Facial Trauma Care in the Austere Environment

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ABSTRACT

As the United States continues to increase its use of Special Operations Forces worldwide, treatment of craniomaxillofacial (CMF) trauma must be adapted to meet the needs of the warfighter. The remoteness of Special Operations can result in potentially longer times until definitive treatment may be reached. A significant portion of Servicemembers incur injury to the CMF region (42%). Severe CMF trauma can result in substantial hemorrhage and airway compromise. These can be immediately life threatening and must be addressed expeditiously. Numerous devices and techniques for airway management have been made available to the forward provider. A thorough review of nonsurgical and surgical airway management of the patient with facial injury for the forward provider and providers at receiving facilities is provided in this article. Techniques to address flail segments of the facial skeleton are critical in minimizing airway compromise in these patients. There are many methods to control hemorrhage from the head and neck region. Hemorrhage control is critical to ensure survival in the austere environment and allow for transport to a definitive care facility. Associated injuries to the cervical spine, globe, skull base, carotid artery, and brain must be carefully evaluated and addressed in these patients. Management of vision-threatening orbital compartment syndrome is critical in patients with CMF injuries. Because the head and neck region remains relatively vulnerable in the warfighter, combat CMF trauma will continue to occur. Forward providers will benefit from a review of the acute treatment of CMF traumatic injury. Properly triaging and treating facial injuries is necessary to afford the best chance of survival for patients with a devastating combat CMF injury.

KEYWORDS: *craniomaxillofacial trauma; airway management; acute care; hemorrhage; ocular trauma*

Introduction

As the United States continues to increase its use of Special Operations Forces worldwide, treatment of craniomaxillofacial (CMF) trauma must be adapted to meet the needs of the warfighter. The remoteness of Special Operations can result in to potentially longer times until definitive treatment may be reached. Recent reviews on trauma sustained in US combat operations revealed a substantial portion of Servicemembers have incurred injury to the CMF region.[1,2] Survival rates after sustaining an injury in combat are now greater than 90%.[3]

Severe CMF trauma can result in hemorrhage and airway compromise. These can be immediately life threatening and must be addressed expeditiously. Poor outcomes in airway management have been reported[4,5] that likely are due to the challenging management of airways in these patients with critical wounds. Numerous devices and techniques for airway management have been made available to the forward provider.[4,6,7]

A thorough review of nonsurgical and surgical airway management of the patient with facial injury is presented in this article for the forward provider and providers at receiving facilities. Techniques to address flail segments of the facial skeleton are critical in minimizing airway compromise in these patients. There are many methods to control hemorrhage from the CMF region, which is essential to ensure survival in the austere environment and allow for transport to a definitive care facility. Associated injuries to the cervical spine, globe, and skull base must be carefully evaluated and addressed in these patients.

Because the head and neck region remains relatively vulnerable in the warfighter, combat sustained CMF trauma will continue to occur. Forward providers will benefit from a review of the acute treatment of CMF traumatic injury. Properly triaging and treating facial injuries are necessary to afford the best chance of survival for patients with a devastating combat CMF injury. In most cases, fracture stabilization and soft-tissue repair can be delayed until the patient has been stabilized.

Systems Management in Craniomaxillofacial Trauma

Airway Management

Immediate recognition of airway compromise is critically important in the patient who sustains a combat CMF injury. Establishment of a stable and functioning airway according to advanced trauma life support protocols should be of the utmost importance.[8] Assessment and management of the airway in a patient with severe CMF trauma can be a challenge. Adams et al.[4] reported that 5% of patients arriving at a combat support hospital did not have a definitive airway placed, although one was needed. Complications related to airway

