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5 Panfacial fractures

1 Introduction

In the presence of multiple simultaneous facial fractures, an order of treatment should be developed. In the past, so-called inside-out, top-to-bottom, or bottom-to-top philosophies have prevailed, each with its own vigorous proponents. Recently, an outside-to-inside management scheme for the midface has been proposed, emphasizing the zygomatic arch as a key midface structure.

2 Anatomy and definitions

The face is divided into an upper face and a lower face at the Le Fort I level. Each facial half is divided into two facial units. The buttresses of the midface, skull, and mandible are indicated in **Fig 5-1a**.

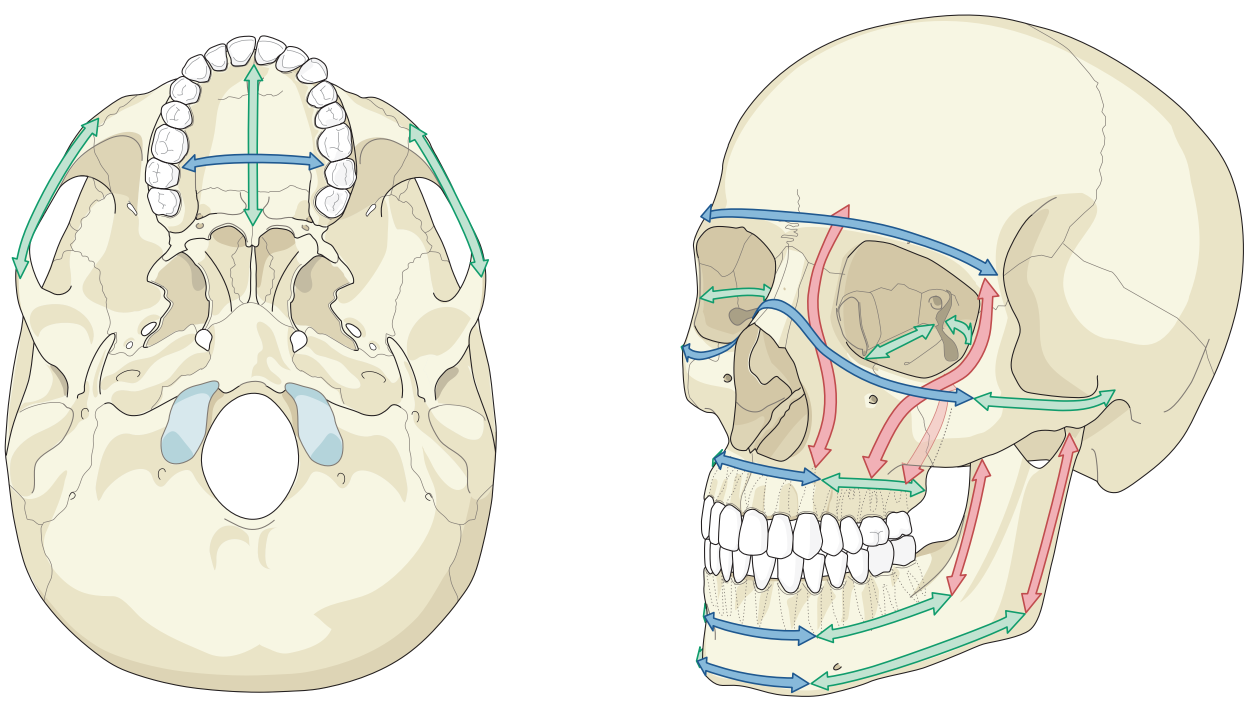


Fig 5-1a Transversal, vertical, and sagittal buttresses of the facial skeleton (arrows).

Lower face

The occlusal and the mandibular units are situated in the lower face. The occlusal unit consists of the teeth, the palate, and the alveolar processes of the maxilla and mandible. The mandibular unit consists of horizontal and vertical sections. The vertical section of the mandible includes the condyle, the ramus, and the angle. The horizontal section includes the body, parasymphysis, and symphysis.

Upper face

In the upper face are the frontal and upper midfacial units. The frontal unit consists of the supraorbital, frontal, and temporal bones, the supraorbital rims, the orbital roofs, and the frontal sinus. The upper midfacial unit is composed of the zygomas laterally, the nasoorbitoethmoidal (NOE) area centrally, and the internal portion of the orbits bilaterally. The upper and lower face meet at the Le Fort I level (**Fig 5-1b–c**).

Midface fracture treatment is based on an accurate physical examination and on evaluation with a thorough CT scan of the face.

Considering the complexity of the face and its multiple parts, it is important that an order of facial fracture treatment be developed to address midface and accompanying fractures of the mandible and frontal bone. There are three areas of the facial skeleton, (mandible, midface, and frontal bone including skull base) and four facial units (**Fig 5-1c**). Extended midface fractures combining two or more anatomical facial areas are referred to as panfacial fractures.

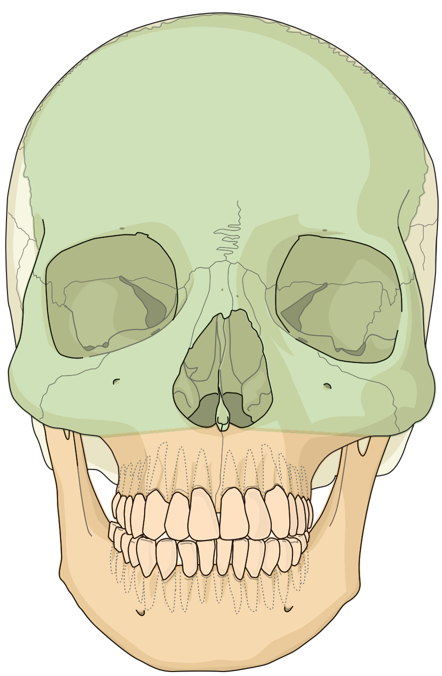


Fig 5-1b View of the face with a division line for upper and lower face at the level of Le Fort I.

