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

First Edition

AMERICAN ACADEMY OF OTOLARYNGOLOGY–HEAD AND NECK SURGERY FOUNDATION

For more information, visit our website at www.entnet.org.

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.

G. Richard Holt, MD, MSE, MPH, MABE
Editor and Chair
Task Force on Resident Trauma Manual

Joseph A. Brennan, MD, Colonel, MC, USAF
Chair
AAO-HNS Committee on Trauma

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.

G. Richard Holt, MD, MSE, MPH, MABE
Editor and Chair
Task Force on Resident Trauma Manual

Joseph A. Brennan, MD, Colonel, MC, USAF
Chair
AAO-HNS Committee on Trauma

Resident Trauma Manual Authors

Joseph A. Brennan, MD, Colonel, MC, USAF
Chair, AAO-HNS Committee on Trauma
Chief, Department of Surgery
San Antonio Military Medical Center
Fort Sam Houston, Texas

G. Richard Holt, MD, MSE, MPH, MABE
Chair, Task Force on Resident Trauma Manual
Professor Emeritus, Department of Otolaryngology–Head and Neck Surgery
University of Texas Health Science Center
San Antonio, Texas

Matthew P. Connor, MD, Captain, MC, USAF
Resident Physician, Department of Otolaryngology–Head and Neck Surgery
San Antonio Uniformed Services Health Education Consortium
Fort Sam Houston, Texas

Paul J. Donald, MD
Professor and Vice Chair, Department of Otolaryngology
University of California-Davis Medical Center
Sacramento, California

Vincent D. Eusterman, MD, DDS
Director, Otolaryngology–Head and Neck Surgery
Denver Health Medical Center
Denver, Colorado

David K. Hayes, MD, Colonel, MC, USA
Chief of Clinical Operations, US Army Southern Regional Medical Command
San Antonio Military Medical Center
Fort Sam Houston, Texas

Robert M. Kellman, MD
Professor and Chair, Department of Otolaryngology and Communication Sciences
State University of New York Upstate Medical Center
Syracuse, New York

John M. Morehead, MD
Associate Professor and Program Director
Department of Otolaryngology–Head and Neck Surgery
University of Texas Health Science Center
San Antonio, Texas

Mark D. Packer, MD, Colonel (P), MC, FS, USAF
Director, DOD Hearing Center of Excellence
Chief, Neurotology, Cranial Base Surgery
San Antonio Military Medical Center
Fort Sam Houston, Texas

Whitney A. Pafford, MD
Resident Physician, Division of Otolaryngology
New York University School of Medicine
New York, New York

Mitchell Jay Ramsey, MD, Lt Colonel, MC, USA
Chief Otology/Neurotology
Landstuhl Kaiserlautern Army Medical Center
Germany

Nathan L. Salinas, MD, Captain, MC, USA
Chief, Department of Otolaryngology
Bassett Army Community Hospital
Ft. Wainwright, Alaska

Joseph C. Sniezek, MD, Colonel, MC, USA
Otolaryngology Consultant to the Surgeon General of the Army
Tripler Army Medical Center
Honolulu, Hawaii

Christian L. Stallworth, MD
Assistant Professor, Facial Plastic and Reconstructive Surgery
Department of Otolaryngology–Head and Neck Surgery
University of Texas Health Science Center
San Antonio, Texas

Matthew Scott Stevens, MD
Resident Physician, Department of Otolaryngology–Head and Neck Surgery
University of Texas Health Science Center
San Antonio, Texas

Richard W. Thomas, MD, DDS, Major General, MC, USA
Otolaryngologist–Head and Neck Surgeon
Commanding General, Western Region Medical Command
Joint Base Lewis-McChord, Washington

Chapter 8: Laryngeal Trauma

Joseph C. Sniezek, MD, Colonel, MC, USA
Richard W. Thomas, MD, DDS, Major General, MC, USA

Traumatic injuries of the larynx are diverse, uncommon, and potentially life threatening. While each laryngeal injury is unique, an organized and appropriate management algorithm for the various types of laryngeal trauma results in increased patient survival as well as improved long-term functional outcomes. The management of laryngeal trauma can be complex, as the signs and symptoms are often variable and unpredictable, with severe injuries sometimes presenting with mild and innocuous symptoms. The immediate goal in managing laryngeal trauma is to obtain and maintain a stable airway for the patient. Once the airway is safely secured, the laryngeal injury is repaired in order to optimize the patient's long-term functional outcomes terms of breathing, speech, and swallowing.

