

53 Facial injury

53.1 Introduction

A patient with a severe facial injury may make you think you can do nothing for him. *This is not so!* Such injuries are usually the result of road accidents, assault or gunshot wounds.

Remember to protect the airway & cervical spine while assessing any maxillofacial injury.

Facial deformity will affect someone's life forever and has very personal consequences. Furthermore, not only breathing, but eyesight, chewing, swallowing, talking, smelling and hearing may be implicated in facial trauma.

Fractures of the middle facial 1/3 are complex and invariably multiple, sometimes with >50 fragments. The oral cavity and the sinuses have very specific bacterial flora and contamination from these sources is always an issue in facial trauma. A good blood supply usually prevents infection, but may provoke serious haemorrhage (which may be hidden, in the mouth or sinuses). Cranial nerve damage is not infrequent, and the infra-orbital and superior dental nerves are often affected. As the face is not limited by bony structures, post-traumatic oedema is usually gross.

If the maxilla is pushed downwards, the soft palate is pushed against the tongue (53-1D) and the airway is blocked.

If the alveolus becomes loose & drops onto the lower teeth, the upper molars jam into the lower and prevent jaw closure.

If the orbital floor breaks, the eye muscles may be trapped and cause diplopia (52.12).

If the temporo-mandibular joint is injured, the jaw may dislocate and make chewing impossible.

If the ethmoid bone fractures, the dura mater may be torn, and CSF leaks from the nose. (Drop the fluid emerging onto a filter paper: CSF will make a large ring around the central blood clot)

If the naso-lachrymal duct is injured, tears will flow out of the eyes.

MIDDLE FACIAL INJURY

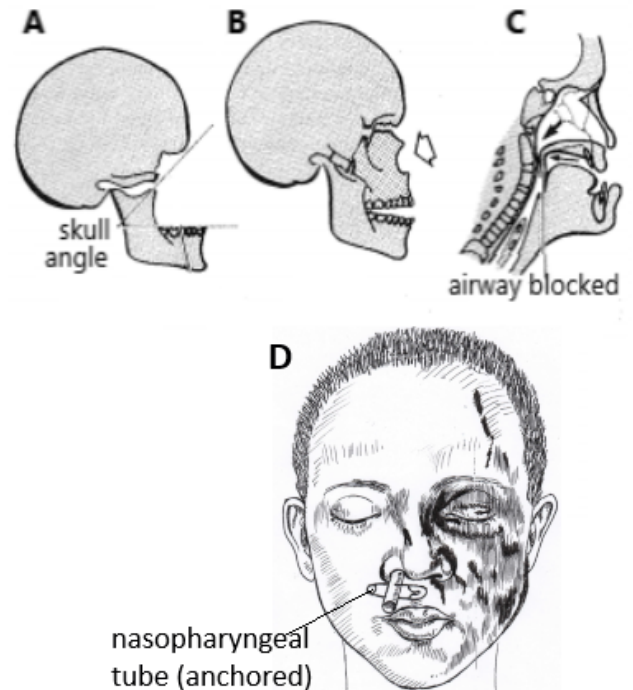


Fig. 53-1 MIDDLE FACIAL INJURY. A, the angled plane of the front of the skull. B, the maxilla pushed back, C, causing airway obstruction, D, relieved by nasopharyngeal intubation. After Killey, HC, *Fractures of the Middle Third of the Facial Skeleton*, Wright, Bristol 2nd ed, 1971, with kind permission.

IMMEDIATE TREATMENT

With facial injuries, *always pay attention to the airway!* Ask the patient to say his or her name!

N.B. Oedema may cause respiratory problems later!

Check to see if obstruction is due to:

- (1) blood, vomit, debris, loose teeth, dentures or foreign bodies in the pharynx,
- (2) the soft palate pushed onto the back of the tongue,
- (3) the tongue falling back because the mandible is loose.

TRANSPORT OF FACIAL INJURIES

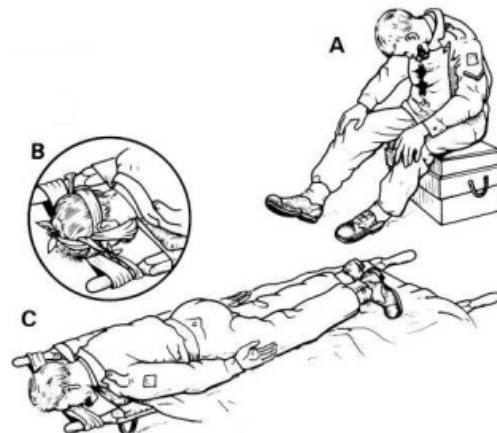


Fig. 53-2 TRANSPORT OF FACIAL INJURIES A, the conscious patient sitting up & leaning forwards. B, C the severe injury lying prone with the forehead supported. After After Killey, HC, *Fractures of the Middle Third of the Facial Skeleton*, Wright, Bristol 2nd ed, 1971, with kind permission.

Aspirate the mouth & pharynx, and remove any loose objects. *Take care not to provoke retching* as this may provoke more bleeding or vomiting.

If there is a mechanical obstruction, *push a nasopharyngeal airway down one or both sides of the nose*. Place a safety pin through the tube to prevent it slipping down the nose.

N.B. Keep the tube sucked out frequently!

If the tube kinks or you cannot pass it easily, proceed immediately to a cricoido-thyroidotomy (42.3) or tracheostomy.

(1) *Don't try inserting a Guedel oropharyngeal airway: it won't work!*

(2) If the tongue keeps falling back because the mandible is loose in an unconscious patient, pull it forward with a suture, or towel clip and attach this to the chest wall.

(3) A conscious patient may be much more comfortable sitting up (53-2A).

(4) A severe jaw injury may be best transported lying prone, with the forehead supported (53-2B).

(5) *Don't try to pass an endotracheal tube (especially through the nose)!*

(6) Most major facial injuries & those with significant bone loss to the mandible need a tracheostomy.

N.B. An immediate life-saving procedure is to hook 2 fingers round the back of the hard palate, and pull the maxilla back up the inclined plane of the skull. This however needs considerable force and the fracture may be impacted. In this case don't waste time trying.

For troublesome haemorrhage, place adrenaline packs against the bleeding site, or as nasal or anterior & posterior postnasal packs.

If there is an injury cavity, insert a Ch20 Foley catheter and inflate the balloon to produce tamponade.

N.B. A conscious patient can swallow a large amount of blood, which may reappear as a haematemesis!

HISTORY

Try to obtain a reliable history of what happened.

N.B. A patient may not be able to talk because of:

- (1) an obstructed airway,
- (2) cerebral trauma, or
- (3) a dislocated jaw.

Is movement of the jaw painful?

Once you have followed the ABC rules, gently wash the face with clean warm water.

LOOK

Look inside the mouth with a good light for loose objects, lacerations, or bruising. See if the tongue moves normally.

Gently swab away any clotted blood. Lift any loose pieces of tooth and alveolus out of the mouth.

Check for facial asymmetry.

Look if the nose is flattened or deviated. Check if the septum is in the midline. Is there a fluid leak?

Check for jaw opening & closure. See if the teeth occlude properly. Does the jaw open abnormally?

Is there dribbling of bloody saliva? Is swallowing or talking easy or not?

Check for depression or angulation of the zygoma (53-3D, F)

See if the palpebral fissure is oblique (53-3B)

Look at the eyes and check the vision (52.1)

Examine the ears for bleeding. Put both your little fingers into the ears and compare the movement of the condyles.

(If you cannot feel a condyle moving, suspect a fracture.)