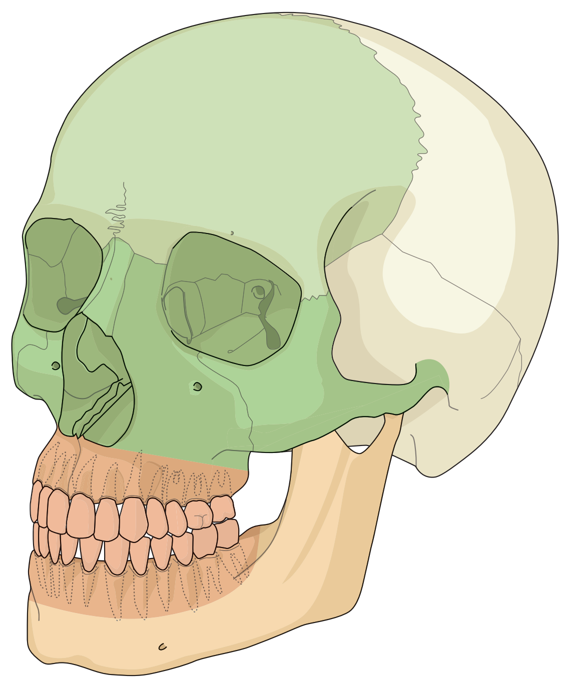


Fig 5-1c View of the face identifying the facial units: frontal, upper midface, occlusal, and mandibular units. The occlusal unit consists of the teeth, the palate, the alveolar process of the maxilla, and the mandible. The mandibular unit consists of a vertical and a horizontal part. The vertical consists of the condyle, ramus, and angle; the horizontal consists of the body, symphysis, and parasymphysis. The frontal unit consists of the frontal bone area medially and two lateral frontotemporal-supraorbital segments. The upper midface unit consists of the zygoma laterally, the nasoorbitoethmoidal areas centrally, and the internal portion of the orbits bilaterally.

3 Order of treatment

The exact order of treatment is not as important as the development of a plan which permits accuracy of anatomical positioning of the various facial segments. Exposure, identification, and fixation of the facial buttresses guarantee the best anatomical alignment. The application of fixation stabilizes the facial skeleton three-dimensionally.

4 Graded (anterior and posterior) approaches

The approach described is the author's uniform format for recreating facial dimensions for any fracture and proceeds from intact cranial vault or cranial base landmarks through the entire anterior portion of the face. The treatment of all Le Fort and any associated fractures may be integrated into this plan, which provides for both simple and panfacial injuries in all degrees of complexity. The treatment plan emphasizes reconstruction in anatomical areas, such as the horizontal part of the mandible, the vertical part of the mandible, the Le Fort I level and the palate, the zygomas, the NOE area, and the frontal bone with the frontal sinus.

5 Facial subunits and energy of the fracture

Four anatomical units are identified. Treatment is organized by identifying the degree of injury (energy or comminution of the fracture) in each of the four anatomical units and applying the fracture severity classification in a scheme for determining the necessity for anterior or anterior and posterior exposures. The selection of these two separate exposure techniques depends on the anatomical area and the energy or fragmentation of the fracture.

This algorithm allows for an individually adjusted treatment plan and brings order to the operative intervention by structuring efficient, sequential manipulation.

6 The importance of first excluding other injuries in the head and neck

Although it may seem obvious, patients must have other significant injuries evaluated prior to undertaking facial fracture treatment. The airway is ensured by intubation or tracheostomy. The endotracheal tube should be placed either through the nose, through a gap in the dentition, behind the molar teeth, or may be brought through the floor of the mouth via a submental skin incision, or a formal tracheostomy may be employed.

It is obvious that when the anatomical unit of the head and neck carries extensive facial fractures, the presence of skull, brain, and neck injuries needs to be excluded or addressed before operative planning is completed. Similarly, all injuries need to be assessed and their effect on facial injury treatment determined prior to initiating operative facial intervention in order to determine preoperative facial fracture positioning and monitoring strategies.

7 The occlusion

Attention is directed first to the dentition. Arch bars, such as Erich or Schuchardt arch bars, are applied to the teeth of the maxilla and the mandible and should extend the entire length of the dental arch. For edentulous patients, the dentures or suitable splints can be used to position the alveolar ridges for fixation.

IMF screws are only satisfactory for simple, undisplaced single-unit fractures but do not provide multiple points of forced occlusal contact or permit any possibility of adjustment required by panfacial or complex fracture treatment.

8 The maxilla, the hard palate, and alveolar fractures of the mandible and maxilla

Alveolar fractures of the maxilla and mandible as well as fractures of the hard palate should be reduced and stabilized with stable fixation before mandibulomaxillary fixation (MMF) is completed (**Fig 5-2**). Two areas of stabilization are required. Small plates can be applied in the palate paracentrally in median fractures, or laterally along the alveolar ridge, or at the junction of the alveolus with the basal bone of the maxilla. The piriform aperture may additionally be stabilized with a plate or a lag screw. Two-dimensional palato-alveolar fracture fixation stabilizes the Le Fort I segment as a one-piece unit. It may be then managed as a traditional Le Fort I fracture segment.

When mandibular alveolar fractures exist or when comminuted fractures involve tooth-bearing bone in mandibular fractures, the smaller pieces carrying the teeth can be reattached to larger pieces using small plates. The reassembled larger pieces may then be oriented for a final reduction (**Fig 5-3**).

These steps set the template for the correct width of the lower face by providing an anatomically reduced maxillary arch as an absolute guide for mandibular width. Similarly, alveolar fractures of the mandible may be reduced and fixed with small plates, such as miniplates 1.5, or corresponding Matrix plates. Microsystems can be considered in some cases as well.