Laryngeal trauma is often divided into two main groups—blunt trauma and penetrating trauma. Blunt laryngeal trauma most commonly results from motor vehicle accidents, personal assaults, or sports injuries. Knife, gunshot, and blast injuries account for most cases of penetrating laryngeal trauma. Both blunt and penetrating laryngeal injuries may present along a spectrum of severity ranging from mild to fatal. Laryngeal trauma may also affect children, though pediatric injuries to the larynx are much less common than adult injuries, since the pediatric larynx sits much higher in the neck than the adult larynx and is, therefore, better protected by the mandible.

I. Physical Examination

The immediate goal of the examination of a patient with suspected laryngeal trauma is to ascertain the severity of injury, rapidly identifying patients who require immediate airway intervention. This can be a challenge, since relatively minimal signs or symptoms may mask a severe injury that has not yet reached a critical level of obstruction.

A. SYMPTOMS OF LARYNGEAL TRAUMA (SUBJECTIVE)

- Pain or tenderness over the larynx.
- Voice change or hoarseness.
- Odynophagia.
- Dysphagia.

B. SIGNS OF LARYNGEAL TRAUMA (OBJECTIVE)

- Dyspnea.
- Stridor—The type of stridor may indicate the location of injury:
  - Inspiratory stridor implies a supraglottic obstruction that may be caused by edema or a hematoma.
  - Expiratory stridor generally results from a subglottic source, such as a tracheal injury.
  - Biphasic stridor (inspiratory and expiratory) implies an injury at the level of the glottis.
- Hemoptysis.
- Ecchymosis of overlying cervical skin.
- Subcutaneous emphysema.
- Loss of normal thyroid prominence.
- Deviation of larynx.
- Loss of laryngeal crepitus—A "click" is generally palpated when the larynx is palpated and moved laterally. The loss of this "click" may occur due to laryngeal fixation or an injured larynx.

II. Diagnosis, Imaging Studies, and Laboratory Assessment

A. AIRWAY EVALUATION

Once the airway is deemed to be stable, further evaluation of the laryngeal injury is possible. Flexible fiberoptic laryngoscopy is a critical step in evaluating the status of the airway after laryngeal trauma. It can and should be performed promptly, safely, and carefully during the initial evaluation. During this period of evaluation, it is critical to closely observe the patient's airway for any signs of compromise or impending airway instability. If the airway worsens, a tracheotomy should be performed immediately.

B. TRAUMA EVALUATION

A complete trauma assessment must be performed due to the possibility of concurrent injuries associated with laryngeal trauma.

C. RADIOLOGIC EVALUATION

- Cervical spine injuries must be ruled out in all cases of laryngeal trauma.
- Chest x-ray is often helpful to rule out a pneumothorax, tracheal deviation, or pneumoediastinum (suggesting an airway injury).
- A computed tomography (CT) scan is indicated and helpful in all but the most minor laryngeal injuries. CT scans diagnose laryngeal

fractures and aid in operative planning for the repair and reconstruction of the fractured larynx.

III. Surgical Decision-Making Principles

While each laryngeal injury is unique and must be treated as such, division of laryngeal injuries into an organized classification scheme helps to guide treatment planning and patient management. Laryngeal injuries are generally divided into five categories, based on the Shaefer Classification System's severity of injury (Table 8.1).

Table 8.1. Classification Scheme for Categorizing the Severity of Laryngeal Injuries

Groups	Severity of Injury in Ascending Order
Group 1	Minor endolaryngeal hematomas or lacerations without detectable fractures.
Group 2	More severe edema, hematoma, minor mucosal disruption without exposed cartilage, or nondisplaced fractures.
Group 3	Massive edema, large mucosal lacerations, exposed cartilage, displaced fractures, or vocal cord immobility.
Group 4	Same as group 3, but more severe, with disruption of anterior larynx, unstable fractures, two or more fractures lines, or severe mucosal injuries.
Group 5	Complete laryngotracheal separation.

Source: Schaefer Classification System.

A. GROUP 1

1. Evaluation

After a complete trauma evaluation, flexible fiberoptic laryngoscopy is performed to carefully evaluate the airway.

