14 Midfacial Fractures

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A complete evaluation of the maxillofacial skeleton is paramount in order to produce the best anatomic and functional results. The aim, then, of the maxillofacial reconstructive surgeon, after a thorough evaluation of the patient, is to properly diagnose the fractures involved, reestablish proper occlusion, provide for proper open reduction and fixation of all fracture sites through adequate exposure, augment with bone grafting those areas of missing bone or skeletal structure, and correct any soft tissue deformities present. The following will be a review of that process.

The face has traditionally been divided into upper face, midface, and lower face. Fractures of the craniofacial skeleton can similarly be divided into these three regions. The upper face consists of fractures involving the frontotemporal bones, including the frontal sinus as well as the orbital roof, while the lower face includes fractures of the mandible. The midface is more complex, secondary to its many and variable components. It involves all entities of the facial skeleton between the upper face and the lower face, including the orbital rims and walls (except the roof), the nasal bones, the maxilla and pterygoids, and the zygoma and its arch.

Buttress System

The skeletal components of the midface, while distinct entities, form a network of reinforced bone that surrounds the pneumatic cavities, the sinuses, and the nasal airway. They also serve as a platform for the globe and surrounding tissues, the nose, and the maxillary dental arch. This reinforced bone is oriented into vertical and horizontal pillars or buttresses (see Fig. 14.1). Vertically oriented buttresses relate the facial bones to the frontal cranium and cranial base. They protect the maxilla from vertically directed forces and provide midfacial height. The horizontally oriented buttresses of the midface protect it against horizontally directed forces and provide the midface with width and projection. There are three pairs of vertically oriented buttresses: two anterior and one posterior. These include the nasomaxillary medially, the zygomaticomaxillary laterally, and the pterygomaxillary posteriorly. The horizontal buttresses of the midface include the zygomaticotemporal (arch) laterally and the orbital rim, maxillary alveolus, and palate medially.

Evaluation

In general, patients with fractures of the midface can present with pain at the fracture site, swelling, paresthesia in the distribution of the infraorbital nerve, periorbital ecchymosis, or subconjunctival hemorrhage. Patients with nasal bone fractures can present with epistaxis and nasal airway obstruction secondary to a deviated septum or a septal hematoma. The nasal bones may also be mobile and/or comminuted. Patients with zygomatic fractures may present with a step-off or tender point at the inferior or lateral orbital rim, globe dystopia, or enophthalmos. The buttress concept explains why these fractures most commonly occur in combination. Hence, a serious zygomatic fracture or zygomaticomaxillary complex (ZMC) fracture will present with at least four breaking points or a quadripod fracture (see Fig. 14.2). Patients with orbital fractures can present similarly to those with zygomatic fractures but also with diplopia and limited extraocular movement with entrapment of periocular tissues. Any periorbital fracture, including zygomatic fractures, demands a thorough evaluation of the globe and its various functions. Finally, those individuals presenting with maxillary fractures cannot only present with similar findings associated with other types of midfacial fractures but also with malocclusion.

In addition to the history and physical examination, a radiographic examination is also of paramount importance. Once considered too costly and unnecessary, spiral computed tomography (CT) has become the gold standard for evaluat-

