Resident Manual of Trauma to the Face, Head, and Neck

First Edition

AMERICAN ACADEMY OF
OTOLARYNGOLOGY–
HEAD AND NECK SURGERY
FOUNDATION

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eBook Format: First Edition 2012.

ISBN: 978-0-615-64912-2

Preface

The surgical care of trauma to the face, head, and neck that is an integral part of the modern practice of otolaryngology–head and neck surgery has its origins in the early formation of the specialty over 100 years ago. Initially a combined specialty of eye, ear, nose, and throat (EENT), these early practitioners began to understand the inter-relations between neurological, osseous, and vascular pathology due to traumatic injuries. It also was very helpful to be able to treat eye as well as facial and neck trauma at that time.

Over the past century technological advances have revolutionized the diagnosis and treatment of trauma to the face, head, and neck—angiography, operating microscope, sophisticated bone drills, endoscopy, safer anesthesia, engineered instrumentation, and reconstructive materials, to name a few. As a resident physician in this specialty, you are aided in the care of trauma patients by these advances, for which we owe a great deal to our colleagues who have preceded us. Additionally, it has only been in the last 30–40 years that the separation of ophthalmology and otolaryngology has become complete, although there remains a strong tradition of clinical collegiality.

As with other surgical disciplines, significant advances in facial, head, and neck trauma care have occurred as a result of military conflict, where large numbers of combat-wounded patients require ingenuity, inspiration, and clinical experimentation to devise better ways to repair and reconstruct severe wounds. In good part, many of these same advances can be applied to the treatment of other, more civilian pathologies, including the conduct of head and neck oncologic surgery, facial plastic and reconstructive surgery, and otologic surgery. We are indebted to a great many otolaryngologists, such as Dr. John Conley's skills from World War II, who brought such surgical advances from previous wars back to our discipline to better care for patients in the civilian population. Many of the authors of this manual have served in Iraq and/or Afghanistan in a combat surgeon role, and their experiences are being passed on to you.

So why develop a manual for resident physicians on the urgent and emergent care of traumatic injuries to the face, head, and neck? Usually the first responders to an academic medical center emergency department for evaluation of trauma patients with face, head, and neck injuries will be the otolaryngology–head and neck surgery residents. Because there is often a need for urgent evaluation and treatment—bleeding and

airway obstruction—there is often little time for the resident to peruse a reference or comprehensive textbook on such trauma. Thus, a simple, concise, and easily accessible source of diagnostic and therapeutic guidelines for the examining/treating resident was felt to be an important tool, both educationally and clinically.

This reference guide for residents was developed by a task force of the American Academy of Otolaryngology—Head and Neck Surgery (AAO-HNS) Committee on Trauma. AAO-HNS recently established this standing committee to support the continued tradition of otolaryngology–head and neck surgery in the care of trauma patients. An electronic, Portable Document Format (PDF), suitable for downloading to a smart phone, was chosen for this manual to facilitate its practical use by the resident physician in the emergency department and preoperative area.

It should be used as a quick-reference tool in the evaluation of a trauma patient and in the planning of the surgical repair and/or reconstruction. This manual supplements, but does not replace, more comprehensive bodies of literature in the field. Use this manual well and often in the care of your patients.

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Acknowledgments

This quick reference guide for resident physicians in trauma management reflects the efforts of many individuals in the American Academy of Otolaryngology—Head and Neck Surgery and a special task force of the AAO-HNS Committee on Trauma.

The editors would like to thank all of the authors who generously gave their time and expertise to compose excellent chapters for this Resident Manual in the face of busy clinical and academic responsibilities and under a very narrow timeframe of production. These authors, experts in the care of patients who have sustained trauma to the face, head, and neck, have produced practical chapters that will guide resident physicians in their assessment and management of such trauma. The authors have a wide range of clinical expertise in trauma management, gained through community and military experience.

