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Saving Face: Evaluation and Treatment of Facial Trauma in the Emergency Department

Accident and assault victims with varying degrees of facial trauma present an interesting diagnostic dilemma for the emergency physician. What are the significant facial injuries? Are there diagnostic findings specific for these injuries? Are facial films helpful, confusing, or even indicated, or should computed tomography scanning of the face become the standard of care? Which factors require emergent, urgent, or routine referral? These and other pertinent questions relating to treatment options will be discussed.

- Explain the classification of facial trauma, and list significant facial injuries.
- Identify the definitive radiographic examinations needed in the evaluation of facial fracture.
- List the options for immediate versus delayed treatment of facial injuries.

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MAXILLOFACIAL TRAUMA

BY

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Introduction

Maxillofacial trauma is a frequent and important reason for emergency department (ED) visits. Patients have the potential for rapid decompensation from airway compromise. Management requires a coordinated team approach, necessitating involvement of emergency physicians, and surgical specialists in ENT, trauma, plastics, and oral surgery. There are many pitfalls in emergency care, not the least of which is the potential to become distracted by the sometimes alarming gore of these injuries. Facial trauma may divert attention from more occult life threats. Up to 60% of patients with severe facial injuries have multisystem trauma.

This chapter will help the emergency physician (EP) recognize and treat maxillofacial injuries. Central priorities include airway management, and a sophisticated examination. It is essential to understand the utility and limitations of various imaging studies. While most injuries are managed entirely by emergency physicians, we must recognize which cases require consultation or admission.

Etiology/Incidence

During the last half of the Twentieth Century, nearly 50% of severe facial injuries were secondary to motor vehicle accidents. However, as the millennium closes, assaults are now the major cause of facial trauma in urban centers. Interpersonal violence is closely associated with fractures of the nose, zygoma, orbit, midface, and mandible. In both the young and elderly, falls play a significant role.

The etiology of facial fractures varies between urban and rural environments. Penetrating trauma and assault-related injuries are more common in cities, while motor vehicle crashes (MVCs), sporting and other recreational injuries are seen frequently in community hospitals. In the community ED, the nose and mandible are the most common facial fractures, however, in trauma centers, midface and zygomatic injury is pervasive. Domestic violence, elder, and child abuse are important causes of facial trauma. Injury to the face accounts for the majority of ED visits for domestic violence. As many as one fourth of women with facial trauma, are victims of domestic violence. (Ochs HA 1996) If the woman has an orbital fracture, the likelihood of sexual assault or domestic violence rises to more than 30%. (Hartzell KN 1996)

Associated Injury

Head Trauma

Intracranial injury frequently occurs with facial trauma, especially in those with upper and mid-face fractures. As many

as 20 to 50% of victims of facial trauma sustain concurrent brain injury.

Cervical Injuries

While most series show no increased incidence in cervical spine injury with facial trauma (1-4%), this is of statistical interest only. The emergency physician must suspect spinal injury in all patients with significant maxillofacial fractures, as it takes considerable force to shatter the mid and upper face. Always rule out c-spine injury clinically or radiographically in such patients. One study linked carotid artery injury to severe facial trauma. (Marciani RD 1997)

Ocular Trauma

Facial trauma poses a significant threat to vision, especially to those with periorbital fractures, who may experience globe disruption. The dangerous triad of limited extraocular motions, decreased visual acuity, and amnesia presage ophthalmic disaster.

Blindness occurs in .5 to 3% of patients with facial fractures, and is most frequent in patients with LeFort III (2.2%), LeFort II (0.64%), and zygomatic fractures (0.45%). (Zachariades N 1996) Motor vehicle accidents and gunshot injuries are responsible for most cases of visual loss.

Psychiatric

In addition to the physical consequences of facial trauma, there are psychological costs as well. More one quarter of patients with significant facial trauma may develop posttraumatic stress disorder. (Bisson JI 1997)

Anatomy (Fig X)

Knowledge of the facial anatomy allows the emergency physician to anticipate injury patterns. The facial buttresses, bony arches joined by suture lines, provide vertical and horizontal support. Vertical stability depends upon the zygomatic-maxillary buttress laterally and the frontal process of the maxilla medially. The zygomatic-maxillary arch and the hard palate bolster the horizontal face. Sutures linking these facial bones rupture in predictable fashion during trauma. Knowledge of their location allows the physician to palpate these sutures to detect diastasis or tenderness.

The novice anatomist rarely appreciates the attachments of the face to the skull. Sutures found at borders of the sphenoid wings, pterygoid plate, and the zygomatic arch anchor the face to the skull. These are the structures disrupted in LeFort injuries.

The most complex aspect of facial anatomy is the orbit. These elaborate structures are comprised of seven different bones: maxilla, zygoma, frontal, sphenoid, palatine, ethmoid and lacrimal. Between these bones, lie the orbital fissures, through which course vital nerves, including the all-important optic nerve. Rupture of orbital bones may compress these fissures and imperil vision.

Prehospital Care

The major concern in prehospital care is control of the

airway. The mouth should be cleared of any foreign body, debris, and suctioned of blood. The tongue may block the airway, and a jaw thrust or modified chin lift without neck extension often relieves the obstruction. With severe mandible fractures, these maneuvers sometimes leave the tongue behind, necessitating manual extraction. If the injuries are significant, medics must immobilize the cervical spine during transport.

