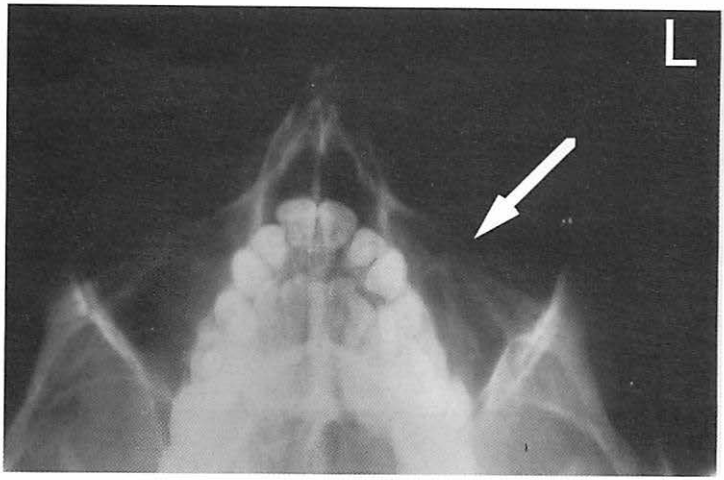
Treatment

Nondisplaced fractures can be left without treatment and most heal without complication. Prophylactic antibiotics should be prescribed and penicillin is the drug of choice unless the patient is hypersensitive or there are other contraindications (in which case erythromycin should be used). The patient should be warned not to blow the nose vigorously, otherwise air can be blown into the tissues and may close the eye and/or cause infection.

Definitive Surgery

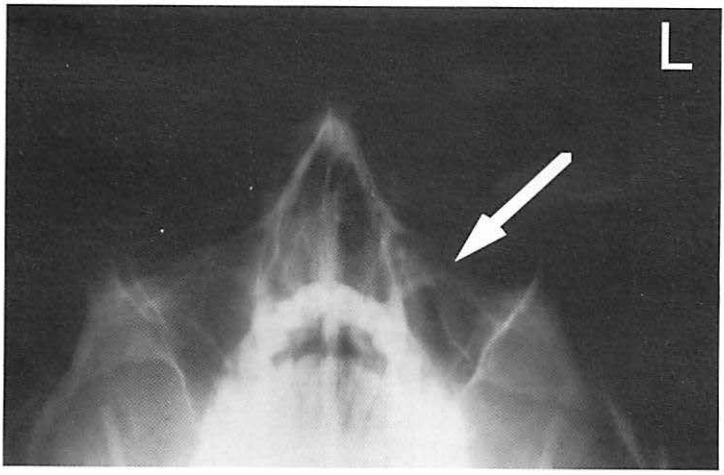
Most zygomatic bone fractures can be easily surgically treated by elevation from an incision in the temporal region, thus hiding a visible scar in the hair. An incision through the skin to the temporal fascia is fashioned. The temporal fascia is then incised and an elevator passed beneath the fascia,

Figure 3



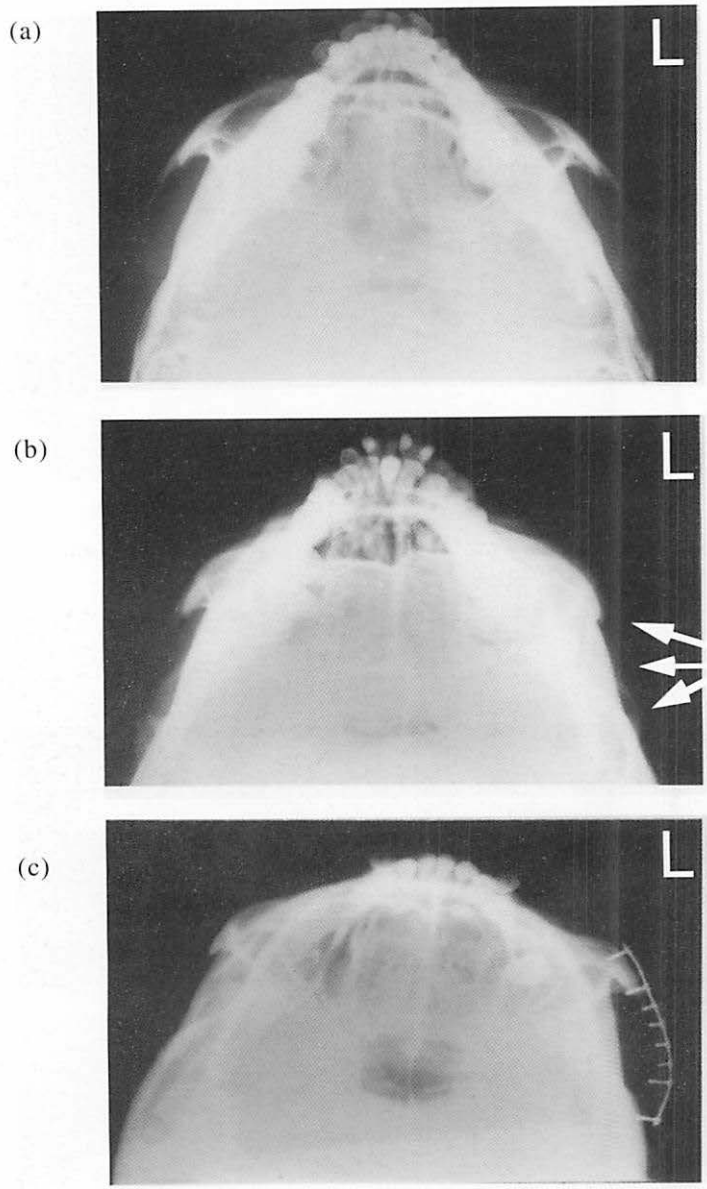
15° occipitomental radiograph demonstrating a fracture and medially displaced left zygomatic bone.

Figure 4



30° occipitomental radiograph demonstrating a fracture and medially displaced left zygomatic bone.

Figure 5



Submentovertex radiographs showing:- (a) no fracture, (b) fractured left zygomatic arch, (c) Champy plate reconstructing left zygomatic arch.

Figure 6a
The temporal fascia incised to show the temporalis muscle.

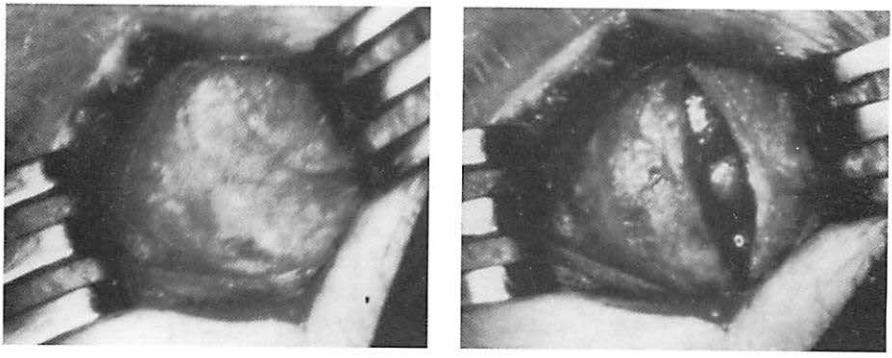
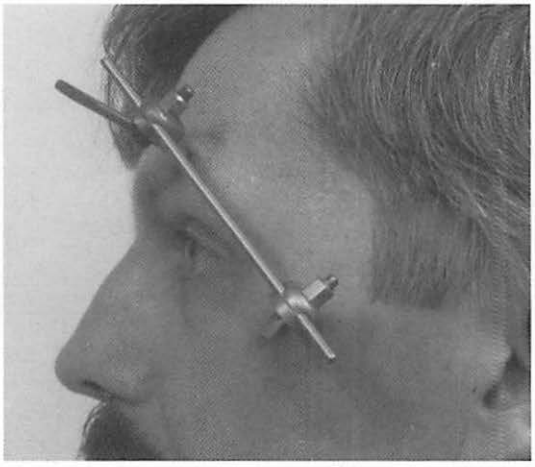


Figure 6b
Elevating a fractured right zygomatic bone.

inferiorly, deep to the zygomatic arch (Figure 6a). The bone can be elevated and impacted into position without pressure on the parietal bone and its reduction checked by palpation of the infraorbital rim (Figure 6b). A zygomatic bone which does not impact in position by this method and is unstable will require further surgical treatment. Many varied techniques are used by Oral and Maxillofacial surgeons for fixing an unstable fractured zygomatic bone these include; direct wiring, plating with mini-plates and/or extra-oral pin fixation (Figure 7).