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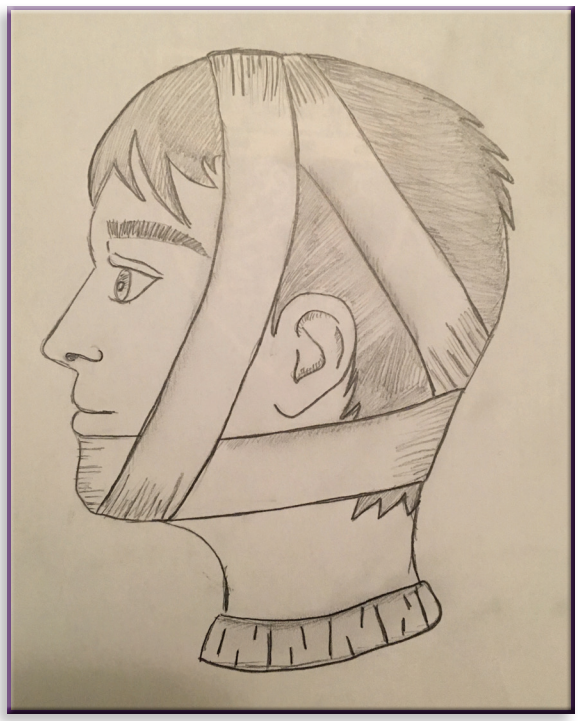
obstruction continue to be a common cause of preventable death on the battlefield.[5,6,9] Providers in the austere environment should be adept at nonsurgical and surgical establishment of a secure airway in the warfighter with CMF trauma.

Battlefield CMF injuries can be from blunt mechanisms, penetrating mechanisms, or a combination of the two. With injuries to the CMF region, the airway may be obstructed by bleeding, a foreign body, vomitus, edema, or prolapsed tissue. Patency must be quickly established and the obstruction removed. Some CMF injuries may present with delayed airway compromise due to swelling or accumulated blood. Obstruction may occur after several hours, and it is critical to constantly reassess the patient's airway to provide the best possible outcome. Patients with concomitant cervical spine injuries must be immobilized. Although this may not be an issue for some, patients with CMF injuries that are bleeding, swollen, or may obstruct for other reasons are at high risk for airway compromise. Mandible fractures may cause obstruction due to loss of support of the tongue base, allowing the tongue to drop back into the airway. Midface fractures can severely adversely affect airway patency as well by structural interference and swelling. Patients with asymmetry or swelling of the neck may have an expanding vascular injury with impending airway compromise. Crepitus in the neck may indicate an airway injury. Unconscious patients or patients with low Glasgow Coma Scale scores will not be able to maintain their airway on their own by repositioning and clearing secretions or blood. In addition, the patient with a cervical spine injury must be immobilized in the supine position, making it impossible for the patient to sit up or turn to clear their airway. The provider should have a very low threshold for establishing a definitive airway (i.e., intubation or surgical airway) in these patients while maintaining cervical spine immobilization.



The Barton bandage. Illustration by Samantha Maliha.

In the unconscious patient, simple head tilt or jaw thrust (in cervical spine injury) may help clear the tongue from airway obstruction. There are many nonsurgical airways available to the provider. Basic airway adjuncts such as nasopharyngeal and oropharyngeal airways can be very useful when applied to the correct patient with CMF injury. Nasal airways should be avoided in patients with midface fractures, because of potential intracranial communication and inadvertent intracranial placement of the device. Oral airways should be avoided in a patient with an intact gag reflex, the cause such an airway may induce vomiting or laryngospasm. These devices can be very helpful with bag-valve-mask ventilation in the semiconscious patient by facilitating upper airway stenting. Devices such as laryngeal mask airways (LMA™; Teleflex Medical Europe, http://www.lmaco.com) or esophageal gastric tube airways (Combitube®; Medtronic, http://www.medtronic.com) may be placed blindly in an emergent scenario, but this may be challenging in a patient with CMF injury, because of disruption of normal anatomy. These devices are difficult to secure to protect the airway and may become dislodged easily.