EXAMINATION OF A ZYGOMATIC INJURY

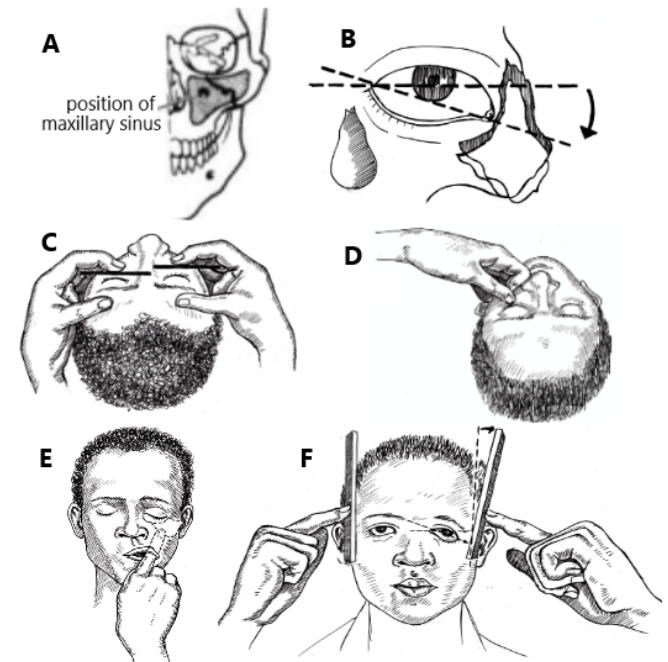


Fig. 53-3 EXAMINING A ZYGOMATIC INJURY A, the zygoma forms the prominence of the cheek and the floor & lateral orbital wall. The maxillary sinus extends into it. B, if a fragment of the zygoma is displaced downwards, the lateral canthus will also be displaced downwards, and the palpebral fissure will be oblique. C, press gently: if the body of the zygoma is depressed, one finger will be lower than the other. D, press gently on the lower border of the orbit, you may elicit tenderness and feel a fracture between the zygoma and the maxilla. E, feel inside the mouth for a fracture in the lateral wall of the maxillary sinus. F, place rulers against the zygomas to check deviation (if the patient has a slim face). After Watson-Jones R, *Fractures & Joint Injuries*. Churchill Livingstone 6thed. 1982.

FEEL

Palpate the bones of the maxilla & mandible externally. Are they abnormally mobile?

Feel both the condyles with the tips of your fingers. Feel downwards along the borders of the mandible.

Feel for tenderness, step defects, alterations in contour, and crepitus.

Feel inside the mouth for the lateral wall of the maxillary sinus. Examine the buccal and lingual sulci.

N.B. Bruising in the buccal sulcus does not necessarily indicate a fracture, but in the lingual sulcus almost certainly does.

Palpate the mandible down the whole length of each sulcus carefully. If you suspect a fracture, can you make the fragments move relative to one another?

Palpate all the teeth & check if they are mobile. Tap them to hear a 'cracked cup' noise.

Check for sensation on the cheeks & upper gums.

N.B. Radiographs are difficult to interpret, and involve turning the patient into a position which may obstruct the airway. Try to get: (1) AP & oblique views of the mandible. (2) An occipito-mental (Waters/Blondeau) view of the skull (29-8) to look for filling of the maxillary sinuses, and irregularities in the outlines of the mandible.

TREATMENT

- (1) Attend to airway problems & haemorrhage immediately first.
- (2) Thorough wound toilet in theatre is mandatory. This is not usually possible without GA. Unless the wounds are relatively simple, you should secure the airway, best by a tracheostomy. Scrub the skin with a toothbrush; only remove clearly necrotic or detached pieces of tissue. Use fine instruments & hooks to handle the skin.
- (3) Extract any foreign bodies, but leave any bone still attached to periosteum.
- (4) Repair mucosal lacerations with absorbable sutures.
- (5) Put petroleum jelly on the lips to stop them sticking together.
- (6) Commence antibiotic prophylaxis (gentamicin & metronidazole).
- (7) Protect the eyes if the patient is unable to close them or he is unconscious.

Remove all packs within 48-72h.

It is usually better to delay reduction and fixation of fractures till after 24-48h when swelling has subsided.

N.B. Most conscious patients can suck fluids round the sides and back of the jaw. The mouth needs rigorous rinsing after food.

If part of the cheek is missing, try to close the mucosa and muscular layers. Suture the buccal mucosa to the skin (61-4). If necessary, do the same with the nose.

53.2 Maxillary & zygomatic fracture

(1) Unilateral maxillary fracture

Here the alveolus holding the teeth becomes loose (53-4A). Reduce it to the correct position of bite and fix it by interdental wiring to the mandible (53-12); if this is also fractured, you need to fix this first (53.6)

(2) Bilateral maxillary fractures

Here there is gross malocclusion of the teeth (53-4G) and reduction may be difficult to hold by interdental wiring alone, so wire the zygomatic arch to the mandible, provided this is intact.

TYPES OF MAXILLARY FRACTURES

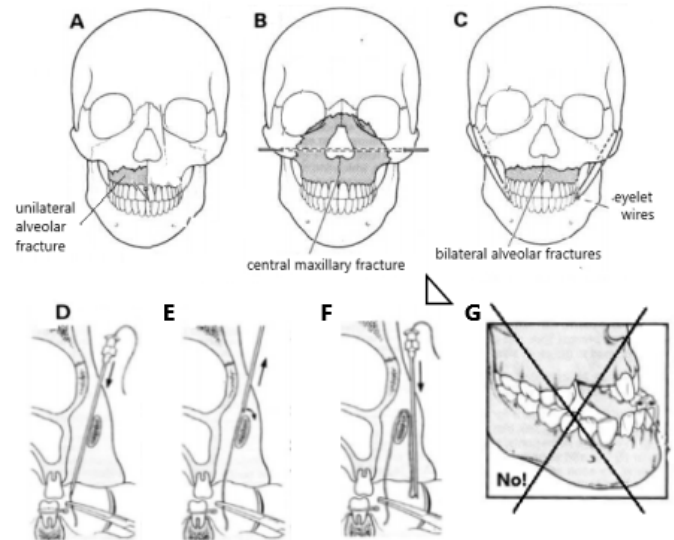


Fig. 53-4 MAXILLARY FRACTURES. A, a unilateral fracture in place. B, central maxillary fracture (which may occasionally be held with a transverse K-wire). C, wire round the zygomatic arches holding a bilateral alveolar fracture in place. D, pass a wire threaded in a needle medial to the zygomatic arch into the upper buccal sulcus, and down it. E, withdraw the needle partially. F, pass the needle lateral to the zygomatic arch pulling the wire along. G, *don't leave this gross malocclusion unreduced.* Kindly contributed by Susan Likimani & Andrew Curnock.

ZYGOMATIC ARCH WIRING (GRADE 3.1)

Use ketamine with LA to the gums.

Fix wire eyelets to the teeth on both sides of the lower jaw (53-12). Thread wire along a blunt aspiration or large lumbar puncture needle: push the needle through the skin just above the zygomatic arch and posterior to the outer canthus (53-4D), downwards medial to the zygomatic arch into the superior buccal sulcus. Thread the wire through the needle and grab it with a clamp; remove the needle gently to a point above the zygomatic arch, and push the needle down, pulling the wire with it, lateral to the zygomatic arch (53-4E), so that it emerges at the same point where it perforated the buccal mucosa before (53-4F). Hold this end of the wire in another clamp, and remove the needle; then tie the wires to the eyelets you have prepared.

Repeat the procedure on the other side of the face.

(3) Central maxillary (Le Fort II or III) fractures

These may be very difficult to reduce if impacted.

(4) Zygomatic fractures

A blow to the side of the face drives the zygoma inwards. The zygomatic bones are so closely joined to the frontal and temporal bones, that these bones usually fracture at the same time also. The displaced zygomatic fragment can rotate clockwise, or anticlockwise, and its orbital rim can be inverted or everted. *The floor of the orbit is always partly comminuted.* There may be diplopia & trismus.

Early on, the prominence of the cheek is flattened, but oedema fills it out within 3h. There is swelling & bruising beneath the eye. Test for deviation of the zygoma (53-3F) The maxillary sinus fills with blood, and there is epistaxis on the same side. Damage to the infra-orbital nerve makes the cheek numb, and displacement of the lower part of the orbit pushes the eye downwards, and restricts its movements (52.12).

In a gunshot injury, the maxillary sinus may be shattered, requiring packing. If the sinus remains relatively intact, you should drain in to avoid inevitable infection.

DRAINING BLOOD FROM THE MAXILLARY SINUS (GRADE 3.1)

Bleeding into the maxillary sinus may become infected, and may hide an orbital floor fracture. If the sinus is full, the space normally filled by air becomes full of blood: it sounds dull to percussion, and a lateral radiograph of the head will show opacification (29-8).

Make an opening under LA into the maxillary sinus (29.8) and wash out the cavity with warm sterile water.

If there is continued copious bleeding into the maxillary sinus, pass a Foley catheter into the sinus and inflate the balloon for a tamponade effect (52.11)

If only the zygomatic arch is fractured, movement of the coronoid process of the mandible is restricted. Fragments are held by the zygomatic fascia, and displace solely inwards. The temporalis fascia is attached to the superior border of the zygomatic arch, whereas the *temporalis* muscle is attached to the coronoid process. This means it is possible to pass an elevator between the fascia and the muscle, and lever the zygomatic arch outwards into place.