Figure 7
Pin fixation holding a fractured left zygomatic bone in place.



Complications

Postoperative infection is unusual if the operative surgery is covered by prophylactic antibiotics. Infection, when it occurs, is treated by antibiotics selected according to the sensitivity of the organism cultured and drainage as necessary. Blindness, as a result of postoperative retrobulbar haemorrhage, is a very rare complication of surgery (prevalence of 0.3 per cent). Postoperative surgical management of the reduced fractured zygomatic bone should include visual testing and observation for gross swelling as blindness can be avoided by speedy surgical intervention to decompress the orbit.

Trismus immediately following surgery is a common finding and active exercises to open the mouth should be encouraged immediately postoperatively. Persistent trismus can be treated by forced opening of the mouth. The patient gradually forces wooden tongue spatulas between the teeth, increasing the opening progressively over several days. Most cases of trismus can be managed in this way and rapid resolution occurs.

Failure to recognize and treat zygomatic bone fractures soon after injury complicates the treatment. Many cases go unrecognized or are referred several weeks after injury, when bony union of the fractured ends in a malposition is well advanced. Treatment of such cases may need grafting by homo- or allo-grafts, involving long operations, extended hospitalization and considerable anxiety and suffering for the patient. Correct diagnosis and prompt treatment is essential for optimal treatment of the fractured zygomatic bone.

Learning Points

Clinical Diagnosis

1. Flattening of the injured cheek (possibly masked by swelling).
2. Circumorbital and subconjunctival bruising.
3. Step deformity of the infraorbital rim.
4. Enophthalmos.
5. Numbness of infraorbital and anterior, middle and superior dental nerves.
6. Inability fully to open or close mouth.
7. Unilateral epistaxis.
8. Tenderness to palpation along the infraorbital rim.
9. Diplopia and/or blurring of vision.
10. Limitation of eye movements.

Radiographic Examination

1. 15°/30° occipitomental views.
2. Submentovertex view.
3. Tomography/CAT scan of orbit if a blow-out fracture is suspected.

THE FRACTURED MANDIBLE

The mandible, the largest and strongest bone of the face, has a horizontal body and two rami that project upwards from the posterior ends of the body. The condylar processes of these rami articulate with the temporal bone to form the temporomandibular joints. The mandibular body is hollowed to house the teeth (Figure 8). Despite its comparative strength, the mandible is a commonly fractured facial bone.

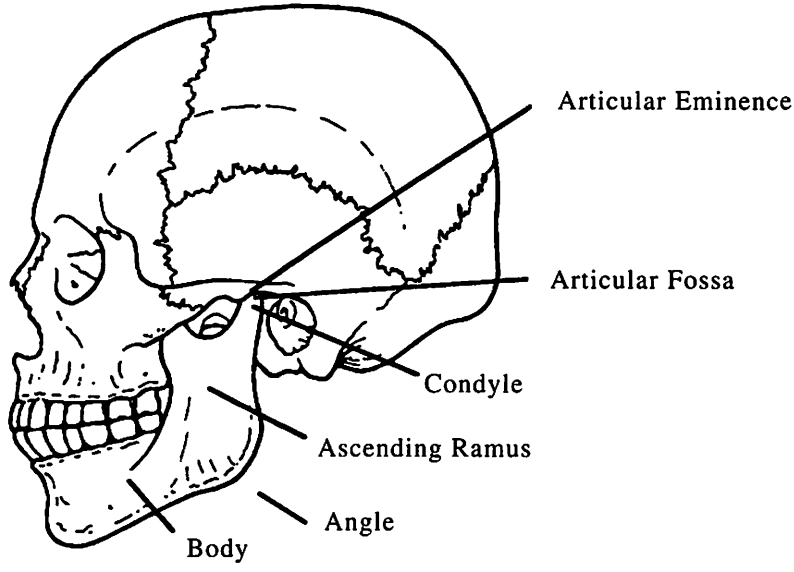


Figure 8
Anatomical parts and relations of the mandible.

Many combinations of fractures of the mandible can occur and if one fracture is identified a second should always be sought. Most civilian injuries do not involve bone loss, and reconstruction of the mandible following tissue loss is best undertaken as a secondary procedure.

Causes of Fracture

Most civilian fractures of the mandible are the result of a violent blow received during a fight. Between 1945 and 1957, assault and battery were the predominant aetiological factors, while between 1958 and 1967 it was road traffic accidents. Following the compulsory wearing of seatbelts while travelling in a car, interpersonal violence now accounts for the majority of mandibular fractures.

Numerous statistical analyses of mandibular fractures point out that the mandibular angle and the neck of the condylar process are the sites most frequently involved. Where fights and sports accidents are more frequent the incidence of angle fractures is higher, whereas in areas where road traffic accidents predominate, fractures of the condylar process are more common.

Diagnosis should be the result of a comprehensive clinical examination supported by radiography. Signs and symptoms vary with the site of fracture, the violence of the blow and the influence of muscle pull on bone fragments.

THE FRACTURED CONDYLE

Clinical Diagnosis

Fractures of the mandibular condyle have been recognized and treated since the beginning of the 19th century. The clinical signs of certain fractures of the mandibular condyle may be scarcely perceptible and symptoms may be negligible or absent. Signs and symptoms commonly exhibited, include one or more of the following:

1. Local pain and swelling.
2. Some degree of trismus.
3. Gagging of the bite in the molar region of the affected side.
4. Deviation of the mandible to the affected side on opening.

If the impact to the jaw was at the point of the chin both condylar necks may be fractured. The bite is then gagged bilaterally in the molar region and mandibular deviation on attempted wide opening may not be apparent. In this situation the patient is unable to fully close the mouth. On rare occasions rupture of the external auditory meatus giving rise to bleeding from the ear can or may result.

Radiographic Examination

The posterior-anterior radiograph of the mandible with the mouth open (figure 9), Towne's View (figure 10) and orthopantomograph views are recommended as standard and temporomandibular joint projections when a more detailed view of the condyle is required. Detailed radiographic examination is best left to the Oral and Maxillofacial surgeon. CAT scanning of the condylar processes is uncommonly performed but when a rare vertical fracture is suspected by an experienced clinician the investigation is invaluable.