Some patients may require field intubation, which can be problematic if there is copious bleeding. In such cases, medics should notify the receiving hospital. Early notification allows the EP to prepare for a difficult airway.

Emergency Management – Resuscitation

The compelling and sometimes grotesque nature of facial injuries must not distract the physician from routine, sequential trauma protocol. The most urgent complication of facial trauma is not shock, but airway compromise, particularly with mid- and low face trauma.

Airway

Simple intervention, such as the chin lift without neck extension, jaw thrust, and oropharyngeal suctioning often clear the airway. However, in mandibular fractures, loss of bony support may result in a "flail mandible," leaving the tongue to obstruct the airway. (Bavitz JB 1995) In this case, open the mouth and pull the tongue forwards with a gauze pad, towel clip, or a large suture placed through the anterior tongue. When the

cervical spine has been cleared, clinically or radiographically, allow the patient to sit up, lean forward, and give them a tonsil-tip suction. This position may be lifesaving in patients with significant mandible fractures. Patients who do not respond to simple maneuvers may require intubation.

Intubation Considerations

Because the cribriform plate may be disrupted, avoid nasotracheal intubation in patients with mid-face trauma. Zealous nasotracheal intubation could result in unanticipated naso-cranial intubation or dramatic nasal hemorrhage. Admittedly, these complications are rare, and some patients have successfully intubated via the nasotracheal route. (Rosen CL 1997) Nonetheless, orotracheal intubation is often successful even with severely distorted facial anatomy.

Rapid sequence intubation carries particular risk in facial trauma. These dangers include the failure to intubate and subsequent failure to ventilate with a bag-valve mask. Before paralyzing any patient, evaluate the degree of difficulty anticipated for mask ventilation. Patients with distortion of the maxilla or mandible, may be impossible bag because the mask will not fit tightly on the unstable face.

In such cases, consider an awake intubation. Options include sedation with a benzodiazepine, droperidol, or other induction agent in a dose that minimizes respiratory depression. If the patient with severe maxillofacial trauma is given paralytics, prepare for immediate back-up cricothyroidotomy.

"Preparation" in this case implies more than locating a surgical tray: it extends to Betadine on the neck, a ready blade, an opened cricothyroidotomy tray, and a tracheostomy tube at the bedside

Some authors describe creative approaches to intubation in facial trauma. Fiberoptic intubation in the semi-prone position may useful in penetrating injuries of the face. (Neal MR 1996) The traditional, supine intubating position may be impossible with a ruined maxilla that falls into the airway. Such airways may clear when the patient lies on their side, (although this may be both awkward and disconcerting to the physician). The Bullard intubating blade and the pharyngeal-esophageal airway are both used to manage the difficult airway in patients with a crushed face.

Other alternatives include percutaneous transtracheal ventilation as a temporizing measure and retrograde intubation. Both require considerable preparation, and the most dependable alternative airway is surgical. Emergency cricothyroidotomy is preferable to emergency tracheostomy, being faster and associated with fewer complications.

Hemorrhage Control

Patients rarely develop shock from facial bleeding. In the hypotensive patient, look for other sources of blood loss, such as intra-thoracic, intra-abdominal, and retroperitoneal hemorrhage. Control maxillofacial bleeding with direct pressure, and avoid blindly clamping in wounds, as important structures

such as facial nerve or parotid duct may be injured. Severe pharyngeal bleeding may require packing of the pharynx and hypopharynx around a cuffed endotracheal tube. In patients with LeFort fractures, manual reduction of the face should stem bleeding. Grasp the anterior hard palate at the maxillary arch and realign the fragments.

Severe nasal bleeding requires direct pressure to the nares, or combined posterior and anterior packing, taking care not to pack the cranium. In the case of massive nasopharyngeal bleeding, a Foley catheter placed along the floor of the nose and inflated with saline is life saving. Nasopharyngeal dual-lumen balloons are commercially available for this purpose.

Once the airway is secure and gross hemorrhage controlled, only then search for life threats in the chest, abdomen, and pelvis.

History

Obtain history regarding injury from patient, witnesses and prehospital care providers. It is important to determine mechanism and time of injury and assess for loss of consciousness. Allergies and tetanus status are standard inquires. The following three "face-oriented" questions are essential: 1. ‘How is your vision? 2. ‘Is any part of your face numb?" and 3. "Are your teeth meeting normally?" These questions target eye involvement, injury to facial nerves, and alignment of central and lower face.

Question the patient regarding vision, diplopia, and whether

there is pain with eye movement. Monocular double vision occurs with lens dislocation, corneal, or retinal injury, while binocular double vision implies dysfunction of the extraocular muscles or nerves. Pain on eye movement suggests injury to the orbit or globe.

Be suspicious about abuse. If the mechanism of injury is not a motor vehicle crash, ask women about domestic violence. While a domestic violence victim may tell the triage nurse that they fell or "ran into a door," most patients reveal the true etiology if directly questioned by a physician. Child abuse and elder abuse are important considerations when patients at the extremes of age present with facial trauma. More than half of all abused children present with injury to the head, face, mouth, or neck (Jessee SA 1995)

Physical Examination

Inspection

Begin the examination by viewing the patient from the front. Facial elongation occurs with high grade LeFort fractures. Then view the face from above looking down (bird's eye view), and from below up (worm's eye view). These perspectives reveal subtle asymmetries. Because post-traumatic Bell's palsy occurs with fractures of the temporal bone, test the muscles of facial expression. Ask the patient to smile, frown, whistle, raise their brows, and close their eyes tightly. Look for ecchymosis

around the eyes (Raccoon's eyes) and over the mastoid area (Battle's sign). These findings usually develop over several hours and are often absent on admission, despite serious facial trauma.

