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INSIDE

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How Good Are the New CT Scanners for PE?

ABSTRACT & COMMENTARY

By Stephanie B. Abbuhl, MD, FACEP

Vice Chair, Department of Emergency Medicine, The Hospital of the University of Pennsylvania; Associate Professor of Emergency Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA.

Dr. Abbuhl reports no relationships with companies having ties to the field of study covered by this CME program.

Source: Perrier A, et al. Multidetector-row computed tomography in suspected pulmonary embolism. *N Engl J Med* 2005;352:1760-1768.

THE PURPOSE OF THIS PROSPECTIVE STUDY WAS TO ASSESS whether a strategy of D-dimer testing and multidetector-row computed tomography (CT)—without the use of lower-limb ultrasonography (US)—would safely rule out pulmonary embolism (PE) in emergency department (ED) patients suspected to have PE. All patients were followed for three months. Of 1014 patients screened, 18% were excluded due to predefined protocol criteria, while another 7% were excluded for violations of the study protocol.

Patients were categorized into one of three pretest probability categories, based upon their Geneva scores. In patients with either a low or intermediate clinical probability, an ELISA D-dimer was used to rule out PE with a level below 500ug/L. In all patients with a D-dimer level above the cut-off, both a lower limb proximal venous compressive US and a multidetector-row CT scan were performed. If either CT or US results were positive, the patient was given anticoagulation treatment. If both were negative, the patient was discharged without anticoagulation treatment.

In patients with a high pretest probability of PE, no D-dimer test was done and both CT and US imaging were done. If either was positive, the patient was anticoagulated, but if both were negative, a pulmonary angiogram was performed. The results of CT imaging were considered inconclusive if there were technical problems or if only a subsegmental PE was diagnosed. Inconclusive CT results were followed by a VQ scan or a pulmonary angiogram for final diagnosis.

The prevalence of PE was 26%. In the 82 patients with a high pretest probability of PE, CT imaging was positive in 78 (95%), and 37 of the 78 had proximal deep vein thrombosis (DVT) (47%; 95%CI, 37-58%). Only one patient had DVT and a negative CT scan, and that patient was treated. Three patients had negative CT, US, and angiogram results. Of the 674 low/intermediate pre-test probability patients, 34% had a negative D-dimer test and an uneventful follow-up. In the remaining 442 patients, CT results were positive in 109 and 2 additional patients with negative CT results were identified with DVT on US. CT and US results were negative in 318 patients in whom the three-month risk of thromboembolism was 1.7% (95%CI, 0.7-3.9). ❖

COMMENTARY

The main question this study addresses is: What is the additional value of looking for proximal DVT in patients with a negative CT scan after initial screening with both a pretest probability assessment and a D-dimer? Only 0.9% (95% CI, 0.3-2.7) of patients had proximal DVT despite a negative CT scan. This low rate is consistent with at least one previous study[1] but significantly less than the rate in another.[2] With such a marginal improvement in overall detection of thromboembolism (VTE) with US, the authors determined that the three-month VTE risk in patients untreated after a negative CT scan alone would have been 1.5% (95%CI, 0.8-3.0), a risk similar to that after pulmonary angiography and similar to other outcome studies. Because the study did not truly manage patients without US, the authors concluded that "a larger outcome study is needed before this approach can be adopted."

Our dilemma is whether we can adopt this strategy now or be cautious and continue to do US as a complementary study when CT imaging is negative. The weight of evidence clearly is suggesting that this is not necessary, at least in patients with low-to-intermediate probability and especially in outpatients.

It is worth noting that the number of high pretest probability patients in this study was small (i.e., only 10% of all the study patients) and a larger outcome study where patients are managed without US would be reassuring in this group. The authors, in fact, made the suggestion that US be eliminated in those patients *without a high probability of PE*, but this recommendation is buried in the discussion and undoubtedly will be missed by many readers.

In addition, this series adds to other studies that have validated the use of ELISA D-dimer as an initial test in patients with low-to-intermediate pretest probability. Not a single thromboembolic event occurred in the 220 patients with low-intermediate probability with a normal D-dimer test result who were left untreated.

References

1. van Strijen MJ, et al. Single detector helical computed tomography as the primary diagnostic test in suspected pulmonary embolism: A multicenter clinical management study of 510 patients. *Ann Intern Med* 2003; 138:307-314.
2. Musset D, et al. Diagnostic strategy for patients with suspected pulmonary embolism: A prospective multicentre outcome study. *Lancet* 2002;360:1914-1920.

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Continuing Efforts to Predict Mortality in CAP Patients

ABSTRACT & COMMENTARY

***By Nathan I. Shapiro, MD, MPH**, Research Director, Harvard Medical School, Beth Israel Deaconess Medical Center, Department of Emergency Medicine, Boston, MA.*

Source: Marrie TJ, et al. Factors influencing in-hospital mortality in community-acquired pneumonia. *Chest* 2005: 127:1260-1270.

Community acquired pneumonia (CAP) remains a serious health care issue with an incidence rate of approximately 11.6/1000 adults per year, of which approximately 30% are admitted to a hospital. The case mortality rate is approximately 10%. There are a number of recommendations as to the best available approach to the care of patients with pneumonia. This investigation is part of a larger study looking at the effect of a pneumonia pathway on patient outcomes.

The specific goals of this study were to determine the factors that predict mortality in patients admitted to the hospital in a non-intensive care unit (ICU) setting with CAP. This is a six-hospital (two tertiary care, two mixed tertiary and community, and two community hospitals) study where an evidenced-based pathway was implemented. Included in the study were adult patients with pneumonia defined by two or more symptoms on history or physical examination plus radiographic evidence of pneumonia. Exclusion criteria were: ICU admission, palliative care, physician unwillingness, pregnancy, immunosuppression, nosocomial pneumonia, underlying lung disease, and a change to a non-pneumonia diagnosis within 48 hours. Patients were placed on a standardized pathway that included criteria for admission, standardized antibiotics, and criteria for eventual discharge from the hospital. Investigators collected elements of history, physical examination, co-morbidities, functional status, administered treatments and laboratory testing. These factors underwent a comprehensive statistical analysis using univariate and multivariate regression along with propensity scoring to determine which were independently associated with death.

During the two-year study period, 3043 patients were included with a total of 246 deaths (8.1%). The population was generally older (mean age 69.6 ± 17.7 years with 68% age ≥ 65), had an average pneumonia risk (Patients Outcome Research Team [PORT]) score of 101.2 (±35), and was male-predominant (52%). The crude mortality rate by functional status evaluated by ambulation status was: walking independently (4.0%), walking with assistance (11.6%), wheelchair bound (20.1%), and bedridden (25.2%).

Using a multivariate regression model, the following variables were all determined to be statistically significant independent predictors of death: pneumonia risk score, age, functional status determined by ability to walk, individual hospital, antibiotic therapy with levofloxacin (i.e., may be a marker of pathway use), and consultation with an infectious disease specialist (i.e., likely marker for complexity). Patients were then stratified by time of death, with five days or fewer considered *early* and six days or more considered *late*. Pneumonia risk score, age, and functional status remained significant predictors of death for both early and late mortality, while use of a pathway, lymphocytes < 1000, potassium > 5 mEq/L (correlated with creatinine > 2 mg/dL), and substance abuse were predictive of early mortality only. An infectious disease consultation and treatment with levofloxacin or ceftriaxone/azithromycin were predictive of late mortality.

The authors concluded that functional status at the time of hospital admission is an important predictor of mortality. This is above the effect of age and pneumonia risk score and should be included in any risk assessment of patients with CAP. ❖

COMMENTARY

This is a large-scale, multi-center study that underscores the importance of functional status as a predictor of mortality. This effect is independent of age and risk score, and should be a critical consideration in the ED patient with pneumonia, although it perhaps is not sufficiently accounted for in the current PORT risk score.

This study is part of an industry-sponsored implementation study of a pneumonia pathway where, although benefit from levofloxacin is implied, the study design does not permit proper assessment of this conclusion, and the results could be purely from effects of protocol compliance or the confounding effects of more complicated pneumonias in other therapy groups. Compliance with the pathway showed a strong trend toward beneficial effect for all deaths and had a statistically significant protective effect on early mortality. A regimented pneumonia pathway deserves consideration when organizing an institutional approach to the patient with pneumonia. Patients who did not receive antibiotics were excluded from the study without explanation, and readers are not informed if this occurred in the setting of a pathway.

This complex analysis gives EPs an important take-home message when assessing ED patients with pneumonia. Specifically, risk score, age, and functional status are important prognosticators of mortality, and each should be considered in mortality prediction and when considering discharge disposition.

Abciximab: Good Adjunct to PCI, Not So Good With Fibrinolysis

ABSTRACT & COMMENTARY

By Andrew D. Perron, MD, FACEP, FACSM,
Residency Program Director, Department of Emergency Medicine, Maine Medical Center, Portland, ME.

Source: De Luca G, et al. Abciximab as adjunctive therapy to reperfusion in acute ST-segment elevation myocardial infarction: A meta-analysis of randomized trials. *JAMA* 2005; 293:1759-1765.

The treatment of ST-segment elevation myocardial infarction (STEMI) continues to evolve at a rapid pace, particularly with the continuing development of adjunctive treatments to aid in reperfusion. While both fibrinolysis and mechanical reperfusion strategies (e.g. primary angioplasty) are clearly beneficial, suboptimal results may occur after reperfusion due to distal platelet embolization or platelet aggregation on reperfused endothelium. The glycoprotein (GP) IIb/IIIa inhibitors are designed to address and inhibit this process. While benefit has been shown in some studies when treatment is coupled with mechanical reperfusion, the effect of GP IIb/IIIa inhibitors on overall patient outcome remains controversial.

The purpose of this study was to perform a comprehensive meta-analysis of all randomized trials with abciximab as adjunctive treatment of STEMI, including both fibrinolytic and mechanical reperfusion strategies. This meta-analysis covered the years 1990 2004, and included 11 trials involving 27,115 STEMI patients. The primary outcomes assessed were 30-day mortality, long-term mortality (i.e., 6-12 months), 30-day re-infarction rate, and bleeding incidence.

The study findings demonstrated a significant reduction in short-term (2.4% vs 3.4%, p = 0.047) and long-term (4.4% vs 6.2%, p = 0.01) mortality in patients treated with abciximab and undergoing primary angioplasty vs controls. Significantly, such an association was *not* found when abciximab was combined with fibrinolysis. Abciximab was associated with reduced 30-day re-infarction rates in both groups (2.1% vs 3.3%, p < 0.001). Finally, abciximab did not result in increased episodes of intracranial or major bleeding when combined with primary angioplasty (4.7% vs 4.1%, p = 0.36), but was associated with these complications when combined with fibrinolysis vs controls (5.2% vs 3.1%, p < 0.001). Notably, this was true even when the studies using reduced-dose fibrinolytics were analyzed.

