

Continuing Education Independent Study Series



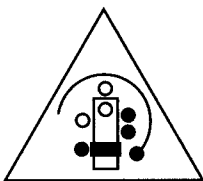
MIDFACE TRAUMA

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Association of Surgical Technologists

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PREFACE

“Midface Trauma” is part of the AST Continuing Education Independent Study Series. The series has been specifically designed for surgical technologists to provide independent study opportunities that are relevant to the field and to support the educational goals of the profession and the Association.

Acknowledgments

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INTRODUCTION

Purpose

The purpose of this module is to provide an overview of the structure of the midface and acquaint the learner with the types of fractures to which the midface is subjected through trauma; the posttraumatic evaluation of patients; the methods used to achieve diagnosis; and the treatment measures undertaken for specific types of fractures. In addition, special patient considerations are addressed. Upon completing this module, the learner will receive 2 continuing education (CE) credits in category 3.

Objectives

Upon completing this module, the learner will be able to do the following:

1. Describe the anatomy of the midface and identify all of the bordering bones and buttresses and the structural purposes they serve.
2. Discuss the different types of midface fractures and the various forms of trauma (and forces) that create the fractures.
3. Discuss the treatment of midface fractures and the factors influencing the selection of specific treatment modalities for each type of fracture.
4. Describe the two patient groups that require special consideration in the treatment of facial-bone fractures.

Using the Module

1. Read the information provided, referring to the appropriate figures.
2. Complete the enclosed exam without referring back to the text. The questions are in a multiple choice format. Select the best answer from the alternatives given.
3. Mail the completed exam to AST, CEIS Series, 7108-C S. Alton Way, Suite 100, Englewood, CO 80112-2106. Please keep a copy of your answers before mailing the exam. You must return the original copy of the answer sheet; this exam may not be copied and distributed to others.
4. Your exam will be graded, and you will be awarded continuing education credit upon achieving a minimum passing score of 70%. If you are an AST member, your credits will be automatically recorded and you do not need to submit the credits with your yearly CE report form.
5. You will be sent the correct answers to the exam. Compare your answers with the correct answers to evaluate your level of knowledge and to determine what areas you need to review.

Studying Technical Material

To study technical material, find a quiet place where you can work uninterrupted. Sitting at a desk or work table will be most conducive to studying.

Having a medical dictionary available as you study is very helpful so you can look up any words with which you are unfamiliar. Make notes in the margins of any new definitions so that you can review them.

The ultimate test of how well you learn this material is your ability to relate your knowledge to what is happening in the surgical field. Apply your knowledge to the progress of the surgery and the postoperative results for the patient.

MIDFACE TRAUMA

Anatomy

The human face is central to each individual's identity. It is unique because in addition to its aesthetic function, it serves many essential nonaesthetic functions as well. When midface trauma occurs, the restoration of both aesthetic and nonaesthetic functions is considered during evaluation and treatment.

Because of its complex structure, the face can be divided into three anatomic regions that do not reflect any functional divisions (Figure 1). The middle third, or midface, is the most anatomically compli-