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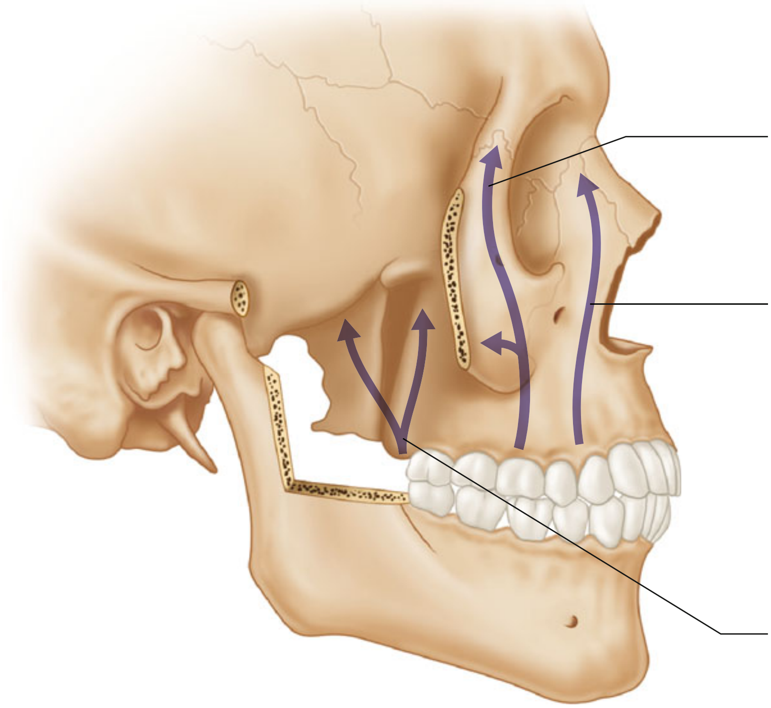

Fig. 14.1 Vertical buttresses of the maxillofacial skeleton

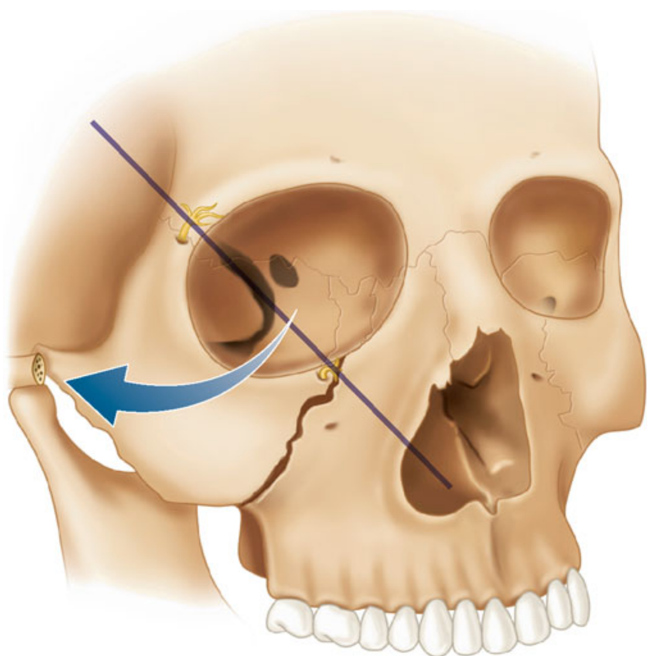

Fig. 14.2 Rotation of the zygomaticomalar complex if fixation is not performed at three points

ing facial trauma with suspected fractures, especially of the midface. Axial and coronal views are indispensable in demonstrating the fracture lines, the degree of displacement, and the associated injuries. In addition, newer high-resolution 3D CT reconstruction aids in understanding the orientation of the fracture, the size and number of broken fragments, and the degree of dislocation, depression, elevation, distraction, and rotation, all of which aid in optimal surgical planning.

Classic patterns of midfacial fractures were originally described by Rene Le Fort in 1901 (see Fig. 14.3). He demonstrated that these common fractures occur along lines or areas of thin and weak bone surfaces due to sinuses or various foramina. The Le Fort type I fracture is a transverse fracture of the maxilla above the dentition extending from the area of the maxillary tuberosity to the nasal aperture. The Le Fort type II or pyramidal fracture extends medially from the nasal bones, down through the medial orbit, the infraorbital rim and foramen, and the zygomaticomaxillary suture or buttress and extending posteriorly to the pterygomaxillary fossa. The Le Fort type III fracture, or craniofacial disjunction, occurs in more severe injuries and separates the facial bones from the attachments to the cranial base.

True and classic Le Fort fracture patterns are rarely seen in modern day clinical practice due to the high impact and velocity injuries that are typically encountered in major medical centers. Depending on the mechanism of injury, the force and direction of the blow, and the position of the craniofacial skeleton, any combination of fracture patterns can occur. The Le Fort classification is still useful to direct the maxillofacial surgeon in a full analysis of the midfacial injury. Typically, one or more of the vertically and/or horizontally oriented buttresses are involved.

