



FRONTLINES OF EYE CARE

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Head and Neck Team surgeons repair an orbital fracture at Joint Base Balad, Iraq. (Source: U.S. Air Force)

► FEATURE

THE TRINITY: THE HISTORICAL ORIGINS, RATIONALE, AND FUNCTIONS OF THE MILITARY'S DEPLOYED HEAD AND NECK TEAM

As the use of high-energy explosive devices has increased with each military conflict, so has the frequency of multisystem trauma involving the head, neck, and eye. The recognized combination of these injuries in modern warfare drove the creation of Head and Neck surgical teams composed of co-located neurosurgical, otolaryngology/maxillofacial, and ophthalmic specialists (colloquially known as “The Trinity”) at certain locations in the combat zone. First employed by the British Army in WWI and rapidly adopted by

the United States, the continued and increasing frequency of this injury complex in the wars of the last 100 years argues for continuation of this practice. The co-location of this same capability is equally critical at rearward facilities to ensure the best reconstructive and rehabilitative outcomes by team management. The Eye Surgical Team component—a three-ophthalmologist team in the current Army model—comprises anterior segment, posterior segment, and oculoplastic/orbit sub-specialists, a “sub-Trinity” reflecting the predominant

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components of ocular polytrauma injuries. This report will consider the evolution, rationale for, and the function of the deployed Head and Neck surgical team.

OPHTHALMOLOGY IN PEACE AND WAR

During peacetime, the average ophthalmologist in private or academic practice is rarely, if ever, confronted with more than a single injured individual who, most often, has only limited and isolated ocular trauma and does not require a team approach for injury management. It is quite the opposite in a combat zone, where multiple casualties with both ocular and general polytrauma are the rule and teams of specialists and sub-specialists are needed simultaneously to provide appropriate comprehensive management of injured individuals. As a critical member of a Head and Neck Team, a deployed ophthalmologist may be required to assist with the care of neurosurgical and facial injuries in addition to managing ocular trauma. Thus, deployed ophthalmologists are involved in more aspects of the care for life, limb, and eyesight than ophthalmologists who practice stateside. The presence of ophthalmologists on the Head and Neck team is essential for the effective management of multi-system injuries and can enhance the capability to treat such injuries at the combat support hospital (CSH) in which they operate.

HISTORICAL ORIGINS OF THE HEAD AND NECK TEAM OF SPECIALISTS KNOWN AS "THE TRINITY"

The Trinity is a long-established concept in military medicine. In WWI, the term was initially used to describe the complex of eye, head, and neck injuries, and eventually evolved to describe the team of specialists treating these injuries. Duke-Elder¹ described in *System of Ophthalmology* that the combined ophthalmic, neurosurgical, maxillo-facial injuries observed during WWI colloquially became known as "The Trinity." The need for designated eye centers, where eye injuries could be transported and treated, was soon realized by the British Eye Service. Five eye centers were established by the British at the front, which were typically staffed with one ophthalmologist who was capable of treating mild cases such as corneal foreign bodies and conjunctivitis and, if needed, stabilizing serious ocular injuries before they were transported to base hospitals for more specialized care. The British also established six eye centers at base; three large centers (with 140 beds) located in Boulogne, Étaples, and Rouen, and three smaller centers (40 beds) located in Calais, Le Tréport, and Le Havre.² The advantages of a special hospital devoted to the surgical management of head injuries that also include injuries to the eye, ear, nose, and throat became apparent. The grouping of special centers (i.e., eye centers, jaw

centers, etc.) would enhance the surgical teams' capability of managing this group of injuries.² Based on the experiences of the British military, U.S. Army medical authorities were quick to realize that the overwhelming numbers of head injuries required the establishment of a designated "head hospital" combining the expertise of four separate surgical specialties: ophthalmology, otolaryngology, neurosurgery surgery, and oral and plastic (maxillofacial) surgery, to provide appropriate and comprehensive casualty care. This led to the establishment of Special Base Hospital 115 at Vichy, France, commanded by LTC EC Ellett, a prominent U.S. ophthalmologist, in September 1918. At Base Hospital 115, which originally functioned as a general hospital, "a very creditable ophthalmic clinic was built up, and had the war continued a vast amount of material would have been handled. Enough was accomplished in a short time, however, to more than justify the organization of the special hospital for surgeries of the head."³ Additionally, the United States established eight base hospitals in Europe, each with a co-located ophthalmologist and otolaryngologist to care for these multi-system injuries.² In the United States, the need for multidisciplinary care for head, neck, and eye injuries was recognized soon after casualties from the European theater of operations began to arrive stateside during WWI. Thus, six stateside base hospitals with co-located ophthalmologists, neurosurgeons, and ENT/maxillofacial surgeons were established and designated as eye centers to provide definitive care for patients with head, face, eye, and neck polytrauma. These were located at Williamsbridge, NY (U.S. Army General Hospital (GH) 1); Fort McHenry, MD (U.S. Army GH 2); Fort McPherson, GA (U.S. Army GH 6); Cape May, NJ (U.S. Army GH 11); Walter Reed Hospital, Takoma Park, DC; and Letterman General Hospital, San Francisco, CA.⁴ Additionally, U.S. Army GH 7 was established at a private estate known as "Evergreen" in Roland Park, MD, to provide rehabilitative services to blinded soldiers. Like most U.S. facilities during WWI, these base hospitals were short-lived due to the