The authors concluded that there are sufficient aggregate data for use of abciximab as adjunctive treatment to primary angioplasty (reduces 30-day mortality and re-infarction rates, as well as long-term mortality without increased risk of major bleeding). They also concluded that abciximab *cannot* be recommended as adjunctive treatment to fibrinolysis as it confers no difference to short or long-term mortality benefit, but does increase the incidence of significant bleeding. ❖

COMMENTARY

Practicing at a tertiary care medical center, I have the luxury of 24-hour cardiac catheterization laboratory availability, cardiology fellows, and smart residents who challenge me to keep current on myriad topics. For its part, the faculty tries to keep in mind that most of our graduates who complete the program won't be practicing in such an environment. In our ED, STEMI patients embark on a set clinical pathway from the moment they enter the door until they have (hopefully) TIMI-3 blood flow through the culprit artery a very short time later. Abciximab is given by the nursing staff as part of this pathway, just as nitroglycerin, oxygen, and heparin are. My warning to residents is to not get too comfortable with these clinical pathways, as they may not be there when they get out in the real world.

The use of abciximab in our STEMI pathway is a perfect case in point. Because we use primary angioplasty in more than 95% of our STEMI patients, residents may never have the opportunity to give thrombolytics to a patient during their residency. If they subsequently join a practice where fibrinolysis is the reperfusion modality of choice, they may combine their treatment experience with that reperfusion strategy, potentially resulting in patient harm.

This study is useful for two reasons. First, it confirms the relative benefit of GP IIb/IIIa inhibitors as adjunctive treatment with primary angioplasty in an enormous patient population. The benefits are not huge, but I personally would prefer the smaller short and long-term mortality rates over the alternative, especially since bleeding does not seem to be increased with this strategy.

Second, it also clearly demonstrates no added benefit of such adjunctive treatment if fibrinolysis is utilized. Again, on a personal level, if I have a STEMI and am going the lytic route, I would not want a GP inhibitor to be used on me, as it confers no survival advantage but adds to my major bleeding potential.

Special Features

Injuries from Less Lethal Weapons: Are You Ready?

By Theodore C. Chan, MD, FACEP,
Professor of Clinical Medicine,
Medical Director, Department of Emergency Medicine, University of California San Diego Medical Center, San Diego.

Less lethal weapons are becoming increasingly popular amongst law enforcement agencies and the military to apprehend and subdue violent and dangerous persons in the field. Compared with firearms and other lethal force activities, these weapons are designed to be nonlethal to the targeted subject(s). Police agencies have adopted these weapons as a part of their use of force continuum in the face of public scrutiny and criticism regarding the supposed overzealous use of lethal force in many communities.

Less lethal weapons take advantage of a variety of technologies including blunt kinetic energy projectiles, riot control agents such as pepper spray, and electric stun devices such as the TASER. These weapons are designed to incapacitate individuals while minimizing the risk of fatality to the subjects, and reducing the risk of injuries to law enforcement personnel and bystanders. However, these weapons have been reported to cause significant and serious injuries to subjects, often resulting in the need for emergency medical care. Because of the increasing deployment of these technologies, EPs need to be aware of the emerging injury patterns associated with these less lethal weapons.

Blunt Projectiles

Blunt projectiles are designed to deliver blunt force kinetic energy (imparting energies of 100-200 Joules) to induce pain and incapacitation, but not necessarily to deliver lethal injury. In fact, unlike firearms, these projectiles are not designed to penetrate the body. However, because of the force required to incapacitate, significant blunt, as well as penetrating traumatic injuries have been reported with the use of these devices.

Less lethal blunt projectiles are classified into flexible and nonflexible projectiles. Flexible projectiles conform to the target shape and reduce the density of kinetic energy delivered. These projectiles include bean bag rounds, flexible batons, doughnut-shaped projectiles, and web-dispensing shots that immobilize the subject. Nonflexible projectiles are made of plastic, rubber, polyvinylchloride material, or wood, and are single or multiprojectile. These projectiles tend to have higher velocities than flexible projectiles and deliver an increased energy density to the subject.

Important factors include the anatomic area struck by the projectile, the distance range from which the projectile was delivered, and the number of rounds fired at the subject. Although most injuries occur to the extremities, early experiences with blunt projectiles in the 1950s and 1960s identified the head and neck regions as most vulnerable for significant injury. In particular, these weapons were reported to have caused significant closed head and brain injuries, as well as neck trauma in some cases.[1] More recent reports have noted significant and even fatal injuries associated with projectiles that struck the chest and abdomen.[2,3] Reported injuries have included pneumothorax, lung contusion and laceration, as well as myocardial lacerations.[4] In addition, the potential for inducing life-threatening cardiac dysrhythmias from blunt projectiles striking the chest, similar to commotio cordis, has been suggested as a mechanism by which these less lethal weapons can, in fact, become lethal.

Riot Control Agents – Pepper Spray

Riot control agents (e.g., tear gas, mace, and most recently pepper spray) now are used widely to subdue crowds as well as individuals. Pepper, or oleoresin capsicum (OC) spray, can be delivered at a subject via liquid spray, aerosol and powder delivered by a projectile. In fact, OC spray is now available for general public use.[5]

OC is made up of a mixture of fat soluble phenols, capsinoids, derived from the natural oily extract of the capsicum pepper plant (i.e., hot chili peppers). These agents act as direct irritant and stimulate chemo-nociceptors in primary afferent nerve endings, resulting in immediate pain and burning sensation over exposed areas. In addition, they cause the release of peripheral neuropeptides, including substance P, which can result in neurogenic inflammation, vasodilatation, capillary leakage of plasma fluid, and pain sensation.[6]

OC exposure can result in burning sensation to the skin, eyes, and mucous membranes. Exposure to the nasal passages can result in irritation, congestion, and rhinorrhea. Airway exposure can cause coughing, gagging, temporary inability to speak, and shortness of breath. Most of these symptoms are short-lived, resolving after 15 to 30 minutes.

More significant injuries have been reported with OC exposure. Because most exposures are directed at the face, ocular injuries have been reported. In two large case series, significant corneal abrasions were found in 7-8.6% of all OC exposures.[7,8] Fatalities also have been reported associated with OC spray.[9] However, in nearly all of these cases, death was attributed to causes other than the exposure. Only one case reported in the medical literature clearly implicates OC as a cause of death. In that case, Steffee and colleagues reported the death of an asthmatic person sprayed 10-15 times with OC who suffered a sudden cardiorespiratory arrest. Autopsy revealed severe epithelial lung damage and evidence of bronchospasm likely precipitated by pepper spray exposure.[10] However, considering the widespread use of OC, and the limited number of fatalities associated with exposure — and even fewer cases in which a causal connection is clear — it is doubtful that OC itself is inherently lethal.

Electric Stun Devices – TASER

Electric stun devices include various guns, belts, and shields, which are designed to deliver an incapacitating electrical shock to subjects on contact. These devices gained notoriety as the weapon used by Los Angeles police to subdue Rodney King in 1992. Most recently, the TASER — an acronym for its inventor, the Thomas A. Swift Electric Rifle — has been deployed widely throughout law enforcement agencies nationwide.[11]

The TASER consists of two barbed probes connected to a gun by 15- to 20- foot copper wires. The barbed probes are fired at a subject, penetrating the clothing or skin, and the electrical charge is discharged from the gun through the wires to the probes. The newest TASER model can deliver 50,000 volts with rapid fire, low amplitude shocks. The device incapacitates subjects by causing involuntary contraction of skeletal muscle and painful shock-like sensations throughout the muscles of the body. Most shocks are five seconds in duration or fewer. Once the discharge is halted, the subject usually recovers immediately.

Medical concerns regarding the TASER relate to injuries associated with the barb probe, indirect trauma from falls or other injuries associated with loss of voluntary muscle control, and the potential for injuries from the electrical discharge throughout the body. Subjects often present to the ED for care related to barb injury or removal. Barbs can be removed simply by stretching the surrounding the skin and tugging sharply on the probe.[12] Because the barb only penetrates to a maximum depth of 4 mm, significant penetrating trauma has not been associated with the TASER. However, minor skin burns, have been reported at these sites.[12]

Of greater concern have been reports of injuries potentially related to the discharge of electrical current through the body. These reports include a spontaneous miscarriage occurring seven days after TASER shock, and allegations of testicular torsion and sterility associated with exposure.[12,13] In addition, the American Civil Liberties Union and Amnesty International have reported a number of deaths associated with TASER shock, though a clear causal connection remains unproven. In particular, concerns have been raised regarding the potential of the TASER electrical discharge to cause cardiac injury and induce life-threatening dysrhythmias (e.g., ventricular fibrillation or asystole), particularly in individuals with preexisting heart disease or pacemakers. Thus far, safety data on TASER use have been limited mainly to animal studies, though industry data suggest a low case fatality rate of 4 in 40,000 TASER shocks in humans.[12] Further comprehensive research is needed to ultimately determine the safety of this less lethal technology. ❖

References

1. Millar R, et al. Injuries caused by rubber bullets. A report on 90 patients. *Br J Surg* 1975;62:480.
2. Ritchie AJ, et al. Life threatening injuries to the chest caused by plastic bullets. *BMJ* 1990;301:1027.
3. Steele JA, et al. Plastic bullet injuries in Northern Ireland: experiences during a week of civil disturbance. *J Trauma* 1999;46:711.
4. Chute DJ, et al. Injury patterns in a plast (AR-1) baton fatality. *Am J Forensic Med Pathol* 1998;19:226.
5. Smith J, et al. The use of chemical incapacitant sprays: a review. *J Trauma* 2002;52:595.
6. Sanico AM, et al. Dose–dependent effects of capsaicin nasal challenge: in vivo evidence of human airway neurogenic inflammation. *J Alergy Clin Immunol* 1997;100:632.
7. Brown L, et al. Corneal abrasions associated with pepper spray exposure. *Am J Emerg Med* 2000;18:271.
8. Watson WA, et al. Oleoresin capsicum (Cap-stun) toxicity from aerosol exposure. *Ann Pharmacother* 1996; 30:733.
9. Granfield J, et al. Pepper spray and in-custody deaths: International Association of Chiefs of Police Executive Brief. *Sci Tech* 1994;1.
10. Steffee CH, et al. Oleoresin capsicum (pepper) spray and "in-custody deaths". *Am J Forensic Med Pathol* 1995;16:185.

