Chapter 27

COMPLEX HEAD AND NECK RECONSTRUCTION IN THEATER

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INTRODUCTION

Impressive advances in resuscitation, casualty evacuation, and damage-control surgery in the care of combat wounded during more than a decade of war in Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) have helped reduce mortality rates to below 10% for US and NATO service members compared to 25% in previous conflicts.[1] Because of this improvement in survival, providers must be prepared to face the challenge of managing massive and complex wounds that previously would not have been survivable.

Head and neck injuries made up a larger proportion of combat wounds in both OIF and OEF compared with previous conflicts. Approximately 25% to 40% of all injured OIF/OEF service members suffered from an injury to the head, neck, and face, an increase compared to World War II, the Korean War, and the Vietnam War, where the incidence of head, face, and neck injuries was 15% to 20%.[2–9] Significant improvements in body armor likely contributed to the decreased incidence in injuries to the well-protected torso compared with the relatively unprotected extremities, face, and neck. Due to the increased incidence of head and neck injuries in modern combat, reconstruction of traumatic soft tissue and bony defects of the face, head, and neck presents an additional challenge for the deployed surgeon.

The vast majority of combat-injured US and NATO service members in OIF and OEF who required complex reconstructive surgery underwent delayed reconstruction after evacuation from the combat zone. Numerous reports in the medical literature of successful reconstruction of traumatic war wounds have been published.[10–16] In both OIF and OEF, however, local national military, police, and civilians suffered combat-related injuries at a much higher rate than either US or NATO service members. When local nationals sustained complex traumatic wounds requiring reconstructive surgery, definitive procedures usually needed to be performed in the combat theater by military surgeons. In general, Iraqi and Afghan host-nation medical services were either unavailable or did not possess the appropriate resources to perform complex reconstructive surgery, frequently leaving US and NATO surgeons as the only alternative for care. Although reconstruction of traumatic head and neck wounds is well documented in the civilian literature, numerous complicating factors exist when these complex surgical procedures are performed in a theater of war.[12,14,17–19] The recognition that military surgeons in future conflicts will likely be faced with the challenge and responsibility of definitive reconstructive surgery in a combat zone requires thorough discussion of the topic and documentation of the OIF and OEF experience.

TYPES OF WOUNDS

The vast majority of head and neck wounds in OIF and OEF were penetrating injuries caused by explosive devices (88%) and high-velocity gunshot wounds (7%).[5] Traumatic combat wounds frequently demonstrate extensive tissue damage and loss and are often slow to heal without additional soft tissue coverage (Figure 27-1).[13,14] The massive amount of energy transfer and bacterial contamination associated with these types of wounds has been shown to increase complication rates for reconstructive surgery.[20,21] Concomitant injuries in the head and neck region, especially the brain and eyes, are common when massive facial trauma is present from a ballistic missile wound.[22] Injuries remote from the head and neck are also extremely common after an improvised explosive device (IED) blast and may limit options for reconstruction. Despite these challenges, US and NATO service members injured in OIF and OEF have undergone successful complex reconstructive procedures, including microvascular free tissue transfer, for combat trauma after evacuation to medical centers in their native countries with excellent success rates.[10,12,23] Two series from OIF and OEF even document the experience of reconstructive surgery performed in a combat zone, highlighting both the achievability and challenges faced in this austere environment.[17,24]

Definitive management of traumatic tissue defects typically follows an algorithm from simple (healing by secondary intention, primary closure, etc) to more complex (regional flap, free flap, etc) based on multiple factors including extent of injury, concomitant injury, timing, available resources, and surgeon skill-set.[13,14,25,26] Simpler methods of reconstruction are often more desirable, especially in a low-resource setting. Because of important functional and aesthetic considerations, however, large tissue defects of the head, neck, and face region are often best reconstructed with either regional flaps or microvascular free tissue transfer. Especially with large head and face wounds, failure to successfully reconstruct may lead to pharyngocutaneous fistula, inability to speak or swallow, and significant disfigurement.