General Hospital 11 at Cape May, NJ became one of the six stateside hospitals that were designated as Eye Centers during WWI. (Source: U.S. Army)

United States' brief participation in the war. The majority of these GHs were only operational from 1918-1919.⁴ [ED: It is interesting to note that, in contrast to the recognition and establishment of six stateside specialty eye centers (and a similar number of secondary eye specialty hospitals) in WWI, no similar designation or recognition of eye specialty treatment centers has occurred in the current conflict, despite the increasing complexity of ocular injuries and correspondingly complex reconstructive surgeries requiring ophthalmic sub-specialty expertise.]

Early reports of The Trinity as a team of specialists have described its historical origins during WWII. In *History of the Second World War: Surgery*, Cope⁵ stated: "The principle laid down in the War of 1914-18 that the ophthalmic surgeon should be brought as far forward as possible so as to be near his potential patients, proved basically sound. Mobile ophthalmic units were sited at the first bottleneck in the medical line of evacuation. The regimental-aid personnel applied the first dressing and then the ophthalmic casualties were transferred to the ophthalmic units as quickly as possible. At these units urgent operations only were performed, the regular administration of sulphonamides and penicillin was initiated and the cases were evacuated by air, road or rail to the ophthalmic wing of the base hospital. In general, it was found that ophthalmic casualties formed 2.5 percent of all casualties in battle. When ophthalmic casualties were grouped with neurosurgical and maxillo-facial cases the combined group might total 10% of the whole. These three special groups had begun to be grouped together at the end of the War of 1914-18 and this was the rule in the War of 1939-45, when the three specialties were brigaded at the first medical evacuation bottleneck. These combined units acquired the nickname of 'The Trinity' and did excellent work which can best be judged by the results."⁵ The continued increase in head and neck polytrauma involving the eye was noted in WWII. Ocular injuries were associated with one-third of maxillofacial injuries and

between 20-40% of head injuries observed during WWII.⁶

Though the term has fallen out of use, the military medical realities that led to its adoption remain and will be considered next.

RATIONALE FOR THE HEAD AND NECK TEAM

War trauma is polytrauma in which severely wounded patients often suffer from multi-system injuries that require a team approach to trauma care.⁷ The presence of a Head and Neck Team facilitates timely and effective management of polytrauma and minimizes the need to transport severely injured patients. Zorab⁸, a British Army ophthalmologist in WWII, describes the successful implementation of the Head and Neck team in early conflicts: "For more than six months, I was associated at various Casualty Clearing Stations (CCSs) with the advanced sections of a maxillo-facial and a neurosurgical unit, often sharing an operating theater and an anaesthetist. This association, which came to be widely known as 'The Trinity,' was most satisfactory from all points of view and enabled all wounds occurring above the neck to be dealt with at one centre, with one anaesthetic, and, not the least important, it gave all three specialists valuable experience in other closely allied specialties."

Combat in the 20th and 21st centuries has been associated with a significantly increased use of high-energy explosive weapons with greater levels of fragmentation. The use of Kevlar helmets has been effective in shielding the head in combat, but the face and neck remain largely unprotected. Anti-ballistic eyewear is currently the only available method of protection for the face, however its utilization by Service members in combat is not uniform.⁹ This has resulted in an increased incidence of both blunt and penetrating ocular, head, face, and neck injuries associated with the effects of the blast as well as the debris and fragments propelled out from the blast site. A review of war injuries from 1914 to 1986 reported that head and neck injuries were present in 16% of total injuries sustained, and these injuries were more prevalent in terrorist attacks than in conventional warfare.¹⁰ Reports from recent theaters of conflict in Iraq and Afghanistan indicate an increase in the incidence of head and neck injuries. Wade et al.¹¹ reported that head, face, and neck injuries were present in 39% of Service members examined during Operation Iraqi Freedom (OIF) II, with improvised explosive devices (IEDs) causing 64% of these injuries. Other reports (Table 1) provide additional

TABLE 1. Incidence of Head, Face, and Neck Injuries Reported in Recent Theaters of Conflict.

