Safety of Definitive In-Theater Repair of Facial Fractures

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Objective: To determine the safety of definitive in-theater facial fracture repair on American military personnel wounded during Operation Iraqi Freedom.

Methods: A retrospective review of all patients with head and neck trauma treated at the 322nd Expeditionary Medical Group/Army Medical Command Hospital, Balad Air Base, Iraq, from May 7, 2005, through September 18, 2005, was performed. This study focused on the outcomes of wounded American military personnel whose facial fractures were definitively repaired in theater. The criteria used to determine candidacy for definitive in-theater facial fracture repair on American military personnel were (1) the fracture site was exposed through either a soft tissue wound or because of an adjacent surgical approach, (2) treatment would not delay evacuation from theater, and (3) treatment would allow the military member to remain in theater.

Results: From May 2005 to September 2005, 207 patients were taken to the operating room and required 388 procedures. A total of 175 patients (85%) were operated on for traumatic injuries, and 52 of these patients required open reduction and internal fixation (ORIF) of a facial fracture. Of the 52 patients who underwent an ORIF, 17 were American military personnel. Of the 17 American patients who were definitively treated for their facial fractures in theater, 16 were contacted and/or followed up on the global military medical database. None of these patients developed an *Acinetobacter baumannii* infection or had a complication caused by the definitive in-theater ORIF. The range of follow-up was 2 months to 11 months, with a mean of 8.3 months.

Conclusions: Definitive repair of facial fractures with ORIF on American military personnel in theater is advised when the aforementioned criteria are observed. An otolaryngologist is a crucial member of the head and neck trauma team.

Arch Facial Plast Surg. 2007;9(6):400-405

Since the inception of Operation Iraqi Freedom on March 19, 2003, 3441 American military personnel have been killed and 24 314 have been wounded in action. The survival rate for American military personnel wounded in Operation Iraqi Freedom is excellent at approximately 90%. By comparison, the survival rate for American military personnel wounded during the Vietnam War was just above 75%. There are 3 principal reasons for the considerably higher survival rate seen among wounded American military personnel in Operation Iraqi Freedom compared with previous conflicts: (1) improvement in protective equipment, (2) rapid mobilization of the wounded to higher echelons of care, and (3) improved access to immediate and urgent medical care. The Combat Lifesavers Program has trained military personnel to provide immediate lifesaving care that allows the patient to then be transported to a treatment facility. The Interceptor body armor system has prevented countless wounds to the chest and abdomen, which would have been lethal in prior wars. The capability of the US medical evacuation and air evacuation systems to rapidly and efficiently move the wounded to higher echelons of care has been well documented. During the Vietnam War, the average time from injury to arrival back in the United States for wounded soldiers was 45 days. Today, for personnel injured in Iraq, the trip home averages less than 4 days. The stabilization of the wounded by forward surgical teams coupled with unprecedented access to both state-of-the-art facilities and a full array of surgical subspecialists in theater has also contributed to the higher survival rate.

Associated with this higher survival rate has been an increase in the incidence of operative head and neck trauma. It has been reported that up to 61% of all pa-
patients wounded during Operation Iraqi Freedom had a head and neck wound. The Interceptor body armor system protects the chest and abdomen well but leaves the face and neck vulnerable. Prior to May 2005, most American military personnel with facial fractures were air evacuated from the Iraqi theater for definitive treatment of their facial fractures. Concerns about sterility, infection with Acinetobacter baumannii (a bacteria that has infected wounds and prostheses and caused catheter-related sepsis in many troops returning home), and delaying evacuation out of theater were all reasons cited for not definitively repairing facial fractures in theater. Beginning in May 2005, American military personnel meeting strict guidelines underwent definitive repair of their facial fractures by open reduction and internal fixation (ORIF) in theater. This article describes definitive in-theater facial fracture repair in Americans as well as Iraqi army personnel, insurgents, and civilians and third-country nationals.