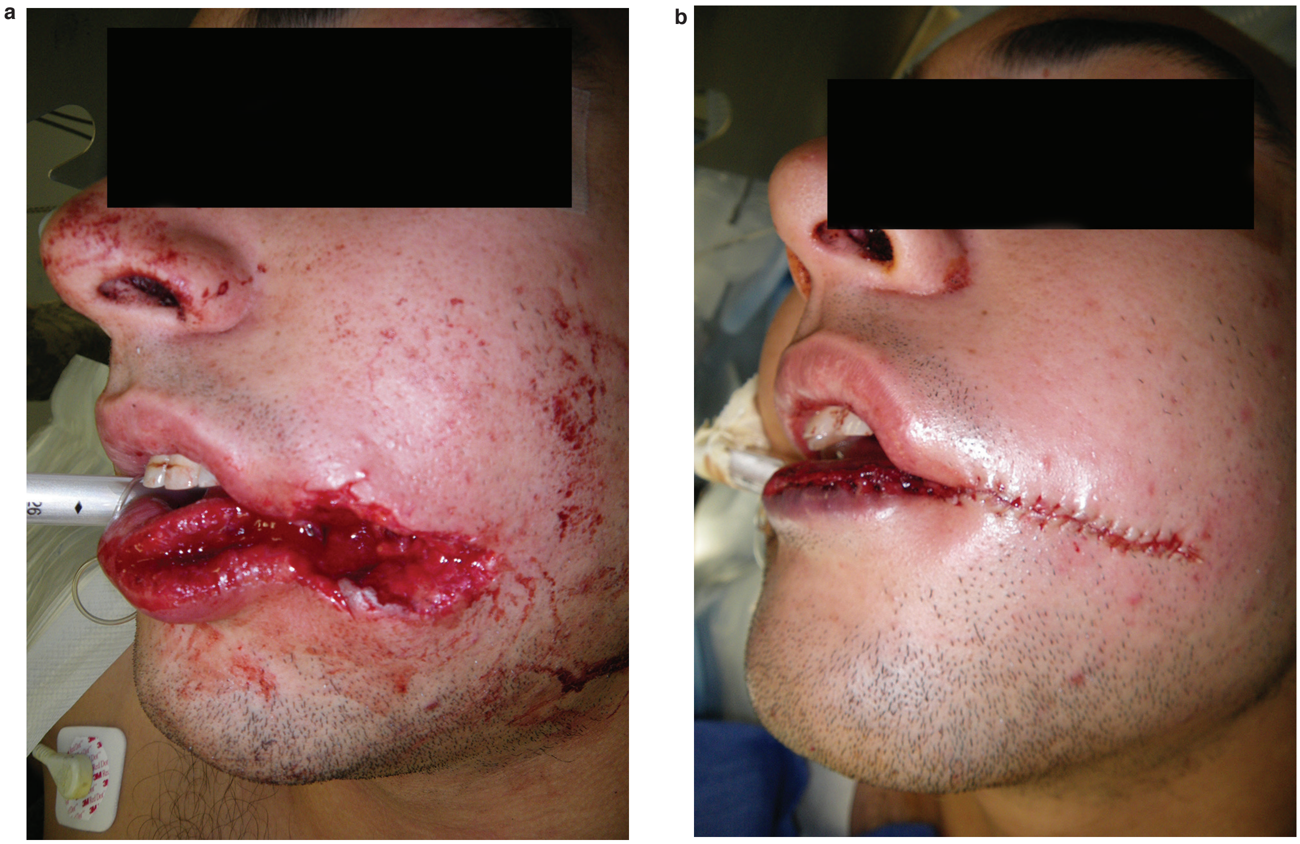


Figure 27-1. A US marine with a traumatic complex laceration of the lower lip and left cheek from an improvised explosive device blast, immediately before (**a**) and after (**b**) debridement and primary closure. The patient returned to duty without evacuation from the combat theater.

MANAGEMENT OF SMALL WOUNDS

Repair of traumatic facial lacerations was the most common procedure performed by otolaryngologist/head and neck surgeons in both OIF and OEF.[6,27] These procedures ranged from simple to extremely complex, depending upon severity of the injury and state of the damaged tissue. Aggressive irrigation and debridement (I&D) is of paramount importance to remove embedded debris that often becomes implanted by an explosion (Figure 27-2). Deeply embedded dirt and fragments may lead to infection, poor wound healing, or traumatic tattooing, and typically migrate to the surface over time. I&D was often performed under general anesthesia using an operating room scrub brush, mild detergent, and copious amounts of water. Repeat I&D was common and done as needed to ensure a clean wound prior to any form of closure or reconstruction.[28]

Definitive closure of smaller traumatic soft-tissue defects can often be performed by secondary intention, primary closure, skin graft, or local flap (Figure 27-3). The advantages and disadvantages of reconstructive techniques in distinct facial regions must be considered in the surgical plan. Numerous textbooks and publications document the abundant methods to repair face and neck defects; the deploying otolaryngologist/head and neck surgeon should consider a textbook of facial reconstruction a mandatory piece of equipment.[29–31]

RECONSTRUCTIVE OPTIONS FOR LARGE SOFT-TISSUE DEFECTS

When simpler means of reconstruction are not viable options for a complex wound of the head and neck, using vascularized tissue from a remote location is often necessary. Regional flaps allow healthy donor tissue to be transferred to a wound bed with intact vascular pedicle from a site adjacent to the head and neck region. Common regional flaps used for head and neck reconstruction include the pectoralis major