Author (Year)	Theater of Conflict	Population	Head, Face, and Neck Injuries (% of total injuries)
Beekley et al. (2004) ¹²	Afghanistan	U.S. Military, Coalition Troops, Afghani National Forces	17
Belmont et al. (2010) ¹³	Iraq	U.S. Military	36
Breeze et al. (2011b) ¹⁴	Afghanistan	U.K. Military	21
Breeze et al. (2011c) ¹⁵	Iraq and Afghanistan	U.K. Military	29
Kosashvili et al. (2005) ¹⁶	Israel	Israeli Military	18
Lakstein et al. (2005) ¹⁷	Israel	Israeli Military	54
Lew et al. (2010) ¹⁸	Iraq and Afghanistan	U.S. Military	26
Patel et al. (2004) ¹⁹	Iraq	U.S. Military	22
Wade et al. (2007) ¹¹	Iraq	U.S. Military	39
Xydakis et al. (2005) ²⁰	Iraq and Afghanistan	U.S. Military	21



Multi-system injuries involving the head, neck, face, and eyes, during WWI established the need multidisciplinary care by a Head and Neck Team.

evidence of the rise in incidence of head and neck injuries in recent conflicts.

Because of the close anatomic proximity of these organs and structures, it is likely that combat injuries to these areas will occur simultaneously and will include ocular injuries. In OIF, Operation Enduring Freedom (OEF), and Operation New Dawn, eye injuries were noted in 20% of Service members medically evacuated for treatment of blast-related head and face injuries.²¹ Cho et al.²² reported that in OIF alone, 21.5% of patients with ocular trauma also sustained cranial injuries and 32.7% of patients with cranial injuries also sustained ocular injuries, the majority of which were caused by IED explosions. Patients with cranial injuries were also found to have a higher incidence of concomitant orbital fracture, orbital compartment syndrome, and other multiple ocular injuries.²² Studies have also examined the coexistence of traumatic brain injury (TBI) with ocular trauma. Colyer et al.²³ reported TBI in 24 of the 61 U.S. soldiers (39%) with perforating globe injuries examined during OIF. Weichel et al.²⁴ reported that the incidence of combat ocular trauma with coexisting TBI was 66% in U.S. Service members injured during OIF and OEF.

Evaluation and treatment of concomitant

head, neck, and eye injuries requires expert knowledge of the anatomy and physiology of these regions. In cases of orbital trauma, adjacent non-ocular structures such as the nose, midface, jaw, and brain can also be affected. It is critically important to recognize and acknowledge that specialists in one area often lack the training and experience to provide care for injuries in contiguous structures; the ophthalmologist lacks familiarity with neurosurgery, and vice versa. While it is important for each individual specialty to be familiar with the procedures and techniques of the other, it is impossible for one surgeon to be an expert in the other disciplines. Basic familiarity of the other specialties is not a substitute for the presence of the actual specialist. Therefore, timely and efficient management of such injuries requires a multidisciplinary approach consisting of ophthalmology, neurosurgery, otorhinolaryngology, plastic surgery, and oromaxillofacial surgery, thereby preventing needless and inappropriate stop-overs.²⁵ Retired Army COL Francis La Piana, MC USA, had the unfortunate (for the casualty) experience of having a wounded soldier evacuated to his Field Hospital in Vietnam with eye, midface, and neurosurgical injuries [see <https://vce.health.mil/Resources/Products/Newsletters/Frontlines-of-Eye-Care-Spring-2017>]. Because the hospital did not have a neurosurgeon assigned to it, the casualty had to be reloaded on the MEDEVAC helicopter and flown to a military treatment facility (MTF) with a full Head and Neck Team, resulting in delayed treatment of all injuries. It was judged that neurosurgical considerations were primary in this casualty despite the realization that transfer of casualties can have deleterious effects on the injured eye. This type of problem can be prevented by intimate knowledge of theater assets possessed by United States and allied forces, as well as efficient in-theater patient medical regulation to appropriately staffed facilities. The implementation of theater specialty consultants and Theater Trauma Systems has proven to be a critical component in improved outcomes.²⁶ These lessons learned, and re-learned, were acted

upon successfully in the Iraqi insurgency. During his deployment to Iraq, retired Army COL Thomas Mader, MC USA, was fortunate to have the support of neurosurgeons and maxillofacial surgeons at his CSH:

“We found that a close working relationship between maxillofacial surgery, neurosurgery, and ophthalmic surgery provided an effective environment for surgical management of head and neck injuries. The importance of this concept is underscored by the fact that, of the 207 patients with severe ocular and ocular adnexal injuries, 128 were associated with coexisting face, intracranial, or neck injuries. Once a wounded patient was stable for transport, all patients in Iraq with serious eye, head, or neck injuries were transported by helicopter to the 31st CSH. Because many patients were wounded in and around Baghdad, sometimes very near the location of our hospital, we were in an ideal geographic location to provide timely care for the wounded. At this location, a head and neck surgical team composed of neurosurgeons, maxillofacial surgeons, ophthalmic surgeons, and intrinsic anesthesia personnel were available. As demonstrated in previous conflicts, this surgical team concept, with routine access to computed axial tomography, proved to enhance greatly the surgical capabilities of the CSH.”²⁷

Polytrauma casualties (see page 5) illustrate the importance of the Head and Neck team. The casualty sustained injuries from a rock penetrating the nose and then penetrating through the medial right orbit and into the intracranial space. The presence of a Head and Neck Team at a facility enables appropriate and timely treatment for casualties with polytrauma and reduces the need for subsequent surgical procedures.

RATIONALE FOR THE EYE TEAM COMPONENT OF THE TRINITY

The Eye Team component of the Head and Neck Team comprises a sub-trinity of three ophthalmologic sub-specialists: (1) Anterior segment sub-specialist providing expert care for corneal, lenticular, and

anterior scleral injuries; (2) Posterior segment sub-specialist providing expert care for retino-vitreous and posterior scleral injuries and management of intraocular foreign bodies, if necessary; and (3) Oculoplastic/orbit sub-specialist providing expert care for ocular adnexal injuries of the eyelids and lacrimal secretory and excretory structures, and for injuries of the orbit walls and non-globe intraorbital soft tissue structures. The level of expertise possessed by these Eye Team members is necessitated by the complexity of ocular injuries for which they must provide the best possible care. Ocular trauma in recent conflicts has been characterized by injuries to multiple ocular anatomical zones, categorized into zone 1 (conjunctiva, external cornea), zone 2 (iridocorneal angle, iris, lens), and zone 3 (vitreous, retina, choroid, macula, optic nerve).²⁸ In Iraq and Afghanistan, 50% of Service members with blast-related closed-eye injuries were found to have sustained injuries to multiple ocular zones.²⁸ In another study, 32% of open-globe injuries evaluated at a CSH involved injuries to all three zones.²⁹ The frequency of ocular polytrauma necessitates the doctrinal

establishment of this trio of ophthalmologists to form the Eye Team component of The Trinity. The functions of an ophthalmologist cannot be completed by any other surgical specialty. While oral surgeons may have the expertise to repair maxillofacial injuries typically managed by otolaryngologists and general surgeons may have the ability to perform craniectomies, no other surgical specialty receives the training necessary to perform ophthalmic surgery. Due to this high level of specialization required to manage ocular trauma, ophthalmic surgeons are an indispensable component of the Head and Neck Team.

The current military practice of deploying a single ophthalmologist to the combat zone has been made possible by air supremacy and the military's aeromedical evacuation capabilities, which have nearly eliminated the need for providing definitive eye care at the point of injury. In these circumstances, stabilizing the globe in accordance with Damage Control Ophthalmology (DCO) principles becomes the primary objective, followed by the evacuation of the casualty to and from all echelons of theater care to a Level

4 facility if more specialized eye care is needed. However, the United States may not have the benefit of unimpeded aeromedical evacuation in future conflicts, potentially causing delays in the evacuation of casualties and requiring prolonged field care. In such instances, deployed ophthalmologists may be required to perform more definitive surgeries in theater involving procedures that will likely require the presence of ophthalmologic sub-specialists in theater rather than at a Level 4 facility.