REDUCTION OF THE DEPRESSED ZYGOMA FRACTURE (GRADE 3.1)

Don't try to elevate the fragment, unless there is difficulty moving the jaw. Occasionally, passively opening the mouth may spontaneously reduce the zygomatic fragments and allow mouth opening, thus avoiding the need for surgical reduction.

Otherwise operate within the first 48h, because after 2wks, the ends of the fragments will have softened and rounded, and will probably need fixation by wiring; after 4wks they will have malunited, requiring open re-fracture, reduction, and fixation.

Use ketamine. Protect the eyes. Make a 2cm lateral incision in the temporal fossa, just above the level of the upper border of the pinna (53-5A), anterior to the superficial temporal artery. Reflect the skin, and divide the superficial fascia, under which is the *auricularis superior* or *anterior* muscle.

Spread its fibres (53-5B), vertically in the case of the former, horizontally in the latter, so you reach the thick *temporalis* fascia, which may have a double layer, covering the *temporalis* muscle (53-5C).

ELEVATION OF THE DEPRESSED ZYGOMA FRACTURE

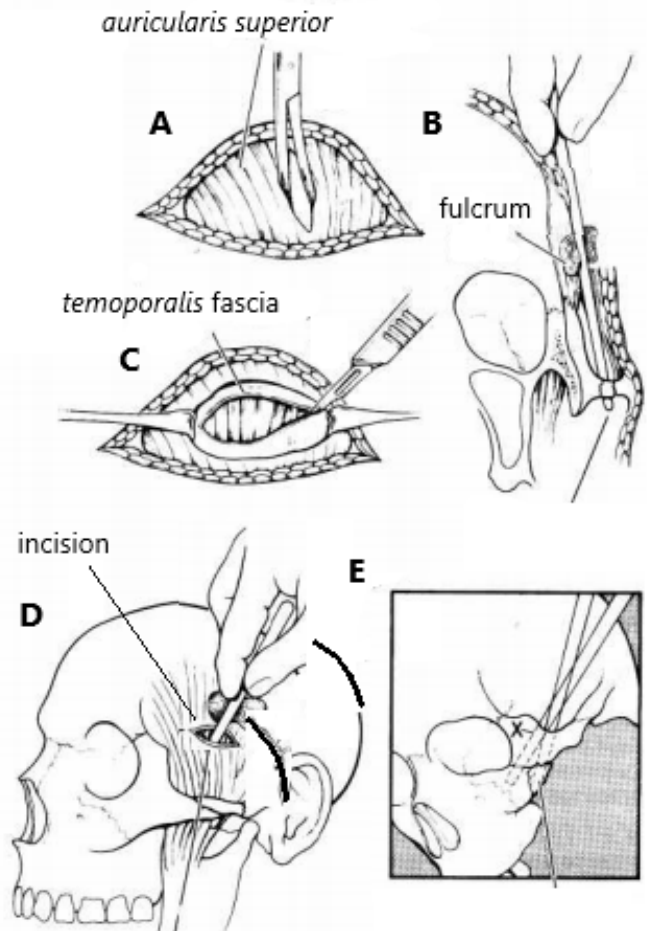


Fig. 53-5 ELEVATING A DEPRESSED ZYGOMA FRACTURE. A, separating the *auricularis* fibres. B, incising the *temporalis* fascia. D, passing the elevator through the incision along the *temporalis* muscle. E, levering the arch or body of the zygoma. Kindly contributed by John M Lore Jr.

Cut through this carefully in the line of the skin incision: *beware: there is often a vessel just deep to the fascia!* Insinuate Bristow's or McDonald's elevator (or a long flat screwdriver) between the muscle and fascia till it reaches the level of the zygoma (53-5D). Manipulate it so it lies behind the depressed section of bone. Using a solid object protected by a gauze swab as fulcrum, lever the zygoma laterally into a slightly over-corrected position (53-5E,F). Then close the fascia with absorbable and close the skin.

If the reduction is unstable, expose the fracture by blunt dissection through an incision over it. Take care to avoid branches of the facial nerve supplying the *orbicularis* muscle. Drill small holes in the bone and fix them together with strong stainless steel wire.

53.3 Tooth injury & alveolar fracture

The front of the upper jaw is most at risk in blunt trauma. The teeth may be damaged with or without the alveolus. Injured teeth don't threaten life, unless they are inhaled and block the airway. However, they are acutely painful, especially when the pulp is hanging out. Fragments of teeth may be embedded in the soft tissue of the mouth, or swallowed.

If the oral mucosa is torn, clean it, remove any foreign bodies & suture it with 4/0 long-acting absorbable.

If the crown of a tooth is detached, its exposed pulp will be visible as a pink spot on its root surface. Clean it and make a temporary covering with zinc oxide, calcium hydroxide, stomahesive or clear nail polish or moist cotton covered in foil. *Don't use bone wax!* It will be acutely painful, so if the pain remains intolerable, touch it with phenol on a small piece of cotton wool. This will kill and anaesthetize the nerve. Obtain a chest radiograph in case a fragment is missing.

If a denture is missing, it can likewise be inhaled or swallowed, but *may not be visible on a radiograph!*

If a tooth is loose, push it back in place; it will probably tighten up and survive. If it is still loose, with LA, fix it in place with interdental wiring and/or an arch bar (53.6).

In a child, extract any loose non-permanent teeth.

N.B. Beware of damaging tooth buds with drills or screws!

If a tooth is avulsed, and out of its socket <2h, clean it (*but don't scrub, touch or hold the root surface*) and applying LA to the socket, irrigate the socket of debris and push it back firmly in place. *Don't delay doing this waiting for radiographs! Don't let the tooth dry out!* Ask the patient to bite down onto gauze over the replaced tooth. Advise prophylactic penicillin V 500mg qds, and mouthwash. Brushing of adjacent teeth is still necessary! Remember protection against tetanus, and to provide analgesia.

N.B. Don't re-attach non-permanent children's teeth.

If a tooth is avulsed, and out of its socket >2h, the periodontal ligament and pulp will have died, so remove these. Soak the tooth in 5% sodium hypochlorite for 30mins. Then, if possible, for 5mins in each of saturated citric acid, 1% stannous fluoride, & 5% doxycycline before re-implanting the tooth.

N.B. Don't re-attach an avulsed tooth if there is a complicated crown fracture, a fractured root or an alveolar fracture.

If there is an opening between the sinus & the mouth, close this temporarily by packing with ribbon gauze impregnated with povidone. Change this daily with Bismuth iodoform paraffin paste (BIPP), or with petroleum jelly gauze. Provide prophylactic antibiotics. When the patient's general condition is stable, close the gap with a flap of mucosa from the adjacent cheek. Suture it carefully, with 4/0 long-acting absorbable.

Advise against blowing the nose or sneezing with the mouth open.

If the sinus is already infected, leave it open and irrigate it daily. *Don't pack it.*

If there is a comminuted alveolar fracture, and the bony fragment with its teeth is still attached to periosteum, leave it, and splint the teeth with an arch bar (53-12). If the alveolar fragment is completely detached, dissect it out and remove it.

53.4 Nasal fracture

Suspect a fracture after any blow on the nose. The nasal bones are superior to the nasal cartilage and form a tent-shaped covering for the upper nasal passages.

Sometimes the swelling hides the displacement of the nasal bones; there may be blood in the orbits and under the medial halves of both conjunctivae. Unreduced fractures result in deformities (53-6). Radiographs are usually unnecessary.

A severe force may:

- (1) Fracture the frontal processes of the maxilla.
- (2) Displace the nasal cartilages.
- (3) Dislodge the septal cartilage from its groove in the vomer.
- (4) Fracture the vomer.
- (5) Fracture ethmoid bones so CSF leaks in the nose.

CONTROLLING BLEEDING

Insert a gauze with LA & adrenaline for a few minutes, then pack the nose (29.7, 53-6). Treat the patient as soon as possible without waiting for the swelling to go down.

ANTERIOR & POSTERIOR NASAL PACKING

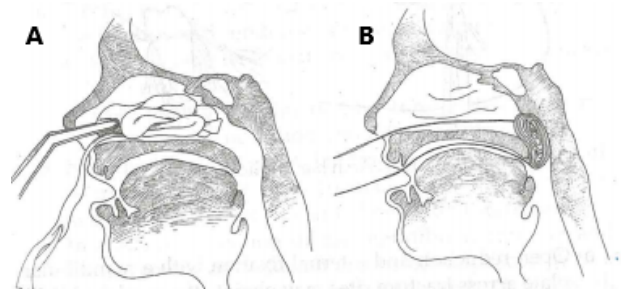


Fig.53-6 NASAL PACKING. A, anterior. B, posterior.

