K. J. Lee: Essential Otolaryngology and Head and Neck Surgery (IIIrd Ed)

Chapter 13: Facial and Airway Trauma

General Considerations

1. Generally, facial fractures are not life threatening and have a relatively low priority in the management of the multiple-injured patient. However, these fractures may be the source of airway obstruction and hemorrhage which may make their management more urgent.

2. Definitive reduction of facial fractures should be performed within 7-10 days of injury. The exact timing will depend on the patient's overall suitability for general anesthesia, the amount of swelling, as well as other injuries. If the patient is to have surgery for repairing injuries elsewhere in the body, every effort should be made to repair the facial fractures at that time to avoid repetitive general anesthetics.

3. When transportation is necessary, and if other injuries permit, the patient should be placed in the prone position to allow drainage of blood and saliva out of the airway and also prevent collapse of the tongue into the airway. Intubation or tracheostomy may be indicated before transport is undertaken.

4. Cervical spine films should be considered in patients with facial fractures since the force which caused the facial fracture may potentially injure the cervical spine.

Nose

Anatomy

The nasal bones are paired structures which are attached superiorly to the frontal bone, laterally to the maxilla, and medially to each other. The paired upper lateral cartilages attach to the inferior border of the nasal bones. The bony septum (perpendicular plate of the ethmoid) is related posteriorly. The lower two-thirds of the nose is supported by the paired upper and lower lateral cartilages as well as the cartilaginous septum (quadrilateral cartilage). The vomer forms the posterior inferior portion of the septum.

Blood is supplied to the nose by the internal and external carotid arteries. The arteries derived from the external carotid are the nasopalatine, sphenopalatine and greater palatine (branches of the internal maxillary), and septal (branch of the facial). The internal carotid supply is by way of the ophthalmic artery and its branches, the ethmoid arteries, and the dorsal nasal artery.

Internally, the nerve supply to the nose is from the internal nasal branches of the anterior ethmoidal ganglion and branches from the sphenopalatine ganglion. Externally, the upper part of the nose is supplied by the supratrochlear and infratrochlear nerves; the external nasal branch of the anterior ethmoidal and the infraorbital nerve supply the lower part of the nose.

Signs and Symptoms

1. Pain and tenderness

2. Epistaxis

3. Nasal congestion

4. Ecchymosis and swelling which may also include the periorbital area

5. Deformity - may be difficult to recognize initially because of swelling.

X-rays

Anteroposterior, lateral, and submental vertex views should be obtained.

Treatment

1. All patients with a question of nasal fracture should be examined for a septal hematoma which should be drained immediately.

2. Reduction is indicated when there is a bony deformity or an airway obstruction secondary to a bone deformity.

3. Significant swelling should be allowed to subside before reducing the fracture to achieve a more accurate result. This usually takes 3-5 days.

4. Closed reduction is the treatment of choice for most nasal fractures. Anesthesia is achieved with topical cocaine intranasally and lidocaine infiltrated sparingly over the dorsum and in the area of the infraorbital foramen. A splint will help protect the reduced fracture and reduce the amount of edema.

5. Open reduction is indicated in a multiple-comminuted fracture which cannot be managed by closed reduction. This is accomplished through an H-like incision in the area of the nasion and wiring the fragments in the position.

Nasofrontal Ethmoidal Complex Fractures

These are unusual but more serious injuries with involvement of the nasal and frontal bones which are displaced into the ethmoid labyrinth. There may be associated injuries of the lacrimal system, medial canthal ligaments, and dura with CSF leakage. Physical examination reveals marked posterior displacement of the nose, and x-rays confirm the involvement of the frontal sinus. In addition to repair of the associated injuries (including obliteration of the frontal sinus), the nasofrontal area must be held in a reduced position. Lead or Silastic plates placed on both sides of the nasal bones with transnasal wiring has been used in the past. A better technique employs an acrylic external fixation device which is attached laterally to the frontal bone and mediallly to the fracture area.

Complications

1. Untreated septal hematoma may lead to abscess with loss of quadrilateral cartilage and dorsal depression.

2. Unrecognized, untreated displaced fracture will lead to deformity.

3. Untreated mucosal lacerations may lead to synechia and stenosis.

4. Untreated septal fracture or dislocation may lead to nasal obstruction.

Mandible

Anatomy

The mandible is a horseshoe-shaped bone which contains the lower teeth. It is attached to the skull by a sliding-binge (ginglymoarthroidal) joint in the glenoid fossa of the temporal bone. The inferior alveolar nerve (third division of cranial nerve V) and artery enter the mandible through the mandibular foramen on the medial aspect of the ramus. They exist through the mental foramen (the weakest point of the mandible) to supply the chin and lower lip. The mandible may be divided into various anatomic areas which are outlined in Fig. 13-1. The frequency of fractures in each area is noted.