When stabilizing the occlusion, special consideration is required with regard to the occlusal plane. The patient is placed in MMF, usually with the help of arch bars. In edentulous or partially edentulous patients it is sometimes necessary to use the original dentures or splints to establish MMF. Special attention must be paid to the presence of subcondylar fractures, especially the low subcondylar fracture which begins at the sigmoid notch and exits the ramus posteriorly. If these fractures are present and treated closed, the lack of an anatomically correct and stable reduction of ramus height may lead to an unstable vertical dimension. An unstable, non-level occlusal plane, a retruded Le Fort I mandibular unit, or a rotated facial unit will create a change in facial height or facial alignment producing an oblique occlusal plane or retrusion of the entire unit in MMF.

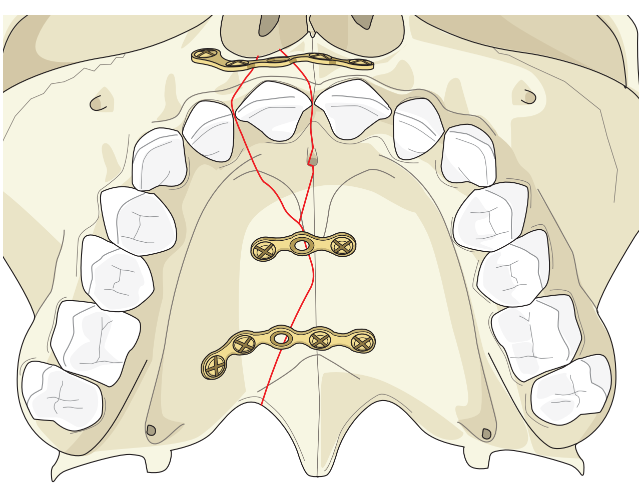


Fig 5-2 Sagittal fractures of the maxilla should be stabilized by an approach through the roof of the mouth. The maxillary alveolus is stabilized at the piriform aperture. One or two plates 1.5 or corresponding Matrix plates are used.

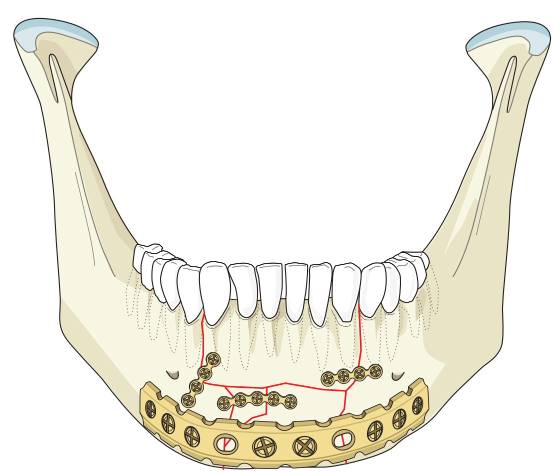


Fig 5-3 Alveolar fractures of the mandible should be reduced with small plates and screws of the midface system placed monocortically.

9 Preinjury photographs

Preinjury photographs assist in the definition of the facial dimensions to be achieved. Prominence of the eyes, the prominence and shape of the nose, the amount of lip-tooth (incisor) show, and the architecture of facial features is clearly demonstrated by preinjury photographs. These facts are not apparent from CT scans alone or from an examination of the injured patient.

10 Upper face: the cranial unit

Exposure is provided by a coronal incision which should be carried retroauricularly if an inferior extension is required and can be of a stealth (zigzag) pattern across the calvaria (chapter 3.2 Upper midface (Le Fort II and III)).

Frontal bone fracture fragments are marked in orientation and sequence as they are removed for exposure of any intracranial neurosurgery.

Reassembly of the removed cranial bone fragments can be completed on a back table while neurosurgical exploration is in progress. The surgeon should preoperatively prepare one or two bone graft donor sites (ribs, iliac) and a thigh in case a fascia lata graft is necessary to reinforce the closure of the dura. In frontal or ethmoid sinus obliteration, any remaining frontal sinus mucosa must be thoroughly removed from the fracture fragments and the walls of the sinus burred lightly to eliminate mucosa which follows the veins of Breschet into the internal layers of the skull. This mucosa may regrow if it remains. The frontal sinus is then either obliterated or cranialized depending on the presence or absence of a relatively intact posterior wall. Cranial base bone grafting must also be complete to provide a layer of bone between the nose and the intracranial cavity. The frontal bar (which includes the supraorbital rims and the internal and external angular processes of the frontal bone) must be reconstructed as a stable unit (**Fig 5-4**). The lower section of the supraorbital rims and lower anterior frontal sinus form the frontal bar, and this structure provides the inferior stable positioning in frontal bone reconstruction. Cranial base bone grafting (the orbital roof and anterior cranial fossa) is generally attached to the frontal bar or floor of the anterior cranial fossa for stability. The frontal bar is reconstructed and the anterior sinus wall reassembled. Temporal bone alignment must be correct in narrowness (facial width) and length (anterior projection).

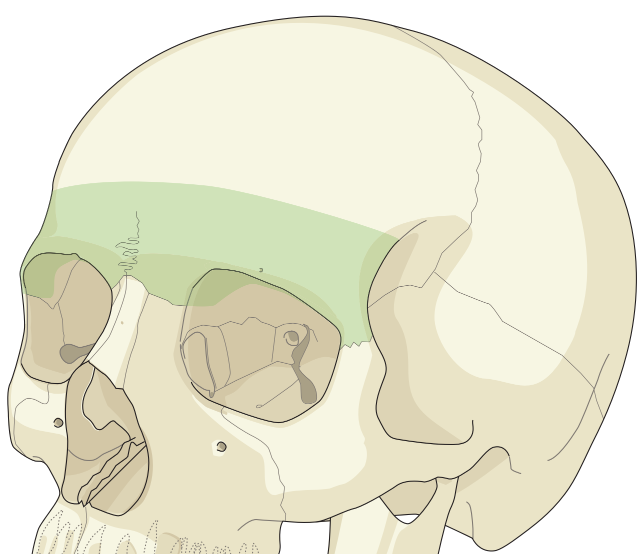
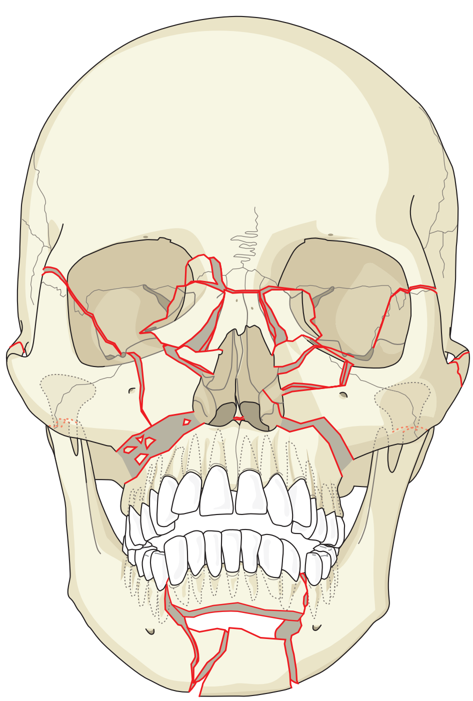