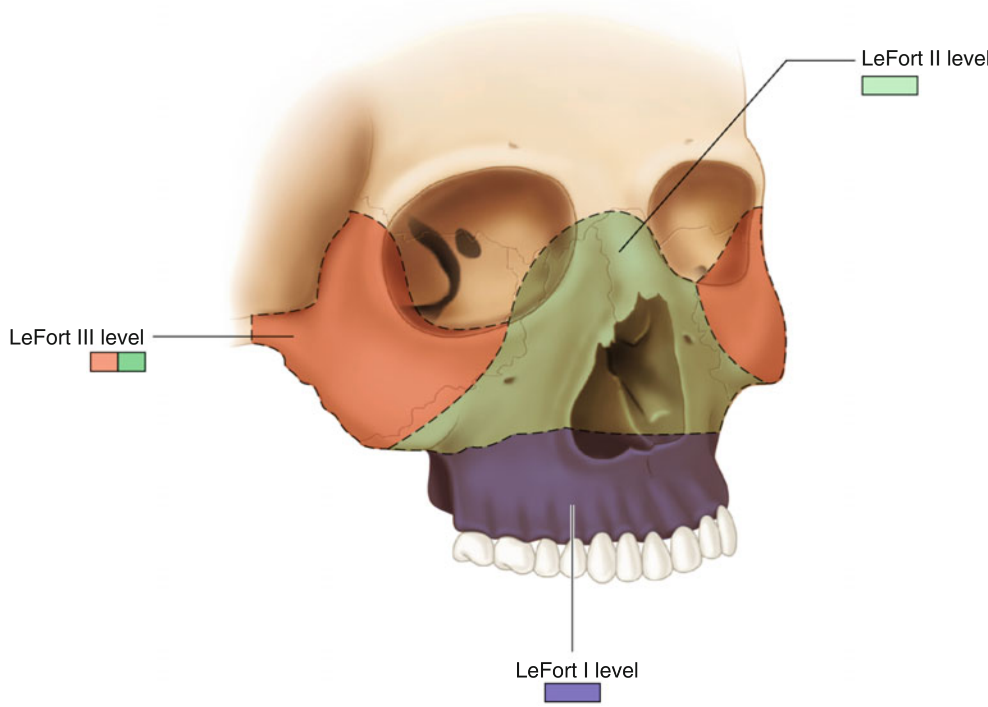

Fig. 14.3 Classification of Le Fort midfacial fractures

Management

Regardless of the fracture pattern, the treatment goal for midfacial fractures is the same: (1) to restore the anatomic relationship between the maxilla and the cranial base above and the mandible below, (2) to reestablish normal midfacial height and projection, and (3) to stabilize the fractures by means of rigid fixation. One of the major objectives in treating midface fractures is to preserve or reestablish the patient's pre-injury occlusion. This is accomplished through mandibulo-maxillary fixation, which reestablishes the relationship between the mandible and the midface. This is accomplished by means of Erich arch bars or direct screw posts with eyelets to provide for wire fixation of the teeth. After doing so, the fracture sites of the midface can be addressed through a combination of an upper gingivobuccal sulcus incision and an eyelid incision – either a subciliary or a transconjunctival incision (see Fig. 14.4). An equally important goal in the treatment of midfacial fractures is to reestablish the patient's pre-injury facial height and projection (see Fig. 14.5). Reestablishing facial height is a product of anatomic reduction of the anterior vertically oriented buttresses. In doing so, the relationship between the cranium and the midface is restored. Treatment of fractures of the posterior buttresses is generally unnecessary. Facial projection and width is a function of the horizontal buttresses, and anatomic reduction helps to reestablish the pre-injury midfacial characteristics and form.