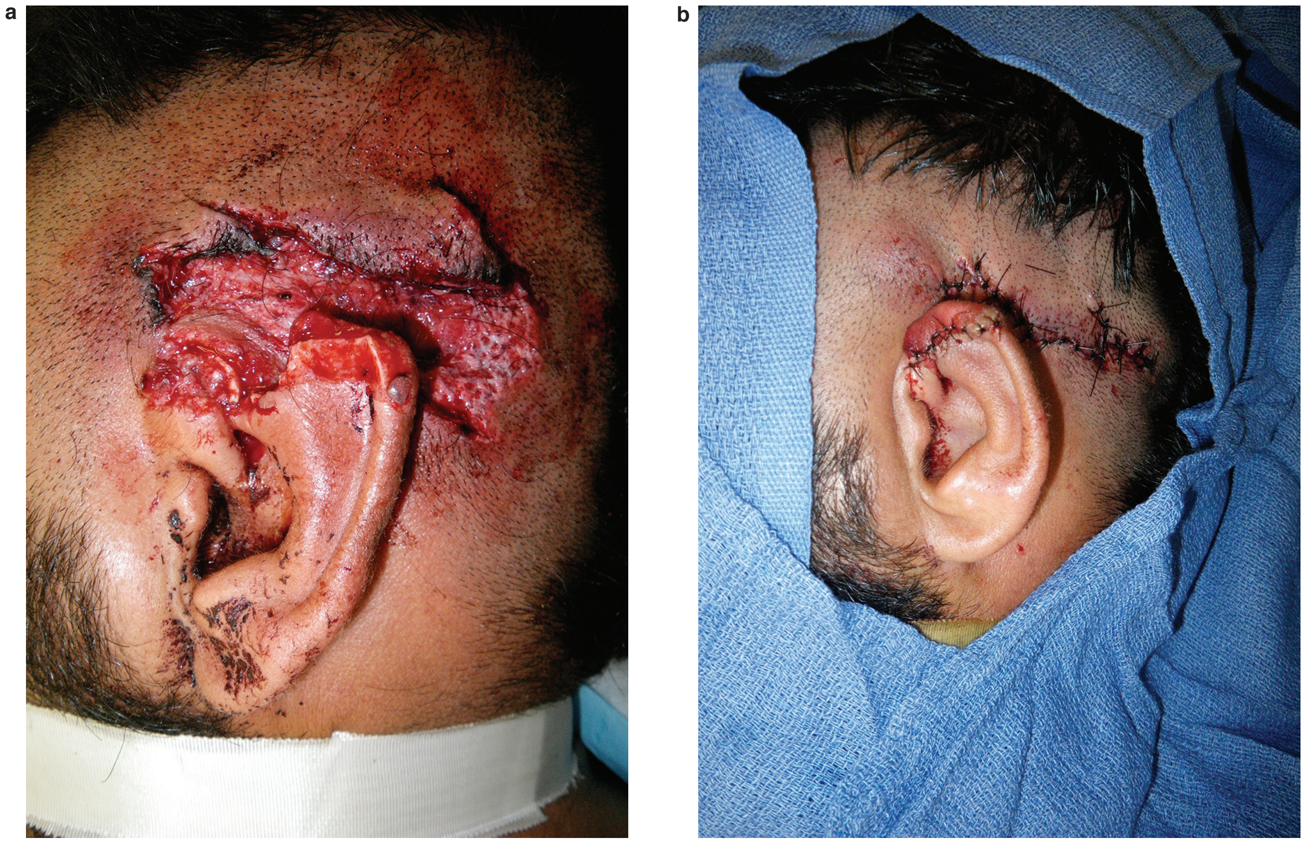


Figure 27-2. (**a**) Traumatic left ear and scalp defect from improvised explosive device blast. (**b**) Appearance after wound debridement, primary closure of the scalp wound, local flap and split-thickness skin graft reconstruction of the superior helical rim defect.

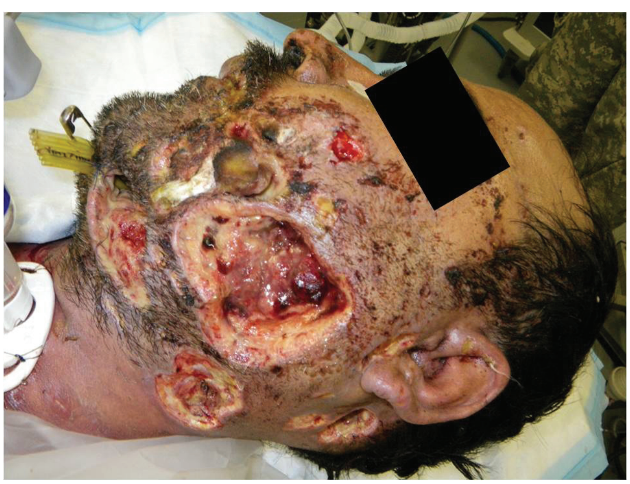


Figure 27-3. Afghan civilian who suffered massive neck, face, chest, and extremity trauma from an improvised explosive device blast. Note the extensive soft tissue loss after irrigation and debridement. The patient was transferred prior to reconstructive surgery.

flap, the trapezius flap, the deltopectoral flap, the latissimus dorsi flap, the paramedian forehead flap, and the temporoparietal fascial flap. Each of these flaps is well described in the literature, and they can often be harvested in a variety of ways to include multiple types of tissue.[32,33]

As an example, flaps based on the pectoralis major muscle can include the following options: muscle-only, based on the thoracoacromial artery; pectoralis muscle with overlying skin based on musculocutaneous perforators; or a segment of rib with periosteal blood supply from the overlying pectoralis major muscle, with or without a skin paddle. With its excellent mobility and potential to include various tissue components, it is possible to reconstruct skin, mucosal, and bony tissue defects simultaneously in most areas of the head and neck with this reliable regional flap.[32]

When regional flaps are either insufficient or unavailable due to concomitant injury, remote donor sites may be necessary to provide tissue for reconstruction. Microvascular free tissue transfer is commonly used for reconstruction of head and neck tissue defects after cancer extirpation, and less frequently for civilian trauma.[10,19,34] Though an incredibly powerful tool when needed, microvascular surgery requires specialized training and equipment that is not typically found in a combat support hospital (CSH). Despite these challenges, numerous microvascular procedures were performed by otolaryngologist/head and neck surgeons and plastic surgeons during OIF and OEF.[24]

Microvascular reconstructive surgery performed in an austere setting for combat wounds is not unique to OIF and OEF. In the 1990s, war injuries in Croatia were treated using free flap reconstruction with good results. Tajsic[35] described his experience in the Balkans crisis completing 34 free flaps for extremity combat injuries. Despite performing microsurgery in a low-resource setting, he had a complication rate of only 8.3%, demonstrating that complex reconstruction could be successfully achieved in the subacute time period on combat wounds.[35]

Outcomes from a series of free flaps performed by six US surgeons in OIF and OEF compare favorably to the Balkan experience. Of the eight patients who underwent free tissue reconstruction of head and neck defects, six tolerated an oral diet at the time of discharge. Complication rates were similar in both series. Although a range of microvascular surgical techniques and required instrumentation are described, there are no uniformly accepted standards. Perhaps most important to successful outcomes in microvascular reconstructive surgery are knowledge of microvascular anatomy, meticulous tissue handling, and good surgical judgment.[24,35]

MAXILLARY AND MANDIBULAR RECONSTRUCTION

The performance of open reduction internal fixation (ORIF) surgery in a combat theater for repair of maxillofacial combat trauma is a controversial topic. Routine management of bony facial trauma in the civilian setting often involves delaying of definitive repair until soft-tissue edema in the fracture vicinity decreases, typically 1to 3 days. The vast majority of US and NATO service members with maxillofacial trauma underwent definitive repair after evacuation from the combat zone. Fear of infection from multiply drug-resistant organisms frequently seen in evacuated injured service members prompted significant caution with regard to biologic implants such as plates and screws.[28] Two studies, however, demonstrated that in certain US service members, ORIF of uncomplicated facial fractures in theater was associated with a lower complication rate than that for patients who underwent delayed repair after evacuation out of the combat zone.[8,36] This data was extrapolated to the treatment of local nationals with bony maxillofacial injuries who successfully underwent definitive ORIF in numerous Role 3 facilities throughout the decade in both OIF and OEF.