After Szul AC (ed) Emergency War Surgery. US Army 3rd ed 2004.

REDUCING NASAL FRACTURES (GRADE 2.3)

Spray LA into the nares. Protect the eyes. Clean the face thoroughly. Inject LA above the philtrum & above the bridge of the nose.

Use guarded Walsham's septal forceps (so their blades don't meet & crush the fine nasal bones) and pass the thin blade into the nose leaving the thicker guarded blade outside; disimpact the bones by a medial-lateral rocking movement (53-8A), and then lever the fragments into place.

DEFORMITY FROM UNREDUCED NASAL FRACTURES

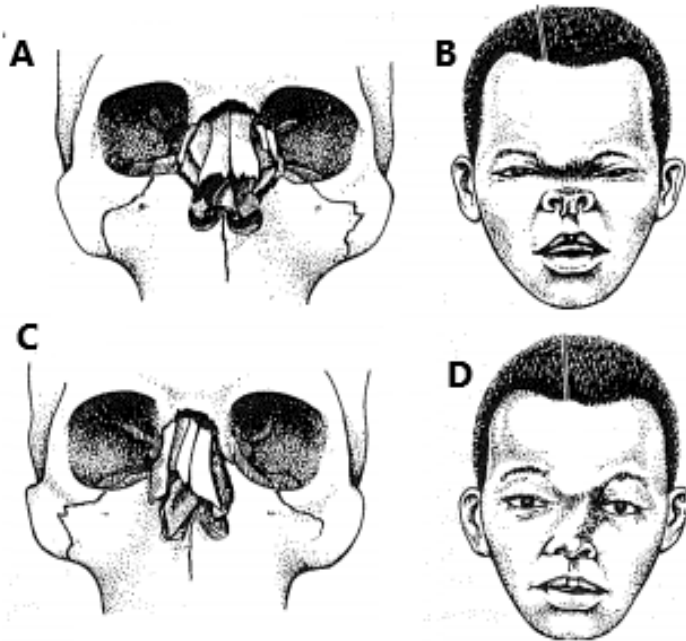


Fig.53-7 UNREDUCED NASAL FRACTURES. A,B depressed bridge from an anterior blow. C,D, deviation from a lateral blow. After After Killey,HC, *Fractures of the Middle Third of the Facial Skeleton*, Wright, Bristol 2nd ed, 1971, with kind permission.

Repeat the process on the contralateral side. Mould the bones into a symmetrical position with your thumbs. (53-8B).

Inspect the septum. If it is not reduced, pass both blades of the forceps, or any other suitable instrument, down each side of the septum and straighten it, so that it lies in the midline. If necessary, grasp the septal cartilage and bring it forward, to replace it in its groove in the vomer.

Then restore the full height of the bridge of the nose if this is collapsed by passing the thin blade along the nasal floor, closing the forceps and swinging them downwards to push the bridge up (53-8C)

Check there is a clear nasal airway by looking up & passing an instrument in the nasal passage. Pack both nostrils gently with BIPP to maintain the position for 48h. Splint the nose if the depression or deviation was severe. Get a malleable plastic and mould this into a T-shape to fit onto the nose.

If there is a septal haematoma, evacuate it immediately through a small mucosal incision, otherwise it will destroy the septal cartilage and produce a saddle nose (53-7B).

REDUCING A NASAL DEVIATION

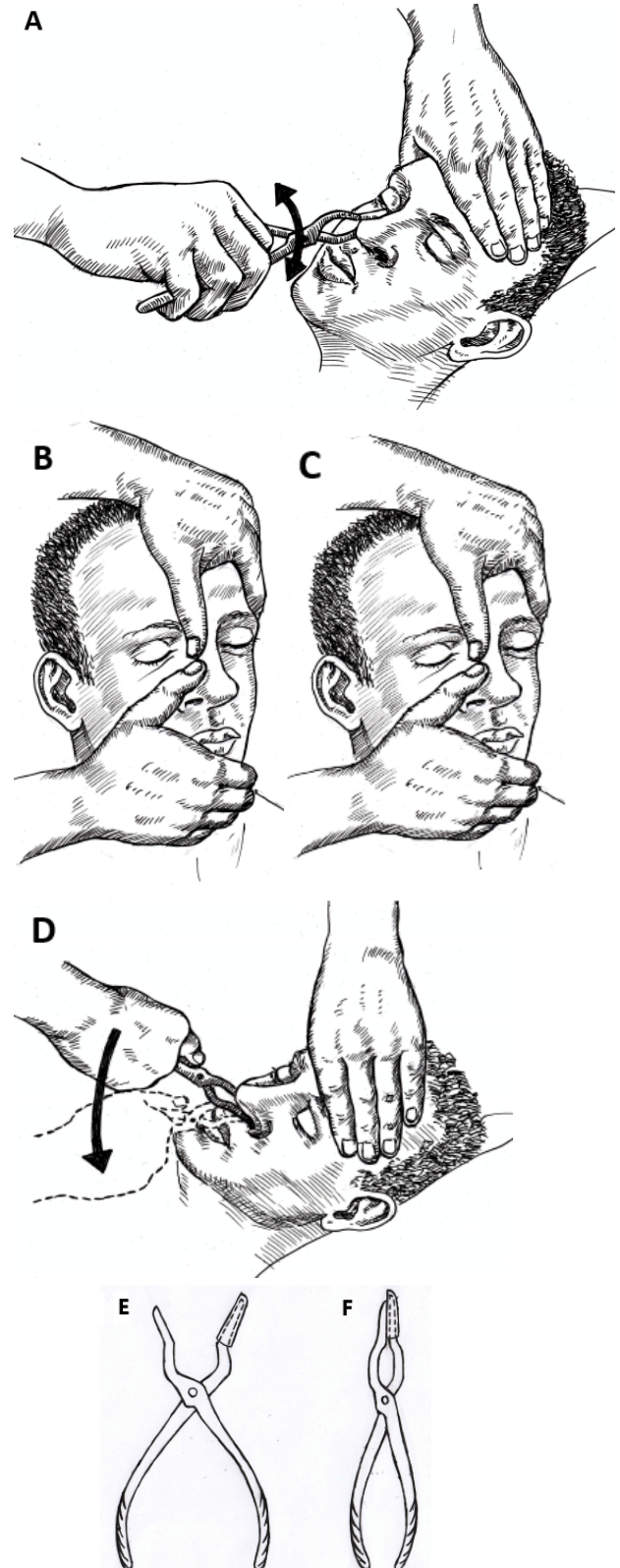


Fig. 53-8 REDUCING A NASAL FRACTURE. A, inserting the forceps and disimpacting the nasal bones by a medial-lateral motion. B, manipulating the bone into place. C, moulding out any asymmetry by the thumbs. D, raising the depressed bones by a downward movement of the forceps. E, Walsham's forceps and their guards, open but never completely closed After McGregor IA. *Fundamental Techniques of Plastic Surgery*. Churchill Livingstone 7th ed 1980.

53.5 Jaw dislocation

When the mandibular condyles slip forward in their sockets over the articular eminences of the temporomandibular joints, the jaw dislocates. This can happen on laughing, yawning, or being hit in the face with the mouth open.

The mouth remains permanently half-open in an anterior open bite. Swallowing and speaking is difficult, so that saliva dribbles from the corners of the lips. On examination there is a small depression over the temporomandibular joints.

JAMES, 28 years, was brought to hospital on a stretcher by his work colleagues because all of sudden he could not talk, though he was gesticulating wildly. Most of them thought he had had a stroke, though one was of the opinion he was bewitched! His mouth was half-open and fixed. There was obviously no neurological deficit.

The duty medical officer pulled gloves out of his pocket, grabbed the man's lower jaw and eased it back into place, whereupon the man cried, "Alleluia". The work colleague was now convinced that the evil spirit had been exorcised!

If the mandible dislocates on one side only, it deviates away from the midline.

Try first to get the patient to roll a large plastic syringe between the upper & lower molars; this action may reduce the dislocation spontaneously.

If this doesn't work, sit the patient forward in a chair. Most patients need no anaesthetic, though some may need a sedative. Ask an assistant to stand behind and hold the head. Put on gloves. Place some gauze over the lower posterior teeth on each side. Press the premolar teeth downwards. At the same time press the underneath of the chin upwards and backwards (53-8). Advise the patient not to open the mouth too wide again, for the dislocation may recur.