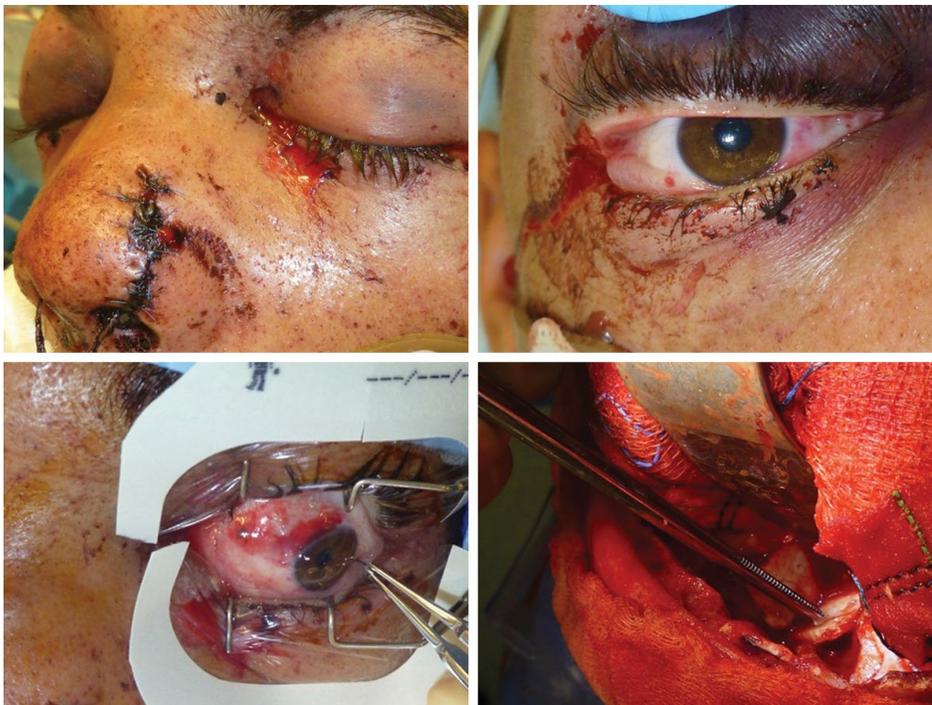
FUNCTIONS OF THE EYE TEAM AS PART OF THE HEAD AND NECK TEAM

The Head and Neck Team provides multidisciplinary care and requires the integration of surgical specialties: "...head and neck [team] provides special surgical care for ear-nose-throat surgery, neurosurgery, and eye surgery to support the Combat Support Hospital plus specialty consultative services... the hospital team (head and neck) is the only organization authorized a CT scanner."³⁰ However, realizing that PANSCAN CT has proven its utility for trauma surgery during current conflicts, a CT will likely be more available in theater in the future.

The Head and Neck Team functions best when supported by CT scan capability, skilled and experienced operating room nurses and supporting personnel, and required equipment and supplies. The theater consultant (or equivalent) should be responsible for ensuring the availability of necessary equipment and personnel in theater. Additionally, the service consultants must coordinate with logisticians to ensure that equipment kits are appropriately constructed, well-maintained and up to standard, and are adequate for the mission.

In conjunction with other care providers, the Head and Neck Team at a deployed Level 3 CSH has as its mission the saving of life, limb, and eyesight. The Eye Team component applies the principles of DCO to preserve vision and the integrity of adnexal structures, in such a way as to

Polytrauma of the head, neck, and face requiring multidisciplinary treatment. Repair of the left open globe was performed by an ophthalmologist, and a neurosurgeon performed a craniotomy to remove the rock from the posterior orbit.





Penetrating injury of the orbit and head. (Source: Dr. Laughlin Dawes, MBBS)

facilitate the performance of further reconstructive surgery, if necessary. All deploying ophthalmologists are expected to be proficient in DCO principles such as open-globe repair, primary lid repair, and primary enucleation; these repairs must be meticulous enough to stabilize the eye and allow for more complex and definitive procedures at higher echelons of care. Ocular tissue is typically not amenable to revision surgeries. Therefore, the first repair is often final and definitive in predicating the outcome. However, Eye Team members must provide more definitive care when faced with the expectation of delayed patient transportation due to impeded aeromedical evacuation or when treating host-nation patients who lack access to specialized eye care. Our recent conflicts have taken place in countries where indigenous medical facilities are often deficient and/or unavailable to both civilians and combat injured military personnel. Many of these individuals frequently seek care in United States MTFs. This reality requires careful deployment planning to provide appropriate personnel (physicians and their supporting personnel), equipment, and

supplies to meet additional humanitarian needs. In the experience of the Army during OIF and OEF: "While most injured U.S. service members are stabilized for evacuation to a Level IV or V medical facility for definitive care, the deployed surgeon will be expected to provide definitive care to injured host nation patients, security forces, and detainees."³¹ Per Department of Defense Instruction 6200.7 *Delivery of Direct Health Care to Non-Detainee Host Nation Civilians*, when delivering care to host nation civilians, "Use professional judgments and standards similar to those applied to treatment of personnel of the Military Services in comparable circumstances, particularly in situations that would otherwise likely result in loss of life, limb, or eyesight."³² This principle provides further justification for the inclusion of the ophthalmic sub-trinity of anterior segment, posterior segment, and oculoplastic sub-specialists on the Eye Team.

The need to provide Eye Team sub-specialists in war necessitates the establishment and support of sufficient fellowship positions so that the demand for sub-specialists can be met.

Ophthalmologists may be expected to assist surgeons in other fields in their patient care, if not actively engaged in caring for eye patients. Furthermore, the Tri-Service Ocular Trauma Course can provide opportunities to exchange knowledge among specialists on the Head and Neck Team. The successful implementation of a Head and Neck Team, as well as its Eye Team component, is predicated upon the establishment of cross-training in the practice of trauma management for all members of the Head and Neck Team and the Eye Team. Additionally, all members of the Head and Neck Team must be knowledgeable of the functions of their colleagues' specialty, which can be facilitated by the establishment of clinical rotations in the other specialties as part of internships, residency programs, fellowships, and pre-deployment team trainings. The establishment of training opportunities and knowledge-sharing can improve the functionality and readiness of neurological, maxillofacial, and ophthalmic surgeons should they be deployed as part of an operational "Trinity."