Fig 5-4 The frontal bar should be used as the key lower landmark in frontal-bone reconstruction.

11 Upper face: the midfacial unit

The author prefers to initially link all fragments of the orbital rims including superior, lateral, inferior, and medial segments in the upper midfacial unit with interfragmentary wires. A temporary stabilization with malleable small plates such as mini- or microplates is also possible. In the upper midfacial unit, the NOE area is reduced first. It is important to establish a narrow intercanthal distance by first tightening the transnasal wires, thereby narrowing the intercanthal distance. This step is the most important procedure in NOE fracture reduction, as the transnasal wire links one medial orbital rim with the other (**Fig 5-5a–b**). The NOE area, reduced with interfragmentary transnasal wires, is then linked superiorly to the frontal bar reconstruction and inferiorly to the maxillary Le Fort I level by plate and screw fixation. This technique, called junctional rigid fixation, implies that the central NOE area is linked to its peripheral attachments with rigid fixation. This step stabilizes projection of the entire reassembled NOE complex. Le Fort I level and orbital-rim fixation stabilize the lower NOE segment projection. Thick plates extending along the medial orbital rim above the canthal ligament produce an unnatural thickness and do not fully stabilize the area against rotation, and should be avoided. Junctional rigid fixation is preferred.

An alternative approach, especially for patients with severe comminution of the NOE complex, is to reconstruct the outer facial frame first. This implies reduction and fixation of the zygomatic arches and zygomas to the cranium (**Fig 5-6a**). Stable fixation of the zygoma begins by exposing all articulations of the zygoma with its adjacent bones (**Fig 5-6b**). These are the zygomaticofrontal suture, the infraorbital rim, and the zygomatic arch, intraorbital inferior and lateral orbital walls, and the maxillary buttresses. The zygomatic arch is explored if the fracture in the arch is laterally displaced or if there is a severe posterior dislocation of the malar eminence. These fractures benefit from arch exposure for stability and alignment of the width of the midface. Additionally, the inferior internal orbit is explored, as are the lower medial and lateral orbit. Interfragmentary wires may initially be placed in the zygomaticofrontal suture and in the inferior orbital rim or zygomatic arch to provide initial positioning of the zygoma. Conceptually, exposure of all of the articulations of the zygoma would require two to four different incisions, as only one or two of these fracture sites



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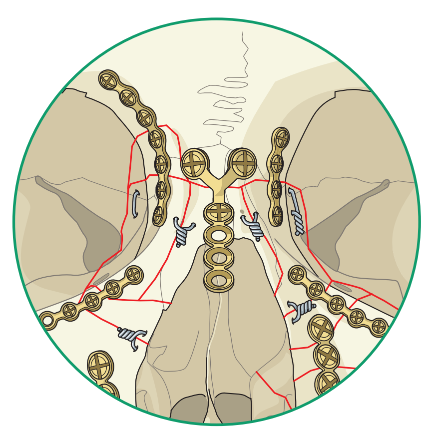


b

Fig 5-5a–b

a NOE fracture with dislocation as part of a panfacial injury.

b Initially, all bone fragments in the NOE area can be linked with wires. Junctional stable fixation then stabilizes the assembled NOE unit to the frontal bone superiorly, the inferior orbital rim (midface plans recommended), and the piriform aperture inferiorly.

can be viewed through one incision. Positioning wires protect the initial position achieved in one area, while the other areas are visually assessed. The zygomaticomaxillary buttress is visualized to confirm approximate position. Next, the zygomatic arch is reduced beginning with the intact segment posteriorly, holding the anterior arch segments in a flat reduction which emphasizes the anterior projection of the malar eminence. If the most posterior fracture in the zygomatic arch is oriented sagittally through the glenoid fossa, a lag screw technique should be used. Rarely, the superior aspect of the glenoid fossa should be plated. A midface plate 2.0 or a corresponding Matrix plate is placed over the remaining arch segments laterally. This plate should be of the stronger adaptation-plate variety which resists muscular loading. Before arch reduction is stabilized, the zygoma at the inferior orbital rim and in the lateral orbit must be checked for alignment so that proper reduction of the lateral orbital wall and reduction of the zygoma with the medial NOE orbital segments is achieved.

The zygoma is then stabilized with miniplates 1.5 or 1.3 at the inferior orbital rim in panfacial fractures. The use of a smaller miniplate in this region is insufficient for cases in which NOE support is lost. When multiple segments of the infraorbital rim are present, the segments are initially linked with interfragmentary wires or with smaller miniplates with one screw in each rim segment. Rim fragments can then be held superiorly and anteriorly as stable fixation is completed. The zygomaticofrontal suture is reduced using a miniplate 1.5 or a Matrix miniplate. The inferior orbital rim is to be corrected in terms of anterior projection and vertical positioning. Proper zygomatic reduction can be confirmed only by repeatedly visualizing multiple areas of alignment with adjacent bones through several incisions. A key area for position control is the lateral orbital wall, especially the junction between zygoma and greater wing of the sphenoid bone.