11. Hamilton A. From Zap to Zzzz. *Time.* March 28, 2005. Online at www.time./com/tim/magazine (accessed March 28, 2005).
12. Bleetman A, et al. Introduction of the TASER into British policing. Implications for UK emergency departments: an overview of electronic weaponry. *Emerg Med J* 2004;21:136.
13. Ordog G, et al. Electronic gun (TASER) injuries. *Ann Emerg Med* 1987;16:73.

Physician CME Questions

6. Which of the following is *not* a typical reaction to oleoresin capsicum pepper spray?
- a. cough
- b. inability to vocalize
- c. corneal abrasion
- d. skin vesiculation
- e. rhinorrhea

7. TASER barb removal can be accomplished most easily by which of the methods stated below?
- a. Stretching the skin at the probe site and tugging sharply
- b. Making a 1-cm incision into adipose tissue and gently grasping the probe with forceps
- c. Elevating the barb through the skin and cutting the barb off, then removing the remainder of the probe
- d. Obtaining surgical consultation for removal in the operating room

8. Which of the following factors was *not* found to be an important predictor of death in patients with community-acquired pneumonia?
- a. functional status
- b. pneumonia risk score
- c. gender
- d. advanced age

9. In the recent study by Perrier and colleagues, examining multi-detector row computed tomography for diagnosis of pulmonary embolism, thromboembolic disease was captured by lower extremity ultrasound but missed by computed tomography in approximately what percentage of patients?
- a. 1%
- b. 20%
- c. 40%
- d. 80%

10. In the recent study by Perrier and associates, which of the following recommendations was made regarding lower extremity ultrasound in the evaluation of thromboembolic disease?
- a. It is never necessary if the multidetector row computed tomographic scan is used.
- b. It can be eliminated in patients without a high probability of pulmonary embolism.
- c. It is necessary only in patients with a history of pulmonary embolism.
- d. It is necessary only in pregnant patients.

11. Which of the following medications has been found to be an effective adjunctive therapeutic agent in ST-segment elevation myocardial infarction patients receiving percutaneous coronary intervention, but *not* so in patients receiving fibrinolysis?
- a. aspirin
- b. heparin
- c. metoprolol
- d. abciximab

12. A recent meta-analysis revealed that, in patients receiving fibrinolysis for ST-segment elevation myocardial infarction, intracranial or major bleeding episodes were more common in abciximab-treated patients than in controls.
- a. True
- b. False

Answer key:
6. d
7. a
8. c
9. a
10. b
11. d
12. a

CME Objectives

To help physicians:
- Summarize the most recent significant emergency medicine-related studies;
- Discuss up-to-date information on all aspects of emergency medicine, including new drugs, techniques, equipment, trials, studies, books, teaching aids, and other information pertinent to emergency department care; and
- Evaluate the credibility of published data and recommendations.

CME Instructions

Physicians participate in this continuing medical education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge.

To clarify confusion surrounding any questions answered incorrectly, please consult the source material. After completing this activity, *you must complete the evaluation form that will be provided at the end of the semester and return it in the reply envelope provided to receive a certificate of completion.* When your evaluation is received, a certificate will be mailed to you.

ECG Review

What Would You Ask the Technician?

***By Ken Grauer, MD**, Professor and Associate Director, Family Practice Residency Program, College of Medicine, University of Florida, Gainesville.*

Clinical Scenario: How would you interpret the 12-lead electrocardiogram (ECG) shown in the Figure? What is distinctly unusual about this tracing? What would you ask the technician who recorded this tracing?

Interpretation/Answer: There are a number of interesting findings on the 12-lead ECG shown in the Figure. Although the variation from beat to beat is not great, the rhythm is irregularly irregular. QRS duration is upper normal, suggesting a supraventricular mechanism for the rhythm. No P waves are seen in lead II. Instead, a sawtooth pattern of atrial activity is noted in a number of other leads at a rate of approximately 300/minute. This fact strongly suggests that atrial flutter is the rhythm, seen here with a variable but controlled ventricular response. Marked right axis deviation (RAD) is present. There is voltage for left ventricular hypertrophy (LVH). Assessment of ST-segment morphology is difficult to ascertain because of baseline artifact and the effect of flutter activity, however, acute ST-T wave changes do not appear to be present.

There are two distinctly unusual features about this tracing. The first relates to the cardiac rhythm. Despite the baseline artifact that is present, identification of repetitive atrial activity at a rate of approximately 300/minute in several leads (especially leads I, II, and V1) defines the rhythm as atrial flutter. The most common type of atrial flutter manifests a characteristic sawtooth pattern that generally is seen best in all three of the inferior leads. However, there is no indication of flutter activity in lead II of this tracing. Instead, the lead that is most suggestive of flutter activity is lead I, a lead that often shows no trace of flutter activity on a 12-lead ECG. The second unusual finding is also noted in lead I, which shows a predominantly — if not totally — negative QRS complex. While this finding may be indicative of lateral infarction, there is no suggestion of lateral infarction in the precordial leads. The most common type of electrode reversal (i.e., mixing up left and right arm electrodes) is also unlikely because lead aVR is predominantly negative, as it should be. Lead aVR shows a QR pattern, instead of manifesting a positive QRS complex as would be expected if the arm electrodes were reversed. Thus, some technical mishap other than electrode reversal should be suspected as a possible cause of the unusual appearance of the QRS complex in lead I and the unexpected presence of characteristic flutter activity in lead I instead of in lead II.

The patient in question was a 67-year-old woman with severe mental retardation, who was admitted to the hospital for an exacerbation of heart failure. She could not understand instructions, and would only allow an ECG to be recorded while she was lying on her right side. The importance of verifying proper body position during ECG recording is essential for understanding potential alterations in ECG complex morphology from what normally is expected. Although this case is admittedly a more extreme example, it is important to appreciate that recording an ECG with a patient supine but with elevation of the bed — even by a small amount — may produce surprising changes in QRST morphology compared with ECG recordings made with the bed flat. Asking the technician to always indicate in writing on the ECG such alterations in body position during ECG recording would obviate many problems with interpretation. ❖

In Future Issues:

Serotonin Syndrome

Thomson American Health Consultants
Building Six, Suite 400
3525 Piedmont Road NE
Atlanta, Georgia 30305-1515
Tel (404) 262-7436 Fax (404) 262-7837
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Trauma Reports

Vol. 6, No. 4

Supplement to *Emergency Medicine Reports*, *Pediatric Emergency Medicine Reports*, *ED Management*, and *Emergency Medicine Alert*

July/August 2005

Maxillofacial Injuries: Imaging, Management, and Disposition

Authors: **Brian Euerle, MD**, Attending Physician, University of Maryland Medical Center; Assistant Professor, University of Maryland School of Medicine, Baltimore; and **Brian Kelly, MD**, Emergency Medicine Resident, University of Maryland Medical Center, Baltimore

Peer Reviewer: **John P. Santamaria, MD, FAAP, FACEP,** Medical Director, After-Hours Pediatrics, Affiliate Professor of Pediatrics, University of South Florida School of Medicine, Tampa

Emergency department (ED) practitioners commonly encounter patients with maxillofacial trauma. ED physicians must use all of their training and skills to provide the initial stabilization and make an accurate and timely diagnosis of the spectrum of injuries that commonly occur.

Following the initial assessment and stabilization, the ED physician must utilize the physical examination to direct the radiographic testing necessary to obtain a definitive diagnosis and provide care as mandated by the specific injury. Many injuries, such as facial lacerations, may receive definitive care from the ED practitioner. More complex and severe injuries may require further evaluation. Plain radiographs and/or computed tomography (CT) scanning of the injured structures frequently provide the required information to provide definitive patient care, appropriate referral and timely follow-up to minimize potential complications. Certain injuries that are identified, (e.g., acute temporomandibular joint [TMJ] dislocation) may require specific treatment strategies in the ED whereas others may only require timely outpatient follow-up.

The authors discuss radiographic imaging, specific management of different types of commonly seen injuries, and appropriate consultation and disposition of patients who have sustained maxillofacial trauma. (See the May/June issue for a discussion of clinical characteristics and initial management of these injuries.)

— The Editor

Introduction

Maxillofacial trauma is common with 5-10% of all patients presenting to the ED having an injury in this region. The first article on maxillofacial trauma discussed the recognition and initial stabilization of the patient who has sustained maxillofacial trauma. Focusing on anatomy and the mechanism of injury assists the ED physician in the early identification of potentially

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injured areas. The typical priorities for ED management apply: airway stabilization with cervical spine control, and early assessment, recognition and stabilization of breathing and circulatory complications. Following stabilization, the ED physician then faces the challenge of identifying specific injuries that the patient may have sustained. Maxillofacial trauma is particularly frightening to patients and their families because of the importance of the face and implications for long-term quality of life.

Diagnostic Studies

Radiographic assessment is one of the most important steps in the evaluation of the patient with maxillofacial trauma; however, it should be done only after the patient has been stabilized, the ABCs addressed, and the physical examination completed. The physical examination is important because it can focus the radiographic assessment to a specific bone or part of the face and allow for the identification of specific types of fractures. Focused radiography is much more efficient and allows for the appropriate use of the optimal technique and imaging strategy for each patient.

Radiologic assessment of maxillofacial trauma consists mainly of plain radiographs and CT imaging. Magnetic resonance imaging (MRI) and special procedures such as arteriography may be useful at times, but are modalities that are used rarely by the emergency physician (EP), and are reserved for complex cases typically not in the acute setting.

Standard Radiographic Facial Series. Before CT imaging became widely available in the 1980s, plain radiography and tomography were the mainstay of evaluation of the patient with maxillofacial trauma.[1] Plain radiographs continue to provide considerable information about the facial skeleton. Radiographic evidence of injury that can be detected includes cortical defects or overlap, bone displacement or rotation, and abnormal bone angulation.[2] Indirect signs of a fracture,(e.g., soft-tissue swelling, opacification or air–fluid levels in the sinuses and localized air collections) also may be detected on plain radiographs.