REDUCTION OF A DISLOCATED JAW

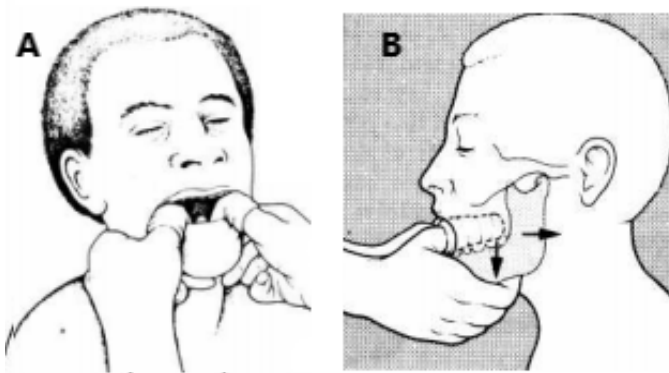


Fig. 53-9 REDUCING A DISLOCATED JAW. A, press the premolar teeth downwards and B, press under the chin upwards & backwards.

REDUCTION OF A DISLOCATED JAW (GRADE 1.2)

N.B. For old dislocations, where the masseter muscles are contracted and hold the jaw dislocated, fix arch bars to each jaw (53-14). Cut an ordinary rubber eraser (or cork) into 2 pieces, and put a piece between the posterior molars on each side to act as a fulcrum.

Fix steel wires between the arch bars in front, and Tie them together firmly. The next day the wire will be loose, so tighten it by a complete or half-turn every day. By steady traction, the anterior open bite will gradually close.

53.6 Mandibular fracture

Treat fractures of the oral bony structure as 'facial orthopaedic injuries' and apply the same general principles, especially regarding soft tissue injuries in the presence of contamination. Every fracture in the toothed parts of the facial bones is a compound fracture.

Fractures of the angle and body of the mandible are therefore open, but not those of the rami, condyles, or coronoid processes. Often, the patient has other injuries too, and the combination of a jaw injury and a head injury is common. But, provided there is no gross comminution or tissue loss, you should be able to treat most of these fractures successfully.

The mandible remodels readily, even after a comminuted fracture, and left untreated, many fractures heal by themselves, but often with considerable disability if there is malalignment.

The purpose of the mandible is to bite, so *decide whether or not the patient has a normal bite. If not, think how best you can restore it.* The methods described are for single fractures. For multiple fractures, adapt the techniques to obtain as good occlusion as you can.

TYPES OF MANDIBULAR FRACTURE

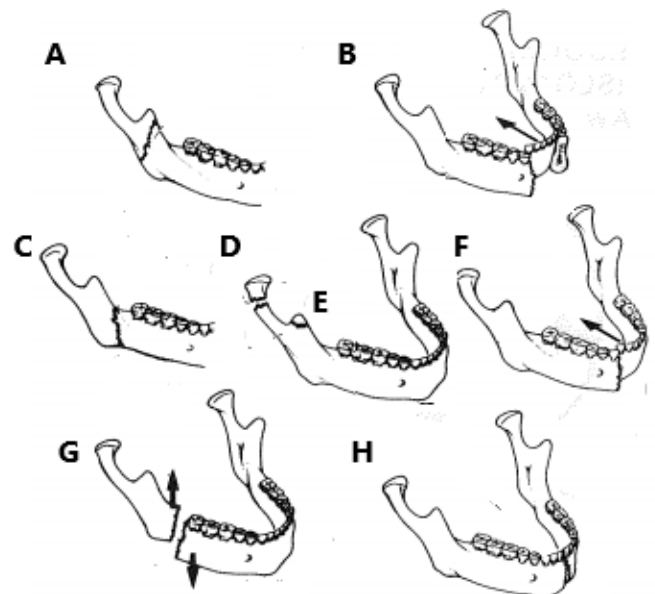


Fig. 53-10 PATTERNS OF MANDIBULAR FRACTURE. The principle of reducing these fractures is to make the bite normal. A, fractured ramus. B, displaced bilateral central fracture. C, undisplaced fractured angle. D, fractured condyle. E, fractured coronoid process. F, displaced unilateral fracture. G, displaced fractured angle (*note the muscle pull*). H, minimally displaced midline fracture.

TREATMENT

For undisplaced fractures where the bite is normal, use a skull-jaw bandage (53-11). This is also useful for temporary immobilisation, or when other methods of immobilisation are impossible. Add fixation if the fracture is unstable.

For displaced fractures or where there is a mandibular fracture or dislocation with an open bite, use maxilla-mandibular rubber bands or wiring, provided there are enough teeth to which you can make the fixation. (You can make these by cutting small circular pieces from the latex rubber parts of used intravenous infusion sets). The wire or band is thin enough to pass between the teeth, but strong enough to hold bone fragments stable. It is usually 0.4 or 0.25mm in diameter. Although special wire-cutters and surgical pliers are useful, you can use Kocher or haemostat forceps, or even ordinary pliers properly sterilised.

If you can obtain them, arch bars are a useful adjunct, but not as simple to use as it may appear.

It is possible to drill holes through the bone to find anchor for the wires, but this is not as strong as fixing them to the teeth, and you should not rely on the former alone. External fixation is preferable.

Study the way a patient's jaws fit together, because occlusion of the teeth is not the same with everyone.

Remember you should immobilize the jaw before closing the skin, but after repairing lacerations inside the mouth.

N.B. Beware the dangers of not being able to open the mouth in the event of intra-oral bleeding or vomiting! A tracheostomy is therefore mandatory if there is much oedema, or depressed level of consciousness (especially due to alcohol)

N.B. If you have used wire, keep a wire cutter and scissors at the patient's bedside in case of emergency!

A SKULL-JAW BANDAGE



Fig. 53-11 A SKULL-JAW BANDAGE. Use this for undisplaced fractures (53-10A,E,H). *You may still need fixation by wiring, or banding, though.* The straps of the bandage intertwine, and must support the whole chin. After Giannou C, Baldan M, Molde Á War Surgery ICRC Geneva 2013

INTERDENTAL WIRING (GRADE 1.4)

When you work with wire, stretch it a little before you use it. *Remember always to protect the eyes,* as a piece of wire may suddenly spring out of position.

There are 2 main techniques for fixing the wires on teeth: the Ivy and the Ernst ligatures.

In the former, use a loop on the labial side to capture the wire which has passed round the tooth from the lingual side, and twist the two ends together as well as the loop to secure the fixation (53-12A-D).

In the latter, there is no interdental loop; one large loop encircles two adjacent teeth on the labial side, and the free ends pass between the teeth and are twisted together (53-12E).

Remember always to make all twists in a clockwise direction. The Ernst ligature is useful as a temporary holding measure. Tuck the wire ends towards the gum, so that they don't cause irritation. You need 2-3 eyelets on each side for proper fixation; when fixing maxilla to mandible, *don't put eyelets directly above & below each other* for this will not anchor the fragments.

INTERDENTAL WIRING

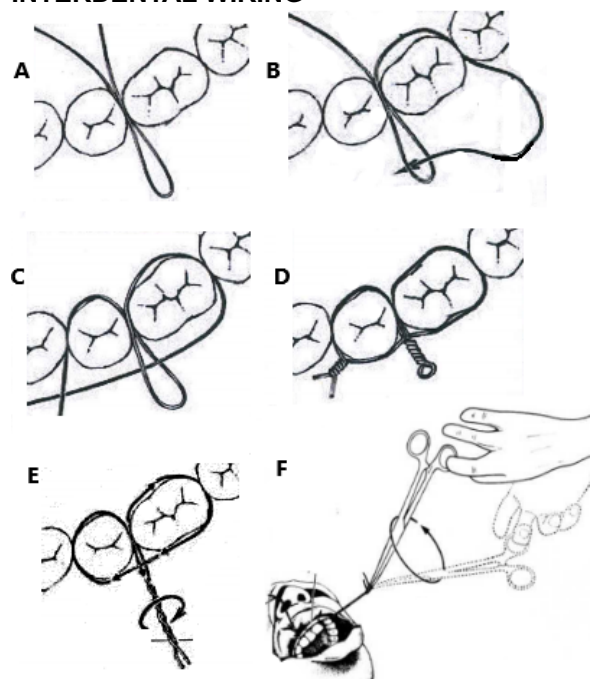


Fig. 53-12 INTERDENTAL WIRING. A, the Ivy ligature: pass a loop between adjacent teeth from the lingual to labial side. B, pass one free end round the tooth between the next tooth gap to the labial side and through the loop. C, pass the other free end through the next tooth gap on the other side. D, twist the free ends together and the loop *in a clockwise direction*. E, the Ernst ligature: 1 large loop encloses 2 adjacent teeth on the labial side, with both free ends passing between the teeth, one above and the other below the encircling wire, to be twisted together on the labial side. F, a technique for twisting the wire. After Giannou C, Baldan M, Molde Á, War Surgery ICRC Geneva 2013. F, contributed by Frederick Onyango.