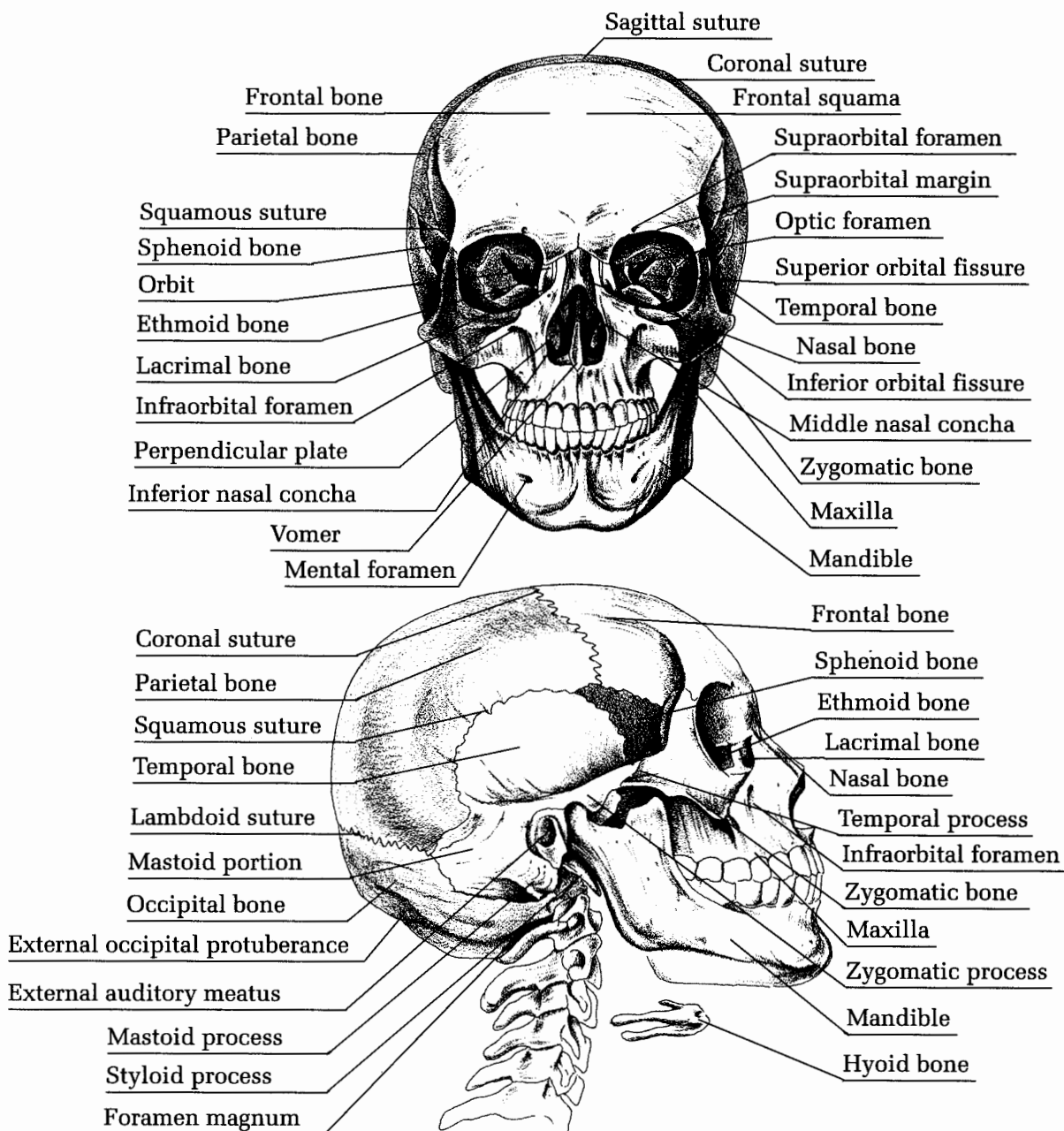


Figure 1. Anterior (top) and right lateral (bottom) views of skull. Adapted from Tortora GJ, Grabowski SR: Principles of Anatomy and Physiology. 7th ed. New York, HarperCollins, 1993.

cated and serves many purposes in addition to connecting the upper and lower thirds. The bones of the midface include the maxilla, zygoma, nasal, lacrimal, palatine, and inferior nasal concha, which are all bilateral, and the midline vomer. Closely related to these bones through various sutures are the frontal, ethmoid, sphenoid, and temporal bones. Together these bones form the orbit, the external nose and bony nasal septum, and the malar prominence, all of which have aesthetic and functional import. They also form the buttress system of the face. This consists of a series of vertical pillars and horizontal struts that maintain the width, height, and projection of the face and resists the powerful masticatory forces. The vertical components of this latticework are the nasomaxillary, zygomaticomaxillary, and pterygomaxillary buttresses. The horizontal buttresses include the frontal bar, inferior orbital rims, maxillary alveolus and palate, zygomatic processes of the temporal bones, and the serrated edges of the greater wings of the sphenoid. The series of compartments within and formed by these buttresses, such as the orbits, the nasal cavity, and the paranasal sinuses, ideally allow this part of the facial skeleton to absorb and dissipate energy from a traumatic blow to protect other vital structures, which frequently results in midface fractures.¹

