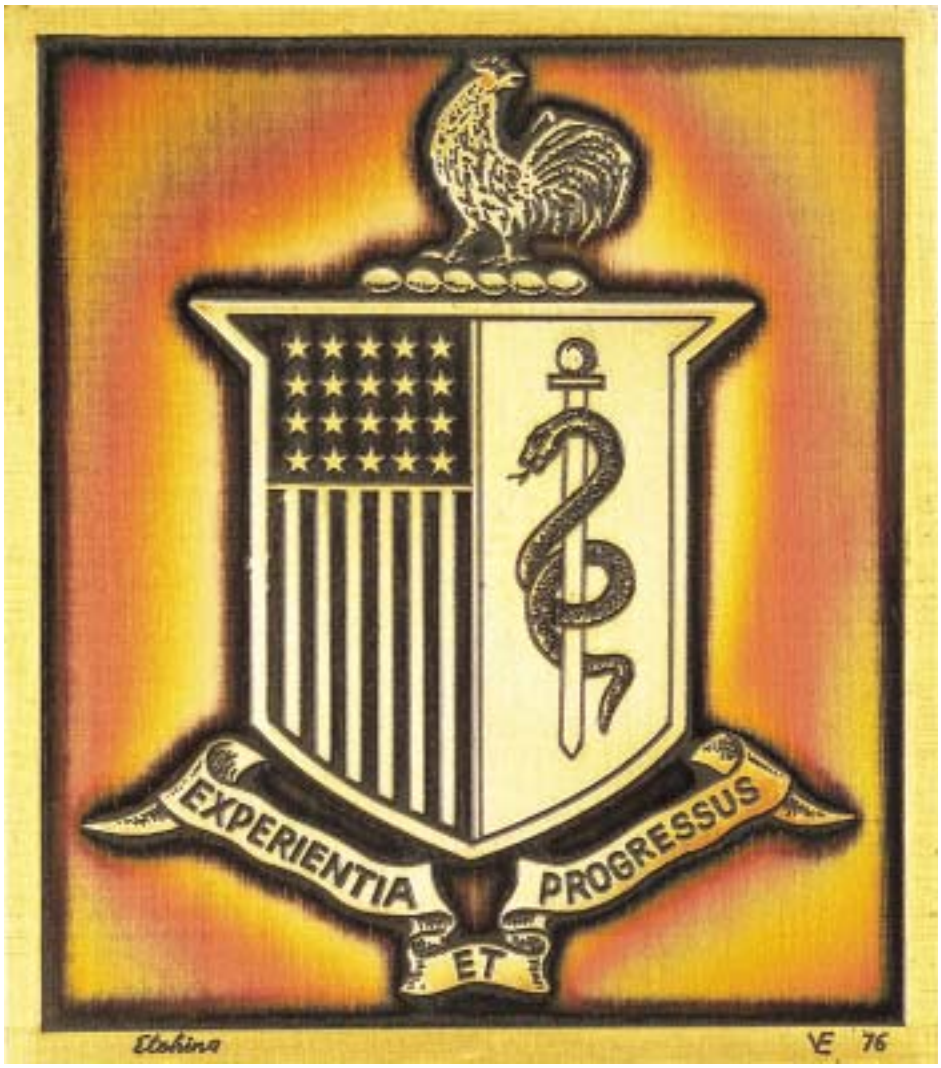
OPHTHALMIC CARE OF THE COMBAT CASUALTY



The Coat of Arms
1818
Medical Department of the Army

A 1976 etching by Vassil Ekimov of an
original color print that appeared in
The Military Surgeon, Vol XLI, No 2, 1917

The first line of medical defense in wartime is the combat medic. Although in ancient times medics carried the caduceus into battle to signify the neutral, humanitarian nature of their tasks, they have never been immune to the perils of war. They have made the highest sacrifices to save the lives of others, and their dedication to the wounded soldier is the foundation of military medical care.