Bone loss is not uncommon after high-velocity combat trauma wounds to the face and may require complex reconstruction for optimal function and cosmesis. In a study of Iraqi patients treated at a surgical specialty hospital in Bagdad over a 4-year period, over 40% of patients who underwent facial reconstructive surgery from combat-related trauma had bone loss.[17] Deciding which bony defects should be reconstructed, the optimal method of reconstruction, and the timing of surgery requires a surgeon experienced in head and neck reconstruction. Treatment plans must be individualized for each patient, taking into account available resources.

Reconstruction of bony defects of the maxilla and mandible due to combat wounds is typically performed in multiple stages. Initially, a thorough wound exploration to debride any obvious nonviable bone and soft tissue should be performed. Large bony fragments with an intact periosteal blood supply should not be debrided initially, because they may be useful in later repair or reconstruction. Immobilization of mandibular fractures and establishment of premorbid occlusion is important and may be performed using dental wires, arch bars, or external fixation devices. Secondary reconstruction is typically performed after more serious concomitant injuries are addressed. The method of reconstruction and donor site depends upon the extent of local and concomitant injury.

The controversy over which bony defects mandate reconstruction is substantial. Both functional and cosmetic outcomes must be analyzed and prioritized by the treating surgeon as well as the patient, if he or she is able to participate in the decision-making process. In general, some bony defects may be reconstructed with soft tissue instead of bone, while some defects do not require reconstruction at all.

Concerning maxillary defects, functional considerations of orbital support, oronasal separation, and occlusive stability often take precedence over cosmetic concerns, although they are frequently complementary. Rehabilitation of small (less than half of the hard palate) palatal defects that cause oronasal regurgitation may be achieved with prosthetic obturation if resources are available.[37,38] A dentist with some additional training in maxillofacial prosthodontics may be available and able to manufacture a prosthesis in theater. When an obturator is not available, local, regional, or free soft tissue flaps may be used to effectively reconstruct defects of up to one-half of the hard palate and maxillary alveolus, providing excellent oronasal separation.[39,40] Local and regional flaps that may be used include the buccal mucosal flap, tongue flap, facial artery myomucosal flap, temporoparietal fascial flap, and temporalis muscle flap.

Palatal defects involving over half of the maxillary alveolar ridge should usually undergo bony reconstruction. Bone grafts that are not completely surrounded by healthy vascularized tissue should be avoided. Staged procedures that first bring healthy vascularized soft tissue to a wound, followed by bone grafting at a later time, may improve outcomes. Single-stage bony reconstruction is best performed with free-tissue transfer using either the fibular, radial forearm, or scapular osteocutaneous free flaps.[41]

The anterior mandibular arch (the area between the two mental foramina) is important both functionally and aesthetically. Failure to reconstruct a bony defect of the anterior mandible leads to severe morbidity including the loss of oral competence, significant dysphagia, poor speech and articulation, and the characteristic "Andy Gump" cosmetic deformity.[34,42] Unilateral defects of the posterior mandible, from the midbody back to the mandibular condyle, are often much better tolerated than anterior defects, as long as the contralateral hemimandible remains intact. Function and cosmesis are typically very acceptable when a posterior mandibular defect is not reconstructed.

It is fairly well accepted that maxillary and mandibular bony defects less than 4 to 5 cm can be bone grafted successfully if there is healthy, vascularized tissue surrounding the bone graft. Multiple I&Ds are commonly performed prior to bone-grafting to ensure the healthiest possible recipient bed. Common donor sites for cortical or cortico-cancellous bone grafts include split calvarial, iliac crest, and rib. Teamwork is imperative; if a reconstructive surgeon is not exquisitely familiar with a donor site, a surgeon from another specialty may harvest the bone graft and manage the donor site wound.

Kummoona[17] reported on a series of combat-wounded Iraqis who underwent bony maxillary or mandibular reconstruction using either Dacron (Invista, Wichita, KS) mesh with bone chips or an iliac crest cortico-cancellous bone graft. All patients were immobilized for 6 weeks in maxilla-mandibular fixation, using wires because screw and plate fixation was not available. Although specific outcomes were not given, 10 of 24 patients reconstructed with the mesh and bone chips suffered complications requiring removal of the reconstruction. Patients who underwent reconstruction using cortico-cancellous bone grafts had "excellent results" with failure in only two cases.[17]

Larger defects of the maxilla or anterior mandibular arch, typically larger than 5 cm, usually require regional or microvascular free flap coverage.[39,40] When microvascular reconstructive techniques are not available, the pectoralis major osseomyocutaneous flap can be harvested with a segment of rib attached to the overlying muscle, providing blood supply through the rib periosteum.[43] A large segment of bone can be harvested with minimal donor site morbidity, and the bone can tolerate a single osteotomy. Concomitant mucosal or facial skin defects can be repaired with the accompanying skin paddle. The pectoralis major flap has long been considered a workhorse for head and neck reconstruction and is familiar to nearly all otolaryngologist/head and neck surgeons and plastic surgeons.

Because of the remote access from many donor sites, microvascular free tissue transfer offers optimal outcomes for reconstruction of large mandibular defects, but requires special skills and instrumentation. Common donor sites include the fibula, scapula, and iliac crest osteocutaneous flaps.