If a definitive airway is needed, standard laryngoscopic endotracheal (ET) intubation is the safest option.[4,10] Extreme care must be taken in patients with CMF, because they may have concomitant cervical spine injury. Maintenance of inline stabilization with rapid sequence ET intubation is the safest method. This may not be straightforward, because of the pattern of injury and the anatomy involved. Extreme caution should be taken to avoid intracranial injury when inserting a nasal ET in a patient with a midface injury. Video laryngoscopy (Glidescope®; Verathon, https://www.verathon.com) may be very useful to assist with ET intubation but may not be available to forward providers in an austere environment. Awake, controlled fiberoptic-assisted ET intubation may be necessary in a patient with CMF injury secondary to distorted anatomy. These devices are not available in the field, but if they are available in the medical treatment facility, they should be taken advantage of to provide safe, definitive airway establishment in the patient with CMF injury. On occasion, when intubating, the provider can take advantage of a fractured mandible by distracting it forward to help remove airway obstruction by the tongue. In a patient with severe CMF injury, ET intubation may become very difficult, and a surgical airway may be required and always available to get out of the zone of injury if visualization is impossible due to the injury and destruction of tissue.

Currently, the Tactical Combat Casualty Care (TCCC) guidelines have established surgical cricothyroidotomy as the only definitive airway management modality.[7,10] Indications for a cricothyroidotomy are inability to establish a definitive airway by ET intubation or inability to provide adequate bag-valve-mask ventilation. It is critically important that deploying providers be well versed in the management and establishment of emergency airways in CMF injury, because these are typically more difficult than seen in the typical patient with trauma. Placing these surgical airways can be very challenging in the austere environment, as well as in severe CMF injury.[4,5,7] Cricothyroidotomy is preferred to tracheotomy in the emergent setting due to the proximity of the cricothyroid membrane to the skin and the reduced chance of injuring vascular structures that may bleed and obstruct visualization of the trachea. It is important that forward providers be well equipped and trained to establish these secure surgical airways.

Hemorrhage Control

Once the airway is established, attention should be turned to controlling hemorrhage from the CMF region through use of

nasal and oral packing and pressure dressings. Hypovolemic shock is an important cause of death after trauma. According to studies from civilian and military research groups, hemorrhage is responsible for up to 40% of deaths after traumatic injury.[11,12] Importantly, more than half of these deaths are thought to occur before patients reach the hospital, which highlights the importance of early and aggressive control of posttraumatic bleeding on the battlefield.[11] Substantial, life-threatening CMF bleeding is relatively uncommon[13] in patients with multiple injuries but has been reported to be as high as 11% and, therefore, requires prompt intervention when present.[14] Substantial CMF bleeding is most likely to occur after extensive mid- or panfacial injuries such as those encountered on the battlefield.[15]

Manual pressure is of utmost importance on the field to temporize visible hemorrhage. Actively bleeding wounds, most notably in the scalp, and other major facial lacerations should be closed promptly, preferably using strong, nonabsorbable suture in a continuous and full-thickness fashion to minimize the risk of any persistent deep wound bleeding. Substantial blood loss can occur from large scalp lacerations. Stapling wounds closed temporarily will help reestablish hemostasis, as well. Compression wraps can help temporize bleeding wounds and stabilize fractures. Caution should be taken when applying pressure wraps to patients with suspected ocular injuries, because this can potentially exacerbate a ruptured globe.

Battlefield providers should be particularly vigilant about posterior scalp lacerations, which might not be easily detected when patients are in the supine position. Significant epistaxis is usually controlled successfully with pressure packing.[16] In cases of persistent bleeding of nasal origin or from deep cervical wounds, balloon tamponade using a an inflated Foley catheter balloon has been reported.[17] Care should be taken, however, to prevent injury to surrounding deep cervical structures and significant displacement of unstable facial skeletal segments, both of which can exacerbate bleeding. Therefore, it is important to proceed with manual stabilization of facial fractures before nasal packing or other maneuvers that may displace facial skeletal segments. On occasion, the reduction itself can help tamponade hemorrhage. If substantial hemorrhage persists, exploration and ligation of the external carotid artery through a cervical approach and the ethmoidal artery through an orbital approach have been described.[18] However, these approaches have been associated with poor success rates due to extensive collateralization between the internal and external carotid arteries.[19]