As the incidence of combined combat head, face, neck, and eye injuries continues to rise, so does the need for a Head and Neck Team, "The Trinity," to best manage these injuries. The Eye Team, a "sub-Trinity," when fully staffed with deployed anterior segment, posterior segment, and oculoplastic/orbit sub-specialists offers the best opportunity for definitive surgery as far forward as possible. The evidence accumulated and re-verified over the past 100 years clearly indicates that the multidisciplinary approach of The Trinity is the correct way to provide timely and effective management of head and neck polytrauma in war and may be needed in future wars. 

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TRAUMA & DAMAGE CONTROL OPHTHALMOLOGY

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VISION CENTER OF EXCELLENCE FOCUS ON CARE OF HEAD AND NECK INJURIES

Emergency management of ocular trauma and damage control ophthalmology (DCO) are necessary for both the ophthalmic and non-ophthalmic communities. To this end, VCE is sharing quarterly emergency management tips for the non-ophthalmic communities as well as DCO principles specifically for the ophthalmologist.

In this issue of Frontlines, we share principles for treatment of ocular injuries concomitant with head, facial, and neck injuries.

Head and neck injuries are initially managed by forward surgical teams (FSTs) or facilities that may not include neurosurgeons, maxillofacial surgeons, or ophthalmologists. Therefore, it is imperative for FSTs and



Otolaryngology and facial plastic surgeons perform a facial reconstruction on a patient at the Craig Joint Theater Hospital, Afghanistan. (Source: U.S. Air Force)

any non-ophthalmic providers to be aware of the high incidence of ocular injuries that occur with head and neck polytrauma. The complexity of combat-related head injuries usually necessitates co-management by a team of specialty trained surgeons, the Head and Neck Team, comprising neurosurgery, ENT/maxillofacial surgery, and ophthalmology specialists, colloquially known as "The Trinity" [\[Click to see Feature article\]](#).

These surgical specialists must be deployed as a unit at strategically located Combat Support Hospitals (CSHs). These CSHs must also possess CT scanning capability, the necessary support staff, equipment, and supplies. Within the Head and Neck Team, the ophthalmology component (the Eye Team) is optimally comprised of anterior segment, posterior segment, and oculoplastic/orbit sub-specialists, especially if more definitive ophthalmic surgery is required in theater. The presence of a Head and Neck Team Trinity at the CSH benefits the providers as well as the patients.

Further principles regarding combat-related ocular trauma need to be developed and formalized. VCE is

currently developing DCO principles, which will encompass the following: *Necessity, Urgency, Adequacy, and Avoidance.* **V**

Necessity - Addresses aspects of care that must be applied at a particular point of care prior to transfer to the next level of care. The need for immediate intervention largely depends on severity of injury.

Urgency - Addresses the time frame in which any necessary treatment or intervention must be performed. Severity of injury will dictate urgency with which the eye must be treated.

Adequacy - Addresses how meticulous or definitive repairs must be. Repairs for severe injuries must be meticulous, where the first repair is typically the final one. However general practitioners and ophthalmologists must also identify injuries for which repairs can be ignored, or be temporized and revised later.

Avoidance - Addresses interventions that should not be performed in order to effectively manage the eye injury.

Emergency Management of Ocular Injuries: For Non-Ophthalmic Providers

PRINCIPLE 1: Suspect severe eye injury in any casualty with head, neck, and facial injuries, who has:

- Been in the vicinity of an explosion
- Fragment wounds of the head, neck, or face and/or foreign bodies embedded in the eyelids and periocular area
- Any laceration or injury to any part of the eye/lid that would otherwise be protected by spectacles or goggles
- Loss of vision following any injury involving the face, eyelids, or globe
- Foreign bodies embedded in the cornea, conjunctiva, or globe
- Intraocular contents such as iris, lens, vitreous, retina, or choroid/uvea outside the eye. Prolapsed tissue may look like debris, such as dirt or other foreign object. Be careful not to wipe this away
- An abnormally deep or shallow anterior chamber (the space between the cornea and the iris-pupil)
- A pointed/peaked rather than a round pupil
- Blood in the anterior chamber or back of the eye that blocks the normal red reflex
- Subconjunctival blood, especially if dark brown and elevated like a thickened clot
- Clear fluid leaking from the eye
- Decreased eye movements
- A deformed globe

PRINCIPLE 2: Do not put pressure of any type on an injured eye.