After stabilization of the inferior orbital rim is complete, the inferior internal orbit must be reconstructed. Stable posterior bone ledges in the back of the orbit are identified medially, laterally, and inferiorly. Meshes, orbital plates, or bone grafts should then be strutted between the reconstructed rim and the stable posterior ledges, completing the reduction of the internal orbit and, in so doing, the upper midface. If desired, the bone grafts may be stabilized behind the orbital rim with plates or screws.

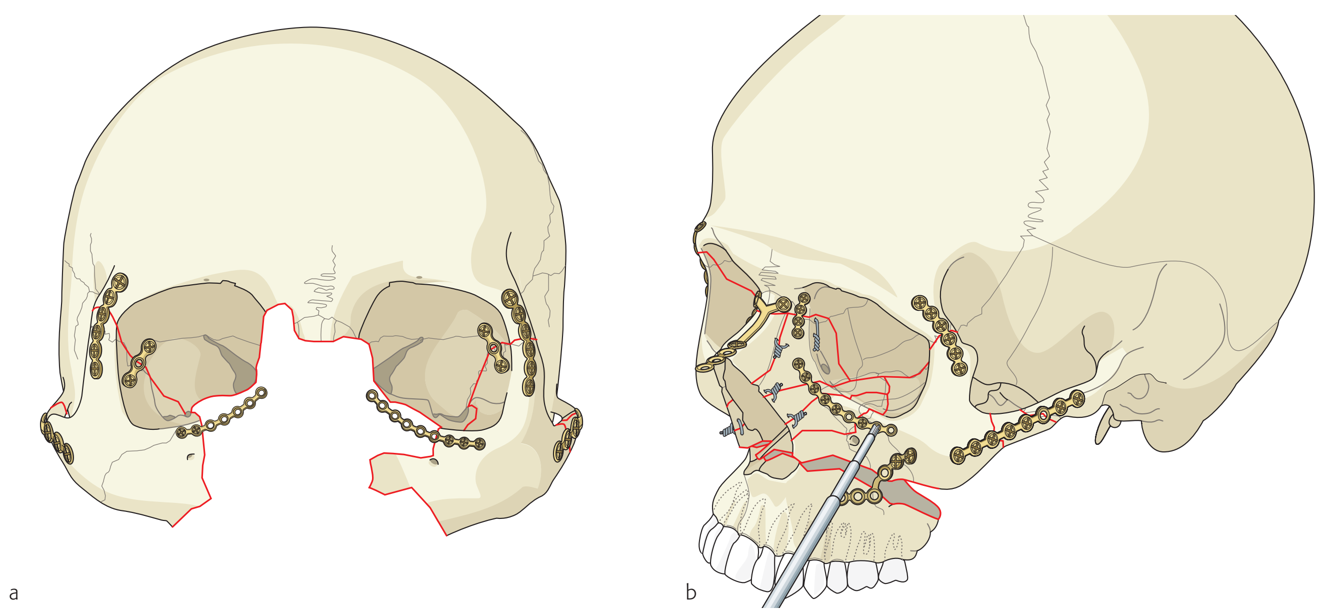


Fig 5-6a–b

a Reconstruction and fixation of the outer facial frame consisting mainly of correct positioning of zygomatic bones to the cranial vault and posterior root of zygoma. This may be the first step in outside-to-inside management.

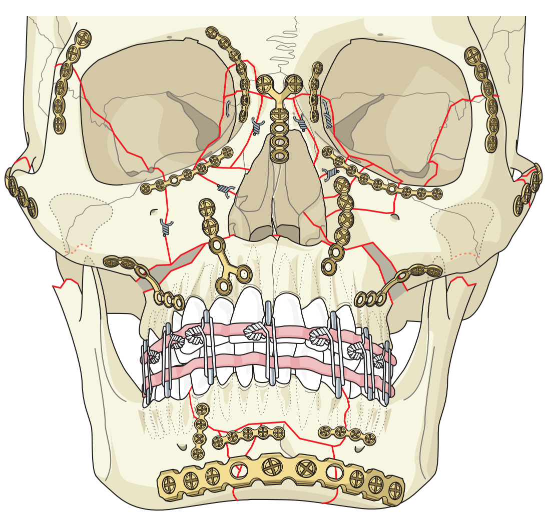
b Initial alignment of the zygoma is achieved by positioning its five peripheral articulations. Subsequently, stable fixation of the zygoma is achieved at the zygomaticofrontal suture, the infraorbital rim, and the zygomaticomaxillary buttress.

12 Lower face

The first step in the treatment of the lower face is to ligate arch bars to the maxillary and mandibular dentition and place the patient in MMF in occlusion. Sometimes, dental models or old dental records are helpful in more difficult cases of preexisting malocclusion. In the case of a split palate, the arch bar may be ligated to the major segment and a provisional reduction of the palate in the roof of the mouth performed. The arch bar may then be ligated to the minor segment. The patient should then be placed in occlusion and the piriform aperture plate applied. In the case of a mandibular fracture, the arch bar is ligated to the major segment and a provisional reduction of the fracture is performed with an interfragmentary or circumdental wire or one loose screw on each side of an upper border plate. The minor segment is then ligated to the arch bar and the patient placed in MMF.

In general, fractures in the horizontal portion of the mandible are exposed through transoral incisions. Sometimes transcutaneous incisions are utilized; however, scarring may be disfiguring. If a skin laceration exists and is of suitable size, it can be used for fracture treatment.