It is critical to highlight and discuss the challenges and considerations that should be kept in mind when managing CMF trauma in the acute setting. Although CMF hemorrhage can be substantial, it is unlikely to be the sole cause of hypovolemic shock,[20] and battlefield trauma teams must adhere to established trauma protocols such as advanced trauma life support and TCCC, and maintain a heightened level of clinical vigilance for other injuries that could be responsible for hypovolemic or other forms of shock. Furthermore, CMF hemorrhage management is closely related to airway stabilization and management, because significant bleeding reaching the airway can compromise ventilation and oxygenation. CMF fracture maneuvering should also be performed with cervical spine inline stabilization in mind, given that patients with CMF trauma are at risk for concomitant cervical spine injury.[21,22] Finally, battlefield providers should be aware of the dynamic nature of CMF trauma and continuously reevaluate wounded warriors for sources of bleeding that may become more apparent with resuscitation and normotension.

Ocular Trauma

Combat-sustained trauma to the CMF region may result in ocular injury.[23,24] Patients with combat-sustained CMF trauma have a higher incidence of ocular injury.[25] These injuries include open globe, orbital fractures, intraocular foreign bodies, corneal injury, orbital compartment syndrome, and optic nerve injuries.[24,25] Forward providers should be aware of these injuries and make the assessment of when these patients should be evacuated to a higher echelon of care to be treated by a specialist. At a minimum, forward providers should be able to obtain visual acuity, extraocular motility, pupil examination, and visual fields. Although recognizing ocular injury is more difficult on an unconscious patient, doing so is critical for TCCC providers. Patients with anomalies on any of these examinations should be promptly evacuated, when possible, to a higher level of care. If globe rupture is suspected, the examination should be discontinued and the globe protected by a Fox eye shield or a cup secured to the face. The presence of hemorrhagic chemosis, loss of vision, uveal prolapse, and intraocular hemorrhage may indicate a globe rupture. It is important to not place any pressure on the globe if a rupture is suspected. Foreign bodies protruding from the orbit should be left in place until evacuated to a higher echelon of care. Intraocular foreign body should be suspected in a patient who sustained a blast injury and has abnormal findings on ocular examination.

Orbital compartment syndrome can have devastating visual consequences if unrecognized and not treated promptly. CMF trauma can result in retrobulbar hemorrhage or intrusion of bone into the orbit, which, in turn, can cause increase in intraorbital pressure. This increased pressure may limit perfusion of the globe and the optic nerve, resulting in irreversible ischemic injury. Symptoms of orbital compartment syndrome include vision loss, eye pain, proptosis, ophthalmoplegia, and an afferent pupillary defect. The diagnosis is clinical. Lateral canthotomy and inferior cantholysis should be performed promptly by the forward provider when these signs are present and orbital compartment syndrome is suspected. This simple intervention can save a patient's eyesight.

Management of Concurrent Injuries

Forward teams treating patients who sustain combat-related CMF trauma should be vigilant about frequently encountered concurrent injuries and familiar with their initial management on the field. Cervical spine injury is notoriously common in patients sustaining CMF trauma and has been reported to be as high as 6%.[26] The main goal of early, appropriate cervical spine management is to prevent spinal cord injuries and their potential devastating consequences.[27] Challenges in assessment of the cervical spine include patient confusion, altered mental status, or unresponsiveness following CMF injury, which may prevent forward providers from obtaining an objective evaluation. The intimate relationship between definitive airway establishment in patients who require it and prevention of cervical spine injury is another important consideration that challenges combat trauma teams in the austere environment. Other traumatic injuries that may compromise patient hemodynamic stability, blood pressure, and spinal cord perfusion also must

be addressed promptly. In light of all these considerations and challenges, cervical spine immobilization by forward providers should be performed promptly with manual inline immobilization followed by application of a hard collar. Given the chaotic nature of forward combat zones, it is recommended that clearance of the cervical spine and removal of the collar only be performed when patients are transported to a higher-level facility. Clearance of the cervical spine may then be performed as appropriate based on well-established criteria.[8,26]