A standard radiographic facial series consists of four views: the Waters (occipitomental projection), Caldwell (occipitofrontal projection), lateral, and submentovertex views. Of these, the Waters view is the single most useful. In fact, some authors have suggested that it alone can identify accurately all midfacial fractures requiring treatment.[1,3]

In a Waters view, the x-ray beam passes in a posterior-to-anterior direction, at an angle of 37° caudad to the canthomeatal line.(*See Figure 1*.)[1] The patient's face is placed against the x-ray plate, and thus, a prone position is necessary. Because of this patient positioning, the cervical spine must be cleared of injury before this view is taken. If this is not possible, a reverse Waters view can be used with the patient in the supine position; however, this method produces a poorer quality image because the beam travels in an anterior-to-posterior direction, which enlarges the facial structures.[1,4]

The Waters view provides excellent visualization of the midfacial region, especially the anterior portion of the face. Features that are well demonstrated include the orbital rim and floor, nasal bones, zygoma, maxilla, and maxillary sinuses.[2,1] The Waters view can be confusing to interpret, especially to the inexperienced physician because of the large overlap of bony structures; however, with experience and a systematic approach, the clinician will find it to be a very useful film in a search for asymmetry, abnormal contours, bony disruption, and opacified sinuses.[1]

The Caldwell view utilizes a posterior-to-anterior x-ray beam angled 15° caudad to the canthomeatal line. This view allows visualization of the orbits, frontal bones and sinuses, and zygoma and is complementary to the Waters view.[2,1]

The lateral view is obtained with the x-ray beam centered at the lateral canthus.[1] One option is to place the most severely injured side of the patient's face toward the film cassette, as that will give optimal imaging of the injured area. The presence of an air-fluid level in the spheroid sinus can indicate a basilar skull injury. The lateral view is useful to visualize the superior orbital rim, frontal and maxillary sinuses, and the pterygoid plate. The nasal bones can be visualized, preferably with the use of a coned-down lateral view.[1]

The submentovertex view is taken with the patient prone and the neck hyperextended; thus, the same concerns about cervical spine clearance as with the Waters view apply here. This view gives the best visualization of the zygomatic arch and thus, is the view of choice when this fracture is suspected. It also allows visualization of the sphenoid sinuses and the anterior wall of the maxillary sinus.

Standard Radiographic Mandible Series. The unique shape

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Vice President/Group Publisher: Brenda Mooney
Editorial Group Head: Glen Harris
Managing Editor: Martha Jo Dendinger

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Subscriber Information

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Figure 1. Facial Radiographs

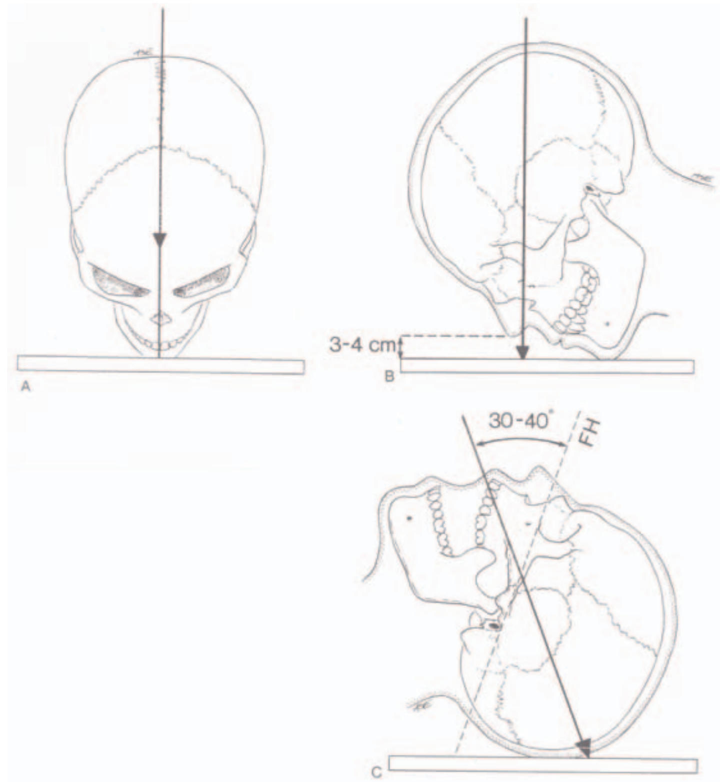

Figure 1. Facial radiographs. A and B, standard Waters (PA) view. C, reverse Waters view.

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Figure 2. Penetrating Trauma to the Mandible

Figure 2. Three-dimensional reconstructed image demonstrating a comminuted fracture through the body of the mandible after a gunshot wound.

Image courtesy of the authors.

of the mandible can make radiographic assessment challenging; however, plain radiographs can be very helpful. The standard radiographic mandible series consists of four views: posterior-anterior (PA), right lateral oblique, left lateral oblique, and the Townes view.[1] The combination of these four views allows adequate visualization of the majority of the mandible.

The patient is placed prone for the PA view, with the forehead and nose resting on the film cassette.[1] This positioning requires that the patient's cervical spine has been cleared. If this is not the case, the beam can be directed in the anteroposterior (AP) direction.[1] The PA view offers good visualization of the ramus, angle, and body of the mandible. It is suboptimal in its assessment of the condyles, coronoid processes, or symphysis.

For the two lateral oblique views, the patient's head is placed on a block inclined to 23°, and the x-ray beam is directed cephalad to the occlusal plane.[1] This view allows visualization of one side of the mandible without interference of the other side. As a result, the condyles, coronoid processes, ramus, angle, and body of the mandible are well visualized with these views.[1]

The Townes view is taken with the patient supine, with the occiput resting on the film cassette. The x-ray beam is directed caudad through the frontal bone and the temporomandibular joints.[1] The condylar region is seen well on this view.

Although these four views compose the standard mandibular series, there are two other views that can be very useful and bear mention: the standard lateral and the panoramic views. The standard lateral view is not used often to evaluate the mandible, but it can provide some information about the subcondylar area, ramus, angle, and mandibular body.[2] It can be useful in assessing airway patency because the lingual, soft palate, retropharyngeal, and prevertebral soft tissues are seen well.

The panoramic (Panorex) view is considered the single best view for evaluation of the mandible, and when used in conjunction with the four-view plain film series, has the highest sensitivity for identification of mandibular fractures.[1] The view is taken with a dedicated x-ray machine in which the x-ray beam and plate rotate around the patient's head. As a result, the entire mandible is visualized. Unfortunately, the Panorex is not available in all emergency departments (EDs), and even in those in which it is available, there may be limitations in its hours of operation.

Computed Tomography Imaging. Because of the complex anatomy of the facial skeleton, high-resolution CT has become the imaging modality of choice for many patients with maxillofacial trauma.[5] CT imaging reveals details of the complex facial anatomy not possible with standard radiography. In some cases, routine facial radiography will suffice if the injury is limited to a single structure; however, CT imaging is indicated when exten-

Figure 3. Coronal CT Image

Figure 3. Coronal CT image demonstrating a left orbital floor fracture with fat herniation after an altercation.

Images courtesy of the authors.

Table 1. Summary of Recommendations for Facial Wound Treatment

- Do not place staples on facial wounds—especially the forehead.
- Do not treat parotid gland/duct injury without evaluating for facial nerve injury (and vice versa).
- Do not assume patients with facial fractures from MVAs or assaults are isolated injuries without proving otherwise.
- Do not leave disfiguring facial bite wounds to heal by secondary intention.
- Do not forget to anesthetize wounds before cleaning them.
- Always align the vermillion lip border first.
- Try not to place absorbable sutures in ear cartilage.

Key: MVA = motor vehicle accident.

sive osseous or soft-tissue injuries are apparent. Additionally, CT imaging is indicated for penetrating trauma (*Figure 2*) and all fractures that may involve the frontal sinuses, nasoethmoid complex, or orbits. Definitive surgical management almost always is based upon the results of CT imaging.[3]

CT imaging of the facial complex in two orthogonal planes, axial and coronal, allows accurate diagnosis and facilitates preoperative planning.[5] Direct coronal images of the face require the patient to be in the prone position with extreme hyperextension of the cervical spine. Coronal imaging provides superior visualization of the cribiform plate, orbital roof, and orbital floor (*Figure 3*) because these structures are oriented predominantly in the axial plane. However, because of the high concurrence of cervical spine injury and facial fractures, direct coronal images often are unobtainable at the time of initial presentation to the ED. Standard imaging in the axial plane using 3-mm sections from the level of the mid-mandible through the frontal sinus performed on conventional helical CT scanners is rapid but provides poor quality, nondiagnostic, reformatted coronal images.[6] Newer generation multidetector CT (MDCT) scanners and image reconstruction algorithms allow rapid acquisition of very thin (e.g., 0.5-mm) axial images, yielding high-resolution multiplanar reformatted images.[5] This ability to obtain diagnostic-quality images at the time of initial presentation substantially improves patient care, obviating the need for the patient to return to the radiology department for additional studies, lessening exposure to ionizing radiation, and ultimately reducing cost.[6]

Management of Specific Injuries

Lacerations. Management of facial lacerations begins with assessment of cranial nerve integrity and documentation of any deficits prior to administration of local anesthetic. Depending upon the location of the laceration, the temporal, zygomatic, or marginal mandibular branch of the facial nerve may have been injured (Figure 4). Lacerations located lateral to a vertical line running through the lateral canthus of the eye and involving any of the branches of the facial nerve generally are considered for microscopic repair of the transected nerve tissue with 8.0 or 9.0 nylon epineural simple suture. Nerve injuries that result from lacerations medial to this line generally are not considered repairable, owing to the small caliber of the nerve.

The surgical area may be anesthetized by local infiltration of the wound edges or by regional block. Common regional blocks useful for repair of facial lacerations include blocks of the supraorbital, supratrochlear, infraorbital, and mental nerves. Complete instruction regarding these regional blocks is beyond the scope of this article; however, if they are used, the patient must be warned of the possibility of swelling and ecchymosis of the upper or lower eyelids.