A very special appreciation is extended to Audrey Shively, MSHSE, MCHES, CCMEP, Director, Education, of the AAO-HNS Foundation, for her unwavering efforts on behalf of this project, and her competent and patient management of the mechanics of the Resident Manual's production. Additionally, this manual could not have been produced without the expert copyediting and design of diverse educational chapters into a cohesive, concise, and practical format by Joan O'Callaghan, Director, Communications Collective, of Bethesda, Maryland.

The editors also wish to acknowledge the unwavering support and encouragement from: Rodney P. Lusk, MD, President; David R. Nielsen, MD, Executive Vice President and CEO; Sonya Malekzadeh, MD, Coordinator for Education; and Mary Pat Cornett, CAE, CMP, Senior Director, Education and Meetings, of the AAO-HNS/F. We also appreciate the administrative support of Rudy Anderson as AAO-HNS/F Staff Liaison for the Trauma Committee.

Since it takes a group of dedicated professionals to produce an educational and clinical manual such as this, all have shared in the effort, and each individual's contribution has been outstanding.

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Chapter I: Patient Assessment

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Because the otolaryngologist may not be present during patient arrival in the trauma bay, the patient assessment often begins with a call from a referring physician. Important information to retrieve includes the urgency of the patient's status, mechanism of injury, injury list, medical and demographic information, and, most important, airway status. It is important to review with the trauma team the potential for an unstable airway in any patient with craniofacial or neck trauma. When in doubt, the otolaryngologist should consider himself or herself the definitive airway expert. The importance of an ear, nose, and throat evaluation has been proven to be critical.[1] Otolaryngologists have the airway, endoscopy, and neck exploration skills necessary to take care of the most critically injured patients.

I. Diagnostic Evaluations

A. FULL-BODY TRAUMA ASSESSMENT

Trauma patients will often have a wide range of concomitant injuries. These patients require evaluation according to the Advanced Trauma Life Support (ATLS) protocol. This includes the airway, breathing, circulation, neurologic, and bodily assessments. Patients with severe or life-threatening head, chest, abdominal, or orthopedic injuries are challenging. A cursory head and neck exam performed by the trauma team may miss foreign bodies, facial nerve, parotid duct, ocular, inner ear, and basilar skull injuries, which can be time-sensitive matters for diagnosis and intervention. If possible, the otolaryngologist should make every effort to obtain an accurate and complete head and neck exam as soon as possible to mitigate potential threat and damage, and optimize outcomes through timely repair.

The injury severity score (ISS) is accepted as the gold standard for scoring the severity of anatomic injury.[2,3] It is built on an Abbreviated Injury Scale.[3,4] Summation of scores from the three most severe injuries, considering one injury per body region, results in an ISS that correlates with survival and estimates the overall severity of injury for patients with multiple injuries. An ISS of 16 or greater is associated with critical injury.[5] Salinas et al. defined massive facial trauma as any injury to the face involving three or more facial aesthetic units. Using this definition, they found that massive facial trauma was associated with higher ISS,

higher transfusion rates, and an increased risk for eye and brain injuries.[3]

The otolaryngologist must work with the trauma team and consulting services prioritizing management of head and neck injuries in light of known and potential injury to other critical regions of the body to optimize systematic care of all injuries. For example, a patient with facial lacerations may be mistakenly triaged to the facial trauma service for repair, neglecting a mechanism that should prompt further scrutiny to rule out cervical spine or intracranial injury. Communication between teams is critical for optimal management of the polytrauma patient.

B. HISTORY

The history of the injurious event is paramount. The mechanism (blunt versus blast versus penetrating), time, degree of contamination, and events since the injury should be documented.

When secondary to a motor vehicle accident, information related to the status of the windshield, steering column, and airbags should be elicited. Details related to extrication and whether exposure to chemical, fire, smoke, or extreme temperatures were encountered are important. Information related to events preceding the event, such as timing of the last meal or use of medications or substances that might alter mental status and ability to respond coherently, are relevant. The patient's medical history, including medications and tetanus status are also relevant.