**METHODS**

**SETTING**

The 322nd Expeditionary Medical Group (EMDG) at the Air Force Theater Hospital, Balad Air Base, Iraq, served as the definitive collection point for all American personnel injured in the Iraqi theater during the senior author’s (M.A.L.) deployment from May 2005 to September 2005. The hospital is located in the Sunni Triangle, approximately 40 miles north of Baghdad, Iraq. The hospital was staffed with a comprehensive array of surgical subspecialists. The head and neck team comprised 2 neurosurgeons, an otolaryngologist, an oral surgeon, and an ophthalmologist. The addition of an otolaryngologist to the head and neck team occurred in September 2004, when the first otolaryngologist was deployed to an Air Force Theater Hospital to serve as an otolaryngologist.

**DESIGN**

A retrospective review of all patients with head and neck trauma treated at the 322nd EMDG from May 7, 2005, through September 18, 2005, was completed. The operative case log of the senior author was used to review the cases performed during his deployment as well as specifics regarding the patients and the operative cases. Patients who were Iraqi army personnel, civilians, insurgents, and third-country nationals who were treated by the head and neck service were followed up at the ear, nose, and throat (ENT) clinic at Balad Air Base. American patients who were evacuated from the theater after their surgery were followed up using the military global medical record system (Armed Forces Health Longitudinal Technology Application [AHLTA]), and/or were contacted by telephone. The medical charts reviewed on AHLTA gave follow-up information on the patients’ general health and specifics regarding the site of injury. When the medical chart review did not provide adequate information, the patients were telephoned directly and questioned specifically regarding their postoperative course. All patients were asked if they were given antibiotics for an infection at the site of injury. In addition, all patients contacted were asked if they required a second surgery of their face. American military who were allowed to stay in theater after treatment were seen 1 month after surgery in the ENT clinic at the Air Force Theater Hospital.

All trauma patients were initially evaluated by an emergency department physician and a trauma surgeon at the 332nd EMDG. The otolaryngologist and oral surgeon were formally consulted on all patients with traumatic injuries to the head and neck. When feasible, a preoperative maxillofacial computed tomographic scan was completed. Trauma patients requiring emergent operative intervention for their head and neck injuries were taken to the operating room the day of the injury. Written informed consent was not obtained prior to operative intervention in patients who had altered levels of consciousness. Logistically, family members were unable to be reached prior to operative intervention to obtain consent. Elective cases were scheduled from the ENT clinic and were posted for times that the hospital census could support elective cases. Patients who had elective surgery verbalized that they understood the procedure and gave oral informed consent. An Iraqi translator was used to communicate with Iraqi patients.

The surgical approaches for midface and frontal sinus fractures were individualized for each patient. If an overlying soft tissue wound afforded appropriate exposure to the fracture site, it was used for access. In the event no laceration afforded adequate exposure, standard maxillofacial incisions were used such as a bicoronal flap for frontal sinus fractures and transcconjunctival, sublabial, and lateral brow or upper blepharoplasty incisions for zygomaticomaxillary fractures with or without orbital floor fractures. All mandible fractures were placed into a maxillomandibular fixation prior to open reduction and internal fixation. Mandible fractures were accessed through an open wound or primarily through an intraoral approach with the exception of parasymphyseal fractures, which were accessed though a small submental incision.

Fracture fixation was done using the Synthes 1.3-mm plating system for midface and frontal sinus fractures. Mandible fractures were plated using the Synthes 2.0 and 2.4 plating system (Synthes Inc, West Chester, Pennsylvania). Orbital floor fractures were reconstructed using titanium mesh implants. One patient with an isolated central orbital floor defect had a high-density implant polyethylene implant (Medpor; Porex Surgical Inc, Newnan, Georgia) placed.