Figure 13-1. Frequencies of fractures of the mandible

Condyle 36%
Coronoid 2%
Ramus 3%
Angle 20%
Alveolar 3%
Body 21%
Parasymphyseal 14%
Symphyseal 1%.

Major Muscles of Mastication

1. Temporalis

a. Nerve: mandibular division of the fifth cranial nerve.

b. Arises from the floor of the temporal fossa.

c. Attachment is to the coronoid process of the mandible.

d. Action: powerful elevator of mandible.

2. Masseter

a. Nerve: mandibular division of the fifth cranial nerve.

b. Arises from the lower and medial border of the zygomatic arch.

c. Attachment to the mandible is the lower one-half of the lateral surface.

d. Action: powerful elevator of mandible.

3. Internal pterygoid (medial pterygoid)

a. Nerve: mandibular division of the fifth cranial nerve.

b. Arises from the medial surface of the lateral pterygoid plate and tuberosity of the maxilla.

c. Attachment is to the lower one-half of the mandible on the inner surface.

d. Action: to pull the mandible upward, inward, and forward.

4. The external pterygoid (lateral pterygoid)

a. Nerve: mandibular division of the fifth cranial nerve.

b. Arises from the lateral surface of the lateral pterygoid plate and from the greater wing of the sphenoid.

c. Attachment is to the inner and anterior aspect of the neck of the condyle.

d. Action: to pull the mandible forward.

Depressors of the Mandible

1. Geniohyoid

a. Nerve: hypoglossal.

b. Attachment is to the genial tubercle at the mandibular symphysis.

c. Action: to open the mouth.

2. Digastric (anterior belly)

a. Nerve: mandibular division of the fifth cranial nerve.

b. Attachment is to the lower border of the mandible near the midline.

c. Action: to open the mouth.

3. Mylohyoid

a. Nerve: mandibular division of the fifth cranial nerve.

b. Attachment is to the mylohyoid ridge of the mandible and to the hyoid bone.

c. Action: raises the hyoid bone as well as opens the mouth.

To open mouth: The lateral pterygoid pulls the condyle forward while the digastric, mylohyoid and geniohyoid depress the jaw.

Muscles attached to the lateral side of the mandible include: The masseter, part of the temporalis on the coronoid, and the lateral pterygoid muscle on the condyle.

Muscles attached to the lateral side of the mandible include: The digastric, mylohyoid, medial pterygoid, temporalis, and lateral pterygoid on the neck of the coronoid.

Fractures of the mandible may be described as favorable or unfavorable (Fig. 13-2). Favorable fractures are those in which the muscles of mastication help hold the fragments in place, whereas unfavorable fractures tend to be displaced by the muscular forces acting on the mandible.

The temporomandibular joint is innervated by the masseter and auriculotemporal nerves. The meniscus that separates the upper cavity from the lower cavity is made of fibrocartilage. The three ligaments which attach to this area are the (1) temporomandibular, (2) stylomandibular, and (3) sphenomandibular. The tubercle of the zygomatic process of the temporal bone helps hold the condyle in position.

There are 20 deciduous teeth which begin to appear at 6 months of age, and all have erupted by 24 months. Permanent teeth begin to appear at 6 years and all 32 have erupted by age 24. The angle of the mandible measures slightly more than 90° in the young and becomes more obtuse with increasing age and loss of dention.

Signs and Symptoms

1. Maloccclusion: perhaps one of the most sensitive indicators of a fracture. The displacement may be great enough that it is noted on inspection, or only the patient may be able to notice it when he tries to achieve normal occlusion.

2. Trismus: the patient will have pain on moving the mandible (such as opening the mouth) as this causes movement of the fracture fragments.

3. Swelling, ecchymosis, and intraoral lacerations may be present.

4. Palpable displacement may be noted externally or by palpating intraorally.

5. Mental nerve hypesthesia may be present if the inferior alveolar nerve has been injured by the fracture.

6. Look for more than one fracture. Since the mandible is firmly attached to the base of the skull, it is (more or less) a ring (much like the pelvis). Consequently, to displace a fracture, the mandible must be able to move at some other point, which is commonly another fracture.