UNIQUE CONSIDERATIONS IN A COMBAT ZONE

When dealing with local national patients in a combat zone at a military CSH, advanced medical capabilities are often available; however, multiple extenuating factors exist that must be taken into consideration when deciding how to best treat a massive traumatic tissue defect.[24,35]

Equipment and Skills

Specialists typically trained to perform complex head, face, and neck reconstructive surgery include otolaryngologist/head and neck surgeons and plastic surgeons. Although personnel from both of these specialties have deployed to Iraq and Afghanistan and performed numerous reconstructive procedures, there is currently no uniform requirement that Role 3 facilities have personnel with these skills available. The limited resources inherent to a combat zone demand that a multidisciplinary approach be used for all reconstructive cases. For example, when a bone graft was required for reconstruction of a mandibular defect, an orthopedic surgeon often harvested an iliac crest bone graft while the reconstructive surgeon prepared the recipient site. This coordination and simultaneous approach by multiple surgeons resulted in faster surgical times, thus freeing operating rooms and critical personnel for other procedures.

Preexisting local medical capabilities differed significantly between Iraq and Afghanistan. Iraq had fairly sophisticated medical infrastructure and care available, so patients could often be transferred to local national medical facilities for follow-on care. In Afghanistan, however, specialized medical care was virtually nonexistent outside of NATO facilities, so nearly all definitive care needed to occur prior to discharge from the CSH.

The variability of CSHs is extreme, ranging from state-of-the-art fixed facilities in the middle of large cities to tent hospitals situated in remote areas of the desert (Figure 27-4). Available surgical specialties and equipment vary as well, and CSHs often lacked surgeons with head and neck reconstructive skills.

Location

Medical assets in OIF and OEF are arranged so that injured patients can be treated and evacuated to higher levels of care based upon acuity of injury. Lifesaving measures are performed at or near the point of injury, and patients are transported to higher roles of care after stabilization. The CSH constitutes the most advanced military medical care available in the combat theater, and nearly all head, face, and neck reconstructive surgeries were performed in US CSHs. In Afghanistan and many parts of Iraq, the CSH also offered the most sophisticated specialty and surgical care available to wounded local nationals.

Figure 27-4. US expeditionary combat support hospital in Helmand Province, Afghanistan, 2010.

Timing

Much controversy surrounds the timing of reconstructive surgery for traumatic defects. In the civilian trauma literature, Godina demonstrated increased flap failure and complications when microvascular free tissue transfer was performed more than 72 hours after injury.[44] Similar findings of decreased complications with early free flap coverage are reported in multiple other studies. When surgery is not possible within the first 3 days, many recommend a delayed reconstruction until all wounds are clean and infection is controlled.[44–46]

Wounds from combat trauma in OIF and OEF, however, are significantly different than those seen in civilian trauma centers. The vast majority of battlefield injuries are due to IEDs and high-velocity gunshots, both of which tend to cause heavily contaminated wounds. In addition, many patients have multiple injuries requiring aggressive resuscitation and stabilization, as well as multiple surgical procedures and washouts of wounds prior to definitive reconstructive surgery. For these reasons, from either a systemic or wound-specific standpoint, most trauma patients are not ready to undergo reconstructive surgery within 72 hours. All of the free flaps in one series from OIF and OEF were performed within 1 month of injury, the so-called subacute period when Godina reported the highest microvascular failure rate after trauma. Time constraints may have been a contributing factor in the total flap failure rate in this series (9.7%) compared to flap failure rates in the literature (1%–3%). Further delaying reconstructive surgery might be optimal for patient outcome, but delays place significant stresses on critical medical resources in the combat theater.

Bed Space

In a combat zone, one invariable responsibility of military surgeons is to take into account the success of the overall mission. With the constant potential for mass casualties, maintaining available bed space is a high priority at all medical facilities. For injured US and NATO service members, prompt evacuation out of the combat theater after stabilization is standard practice, ensuring medical assets are available for future casualties. For wounded local nationals in OIF and OEF, however, options for definitive medical and surgical care outside of a CSH are limited or nonexistent. These patients often remain in the CSH until either treatment is complete or similar care is available at a local facility. Reconstructive surgery on local national patients is often performed at the earliest opportunity, once the patient is stable and involved wounds are clean, regardless of time since injury.

Follow-up and Rehabilitation

Optimal functional outcomes after head, neck, and face reconstructive surgery are achieved with aggressive therapy for speech and swallowing rehabilitation. The vast majority of local national patients treated at US and NATO facilities in OIF and OEF did not have access to rehabilitative care once discharged. Responsibility for follow-up care rests with local providers, who are frequently either overwhelmed with other patients, lack necessary skills, or are simply nonexistent.[47] Due to both poor long-term follow-up and lack of postoperative rehabilitative services, it is unclear how much injured local national patients ultimately benefitted from reconstructive surgery despite excellent swallowing at the time of discharge.

Military Mission

The role of the US military in combat operations continues to evolve and often includes both nation-building and support of host-nation forces. As the overall military mission changes, the deployed medical team must remain flexible. Inevitably, combat casualties will include local national personnel and adequate care may not be available outside of US medical facilities. From both a diplomatic and humanitarian standpoint, it is often beneficial to provide an advanced level of care to local nationals injured in the combat zone.

SUMMARY

Reconstructive surgery for complex head, neck, and face defects in a combat zone is a critically important task and can be performed successfully in a variety of settings, including relatively austere conditions. Functional outcomes after reconstruction performed in the combat setting are generally excellent and may improve the quality of life of local national injured patients. Major US combat hospitals deployed to a war zone should consider including personnel who are trained and capable of performing complex reconstructive procedures of the head, face, and neck and who understand the many nuances of optimizing outcomes in this challenging environment.