Palpation

Palpation will disclose the majority of facial fractures. Carefully palpate the entire face for tenderness, bony crepitus, and subcutaneous air. The presence of subcutaneous air is pathognomonic for fracture of a sinus or nose.

During palpation, target vulnerable sutures such as those on the infraorbital rim and the zygomatic-frontal suture located on the upper lateral aspect of the orbit. Simultaneous palpation of the zygomatic arches will reveal any asymmetry. The best way to distinguish tenderness of the soft tissues of the cheek from bony tenderness is by intraoral palpation. Place a gloved finger inside the patient's mouth and on the buccal surface of the upper molars (outside the teeth). In this position, locate the examining finger under the zygomatic arch. This method will identify displacement or collapse of the arch.

To assess facial stability, open the patient's mouth and grasp the maxillary arch, (not the central incisors – which might pull out.) LeFort fractures are best diagnosed by rocking the maxillary arch and simultaneously feeling the central face for movement with the opposite hand. This maneuver is more sensitive for maxillary fractures than plain films.

Test sensation. While anesthesia of the face may be

secondary to nerve contusion, it often signifies a fracture. Damage to the infraorbital nerve (often due to blowout or rim fractures) results in anesthesia of the upper lip and maxillary teeth, whereas lower lip and lower dental anesthesia occurs with mandibular fractures.

Periorbital and Orbital Exam

The eye exam deserves particular attention, especially when there is periorbital injury. This should be done early during the ED encounter, because if not timely, progressive lid edema may prevent further examination. If lids are already swollen, lid retractors help visualize the globe. The "bird's eye" and "worm's eye" views help detect exophthalmos or enophthalmos.

The pupil exam includes reactivity, and whether the pupils line up in the horizontal plane. Examine for hyphema, as well as lens and retinal injury. The presence of a hyphema correlates with significant visual loss. The Snellen chart, either standard or hand-held, should be used to document visual acuity. If the patient cannot see the chart, record finger counting, or barring that, the presence, or absence of light perception. Early recognition of traumatic optic neuropathy should trigger an emergency consultation, as timely decompressive surgery may prevent blindness.

The best way to detect damage to optic nerve or retina is the swinging flashlight test. A Marcus Gunn pupil initially dilates (rather than constricts) when first exposed to a light that swings between both eyes.

Subconjunctival hemorrhage is often present with periorbital fractures, and lateral hemorrhage frequently accompanies zygomatic fractures. Soft tissue bruising provides other important clues. Periorbital ecchymosis (Raccoon's eyes) result from a variety of insults, including basilar skull fracture, as well as direct trauma to the periorbital area. Fractures of the orbit, nose, and midface also produce Raccoon's eyes.

In patients with severe periorbital trauma, measure the distance between the medial canthi. In the average adult, the inter-canthal distance should be 35-40 mm – or approximately the width of the patient's eye. Widening of this distance is called telecanthus, and portends serious orbital injury. In patients with telecanthus, the bridge of the nose appears wide, but the distance between the pupils is unchanged. This is usually seen with naso-ethmoidal-orbital (NEO) trauma. A more serious condition known as hypertelorism occurs when the inter-pupillary distance increases. In this case, the orbits are dislocated, and literally "blown-apart." This devastating injury usually results in blindness.

Extraocular motions must be evaluated for restriction. Fractures of the zygomatic and infraorbital floor frequently cause diplopia, especially on upward gaze. Significant pain with extraocular motions provides a clue to occult injury.

Palpate the entire orbit for tenderness, subcutaneous air, and for deformity. Inexperienced physicians frequently neglect the superior and lateral rims.

Bimanual Palpation Test (Fig x)

One of the most important concerns is the status of the medial orbital area, known as the naso-ethmoidal-orbital complex or NEO. Consider this injury if the medial canthus is tender, or if the patient has telecanthus. When an NEO injury is suspected, the bimanual nasal palpation test is a helpful adjunct.

To perform this test, anesthetize the nose with either cocaine or Xylocaine. Then insert clamp or long cotton swab into nose. Use the clamp or swab to press intranasally against medial orbital rim (just inside the medial canthus). At the same time, use the other hand to press the medial canthus. If the bone moves, the NEO complex is fractured.

Penetrating Injuries

With penetrating injuries around the eye, consider occult globe penetration. When the orbital septum is violated, fat protrudes from the wound, signaling possible globe perforation. Injuries to the medial third of the eyelids often damage the lacrimal apparatus and should be considered high risk. Check all lid lacerations for disruption of levator palpebral muscle and tarsal plate.

Nose

Inspect the nose from various angles to detect any deformity. Recognize that post-traumatic edema often obscures nasal deviation. The patient is the best judge of their personal nasal anatomy, so allow them to look in the mirror and assist in the exam. Hopefully they will alert the EP to the presence of

preexisting nasal deformity. Palpation will detect crepitus, subtle deformity, and subcutaneous air. In all patients with nasal trauma, inspect the inside of nose for a septal hematoma. This appears as a bluish, bulging mass on a widened septum. If in doubt, palpate the septum with a cotton swab to appreciate the doughy swelling.