For penetrating injuries related to gunshot wounds, information related to the type of firearm, number of shots, and proximity of the victim can predict the extent of damage and the level of threat to internal organs. For stabbing injuries, possession of the weapon and information about the assailant can predict potential damage. When able, the patients should be asked about any new deficits or changes to their hearing, vision, voice, occlusion, or other neurologic deficits, as well as if they have new rhinorrhea or epistaxis. They should specifically be asked about and observed for signs of difficulty breathing, and whether they feel short of breath.

Sometimes patients come from a referring institution, where initial wound washouts, packing, or other interventions have taken place. Operative reports from those encounters are a vital piece of information in these instances. When a patient arrives intubated with an injury pattern concerning for facial nerve injury, every attempt should be

made to identify whether the patient was able to display facial nerve function in the interval between injury and intubation. Confirmation that the patient had normal facial nerve function prior to the injury is extremely helpful in managing such injuries. Details from premorbid photos or history provided from family and friends is often helpful.

The social context should be considered in all trauma patients. Unfortunately, domestic violence produces a large component of facial trauma. These patients must be assured of their security, and their treatment should only be discussed with appropriate persons. When children are involved, it is imperative to enlist the resources of the hospital (social work, childhood protection agencies, etc.) in the care of the patient and include them when planning both treatment and disposition. Over 50 percent of cases of child abuse include injuries to the face.[6]

Personal history from an alert patient provides perspective and insight that may not be available from a second- or third-party interview.

It is important to identify the assault weapon. Knowledge of the ballistics of the penetrating object can help determine the management plan and predict risk of injury.[7-10] Civilian handgun injuries have low-muzzle velocity and have less damaging effects than other projectiles. Military rifles, on the other hand, have high-muzzle velocity and can transmit energy to surrounding tissue. A cavity of up to 30 times the size of the missile may be created and may pulsate over 5 to 10 centimeters.[11] In this kind of injury, it is necessary to examine surrounding structures (trachea, esophagus), even when the bullet wounds are inches away. Some hunting rifles use expanding bullets that can create a large wound cavity. Some may not cause an exit wound, or may fragment with partial projectiles, causing injury far from the primary direct path. Shotguns are typically low-muzzle velocity, but the severity of shotgun wounds will vary, depending on the proximity to the victim. At close range, the entire charge can act like a high-velocity bullet.[12]

From the wars in Iraq and Afghanistan, we have learned that improvised explosive devices (IEDs) can send shrapnel wounds that pepper patients through small and seemingly insignificant entry sites.[1] These small holes, however, can represent high-velocity injury, requiring neck exploration (when symptomatic), imaging such as computed tomography (CT) angiography, and panendoscopy.[1]

C. HEAD AND NECK EXAMINATION

It is important to perform a systematic and thorough examination. This examination should become routine for the otolaryngologist to overcome assumptions and avoid missing unexpected but significant injury.

Every practitioner caring for a trauma patient is obligated to follow the ATLS protocol.[13] The new ATLS guidelines have instituted a CABDE algorithm to replace the historical ABCDE prioritization. This new algorithm stresses the importance of establishing circulation early. Still, the otolaryngologist will more frequently be consulted as the airway expert. Airway compromise may come from significant swelling as a result of skeletal fracture, from hemorrhage, or even from superficial trauma. Once the status of the airway is secured or confirmed to be safe, the rest of the head and neck exam can proceed. Information obtained from flexible laryngoscopy can prove to be a vital tool in the airway assessment when time and stability permit. The exact order of the head and neck exam may vary, but this Resident Manual will illustrate the anatomic "top-down" approach.

Before beginning this secondary exam, the resident physician should carefully clean the wounds and surrounding skin. This not only decreases the risk for infection but also improves visualization of wounds. Many times the otolaryngologist may find these patients intubated, in a cervical collar, with a nasogastric tube in place, and face covered with dried blood and debris. It is imperative to cleanse the patient, and ask for assistance to remove the cervical collar and maintain inline stabilization to examine the neck, and to examine the hair-bearing scalp and back of head. These wounds may be irrigated with warm saline solution under moderate pressure, and diluted hydrogen peroxide. When there is concern for foreign bodies, it may be helpful to use loupe magnification to remove small debris from the wounds.