CASE PRESENTATIONS

Case Study 27-1

Presentation

A 23-year-old Afghan civilian was transferred from a British Role 3 facility in Afghanistan to a US Role 3 facility 3 days after sustaining a left face shotgun wound. The patient also suffered an above-knee amputation (AKA) from a high-velocity gunshot wound and had undergone resuscitation, debridement of his wounds, tracheotomy, and gastrostomy tube placement on the day of injury. Because no reconstructive surgeon was available at the British facility, the patient was referred for facial reconstruction.

Physical examination revealed massive left facial bone and soft tissue loss including left oral commissure, half of the upper lip and one-third of the lower lip; 10-cm left full-thickness cheek and chin skin; left mandible from parasymphysis to condyle; left maxilla and hemipalate from canine to maxillary tuberosity, with orbital rim and floor preserved; and partial-thickness left nasal sidewall and alar rim (Figure 27-5a,b).

Preoperative Workup/Radiology

A computed tomography scan confirmed the physical exam findings, including the bony defects of the maxilla and mandible described above.

Operative Plan/Timing of Surgery

On the day after transfer, the patient was brought to the operating room and underwent wound irrigation and debridement, ORIF of the comminuted right maxillary fracture, and maxilla-mandibular fixation with arch bars. After surgery, a detailed discussion of the possible reconstructive options was undertaken with the patient through an interpreter. With the large, complex defect, a regional or microvascular free flap was felt to be the best option to restore adequate function and cosmesis, while minimizing donor-site morbidity.

The patient underwent a right (contralateral to his AKA) anterolateral thigh free flap on day 3 after transfer. The flap size was 10 by 30 cm and the donor site was closed primarily (Figure 27-5c,d). After inset, the patient had acceptable cosmesis and was able to speak

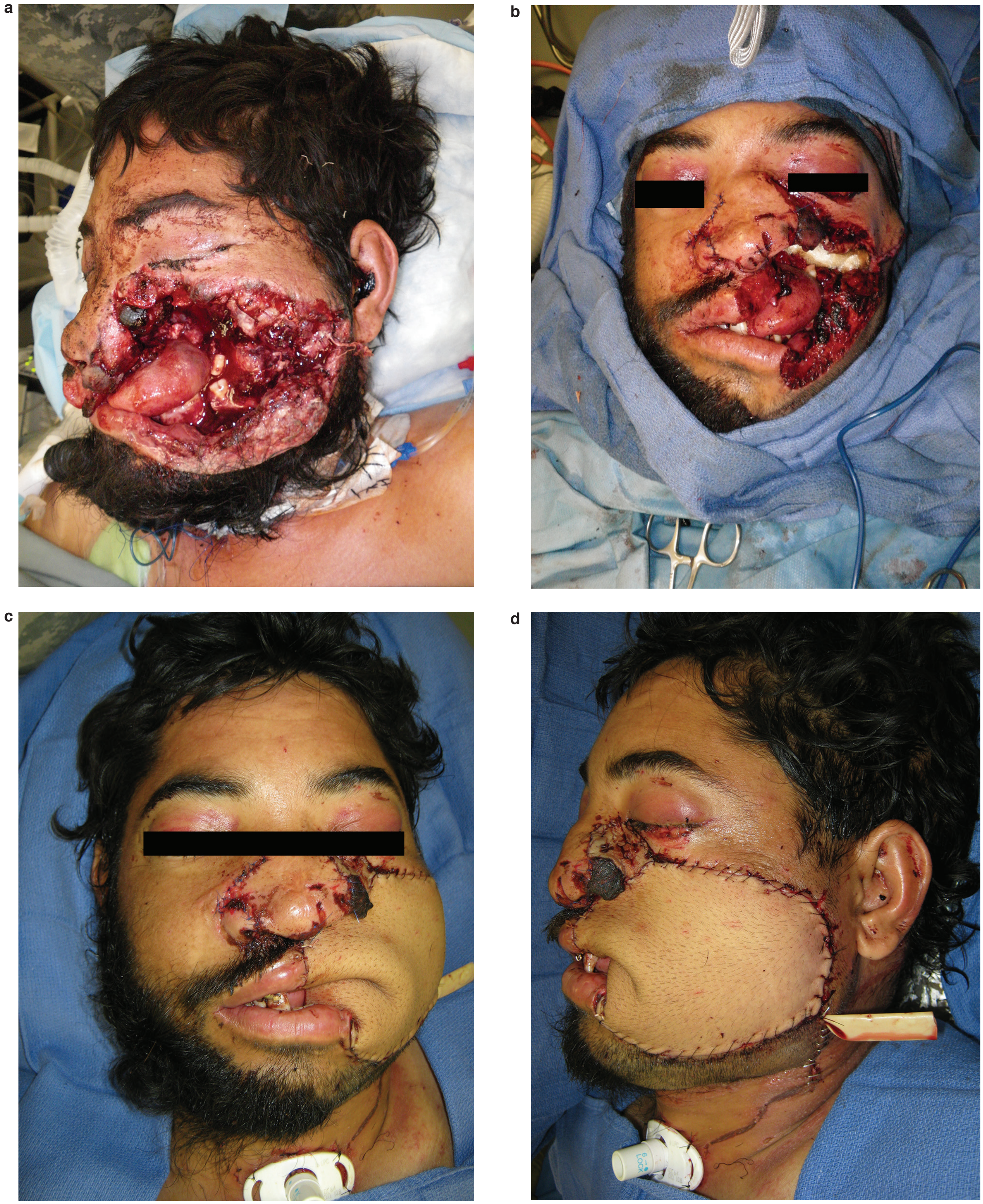


Figure 27-5. (**a**) A 23-year-old Afghan male 3 days after a shotgun wound to the left face. Note the extensive soft and bony tissue loss. (**b**) Patient after initial debridement and plating of bilateral midfacial fractures. (**c, d**) Patient immediately following definitive reconstruction with anterolateral thigh free flap.

with his tracheotomy tube capped 3 days after his final surgery. The patient was transferred to an Afghan local medical facility for further recovery 10 days after initial transfer. He was able to swallow liquids at the time of discharge, but had oral incompetence. There is no long-term follow-up available.