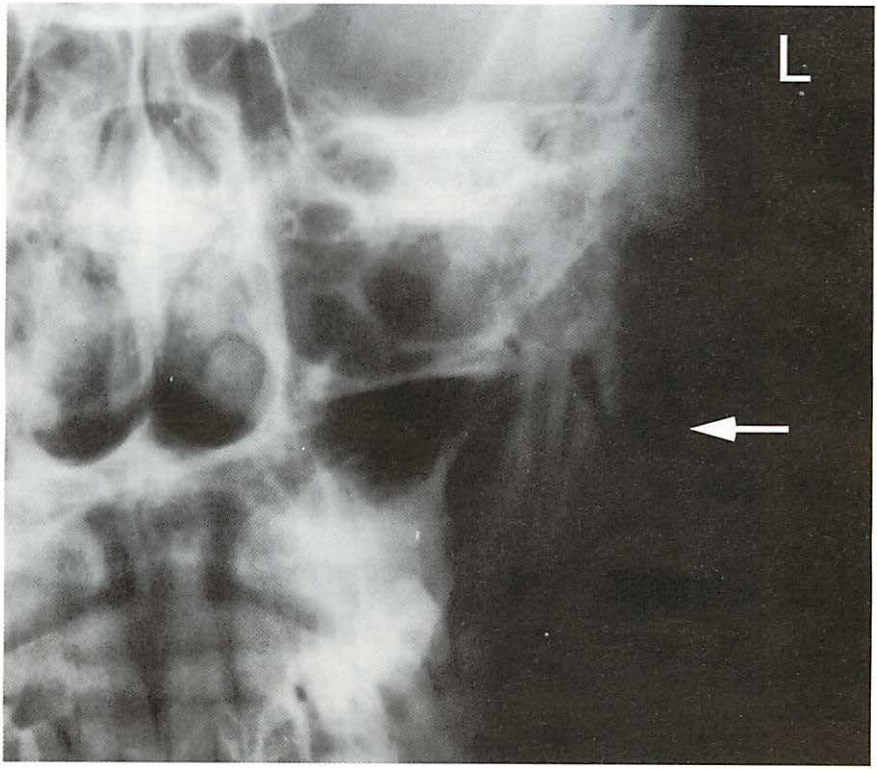
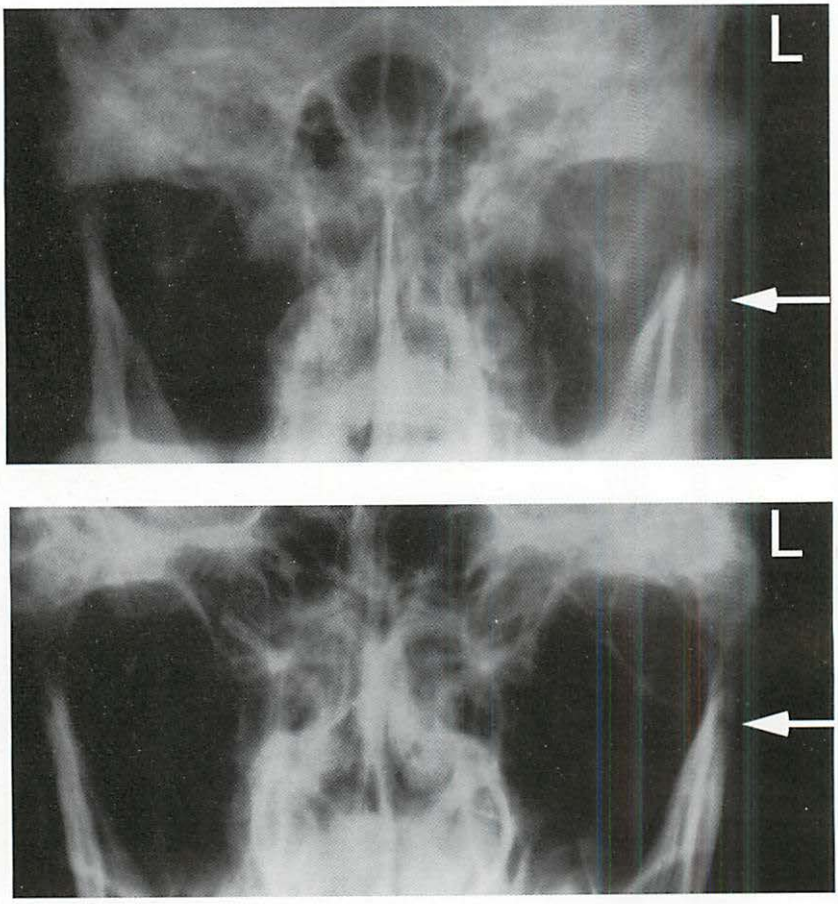


Figure 9
A posterior-anterior radiograph showing a fractured left mandibular condyle.

Figure 10
Reverse Towne's radiographs demonstrating fractures of the left mandibular condyles.



Treatment

Treatment of the condition has provided one of many challenges to the surgeon over the years and is still a controversial subject. One of the oldest documents on the subject is DeSault's (1805). He recognised that bony union of the fractured bone ends might not result if the slightest movement of the jaw occurred during the healing process. He also noticed that lack of bony contact of the fractured ends produced a large callus which rendered the condyle irregular and deformed and was likely to impede function of the jaw.

There are essentially only two philosophies regarding the treatment of condylar fractures; either the fracture is permitted to heal without surgical intervention (conservative approach) or it is reduced by open operation.

The conservative treatment by means of intermaxillary fixation (see p 19) and/or functional therapy, does not allow the fragments to be positioned, which the open reduction techniques facilitate. The functional result of conservative treatment is dependent entirely on the accidental position of the fragments while the result of the operative procedure depends in addition on the skill and experience of the operator both in the application of methods to resolve normal anatomical relations and in the avoidance of operative complications.

Treatments as diverse as open reduction with intra-osseous fixation and intermaxillary fixation, immobilisation with intermaxillary fixation or non-immobilisation with intermaxillary fixation or non-immobilisation with emphasis on early movement and normal eating habits have all been recommended.

Thoma (1954) stated that the conservative treatment should be reserved for fractures with a favourable prognosis and any of the following was an indication for open reduction:-

1. A unilateral fracture with considerable overriding of the fragments, the operation being necessary to avoid derangement of the other joint.

2. A bilateral fracture with considerable overriding and resultant open bite.

3. Gross malalignment of the condylar fragment i.e. situated at an angle to the ramus and projecting over it.

4. A position of the condyle that causes interference with the movement of the jaw or limits its opening.

Thoma's appreciation of Kazanjian & Strock (1942) that "Much harm can be done by failing to recognise the fact that condyle fractures do well if no radical procedures are attempted and the operator contents himself with simple immobilisation" still applies today.

A conservative approach is recommended and if the patient can close their teeth in centric occlusion no treatment is required other than regular follow up. A growing child who sustains a fractured mandibular condyle should be seen at least annually for five years to ensure the condylar cartilage continues normal growth. Regular review will enable mal-development to be diagnosed early and corrective treatment instigated.

A patient sustaining a fractured mandibular condyle who is unable to close their teeth in centric occlusion should have intermaxillary fixation applied (see p 19) for at least three weeks.

Learning Points

Clinical Diagnosis

1. Pain and swelling over the fractured temporomandibular joint.

2. Trismus.

3. Gagging of the bite in the molar region of the affected side.

4. Deviation of the mandible to the fractured side on opening the mouth.

Radiographic Examination

1. Orthopantomograph or left and right lateral oblique views.

2. Towne's view.

3. Posterior-anterior (mouth open) of the mandible.

FRACTURES OF THE MANDIBULAR BODY

Clinical Diagnosis

The patient has a "hurt" expression and generally supports the jaw. Pain and inflammation over the fracture site and numbness over the distribution of the mental nerve on the fractured side with numbness of the lower lip are common complaints.