N.B. You can apply circular rubber elastic cut from parts of IV infusion sets instead of wire! This is cheaper and elastic bands are easy to cut out in an emergency if there is airway compromise.

CAUTION!

- (1) *Check the occlusion before you tighten the wires!* Do this little by little, first with the molars on one side then the other, then with the incisors, *or else you will create a cross-over or posterior bite.*
- (2) *Don't twist the wire too tightly on a single-root tooth: you may pull it out!*
- (3) *Don't include dentures with your interdental wiring: they are loose and provide no proper fixation.*
- (4) *Make sure you have not trapped the tongue!*
- (5) Check that there are no loose wire ends by running your finger inside the mouth.

RISDON WIRING

Here the wire is used to reduce a mandibular fracture rather than bringing the maxilla & mandible to close opposition. Anchor a 0.25mm wire round a stable pre-molar or molar tooth and twist it on the labial side to make its hold secure.

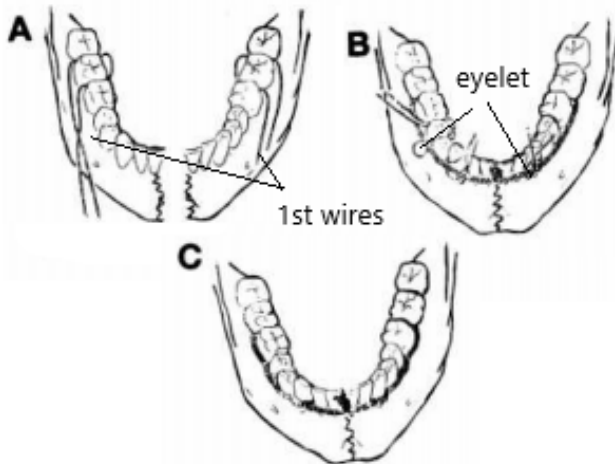
RISDON WIRING

Fig. 53-13 RISDON WIRING A, on both sides of the mandible, pass the wire round a premolar (or molar) tooth and twist it. B, create eyelets between more anteriorly placed teeth. C, pass the double-stranded wires through the eyelets, so that they meet in the midline and twist both double strands together to reduce the mandibular fracture into its correct position.

Do the same on the opposite side of the mandible; then bring both double strands of wire towards the midline and twist them together. You will gain more stability, and have less risk of the wire slipped off, if you pass the wire strands through eyelet loops you have created along the more anteriorly placed teeth (53-13)

ARCH BARS

Commercially made arch bars are made of malleable metal available in specific lengths. They are very useful for patients with missing teeth

Cut the bar so it is long enough to span the whole length of the tooth arch for each jaw: bend it to shape, *but remember its shape must conform to the reduced, not the displaced, mandible or maxilla. Make sure you place it with the hooks facing the gums.* Make it long enough so you can bend it round the last posterior tooth (15-14C).

Place the bar on the necks of the teeth. Fix it to each remaining tooth by passing 0.4mm wire loops above the bar from labial to lingual side, round the tooth and out again lingual to labial side below the bar (15-14D), and twisting the wire onto the hooks (15-14E). You can combine fixation with eyelets for extra security. At the time of wire insertion, circle one end of the 1st wire, then pass the 2nd wire and bend its end. This way, alternative wire-ends are circled or bent, making it easy to identify correct ends for tightening.

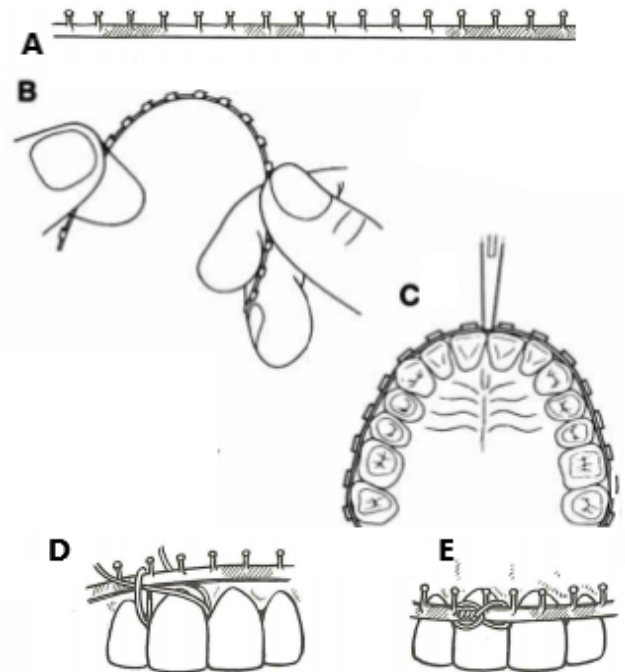
ARCH BARS

Fig. 53-14 ARCH BARS. A, malleable pre-fabricated arch bars with hooks. B, bending it into shape, C, round the last posterior teeth. D, fixing it to the teeth by passing one wire above the bar and one below, E, twisted onto the hooks. After R.O. Dingman RO, Navig P. *Surgery of Facial Fractures Saunders 1965 & McGregor IA. Fundamental Techniques of Plastic Surgery. Churchill Livingstone 7th ed 1980*

N.B. You may not be able to make a loop hold on the incisors, unless you lift the gum with a periosteal elevator. Take care the bar does not irritate the gums.

EXTERNAL FIXATION

This is useful where there is extensive bony or soft tissue loss. Make sure the mucosa is closed. Ensure correct occlusion by immobilization using temporary wiring. Repair soft tissue injuries and close the skin (to prevent cosmetic malpositioning of wounds), and insert pins in a 3-dimensional manner.

INDICATIONS FOR INTERNAL FIXATION

- (1) Condylar displacement into the middle cranial fossa (with or without fracture),
- (2) Where obtaining proper occlusion by closed techniques is impossible,
- (3) Condylar fractures associated with comminuted fractures of the mandibular body or symphysis.

ANAESTHESIA

Ketamine is not ideal as you will not be able to pack the throat. Where there is bleeding in the mouth, there is always risk that fluid passes into the airway unless you protect it.

The safest method is to use a cuffed endotracheal tube but this may interfere with your surgery unless it is a nasotracheal tube (which is contraindicated if there is suspicion of ethmoid fractures), so a tracheostomy is usually safer, also for the post-operative period.

To avoid the danger of a closed mouth after the operation, you may delay maxilla-mandibular fixation till later, and perform this under LA. Or alternatively, you can use strong short rubber bands.

POSTOPERATIVE CARE

N.B. In major injuries, oedema may cause late airway obstruction.

Check occlusion. Encourage the use of chewing gum. Oral hygiene is crucial; use an antiseptic mouthwash several times a day, and always after food. Use a soft toothbrush likewise several times a day.

Make sure the patient can receive enough high energy, high protein liquidized food, either by straw (round the back of the jaw) or by nasogastric tube. Keep the wires in place 4-6wks.

53.7 Difficulties with facial fractures

If opening of the jaw is difficult, this may be simple *trismus* which improves with exercises. It may be due to coronoid process hyperplasia where the *temporalis* muscle becomes calcified, and require excision of the coronoid process. Alternatively, it may be due to ankylosis of the temporo-mandibular joint, which does not respond even to condylectomy. *Make sure there is no chronic dislocation* here.

If osteomyelitis develops in the bone, it is usually combined with a salivary fistula. Remove any sequestrum and lay open the infected area, and make sure the patient remains well-nourished. Copious mouth irrigation is necessary until the mucosa closes.

If there is severe malocclusion of the teeth, you can try to grind down the cusps of the affected teeth. Alternatively remove any teeth preventing mouth closure, or in the last resort, arrange for re-fracture & re-fixation of the mandible.

In edentulous patients, make Gunning splints, moulded to fit the existing mandible & maxilla, and cut the splint at the site of the bony fracture. Attach the mandibular (or maxillary splint to its bone base with circular wires. Then fix the splints to each other by wires or elastic bands.