The reported rate of traumatic brain injury associated with CMF trauma and facial fractures varies widely in the literature, from 5.4% to 85%.[28–32] This wide variation is partly due to different diagnostic algorithms used by different groups, traumatic mechanism, and severity, but the variation could also represent the challenge in recognizing these injuries. More importantly, when traumatic brain injury is present, it is usually associated with a high mortality rate.[13,33] Life-threatening traumatic brain injuries often necessitate prompt neurosurgical interventions, including evacuation of hematomas and monitoring of intracranial pressures. Because these interventions are not available in the austere environment, it is critical for forward trauma team members to have a heightened level of clinical vigilance when conducting primary and secondary surveys on patients with CMF trauma, to recognize any sign of disability. Early recognition of disability would then prompt conducting primary stabilization in a hasty and efficient manner accordingly, followed by evacuation of affected patients to higher-level facilities where neurosurgical interventions are available.

Blunt injury to the carotid artery is possible in patients with CMF trauma, particularly in patients with extracapsular condylar fractures and LeFort-type fractures. In addition, bilateral facial fractures in any vertical third of the face are associated with an increased risk of blunt carotid injury. The incidence has been reported approximately 5% in patients with CMF fractures.[34,35] Patients with combat-sustained CMF trauma can be screened according to the guidelines established by the Eastern Association for the Surgery of Trauma.[36,37] A high suspicion for a blunt carotid injury should occur in patients with neurologic abnormalities unexplained by the pattern of injury, diffuse axonal injury, a Glasgow Coma Scale score of less than or equal to 8, epistaxis from an arterial source, petrous bone fractures, cervical spine fracture, and LeFort-type facial fractures. At Echelon III treatment facilities, appropriate diagnosis of these patients with an angiogram and subsequent treatment where applicable can be life saving.

Other Considerations

To stabilize a flail mandibular fracture, a forward provider may apply a Barton bandage. This bandage is passed under the chin to oppose the mandible to the maxilla and provide temporary stabilization to minimize motion of the fracture fragments and the resulting pain. When applied, the patient must be monitored closely for airway compromise and treated accordingly. Facial lacerations can typically be washed out and packed open for definitive repair at a higher echelon of care when the patient is stabilized. Early debridement and irrigation of facial wounds are recommended to decrease infection rates among patients with CMF injuries.[22,38] Antibiotic prophylaxis is recommended at time of injury until point of definitive repair, particularly in open facial injuries. There is no evidence to support antibiotic administration beyond surgical repair.[22,39]

Forward surgical teams have been established to push forward the reach of advanced surgical care into active combat areas. Golden Hour Offset Surgical Transport Teams push the envelope further, allowing for establishment of highly mobile and light surgical capabilities to support Special Operations missions.[40,41] They are equipped to establish surgical airways in addition to performing other basic damage control surgery.[41] A recent publication reported their experiences over the course of a deployment and indicated treatment of patients with facial trauma and concomitant compromised airway.[40] These teams are likely to see facial trauma as Special Operations missions continue around the globe.

Conclusion

It is important for Echelon I and II providers to understand the management of patients with combat-sustained CMF injuries and what can be done to decrease mortality and morbidity rates. Continued education about and training in this anatomic region is critical for forward providers.

Disclosures

The authors have indicated they have no financial relationships relevant to this article to disclose.

Author Contributions

SJF and RSK collected pertinent data and compiled the manuscript draft after thorough review of the topic. All authors contributed to editing and final approval of the manuscript.