After the laceration is anesthetized, the wound must be explored meticulously for the presence of foreign bodies. Removal of foreign material can be facilitated with the use of a surgical scrub brush or sharp excision. The skin surrounding the surgical site may be prepared using various surgical scrubs (e.g., povidine-iodine or chlorhexidine), exerting caution to avoid introduction of the cleaning agent into the wound. Following skin preparation, copious, pressurized irrigation with normal saline or sterile water using a 60-mL syringe affixed with an 18-gauge angiocatheter is performed. Conservative debridement of macerated or devitalized tissue is recommended. Repair proceeds with approximation of the deep tissues using buried, interrupted, fine-gauge absorbable sutures. Horizontal mattress sutures may

Figure 4. Facial Nerve and Parotid Gland

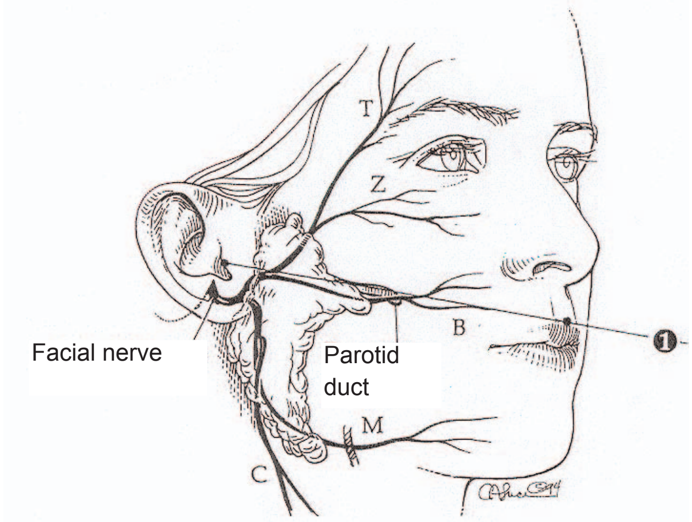

Figure 4. Note that the parotid duct lies roughly along a line drawn from the tragus to the mid upper lip. It enters the oral cavity along a line from the pupil to the mental nerve. The facial nerve divides into five main branches inside the parotid gland. Any laceration of the parotid gland or duct mandates an exam for facial nerve injury.
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Figure 5. Classification of Tooth Fractures

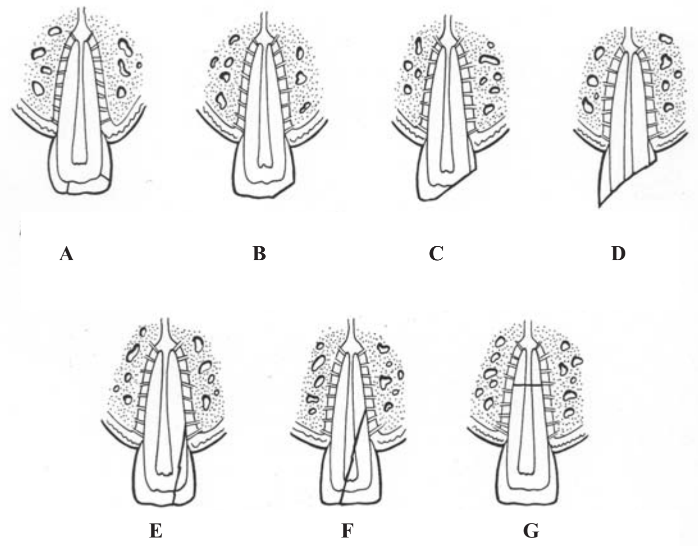

Figure 5. Dental injuries. A: crown infraction. B, uncomplicated crown fracture (Ellis I). C: uncomplicated crown fracture (Ellis II). D: complicated crown fracture (Ellis III). E: uncomplicated crown-root fracture. F: complicated crown-root fracture.

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be used to approximate the deepest portion of the dermis, relieving tension on the skin closure. Reduction of tension across the sutured wound is key to achieving an optimal cosmetic result. The epidermis is closed with 6-0 or 7-0 monofilament sutures. (*See Table 1.*)

General follow-up care of facial wounds consists of gently cleansing the affected area with soap and water at least six times daily beginning 24 hours after wound closure.[7] Bacitracin ointment, applied in a thin layer, may be applied after each cleansing until sutures are removed. To minimize scarring, sutures should be removed no later than three to five days after initial closure in most patients. In patients with risk factors for impaired wound healing, sutures may be left in place for longer periods.[8] Initiation of systemic antibiotics— most often penicillin G or penicillin VK, a cephalosporin, or amoxicillin /clavulanic acid — generally is recommended for any facial wound contaminated by oral, nasal, or skin flora.[9-10] Sunscreens should be used for six months following repair. Finally, patients should be instructed to watch for signs of infection and reminded that generally it will take six to nine months before a final scar is formed. Seeking advice about potential revision prior to this time may be premature.

High-risk soft-tissue injuries involve areas associated with an increased incidence of late complications. These injuries include any laceration of the margin of the eyelid, the rim of the nostril, the vermillion border of the lip, and the helical rim of the auricle.[11] Injuries involving these structures may warrant ophthalmology or plastic surgery consultation. Lacerations of the cheek may transect the parotid duct, which runs along a line connecting the tragus of the ear to the philtrum of the upper lip, and must be inspected carefully to exclude duct injury prior to closure. (Figure 4.)

Dentoalveolar Injuries

The main goal in the management of dentoaveolar injuries is restoration of aesthetic form and masticatory function. The prognosis depends largely upon the type of injury and the time elapsed from the injury to the completion of treatment. Ellis I and II fractures tend to be uncomplicated. Ellis I fracture of the enamel requires no emergent treatment. Ellis II fractures, involving the enamel and the dentin, should be treated within 48 hours to prevent bacterial migration into the pulp with ensuing pulpal inflammation. Complicated crown fractures, Ellis III, should be treated within a three-hour window when possible.[13] Prompt treatment with calcium hydroxide and restoration within that timeframe can prevent pulpitis and the need for further endodontic therapy. (*See Figure 5.*)

Treatment of root fractures depends upon the location of the fracture. Apical root fractures often are stable and require referral to a dentist for periapical radiography and observation. Treatment of middle-third fractures consists of anesthetizing the area, reduction of the fracture, and rigid fixation of the injured tooth to adjacent teeth for six to eight weeks. With this treatment, the

Figure 6. Displaced Mandible Fracture

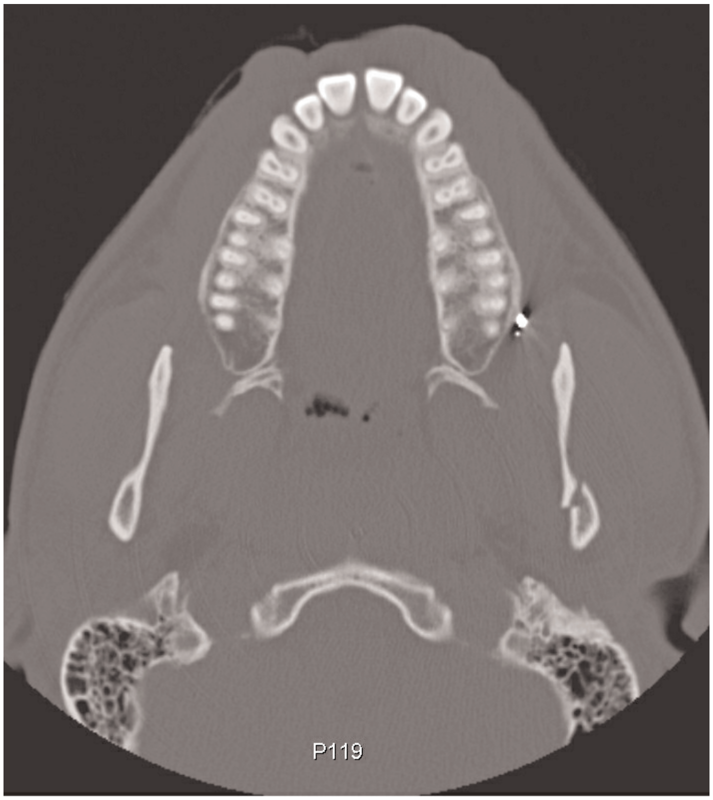

Figure 6. Non-contrast axial CT image demonstrating a displaced fracture through the ramus of the mandible.

Image courtesy of the authors.

Figure 7. Open Reduction and Internal Fixation of Mandible Fracture

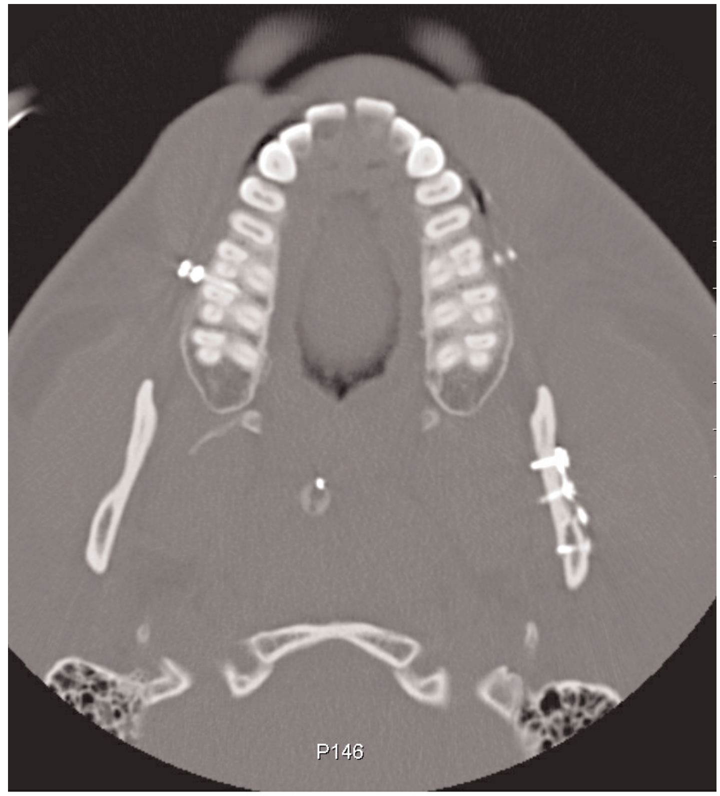

Figure 7. Non-contrast axial CT image performed after open reduction and internal fixation of the mandible fracture utilizing miniplates.

Image courtesy of the authors.

tooth often will remain vital. Treatment of cervical root fractures requires extensive therapy; extraction and prosthodontic replacement are often necessary. Fractures through the middle third or cervical root are unstable and require immediate referral to the patient's dentist or an endodontist.[12]

Subluxation and concussive tooth injuries represent injury to the periodontal ligament, which is responsible for maintaining the teeth in their sockets. Immediate treatment is not necessary; however, patients should be referred to a dental practitioner because a small portion of these injuries results in pulpal necrosis within one year of the initial incident.