When dropped on a paper towel or a bed sheet, cerebral spinal fluid (CSF) mixed with blood forms a double ring or "halo sign." The central splotch is blood, and the surrounding clear to rose' tint represents CSF. This finding is not specific for a CNS leak, and will occur with a traumatized runny nose. Unlike CSF, simple rhinorrhea (absent blood) does not contain glucose. Unfortunately, the bedside glucose tests cannot distinguish between spinal fluid and a rhinorrhea. However, standard laboratory glucose can make the distinction.

Ears

Examine the pinna for subperichondral hematoma. The ear canals should be inspected for lacerations and CSF leak. Hemotympanum appears as a purple, (not red), eardrum and is pathognomonic for basilar skull fracture. Tympanic membrane ruptures are also seen in conjunction with fractures of the mandibular condyle. In the presence of a basilar skull fracture, the mastoid area may be ecchymotic, (Battle's sign.)

Oral and Mandibular Exam

During inspection, determine if the jaw is deviated.

Deviation results from either a condylar fracture or dislocation. The chin will point away from a dislocation, and towards a fracture. While the patient opens and closes their mouth, look for malocclusion. With LeFort fractures, patients may be unable to close the mouth due to premature occlusion of the molars. Zygomatic fractures also prevent jaw closure if the bone fragment either presses against the masseter or impinges on the coronoid process of the mandible. Test for anesthesia of the lips and gingiva, usually due to a fracture- associated nerve injury.

An intraoral exam may reveal significant pathology. The exam should include manipulation of each tooth, a search for intraoral lacerations, and stress of the mandible. Essentially all fractures can be detected or excluded by both palpating and stressing the jaw. By placing a finger in the external canal while patient opens and closes their mouth, the physician can palpate the mandibular condyle during jaw motion.

The Tongue Blade Test (See Fig X)

The tongue blade, or spatula test, is a useful technique to detect mandibular fractures. While unnecessary in patients with an obvious fracture, it allows the physician to determine the need for x-rays in patients with jaw pain and no obvious instability. Ask the patient to bite down forcefully on a tongue blade. The physician then twists the tongue blade in an attempt to break it (the blade). Patients with a broken jaw will reflexively open their mouth, while those with an intact mandible will break the blade. In one study, this test was more than 95% sensitive and nearly 65% specific for mandibular fracture.

RADIOLOGY

The choice and timing of radiographic studies depends upon the clinical stability of the patient. Management of head, chest, and abdominal trauma takes precedence over facial imaging. In the critically injured, diagnostic imaging, including CT, may be deferred for days, until the patient's condition has stabilized.

It is not always clear which patients require facial imaging. In one study, physical examination alone detected 90% of clinically significant fractures. (Thai KN 1997) However, management was altered in 17% of patients based on either' CT or plain films. (Thai KN) CT scan is not always required before surgical repair. Some authorities consider scans expensive, time-consuming, and labor-intensive, adding little information to physical examination and plain films.

Because immediate surgical intervention is rarely indicated for patients with facial trauma, some argue that most x-rays or CTs may be deferred in the ED. If adequate follow-up is available, the facial surgeon could determine the need for imaging studies at the time of outpatient consultation. On the other hand, because most patients with facial fractures are non-compliant when it comes to follow-up, definitive ED diagnosis of an injury *theoretically* prompts the patient to keep their consultative appointment.

Plain Films

Plain films are useful screens for maxillofacial injury, and are available in all hospitals. For the uninitiated, the numerous overlapping lines and complex shadows make interpretation daunting. A systematic approach combined with knowledge of common fracture patterns simplifies interpretation.

One of the most useful approaches is to assess symmetry. Consider the right and left sides as mirror images. Are there lucencies or shadows that are unilateral? Are the sutures and sinuses symmetrical? Look for bony integrity, and subcutaneous air. While air/fluid (ie. blood) levels in the sinuses may occur with acute sinusitis, in the presence of trauma they are nearly pathognomonic for sinus fracture. Clouding of a sinus may be secondary to soft tissue swelling or due to complete filling of the sinus with blood.

Radiographic Views of the Face

The Water's or occipital-mental view is the single most valuable study of the mid-face. It evaluates continuity of orbital rims, provides an initial diagnosis of blowout fractures, and will demonstrate air/fluid levels in maxillary sinus.

The posterior-anterior (PA or Caldwell view) confirms ethmoidal and frontal sinus fractures as well as lateral orbital injuries. It best details the bones of the upper face.

For many physicians, the cross-table or upright laterals are difficult to read. On occasion, they suggest elongation of the face in LeFort injuries or disruption of the posterior sinus wall. Look for air/blood levels in sphenoid or ethmoidal

sinuses. In general, this view is rarely helpful to detect facial fractures.

The submental-vertex view, known colloquially as the "jug handle" or zygomatic arch view, shows the base of the skull and the zygomatic arches. It may be the only film necessary for suspected arch fractures.

The Towne's view is useful for evaluating the mandibular ramus and condyles as well as the base of the skull.

The Panorex view is the most useful projection of the mandible. Either the patient or x-ray beam rotates to cast the entire mandibular shadow on the plate.