X-Rays

1. Antero-posterior view: good for ramus and condylar fractures.

2. Lateral views (or even better, oblique views): good for condyle, angle, and body.

3. Panorex (orthoplanography): not always available, but good for condyle, ramus, and body, as well as associated injuries to the teeth.

4. Occlusal: good for symphyseal fractures.

Treatment

1. Initial therapy includes a complete evaluation of the patient. The airway may be compromised by blood, secretions, or the tongue. Since the mandible provides support for the tongue, a severe fracture (such as a bilateral body fracture) may allow the tongue to fall back into the airway causing dyspnea. This can be managed quickly by grasping the tongue with a towel clip and pulling it forward.

The patient can be made more comfortable by temporarily immobilizing the mandible by use of a Barton's dressing (gauze wrapped around the vertex of the head and under the mandible). Also, a wire can be secured around a stable tooth on each side of the fracture.

2. When the patient has a normal or near normal dentition:

a. Symphysis: If undisplaced, intermaxillary fixation only. If severely displaced, then open reduction and wiring may be necessary.

b. Body: Generally, intermaxillary fixation alone is necessary.

c. Angle: If undisplaced, intermaxillary fixation alone. If displaced, open reduction and internal fixation.

In all of the above fractures, even if some displacement is present, closed reduction and intermaxillary fixation can be attempted for a week. If the results are unsatisfactory, then open reduction with wiring can be performed.

d. Ramus: Intermaxillary fixation alone.

e. Condyle: Unilateral - may require no therapy other than a soft diet.

Bilateral - intermaxillary fixation. If proper occlusion cannot be achieved, the open reduction and fixation may be necessary.

f. Coronoid process - no therapy indicated. Not infrequently, there is an associated zygomatic arch fracture.

3. When the patient is edentulous, the patient's dentures can be used to achieve intermaxillary fixation by wiring the upper denture to the alveolus, pyriform aperture, or the zygomatic arch. The lower denture can be stabilized to the patient by circummandibular wiring. The two dentures are held in occlusion by wiring together arch bars placed on the dentures before surgery. Gunning splints can be fabricated from impression if the patient's dentures are not available.

Most fractures (except coronoid and unilateral condyle fractures) must be openly reduced and wired. This is particularly true in bilateral condylar fractures in the edentulous patient.

4. In pediatric fractures, open reduction is rarely required. Furthermore, the period of intermaxillary fixation is much shorter than in adults because children are more susceptible to ankylosis of the temporomandibular joint than adults.

5. Dislocation of the mandible occurs when the condyle is displaced anterior to the tubercle of the zygomatic arch. The patient has an obvious open-bite deformity with pain. This can be managed by placing gauze over the molars and placing the fingers under the mandible with the thumbs on the gauze covered molars. By pushing inferiorly and posteriorly, the mandible can be rocked back to its normal position. Injection of a local anesthetic into the pterygoid muscles, or intravenous muscle relaxants, may help in the reduction.

Complications

1. Nonunion: May result from a number of factors including infection, lack of adequate immobilization, and inadequate approximation of fragments.

2. Ankylosis of temporomandibular joint: Due to prolonged intermaxillary fixation.

3. Permanent anesthesia of mental nerve.

4. Malunion: Occurs when fragments are improperly aligned.

5. Failure to diagnosis multiple fractures.

Zygoma

Anatomy

The zygoma provides prominence to the lateral side of the face. It has attachments to three other bones of the skull: the frontal bone, the maxilla, and the zygomatic process of the temporal bone. When these three attachments are injured, this gives rise to the "trimalar" or "tripod" fracture. Additionally, it forms part of the floor of the orbit (roof of the maxillary sinus) and provides an attachment for the lateral suspensory ligament of the eye.

Signs and Symptoms

1. Periorbital ecchymosis and swelling.

2. Depression of the cheek - this may be difficult to detect initially because of swelling.

3. Tenderness and palpable separation (step-off) at the fracture site.

4. Either proptosis or enophthalmus may be present initially.

5. Hyperesthesia of the upper lip may indicate involvement of the infraorbital nerve.

6. Trismus may be present if the depressed zygomatic arch is impinging on the temporalis muscle or the coronoid.

X-Rays

1. The Waters' view is probably the best single view for diagnosing malar fractures. In addition to the fractures there generally will be opacification of the antrum. The Caldwell's view demonstrates the zygomaticofrontal suture area nicely and the submental vertex ("bucket handle") view will demonstrate fractures of the zygomatic arch.