Iraqi army personnel, insurgents, and civilians, along with third-country nationals, had their facial fractures definitively repaired during their hospitalization at the 322nd EMDG. Americans, both military and civilian contractors, with facial fractures that were exposed through an open wound were definitively treated at the time of wound closure. Fractures that were exposed during a neurosurgical procedure as well as Americans with isolated facial fractures who would be able to return to duty once the fracture was fixed were also definitively repaired.

**RESULTS**

More than 3000 patients were seen at the Air Force Theater Hospital at Balad Air Base in Iraq from May 2005 to September 2005. A total of 485 patients were seen at the ENT clinic as outpatients, and 207 patients were taken to the operating room by the otolaryngologist–facial plastic surgeon. Of the 207 patients taken to the operating room, 85 (41%) were US military, 98 (47%) were Iraqi (Iraqi military and civilian), 14 (7%) were insurgents, 8 (4%) were third-country nationals, and 3 (1%) were US civilians.

A total of 388 procedures were performed on the 207 patients. Of the patients operated on, 175 (85%) were trauma related. The Table gives a breakdown of the trauma-related cases. Among the 189 male patients (92%) who had surgery, 86% were trauma related. Among the
16 female patients who had surgery, 62% were trauma related. Of the 207 patients who were operated on, 52 underwent ORIF for either a facial fracture or mandible fracture. Of the patients who required ORIF of midface, frontal sinus, or mandible fractures, 17 were American military.

The criteria applied for in-theater facial fracture definitive treatment on Americans included the following:

1. The fracture site was exposed through either a soft tissue wound or because of an associated approach (eg, a frontal sinus fracture exposed by a bicoronal flap during a decompression craniectomy).
2. Definitive treatment of the fracture would not delay the evacuation of the soldier from the theater.
3. Treatment of the facial fracture would allow the soldier to remain in theater (Figure 1).

Factors that excluded a patient from being definitively treated in theater included the following:

1. The patient’s transport out of the war zone would be delayed in order to treat the fractures. Flights out of Balad Air Base were generally done at night for safety reasons. The flights were readily available; however, a sandstorm could occur at anytime, thus delaying transport of a wounded patient. In general, patients were evacuated as soon as medically stable to fly, weather permitting.
2. The fracture site was not exposed by an open wound or neurosurgical approach and the patient required evacuation out of theater.

The most important principle of any fracture reduction and fixation is adequate irrigation of the wound and debridement of devitalized tissue. This principle was strictly adhered to in each case. Fractures were also fixed such that there was no mobility at the fracture site.

Of the 17 American patients who were definitively treated for their facial fractures in Iraq, 16 were able to be contacted and/or followed up on the global military medical database. None of these patients developed an A baumannii infection. Only 1 of the 16 patients required plate removal and revision. The patient had elevated intracranial pressure when he arrived in Germany and a decompression craniectomy was performed, which included removal of the plates from the frontal sinus fracture repair (Figure 2). The range of follow-up was 2 to 11 months.

Concerns about sterility, A baumannii infection, and delaying evacuation out of theater were all reasons cited for not definitively repairing facial fractures on American military personnel in theater when the senior author arrived at the 322nd EMDG in May 2005. However, it was observed that Iraqi patients who underwent ORIF of facial fractures that had been treated by the previous head and neck teams had neither an increased number of wound infections nor problems with A baumannii infection.

Acinetobacter baumannii is a pleomorphic gram-negative bacillus primarily found in soil that has shown increased pathogenicity and antibiotic resistance since the 1980s. Since the start of Operation Iraqi Freedom, the incidence of patients infected at military facilities with A baumannii has been increasingly reported. From January 2002 to August 2004, military health officials identified 102 patients with blood cultures that grew A baumannii at military medical facilities treating service members injured in Afghanistan and the Iraq-Kuwait region. All of these cases met the criteria for A baumannii bloodstream infection on the basis of criteria established by the National Nosocomial Infection Surveillance (NNIS) system of the Centers for Disease Control and Prevention. Of these 102 cases, 85 (83%) were associated with activities during Operation Iraqi Freedom and Operation Enduring Freedom. Acinetobacter baumannii has a propensity for the respiratory tract, but the bacteria have been shown to cause osteomyelitis. Therefore, there was a theoretical concern about placing hardware in American patients because of the question of sterility in the Air Force Theater Hospital and the possibility of the patient developing an A baumannii infection. None of the 16 Americans who were followed up after definitive repair of their facial fractures in theater developed osteomyelitis or a wound infection secondary to A baumannii.