CT Scans

Computerized tomography provides a conclusive diagnosis of complex maxillofacial fractures. Opinions regarding the role of CT vary widely. Some authorities recommend routine CT scanning for every case of significant facial trauma, while others decry it as generally superfluous. It's greatest utility lies in the patient with known or suspected periorbital and midface fractures. Scans are especially useful to evaluate the globe and orbital fissures. Specialized views, such coronal, sagittal, or parasagittal cuts, thin-slice scans, and 3-D reconstruction are useful in particular circumstances. In general, the slices should be in a plane 90 degrees to that of the suspected fracture- and not parallel to the fracture line. Three-dimensional CT is superior to two-dimensional CT for serious midface fractures such as tripod and complex maxillary fractures.

- (Ohkawa M 1997)

Multiply injured patients, who are intubated, unconscious, or sedated, frequently have significant and unsuspected facial fractures. If they require a CT of the head, consider adding a scan of the face to clinically stable patients. Slightly more than 10% of such patients have unsuspected facial fractures needing surgical repair. (Rehm CG 1995) However, an unstable patient with severe concomitant injuries should not receive a facial scan if it delays emergency surgery.

MRI

Magnetic Resonance Imaging (MRI) is useful to the consultant who wishes to visualize the soft tissues of the face, particularly the optic nerve or retrobulbar hemorrhage. MRI does not adequately delineate fractures and should rarely if ever, be ordered by the emergency physician.

Controversies in Imaging

Some authorities consider facial x-rays of historical interest only, and argue they should be eliminated. Indeed, CT with various manipulations, such as coronal and axial views, is essential for management of particular complex fractures. However, plain films still have an important role in screening for maxillofacial injury. In the case of clinically obvious, complex facial injuries (in particular, periorbital and midface fractures), plain films may be eliminated and CT performed directly. Coronal films should be ordered for periorbital fractures, and thin-slice scans may be appropriate in this area.

Cost

While charges vary among institutions, a full CT of face with coronals costs the patient approximately $900. This contrasts with the average charge of $100-$200 for plain film of the face.

Specific Facial Fractures

Frontal sinus/frontal bone fractures.

This injury commonly results from a direct blow to the frontal bone with a blunt object – classically a lead pipe or brick. This fracture is frequently associated with intracranial injury, secondary to disruption of the posterior table of the sinus. Dural tears are frequent, and patients may have associated injuries to the orbital roof (leading to blindness) and to the brain (Martello JY 1997). Complications are frequent, and patients may develop late cranial empyema or mucopyoceles. Cranial empyemas are collections of pus between the skull and brain and require craniotomy. Mucopyoceles are collections of pus and mucus, which occur when fractures block the nasal frontal duct preventing sinus drainage.

Physical examination may reveal disruption or crepitance of the supraorbital rims. Some patients present with subcutaneous emphysema. These fractures are often overlooked because of traditional prohibitions against skull films for head trauma. Patients with a suggestive mechanism or examination, benefit from skull films or a Caldwell view of the face. If a depressed or

posterior wall fracture is seen on plain film, obtain computerized tomography. Patients with hard signs of a frontal bone fracture (subcutaneous air, bony step-off, etc.) require only a CT.

Consult with the ENT specialist or neurosurgeon regarding antibiotics in patients with frontal sinus fractures. Many specialists recommend antibiotics that cover common sinus pathogens although the literature lacks definitive evidence on this issue. Frequently prescribed'antibiotics include first generation cephalosporins, amoxicillin/clavulanate, erythromycin, and trimethoprim/ sulfamethoxazole. Patients with depressed fractures, or those who have posterior wall involvement, require IV antibiotics, admission, and consultation. Those with isolated fracture of the anterior wall may be treated as outpatients.

Nasoethmoidal Orbital Injuries (NEO). (See Figure X)

Suspect NEO injuries in those with trauma to the bridge of the nose or medial orbital wall. The mechanism of injury is usually dramatic and these fractures are not likely due to fisticuffs. NEO fractures are frequently associated with lacrimal disruption and dural tears. Patients may complain of pain on extraocular motions, and physical examination may reveal traumatic telecanthus or epiphora (tears spilling over the lid).

If the medial canthus is tender, perform the intranasal palpation test, and examine for CSF rhinorrhea. Plain radiographs are insensitive. (Nolasco FP 1995). If the examination is suggestive, order a CT of the face to include

coronal sections and thin axial slices through the medial orbital wall.

If an NEO fracture is present, consult a maxillofacial surgeon. As with many facial fractures, intravenous antibiotics such as first generation cephalosporins are frequently prescribed for CSF leaks. However, no controlled studies have proven their efficacy. Some authorities believe prophylactic antibiotics increase the risk of resistant organisms.

Orbital fractures.

Blowout fractures are the most common orbital fracture. These injuries occur when a blunt object strikes the globe, resulting in expansion of orbital contents and subsequent rupture through the bony floor. A direct blow to the orbital rim will also result in a blowout. Several clinical findings suggest the diagnosis. Rare patients may have enophthalmos, or sunken globe, when a large section is ruptured. Infraorbital anesthesia is a very common finding, and develops when the infraorbital nerve is contused by the initial trauma or when bony fragments compress it. Anesthesia of the maxillary teeth and upper lip is more reliable than numbness over the cheek. Subcutaneous emphysema is pathognomonic for fracture into a sinus or nasal antrum.