Difficulty with speech and swallowing occur when there is significant displacement of bone fragments and one should always appreciate the potential risk to the patency of the airway.

The mandible often has reduced movement and crepitus of the bone ends may be palpable and/or audible. A step deformity along the lower border of the mandible is frequently not palpable because of swelling of the soft tissues.

A derangement of the dental occlusion frequently results and closing of the teeth in centric occlusion is often not possible because of obstruction and/or pain.

Intra-oral examination often demonstrates a buccal and lingual haematoma adjacent to the fracture site. The teeth on either side of the fracture may become mobile and/or the roots become exposed with derangement of the arch of the teeth. Gagging of the occlusion can occur if bony fragments are fractured unfavourably and gross displacement has resulted.

Radiographic Examination

Radiographic examination confirms the diagnosis. An orthopantomograph (Figure 11), or left and right lateral oblique mandibular radiographs, in addition to a posterior-anterior view are essential (Figure 12). The periapical and occlusal dental views can give valuable information on the state of the teeth on either side of the fracture and should be taken if the tooth bearing part of the mandible is fractured. These views are best prescribed by the Oral and Maxillofacial surgeon.

CAT scanning of the mandible only infrequently adds significant information to a conventional examination and is only requested when gross comminution has occurred.

Figure 11
An orthopantomograph demonstrating a fractured left body of the mandible at the angle.

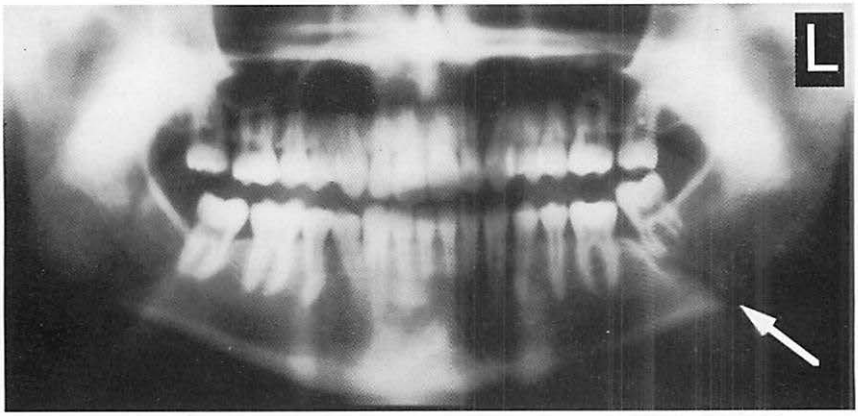
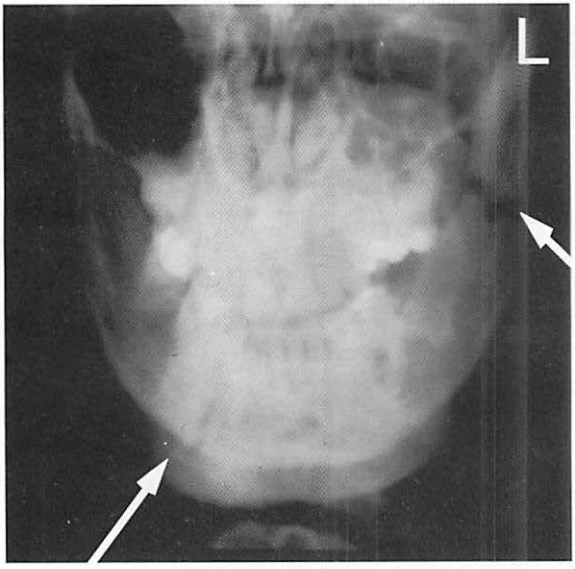


Figure 12
Posterior-anterior radiograph demonstrating a fractured left body of the mandible at the angle and right body in the mental area.



Treatment

A fracture of the mandible through the tooth bearing area must be considered compound because of the periodontal membrane of the tooth, which attaches it to the bone and is open to the mouth. Antibiotics should be prescribed and penicillin is the drug of choice unless otherwise contraindicated, in which case erythromycin is a useful alternative. Undisplaced fractures where the patient is able to close into centric occlusion require no active surgical treatment. Conservative treatment should be followed closely by regular review so that any complication can be speedily managed. However, most fractures resulting from assault occur among social groups 4 and 5 and attendance records of such patients tend to be poor. These patients and drug/ alcohol abusers attend when a complication has arisen and often require urgent treatment.

Most fractures of the body require reduction and fixation which can usually be achieved by the application of intermaxillary fixation. The principle of this treatment is that if the teeth are held in the correct alignment in centric occlusion, then the bone fragments will in turn be adequately reduced and fixed to allow bony healing to result. Teeth on either side of the fracture should be extracted if the roots are exposed or the pulp necrosed prior to fracture.

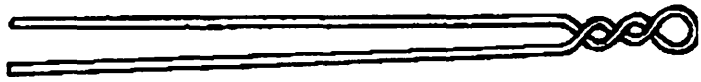
Intermaxillary fixation can be achieved using interdental (eyelet) wires, arch bars and Gunning splints either alone or in combination. The method of choice varies with the dental status of the patient, the degree of displacement of the bony fragments and the fracture pattern. Gunning splints attachment is via circum-mandibular, per (maxillary) alveolar and trans-nasal wiring and arch bar fixation may be improved by such wires.

Clearly, a fracture of the mandible distal to the last permanent molar will require fixation in addition to intermaxillary fixation. There are many techniques, which include an upper border wire, a lower border wire and a mini-plate (Figure14). It is a good principle always to apply intermaxillary fixation for a period, usually up to 6 weeks, to ensure a good occlusion, even though a plate appears to hold a fracture perfectly in place.

Systematic follow up is on a weekly basis whilst intermaxillary fixation is in situ. Fixation (including Champy plates) is usually removed under a local anaesthetic when bony union is established. Long term follow up of satisfactory results is not necessary.

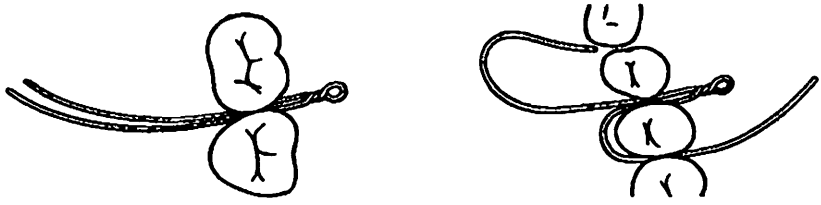
Eyelet Wiring

Eyelet wiring is one of the simplest and most effective methods of applying intermaxillary fixation for dentate patients who have a complete or almost complete dentition.



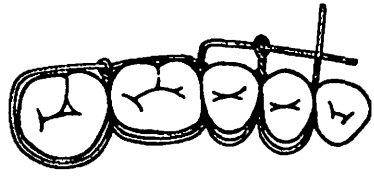
An Eyelet Wire

Eyelets are constructed from 0.4 mm soft stainless steel wire that has previously been stretched by 10%. The pre-stretching prevents loosening of the wires subsequent to wiring, but care must be taken not to overstretch the wires, as work hardening will occur and the wires will fracture.