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Editor in Chief and Director
Dave E. Lounsbury, MD, FACP
Colonel, MC, US Army
Borden Institute
Assistant Professor of Medicine
F. Edward Hébert School of Medicine
Uniformed Services University of the Health Sciences

Military Medical Editor
Ronald F. Bellamy, MD
Colonel, US Army, Retired
Borden Institute
Associate Professor of Military Medicine
Associate Professor of Surgery
F. Edward Hébert School of Medicine
Uniformed Services University of the Health Sciences

Editor in Chief Emeritus
Russ Zajtchuk, MD
Brigadier General, US Army, Retired
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Joseph Hirsch *High Visibility Wrap* Watercolor on Paper, 1944

Although the formidable dressing seen here conceals a wound of the right globe and orbit, it cannot hide the indomitable spirit of this wounded American soldier. One wonders, however, to what extent artistic license was exercised in illustrating this elaborate and robust dressing, which would almost certainly have had a deleterious effect on intraocular pressure. The watercolor first appeared as the frontispiece to Volume 1 of *Neurosurgery* in the *Surgery in World War II* series, part of the official history of the Medical Department, US Army. We are pleased to reproduce the painting here, as its inclusion symbolizes the continuity between the current Textbooks of Military Medicine series and our illustrious predecessor. First printed in Spurling GR, Woodhall B, eds. *Neurosurgery.* Vol 1. In: Hays SB, Coates JB Jr, eds. *Surgery in World War II*. Washington, DC: Department of the Army, Medical Department, Office of The Surgeon General; 1958: frontispiece. Watercolor: Reproduced courtesy of Army Art Collection, US Army Center of Military History, Washington, DC.

OPHTHALMIC CARE
OF THE
COMBAT CASUALTY

Specialty Editor

ALLEN B. THACH, MD
Colonel, Medical Corps, US Army Reserve
Associate Professor of Surgery
Uniformed Services University of the Health Sciences
Bethesda, Maryland
Retinal Consultants of Arizona
Phoenix, Arizona

Office of The Surgeon General
United States Army
Falls Church, Virginia

Borden Institute
Walter Reed Army Medical Center
Washington, DC

United States Army Medical Department Center and School
Fort Sam Houston, Texas

Uniformed Services University of the Health Sciences
Bethesda, Maryland

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Created Especially for This Textbook by

Gary Wind, MD, FACS

Uniformed Services University of the Health Sciences
Bethesda, Maryland

Editorial Staff: Lorraine B. Davis
Senior Production Manager
Colleen Mathews Quick
Volume Editor

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Contributors

DARRYL J. AINBINDER, MD
Lieutenant Colonel, Medical Corps, US Army; Director, Ophthalmic Oncology and Pathology; Staff, Ophthalmic Plastic, Reconstructive, and Orbital Surgery, Madigan Army Medical Center, Tacoma, Wash; Assistant Professor of Surgery (Ophthalmology), Uniformed Services University of the Health Sciences, Bethesda, Md

WENDALL C. BAUMAN, JR, MD
Colonel, US Air Force, Medical Corps; Assistant Chief, Department of Surgery; Chief, Retina Service, Brooke Army Medical Center, Fort Sam Houston, Tex; Staff, Retina Service, Lackland Air Force Base, Tex

JEFFREY P. BLICE, MD
Commander, Medical Corps, US Navy, National Naval Medical Center, Department of Ophthalmology, Bethesda, Md

KRAIG S. BOWER, MD
Lieutenant Colonel, Medical Corps, US Army; Cornea and External Disease Section, Ophthalmology Service, Walter Reed Army Medical Center, Washington, DC

GORDON A. BYRNES, MD
Captain, Medical Corps, US Navy; Department of Ophthalmology, National Naval Medical Center, Bethesda, Md

NEIL T. CHOPLIN, MD
Captain, US Navy (Ret); Eye Care of San Diego, San Diego, Calif; Adjunct Clinical Professor of Surgery, Uniformed Services University of Health Sciences, Bethesda, Md

GLENN C. COCKERHAM, MD
Colonel, US Air Force, (Ret); Cornea Service, Allegheny General Hospital, Pittsburgh, Pa

KIMBERLY PEELE COCKERHAM, MD
Director, Ophthalmic Plastics, Orbital Disease and Neuro-Ophthalmology, Allegheny General Hospital, Pittsburgh; Assistant Professor, Department of Ophthalmology, Drexel University College of Medicine, Philadelphia, Pa

PETER H. CUSTIS, MD
Captain, US Navy; Director, Retina Service, Department of Ophthalmology, Naval Medical Center San Diego, San Diego, Calif; and Clinical Assistant Professor, Department of Surgery, Uniformed Services University of Health Sciences, Bethesda, Md