2. Management

These mild injuries are generally managed medically and do not require surgical intervention. The following adjunctive medical treatments may be helpful:

- Steroids.
- Antibiotics.
- Anti-reflux medications.
- Humidification.
- Voice rest.

B. GROUP 2

1. Evaluation

Direct laryngoscopy and esophagoscopy should be performed, as injuries may be more severe than expected after flexible fiberoptic laryngoscopy.

2. Management

Patients with Group 2 injuries should be serially examined, since the injuries may worsen or progress with time. Occasionally, these injuries may require a tracheotomy. Medical adjuncts may also be helpful (steroids, anti-reflux medications, humidification, voice rest, antibiotics).

C. GROUP 3

1. Evaluation

Direct laryngoscopy or esophagoscopy should be performed in the operating room.

2. Management

- Tracheotomy is often required.
- Exploration and surgical repair of the injury are generally required. The following injuries will require surgical repair:
  - Disruption of anterior commissure.
  - Major endolaryngeal lacerations.
  - Tear involving vocal cord.
  - Immobile vocal cord.
  - Cartilage exposure.
  - Displaced cartilage fractures.
  - Arytenoid subluxation or dislocation.

D. GROUP 4

1. Evaluation

Direct laryngoscopy and esophagoscopy must be performed.

2. Management

- Tracheotomy is always required.
- Surgical repair of these injuries will require stent placement to maintain integrity of the larynx.

E. GROUP 5

1. Evaluation

Disruption of the airway occurs at the level of the cricoid cartilage, either at the cricothyroid membrane or cricotracheal junction. These patients will present with severe respiratory distress, necessitating urgent airway evaluation and management.

2. Management

Tracheotomy is necessary to secure the airway, but can be very difficult due to the altered anatomy. Complex laryngotracheal repair must be performed through a low cervical incision (see below) after the airway is secured.

IV. Informed Consent

When possible, surgical consent should always be obtained prior to the performance of surgical procedures. In the case of laryngeal trauma, informed surgical consent of the patient is critical, as multiple procedures over an extended period of time are sometimes required to repair and rehabilitate patients who suffer these injuries. Likewise, the effects of laryngeal trauma can have long-term impacts on quality of life, affecting the functions of speech, swallowing, and breathing. When informed consent from the patient is not possible due to the emergent nature of the injury, every effort should be made to obtain informed consent from a reliable family member or guardian.

V. Perioperative Care

The goal of perioperative management in laryngeal trauma is to prevent progression of the injury and promote rapid healing.

A. AIRWAY OBSERVATION

Hospitalization with airway observation for 24 hours is recommended for mild injuries that are at risk for progression or airway compromise (edema, hematoma). More severe injuries will require longer periods of hospitalization and rehabilitation.

B. ADJUNCTIVE MEASURES

The following adjunctive measures may be helpful during the treatment of patients who suffer laryngeal trauma:

- *Head-of-bed elevation*—May help to resolve laryngeal edema.
- *Voice rest*—Minimizes worsening of laryngeal edema.
- *Cool humidified air*—Prevents crust formation in the presence of mucosal damage and limits transient ciliary paralysis.
- *Systemic corticosteroids*—Supporting data are minimal, but steroids may help to reduce edema in the early hours after injury.
- *Anti-reflux medication*—Limits potential for laryngeal inflammation.

C. SPEECH THERAPY

Speech therapy may be helpful for all patients who suffer laryngeal trauma. Speech pathology consultation should be obtained as early as possible after the initial laryngeal injury.

VI. Operative Management by Location

A. INHALATION INJURY

Inhalation injury is the most frequent cause of death in burn patients. Airway manifestations of inhalation injury may be extremely severe, as the upper airway absorbs the bulk of the thermal injury suffered during inspiration. Since inhalation injuries may occur without skin burns or other external injuries, a high index of suspicion must be maintained. A history and careful description of possible inhalation injuries should be elicited from either the patient or a witness to the event.

The full extent of airway compromise after inhalation injury may not be evident until 12 to 24 hours after the injury, so symptomatic patients should be admitted and observed. The upper aerodigestive tract should be evaluated serially with flexible laryngoscopy to follow the evolution of the injury. If acute upper airway obstruction is impending or imminent, the most experienced clinician in airway management should intubate the patient and secure the airway. Once an inhalation injury is diagnosed, a multidisciplinary team consisting of otolaryngologists, pulmonologists, and respiratory therapists should be utilized to maximize pulmonary and respiratory care.