Complications

None.

Lessons Learned

Long term, the patient's opportunity for dental prosthetic rehabilitation was virtually nonexistent, so bony reconstruction was not a high priority. A large, pliable soft-tissue flap was felt to be the best option for reconstructing the complex, composite defect. His recent traumatic AKA would likely require the patient to use crutches or a wheelchair for the rest of his life; core strength and the latissimus muscles are critical in using both of these, so the donor site needed to minimize morbidity to these areas. The anterolateral thigh free flap was decided to be the best option because a large, pliable flap could be harvested with the only likely long-term donor site morbidity as numbness along the incision and lower lateral thigh.

Case Study 27-2

Presentation

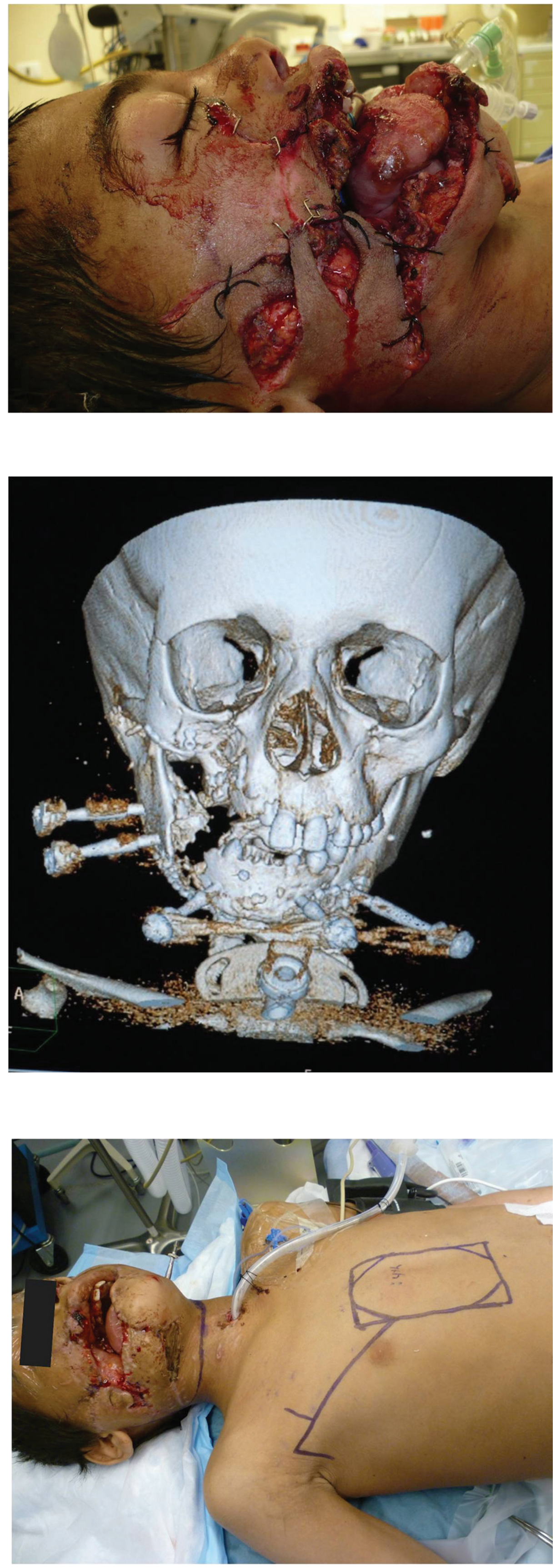
A 10-year-old Afghan boy was involved in an IED blast 3 days prior to transfer from a British Role 3 facility. The patient suffered right facial and upper extremity wounds including a right partial hand amputation. Prior to transfer, he underwent I&D of his wounds and complete right hand amputation.

Physical examination revealed a large right cheek and face complex tissue defect including the right buccal mucosa; right oral commissure; right cheek, chin, and neck skin; right segmental mandible from parasymphysis to angle; and right maxilla and alveolar ridge from the right lateral incisor to the maxillary tuberosity, with orbital rim and floor preserved (Figure 27-6a).

Preoperative Workup/Radiology

Because the patient was clinically stable and had undergone extensive imaging prior to transfer, the decision was made to perform a wound exploration and debridement, maxillomandibular fixation with external fixation, and a tracheotomy and a percutaneous gastrostomy tube prior to any further radio-