ANDREW S. EISEMAN, MD
Lieutenant Colonel, Medical Corps, US Army; Chief, Oculoplastics and Orbit Service, Walter Reed Army Medical Center, Washington, DC

ELIZABETH A. HANSEN, MD
Colonel, Medical Corps, US Army; Director, Comprehensive Ophthalmology, Madigan Army Medical Center, Tacoma, Wash; Assistant Professor of Surgery (Ophthalmology), Uniformed Services University of the Health Sciences, Bethesda, Md

CRAIG D. HARTRANFT, MD
Lieutenant Colonel, Medical Corps, US Army; Chief, Vitreoretinal Service, Madigan Army Medical Center, Fort Lewis, Wash

DAVID E. E. HOLCK, MD
Lieutenant Colonel, US Air Force, Medical Corps; Flight Surgeon; Director, Oculoplastic, Orbital and Reconstructive Surgery Service, Wilford Hall Medical Center, Lackland Air Force Base, Tex

RODNEY D. HOLLIFIELD, MD
Vitreoretinal Surgeon, Retina Consultants of Nevada, Las Vegas, Nev

TIM B. HOPKINS, MD
Lieutenant Commander, Medical Corps, US Navy; Department of Ophthalmology, US Naval Hospital Great Lakes, Great Lakes, Ill

DANIEL J. JANIK, MD
Lieutenant Colonel, US Air Force (Ret); Associate Professor of Anesthesiology and Associate Medical Director of Operating Room Services, University of Colorado Health Sciences Center, Denver, Colo

THADDEUS J. KROLICKI, MD
Vitreoretinal Surgeon, Eye Clinic of Wisconsin, Wausau, Wis

FRANCIS G. LA PIANA, MD, FACS
Colonel, US Army (Ret); Professor of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Md; Ophthalmology Residency Program Director, Department of Ophthalmology, Washington Hospital Center, Washington, DC

SCOTT K. MCCLATCHEY, MD
Commander, Medical Corps, US Navy; Director, Motility Service, Department of Ophthalmology, Naval Medical Center San Diego, San Diego, Calif; Assistant Professor, Department of Surgery, Uniformed Services University of Health Sciences, Bethesda, Md

THOMAS H. MADER, MD
Colonel, Medical Corps, US Army (Ret); Alaska Native Medical Center, Anchorage, Alaska

WILLIAM P. MADIGAN, JR, MD
Colonel, Medical Corps, US Army; Chief, Ophthalmology Service, Walter Reed Army Medical Center, Washington, DC; Associate Professor and Chief, Division of Ophthalmology, Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland

DAVID O. MAZUR, MD
Captain, Medical Corps, US Navy; Chairman, Department of Ophthalmology, National Naval Medical Center, Bethesda, Md

ROBERT A. MAZZOLI, MD
Colonel, Medical Corps, US Army; Chief, Department of Ophthalmology; Director, Ophthalmic Plastic, Reconstructive, and Orbital Surgery, Madigan Army Medical Center, Tacoma, Wash; Associate Professor of Surgery (Ophthalmology), Uniformed Services University of the Health Sciences, Bethesda, Md

ASA D. MORTON, MD
Commander, Medical Corps, US Navy; Chief, Oculoplastics Section, Naval Medical Center San Diego, San Diego, Calif

JOHN D. NG, MD
Assistant Professor of Ophthalmology, Division of Oculoplastics, Orbit, Lacrimal, and Reconstructive Surgery, Casey Eye Institute, Oregon Health and Sciences University, Portland, Ore

MATTHEW J. NUTAITIS, MD
Commander, Medical Corps, US Navy; Head, Glaucoma Service, Department of Ophthalmology, National Naval Medical Center, Bethesda, Md

JOSEPH PASTERNAK, MD
Commander, Medical Corps, US Navy; National Naval Medical Center, Bethesda, Md

WILLIAM R. RAYMOND IV, MD
Colonel, Medical Corps, US Army; Director, Pediatric Ophthalmology and Strabismus, Madigan Army Medical Center, Tacoma, Wash; Clinical Assistant Professor of Surgery (Ophthalmology), Uniformed Services University of the Health Sciences, Bethesda, Md

WILLIAM RIMM, MD
Colonel, Medical Corps, US Army; Ophthalmology Service, Walter Reed Army Medical Center, Washington, DC