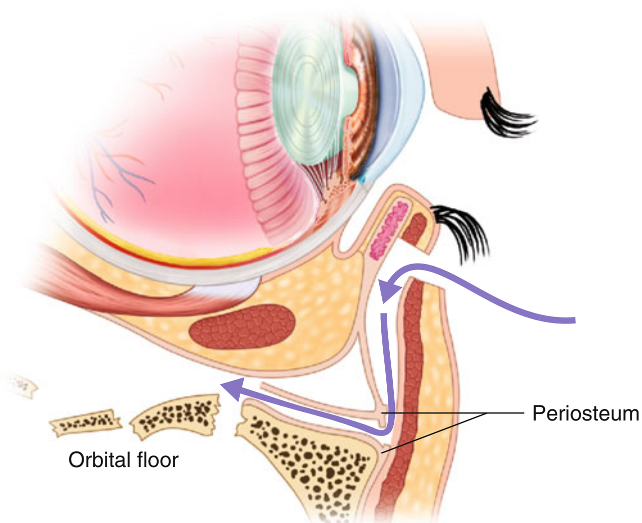

Fig. 14.4 Subciliary approach to the orbital floor

Once the vertical and horizontal buttress fractures have been anatomically reduced, they require fixation. Historically, intraosseous wiring was the preferred fixation technique. Today, rigid or functionally stable fixation with miniplates is the gold standard (see Fig. 14.6a, b). There is currently no consensus regarding the exact size and thickness of plates and screws to utilize within the midface for fixation purposes [4]. This will depend on the nature of the injury and the need for structural support. Different diameter screws are used depending on the thickness of the plate. Newer rigid fixation sets now come with standard diameter screws of different lengths that fit a wide range of plates that vary depending on the thickness of the bone. Thinner more malleable plates are used in thinner bone, usually more cephalad; thicker, stronger plates are used in thicker bone subjected to more forces, such as mastication, that are usually more caudad. The plates are generally non-compression of variable length and configuration depending on the fracture. Newer self-drilling and self-tapping screws and locking screws and plates can be used and may provide the surgeon with several advantages. These advantages may include faster application, less stripping and loosening of the screws, and possibly less compromise of osseous blood supply. The more drill holes and screw fixation on either side of the fracture allows for more load sharing between the plate and the bone and consequently more stable fixation. Further details about rigid fixation can be found in other parts of this book. Bone grafts should be considered for areas of bones loss and bone gaps greater than 0.5 cm. The sources of bone graft are usually from the rib, ilium, or calvarial bone.

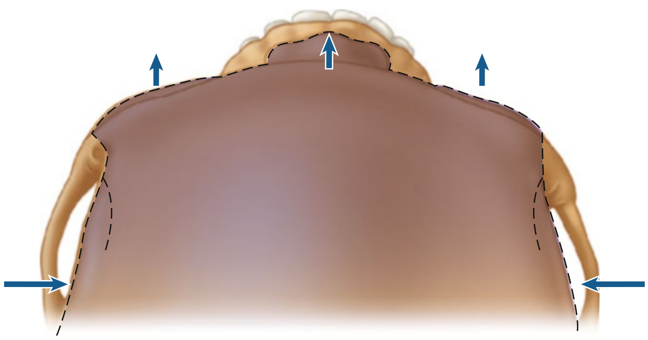

Fig. 14.5 Anterior face demonstrating the importance of reestablishing facial width and projection

Palatal Fractures

Significant forces directed on the midface may also fracture the palate, which, as was noted above, acts as a horizontal buttress of the midface providing for midfacial width. In fact, palatal fractures accompany 8 % of all Le Fort fractures. A common theme with all palatal fractures is the discontinuity of the maxillary alveolus, which permits displacement and rotation of the dental alveolar segments. Because proper reestablishment of pre-injury occlusion is necessary for adequate midface fracture reduction, misdiagnosed or mismanaged