Diplopia, particularly on upward gaze, is another important clinical finding. However, the etiology of diplopia may be multifactorial and does not necessarily imply entrapment of extraocular muscles. True entrapment occurs in a small minority of patients with diplopia, and etiologies that are more common

include direct muscle injury, damage to the third nerve, or entrapment of periorbital fat. Mechanical entrapment is readily diagnosed by the forced duction test. To perform this test, apply a few drops of ophthalmic anesthetic in the conjunctival sac, grasp the inferior sclera with a toothed forceps, and gently tug upwards. In true entrapment, the eye remains fixed. It is not imperative that the emergency physician perform this test, as CT scanning and consultation is necessary for patients with post-traumatic diplopia.

Plain films are useful in the diagnosis of blowout fractures. The "hanging teardrop" sign is seen with herniation of orbital fat into the maxillary sinus, while the "open bomb-bay door" results from bone fragments that protrude into the sinus. Air/blood levels are frequently seen in association with these signs. At least one author suggests that only patients with well-defined indications for surgery (enophthalmos of more than 2 mm, and/or persistent diplopia, require any imaging studies at all. (Bhattacharya J 1997) While this is perhaps a minority view, it has a certain minimalist logic.

Once a blowout fracture is confirmed either radiographically or clinically (ie diplopia, or subcutaneous air), obtain a CT with coronal sections to determine the surface area of the broken floor. This film could be done as an outpatient study, but it may be expedient to obtain it during the ED stay. Patients with orbital fractures tend to have low compliance with follow-up. (Stewart MG) Some centers have used ultrasound to evaluate orbital floor fractures but this modality is not as sensitive as

CT.

There is significant controversy as to timing and necessity of orbital floor repair. Some specialists use CT to determine need for surgery, while others repair the orbit only if there is enophthalmos or persistent diplopia. While enophthalmos mandates surgical repair, most diplopia (up to 70%) resolves spontaneously within several months.

Many consultants recommend antibiotics active against sinus pathogens for patients with subcutaneous emphysema. Patients with fractures into the sinus should avoid blowing their nose to prevent accumulation of sub-Q air.

In rare circumstances, malignant periorbital emphysema may jeopardize vision by injuring the retina or optic nerve. In such cases, emergency cantholysis may salvage the patient's vision. In patients with massive emphysema, and no evidence of an open globe, measure the intraocular pressure. If the pressure is significantly elevated, immediately consult the ophthalmologist on-call and discuss the need for an emergency cantholysis. To perform the procedure, crush the lateral canthus with a hemostat to minimize bleeding, then divide it with a scalpel or scissors to release the pressure in the orbit. The lids should decompress and the intraocular pressure will decline.

Orbital Fissure Syndromes

The oculomotor and ophthalmic divisions of the trigeminal nerve course through the superior orbital fissure. A fracture of the orbit involving this canal compresses these nerves leading to

the superior orbital fissure syndrome. This condition is characterized by paralysis of extraocular motions, ptosis, and periorbital anesthesia. A more serious variant is the orbital apex syndrome, which involves the optic nerve. Patients with the orbital apex syndrome have all the aspects of the superior orbital fissure syndrome, plus blindness or decrease in visual acuity. The swinging flashlight test and visual acuity testing are crucial to the diagnosis. Patients with these syndromes need emergent ophthalmic intervention to save their vision.

Nasal fractures.

Cosmesis and the ability to breathe through the nose are key issues in nasal fractures. Apart from management of a septal hematoma, a fractured nose is of little medical concern, unless deformity or airway obstruction is present. An unrecognized septal hematoma can lead to necrosis of the nasal septum and produce a permanent "saddle" deformity of the nose. Ask the patient several key questions to evaluate nasal fractures. First, "Have you ever broken your nose before?" second, "How does your nose look to you?" and third, "Are you having trouble breathing through your nose?" Because nasal deformity may be due to either acute or prior trauma, have the patient look in a mirror and report if the deformity is new or old. On physical examination, observe for deformity and palpate for crepitus. The intranasal exam is key to detect septal hematoma. The hematoma appears as a bulging, purple mass or an abnormally wide septum. Use a cotton swab to palpate this boggy mass when the diagnosis

is in doubt. Drain any septal hematomas in the emergency department after anesthetizing with a topical anesthetic such as cocaine or benzocaine. Use a #11 blade to incise the inferior portion of the hematoma, and allow it to drain. Packing the nose with Vaseline gauze will prevent re-accumulation of blood. After drainage, reevaluate the patient in 2-3 days or arrange for ENT follow up.

When should the emergency physician order nasal films? The answer is controversial. Recognize that nasal films do not determine the need for intervention and do not affect surgical planning. Despite the presence of a fracture on x-ray, there is no need for intervention if there is no cosmetic deformity and no obstruction to airflow. Obvious nasal deformity (new or old) in absence of radiographic findings may prompt rhinoplasty.

For these reasons, many physicians never or only rarely, order nasal x-rays. Some emergency physicians obtain these films for perceived medical legal concerns or because of patient insistence. Patients with obvious deformity or difficulty breathing through the nose should be referred to a consultant on an outpatient basis. Those with significant swelling or questionable deformity need reevaluation in 5-7 days when edema has resolved. This follow-up is more valuable than radiographic imaging.

Zygomatic fractures

Zygoma fractures occur in two major patterns: The most serious injury is the tripod fracture, while the most common is

the arch fracture. The zygoma forms a tripod, which joins the frontal, maxillary, and temporal bones. The zygoma abuts the frontal bone at the superior lateral aspect of the eye (frontozygomatic suture) and adjoins the temporal bone near the midpoint of the zygomatic arch. It contacts the maxilla near the middle of the inferior orbital rim. The classic tripod fracture breaks the infraorbital rim, widens the zyqomatic-frontal suture, and disrupts the zygomatic arch. The fragment may drop, and pull the lateral canthus, causing the eye to "tilt." Later, the cheek will flatten, but edema usually obscures this finding in the ED.