Temporary reduction of a displaced mandibular fracture can also be performed using interfragmentary wires which permit some degree of mobility or adjustment of the fracture alignment prior to plate and screw fixation. The reduction of comminuted mandibular fractures can also be simplified by using miniplates to place the small pieces to the larger pieces, and then one can deal with the major fragments. Internal fixation is performed using at least three screws for each of the major mandibular fragments (if one screw becomes loose, the two others hold the reduction). After the initial wire reduction, adjustments in bone position are made and stable plate fixation is completed in the horizontal mandibular section. Simple angle fractures may be reduced through a transoral incision with superior border fixation. The occlusion must be checked after the final reduction. The patient is taken out of MMF after the final reduction of the mandible and the mandible is closed with the fingers on the lower border at the angle, seating the condyle in the fossa to see that the occlusion is ideal and reproducible with condylar motion. Make sure the condyle is not displaced from the fossa when bringing the patient into proper occlusion (**Fig 5-7a–b**).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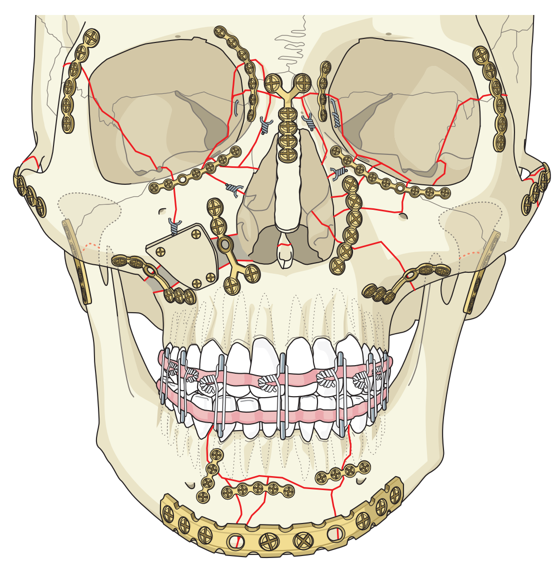
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Fig 5-7a–b

a Fixation of the midface in the Le Fort I plane in displaced position due to subcondylar fractures which are not fixed and not reduced properly, with anterior rotation of the maxilla and shortening of the face.

b Fixation of the midface in the Le Fort I plane in correct position after reduction and fixation of subcondylar fractures and proper positioning of the condyles. The defect of the maxillary wall on the right is bridged with a bone graft.

Complex comminuted angle fractures are more easily reduced with transcutaneous exposures. The hyoid crease, Risdon, or retromandibular incisions are preferred. The correct width of the mandible is obtained by translating the anatomically reduced maxillary arch to the dental inclination of the lateral mandibular dentition. This serves as a guide to prevent lingual rotation of the lateral mandibular segments which results in excessive lateral width of the mandible at the angles. The lingual cortex of the mandible is not routinely visualized in transoral fracture reductions. The fracture line tends to open (gap) lingually if complete approximation of the entire thickness of the mandible's fractured surfaces is not achieved. There is a tendency in parasymphysis fractures (especially in combination with bilateral subcondylar fractures) for the bicondylar width to be too wide, and for the mandibular angles to flare (**Fig 5-8a–c**). The lateral mandibular dentition rotates lingually, increasing the flare (width at the inferior angles). The lingual cusps of the lateral mandibular teeth come out of occlusion creating a crossbite or "fractional" open bite.

Open reduction of the vertical (ramus and condylar) segments of the mandible is required if significant malalignment or overlapping of ramus or subcondylar fractures exists. Condylar head dislocation produces a loss of ramus height which may change facial dimensions, complicating the treatment of the multiply fractured patient. Condylar dislocation in the presence of a loose Le Fort fracture is an indication for open reduction to place the condyle in the fossa and stabilize the height of the ramus and, therefore, the downward and forward projection of the mandible. Depending on the anatomical location of the fracture in the ramus, exposure is performed either by a preauricular, retromandibular, transparotid, or Risdon incision. In difficult exposures (comminution of the ramus), the facial nerve is best identified and protected. The temporomandibular joint can be examined at the time of condylar open reduction. This may be best done by visualization through a preauricular incision. Any meniscus injury is assessed and corrected. Reconstruction of the ramus (in the author's opinion) should precede that of the horizontal mandible in order to achieve proper position of the entire mandible in relation to the cranial base. This maneuver corrects the projection of the mandible. Open reduction also assists the correction of the facial width at the mandibular angles and reestablishes the vertical height of the ramus.

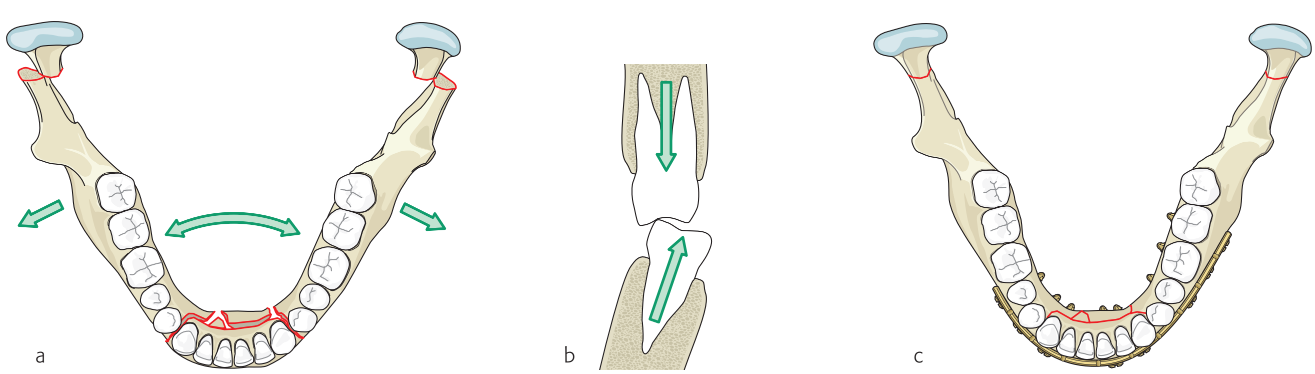


Fig 5-8a–c Fractures in the anterior symphyseal/parasymphyseal area in combination with bilateral subcondylar fractures tend to create a gap on their lingual surface.

a–b If insufficient correction of the mandibular width is obtained, the fracture may appear to be in good reduction on the buccal surface anteriorly, but actually there is an excessive width at the angles allowing the lateral mandibular segments to rotate lingually, tipping the dentition and creating a fractional open bite by bringing the lingual and palatal cusps out of alignment.

c Situation as before, but with correct fixation of the chin fractures by means of a correctly bent reconstruction plate.