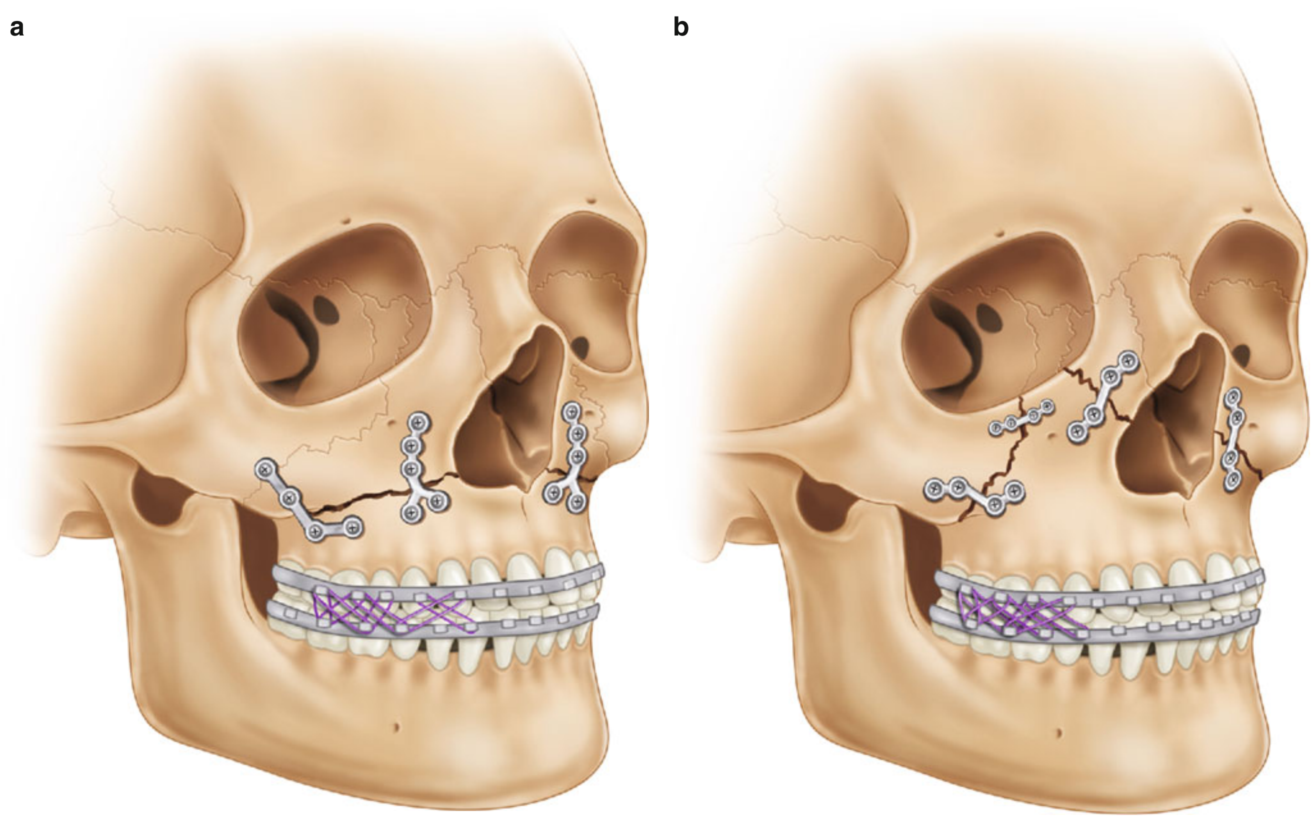

Fig. 14.6 Plating of a Le Fort I maxillary fracture (**a**) and Le Fort II maxillary fracture (**b**)