- Applying pressure may extrude intraocular contents and thereby convert a repairable eye injury to a non-repairable one
- Do not attempt to measure intraocular pressure
- Do not patch the eye
- Do not perform ultrasound on an open eye
- Do not allow head wrap to go over an unshielded eye

PRINCIPLE 3: DO NOT attempt to repair an injured eye. Just SHIELD AND SHIP.

- Do not attempt to repair an open-globe or perform an enucleation. Only a trained ophthalmologist is capable of adequately performing these procedures. Repairs done incorrectly can exacerbate an eye injury and

make socket reconstruction more difficult

- Place eye shields over all injured eyes, and over any eye that may experience pressure from a bi-coronal flap or surgery in prone position. This is particularly true when an open globe injury is present whether or not it has been repaired
- Place a metal or plastic shield over the injured eye and hold in place with tape. APEL/MCEP eye protection, goggles, glasses, or a Styrofoam or paper cup can act as a temporary shield
- Evacuate the casualty expeditiously to the nearest MTF with an available ophthalmologist and Head and Neck Team so that repair can be performed within 24 hours

PRINCIPLE 4: All members of the Head and Neck Team must be involved with the coordination and planning of all surgical procedures needed for the treatment of patients with head and neck polytrauma.

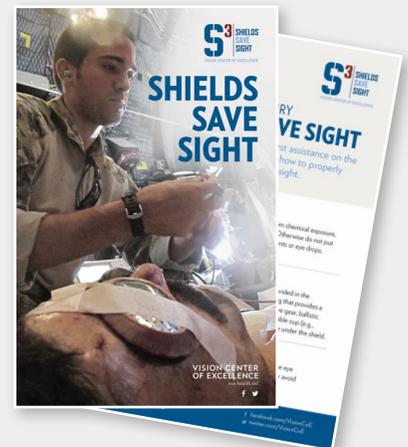
- Ocular injuries are commonly associated with head and neck polytrauma. Common injuries include intracranial and intraocular foreign bodies, midfacial fractures involving the orbit, penetrating wounds of the brain through the orbit, and shattered globes
- Sight takes precedence over everything else except life and the management of limb injuries that could result in exsanguination
- Chlorhexidine should never be used around the eye; it can cause irreparable damage to the cornea and other ocular structures. Only a 5% povidone-iodine antiseptic solution is eye safe. A Betadine (povidone-iodine) detergent scrub should not be used when preparing to perform cranio-facial surgical procedures
- For all head injuries, obtain an orbit/face CT scan (multiplanar, thin cuts). An orbital/face CT protocol differs from a head CT, as it provides images of the eye and orbital socket at different angles. Patients with polytrauma of the head, face, and eyes, may require both orbital/face and head CT imaging protocols.

Learn more about rigid eye shields and how to place them:



<http://vce.health.mil/Resources/Products/Videos/VCE-Eye-Injury-Response-Training-Video>

Download a copy of our Shields Save Sight handout:



Link:
<http://vce.health.mil/Resources/Products/Brochures/Saving-Sight>



Eye protection and Styrofoam cups can serve as temporary shields to protect the eye from further injury.

Damage Control Ophthalmology: For Ophthalmologists

DCO PRINCIPLE 1: Prevent further injury to the eye when injuries to the head, face, and neck are also present.

- Eyes may experience pressure from a bi-coronal flap or surgery in prone position
- Chlorhexidine should never be used around the eye; it can cause irreparable damage to the cornea and other ocular structures. Only a 5% povidone-iodine antiseptic solution is eye safe. A Betadine (povidone-iodine) detergent scrub should not be used when preparing to perform cranio-facial surgical procedures
- Ensure water-tight closure for all open-globe injuries

+ **Necessity** – Critical

+ **Urgency** – Open-globe injuries should be repaired as soon as possible; within 12-24 hours

+ **Adequacy** – Meticulous

+ **Avoidance** – Do not use chlorhexidine or a Betadine detergent scrub around the eye

DCO PRINCIPLE 2: Do not excise injured ocular tissue. Cleanse and debride tissue when faced with contamination.

- Use gentle scrubs to clean contaminated superficial tissue in the face of extensive contamination
- Preserve all possible conjunctival tissue to enable reformation of conjunctival fornices
- Attempt to retain/reform conjunctival fornices to facilitate wear of an artificial eye

+ **Necessity** – Critical

+ **Urgency** – As soon as possible

+ **Adequacy** – Meticulous

+ **Avoidance** – Do not excise tissue

DCO PRINCIPLE 3: It is necessary to perform adequate irrigation and debridement in the presence of contamination within the orbit or surrounding facial structures.