Evaluation of Midface Fractures

The types of fractures that occur in the midface depend on the point of impact, the direction of the force, and the energy behind the force. Anterior forces will result in nasal fracture, nasal-orbital-ethmoid fracture, and/or some variation of the classic LeFort fracture. Lateral forces tend to be centered on the prominent convexity of the zygoma, resulting in a zygomatic complex fracture. Orbital fractures may result from any of these forces.

The most commonly fractured bone in the midface is the nasal bone, followed in frequency by the zygoma. Motor vehicle accidents, altercations, and sports injuries are the most frequent causes of midface fracture. Because of this, it is no surprise that midface fractures occur far more frequently in men than women.

Evaluating a patient suspected of having facial fractures frequently poses a unique challenge. The patient interview is often difficult due to the patient's state of mind, neurologic status, or concomitant injuries. The patient should be specifically asked about occlusion and vision. Other historical information may be elicited from bystanders or rescue personnel. Important information would include the nature of the force and the direction. Similarly, the physical examination can be difficult. Facial edema and pain may conceal facial deformities. The examination should concentrate on inspection and palpation. Inspection is best performed from several points of view, and particular attention is given to symmetry, periorbital ecchymosis and edema, enophthalmos, flattening of the cheek, lengthening of the face, pupillary levels, intercanthal distance, and subconjunctival hemorrhage. Palpation can then be performed in a systematic manner using both hands and while standing at the head of the bed. The entire orbital rims are palpated as are the zygomatic complexes, the nasal bones, the maxillae, and the mandible. This often is made difficult by edema and pain. Intraoral examination should be performed with attention given to trismus, occlusion, and ecchymosis. The buccal vestibule should be palpated. Examination of the cranial nerves should be performed with particular attention given to vision, extraocular movements, and facial movement and sensation. If the patient complains of diplopia, whether it is binocular or monocular must be determined. Monocular diplopia generally points toward globe or lens injury or hyphema, whereas binocular diplopia is indicative of entrapment, neuromuscular disorder, edema or hematoma, or change in orbital shape.²⁻⁴

The diagnosis can be frequently made by radiographic evaluation in a patient with little or no historical information and a difficult physical examination. Computed tomography (CT) performed in the axial

and coronal planes has revolutionized diagnosis of facial fractures and made plain radiographs all but obsolete. Waters, submental vertex, lateral, posteroanterior, and anteroposterior views of the skull are useful when CT is not available. In some patients, these traditional views have to be altered slightly due to patient considerations, which can lead to distortion. Three-dimensional CT scans have been touted as the next great advance in radiologic diagnosis and treatment planning. However, these scans really do not provide much information beyond that gained from the scans available in two planes.

Interest has increased recently in the use of ultrasound in the diagnosis of orbital fractures. This stems from the fact that the trauma patient often is not able to be positioned properly or is unable to cooperate for adequate scanning. In a 1993 study from Toronto, ultrasound was correlated with CT scan in 17 of 18 prospectively studied patients.⁵ The advantages include decreased cost and time, portability, no positioning difficulty, and no radiation exposure. The disadvantages are requisite technical expertise, difficult interpretation of hard-copy images, and uncertainty of usefulness in diagnosis of other facial fractures.

LeFort and Zygomatic Fractures

Because a comprehensive review of all midface fractures is too extensive for this format, only LeFort and zygomatic complex fractures will be considered.