E. GLENN SANFORD, MD
Major, Medical Corps, US Army; Chief, Department of Ophthalmology, Blanchfield Army Community Hospital, Fort Campbell, Ky

RICHARD D. STUTZMAN, MD
Major, Medical Corps, US Army; Staff Ophthalmologist, Department of Ophthalmology, Walter Reed Army Medical Center, Washington, DC

ALLEN B. THACH, MD
Colonel, Medical Corps, US Army Reserve; Retinal Consultants of Arizona, Phoenix, Arizona; Associate Professor of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Md

EDWARD W. TRUDO, JR, MD
Lieutenant Colonel, Medical Corps, US Army Reserve; Assistant Professor of Surgery (Ophthalmology), Uniformed Services University of the Health Sciences, Bethesda, Md; Azar Eye Institute, Salisbury, Md

THOMAS P. WARD, MD
Colonel, Medical Corps, US Army; Ophthalmology Residency Program Director, Ophthalmology Service, Walter Reed Army Medical Center, Washington, DC; Associate Professor of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Md

FLOYD L. WERGELAND, JR, MD
Colonel, US Army (Ret); Adjunct Clinical Professor of Surgery, Division of Ophthalmology, Uniformed Services University of the Health Services, Bethesda, Md; Eye Physicians Medical/Surgical Center, Chula Vista, Calif

Foreword

Since the end of the Cold War, the role of the US military has changed from one of fighting a massive war of prolonged duration to one involved in smaller conflicts requiring rapidly mobile forces. Forces are sent overseas on peacekeeping missions and special operations, yet must also remain prepared to fight larger conflicts. The US Army Medical Department has also changed in response to the demands of these new roles. The vicissitudes of these new missions no longer require large, stationary medical facilities to which the injured soldier will be transported. Instead, our facilities now include smaller, mobile medical units that are able to deploy rapidly and move with our soldiers. Despite these significant organizational changes, giving the best care to our troops as close to the front as possible remains of utmost importance. Previous conflicts have shown that rapid evaluation and treatment improves the ability to save injured soldiers' lives, limbs, and sight. Based in part on the lessons learned in past wars, the Textbooks of Military Medicine series presents the insights, discusses the issues, and provides the requirements of combat casualty care.

Given the trends in current warfare, conventional munitions—especially fragmentation devices—will continue to cause a significant percentage of all injuries to our soldiers, and a large number of those casualties will sustain eye injuries. Lasers (used both in current instrumentation and in offensive weapons) also have the potential to cause numerous eye injuries. Because the preservation of the eye and eyesight is of utmost importance, this volume, *Ophthalmic Care of the Combat Casualty*, was written for the Textbooks of Military Medicine series. This volume's goals are to aid in the early diagnosis and treatment of ocular injuries and to prevent unnecessary blindness—pertinent topics to the soldier giving buddy care at the unit level, to the medic and physician at the battalion aid station, and to the ophthalmologist in the higher echelons of care. The information provided includes lessons learned from the Revolutionary War to the Persian Gulf War, and military ophthalmologists from the Army, Navy, and Air Force have shared their expertise in preparing this thorough, up-to-date textbook.

Lieutenant General James B. Peake
The Surgeon General
US Army

Washington, DC
January 2003

Introduction

Along with saving the lives and limbs of our soldiers, sailors, and airmen injured in battle, the preservation of their eyes and eyesight is an extremely important goal. Despite comprising as little as 0.1% of the total body surface area and 0.27% of the frontal silhouette, the proportion of eye injuries in nonfatal casualties has been escalating in recent conflicts (Table). Several reasons account for the increasing risk of eye injuries:

1. preferential exposure of the eyes during combat (eg, foxholes, tank turrets);
2. improved body armor protecting the head, thorax, and abdomen, leading to fewer fatal injuries to these regions of the body;
3. improved surgical techniques and rapid evacuation of the wounded, which allow physicians to repair wounds that at one time would have resulted in the death of a soldier; and
4. improved munitions, which create more and smaller fragments that can cause severe, even blinding, injuries.