1. Upper Third

For the upper third of the head:

- Evaluate the forehead for sensation and motor function.
- Examine the bony framework of the frontal sinuses stepoffs.
- Cleanse the entire scalp and skin and examine them for lacerations.

2. Middle Third

a. Assessment of the Eyes

The eyes require thorough assessment. The pupillary light reflex should be tested. Failure of the pupil to respond may indicate injury to the afferent system (optic nerve) or efferent system (third cranial nerve

and/or ciliary ganglion), or it may indicate a more serious intracranial injury. If abnormalities are discovered, then these findings must be communicated to a neurosurgeon or ophthalmologist.

Gaze or positional nystagmus may indicate an otic capsule violating temporal bone fracture, but could also be associated with intoxication or medication. Chemosis, subconjunctival hemorrhage, and periorbital ecchymosis are signs of orbital injury. Extraocular motility must be examined—both with voluntary gaze when able, and with forced duction testing when not. Forced duction testing will be quite helpful in differentiating true entrapment of orbital structures from neuropraxia and muscle edema and contusion. The globe position should be assessed in the anteroposterior and vertical dimensions. If the patient is alert, visual acuity and visual fields should be tested, and new deficits confirmed with the patient history. Any injury to the orbit that predisposes the patient to corneal exposure and abrasion should be appropriately treated with artificial tears and coverage. Inability to close the eyelid with a risk of drying from suspected facial nerve injury should be covered by a noncompressive shield.

Despite this preliminary workup, it is always recommended to have ophthalmologic evaluation when compromised function is suspected or before any orbital fracture repair, because subtle injuries, such as retinal tears, may be a contraindication to surgery. Additionally, the presence of a hyphema in the anterior chamber may require postponement of the surgical procedure until the eye is cleared by the ophthalmologist.

b. Palpation of the Bony Fragment of the Midface

Next, the bony framework of the midface is palpated. While zygomatic malposition may be discovered, it also may be obscured by swelling. Nasal fractures may reveal obvious displacement, and crepitus may be palpated with comminuted fractures. If present, a septal hematoma must be drained before it results in necrosis of septal cartilage. Injury to the second division of the trigeminal nerve, V2, may result in cheek and nasal numbness. These findings should be recorded in the patient chart by the examining physician.

Signs of nasal-orbital-ethmoid (NOE) fractures include telescoping of the nasal, lacrimal, and ethmoid bones; loss of nasal dorsal height; development of epicanthal folds; and canthal ligament displacement. This displacement can be determined by measuring the horizontal palpebral widths and the intercanthal distance, which should be equal. Evaluation of the lacrimal collecting system usually takes place during surgery with probing of lacrimal punctum and ducts by lacrimal probes.

However, a positive fluorscein instillation (Jones) test effectively rules this out. The Jones dye test is carried out either preoperatively or intraoperatively, depending on the condition of the patient. (See Chapter 3, section II, on NOE complex trauma.)

c. Palpation of the Palate and Maxillary Dentition

The palate and the maxillary dentition are inspected and palpated for instability. Any missing dentition should alert the physician to the possibility of a fracture. Any missing teeth must likewise be accounted for. If this is not possible, the patient needs a chest x-ray to rule out aspiration of any missing teeth. Although rare, rocking of the midface with fingers on the palate and intact incisors connotes the presence of a craniofacial separation (Le Fort III fracture).

3. Lower Third

Patients often do not have premorbid Class 1 occlusion, as defined by Angle.[14] At least 20 percent will have anatomy that deviates from the ideal bite relationship.[14] The only reliable assessment of malocclusion secondary to trauma is misalignment of wear facets. Thus, the occlusion should be evaluated by inspection of wear facets.