B. ENDOLARYNGEAL TEARS

Tracheotomy placement will generally be necessary to adequately access and repair significant mucosal tears. During surgical repair, the endolarynx is generally best approached through a midline thyrotomy, along with a transverse incision through the cricothyroid membrane. If a concomitant median or paramedian vertical thyroid fracture happens to be present, it may also be used to gain access to the endolarynx. If the fracture is located more than 3 mm from the anterior commissure, however, a midline thyrotomy should still be performed.

All major endolaryngeal lacerations should be repaired with 5-0 or 6-0 absorbable suture. Even minor lacerations that involve the true vocal cord margin or anterior commissure should be closed. If the anterior attachment of the true vocal cord is severed, it should be resuspended by suturing the anterior end of the cord to the external perichondrium.

All exposed cartilage should be covered either primarily or with local mucosal advancement flaps. Displaced or subluxed arytenoid cartilages should also be carefully repositioned.

C. ENDOLARYNGEAL EDEMA

Patients with significant laryngeal edema, particularly if it appears to be progressing, should undergo awake tracheotomy to prevent airway loss. After tracheotomy, the patient with significant laryngeal edema should be evaluated with direct laryngoscopy and esophagoscopy to uncover subtle injuries that may be masked by the edema and missed in initial flexible fiberoptic laryngoscopy. Adjunctive measures, such as head-of-bed elevation, corticosteroids, anti-reflux medications, and humidification should be strongly considered.

D. ENDOLARYNGEAL HEMATOMAS

Patients with endolaryngeal hematomas should be admitted to the hospital for close airway observation, as even small hematomas may progress. Small, nonprogressing hematomas with intact mucosal coverage are likely to resolve spontaneously without significant sequelae. Adjunctive therapies, such as steroids, anti-reflux medication, humidification, and head-of-bed elevation are helpful. Large or expanding hematomas may lead to airway obstruction and necessitate placement of a tracheotomy.

E. RECURRENT LARYNGEAL NERVE INJURY

Recurrent laryngeal nerve injury may occur after blunt or penetrating laryngeal injury. Recurrent laryngeal nerve injury after blunt laryngeal trauma may be due to either stretching of the nerve or nerve compression near the cricoarytenoid joint.

- If a vocal cord is persistently immobile after blunt trauma, the vocal fold should be observed for as long as one year to await the possible spontaneous regeneration of recurrent laryngeal nerve function.
- If a recurrent laryngeal nerve is severed, primary repair should be attempted. While vocal fold mobility will not be regained after even a successful repair due to the mixture of abductor and adductor fibers in the nerve, neural regeneration may prevent muscle atrophy, resulting in improved vocal cord tone and vocal strength in the long term.
- If primary re-anastamosis of the severed nerve is not possible, the ansa hypoglossi may be redirected and sutured to the distal stump of the recurrent laryngeal nerve to improve vocal cord muscle tone.

F. LARYNGEAL FRACTURES

Nondisplaced laryngeal fractures may be observed, although very subtle, long-term voice changes may be noticed if they are not repaired. Displaced thyroid and cricoid cartilage fractures should be reduced and fixed to stabilize the laryngeal framework (Figure 8.1). If the displaced cartilage fracture occurs in conjunction with an endolaryngeal, soft tissue injury, the cartilage reduction and fixation should be performed prior to endolaryngeal soft tissue repair. This ensures that a proper scaffold is obtained before redraping the laryngeal mucosa. If no soft tissue injury accompanies the cartilage fracture, the cartilage may be fixed externally without entering the larynx.

Miniplate fixation of cartilage fractures is superior to wire or suture fixation. Thyroid fractures fixed with wire or suture tend to heal by fibrous—not cartilaginous—union, and often fail to maintain proper anatomic reduction. In particular, wire fixation poorly maintains the proper anatomic position of the thyroid laminae after fixation, allowing midline fractures to heal in an inappropriately flattened position.

When placing a miniplate into the soft cartilage of younger patients, it is often helpful to drill a smaller-than-usual screw hole that results in better purchase for fixation of the screw. Emergency screws may also be helpful in preventing stripped screws (Figure 8.2).