Approximately 100 years ago, Rene LeFort used low-velocity impact forces to describe the "great lines of weakness in the face." These fractures are generally oriented perpendicular to the three main vertical buttresses of the face: the nasomaxillary, the zygomaticomaxillary, and the pterygomaxillary.⁶ The LeFort I fracture courses from the lateral border of the pyriform aperture across the lateral antral wall, behind the maxillary tuberosity and across the pterygoid junction (Figure 2). This fracture usually results from a force delivered above the level of the teeth that produces an open bite deformity because of the posterior and inferior pull of the pterygoid muscles. The LeFort II fracture courses along the nasofrontal suture, through the lacrimal bone, across the infraorbital rim, inferiorly near the zygomaticomaxillary suture, and posteriorly but somewhat higher than in LeFort I. This fraction results from a blow at the level of the nasal bones. The LeFort III fracture is caused by a force at the orbital level and results in complete craniofacial dysjunction. This fracture involves the zygomaticotemporal and zygomaticofrontal sutures and the lateral orbital wall, extending medially across the inferior orbital fissure to the nasofrontal suture. Inferiorly, the fracture extends into the pterygomaxillary fissure.⁷

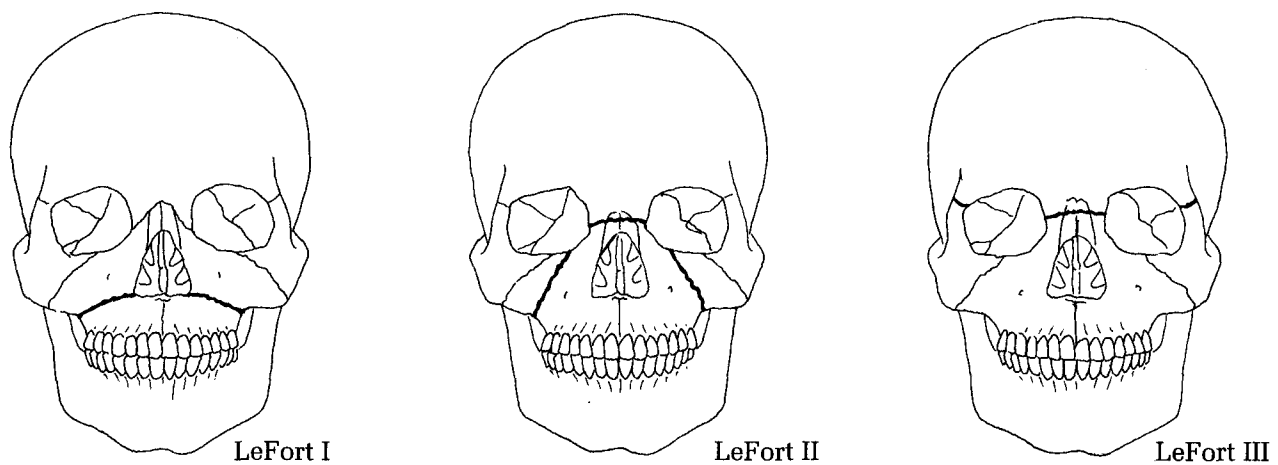


Figure 2. LeFort fractures.

The zygomatic complex is often referred to as a tripod. However, the zygoma is roughly the equivalent of a four-sided pyramid because of its articulation with the frontal, temporal, and sphenoid bones and the maxilla. Fractures of the zygomatic complex may involve one or all of these articulations. A lateral or oblique force usually causes a fracture of the zygomatic complex. The magnitude of the force and the amount of soft tissue covering will determine the extent of fracture.⁸

Because of marked variability in these fractures, a myriad of classifications has been proposed based on extent, displacement, and/or rotation of the fracture. Despite extensive subclassification, categorizing fractures still is often difficult. A simpler system proposed by Zingg et al^{9,10} places fractures into three major groups: incomplete zygomatic fracture, complete monofragment or tetrapod fracture, and multifragment zygomatic fracture.