Evacuation of critically ill casualties from the theater was done by Critical Care Ambulatory Transport (CCAT) missions, which flew patients from Balad Air Base to Landstuhl Regional Medical Center in Germany, and then back to the United States. The coordination of these missions through the Global Patient Movement Requirements Center (GPMRC) was phenomenal and allowed for superb patient care in theater. The CCAT and GPMRC personnel constantly updated the surgeons at the Air Force Theater Hospital to let the surgeons know when the CCAT missions would be flying to Germany. This allowed surgeons to determine without a doubt if there was sufficient time to perform a procedure on a patient without delaying the patient’s evacuation from the theater.

The practice of definitively treating facial fractures in a war zone using the criteria discussed in this article can lead to improved patient outcomes. It has been shown that a delay in fracture fixation can lead to both increased technical difficulties and infectious complications. A fracture that goes untreated can be more difficult to adequately reduce owing to the fibrosis and contraction of the surrounding facial musculature. Tech-
nical complications such as marginal nerve weakness and malocclusion have been shown to be more prevalent in mandibular fractures that had delayed treatment. Previous wars have shown that an appropriately staffed hospital, efficient surgical techniques, and the presence of highly skilled specialists working as a team can provide excellent patient outcomes. The addition of an otolaryngologist has significantly improved the care American military personnel are receiving in theater. A multispecialty head and neck team without an otolaryngologist is devoid of the unique skills necessary to manage penetrating neck trauma, the acute airway, and reconstruct head and neck wounds.

A limitation of this study is the small number of American patients with facial fractures who were treated and then followed up. More data need to be acquired as more Americans with facial fractures are definitively treated in theater.

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Figure 1. A US soldier with a Le Fort I fracture and a left zygomaticomaxillary complex fracture (A) sustained when he struck the forward plate of a Humvee gun turret (B) with his face. The patient was treated at Air Force Theater Hospital, Balad Air Base, Iraq, (C) and rejoined his unit 2 weeks after injury (D). The patient never left the theater for treatment or convalescence.
The medical support of Operation Iraqi Freedom is unique in that never before has such a state of the art in-theater hospital been combined with such completeness of surgical personnel. This combination of facilities and personnel has allowed the most comprehensive care of wounded American military personnel in theater ever.

In the words of Michael E. DeBakey, MD, “Short cuts and measures of expediency are frequently necessary in
military surgery, but compromises with surgical adequacy are not.\textsuperscript{16} Although it was initially appropriate to delay the definitive surgical repair of facial fractures until the wounded were air evacuated out of theater, it has now been shown that delaying treatment is no longer warranted. Definitive treatment of facial fractures with ORIF in American soldiers is advised when the aforementioned criteria are applied.

Accepted for Publication: June 5, 2007.

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Author Contributions: Dr Lopez had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Lopez and Arnholt.

Acquisition of data: Lopez and Arnholt.

Analysis and interpretation of data: Lopez and Arnholt.

Critical revision of the manuscript for important intellectual content: Lopez and Arnholt.

Study supervision: Arnholt.

Financial Disclosure: None reported.

Previous Presentation: This study was presented at the Ninth International Symposium of Facial Plastic Surgery; May 3, 2006; Las Vegas, Nevada.

Additional Contributions: The senior author would like to thank all the members of the 332nd EMDG who provided exceptional care to our deployed military members and were instrumental in the care provided to the patients discussed within this article.

REFERENCES


Announcement

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