New open or crossbite deformities may indicate a fracture. If able, patients should be asked about their occlusion and symptoms of trismus. The oral mucosa should be evaluated for any lacerations or hematomas, with special consideration for the floor of mouth and airway patency. The teeth should again be examined for injury and, when noted, a dental consult should be obtained. Any numbness in the V3 or mental nerve distribution should be documented.

4. Otoscopy

Examination of the ears is a necessary part of the exam that may be overlooked by first responders and not prioritized due to other facial injuries. Ominous indicators of injury in this region include Battle's sign, mastoid echymosis, or a halo sign, a quick indicator of potential cerebrospinal fluid (CSF) leak. The halo sign is manifested by a clear ring extending beyond blood spotting of otorrhea on tissue paper.

Lacerations and hematoma of the pinna are noted and repaired to prevent cartilaginous injury, malformation, and necrosis. When observed, perichondritis generally spares lobule involvement, and should be treated expeditiously. Otoscopy may reveal blood, dirt, or other foreign bodies or material within the external auditory canal that can compromise further examination and necessitates careful removal.

A laceration in the canal or hemotympanum may represent a skull base fracture. When able, these patients should be tested at bedside with a 512-Hertz tuning fork, and should undergo an audiogram as soon as possible. Perforation of the tympanic membrane should be identified, and imploded flaps should be externalized or patched to prevent cholesteatoma formation. Signs and symptoms of facial nerve injury, CSF leak, and otic capsule violation should be further evaluated by high-resolution CT imaging of the temporal bone.

5. Neurologic Examination

Facial nerve function should be tested in each division. If a patient is uncooperative, try eliciting facial grimace with a simple pinch. Any concern for deficit should be appropriately documented and related with the history of the trauma and the injury pattern to assess for facial nerve injury. If the patient can cooperate, perform a thorough evaluation of all cranial nerves. The patient should also be evaluated for possible CSF leakage, otorrhea, and rhinorrhea. Any concern for exposed brain matter should be investigated in the operating room with the neurosurgeon.

D. INFECTION CONTROL

As discussed previously, it is important to thoroughly clean and debride all wounds. Wounds treated within 8 hours of the event and those created surgically are considered "clean" and can be closed primarily. In the face, the window for wound closure can be extended to 24 hours, because the face is a highly vascular area. However, limited data exist regarding precise cutoff points to determine which wounds are too contaminated to safely close. Heavily contaminated or devitalized wounds will benefit from antibiotics. Human bites will require treatment with broad-spectrum agents.[15]

E. IMAGING STUDIES

CT is the workhorse for identifying facial fractures. In massive facial trauma, three-dimensional reconstructions of facial injuries may prove instrumental when planning repair. Imaging may also be helpful to examine for presence of foreign bodies. Glass is easily detected on plain films in wounds deeper than subcutaneous fat.[16] The radiodensity of wood is not visible on plain film, but is detectable on magnetic resonance imaging (MRI). There is also increasing support for using ultrasound to detect radiolucent foreign bodies.[17]

Vascular imaging is recommended for penetrating injuries to Zones I and III of the head and neck, and for fractures of the carotid canal noted

on other CT imaging and associated with neurological deficits. Choice of the appropriate imaging study will be a function of the suspected injuries determined on the primary assessment. MRI imaging may be indicated for brain parenchymal injuries, while enhanced CT scanning may be helpful in ruling out a concomitant stroke in an elderly patient.

F. LABORATORY TESTS

All patients should have basic blood chemistries, blood counts, coagulation panel, and alcohol and other drug studies when indicated. These tests are especially important in preparation for taking the patient to the operating room.

G. DIGITAL PHOTOGRAPHS

Finally, with the patient's permission and if the hospital has the capability, digital photographs should be taken and stored in a secure place according to Health Insurance Portability and Accountability Act (HIPAA) regulations. These photographs are invaluable when planning the patient's subsequent secondary reconstruction, if needed, and for teaching and educational purposes. Each hospital facility generally has guidelines and rules for operative photography. Typically, there is a ban on using cell phone photography, so a dedicated patient photography camera should be used.

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