Look for lateral subconjunctival hemorrhage, and infraorbital anesthesia. A significant percentage of all patients who present with large lateral subconjunctival hematomas have zygomatic injury. Trismus or an open bite will appear if the zygoma impinges on the masseter or coronoid process. Palpate the zygomatic arch from within the mouth to detect arch fractures.

Plain films, consisting of the jughandle or arch view are adequate for suspected arch fractures, and the Water's view can screen for tripod injury. Order CT scans for tripod fractures that are diagnosed or suggested by plain films. In those cases where tripod fractures are unmistakable on physical examination, plain films are superfluous and the patient should go directly to CT. The scans delineate injury to the orbital floor and guide surgical planning.

Patients with tripod fractures require admission for open reduction and internal fixation of displaced fragments. Those

with fractures of the arch may be scheduled for outpatient elevation and repair.

Maxillary fractures.

Fractures of the maxilla are high-energy injuries. Because it requires an impact 100 times the force of gravity to break the mid-face, these patients often have significant multisystem trauma. Many require resuscitation and admission.

The maxilla attaches to the zygoma midway on the infraorbital rim, and to the frontal bone via the maxillary processes of the nose. The most difficult aspect of the maxillary anatomy to conceptualize is the attachments to the skull. The pterygoid plates anchor the face to the skull, and the destruction of these bony sutures result in an unstable maxilla.

If the patient is conscious, inquire about malocclusion and visual symptoms. On physical examination, the patient may have an open bite, facial lengthening, CSF rhinorrhea, or periorbital ecchymosis. LeFort fractures are best diagnosed by grasping and rocking the hard palate. In most cases, parts of the midface will shift with this maneuver, but greenstick and impacted fractures may be immobile. While the "classic" fracture patterns are diagrammed in this text, they are more likely to be seen in print than in the emergency department. In clinical practice, fracture patterns are often mixed, with a low grade LeFort on one side and a higher grade on the other. In LeFort I, a transverse fracture separates the hard palate from the lower portion of the pterygoid plate and nasal septum. With stress of the maxilla,

only the hard palate and upper teeth move. A pyramidal fracture of the central maxilla and the palate defines a LeFort II injury. Facial tugging moves the nose but not the eyes. LeFort III, also called "cranial-facial disjunction" occurs when the complete facial skeleton separates from the skull. The entire face, including most of the orbits, shift with mobilization. The LeFort IV fracture (not initially described by LeFort), involves the frontal bone as well as the midface.

These catastrophic injuries often require aggressive airway control and frequently intubation. Look for associated injuries, especially intracranial, spinal, thoracic, and abdominal. A test of visual acuity is especially important for patients with LeFort III fractures, where the incidence of blindness is high. Plain films are unnecessary, and CT scans may be ordered in conjunction with tomography of the brain in clinically stable patients. Patients with complex maxillary fractures require admission for open reduction and internal fixation. Even if surgery is delayed, admission is prudent to monitor these often multiply injured victims.

Mandibular fractures.

After nasal bone injury, mandibular fractures are the second most common facial fracture. Assaults and falls on the chin are responsible for most injuries. Because of its ring shape, fractures are often multiple. Most injuries are to the body, angle, and the condylar process in that order. The point of the jaw (symphysis) and the coronoid process are less frequently

broken. An impact to the symphysis will transmit forces through the condyles that can fracture the temporal bone and rupture the eardrum.

History and physical examination will detect nearly all injuries. Ask patients if their teeth are meeting normally and if they have pain on jaw movement. Evaluate jaw opening, and search for intraoral lacerations, to determine whether the fracture is open or closed. Gingival lacerations may be hidden between the teeth. Ecchymosis under the tongue is a sensitive finding and occurs with most mandibular fractures. Fracture-induced injury to the mandibular nerve produces anesthesia of the lower lip.

Patients with normal occlusion and a negative spatula (Tongue blade) test rarely require imaging studies. Radiography may include panorex, Towne's, and lateral oblique views. If the symphysis is involved, consider occlusal films if other views are normal. Sometimes plain films are negative despite a condylar fracture. If films are normal but clinical suspicion remains high, consider a CT scan of the condyles.

Patients with open fractures require admission and intravenous antibiotics. Penicillin is considered the drug of choice, but clindamycin and first generation cephalosporins are good alternatives. For open mandibular fractures, give two to four million units of intravenous penicillin G or in the penicillin allergic patient, clindamycin 600 to 900 mg. Patient may be made more comfortable with a Barton's bandage, which is an Ace bandage wrapped around the jaw and head. This prevents

excessive jaw movement. Many closed fractures may be managed as outpatients after consultation with an oral surgeon.

Temporomandibular joint (TMJ) dislocation.

Dislocation of the temporomandibular joint may occur from blunt trauma to the jaw, seizures, or excessive mouth opening. Consider that patients who mumble after a seizure may not be postictal but instead suffering from TMJ dislocation. Unlike condylar fractures where the jaw points towards the side of injury, the chin deviates away from the side of the dislocation. In the less common bilateral dislocation, the chin juts forward. In a TMJ dislocation, the condyle becomes locked anterior to articular eminence, and will not slide back secondary to muscle spasm. If a patient has jaw deviation and an open bite after a blow to the mandible, x-rays are indicated to detect fracture. However, films are not required for spontaneous or recurrent mandibular dislocations brought on by wide opening of the mouth.