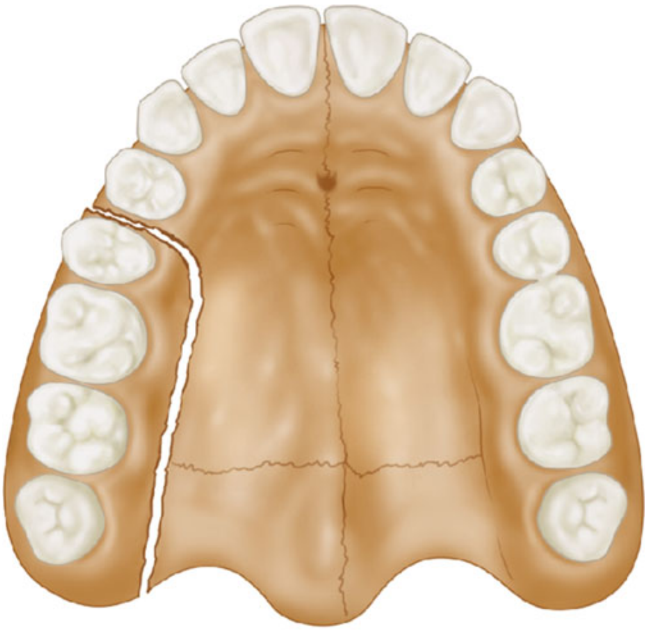

Fig. 14.7 Palatal fracture involving the alveolus

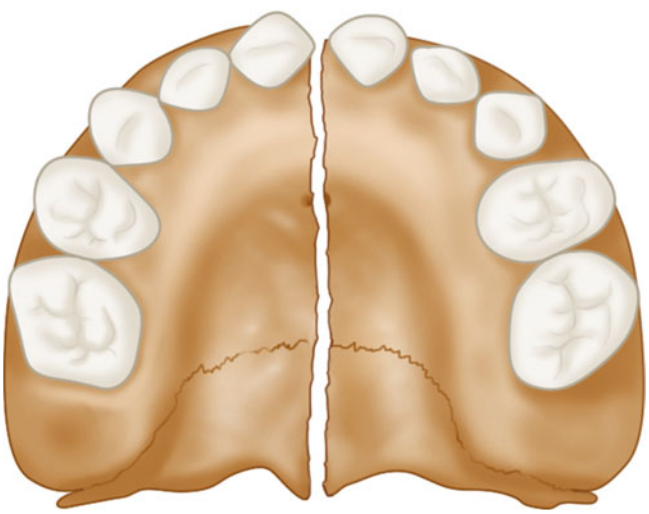

Fig. 14.8 Sagittal palatal fracture

palatal fractures increase the risk of nonanatomic midfacial fracture reduction and consequently persistent malocclusion.

In addition to involving the alveolus (see Fig. 14.7), palatal fractures commonly occur in a sagittal (see Fig. 14.8) plane. Severe injuries produce complex and comminuted patterns (see Fig. 14.9). Very rarely do they occur in a transverse pattern. Hendrickson et al. classified palatal fractures into six fracture types. Type III (the parasagittal) (see Fig. 14.10) and type IV (the para-alveolar) are the most common types of palatal fractures in adults, while type VI (the transverse) is the least common fracture type. Depending on the location and the vector of force,