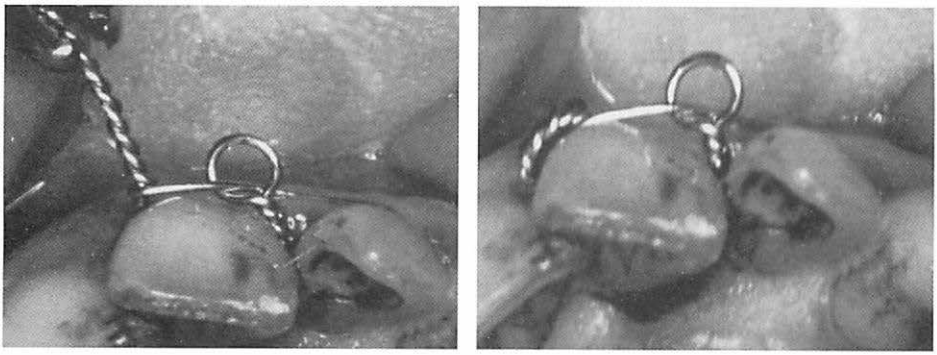
Inserting an eyelet wire

Numerous techniques are described for eyelet wiring. A satisfactory method is to pass an eyelet between two teeth and then return each wire from the deep surface around one tooth, on either side of the eye.

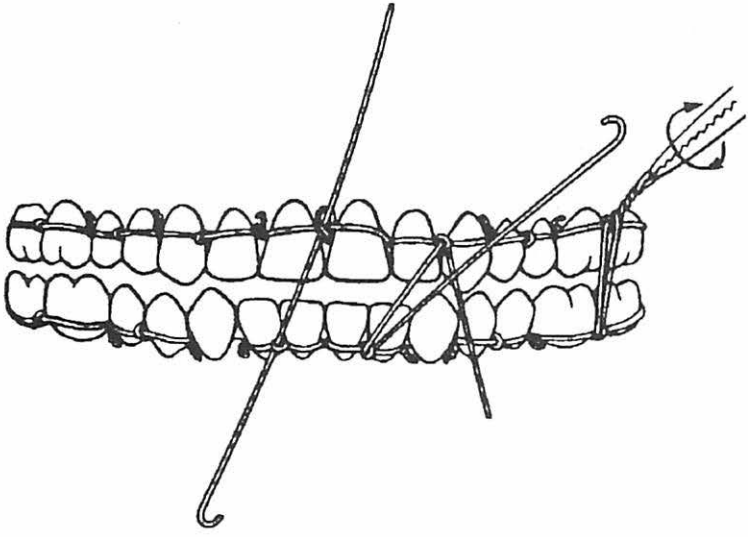


Completing the fitting of an eyelet wire

One wire is passed through the eye and the two ends are twisted together in a clockwise direction, cut short and the end turned towards the gingivae.



An eyelet wire being placed on a patient

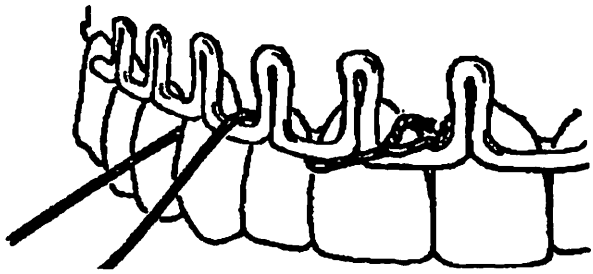


Applying intermaxillary fixation using eyelet wires

The application of eyelets around the maxillary and mandibular teeth will permit the fractured mandible to be fixed to the maxilla in centric occlusion by passing the wires in an inverted V pattern through the eye of each eyelet. When working under a general anaesthetic, a tongue suture should be inserted so that the tongue can be pulled forward if the organ obstructs the airway. A pair of wire cutters should be readily available to cut the tie wires, should the airway become obstructed for any reason. Anti-emetic drug therapy should be given prophylactically as vomit can cause an acute airway obstruction.

Arch Bars

Wiring an arch bar to the maxillary teeth

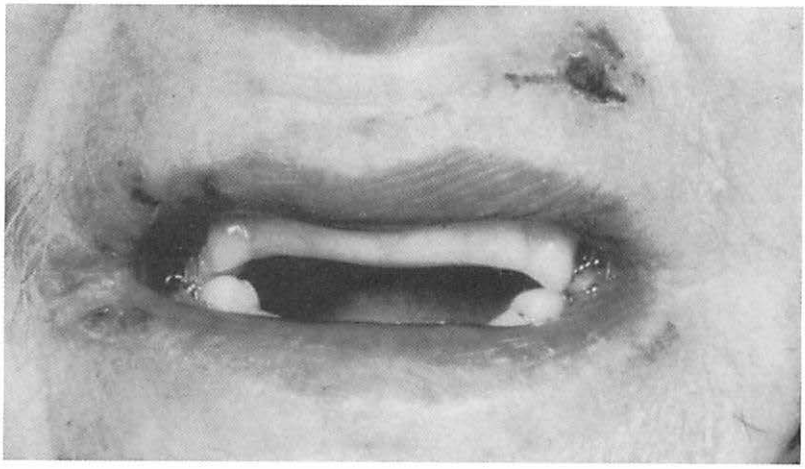


Another effective method of applying intermaxillary fixation is by the use of prefabricated arch bars. The arch bar is cut accurately to the length of the maxillary and mandibular dental arches. The two arch bars are then systematically attached to the teeth of the maxillary and mandibular arches using 0.4mm soft stainless steel wire. The wire is passed around the tooth below the medial and distal interdental spaces of selected teeth and one above and below the arch bar on the surface of the teeth. The wire ends are twisted together in a clockwise direction to form a loop around the tooth and arch bar. Wires are placed around a number of teeth to firmly attach the arch bar to the dental arch and the cut wire ends turned into the gingivae. Intermaxillary fixation is then applied by passing 0.4mm stainless steel wire around the arch bar lugs.

Gunning Splints

Treatment of edentulous cases requires the construction of splints that can be wired to the maxilla and mandible to enable intermaxillary fixation to be applied. Impressions of the upper and lower ridges will allow a technician to construct the splints and the patient's dentures should be retained to allow the correct jaw relationship to be reproduced in the splints. When no technical help is available the dentures can be adapted to serve as splints. Circum-mandibular wires placed around the lower splint will hold it firmly in place on the mandibular alveolar ridge and three wires are usually sufficient. A transnasal wire placed around the maxilla, attached posteriorly and anteriorly around the upper splint, will hold the upper splint in position. Intermaxillary fixation can then be applied using the cleats on the splints (Figure 13).

Figure 13
A patient with intermaxillary fixation using Gunning splints.



Complications

The application of intermaxillary fixation under a general anaesthetic compromises the airway of a recovering patient. Effective control of the tongue via an externally presenting suture is essential in the immediate postoperative period and patients are always nursed with wire cutters immediately available. Meticulous surgery after passive stomach emptying, prophylactic anti-emetic therapy and skilled nursing care reduce the probability of postoperative inhalation of blood or vomit.

Tooth pulp necrosis and related dental abscess may occur as a late manifestation of the original trauma.

Some patients in fixation, when an out patient, indulge in excessive alcohol drinking with potentially fatal consequences. Others remove the intermaxillary fixation themselves and precipitate the unexpected, but non-union, fibrous union and/or union in malposition are rare events.