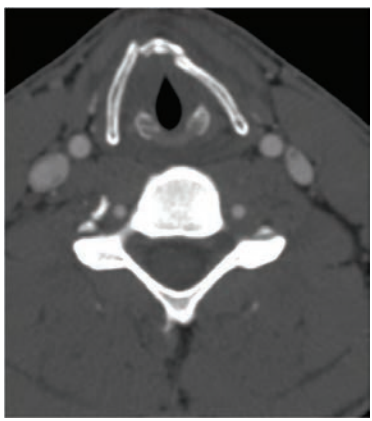

Figure 8.1
CT scan of displaced thyroid cartilage fracture.

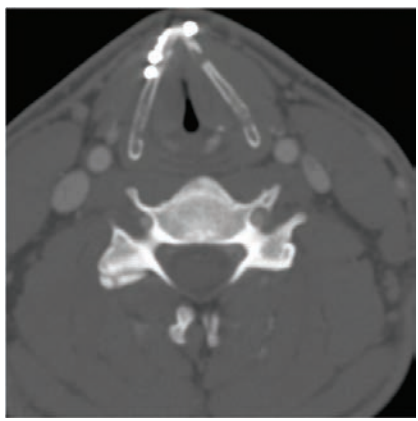

Figure 8.2
CT scan of laryngeal fracture after repair with miniplate.

G. CRICOTRACHEAL (LARYNGOTRACHEAL) SEPARATION

Cricotracheal (laryngotracheal) separation, also known as a Group 5 injury, is the least common but most life-threatening laryngeal injury. Most often, it occurs from "clothesline injuries" (i.e., when the neck contacts a taut line, such as a clothesline or wire support), and results in the separation of the larynx from the trachea at either the cricothyroid membrane or the cricotracheal junction.

Most patients with laryngotracheal separation present with significant respiratory distress and require a tracheotomy. Performance of the tracheotomy can be extremely difficult, however, because of the altered anatomy that results from this injury. After laryngotracheal separation, the larynx usually pulls upward and the trachea retracts into a position behind the sternum, necessitating a low tracheotomy incision. After successful tracheotomy, further radiologic testing, including chest x-ray and CT scans, may be performed. Pneumothorax commonly accompanies a laryngotracheal separation and must be promptly identified and treated.

Following appropriate trauma evaluation and radiologic studies, the patient should return to the operating room for direct laryngoscopy, esophagoscopy, and tracheal repair. The severed ends of the laryngotracheal complex should be freshened and then closed with nonabsorbable sutures with the knots placed extraluminally. Suprahyoid or infrahyoid release maneuvers may be required in order to allow for a tension-free anastamosis.

Most patients with laryngotracheal separation will also have bilateral vocal cord paralysis due to stretching or tearing of the recurrent laryngeal nerves. If the severed ends of the nerves can be located, they should be repaired primarily.

H. EMERGENCY AIRWAY MANAGEMENT

Obtaining and maintaining a stable airway is the first and most important goal in managing laryngeal trauma. When evaluating the stability of the airway, it is important to remember that initially mild signs and symptoms may accompany a very severe laryngeal injury. Further, laryngeal injuries may evolve, progress, and worsen in a relatively short period of time. Therefore, carefully performed flexible fiberoptic laryngoscopy is a critical tool in the initial evaluation of the injured airway.

If the airway is determined to be unstable, awake tracheotomy in an operating room should be performed. Intubation should ideally be avoided, as the endotracheal tube may further traumatize the endolarynx, destabilize laryngeal fractures, or lead to an acute airway compromise.

I. SELECTION OF AIRWAY STENTS AND TRACHEOTOMY TUBES

1. Airway Stents

Stents are often utilized in laryngeal injuries where the anterior commissure is significantly disrupted. In these cases, the stent functions to maintain the proper configuration of the commissure and to prevent anterior glottic webs. They are also occasionally used when massive, endolaryngeal mucosal injuries occur. In these cases, the stent helps to prevent mucosal adhesions and subsequent laryngeal stenosis.

If complete mucosal integrity is reestablished and the laryngeal fractures are properly reduced, stents are best avoided due to their potential complications—infection, pressure necrosis, and granulation tissue formation. While the best type of stent is very controversial, solid silastic stents are generally preferred. In austere settings, stents may be fashioned from portions of endotracheal tubes or a finger cut from a surgical glove and filled with a soft material, such as Gelfoam®. Stents are usually left in place for 2 weeks and removed in the operating room via an endoscopic procedure.