The incomplete fracture involves the arch, lateral orbital wall, or infraorbital rim alone. The tetrapod fracture involves all four pillars and primarily involves extension from the inferior orbital fissure. Anteromedially, the fracture usually courses through the maxilla, infraorbital rim, and along the orbital floor. This is usually medial to the zygomaticomaxillary suture. Superolaterally, the fracture extends along the lateral orbital wall and through the zygomaticofrontal suture. Inferior extension is along the infratemporal aspect of the maxilla and joins the anterior fracture of the zygomaticomaxillary buttress. The fourth fracture is through the arch, usually 1.5 cm posterior to the zygomaticotemporal suture. As the force is dissipated through the four pillars, there may be additional comminution resulting in a multifragment fracture. Forces acting on the fragmented zygomatic complex include those exerted by the masseter muscle and the temporalis fascia in opposite directions.¹¹ In a cadaveric study, Karlan and Cassisi¹² showed that minimal force exerted along the axis of the masseter caused displacement of unstable fractures. Because the fractures were in fact osteotomies without serration and stabilizing forces such as the fascia, periosteum, and skin were unaccounted for, the model is not perfect but does confirm the inferior and medial force exerted by the masseter.

Treatment

In treating these or any other facial fracture, certain tenets must be followed to achieve the best possible result. The primary principle is that re-establishment of occlusion and orbital configuration are vital to regain premorbid function. A secondary principle is that facial projection and height and facial contour and symmetry must be considered. Consideration must be given to the principles of basic fracture healing.¹³ Because most facial bones initially undergo membranous bone formation, the belief was held that they healed by fibrous union when fractured. However, bony union has been shown to occur wherever accurate reduction exists. This can be seen in primary bone repair when good anatomic reduction, no or minimal mobility at the fracture site, and good vascular supply provide optimum conditions for bone repair. Good apposition of the bone plates, particularly with fixation, allows for bypass of the callus phase that usually stabilizes a fracture. This occurrence is part of secondary bony repair that progresses through three stages: hematoma formation and cellular proliferation, callus formation and maturation, and remodeling to lamellar bone. In membranous bone, this may result in bony union or fibrous union depending on the accuracy of reduction.

LeFort Fractures

The treatment of LeFort fractures follows the basic principles of fracture reduction, which is followed by stabilization when necessary. A point that should be remembered is that the occlusal plane has an

approximate 45-degree angle with the cranial base along which the fracture may displace. A minimally displaced fracture may be reduced by manual traction or elastic traction on a maxillary arch bar. If needed, more aggressive closed reduction can be achieved through the use of Rowe and/or Hayton-Williams disimpaction forceps. The Rowe forceps engage the floor of the nose and the hard palate. The Hayton-Williams forceps circumscribe the maxillary alveolus and are braced on the maxillary tuberosities. They are designed to disimpact the pterygoid plates downward and move the maxilla forward. Any fracture recalcitrant to closed reduction should undergo open reduction through an incision in the buccal vestibule with exposure of the lateral antral wall and the zygomatic buttress. The fracture line is followed with a large osteotome to the pterygoid plate. Any further reduction can then be performed with forceps.⁷

After adequate reduction, stabilization must be achieved. Several methods have been described. Any of the described methods may be used in combination with mandibulomaxillary fixation (MMF). Internal craniofacial suspension involves suspension of the mobile portion of the midface to the more superior portions. This is a rapid, uncomplicated, and inconspicuous method. However, it is not rigid and requires maintenance of MMF. Because the fixation is nonrigid, dynamic forces exerted by the mandible may cause small anatomic adjustments that result in a more functional outcome. Several variations on this theme are possible. One is the Obwegeser method of circumzygomatic suspension in which an awl is passed percutaneously deep to the zygomatic arch and zygomatic buttress to penetrate the buccal mucosa. There, a wire is attached, withdrawn to the level of the arch, and then passed over the facial surface of the arch back through the buccal mucosa where it is then attached to the arch bar. Other methods of suspension include frontolateral, central, pyriform aperture, and inferior orbital rim.⁶