Treatment

Gillies' Approach

A small incision is made in the skin under the sideburn and an elevator is passed deep to the temporal fascia (which attaches to the zygomatic arch). This approach is excellent for isolated fractures of the zygomatic arch which generally require no further stabilization to maintain the reduction. This approach also may be used to help mobilize trimalar fractures.

Keen's Approach

Essentially the same as the Gillies', but through an intraoral incision above the molar teeth.

Transantral Approach

The maxillary sinus is entered through the anterior wall (like a Caldwell-Luc procedure) and the malar fracture is reduced by placing a strong elevator in the lateral recess of the maxillary sinus. The undersurface of the orbital floor is explored through the antrum and the overall reduction maintained by placing gauze packing in the sinus. This is removed 10 days postoperatively through a nasoantral window created at the time of the initial surgery. This technique is excellent for multiple comminuted fractures.

Pinning Techniques

The reduction is achieved by manipulating the zygoma with bone hooks and then maintained by passing a Steinman's pin through the zygoma and into the palate. The pin is removed 6 weeks later.

Open Reduction

The infraorbital rim and frontozygomatic fractures are explored through infraorbital and eyebrow incisions, respectively. Reduction is maintained by wiring the fragments in place. This approach allows for the most accurate realignment of fragments and the best exposure for exploration of the orbital floor.

Complications

1. Failure to recognize the fracture because of edema.

2. Failure to recognize and treat the accompanying orbital floor fracture leading to enophthalmos.

3. Permanent anesthesia of the infraorbital nerve.

4. Malunion due to improper alignment of fragments.

5. Fracture of the skull by applying excessive pressure when using the Gillies' approach.

6. Blindness due to hemorrhage into orbit, excessive retraction on globe during surgery, or packing bone fragments into the globe during the antral approch.

Orbit

Anatomy

The orbital floor is a sheet of thin bone composed primarily of a portion of the maxilla witgh contributions from the zygoma and the palatine bone. It transmits the infraorbital nerve and vessels which exit through the infraorbital foramen below the inferior orbital rim.

Pure "blowout" fractures which involve the orbital floor without injury to the inferior orbital rim are unusual. The proposed mechanicm of injury is direct pressure applied to the globe which is displaced posteriorly with a subsequent increase in intraorbital pressure. The orbit "blows out" at its weakest points, most commonly the posteromedial portion of the orbital floor. However, other portions of the orbital floor as well as the medial wall may be involved.

Impure blow-out fractures occur when the orbital rim is involved and may occur as an isolated injury or in conjunction with a fracture of the zygoma (trimalar) fracture.

In any injury that involves the orbital floor, orbital contents may be displaced into the maxillary sinus or trapped in the fracture line giving rise to a variety of symptoms.

Signs and Symptoms

1. Diplopia (primarily an upward gaze): This may be related to edema or entrapment of the inferior rectus (or less commonly the inferior oblique) muscle in the fracture line thereby tethering upward movement of the globe. The best test for entrapment is the forced duction test in which topical anesthesia is applied to the conjunctival sac and then the sclera is gently grasped at the insertion of the tendon of the inferior rectus muscle. If not entrapped, the globe should rotate freely whereas limitation of passive upward movement may indicate indolvement of the inferior rectus muscle.

2. Enophthalmos: Inward displacement of the globe may not be appreciated initially because of periorbital swelling and may be only noticeable a few days after the injury. The enophthalmos is caused by displacement of orbital fat into the maxillary antrum, or in the case of a medial blowout fracture, the ethmoid sinuses.

3. Nasal bleeding.

4. Hypesthesia of the upper lip due to involvement of the infraorbital nerve.

X-Rays

1. The Waters' view may show the herniation of orbital contents into the superior portion of the antrum as well as the fracture.

2. Tomograms of the orbit will more clearly delineate the extent of the fracture.

Treatment

Treatment varies with the severity of injury. Generally, if there is evidence of loss of orbital contents, entrapment, or a large dehiscence on tomograms, then the floor should be explored. Although the floor may be inspected and even packed into position through a transantral approach, a direct approach through the infraorbital skin provides for direct inspection and reduction of entrapped orbital contents as well as an opportunity to reconstruct a large defect. A variety of materials have been used to repair the defect and include cartilage, bone, Silastic, Teflon, and even Gelfilm.