Luxation injuries are described according to the direction in which the tooth is displaced: extrusive luxation, lateral luxation, and intrusive luxation. Intraoral radiographs are necessary to evaluate for concomitant root fractures and alveolar process fractures. Treatment of extruded and laterally luxated permanent teeth consists of anesthetizing the area, manually repositioning the tooth, and nonrigid fixation with a monofilamentous nylon and composite resin splint left in place for two to three weeks. If root fracture or alveolar process fracture is identified on intraoral radiography, the tooth must be fixated rigidly for two to three months with orthodontic wire. Luxated primary teeth often are extracted to avoid risk of damage to the underlying permanent tooth upon repositioning. Approximately 26% of extruded teeth and 58% of laterally luxated teeth develop pulpal necrosis, necessitating endodontic therapy.[13]

Intrusive luxation injuries are severe dental injuries in which the tooth has been forced into the alveolar process and the occlusal surface of the tooth is below that of the adjacent teeth. Severely intruded maxillary teeth can penetrate the floor of the nose and cause epistaxis. The alveolar process often sustains a severe crushing injury, resulting in comminution of the socket. Endodontic therapy almost always is required because of the high rates of pulp necrosis.

Complete avulsion of the tooth represents approximately 16% of dentoalveolar luxation injuries.[13] Avulsed permanent teeth should be cleaned of debris and reimplanted immediately. If the tooth is not replanted immediately, it should be placed in a liquid storage medium such as Hank's Balanced Salt Solution, milk, saline, saliva, or water. The tooth should be handled carefully by the crown to avoid further damage to the periodontal ligament cells. The socket should be irrigated free of clot prior to reimplanting the tooth. Local anesthesia may be necessary for patient comfort. The tooth should be splinted for 10 to 14 days. Reimplantation of avulsed primary teeth is not recommended.

Fractures of the alveolar process are treated with manual

Figure 8. LeFort III Fracture

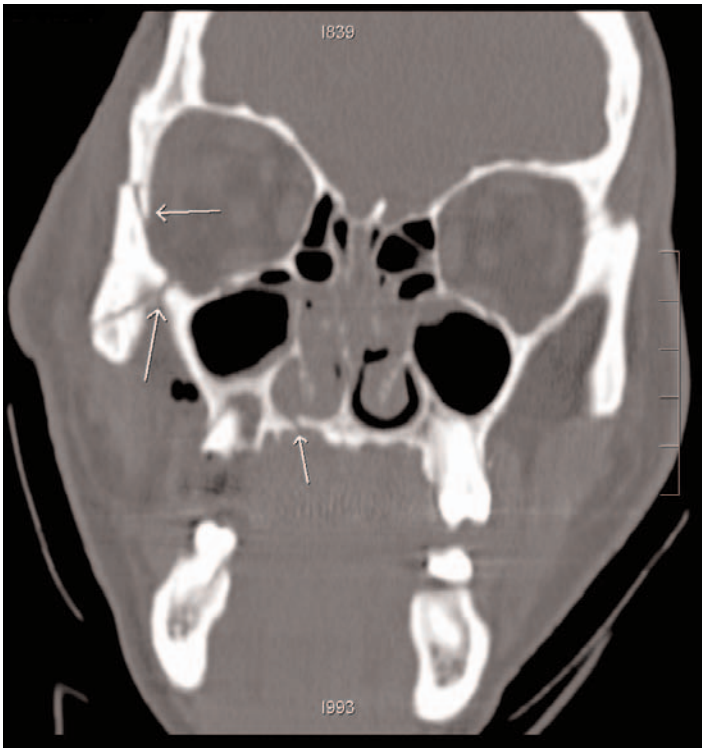

Figure 8. Reconstructed coronal CT image demonstrating multiple fractures consistent with a right hemi-Lefort III fracture.

Image courtesy of the authors.

repositioning and rigid fixation. Occasionally, surgical treatment is necessary. Early consultation with a dental practitioner is recommended, as complications are much more likely to develop if treatment is delayed beyond one hour from the time of injury.[13]

Antibiotics typically are recommended for dentoalveolar injuries. Tetanus immunization status should be evaluated and updated as needed. Opioid medication may be required for patient comfort.

Acute Temporomandibular Joint (TMJ) Dislocation. Acute temporomandibular joint (TMJ) dislocation is best managed with prompt manual reduction. Occasionally, manual reduction may be accomplished without the use of anesthetic or sedative medications; however, as dislocation is prolonged, spasm of the masseter muscles makes further reduction attempts more painful and less successful. In the cooperative patient, immediate manual reduction is best accomplished by positioning the patient in a chair, with the posterior occiput supported against a wall. The examiner places the gloved thumbs of both hands intraorally along the occlusal surface of the posterior mandibular molars, and positions the fingers extraorally along the inferior border of the mandible. Wrapping the thumbs in gauze may prevent injury by the molar cusps. Reduction of the condyle occurs with forceful inferior and posterior displacement of the mandible, allowing the condyle to slip into the glenoid fossa. If initial attempts are unsuccessful, sedation with intravenous benzodiazepines—alone or in combination with an opioid— produces anxiolysis and may aid additional attempts. A panoramic radiograph should be taken after successful reduction to rule out condylar fractures.[10] If repeated attempts at reduction are unsuccessful, subspecialty consultant manual reduction under general anesthesia or operative reduction may be necessary.

After successful reduction of an acute dislocation, patients should be instructed to eat a soft diet for one week and to limit oral opening for two to four weeks. Nonsteroidals and muscle relaxants facilitate patient comfort. Patients should be instructed that they are at increased risk for future dislocation due to ligamentous stretching.

Facial Fractures. Definitive management of facial fractures is highly specialized and requires early surgical consultation. Operative management depends greatly upon the degree of comminution and displacement of the bony segments and focuses largely on restoration of the anatomic buttresses of the face. High-resolution CT scans facilitate diagnosis and serve as the basis for perioperative planning.

Mandibular Fractures. Operative management of mandibular fractures has changed considerably during the past 10 years. Older methods of closed reduction within six weeks of maxillomandibular fixation (MMF) largely have been replaced by intraoral open reduction and internal fixation, using noncompression or compression bone plates or semirigid fixation with miniplates.[11,14] (*See Figures 6 & 7.*) When rigid internal fixation of the mandibular fracture is performed, the duration of MMF is reduced to several days to one to two weeks, permitting enhanced nutrition, oral hygiene, and comfort.[12,14] Correct repair of mandibular fractures results in restoration of occlusion; mandibular function; and the anteroposterior, vertical, and lateral dimensions of the facial complex.

Midfacial and LeFort fractures. Initial surgical management of midfacial and LeFort fractures (*Figure 8*) involves restoration of the occlusal surface by first repairing any associated mandibular fractures. This approach provides the base upon which the midface is reconstructed. Skeletal repair is then accomplished by open reduction after wide exposure of the fragments with restoration of the facial buttresses using extensive miniplating in conjunction with bone grafts and, occasionally, wire osteosynthesis.[10-12] The administration of prophylactic antibiotics to cover for staphylococcal or anaerobic bacteria is recommended. Cerebrospinal fluid (CSF) rhinorrhea, if present, warrants neurosurgical consultation.

Orbital Fractures. Fractures of the orbital floor may result in serious consequences if not managed appropriately. The aim of initial management is to identify processes that may permanently compromise ocular function. One such process occurs when the ocular nerve is compressed by a retrobulbar hematoma. In this situation, an emergency lateral canthotomy can be sight saving. Further management aims to prevent long-term complications such as traumatic enophthalmos, which results from an increase in orbital volume associated with inadequate repair of the orbital floor. The globe is displaced posteriorly and inferiorly, prolapsing into the maxillary sinus, creating a functional and cosmetic defect that may result in permanent diplopia. Surgical repair of an orbital floor fracture usually is accomplished through a transconjunctival or subciliary incision (immediately inferior to the lashes of the lower lid). Materials that commonly are employed to reconstruct the orbital floor include titanium mesh, silastic sheet, and cranial bone.[14] Infections after orbital fractures are rare, therefore, routine antibiotic prophylaxis is not necessary.

Zygomatic Arch Fractures. Pure fracture of the zygomatic arch is rare, owing to the strength and thickness of the zygoma.[9] Fractures tend to extend through adjacent weaker bones. Thus, the term zygomaticomaxillary complex (ZMC) fracture often is used when describing fractures involving the zygoma. ZMC fractures can be repaired using several approaches. The incisions can be made through the periorbital brow region, in a subciliary location, or posterior to the temporal hairline (Gillies incision). Internal fixation is accomplished with miniplates placed at the zygomatic frontal, infraorbital, and maxillary buttresses. Orbital floor fracture occurs commonly in association with ZMC fractures and must be repaired carefully, as above. There is no evidence supporting the use of prophylactic antibiotics for ZMC fractures.

Nasal Bone Fractures. Fractures of the nasal bones and septum are common and can result in nasal airway obstruction secondary to deviation of the nasal septum. Nondisplaced or minimally displaced nasal fractures can be treated with closed reduction and nasal splinting. Treatment of severe epistaxis includes meticulous repair of intranasal lacerations, followed by nasal packing. The nasal septum must be inspected carefully for the presence of a hematoma. If present, hematoma evacuation is accomplished though a small incision with subsequent drainage, then, the septal mucosa is reapproximated, and nasal packing is placed. Antistaphylococcal antibiotic prophylaxis is necessary while packing is in place.

Naso-orbital-ethmoidal (NOE) Fractures. More severe injury involving the nasal bones occurs with naso-orbital-ethmoidal (NOE) fracture. Typically, the result of high-energy impact, an NOE fracture involves the nasal bones, nasal processes of the frontal bone, frontal process of the maxilla, and the delicate lamina papyracea of the ethmoid bones. Any fluid draining from the nose must be evaluated for CSF rhinorrhea because NOE fracture can be associated with fracture of the cribiform plate and anterior cranial fossa. Surgical repair of an NOE fracture begins with evaluation for medial canthal ligament injury. The intercanthal distance should be measured; it averages 30-34 mm in adults. If canthal injury is suspected, careful repair of the medial canthal tendon with restoration of the medial orbital rim using autogenous bone grafts can prevent permanent traumatic telecanthus. Intraoperative stenting of the lacrimal system is performed, as duct injury may occur secondary to NOE fracture. Following medial canthal ligament repair, dental occlusion is re-established through MMF with arch bars and rubber bands. Open reduction usually is accomplished via bicoronal and subciliary incisions, with internal fixation using miniplates and wires to stabilize the fractured bony segments.

Potential Complications of Maxillofacial Trauma

Auricular Hematoma. Much like a nasal septal hematoma, an auricular hematoma, if not treated promptly, may lead to permanent deformity. Hematoma of the auricle occurs when trauma causes shearing forces that separate the perichondrium from the underlying cartilage, leading to collection of blood between these two layers. As the hematoma expands, the increasing pressure leads to vascular compromise and cartilage death. Permanent deformity—commonly referred to as cauliflower ear — ensues as the auricular cartilage is replaced by fibrocartilaginous scar.