External fixation is very similar to internal suspension in terms of time and expertise required, use of nonrigid fixation, and the need for MMF. It allows for dynamic traction, which is a marked advantage when doubt exists about complete reduction. This dynamic traction can be directed anteriorly, preventing the retrusion that can occur with internal suspension. Methods include halo frame, box frame, and Levant frame. The halo and the Levant frames rely on craniomaxillary fixation with rods connecting the frame and a cap splint anteriorly. The box frame relies on craniomandibular fixation, thereby sandwiching the fractured midface between the stable cranium and mandible. Obvious disadvantages include pin care; the bulky, cumbersome appliance; and patient access to the device.⁶

Internal fixation takes the form of either wire or miniplate osteosynthesis. Either method is useful in cases of comminution or severe displacement. However, wire fixation is not rigid and therefore requires supplemental stabilization, including MMF and/or internal or external suspension. Miniplate osteosynthesis provides rigid fixation and obviates the need for other forms of stabilization. Although MMF is necessary to establish proper reduction and occlusion, this can be released upon application of the plates. Rigid fixation with plates and screws provides three-dimensional fixation. Through the use of stronger metals such as titanium and Vitallium and placement of two screws on either side of the fracture, this fixation resists both translational and rotational movement. The key to success with plates is achieving proper occlusion. Because this method is unyielding and unforgiving, failure to recognize condylar displacement or improper reduction will result in malunion and malocclusion.¹⁴

Zygomatic Complex Fractures

In determining the proper course of action in cases of zygomatic complex fractures, both radiologic and clinical findings must be considered. A review of published series on the treatment of zygomatic complex fractures shows that no surgical intervention was necessary in 9% to 49% of cases.¹¹ This treatment is acceptable in cases of nondisplaced or minimally displaced fractures. Taking the status of the

contralateral eye into consideration also is prudent. If vision in the eye contralateral to a displaced zygomatic fracture is diminished or absent, one may elect not to treat the fracture in the functioning eye. The risk of blindness is minimal with repair but would be catastrophic in this situation, whereas a cosmetic deformity can be endured.

If the determination is made that a zygomatic complex fracture warrants intervention, it requires reduction and possible fixation as would any other fracture. However, due to its unique anatomy, strictly closed reduction by external manipulation is not possible. In the sense that skin or mucosa must be violated, all forms of reduction are technically open, some more so than others.

In the Gillies temporal approach, an incision is made 2.5 cm above and anterior to the helix of the ear. This incision is carried through the temporal fascia until temporalis muscle bulges through the incision. The overlying fascia and the muscle are bluntly separated down to the medial aspect of the arch and infratemporal surface of the body. A Rowe zygomatic elevator is inserted to proper depth and firm anterior, superior, and lateral elevation is applied. Once adequate reduction and stabilization have been achieved, the elevator is removed.⁸

Another technique of closed reduction involves a percutaneous approach. This is probably the simplest and most direct approach. To determine the point of application, a vertical line is drawn from the lateral canthus and a horizontal line drawn laterally from the nasal ala. The point of intersection is where a stab incision is made and the reduction instrument inserted. Instruments used in this manner include the bone hook, bone screw, and towel clip. Other approaches include the buccal sulcus, intrasinus, and eyebrow.⁸

In determining the adequacy of reduction, it is not enough to reduce only the infraorbital rim and zygomaticofrontal suture. Because the zygoma has four legs, three must be determined to be in proper position to ensure that the fourth is also. While the orbital rims are generally easily palpated and their reduction readily determined, this is not necessarily the case with the arch and the zygomaticomaxillary buttress. Some feel that palpation of the orbital rim and visual inspection of the malar eminence are sufficient to assess fracture alignment if edema has resolved. Whenever there is doubt about the post-reduction position, it should be verified through surgical exposure. Many approaches to one or multiple zygomatic articulations exist. These include the lateral brow, transoral, infraciliary, transconjunctival, extended preauricular, and coronal.¹⁵

Once accurate reduction has been achieved, a method of stabilization must be chosen if it is needed. Some suggest that firm pressure applied to the malar eminence is an adequate test of stability after reduction. The reported incidence of need for fixation ranges from 13% to 100%.¹¹ Comminution of the fractured ends is a reliable indicator of instability. If there is any doubt about postreduction stability, fixation should be applied.