Complications

1. Enophthalmos secondary to inadequate reduction of orbital fat.
2. Extrusion of graft used to reconstruct orbital floor.
3. Blindness secondary to impingement of graft on the optic nerve or excessive retraction of globe during surgery.
4. Scarring of orbital muscles leading to muscular imbalance.
5. Permanent anesthesia of the infraorbital nerve.

Maxilla

Anatomy

The paired maxilla contain the upper teeth and the maxillary antra. The nasal bones are attached medially and the attachment to the zygom laterally provides support. The blood supply is by way of the internal maxillary artery and innervation is provided by the second division of the fifth cranial nerve.

LeFort, a Frenchman, established three distinct patterns of injury in experiments performed with cadaver skulls (Fig. 13-3). Although his descriptions are widely used today, it should be recognized that the forces involved in a high-speed motor vehicle accident or other trauma today are different from the mechanisms of injury used by LeFort. Consequently, maxillary fractures may not necessarily follow the "classic" lines of LeFort. Most LeFort fractures are bilateral, but may not be the same on each side.

1. LeFort's I (Guerin fracture): A transverse fracture above the apices of the upper teeth.

2. LeFort's II (pyramidal fracture): It is important to note that this is the only LeFort fracture that involves the inferior orbital rim. As with the LeFort's I, the zygomatic arch is not involved.

3. LeFort's III (craniofacial dysjunction): The entire midface is separated from all of its bony attachments to the skull. The zygomatic arch is involved.

Signs and Symptoms

1. Marked swelling and ecchymosis.

2. An elongated, depressed "dish-shaped" appearance of the face.

3. Nasal bleeding.

4. CSF rhinorrhea.

5. Palpable depression in the area of the fractures.

6. The upper alveolus should be grasped and tested for mobility. If the fracture is firmly impaced mobility may not be present.

7. Blindness may be present.

X-Rays

Fractures may be noted on all facial films although the Waters', Caldwell's, and submental vertex views may be most helpful. Anteroposterior and lateral tomograms of the midface should be performed to better delineate the fractures.

Treatment

1. Initial treatment consists of a complete evaluation of intracranial, as well as chest, abdominal, and extremity injuries. The airway may be compromised such that intubation or tracheostomy is required. Once stabilized, the patient is a candidate for repair of the facial injuries.

2. The general principles of repair of LeFort fractures are proper alignment and stabilization. Intermaxillary fixation provides support from the mandible and proper alignment of the midface. If there are insufficient teeth for intermaxillary fixation, the patient's dentures or fabricated splints will be necessary. This should be accomplished before proceeding to suspension of the midface to a stable point superiorly, otherwise malocclusion may occur.

3. LeFort's I: After intermaxillary fixation is accomplished with arch bars, circumzygomatic wires are passed (since the zygomatic arch is not fractured) and attached to the arch bars. Alternatively, the fracture fragments may be wired directly thereby eliminating the need for circumzygomatic wire.

4. LeFort's II: Since the zygomatic arch is intact, intermaxillary fixation and placement of circumzygomatic "drop wires" is the treatment of choice. The nasal and inferior rim fractures may require direct wiring.

5. LeFort's III: Intermaxillary fixation should be accomplished first. Since the zygomatic arch is involved, a more superior point of stabilization is used (generally the frontal bone). In addition to a drop wire from this area, the lateral orbital rim fracture should be wired directly.

Complications

1. Malocclusion by improper intermaxillary fixation.

2. Telecanthus because of untreated medial canthal ligament injury.

3. Inadequate treatment because the severity of injury is not recognized.

4. Enophthalmos due to an inadequately treated orbital component.

Frontal Sinus

Anatomy

Located between the inner and outer tables of the frontal bone, the frontal sinus varies greatly in size and may be unilaterally or bilaterally absent. The sinus usually is separated into at least two unequal sections by one or more vertical septa. Drainage is by way of the nasofrontal duct ostia which variably end in the nose or ethmoid sinus.

Signs and Symptoms

1. Pain and tenderness.

2. Swelling and ecchymosis (may include periorbital area).

3. Epistaxis and CSF rhinorrhea.

4. Fracture may be palpable through lacerations in the area.

5. May be associated with a nasal fracture (nasofrontal ethmoid fracture) as well as skull fractures.

X-Rays

Caldwell's and lateral views of skull should be done. Tomograms should be used to evaluate any posterior wall and nasofrontal duct involvement. Frequently the fractures are more severe than appreciated radiographically. Computerized axial tomography should be performed to rule out intracranial injuries.