TABLE
INCIDENCE OF WARTIME EYE INJURIES

War (Dates)	Eye Injuries (% of Total Injuries)	References
American Civil War (1861–1865)	0.57[1]	(1) Duke-Elder S, MacFaul PA. War injuries. In: *Mechanical Injuries*. Part 1. In: *Injuries*. Vol 14. In: Duke-Elder S, ed. *System of Ophthalmology.* St Louis, Mo: C. V. Mosby; 1972; 49–56. (2) Steindorf K. Die Kreigschirurgie des schorgans. *Berlin Klin Wochensch.* 1914;51:1787–1789. (3) Parsons J. Protection of the eyes from war injuries. *Trans Ophthalmol Soc UK.* 1941;61:157–178. (4) Shimkin NI. Ophthalmic injuries in war. *Br J Ophthalmol.* 1940;24:265–285. (5) Stone W. Ocular injuries in the armed forces. *JAMA*. 1950;142:151–152. (6) Gunderson T. Surgery of intraocular foreign bodies. *Trans Am Acad Ophthalmol Otolaryngol.* 1947;52:604–613. (7) Hornblass A. Eye injuries in South Vietnam. *Surg Forum*. 1973;24:500–502. (8) Lowrey A, Shaffer F. Eye, ear, nose and throat injuries sustained in Korean theater. *Trans Pac Coast Ophthalmol Soc Ann Meet.* 1954;35:39–49. (9) Treister G. Ocular casualties in the 6 Day War. *Am J Ophthalmol*. 1969;68:669–675. (10) Hornblass A. Eye injuries in the military. *Int Ophthalmol Clin.* 1981;21:121–138. (11) Hoefle FB. Initial treatment of eye injuries. *Arch Ophthalmol.* 1968;79:33–35. (12) Belkin M. Ocular injuries in the Yom Kippur War. *J Ocul Therapy Surg*. 1983;2:40–49. (13) Belkin M, Treister G, Dotan S. Eye injuries and ocular protection in the Lebanon War, 1982. *Isr J Med Sci.* 1984;20:333–338. (14) Heier JS, Enzenauer RW, Wintermeyer SF, Delaney M, La Piana FG. Ocular injuries and diseases at a combat support hospital in support of Operation Desert Shield and Desert Storm. *Arch Ophthalmol.* 1993;111:795–798. (15) Jankovic S, Zuljan I, Sapunar D, Buca A, Plestina-Borjan I. Clinical and radiological management of wartime eye and orbit injuries. *Mil Med.* 1998;163:423–426.
Franco–Prussian War (1870–1871)	0.81–0.86[2]	
Sino–Japanese War (1894)	1.2[1]	
Russo–Japanese War (1904–1905)	2–2.22[2]	
World War I (1914–1918)	1.54[3]	
	2.25[4]	
World War II (1939–1945)	2.0[5]	
	2.57–3.38[6]	
Korean War (1950–1953)	4.1[7]	
	8.1[8]	
Arab–Israeli 6-Day War (1967)	5.6[9]	
Vietnam War (1962–1972)	5.0–9.0[10]	
	9.0[11]	
Arab–Israeli Yom Kippur War (1973)	6.7[12]	
Lebanon War (1982)	6.8[13]	
Persian Gulf War (1991)	13.0[14]	
Serbian–Croatian War (1991–1995)	9.8[15]	

Given the trends in modern warfare, as well as the expected increased use of laser devices, the percentage of ocular injuries will continue to increase. Because of advances in the care of eye trauma, however, injuries to the eye that once were deemed unsalvageable can now be repaired—often with the return of useful vision to the soldier. There are five echelons of care for troops injured on the modern battlefield, although their battlefield locations and the number of ophthalmologists at each echelon constantly change to meet the demands of our mobile fighting force.

Echelon 1 is in the unit area, and medics and a battalion aid station will provide initial care. Patients with minor eye injuries may be treated and returned to duty. Patients with more-severe injuries will be stabilized and sent to a higher echelon for more-definitive care.

Echelon 2 is at the division level and consists of a clearing station that can (*a*) provide emergency care (general anesthesia is usually not available) and (*b*) serve as a holding station for those troops who will return to duty, usually within the next 24 to 72 hours.