Skilled treatment under antibiotic cover cannot stop, in some cases, infection and even osteomyelitis. Bone with inadequate blood supply may sequestrate, in spite of determined conservative management and attention to oral hygiene. Complications may lead to significant morbidity and require complex rehabilitation but are fortunately uncommon.

Figure 14
An orthopantomograph showing a bilateral fracture of the mandible treated on the left with a Champy plate and on the right with a lower border wire.

Learning Points

Clinical Diagnosis

1. Pain and swelling over the fracture site.

2. Limitation of mouth opening and mandibular movement.

3. Deranged occlusion with gagging of the bite on the affected side.

4. Numbness of the mental nerve on the fractured side.

5. Difficulty in speaking and swallowing.

Radiographic Examination

1. Orthopantomograph or left and right lateral oblique views.

2. Posterior-anterior view of the mandible (mouth open if possible).

3. Towne's view for fractured condyles.

THE FRACTURED MAXILLA

The face both protrudes and hangs from the skull and for reference it is anatomically divided into upper, middle and lower thirds. The mandible is the skeleton of the lower third and the frontal bone that of the upper. The skeleton of the middle third is made up of the maxillae, nasal bones, ethmoids and vomer and the zygomatic bones. Fractures of the middle third of the face are often referred to as fractures of the maxilla(e) because these bones make the greatest contribution.

Aetiology and Incidence

Fractures of the middle third of the face are the least common of civilian facial features. However, while legislation for the compulsory wearing of seatbelts in cars has reduced their incidence from road traffic accidents involving cars, the compulsory wearing of crash helmets for motorcyclists has increased their incidence from motorcycle accidents because more patients, with severe head injuries, are surviving their accidents.

Classification of Maxillary Fractures

The most universally accepted classification of fractures of the middle third of the face is that formulated by Rene Le Fort in 1900. He concluded that the fractures are generally of three types (Figure 15).

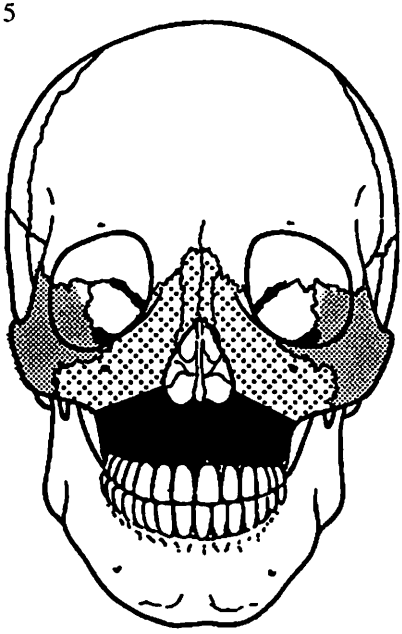
Le Fort I Fractures

The Le Fort I fracture runs from the anterior nasal aperture laterally below the zygomatic buttress through the lateral wall of the maxillary antrum, then posteriorly through the lower third of the pterygoid laminae. In addition, the fracture passes through the lateral wall of the nose and joins the lateral fracture behind the tuberosity (Figure 15) bilaterally, thus detaching the maxillary teeth from their base.

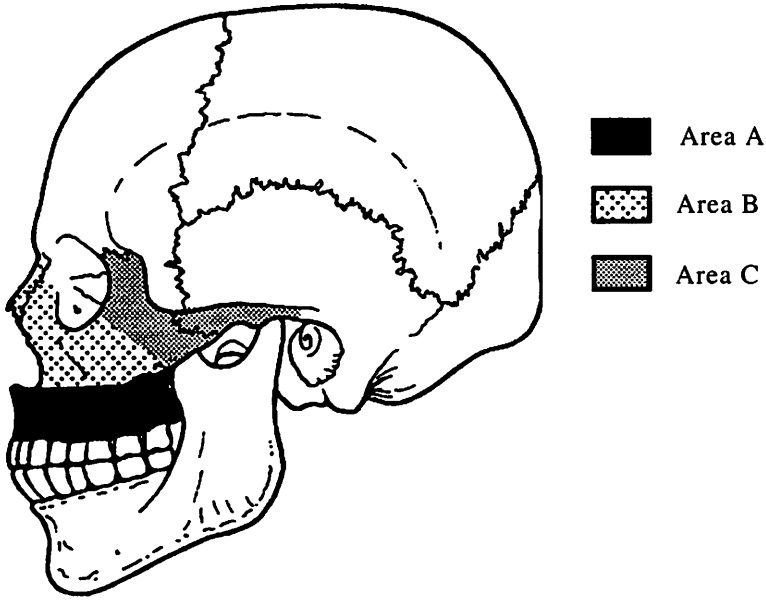
Le Fort II Fractures

The Le Fort II fracture runs from the middle area of the nasal bones down either side laterally across the frontal processes of the maxillae, across the lachrymal bones, and then downwards and laterally through the inferior orbital margin at or about the zygomaticomaxillary suture. In addition, it runs down the infraorbital foramen and along the lateral wall of the antrum beneath the zygomatic buttress, across the pterygomaxillary fissure (Figure 15) and through the pterygoid plates, thus detaching the structure from its base.

Figures 15



Le Fort classification of fractures of the maxilla: in Le Fort I fractures area A becomes mobile; in Le Fort II fractures areas A + B become mobile; in Le Fort III fractures areas A + B + C become mobile.



Le Fort III Fractures

The Le Fort III fracture runs bilaterally from the frontonasal suture, the nasal bones and lachrymal bone, and runs across the thin orbital plates of the ethmoids, around the optic foramen and downwards laterally to the medial aspect of the posterior limit of the inferior orbital fissure. In addition, it runs across the upper posterior aspect of the maxillae, across the pterygomaxillary fissure and the pterygoid laminae, and crosses the lateral wall of the orbit separating the zygomatic bone from the frontal bone (Figure15). This fracture separates the face from the base of the skull.

Clinical Signs and Symptoms

Le Fort I Fractures

Gross facial swelling or facial disfigurement is generally not a feature of Le Fort I fractures, although oedema around the upper lip may occur. Soft tissue injury of the upper lip with tearing of the gingivae frequently results from the causative blow. The most common significant feature of this injury is the mobility of the upper dentoalveolar portion of the jaw which is frequently mobile to digital pressure. Malocclusion may result if the fragment is displaced and impacted. Emphysema can result if the patient blows his nose to free the airway, although bilateral epistaxis rarely results. Percussion of the maxillary teeth produces the dull, 'cracked cup' sound, while ecchymosis in the buccal sulci is a frequent finding. The midline may he displaced to one side and the maxilla can drop to reduce the size of the oral cavity. Occluding the teeth raises the maxillary fragment to the correct position in non-impactcd fractures.

Le Fort II Fractures

Marked facial disfigurement resulting from circumorbital ecchymosis and gross oedema is a common feature of Le Fort II fractures. Frequently, the patient cannot open his eyelids to allow a complete ocular examination because of the oedema. It is important to examine the patient's vision, as damage to the eyes may go unnoticed. Subconjunctival haemorrhage occurs, the posterior limit of which cannot be detected. Enophthalmos resulting from comminution of the orbital floors with loss of orbital fat into the maxillary sinuses results, but it is difficult to detect in the early stages. Considerable lengthening of the face with gagging of the molar teeth occurs, but it is masked initially by the oedema. Displacement of the nasoethmoidal complex results in a broadening of the nares and bridge of the nose, which causes nasal

disfigurement. Measurement of the intercanthal distance (normally 30 mm) will give an indication of ethmoidal disruption.