Treatment

Anterior Wall Only

Nondisplaced fractures require no treatment. Displaced fractures may be elevated through an existing laceration or a surgical incision and wired in place if unstable. Occasionally, the fracture must be reduced through an osteoplastic flap and stabilized with wiring or Gelfoam packing of the sinus.

Posterior Wall Involvement

The frontal sinus should be explored through an osteoplastic flap. The dura must be explored and repaired if dehiscent. Since the integrity of the posterior wall is lacking, the patient will be at risk of serious intracranil complication if a upper respiratory tract infection or frontal sinusitis should develop. Consequently, the sinus should be obliterated with abdominal fat following removal of all mucosa.

Nasofrontal Ostia Involvement

Since scarring and stenosis of the ostia may lead to an increased risk of frontal sinusitis and mucocele development, the patient should be managed aggressively. The frontal sinus should be explored through an osteoplastic flap, and following removal of all mucosa, obliterated with abdominal fat.

Complications

1. Depression of frontal bone due to inadequate treatment or loss of bone.

2. Meningitis or brain abscess due to lack of repair of dura.

3. Chronic frontal sinusitis or mucocele development due to obstruction of nasofrontal duct.

Larynx and Trachea

Trauma to the larynx and trachea is occurring with increasing frequency. The most obvious injuries occur with penetrating (gunshot and stab) injuries of the neck. However, blunt trauma may cause severe injuries with minimal external signs of trauma. Many patients will not survive the initial injury and die before reaching the hospital, whereas some patients with quire severe injuries initially may have minimal symptoms. The early treatment of laryngeal and tracheal injuries is essential for a successful outcome.

Anatomy

The anatomy is reviewed in Chap. 15, The Larynx.

Signs and Symptoms

1. Laryngeal pain.

2. Dysphonia or aphonia.

3. Airway obstruction: May not be present initially, but may develop rapidly.

4. Hemoptysis.

5. Dysphagia and odynophagia.

6. Ecchymosis over the area of blunt injury.

7. Loss of laryngeal landmarks: Inability to delineate the laryngeal framework due to soft tissue swelling or fractures of the thyroid and cricoid cartilages. Crepitus may be present.

8. Subcutaneous emphysema.

9. Air or saliva leakage from a penetrating wound.

Diagnosis

1. Indirect laryngoscopy: Hemorrhage, mucosal lacerations, and internal deformity can be recognized.

2. X-rays of the neck and chest (AP and lateral): Computerized axial tomography may also prove useful.

3. Direct laryngoscopy, bronchoscopy, and esophagoscopy: Esophageal injuries may occur with both blunt and penetrating tracheal injuries.

Treatment

1. Maintain the airway. Severe mucosal lacerations and swelling may make endotracheal intubation difficult and dangerous as passage of the endotracheal tube into a false lumen may further compromise the patient's condition. A tracheostomy may be required. In laryngeal injuries, a high tracheostomy should be avoided.

2. Laryngeal trauma may be overlooked in the patient with multiple injuries. Early diagnosis and management is essential to prevent later complications.

3. Exploration of the larynx and trachea, which should be performed as soon as possible, is accomplished through a U-shaped apron flap. All laryngeal injuries as well as almost all tracheal injuries can be managed through this incision. Furthermore, the carotid sheath can be explored easily.

4. Closed reduction by "ironing out" the laryngeal cartilages over a laryngoscope should not be performed.

5. The interior of the larynx is explored through a midline laryngofissure. Mucosal lacerations are approximated with absorbable sutures, while the cartilage fractures and the laryngofissure are stabilized with stainless steel wire or non-absorbable sutures.

6. The use of stents and grafts is somewhat controversial. Most authorities use stents, but these vary from "hard" endotracheal tubes to "soft" finger cots filled with latex sponge. Also, the recommended period that the stent should be left in place varies from a few days to several weeks. Skin and mucosal grafts have been used successfully particularly when there has been a significant laryngeal mucosal loss.

7. Whenever possible, tracheal injuries should be repaired primarily. Closure of simple lacerations may suffice, or resection of a severely injured area with anastomosis and appropriate tracheal and laryngeal mobilization may be indicated. If the patient's condition is not stable, then a tracheotomy tube can be placed through the injury and definitive repair performed at a later time.

Complications

1. Stenosis of larynx or trachea due to inadequate treatment at the time of injury.

2. Hoarseness secondary to vocal cord paralysis or deformity.

3. Aspiration due to an incompetent glottis.