Echelon 3, at the corps level, is the most forward position in which an ophthalmologist will usually be located. In the Army, this will be at the combat hospital (previously known as the combat support hospital, an evacuation hospital, and the mobile army surgical hospital [MASH]); for the Marines, it is the fleet hospital; and for the Navy, it is the hospital ships (currently, the USNS *Comfort* and USNS *Mercy*). At this level, the ophthalmologist will be equipped with the Deployable Medical Systems (DEPMEDS), which should include all the equipment necessary to examine an injured patient, a diagnostic set (including ultrasound and, in some locations, a computerized tomography device), and equipment to repair most eye injuries (operating room microscope, phacoemulsification/vitrectomy unit, surgical instruments and sutures, and an external magnet). Ophthalmic surgeons at this level (in the Army and with the Marines) must be prepared to move forward with the fighting forces; thus, this equipment is packaged to facilitate movement. Injured troops may receive definitive care at Echelon 3 and either be (*a*) evacuated to a higher level for further treatment or rehabilitation, or (*b*) returned to duty.

Echelon 4 is usually found overseas in a fixed facility, such as a general hospital, which can provide full, definitive care and is equipped to treat any injury.

Echelon 5 is located in the United States at military and civilian hospitals. These hospitals are usually supplied with the latest equipment and can treat the most-severe problems, perform secondary repair and reconstructive surgery, and should have rehabilitative services available.

With the evolution of small fighting teams and rapid mobilization, the medical services must be able to deploy medical assets at a moment's notice. The Navy has instituted a Medical Mobilization Augmentation Readiness Team (MMARTS) for these types of operations. The Air Force has initiated the Expeditionary Medical Support (EMEDS) teams, which replace the Air Transportable Hospital (ATH). The EMEDS are scalable, depending on theater requirements, and support the Small Portable Expeditionary Aeromedical Rapid Response (SPEARR) teams. Ophthalmology as a subspecialty supports the EMEDS + 25 (25-bed) configuration. These teams must be able to deploy rapidly (within 2–48 h) and are to provide short-term (< 180 d) medical augmentation for peacetime and rapid-contingency operations.

The first section of this textbook provides a history of military eye care, including the lessons learned from the Vietnam and Persian Gulf wars. The second section describes some of the basic techniques needed to evaluate an eye injury (history, examination, and ancillary studies) and the techniques available to provide anesthesia to a patient with an eye injury. Included in this section is a discussion of an ocular trauma score (similar to the Glasgow Coma Scale). This trauma score was developed to assist the frontline medics and physicians with an easy-to-use guide for triaging and providing emergency treatment to the injured soldier. The third section deals with injuries to the anterior segment of the eye (ie, the cornea, lens, and conjunctiva), and includes a discussion of injuries to the eye from industrial chemicals and chemical warfare agents. The fourth section covers injuries of the posterior segment, with chapters on intraocular foreign bodies, sympathetic ophthalmia, and endophthalmitis. The fifth section describes the evaluation and treatment of injuries to the orbit, optic nerve, extraocular muscles, and ocular adnexa. The final section

covers a variety of issues important to the military ophthalmologist such as terrorist blasts, laser injuries, eye protection, and geographical ophthalmology.

Although not an all-inclusive treatise on the subject, we hope that this textbook will provide a ready reference for all medical personnel dealing with eye-injured soldiers. Unlike the ophthalmologist in the civilian sector, who usually sees patients with a single injury in a relatively sterile environment, the military ophthalmologist will be faced with numerous casualties who have multisystem injuries in a setting that may be less than ideal. This textbook deals with some of these key issues that will face the military ophthalmologist in wartime situations.

It seems that with each conflict in the 20th century, every new generation of medics and physicians has had to learn—on its own—the lessons from earlier conflicts. We hope that the wisdom, experience, and lessons learned reported in this volume of the *Textbooks of Military Medicine* will enable optimal care to be provided in a timely manner to our eye-injured service members on the battlefield in future conflicts.

William P. Madigan, Jr, MD
Colonel, Medical Corps, US Army
Chief, Ophthalmology Service
Walter Reed Army Medical Center
Washington, DC
Consultant to The Surgeon General,
US Army, Ophthalmology
Associate Professor and
Chief, Division of Ophthalmology, Department of Surgery
Uniformed Services University of the Health Sciences
Bethesda, Maryland

Allen B. Thach, MD
Colonel, Medical Corps, US Army Reserve
Associate Professor of Surgery
Uniformed Services University of the Health Sciences
Bethesda, Maryland
Retinal Consultants of Arizona
Phoenix, Arizona

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