53.8 Soft tissue facial injury

NATURAL LINES OF THE FACE

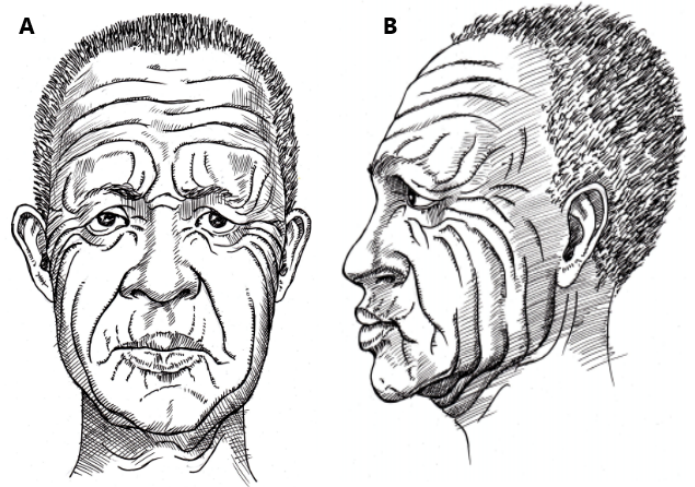


Fig. 53-15 Natural crease (wrinkle) lines in the face. **A**, frontal view. **B**, lateral view. Try to place your sutures along or parallel to these lines.

Don't think wounds of the face are just for plastic surgeons! Don't try to repair such wounds without a good light, and don't rush!

The principles of wound care (46.2) apply just the same, but adhere to certain rules:

- (1) *Pay great attention to detail!*
- (2) *Toilet dirty wounds carefully to avoid 'tattooing' the face.*
- (3) *Be very gentle with skin edges using hooks if possible. Use fine instruments & sharp scissors.*
- (4) *Don't excise more tissue than absolutely necessary!*
- (5) *Approximate wound edges precisely, so that unseemly steps don't ensue. Avoid 'dog ears'.*
- (6) *Don't shave the eyebrows, or else you will lose the landmarks to approximate a wound.*
- (7) *Don't allow a deep wound to heal by secondary intention, as scarring is then inevitable.*
- (8) *Don't attempt a flap closure as the initial procedure.*
- (9) *Don't make 'relaxing' incisions to get a wound to close. Use subcutaneous 4/0 absorbable sutures where the wound is deep.*
- (10) *Don't leave dead spaces.*
- (11) *Regard all bite wounds (including human bites) as septic, and don't be tempted to close them primarily!*
- (12) *Remove skin sutures at 5days.*
- (13) *Avoid haematomas by pressing on wounds long enough for haemostasis, aspirating collections, and firmly applied postoperative dressings.*
- (14) *Try to place your suture lines along the natural wrinkles of the face (53-15)*

EXAMINATION

The wound may be so obvious, that you forget to look elsewhere! Check the eyes (52.2), the facial nerve (by asking the patient to smile & noting any asymmetry, and a leak of saliva from the parotid or submandibular glands.

ANAESTHESIA

You can use LA on most wounds, and ketamine for more extensive procedures. Where there is risk to the airway, perform a tracheostomy and use endotracheal intubation so you can pack the pharynx.

(a) Lips

Be careful to align the skin & vermilion border very accurately. Mark the points with a fine indelible ink pen before you insert LA solution.

Teeth often cause the lip lacerations and occasionally a loose tooth remains *inside* the lip!
Use absorbable sutures.

For a full thickness lip injury, put the 1st suture in to approximate the vermilion-skin border. If this looks wrong, *don't hesitate to pull the suture out and do it again!* Then the 2nd suture onto the labial sulcus and the 3rd to approximate the *orbicularis oris* muscle. Place the mucosal sutures so the knot is buried.

(53-16)

N.B. You can repair up to ¼ of the missing lip primarily.

ANATOMY OF THE LIPS & THEIR REPAIR

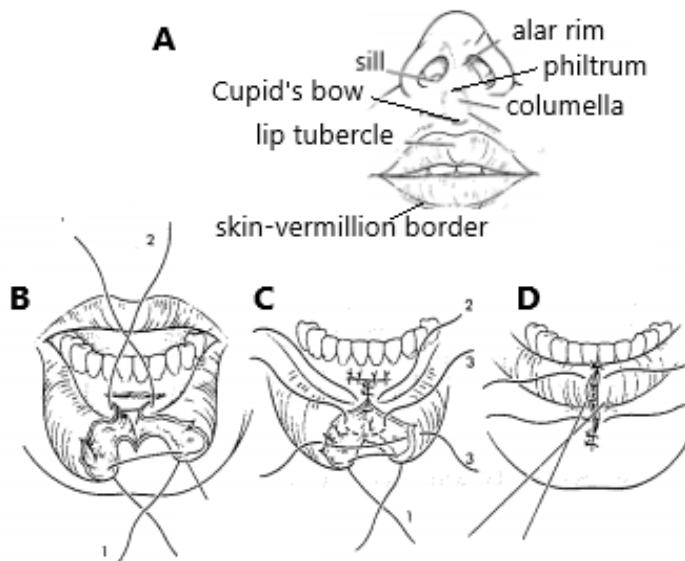


Fig. 53-16 ANATOMY OF THE LIPS & THEIR REPAIR, A, the anatomy of the lips. B, Place the 1st suture carefully at the skin-vermillion border, & the 2nd at the labial sulcus. C, approximate the *orbicularis oris* muscle 3rd. D, finally close the mucosal surface.

V-SWITCH LIP FLAP (GRADE 3.2)

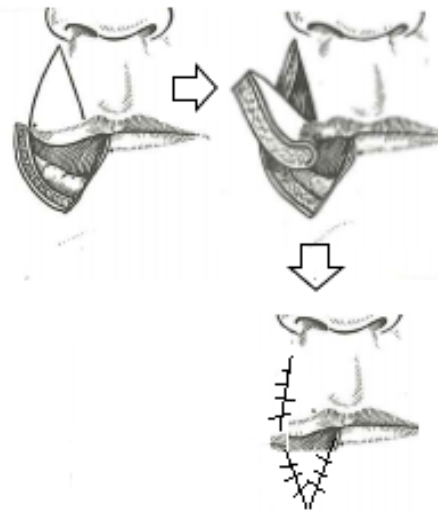


Fig. 53-17 SWITCH LIP FLAP USED TO CLOSE A DEFECT.

A, cut out the flap leaving it pedicled on the labial artery. **B**, swing it round to make the new angle of the mouth. **C**, close in layers. McGregor IA. *Fundamental Techniques of Plastic Surgery*. Churchill Livingstone 7th ed. 1980

If there is a significant defect of the lower lip, *don't try to close it primarily*: it will produce an ugly appearance of the mouth. Mark out ½ of the equivalent portion on the upper lip, and cut it out carefully, leaving the base attached with its blood supply of the labial artery. Then swing this V-switch flap round to make a new angle of the mouth & close the defect (53-17)

N.B. Do this only as a delayed repair.

(b) Gums

If a laceration of a patient's gum retracts and exposes the alveolar margin, *don't leave it exposed*. If there is a big defect which you cannot close, advance a flap of mucosa to cover the gap.

(c) Tongue

Unless a laceration involves the edge of the tongue, makes a free flap, or is >2cm long, *don't suture it*. Otherwise repair it with buried long-acting absorbable. This may be possible under LA, but usually needs ketamine and suction, or if the wound is on the back or underside of the tongue, endotracheal intubation & GA.

If the anterior ⅔ of the tongue bleeds, hold it in a piece of gauze and pinch it between your finger and thumb posterior to the laceration. Put in a mouth gag and repair it with long-acting absorbable, if necessary in layers.

If the tip of the tongue is almost completely avulsed, re-attach it, as it will probably survive.

If the tongue laceration bleeds continuously, use LA with adrenaline, and place a figure-of-8 suture.

If the lingual frenulum is torn in a child, think of child abuse (47.3); it rarely needs repair.

(d) Cheek

Deep lacerations of the cheek may divide a branch of the facial nerve or the parotid duct, or both. Asymmetry in the smile will tell you that the facial nerve has been cut. Its temporal branch is the most important because it controls eyelid movement, and its division will expose the cornea. Division of its marginal mandibular branch will make the lip droop. The parotid gland and its duct lie more superficial than the facial nerve, and are more easily injured.

Repair the muscles of mastication and facial expression if these are lacerated with long-acting absorbable sutures.

Large defects of the cheek will need an advancement flap, but repair the mucosa in the mouth first, and then any laceration of the lip.