13 Linking the upper to the lower face

The lower and the upper facial units are then united at the Le Fort I level by plating the four anterior vertical maxillary buttresses. Midface height and facial length are set by using an intact or an anatomically reconstructed buttress as a guide. If no complete buttress is available, one or more buttresses can almost always be reconstructed anatomically by piecing together existing fragments. One intact buttress gives a clue to the height of the rest of the buttresses. In the absence of a buttress which can be reconstructed, the lip-tooth position provides the best clue to the preinjury facial height. Further photographs may suggest the correct lip-tooth relationship and facial height to be achieved.

The Le Fort I level fixation of the nasomaxillary buttress is the third area where NOE projection is stabilized. The other two areas are the frontal bar and the inferior orbital rim.

Buttress bone gaps exceeding 5 mm should be bone grafted for both functional and esthetic reasons. It is the author's current recommendation that defects in the anterior maxillary sinus wall should be bone grafted or repaired with a mesh graft as this prevents prolapse of soft tissue into the sinuses. Dorsal nasal bone grafting improves the height of the nose in profile or a thin graft can be used to smooth the dorsal nasal contour. This completes the facial reconstruction.

Nasal bone grafting is performed most accurately after the nasomaxillary buttress reconstruction and the anterior nasal spine stabilization of the septum have been completed (**Fig 5-9**). If the medial canthal ligaments have been detached, they should be positioned only after bone grafting of the medial orbit and nose. A separate set of transnasal wires (placed before the NOE reduction is completed) are utilized for canthal reduction (chapter 3.5 Nasoorbitoethmoid (NOE) fractures).

14 Edentulous patients with panfacial fractures

In edentulous patients with panfacial fractures the anterior maxilla often drifts superiorly and posteriorly compromising the internal volume of the nose and exacerbating the adverse retracted appearance of the edentulous patient (**Fig 5-10a**). Posterior displacement of the maxilla is common despite what appears to be satisfactory visual alignment of the anterior maxillary buttresses when the maxilla is not related in anteroposterior position to a properly positioned mandible. The four anterior maxillary buttresses should be visualized, but then the maxilla has to be related to the mandible with regard to anterior projection. If available, the original dentures of the patient provide the correct mandibulomaxillary relationship. If mandibles are broken, a simple fixation should be performed before midface treatment, thus allowing the mandible to act as a guide to midfacial position. If broken, the dentures may be repaired and/or splints made to provide maxillary and mandibular alignment. Plate and screw fixation in an edentulous maxilla may require the use of alveolar bone itself as a stable lower fixation point as the intervening bone may be too thin or splintered (**Fig 5-10b**). Bone grafts may have to be added at the Le Fort I level and the piriform aperture (**Fig 5-10c**). Often these bone grafts also improve the esthetic appearance. The buttress plates, if extended to the alveolus, sometimes must be removed before a denture can be tolerated postoperatively. Proper maxillary projection is confirmed only by relating the maxillary and mandibular alveolar ridges with splints and/or dentures (**Fig 5-10b**). Maxillary vertical buttress reconstruction is therefore a reliable guide for facial height, but not for projection.

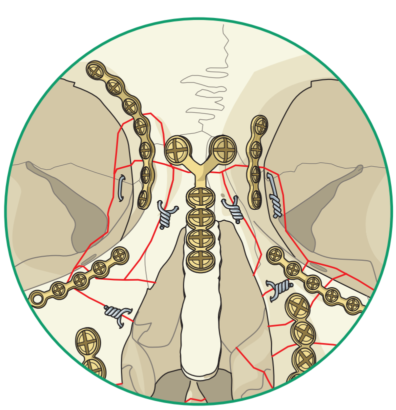
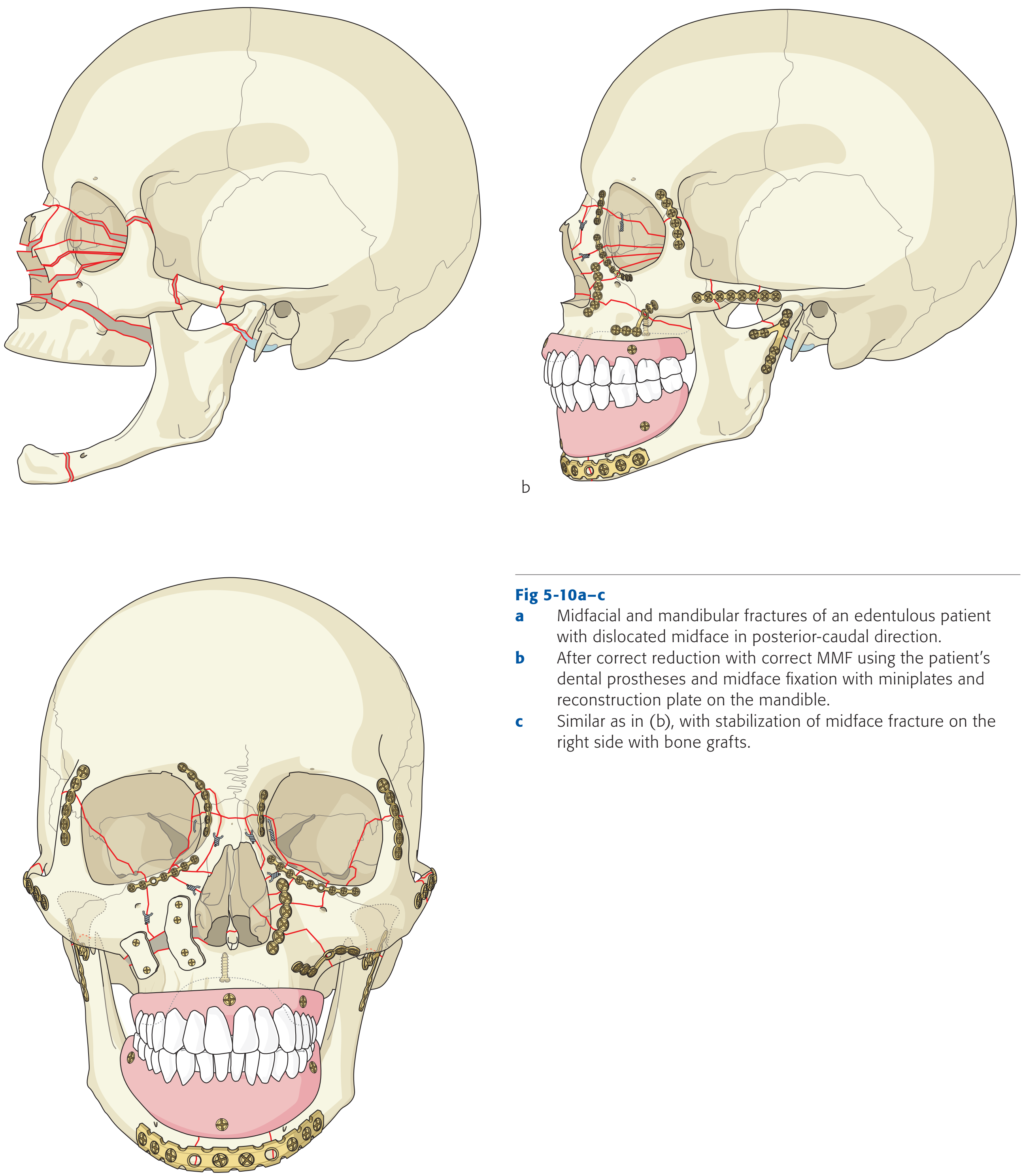