- Do not tightly close deep planes/tissue
- Place drains in the face and orbit to prevent formation of an abscess
- Do not place too many deep sutures to close spaces. Consider the use of vertical mattress sutures
- Repeat cleansing, debridement, and washout as needed
- Culture the abscess material
- Continue patient on appropriate antibiotic therapy if indicated

+ **Necessity** – Critical

+ **Urgency** – As soon as possible

+ **Adequacy** – Meticulous

+ **Avoidance** – N/A

DCO PRINCIPLE 4: Obtain appropriate preoperative imaging studies.

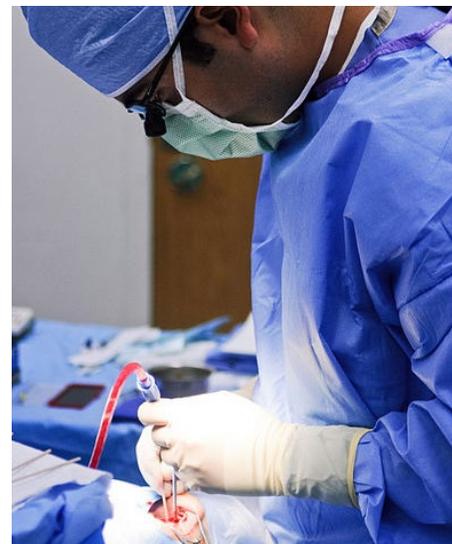
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+ **Necessity** – Critical

+ **Urgency** – As soon as possible

+ **Adequacy** – Meticulous

+ **Avoidance** – Do not perform ultrasound until the eye is closed



The decision to enucleate (shown here) or eviscerate an eye must be made only by an ophthalmologist. (Source: James C. Mutter)

Conference Presentations

The following presentations highlight contributions from VCE staff and collaborators.

Recent Conferences		
<p>Military Health System Research Symposium 27–30 August 2017, Gaylord Palms Resort & Convention Center, Kissimmee, FL https://mhsrs.amedd.army.mil/</p>		
<p>Poster Presentations</p>		
<p>The ABCs of Ocular Trauma: Adapting a Familiar Mnemonic for a Rapid Eye Exam in the Pre-Ophthalmic Zone of Care Christiaan Kroesen, MD; Adam Buchanan, MD; James W. Karesh, MD FACS; Frank La Piana, MD; Erin Seefeldt, MD; Jo Ann Egan, BSN RN MS; Robert A. Mazzoli, MD FACS</p>	<p>The Joint Pathology Center/Vision Center of Excellence Approach to Analyzing Intraocular Foreign Bodies Michael R. Lewin-Smith, MD; Stacy L. Strausberger, MS; H Marie Jenkins, HT; Natalya Merezhinskaya, PhD; Paul A. Latkany, MD; Robert A. Mazzoli, MD; Marcus H. Colyer, MD; Michael J. Mines, MD</p>	<p>US Military Eye Injury Rates During Operation Iraqi Freedom and Operation Enduring Freedom Judy L. Dye, MS RN ANP; James N. Zouris, MS; Helen A. White, MBA; Mary C. Clouser, PhD; Michael R. Galarneau, MS NREMT</p>
<p>Podium Presentation</p>		
<p>Forward Surgical Care: Comparison of a Novel Trainer to a Traditional Swine Model for Training Providers in Lateral Canthotomy/Cantholysis Penelope A. Herder, MBS; Michelle Lu, BS; Christopher Calvano, MD PhD; Robert Enzenauer, MD; Anthony LaPorta, MD</p>	<p>Comparison of Simulation-Based vs Live Tissue-Based Ocular Trauma Training on Novice Ophthalmologists Eva Chou, MD; Robert A. Mazzoli, MD; Joseph Pasternak, MD; Denise Ryan, MS; Rose Sia, MD; Marcus Colyer, MD</p>	<p>Lateral Canthotomy and Cantholysis (LCC) Training System Teresita M. Sotomayor, PhD; Margaret P. Bailey, MS</p>
<p>Blinded Veterans Association 14–18 August 2017, Jacksonville, FL https://bva.org/</p>		
<p>Podium Presentations</p>		
<p>Digital Media Players for People who are Blind Bill Boules, COMS, CLVT, CVRT</p>	<p>Home Automation for People who are Blind Bill Boules, COMS, CLVT, CVRT</p>	
Upcoming Conferences		
<p>American Academy of Ophthalmology 2017 11–14 November 2017, Ernest N. Morial Convention Center, New Orleans, LA https://aao.org</p>		
<p>AMSUS: The Society of Federal Health Professionals 28 November–1 December 2017, Gaylord National Resort & Convention Center, National Harbor, MD www.amsus.org</p>		



FRONTLINES
OF EYE CARE