2. Tracheotomy Tubes

Cuffed, nonfenestrated tracheotomy tubes are preferred, as they minimize airflow over the injured larynx. 6-0 tracheotomy tubes are usually adequate for both male and female patients.

VII. Summary

Laryngeal trauma may result from either a blunt or a penetrating injury. The immediate priority in the treatment of laryngeal injuries is to establish and maintain a stable airway. Airway evaluation should include flexible fiberoptic laryngoscopy and a thorough examination of the head and neck. Further, patients with laryngeal injuries should be evaluated serially, as laryngeal hematomas or edema may progress or worsen with time, ultimately leading to airway compromise or obstruction. Finally, very mild initial signs and symptoms may occasionally mask a very severe laryngeal injury.

Mild laryngeal trauma may be managed with patient observation and adjunctive measures, such as humidified air, voice rest, steroids, and head-of-bed elevation. If the airway becomes precarious or the patient is at risk of airway compromise, an awake tracheotomy should be performed in the operating room.

In general, displaced laryngeal cartilage fractures should be repaired with miniplates to establish a stable laryngeal framework. Mucosal lacerations should be primary repaired with 5-0 or 6-0 absorbable sutures. Stents may be placed if the anterior commissure is significantly injured or if there are multiple, severe endolaryngeal lacerations. These stents are usually removed at 2 weeks post-placement via an endoscopic procedure in the operating room. Finally, speech therapy plays a vital role in the recovery and rehabilitation of patients who suffer laryngeal trauma.

VIII. References

Jalisi S, Zoccoli M. Management of laryngeal fractures—A 10-year experience. *Journal of Voice.* Jul 2011;25(4):473-479.

Jewett BS, Shockley WW, Rutledge R. External laryngeal trauma analysis of 392 patients. *Archives of Otolaryngology–Head & Neck Surgery.* Aug 1999;125(8):877-880.

Kantas I, Balatsouras DG, Kamargianis N, Katotomichelakis M, Riga M, Danielidis V. The influence of laryngopharyngeal reflux in the healing of laryngeal trauma. *European Archives of Oto-Rhino-Laryngology.* Feb 2009;266(2):253-259.

Mendelsohn AH, Sidell DR, Berke GS, John MS. Optimal timing of surgical intervention following adult laryngeal trauma. *Laryngoscope.* Oct 2011;121(10):2122-2127.

Norris BK, Schweinfurth JM. Arytenoid dislocation: An analysis of the contemporary literature. *Laryngoscope.* Jan 2011;121(1):142-146.

Quesnel AM, Hartnick CJ. A contemporary review of voice and airway after laryngeal trauma in children. *Laryngoscope.* Nov 2009;119(11): 2226-2230.

Schaefer SD. The acute management of external laryngeal trauma. A 27-year experience. *Archives of Otolaryngology–Head & Neck Surgery.* 1192;118(2):598-604.

The American Academy of Otolaryngology—Head and Neck Surgery Foundation's education initiatives are aimed at increasing the quality of patient outcomes through knowledgeable, competent, and professional physicians. The goals of education are to provide activities and services for practicing otolaryngologists, physicians-in-training, and non-otolaryngologist health professionals.

The Foundation's AcademyU® serves as the primary resource for otolaryngology–head and neck activities and events. These include an online library of expert-developed learning courses, learning platforms, and e-books, as well as Patient Management Perspectives in Otolaryngology and the Home Study Course. In addition, the AAO-HNSF Annual Meeting & OTO EXPO is the world's largest gathering of otolaryngologists, offering a variety of education seminars, courses, and posters. Many of the Foundation's activities are available for *AMA PRA Category 1 Credit™.*

Visit the Academy's Web site, www.entnet.org, to find out how AcademyU® can assist you and your practice through quality professional development opportunities.

AMERICAN ACADEMY OF
OTOLARYNGOLOGY–
HEAD AND NECK SURGERY

FOUNDATION

American Academy of Otolaryngology—Head and Neck Surgery Foundation

1650 Diagonal Road
Alexandria, VA 22314-2857 USA

T / 1.703.836.4444
F / 1.703.683.5100
www.entnet.org