Fig 5-9 Nasal bone grafting is performed.



a

b

c

Fig 5-10a–c

a Midfacial and mandibular fractures of an edentulous patient with dislocated midface in posterior-caudal direction.

b After correct reduction with correct MMF using the patient's dental prostheses and midface fixation with miniplates and reconstruction plate on the mandible.

c Similar as in (b), with stabilization of midface fracture on the right side with bone grafts.

15 Soft-tissue considerations

Current facial fracture reduction schemes emphasize complete degloving of all bones by subperiosteally detaching periosteal soft-tissue attachments and incising fascial layers. It is important when closing incisions to close the periosteum and reposition soft-tissue attachments to the reassembled craniofacial skeleton. Generally, closure is best begun by first closing the periosteum. The areas for periosteal closure include the zygomaticofrontal suture, the inferior orbital rim, and the periosteal layer over medial and lateral canthus areas. Muscular layers underneath the gingivo-buccal sulcus incisions require muscular closure. The incisions in the temporal fascia for zygomatic arch exposure require closure of the deep temporal fascia. Marking the edges of the periosteal incisions with sutures allows precise identification at the end of the case for periosteal closure. This is especially important in lower eyelid incisions.

Soft-tissue injury

The fundamental challenge in facial fracture treatment is the restoration of the preinjury facial appearance and not simply linking together edges of bone at fracture sites. Deformity following facial fractures results from both soft-tissue changes and from bone malalignment. Deformity of both bone and soft tissue significantly increases in the presence of highly comminuted fractures, especially when they involve the upper midfacial and orbital areas. The contribution of blunt soft-tissue injury and soft-tissue contracture to residual facial deformity has not been emphasized in the literature on facial fractures. Contused soft tissue heals with a network of internal scarring, the configuration of which is dictated by the position of the underlying bone fragments. When soft tissue heals over malreduced fractures, shrinkage and contracture of the soft tissue may occur. Scarring and internal rigidity in soft tissue occur in the pattern of the unreduced bone segments as the soft tissue heals. The internal scarring thickens soft tissue, creating a dense internal scar and an internal stiff web which opposes restoration of the preinjury shape and appearance even if the underlying bone is finally replaced into its proper anatomical position. Examples of soft-tissue envelope rigidity accompanying malreduced fractures include the conditions of enophthalmos, medial canthal-ligament malposition, short palpebral fissure, rounded canthus, and an inferiorly displaced malar soft-tissue pad. Secondary management of any one of these conditions is more challenging and less effective than primary reconstruction of the soft tissue. A unique opportunity thus exists in immediate fracture management to maintain shape, expansion, and position of the soft-tissue envelope, and to determine the geometry of soft-tissue fibrosis by providing an anatomically aligned facial skeleton as support. Excellent restoration of appearance results from primary soft-tissue positioning.

The double insult to soft tissue

Delayed reconstruction of facial fractures more than 7–10 days after injury results in a second soft-tissue injury through dissection and incisions in healing areas of contusions and hemorrhage. A second injury is thus created: first, the initial injury and, second, the surgical manipulation. Delayed treatment creates a double insult to the already contused and damaged soft tissue. This is especially harmful, creating dense subcutaneous fibrosis. The skin, following delayed facial fracture repair, is more thickened, rigid, lusterless, reddened, hyperpigmented, and fibrotic than skin from early injury repairs where the initial contusions, fractures, incisions, and dissection are all part of a single soft-tissue injury and recovery. Accurate skeletal reconstruction requires anatomical assembly and stabilization of the basic configuration of the bone buttresses. Missing or unstable bone fragments should be replaced with bone grafts to recreate the preinjury skeletal framework. If soft tissue and bone do not exist, plates alone maintain the volume of the expanded soft tissue. A thorough reconnection of all buttress fragments must proceed from intact bone to intact bone and must be complete and accurate in three dimensions throughout the entire area of injury. Conceptualizing each unit of the patient skeleton in three dimensions emphasizes supervision of width and therefore restoration of projection. Finally, correction of the facial height in each unit allows assembly of the whole skeleton based on a conceptually precise framework for bone reconstruction.

Performing bone reconstruction early in complicated facial injuries allows the most natural restoration of preinjury appearance to be determined by the combined relationship of bone and soft tissue.

16 References and suggested reading

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6 Fractures in the growing skeleton