In external pin fixation, pins are placed in the supraorbital rim and body of the zygoma. These are connected through another pin and two universal joints. This method provides three-dimensional stability, adjustability, and independence from other facial fractures.⁸ However, it is not useful when the body of the zygoma is comminuted. Internal pin fixation is a fast, technically facile technique that provides sufficiently rigid three-dimensional fixation. However, there is no adjustability once the pin is placed, and the technique cannot be used when there is comminution. In the event of the rare bilateral zygomatic complex fracture, one pin may be used to stabilize both via the transfacial approach. Another approach used in unilateral fractures is the transnasal. Kirschner wires or Steinmann pins may be used. The pins may be inserted from normal-to-fractured or fractured-to-normal depending on the method chosen. A major drawback is that the pin must be removed.⁸ Wire or plate osteosynthesis is useful when exposure has already been obtained to determine adequate reduction. While some have advocated single

wire osteosynthesis at the zygomaticofrontal suture, most studies have shown that additional wiring at the zygomaticomaxillary buttress is more stable. The limitation in using wire is that it prevents translation only. Rotation is still possible because of the masseteric forces. Plate osteosynthesis has become increasingly popular.¹⁴ The drawbacks to this method are its cost, technical demands, and lack of adjustability. However, once the special instrumentation and expertise have been obtained, it is a superior method for rigid fixation. Many advocate single miniplate fixation at either the zygomaticofrontal suture or zygomaticomaxillary buttress in the classic tetrapod fracture that requires stabilization. Early literature advocating two-point fixation was primarily based on wire osteosynthesis, such as the fresh cadaver study and clinical review by Karlan and Cassisi.¹²

Eisele and Duckert,¹⁶ Zingg et al,^{9,10} Holmes and Matthews,¹⁷ and Tarabichi and Muaaz¹⁸ have advocated single-point plate stabilization based on their different series. However, their success was achieved with uncomplicated tetrapod fractures. Some issued the caveat that comminution of the fracture generally warranted further fixation.

Special Patient Considerations

Two special cases that warrant further consideration are the edentulous patient and the pediatric patient. In the edentulous patient requiring MMF, the patient's own dentures may be wired together and held in place with internal suspension and circummandibular wires. However, the patient's dentures may not be available. In this case, a Gunning splint may be cast from the patient's alveolar ridges by a prosthodontist and used in midface stabilization. Another attractive option is plate osteosynthesis. In this case, maintaining the vertical dimension at a minimum is important because new dentures will generally be required anyway.

The incidence of facial fracture is lower in the pediatric population compared with adults. Possible reasons for this include the small facial mass compared to the calvarium, the resiliency of the facial skeleton, and the environment.¹⁹ Evaluation and treatment are essentially the same in this population. However, many advocate the "less is better" approach. They point to the better healing that generally occurs in children. Observation or the least invasive surgical approach for reduction and stabilization are recommended by some. One reason is that any potential malocclusion that may occur will be adapted to once the primary teeth are shed and the permanent teeth erupt. Also, orthodontic intervention remains an option. Rigid miniplate fixation is recommended for complex situations. It is still uncertain whether this alters facial growth; therefore, controversy exists over removal of the hardware.²⁰⁻²²

Conclusion

Regardless of the age of the patient, a logical approach must be taken in the diagnosis and management of midface fractures. Attention to clinical signs and symptoms and complete radiologic examination determine those patients that require further intervention. Rigorous attention to reduction and stable fixation to re-establish premorbid function and form will optimize the opportunity for a satisfactory result.

References

1. Rudderman RH, Mullen RL: Biomechanics of the facial skeleton. *Clin Plast Surg* 1992;19:11-28.
2. Wenig BL: Management of panfacial fractures. *Otolaryngol Clin N Amer* 1991;24:93-101.
3. Marciami RD: Management of midface fractures: Fifty years later. *J Oral Maxillo Surg* 1993; 51:960-968.