Treatment of an auricular hematoma incorporates principles of drainage and compression. Anesthesia is achieved by local infiltration of anesthetic into the subcutaneous tissue directly anterior and posterior to the auricle. Once adequate anesthesia is confirmed, the hematoma can be drained. Common methods of hematoma evacuation include aspiration with an 18-gauge needle or incision and drainage. Following evacuation, a compression dressing should be applied. An advanced compression method involves the use of thermoplastic silicone splints. A silicone splint is cut to cover the involved area of the inner auricle. A second splint, cut to match the first, is applied to the posterior pinna. The two splints are secured to each other with three to four interrupted mattress sutures (i.e., 3-0 nylon suture on a straightened needle) passed through the pinna along the outer edges of the splints. Antibiotic ointment is applied twice daily; systemic antibiotics (e.g., cephalexin or dicloxacillin) are recommended for five days to prevent infection. Silicone splints generally are left in place for 14 days; then the sutures may be removed. Regardless of the method of treatment, patients should follow-up with an otolaryngologist or plastic surgeon, because hematoma recurrence is not uncommon. Complications of auricular hematomas include fibrocartilaginous deformity of the ear, staphylococcal or streptococcal chondritis, and cartilage or skin necrosis.

Massive Bleeding Associated with Midfacial Fractures. Patients with massive bleeding following midfacial fracture must be managed aggressively to prevent the development of hemorrhagic shock or the need for massive transfusions. One standard approach to midfacial bleeding begins by passing 14-gauge Foley catheters through the nares into the posterior nasal pharynx. The correct position is confirmed by direct visualization of the catheter tips in the oropharynx. After balloon inflation with 5-10 mL of air, the catheters are withdrawn slightly and secured externally, allowing the inflated balloons to tamponade bleeding from the posterior nasopharynx. Following Foley catheter placement, posterior and anterior nasal packing with petroleum gauze is placed.

Occasionally, bleeding may continue and must be managed with more invasive techniques. Shimoyama and colleagues reported the use of temporary fracture reduction utilizing maxillomandibular fixation to restore occlusal relations.[15] Additional invasive techniques include direct visualization and surgical ligation of arterial sources. A few authors have reported the successful use of transcatheter arterial embolization of the internal maxillary artery to control unstable epistaxis.[16,17]

Disposition

Once the EP has assessed and stabilized the patient, obtained any needed radiographic studies, and reached a diagnosis, the disposition of the patient must be determined. Under the broad category of disposition are three distinct areas to be considered: consultation, admission/discharge decisions, and transfer.

Consultation. Decisions about consultation vary widely according to the type of injury, other patient injuries, and the type of hospital. Generalizations are presented here, but these practices can vary in different institutions and areas of the country.

The majority of soft-tissue injuries may be treated by the EP without the need for consultation. Examples in which a consultation is more likely to be obtained include unusually large, complex, or deep lacerations; lacerations that involve underlying structures (e.g., the facial nerve or parotid gland or duct); lacerations or abrasions with foreign bodies or debris that cannot be removed; and hematomas that involve the ear or nasal septum.[2]

Most dental injuries require urgent referral to a dentist. A special situation is avulsion of a permanent tooth. In this case, the time until re-implantation is very critical and affects the prognosis.[13] Unless a dental consultant is available immediately to care for the avulsed tooth, the EP should perform this procedure.

A consultant is called for the majority of facial fractures. An exception would be a simple uncomplicated nasal fracture. Generally, this injury may be followed up by a consultant within 48-72 hours. However, patients with a significant deformity or obstruction need consultation in the ED, with manipulation to correct the deformity.[2] Patients without airway obstruction or a gross deformity may be advised to wait for the swelling to decrease before deciding about the cosmetic result. Some minor facial fractures (e.g., those involving only the body of the zygoma) may require only a telephone consultation and close follow-up.[2]

One issue concerning consultation involves the specialty of the consultant physician. Traditionally in the United States, three groups of specialists have cared for patients with maxillofacial trauma: plastic surgeons, otolaryngologists (ENTs), and oral and maxillofacial surgeons. A survey of U.S. teaching hospitals showed that the majority had a formal, documented referral pattern in place for patients with maxillofacial injuries.[18] Most types of maxillofacial injuries were referred equally to all three specialties, with the exception of isolated mandibular fractures preferentially being referred to oral/maxillofacial surgeons.

One additional specialist that should be considered for the patient with maxillofacial injury is the ophthalmologist. This is especially important for patients with mid-face and orbital fractures, because a significant number of them will have injuries ranging from minor to severe.[9] An ophthalmologist should be involved in the care of these patients whenever there is concern about possible eye injury.

Admission/Discharge. Most patients with isolated soft-tissue or dental injuries are discharged from the ED. In the past, the majority of patients with facial fracture were admitted to the hospital; however, in today's changing health care environment this necessarily may not be the case. One important factor in the decision process is the presence of other body system injuries that require inpatient treatment. Other factors that should be considered are the availability and timing of planned surgical intervention and concerns for possible airway compromise. With the right combination of factors, many of these patients may be discharged from the ED.

Transfer. The issue of transfer generally arises because of the patient's need of a higher level of care, either for the maxillofacial injury itself or for associated injuries. In general, patients with minor facial injuries may be transferred if they have been stable in the ED. Patients with major maxillofacial injury potentially are unstable because of the possibility of airway compromise. In these patients, consideration should be given to pre-transfer intubation so that the airway will be protected during transfer.[2]

Additional Aspects

Pediatric Issues. Children may be especially susceptible to maxillofacial injury because of their greater cranial-mass-to-body ratio, yet facial fractures are relatively uncommon in children.[19-22] This may be for a variety of reasons, including a flexible underdeveloped facial skeleton combined with unerupted dentition; in adults, mature teeth reinforce the maxilla and mandible.[22] In addition, children are less likely to be exposed to the mechanisms of injury that cause facial fractures in adults. Pediatric facial fractures can be hard to diagnose, therefore, the EP must be diligent in searching for them. This fact is especially important because the growth and development of the facial bones can be affected by any fracture.

The developing pediatric facial skeleton is notable for incompletely calcified areas, ossification centers, underdeveloped sinuses, and tooth buds. Because of this, plain radiographs do not demonstrate fractures as well as in an adult.[29] Therefore, CT imaging is the modality of choice in the evaluation of the pediatric facial skeleton, even more so than in adults. CT also has the advantage of imaging the cartilaginous areas, which can be especially important in the pediatric maxillofacial region. With the high incidence of associated head injuries in the pediatric patient, it can be advantageous to perform a CT scan of the brain at the same time.

Further management of pediatric facial fractures differs in certain instances from adults because of the different stages of development of the pediatric facial skeleton; however, these issues of definitive treatment mainly concern the consulting specialist physician. Pediatric facial fractures are, in general, treated in a more conservative manner than adult fractures. Observation may be all that is required, especially in patients with minimally displaced fractures.

The evaluation and management of soft-tissue injuries in children largely mirrors that of adults. Children have immature collagen in their soft tissues, and their wounds generally heal with very good cosmetic results.[19] Patient cooperation can be one of the most important aspects of obtaining an acceptable functional and cosmetic result in the child with a facial laceration.[2] A calming and reassuring atmosphere may be paramount, although at times sedation and /or restraint may be indicated. Topical anesthesia has been shown to be very effective for pediatric facial and scalp lacerations and should be considered.

One soft-issue injury of particular concern in children is that of dog bites to the face. Most dog-bite victims are younger than 5 years, and the frequency of dog bites decreases with age.[23] The emergency practitioner must consider rabies and tetanus prophylaxis, antibiotic use, and the type of wound closure. Dog bites to the face can have important implications for cosmetic and functional sequelae, and consultants should be used liberally. Immediate surgical repair has been found to be safe and effective.[23]

Sports-related maxillofacial trauma is an evolving pediatric issue. More and more children are participating in organized sports and starting at a younger age. Countering this fact is the increased development of more and better safety equipment along with rules mandating its use.[12,24,25] Equipment specifically designed to protect the maxillofacial area are mouthguards, helmets, and face masks.

Nasal and mandibular fractures are the most common sports-related facial fractures in children.[24,25] Dental injuries are also common sports injuries, and their incidence is inversely related to mouthguard and face mask use. Dental injuries are found less frequently in football players, and more commonly in sports in which the mouth is not protected (e.g., basketball, baseball, and softball).[25]

Public Health. Several public health initiatives established to reduce motor-vehicle-collision (MVC) associated mortality have led to significant reductions in the incidence of severe maxillofacial injury. Enforcement of seat belt laws has reduced MVC-related mortality, and many states have adopted helmet laws for the protection of motorcycle riders. It is well documented that helmet use by motorcycle riders significantly reduces the risk of severe traumatic brain injury (TBI).[26] Additional reduction in the incidence of facial fractures and soft-tissue injury has been observed in helmeted riders versus non-helmeted riders.[27] Full-face model helmets offer the greatest rates of reduction of all injuries.

The protective effects of helmets also are seen among injured bicycle riders. More than 500,000 bicyclists are treated annually in EDs in the United States.[28] Although the mortality rate associated with bicycle accidents is low, head injury accounts for three-quarters of bicycle-related deaths.[28] In one meta-analysis of seven case-control trials of bicycle riders with maxillofacial injuries, helmet use was associated with a 65-88% reduction in the risk of TBI and a 65% reduction in the risk of middle and upper facial injuries.[29]

A major role of the emergency practitioner is to educate patients to prevent future injuries. The effect of physician intervention on behavior patterns should not be underestimated. Physicians and nurses must educate their patients regarding the beneficial effects of helmet and seat belt use.