Mandibular reduction is a simple emergency department procedure. The physician stands behind the seated patient, after wrapping their thumbs in gauze. Standing on a footstool may increase the mechanical advantage if the physician is short or the patient is tall. Position the thumbs on either on the posterior molars or on the mandibular ridge. (The posterior molars are less slippery but will endanger the physician's digits when the jaw snaps into place.) To unlock the mandible, press downward and forward, and the joint should relocate. A rocking motion is helpful. Intravenous benzodiazepines (such as midazolam

1-2 mg or diazepam 2-5 mg) are helpful in this situation. If the patient has significant spasm despite sedation, inject the lateral pteryqoids with a local anesthetic, such as 1% lidocaine, to facilitate relocation. The pterygoids are easily reached by placing the needle intra-orally along the lateral aspect of the ascending mandible. Immediately reduction, apply a Barton's bandage to prevent repeat dislocation. Unless they are cautioned ahead of time, patients will test their jaw movement after reduction, and re-dislocate their mandible. Patients must drink a liquid diet through a straw for several days and should follow-up with an oral surgeon.

Special Circumstances

Penetrating Trauma to the Face

Penetrating trauma to the face poses special challenges to the emergency physician. Over a third of patients suffer significant complications, including intracranial injury, blindness, or infection. (Chen AY 1996) Shotgun blasts to the face are especially problematic and globe injury is common.

The most immediate concern in patients with penetrating facial trauma, is airway management. A significant percentage of patients will require either emergency intubation or cricothyroidotomy. No only is the risk of intracranial injury high, but includes the possibility of cavernous sinus fistulas. The bullet's path may endanger the great vessels of the neck and zone III injuries to the carotid are common. Patients at risk

require angiography.

Infection is also a concern in patients with gunshot wounds to the face, especially if there is intraoral trajectory. In this situation, administer intravenous antibiotics effective against oral flora. (Wallick K 1997) High dose penicillin G (2 -4 million units or clindamycin (600 – 900 mg) are recommended.

Children vs. adults

Pediatric anatomy and developmental concerns influence the management of facial fractures in children.

Etiology:

Be suspicious of non-accidental trauma in cases of pediatric maxillofacial injury. Associated skull fractures, a torn frenulum, and facial bruising may signify child abuse. Children with facial injuries should be completely undressed, and examined for other stigmata of non-accidental trauma. Some may require a radiographic skeletal survey to detect occult or prior trauma.

Fracture patterns:

Fracture patterns relate to developmental anatomy. Young children have a higher incidence of frontal bone injury due to its prominence. Infants and toddlers almost never suffer midface fractures. The dearth of maxillary fractures under age six is due to the lack of sinuses in the midface. It is these sinuses, which weaken the facial buttresses and predispose to LeFort injury. As the child grows, the sinuses pneumatize, and fractures shift to the mid and lower face. By age 12 to 15, the fracture pattern resembles that in adults.

Associated Injuries:

Children with facial trauma also have dissimilar associated injuries than adults. Because the pediatric skull is more prominent, children have much higher incidence of associated intracranial injuries. Up to 60% of children with significant facial fractures, suffer cranial insult. In addition, the dynamics of cervical injury vary between children and adults. Children are more likely to suffer an upper, rather than lower, cervical spine injury, and are also prone to spinal cord injury without radiographic abnormality (SCIWORA): i.e., no fracture or dislocation on plain film.

Airway management:

The young child's airway is prone to subglottic stenosis and tracheomalacia. For this reason, avoid cricothyroidotomy in children under 12. Intubation is the definitive airway of choice in children who need emergency airway management. If intubation is impossible, percutaneous transtracheal jet ventilation provides temporary airway control until a formal tracheotomy is feasible.

Complications and timing of follow-up:

Because subsequent facial growth may be asymmetric, pediatric facial fractures can lead to serious cosmetic deformities. Subcondylar fractures of the jaw and displaced nasal fractures are of particular concern in children under 5. Condylar fractures in this age group predispose to facial deformity, micrognathia, and ankylosis of the TMJ. Consultation is essential.

Early follow up is important in all pediatric facial fractures because the child's facial skeleton heals faster than that of the adult. Within a week, early callous formation makes delayed reduction troublesome.

Pitfalls in the management of maxillofacial injuries

1. Poor airway management. Be prepared. Remember that the sitting position may be life saving (after the C-spine and associated injuries have been ruled out). The tongue becomes a dangerous "foreign body" in the flail mandible.

2. Inappropriate focus on the face. Gross injuries tend to distract. Initially focus on the airway, hemorrhage, and associated life-threatening injuries.

3. Casual physical exam. Observe, palpate, and ask the patient to move their face and jaw. The eye and mouth exam deserve special attention.

4. Poor choice and timing of x-rays. Get skull films if suspicious of frontal bone fractures. Periorbital fractures usually require a CT. The critically ill may have facial imaging deferred until they stabilize.

5. Failure to consult. Recognize high-risk patients. These include decreased vision, periorbital fractures, tripod and NEO injuries, LeFort fractures, open mandibles, and pediatric injuries.

6. Lack of documentation. Litigation is common in facial fractures and involves criminal, civil, and malpractice issues. Document meticulously.

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