Bilateral epistaxis is common, and cerebrospinal fluid may leak from the nose or run posteriorly down the pharynx, which can prejudice the airway and may be missed by the inexperienced clinician. The loss of the maxillary prominence from grossly posteriorly displaced fractures has given rise to the description of the condition as 'dish-pan face', which becomes apparent only after the initial oedema has resolved.

Le Fort III Fractures

Clinically, the Le Fort III fracture appears to be similar to the Le Fort II fracture, but closer examination will demonstrate a more serious condition. This injury commonly occurs in conjunction with additional injuries to other parts of the body, and the patient may well be unconscious. Bilateral ecchymosis that is circumorbital often closes the eyes completely. As in Le Fort II fractures, the posterior limit of subconjunctival haemorrhage cannot be seen. Examination of the eye may confirm bilateral subconjunctival haemorrhage, enophthalmos and diplopia resulting from the limitation of ocular movements from trapped or damaged extraocular muscles (if present). The nasoethmoidal area is frequently grossly disrupted, and cerebrospinal fluid appears with a bilateral epistaxis or runs posteriorly down the pharynx. Damage to the optic nerve is rare and can be the result of disruption of the optic canal.

The face is lengthened because of the loss of facial bony fixation to the base of the skull. Gross oedema often masks this deformity, as it does the flattening of the face from the disrupted zygomatic bones. The fracture passes above Whitnall's tubercle and so support by Lockwood's suspensory ligament is lost. This results in 'hooding' of the eye from the upper lid, which becomes obvious once the initial oedema resolves. Palpation of the zygomatic areas demonstrates step deformities and tenderness over the fractures. Gripping the maxillary teeth with one hand while touching the bridge of the nose with the other hand, and simple manipulation, will confirm complete freedom of movement of the middle third of the face in non-impacted fractures. Gagging of the occlusion often occurs, and gross displacement of the maxillary and mandibular midlines may be apparent. The airway may be impaired if the fracture has resulted in gross posterior displacement such that the soft palate is touching the posterior aspect of the tongue. Articulation is difficult and often unintelligible. As with the Le Fort II fracture, percussion of the maxillary teeth produces the 'cracked cup' sound.

Radiographic Examination

Fractures of the middle third of the face can be difficult to diagnose accurately from radiographs. The gross facial oedema destroys the radiographic contrast which is essential to the perception of disruption of slender bony processes and suture lines. The medical condition of the patient compromises ideal patient positioning. Subtle signs of severe trauma may be missed unless a threshold of suspicion is raised by a comprehensive clinical examination.

Radiographic examination should include 15° and 30° occipitomental views (Figures 3 and 4) and a lateral skull (brow-up for evidence of fluid in frontal or sphenoidal sinuses) view (Figure 16c); submentovertex (Figure 5) and cranial (posterior anterior and lateral) views are essential. The diagnosis may be missed completely if the radiographs are viewed alone without a clinical examination of the patient to demonstrate some of the above signs and symptoms.

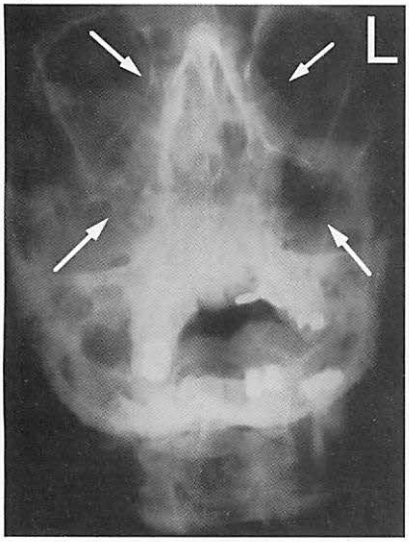
The occipitomental views will show any disruption to the infraorbital rims, the lateral wall of the maxillary antra, or the nasal bones and septum (Figure 16 a,b,c,d). The lateral skull view will illustrate the degree of maxillary displacement in the anteroposterior direction (Figure 16c).

The submentovertex view will show any displacement of the zygomatic arches (Figure 5). Intraoral, periapical and occlusal views will indicate clearly fractures of the alveolar bone, palate or roots of the teeth, and are the most commonly requested views by the Oral and Maxilliofacial surgeon. The cranial views will demonstrate any concomitant fracture of the skull.

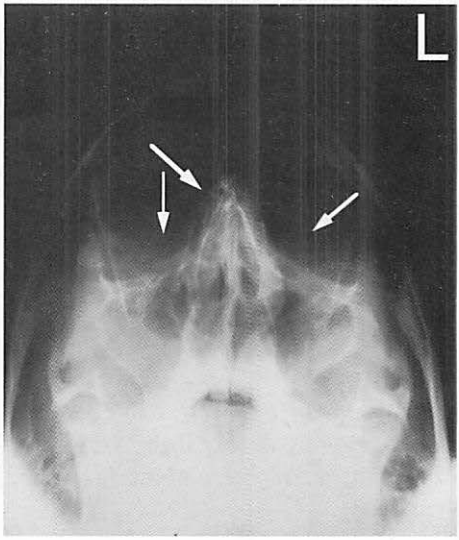
It is wasteful of resources and detrimental to the patient to officiously search after radiographic information prior to referral to an Oral and Maxilliofacial unit because poor quality radiographs frequently result and are inevitably repeated.

CAT scanning, when available, is the imaging modality of choice especially if significant head injury is associated with the facial fracture.

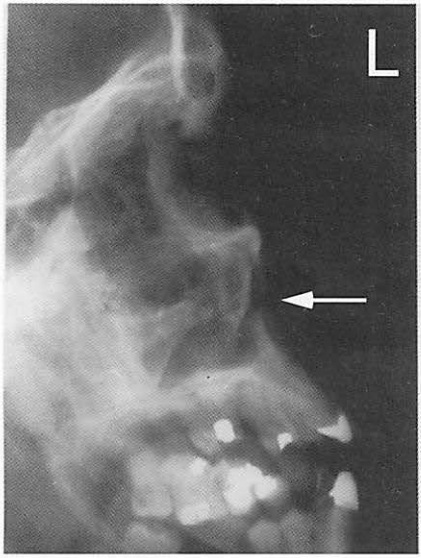
Figure 16



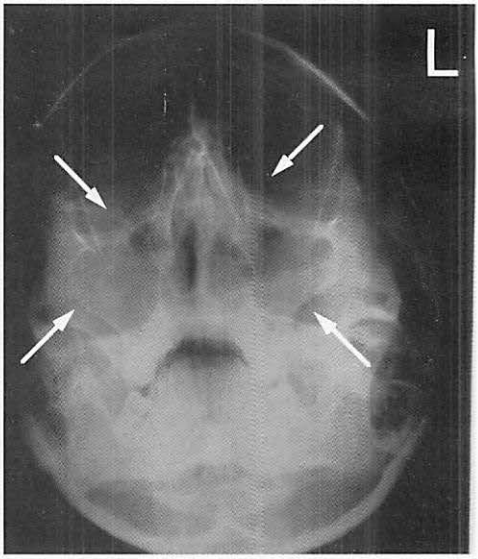
a) An occipitomental radiograph demonstrating a grossly comminuted middle third fracture.



b) A 30° occipitomental radiograph showing a displaced Le Fort II fracture.