References

1. **Chan RK, Siller-Jackson A, Verrett AJ, et al.** Ten years of war: a characterization of craniomaxillofacial injuries incurred during operations Enduring Freedom and Iraqi Freedom. *J Trauma Acute Care Surg*. 2012;73:S453–458.
2. **Lew TA, Walker JA, Wenke JC, et al.** Characterization of craniomaxillofacial battle injuries sustained by United States service members in the current conflicts of Iraq and Afghanistan. *J Oral Maxillofac Surg*. 2010;68(1):3–7.
3. **Goldberg MS.** Death and injury rates of U.S. military personnel in Iraq. *Mil Med*. 2010;175:220–226.
4. **Adams BD, Cuniowski PA, Muck A, et al.** Registry of emergency airways arriving at combat hospitals. *J Trauma*. 2008;64: 1548–1554.
5. **Mabry RL, Edens JW, Pearse L, et al.** Fatal airway injuries during Operation Enduring Freedom and Operation Iraqi Freedom. *Prehosp Emerg Care*. 2010;14:272–277.
6. **Kotwal RS, Montgomery HR, Kotwal BM, et al.** Eliminating preventable death on the battlefield. *Arch Surg*. 2011;146:1350–1358.
7. **Schauer SG, April MD, Cunningham CW, et al.** Prehospital cricothyrotomy kits used in combat. *J Spec Oper Med*. 2017;17:18–20.
8. **ATLS Subcommittee; American College of Surgeons' Committee on Trauma; International ATLS Working Group.** Advanced trauma life support (ATLS®): the ninth edition. *J Trauma Acute Care Surg*. 2013;74:1363–1366.
9. **Eastridge BJ, Mabry RL, Seguin P, et al.** Death on the battlefield (2001–2011): implications for the future of combat casualty care. *J Trauma Acute Care Surg*. 2012;73:S431–437.
10. **Savitsky E, Eastbridge B, Borden Institute, et al.** *Combat Casualty Care: Lessons Learned from OEF and OIF.* Arlington, VA: Department of the Army; 2012.
11. **Kauvar DS, Lefering R, Wade CE.** Impact of hemorrhage on trauma outcome: an overview of epidemiology, clinical presentations, and therapeutic considerations. *J Trauma*. 2006;60: S3–11.
12. **Hoyt DB, Bulger EM, Knudson MM, et al.** Death in the operating room: an analysis of a multi-center experience. *J Trauma*. 1994;37:426–432.