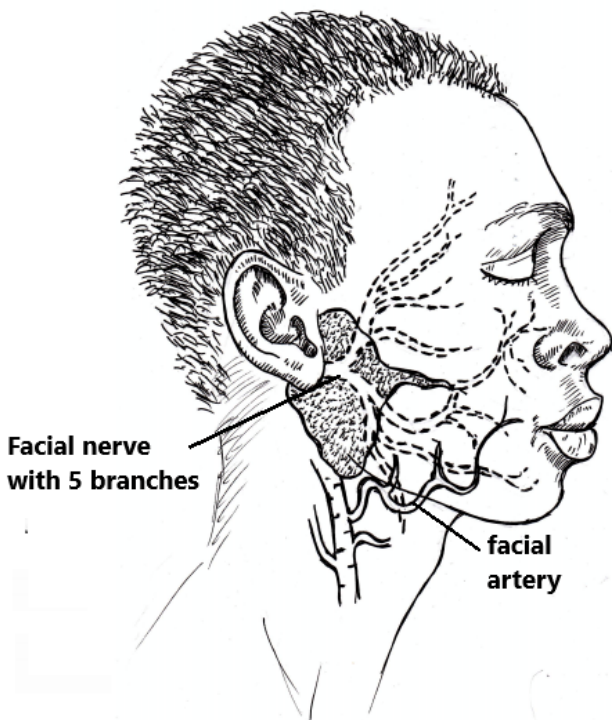
ANATOMY OF THE PAROTID GLAND & FACIAL NERVE

Fig. 53-18 ANATOMY OF THE PAROTID GLAND & FACIAL NERVE. The parotid gland lies anterior to the ear below a line between the tragus and the angle of the lips. The facial nerve is embedded inside the gland in the fascio-venous plane & has 5 main branches.

PAROTID GLAND INJURY

If fluid leaks from a posterior wound of the cheek, the parotid gland is injured. Suture the wound as usual. If a fistulous leak of saliva does develop, it will probably heal spontaneously within a few days, and almost always does so within a month.

PAROTID DUCT INJURY

However, an injury to the parotid duct will *not* close spontaneously. The duct runs under the middle $\frac{1}{3}$ of a line from the tragus of the ear to the commissure of the lips. Press on the wound to see from where the saliva leaks.

Therefore, try to repair an injury to the duct with 6/0 non-absorbable over a stent (e.g. an 0 nylon suture) passed into the mouth. You can pass this from the laceration or from the mouth (opposite the crown of the 2nd upper molar tooth), whichever is easier. *This is not simple*, but easier if you pull the cheek outwards to straighten the duct. If this fails, you can re-implant the proximal end of the duct through a new opening into the mouth.

Both methods need the catheter to be kept in place for 1wk as a stent. If you tie the duct, the gland will swell painfully before shrinking from atrophy, but producing a dry uncomfortable mouth.

FACIAL NERVE INJURY

If the laceration is anterior to a line dropped vertically from the lateral canthus of the eye (53-16), only the peripheral branches of the facial nerve can have been injured. Deformity will be minimal and repair impractical.

If major branches of the facial nerve have been cut posterior to this vertical line, explore the wound and try to repair the nerve (48.1)

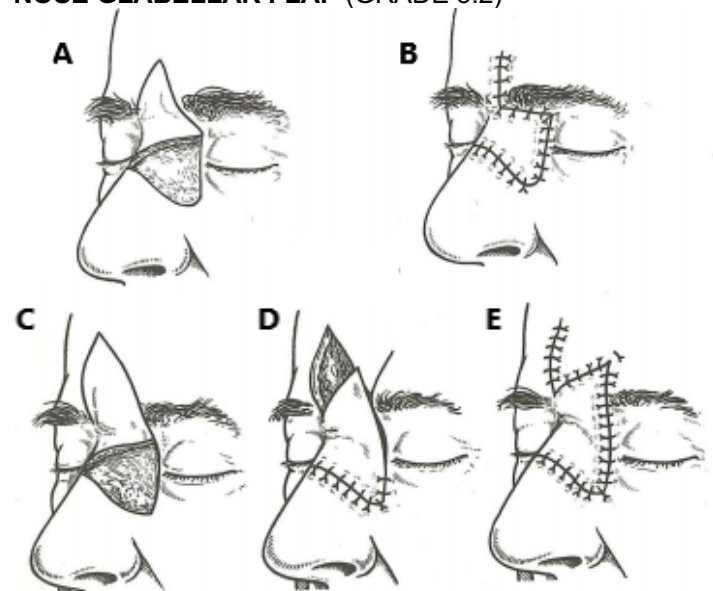
NOSE GLABELLAR FLAP (GRADE 3.2)

Fig. 53-19 NOSE GLABELLAR FLAP. A, mark out the advancement flap. B, primary closure. C, if the secondary defect is difficult to close, D, include a Z-plasty onto the advancement flap. E, the end result. After McGregor IA. *Fundamental Techniques of Plastic Surgery*. Churchill Livingstone 7th ed. 1980

(e) Nose

Align the edges of a laceration of the nose accurately, inserting the 1st suture at both edges.

If an injury penetrates all the layers, repair the mucous membrane first using 4/0 absorbable. Bring the nasal cartilages together, and hold them in place by suturing the skin with 5/0 monofilament.

If there is skin loss in the upper part of the nose, swing a rotation flap from the forehead, which you can usually close primarily (53-19)
Avoid leaving packs in the nasal passage unless they are needed for bleeding (53.4).

(f) Chin

If a submandibular gland is found injured by penetrating trauma, remove it to prevent a salivary fistula (17.4)

(g) Ear

In a major explosion, the ear frequently suffers ototrauma; together with vertigo, tinnitus, hearing loss, there is usually a perforated eardrum (46-48).

An injured pinna has curves in 3 dimensions and is difficult to repair. Lacerations are often jagged and skin or cartilage may be missing. Haematomas are frequent, and may become organized forming a 'cauliflower ear'. Exposed cartilage readily becomes infected causing major deformity. Secondary reconstruction is difficult and not readily available. Fortunately, the ear has a good blood supply, so flaps with even a short pedicle will survive.

Repair a laceration of the helix by inserting the 1st suture at the edge of the helix. This will avoid a ridge forming which can be very conspicuous when the wound has healed. Then align the antihelix.

In a full thickness injury, suture the perichondrium, and 5/0 monofilament for the cartilage. Pack the ear with moist cotton wool to maintain its shape, and bandage it firmly to prevent haematoma formation.

If a minor part of the pinna is missing, cut a V-segment out & suture the edges together in layers (53-20A,B). A defect of $\leq \frac{1}{3}$ will not be very noticeable.

If a major part of the pinna is missing, toilet the wound, and close it without the missing cartilage (53.20C,D)

If this leaves an ugly shape, disguise this by suturing the pinna back in 2 layers and enclose it in a postauricular skin pocket, or attach it to a postauricular advancement flap (53-20E-G).

If a haematoma forms, with or without a laceration, aspirate it and apply a pressure dressing. If it recurs following aspiration, incise it and insert a short rubber drain.

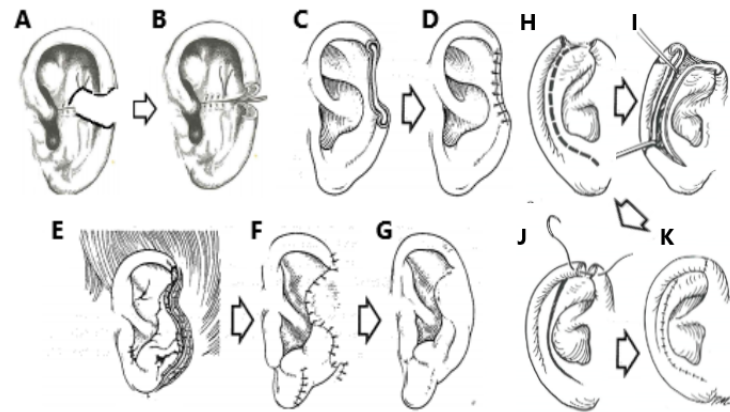
LACERATIONS OF THE PINNA (GRADE 2.1)

Fig. 53-20 WOUNDS OF THE PINNA. A, a segment missing. B, converted into a V-shape and sutured. C, the cartilage exposed. D, covered with skin brought from posteriorly. E, a large part missing, F, excised. G, sutured to postauricular skin. Alternatively, H,I, make an advancement flap by incising the helix. J,K, close the defect. After London PS, *A practical guide to the care of the injured*, E&S Livingstone, Edinburgh 1967 with kind permission.

Repair a laceration of the earlobe by placing your 1st suture at the most inferior portion, making sure the edges are carefully aligned.

Where a pulled earring has produced a defect, excise the wound edges and convert the rent into a neat V-shape, and suture this as before.

N.B. You can salvage the old earring piercing hole by leaving a 2/0 suture thread along it for 4wks. *Don't allow re-piercing through the scar; delay re-piercing for 3months.*