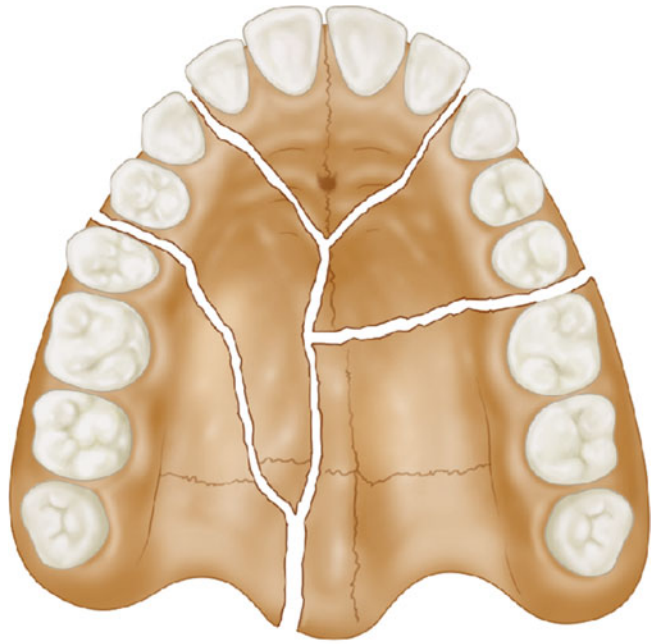

Fig. 14.9 Comminuted palatal fracture

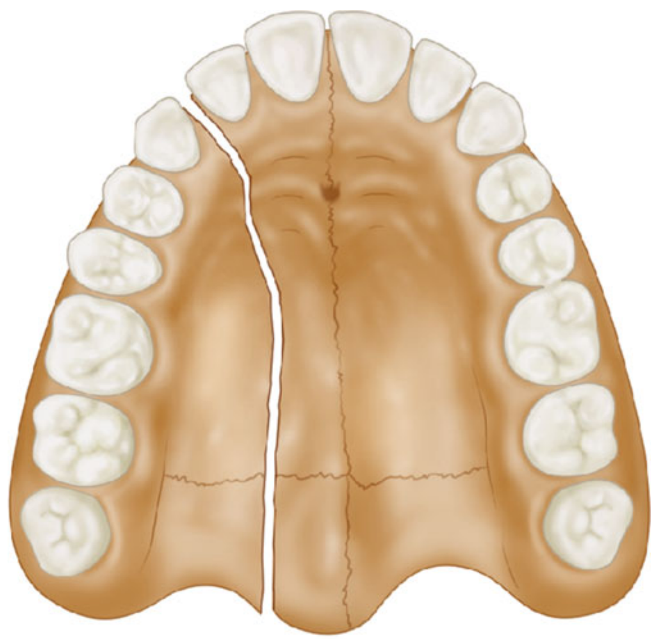

Fig. 14.10 Parasagittal palatal fracture

most involve the alveolus and a sagittally oriented fracture of the palate. In the more severe and complex type V fractures (see Fig. 14.8), oblique or comminuted fracture patterns are present. CT scanning is necessary in the axial, coronal, and sagittal views for determination of the fracture type and pattern. Once the type of fracture pattern is ascertained, the surgical management of the fracture can be determined.

Type I fractures are typically treated with an arch bar with or without mandibulo-maxillary fixation. If the fracture is significantly displaced, small miniplates with unicortical screws may be used to provide supplemental stabilization. Fracture types II, III, and IV may be reduced anatomically by exposure of the palatal vault. Initial alignment with placement of a maxillary arch bar is performed. This also serves as a tension band. Exposure of the palatal vault should be made through traumatic lacerations of the palatal mucosa or through an incision in midline of the palatal mucosa in an anterior-posterior direction in order to optimize the blood supply to the palate. Once the fracture has been reduced, the fracture is rigidly fixated with a medium titanium plate such as a 2.0 mm system. After fixation of the fracture, the maxillary dental segments are intact and can be utilized for mandibulo-maxillary fixation. Commonly, the palatal fracture will be combined with other buttress fractures of the midface that also need to be reduced and rigidly fixated. Complex type V fractures are typically managed with an arch bar, splint, and vertical buttress stabilization.

Pollock noted that despite attempts to avoid malrotation and disinclination of the palato-alveolar segments, this does occur in approximately 1 in 10 patients with standard palatal fracture management. In his opinion, the keys to successful management of palatal fractures include precise fracture pattern classification, anatomical reduction, and instrument stabilization. He describes an instrument similar to a Hayton-Williams forceps used for pelvic reduction (a 205 mm forceps). He proposes rigid fixation with a 2.0 mm locking plate and screws well contoured to the palate. The mucoperiosteum is left intact and lacerations are meticulously repaired. This spares the blood supply to the palate and may aid in fracture healing. This assembly as described provides rigid fixation by acting as an external fixator. The plate and screws can be removed in the office or under conscious sedation at 6 weeks or when proper bone healing has occurred.

In summary, the midface is a highly complex system of bone. Buttresses, or areas of reinforced bone, surround pneumatic cavities, the nasal airway, and the orbit. Adequate reduction and fixation of the vertical and horizontal buttresses is necessary to reestablish midfacial height and width, respectively. In doing so, the anatomic relationship between the maxilla and the cranial base above and the mandible below can be reestablished. Palatal fractures, due to their inherent nature of disrupting the maxillary dentoalveolar segments, can lead to improper anatomic reduction of midfacial fractures if they are not adequately addressed. Adequate identification of the type of palatal fracture is necessary for treatment planning, which commonly requires some form of rigid fixation to avoid malrotation of dentoalveolar segments.

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