13. **Tung TC, Tseng WS, Chen CT, et al.** Acute life-threatening injuries in facial fracture patients: a review of 1,025 patients. *J Trauma*. 2000;49:420–424.
14. **Jose A, Nagori SA, Agarwal B, et al.** Management of maxillofacial trauma in emergency: an update of challenges and controversies. *J Emerg Trauma Shock*. 2016;9:73–80.
15. **Shimoyama,T, Kaneko T, Horie N.** Initial management of massive oral bleeding after midfacial fracture. *J Trauma*. 2003;54: 332–336.
16. **Ardekian L, Samet N, Shoshani Y, et al.** Life-threatening bleeding following maxillofacial trauma. *J Oral Maxillofac Surg*. 1993;21: 336–338.
17. **Perry M, Dancey A, Mireskandari K, et al.** Emergency care in facial trauma—a maxillofacial and ophthalmic perspective. *Injury* 2005;36:875–896.
18. **Perry M, O'Hare J, Porter G.** Advanced trauma life support (ATLS) and facial trauma: can one size fit all? Part 3: Hypovolaemia and facial injuries in the multiply injured patient. *Int J Oral Maxillofac Surg*. 2008;37:405–414.
19. **Lynham AJ, Hirst JP, Cosson JA, et al.** Emergency department management of maxillofacial trauma. *Emerg Med Australas* 2004;16:7–12.
20. **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.
21. **Rodriguez ED, Losee JE, Neligan PC.** *Plastic Surgery E-Book: Volume 3: Craniofacial, Head and Neck Surgery. Pediatric Plastic Surgery (Expert Consult - Online)*. Amsterdam, The Netherlands: Elsevier Health Sciences; 2012.
22. **Fonseca RJ.** *Oral and Maxillofacial Trauma*. The Netherlands: Elsevier; 2013.
23. **Mader TH, Carroll RD, Slade CS, et al.** Ocular war injuries of the Iraqi Insurgency,January-September 2004. *Ophthalmology* 2006;113:97–104.
24. **Thach AB, Johnson AJ, Carroll RB, et al.** Severe eye injuries in the war in Iraq, 2003-2005. *Ophthalmology* 2008;115:377–382.
25. **Cho RI, Bakken HE, Reynolds ME, et al.** Concomitant cranial and ocular combat injuries during Operation Iraqi Freedom. *J Trauma*. 2009;67:516–520.
26. **Perry M, Morris C.** Advanced trauma life support (ATLS) and facial trauma: can one size fit all? Part 2: ATLS, maxillofacial injuries and airway management dilemmas. *Int J Oral Maxillofac Surg*. 2008;37:309–320.
27. **Ravichandran G, Silver JR.** Missed injuries of the spinal cord. *Brit Med J (Clin Res Ed)*. 1982;284:953–956.
28. **Luce EA, Tubb TD, Moore AM.** Review of 1,000 major facial fractures and associated injuries. *Plast Reconstr Surg*. 1979;63: 26–30.
29. **Lim LH, Lam LK, Moore MH, et al.** Associated injuries in facial fractures: review of 839 patients. *Br J Plast Surg* 1993;46:635–638.
30. **Busuito MJ, Smith DJ Jr, Robson MC.** Mandibular fractures in an urban trauma center. *J Trauma*. 1986;26:826–829.
31. **Sinclair D, Schwartz M, Gruss J, et al.** A retrospective review of the relationship between facial fractures, head injuries, and cervical spine injuries. *J Emerg Med*. 1988;6:109–112.
32. **Gautam V, Leonard EM.** Bony injuries in association with minor head injury: lessons for improving the diagnosis of facial fractures. *Injury*. 1994;25:47–49.
33. **Alvi A, Doherty T, Lewen G.** Facial fractures and concomitant injuries in trauma patients. *Laryngoscope*. 2003;113:102–106.
34. **Mundinger GS, Dorafshar AH, Gilson MM, et al.** Blunt-mechanism facial fracture patterns associated with internal carotid artery injuries: recommendations for additional screening criteria based on analysis of 4,398 patients. *J Oral Maxillofac Surg*. 2013;71:2092–2100.
35. **Vranis NM, Mundinger GS, Bellamy JL, et al.** Extracapsular mandibular condyle fractures are associated with severe blunt internal carotid artery injury: analysis of 605 patients. *Plast Reconstr Surg*. 2015;136:811–821.
36. **Bromberg WJ, Collier BC, Diebel LN, et al.** Blunt cerebrovascular injury practice management guidelines: the Eastern Association for the Surgery of Trauma. *J Trauma*. 2010;68:471–477.
37. **Bruns BR, Tesoriero R, Kufera J, et al.** Blunt cerebrovascular injury screening guidelines: what are we willing to miss? *J Trauma Acute Care Surg*. 2014;76:691–695.
38. **Petersen K, Hayes DK, Blice JP, et al.** Prevention and management of infections associated with combat-related head and neck injuries. *J Trauma*. 2008;64:S265–276.
39. **Miles BA, Potter JK, Ellis E 3rd.** The efficacy of postoperative antibiotic regimens in the open treatment of mandibular fractures: a prospective randomized trial. *J Oral Maxillofac Surg*. 2006;64: 576–582.
40. **Benavides JM, Benavides LC, Hale DF, et al.** The Golden Hour Offset Surgical Treatment Team Operational Concept: experience of the 102nd Forward Surgical Team in Operation Freedom's Sentinel. 2015-2016. *J Spec Oper Med*. 2017;17(3):46–50.
41. **Hale DF, Sexton JC, Benavides LC, et al.** Surgical instrument sets for Special Operations expeditionary surgical teams. *J Spec Oper Med*. 2017;17:40–45.

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