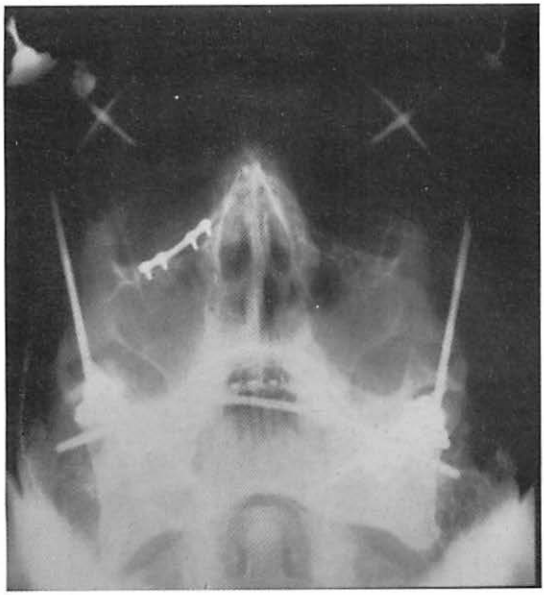


c) A lateral skull radiograph showing a Le Fort I fracture.

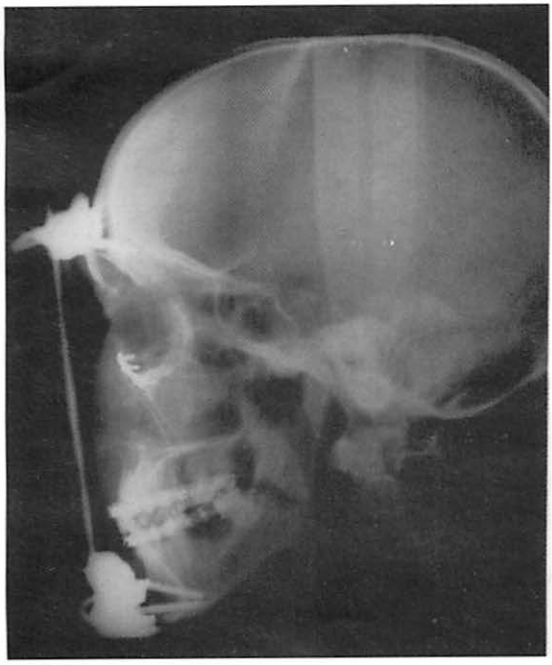


d) A 30° occipitomental radiograph showing a Le Fort III fracture with disruption of the nasoethmoidal complex.

Figure 17

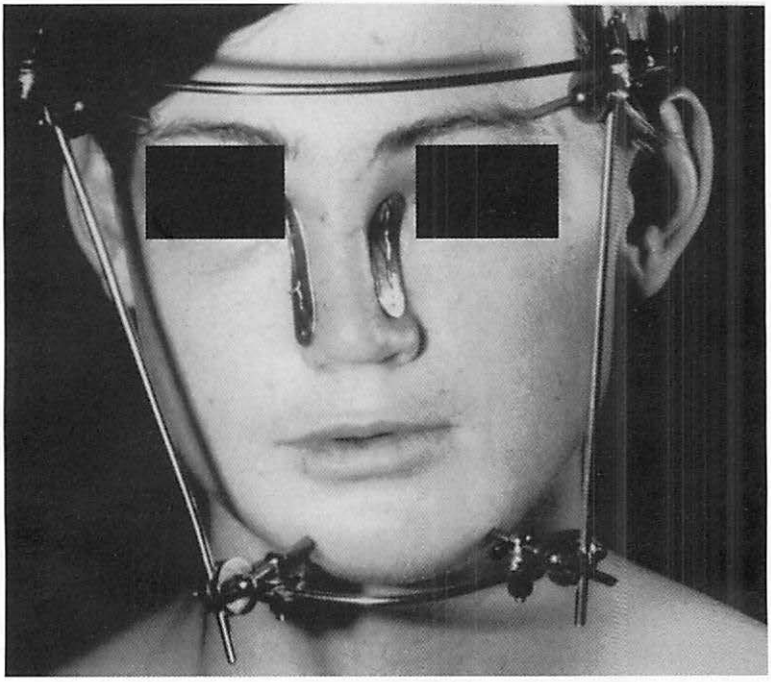


a) A 30° occipitomental radiograph showing a reduced and fixed Le Fort II fracture of the maxilla by a Champy plate and Mount Vernon box frame.



b) A lateral skull radiograph showing a reduced and fixed Le Fort II fracture of the maxilla by a Champy plate and Mount Vernon box frame.

Figure 18
A Mount Vernon box frame and nasal lead plates in position reducing and fixing a fracture of the maxilla and nasoethmoidal complex.



Treatment

Most fractures of the middle third of the face cause a dramatic clinical appearance and immediate action to secure an airway is required. Intubation and/or a tracheostomy may be necessary. Dentures, loose teeth and tooth restorations should be removed immediately from the patient's mouth, otherwise they could be inhaled. If expert assistance is not initially available, the patient should not be positioned lying on the back but lying on the side or face down to allow blood or secretions to flow from the face.

Prophylactic antibiotics should be prescribed routinely; penicillin is the drug of choice, or erythromycin if the patient is hypersensitive to penicillin.

Except in the most exceptional circumstances endo-tracheal general anaesthesia is employed with anti-emetic cover and it is not at all unusual for the reduction and fixation of the displaced facial bones to be performed concurrently with other major procedures. If it is possible the patient is counselled as to the post operative situation.

The repair of fractures of the middle third of the face is the same as that for all fractures; that is reduction, fixation and subsequent rehabilitation.

Reduction is obtained by manipulation, and impacted fractures will require disimpaction, with special forceps. By using the teeth as a guide, the fractured maxilla can be attached to the mandible by the eyelet wiring or arch bar technique or Gunning splints if edentulous (see p 22). This technique will enable the fractured maxilla to be assembled and the occlusion re-established. In some cases it will be all that is required, apart from preventing movement of the mandible by suspensory wires, mini-plates, box frame (Figures 17a, b and 18) or halo techniques. Craniomandibular fixation prevents any gross movement of the mandible that is carrying the fractured maxilla and provides good fixation. Suspensory wires have more limited use, as the zygomatic arches may be disrupted. In addition, a frontal or other bone suspensory wire will require an extraoral incision, which will leave a scar.

Craniomaxillary fixation can be used to treat maxillary fractures (Figure 18), but this will require the construction of metal cap splints or a similar structure to enable the teeth to be held rigid to the cranium. This technique may allow the mandible to move freely during the healing stage, but tends to be an inferior technique to craniomandibular fixation as the re-establishment of the correct occlusion is less likely.

Many treatments for fractures of the middle third of the face will require intraosseous wiring and/or mini-plates by open reduction (Figure 17 a and b), particularly if the fracture involves the nasoethmoidal complex.

Conclusion

Maxillary fractures should always be considered as possible components of any gross injury to the face. Specialist referral to an Oral and Maxillofacial surgeon is advisable to confirm the diagnosis and for treatment. Failure to diagnose the condition may result in bone healing in an incorrect position, resulting in gross malocclusion and facial deformity, which can be treated only by refracturing the middle third of the face.

Learning Points

1. Secure an airway immediately, removing any dentures, loose teeth or loose dental fillings from the month.

2. Do not take special facial radiographs immediately. Wait until the patient is stable and able to cooperate with the radiographer.

3. A working diagnosis can be made by a good clinical examination.

4. Prophylactic antibiotics should be prescribed immediately.

5. The patient should be seen by an Oral and Maxillofacial team as soon as possible.

Reference and Further Reading

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