Domestic Violence. Domestic violence is a widespread problem in the United States and has far-reaching physical, emotional, and social consequences.[30,31] Victims of abuse may not, for a variety of reasons, initially seek treatment for their injuries; however, when they do, they usually come to the ED. Therefore, ED nurses and physicians are frequently responsible for diagnosing and treating these patients. This responsibility extends beyond the immediate medical concerns to include counseling, ensuring a patient's safety, referrals, and legally mandated reporting. Because most injuries arising from domestic violence involve the face, certain facts bear mention here.[30]

In a study of 236 female victims of domestic violence, Le and colleagues documented that 81% had maxillofacial injuries.[30] The most common type of maxillofacial injury resulting from domestic violence is soft-tissue injury, (i.e., contusions and lacerations). Thirty percent of the patients in this study had facial fractures, with nasal fractures being the most common. Injuries most commonly were caused by a blunt mechanism such as the use of a fist or weapon. Other injuries that may be markers of domestic violence include hair loss from pulling, fractured anterior teeth, dislocated jaw, and suborbital ecchymosis.[31] Suspicion of abuse should be aroused when the patient's presentation is inconsistent with the initially offered mechanism of injury, when the clinician observes old injuries in multiple stages of healing, and when the patient has delayed seeking treatment.[31]

Child and elderly abuse are two specific categories of domestic violence. Patients in these situations can present with the same type of maxillofacial injuries already described, including soft tissue injuries, facial fractures, and dental trauma.[31]

Summary

Maxillofacial trauma evokes strong emotional responses for both patients and health professionals. A common injury, maxillofacial trauma accounts for 5–10% of patients presenting to trauma centers. All ages, genders, and ethnic groups are affected. The most common causes of maxillofacial injuries remain MVCs and assault; however, increased participation in competitive sports has increased the incidence of maxillofacial injuries among children. Falls and abuse remain significant causes of maxillofacial trauma among the elderly.

Cervical spine fracture and traumatic brain injury are common in patients with maxillofacial fractures and must be ruled out. Early aggressive airway management with orotracheal intubation is recommended for all patients at risk for airway decompensation. CT has emerged as the imaging modality of choice for many patients. High-resolution multiplanar reformatted images aid diagnosis and preoperative planning.

Current surgical management of maxillofacial fractures more commonly involves open reduction and internal fixation than in the past. Early involvement of surgical consultants facilitates patient evaluation and reduces complications from delayed diagnosis and treatment.

References

1. Druelinger L, Guenther M, Marchand EG. Radiographic evaluation of the facial complex. *Emerg Med Clin North Am* 2000;18:393-410.
2. Euerle B, Lottes M. Maxillofacial trauma. In: Howell JM, ed. *Emergency Medicine*. Philadelphia: WB Saunders; 1998.
3. Pogrel MA, Podlesh SW, Goldman KE. Efficacy of a single occipitomental radiograph to screen for midfacial fractures. *J Oral Max-*

illofac Surg 2000;58:24-26.
4. Fonseca RJ, Walker RV, eds. *Oral and Maxillofacial Trauma*. Philadelphia:WB Saunders; 1991.
5. Philipp MO, Funovics MA, Mann FA, et al. Four-channel mutidetector CT in facial fractures: Do we need 2 x 0.5 mm collimation? *AJR Am J Roentgenol* 2003;180:1707-1713.
6. Rosenthal E, Quint DJ, Johns M, et al. Diagnostic maxillofacial coronal images reformatted from helically acquired thin-section axial CT data. *AJR Am J Roentgenol* 2000;175:1177-1181.
7. Tsakiris P, Cleaton-Jones PE, Lownie MA. Airway status in civilian maxillofacial gunshot injuries in Johannesburg, South Africa. *South Afr Med J* 2002;92:803-806.
8. Hochberg J, Ardenghy M, Toledo S, et al. Soft tissue injuries to face and neck: early assessment and repair. *World J Surg* 2001;25:1023-1027.
9. Ellis E 3rd, Scott K. Assessment of patients with facial fractures. *Emerg Med Clin North Am* 2000;18:411-448.
10. Demas PN. Surgical management of sports-related traumatic injuries. *Dent Clin North Am* 2000;44:137-159.
11. Seyfer AE, Hansen JE. *Trauma*. McGraw-Hill 4th edition. 2000;19:415-433.
12. Ranalli DN, Demas PN. Orofacial injuries from sport: preventive measures for sports medicine. *Sports Med* 2002;32:409-418.
13. Dale RA. Dentoalveolar trauma. *Emerg Med Clin North Am* 2000;18:521-538.
14. Laskin DM, Best AM. Current trends in the treatment of maxillofacial injuries in the United States. *J Oral Maxillofac Surg* 2000; 58:207-215.
15. Shimoyama T, Kaneko T, Horie N. Initial management of massive oral bleeding after midfacial fracture. *J Trauma* 2003;54:332-336.
16. Bynoe RP, Kerwin AJ, Parker HH 3rd, et al. Maxillofacial injuries and life-threatening hemorrhage: treatment with transcatheter arterial embolization. *J Trauma* 2003;55:74-79.
17. Lee CY, Chen MH, Lin TH, et al. Transarterial embolization in the treatment of life-threatening maxillofacial bleeding. *Am J Emerg Med* 2002;20:380-381.
18. Le BT, Holmgren EP, Holmes JD, et al. Referral patterns for the treatment of facial trauma in teaching hospitals in the United States. *J Oral Maxillofac Surg* 2003;61:557-560.
19. Haug RH, Foss J. Maxillofacial injuries in the pediatric patient. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;90: 126-134.
20. Shaikh ZS, Worrall SF. Epidemiology of facial trauma in a sample of patients aged 1-18 years. *Injury* 2002;33:669-671.
21. Iida S, Matsuya T. Paediatric maxillofacial fractures: their aetiological characters and fracture patterns. *J Craniomaxillofac Surg* 2002;30:237-241.
22. Holland AJ, Broome C, Steinberg A, et al. Facial fractures in children. *Pediatr Emerg Care* 2001;17:157-160.
23. Mcheik JN, Vergnes P, Bondonny JM. Treatment of facial dog bite injuries in children: a retrospective study. *J Pediatr Surg* 2000;35: 580-583.
24. Perkins SW, Dayan SH, Sklarew EC, et al. The incidence of sports-related facial trauma in children. *Ear Nose Throat J* 2000;79: 632-638.
25. Tesini DA, Soporowski NJ. Epidemiology of orofacial sports-related injuries. *Dent Clin North Am* 2000;44:1-18.
26. Yates JM, Dickenson AJ. Helmet use and maxillofacial injuries sustained following low speed motorcycle accidents. *Injury* 2002;33: 479-483.
27. Kraus JF, Rice TM, Peek-Asa C, et al. Facial trauma and the risk of intracranial injury in motorcycle riders. *Ann Emerg Med* 2003;4: 18-26.
28. Thompson DC, Rivara FP, Thompson R. Helmets for preventing head and facial injuries in bicyclists. *Nurs Times* 2001;97:41.
29. Bazarian JJ. Evidence-based emergency medicine/systematic review abstract: Helmets for preventing head, brain, and facial injuries in cyclists. *Ann Emerg Med* 2003;41:738-740.
30. Le BT, Dierks EJ, Ueeck BA, et at. Maxillofacial injuries associated with domestic violence. *J Oral Maxillofac Surg* 2001;59: 1277-1283.
31. Fenton SJ, Bouquot JE, Unkel JH. Orofacial considerations for pediatric, adult, and elderly victims of abuse. *Emerg Med Clin North Am* 2000;18:601-617.

CE/CME Questions

1. Which of the following standard radiographs is the single most useful view for a patient with maxillofacial trauma?
   A. Caldwell view
   B. Lateral view
   C. Submentovertex view
   D. Waters view

CE/CME Instructions

Physicians and nurses participate in this continuing medical education/continuing education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. **After completing this activity, you must complete the evaluation form provided and return it in the reply envelope provided in order to receive a certificate of completion.** When your evaluation is received, a certificate will be mailed to you.

CE/CME Objectives

Upon completing this program, the participants will be able to:

a.) discuss conditions that should increase suspicion for traumatic injuries;
b.) describe the various modalities used to identify different traumatic conditions;
c.) cite methods of quickly stabilizing and managing patients; and
d.) identify possible complications that may occur with traumatic injuries.

2. Which dental injury requires the most urgent, timely management?
   A. Avulsed permanent tooth
   B. Avulsed primary tooth
   C. Ellis class I fracture
   D. Ellis class II fracture

3. Which of the following views is considered the single best one for evaluation of the mandible?
   A. Sandard lateral view
   B. Panoramic view
   C. Posterior-anterior view
   D. Townes view

4. A nasal septal hematoma is treated with:
   A. warm compresses and observation.
   B. nasal fracture reduction and splinting.
   C. incision, drainage, and nasal packing.
   D. elective outpatient management.

5. Children are especially susceptible to maxillofacial injury because:
   A. they are more likely to intend to hurt themselves.
   B. they have a disproportionate cranial/body mass ratio.
   C. the anatomic structures are different than the adult.
   D. the relative size of their head is smaller than the adult.

6. Which of the following lacerations is *not* a high-risk soft-tissue injury that is associated with an increased incidence of late complications?
   A. Laceration of the margin of the eyelid
   B. Laceration of the rim of the nostril
   C. Laceration of the inner aspect of the lip that does not involve the vermillion border
   D. Laceration that involves the vermillion border of the lip
   E. Laceration of the helical rim of the auricle

7. Which of the following statements is true regarding naso-orbital-ethmoidal (NOE) fractures?
   A. Typically, they are the result of high-energy impact.
   B. An NOE fracture involves the nasal bones, nasal processes of the frontal bone, frontal process of the maxilla, and the delicate lamina papyracea of the ethmoid bones.
   C. Any fluid draining from the nose must be evaluated for cerebrospinal fluid rhinorrhea because NOE fracture can be associated with fracture of the cribiform plate and anterior cranial fossa.
   D. All of the above statements are true.

8. Which of the following management strategies would be appropriate for a simple uncomplicated nasal fracture?
   A. Generally, this injury may be followed up by a consultant within 48 to 72 hours.
   B. Patients with a significant deformity or obstruction need consultation in the ED, with manipulation to correct the deformity.
   C. Patients without airway obstruction or a gross deformity may be advised to wait for the swelling to decrease before deciding about the cosmetic result.
   D. All of the above

9. Which of the following statements is true regarding pediatric dog-bite injuries?
   A. Most dog-bite victims are older than 5 years.
   B. The emergency practitioner must consider rabies and tetanus prophylaxis for the patient.
   C. Antibiotic use is never appropriate.
   D. Dog bites to the face usually have no significant complications.
   E. Immediate surgical repair is *not* safe nor effective.

10. Which of the following statements is *not* true regarding sports-related maxillofacial trauma?
   A. More and more children are participating in organized sports and starting at a younger age.
   B. More and better safety equipment along with rules mandating its use are mandated in many sports.
   C. Zygomatic arch fractures are the most common sports-related facial fracture in children.
   D. Equipment specifically designed to protect the maxillofacial area are mouthguards, helmets, and face masks.

Answer Key:

1.	D
2.	A
3.	B
4.	C
5.	B
6.	C
7.	D
8.	D
9.	B
10.	C

In Future Issues: **Pelvic Fractures**

Thomson American Health Consultants
Building Six, Suite 400
3525 Piedmont Road NE
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