a b c



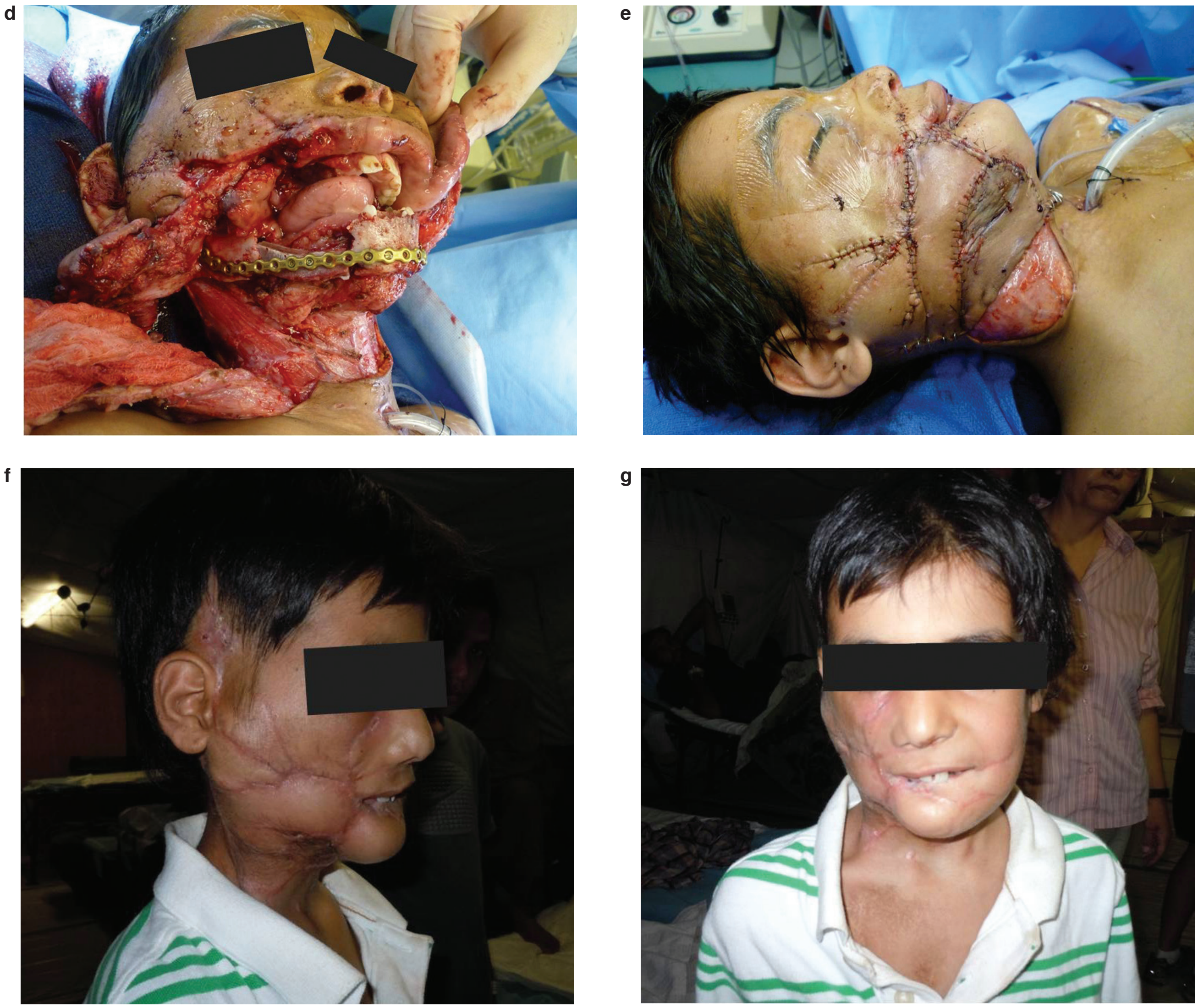


Figure 27-6. *Facing page and above.* (**a**) A 10-year-old Afghan boy 3 days after an improvised explosive device injury. (**b**) A 3-dimensional reconstructed image from a computed tomography scan done the day after transfer. Note placement of a tracheotomy and external fixation of the mandibular fracture with segmental loss of the right mandibular body. (**c**) Pectoralis major myocutaneous flap marked on the patient's chest. (**d**) Iliac crest cortico-cancellous bone graft screwed in place with a mandibular reconstruction bar. The pectoralis major flap is visible coming out of the neck incision on the right prior to inset. (**e**) At the end of the case, local flaps and skin graft are sutured in place. (**f, g**) Six weeks after surgery, the patient has good function and acceptable cosmesis.

graphic studies. Computed tomography including three-dimensional reconstruction confirmed the bony defects (Figure 27-6b).

Operative Plan/Timing of Surgery

A detailed discussion of the possible reconstructive options was undertaken with the father of the patient through an interpreter. With the large, complex defect, a regional or microvascular free flap was felt to be the ideal reconstructive method to restore adequate function and cosmesis, while minimizing donor-site morbidity. Because the otolaryngologist/head and neck surgeon did not perform microvascular surgery, he decided on a free iliac crest bone graft for mandible reconstruction, along with a right pectoralis major myocutaneous flap with split-thickness skin graft for the mucosal and skin defects.

On the day of surgery, an orthopedic surgeon harvested an appropriate-sized left iliac crest bone graft while the pectoralis major flap was harvested (Figure

27-6c). The bone graft was then fixed to the mandible using a mandibular reconstruction plate (Figure 27-6d). The skin paddle of the pectoralis major flap was then inset to the mucosal defect, allowing the attached muscle to drape over the bone graft and surrounding mandible. Skin edges of the right facial wound were then freshened and closed around the muscle of the flap. A split-thickness skin graft was harvested from the left thigh and applied to any muscle not covered with cheek skin (Figure 27-6e).

The patient recovered well and was decannulated 5 days after reconstructive surgery. He was discharged on a soft diet 7 days after surgery. Follow-up 6 weeks later revealed excellent wound healing, good mouth opening and oral competence, and acceptable cosmesis (Figure 27-6f,g).

Complications

None.

Lessons Learned

Planning and teamwork are imperative to successful outcomes in a low-resource setting. In this child with a devastating facial injury, the only option for one-stage reconstruction of missing bone, mucosa, and skin was a microvascular free tissue transfer from a remote location such as the fibula, radial forearm, or subscapular system. However, when microvascular skills are not available, regional flaps such as the pectoralis major myocutaneous flap are extremely reliable. In an adult, it may have been possible to harvest a section of rib for mandibular reconstruction as part of an osseomyocutaneous flap, but the rib in a child would be too soft and unreliable for withstanding the forces of mastication. For these reasons, an iliac crest bone graft was utilized and then surrounded by healthy pectoralis muscle. The patient had an excellent outcome considering the extensive damage from the IED.

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