4. Marciami RD, Gonty AA: Principles of management of complex craniofacial trauma. *J Oral Maxillo Surg* 1993; 51:535-542.
5. Forrest CR, et al: The role of orbital ultrasound in diagnosis of orbital fractures. *Plast Reconst Surg* 1993;92:28-34.
6. Bowerman JE, Fordyce GL, Levant BA: Fractures of the middle third of the facial skeleton, in Rowe NL, Williams JL (ed): *Maxillofacial Injuries*. Edinburgh, Churchill Livingstone, 1985, pp 363-434.
7. Leu D, Sinn DP: Diagnosis and treatment of midface fractures, in Fonseca RJ and Walker RV (ed): *Oral and Maxillofacial Trauma*. Philadelphia, WB Saunders, 1991, pp 515-542.
8. Row NL: Fractures of the zygomatic complex and orbit, in Rows NL, Williams JL (ed): *Maxillofacial Injuries*. Edinburgh, Churchill Livingstone, 1985, pp 435-537.
9. Zingg M, et al: Treatment of 813 zygoma-lateral orbital complex fractures. *Arch Otolaryngol Head Neck Surg* 1991;117:611-620.
10. Zingg M, et al: Classification and treatment of zygomatic fractures: A review of 1,025 cases. *J Oral Maxillo Surg* 1992;50:778-790.
11. Ellis E: Fractures of the zygomatic complex and arch, in Fonseca RJ and Walker RV (ed): *Oral and Maxillofacial Trauma*. Philadelphia, WB Saunders, 1991, pp 435-514.
12. Karlan MS, Cassisi NJ: Fractures of the zygoma. *Otolaryngol Head Neck Surg* 1979;105:320-327.
13. Feinberg SE, Larsen PE: Healing of traumatic fractures, in Fonseca RJ and Walker RV (ed): *Oral and Maxillofacial Trauma*. Philadelphia, WB Saunders, 1991, pp 13-57.
14. Hobar PC: Methods of rigid fixation. *Clin Plast Surg* 1992;19:31-39.
15. Shumrick KA, et al: Extended access/internal approaches for the management of facial trauma. *Arch Otolaryngol Head Neck Surg* 1992;118:1105-1112.
16. Eisele OW, Duckert LG: Single-point stabilization of zygomatic fractures with the minicompression plate. *Arch Otolaryngol Head Neck Surg* 1987;113:267-270.
17. Holmes KD, Matthews BL: Three-point alignment of zygoma fractures with miniplate fixation. *Arch Otolaryngol Head Neck Surg* 1989;115:961-963.
18. Tarabichi, Maaaz: Transsinus reduction and one-point fixation of malar fractures. *Arch Otolaryngol Head Neck Surg* 1994;120:620-625.
19. Thaller SR, Huang V: Midfacial fractures in the pediatric population. *Ann Plast Surg* 1992; 29:348-352.
20. Kaban LB: Diagnosis and treatment of fractures of the facial bones in children 1943-1993. *J Oral Maxillo Surg* 1993;51:722-729.
21. Posnick JC, Wells M, Pron GE: Pediatric facial fractures: Evolving patterns of treatment. *J Oral Maxillo Surg* 1993;51:836-844.
22. Bartlett SP, DeLozier JB: Controversies in the management of pediatric facial fractures. *Clin Plast Surg* 1992;19(1):245-255.

Suggested Readings

- Duckert LG: Management of middle third facial fractures. *Otolaryngol Clin N Amer* 1991; 24:103-118.
- Luce EA: Developing concepts and treatment of complex maxillary fractures. *Clin Plast Surg* 1992;19:125-131.
- Ochs MW, Tucker MR: Current concepts in management of facial trauma. *J Oral Maxillo Surg* 1993; 51(Suppl 1):42-55.