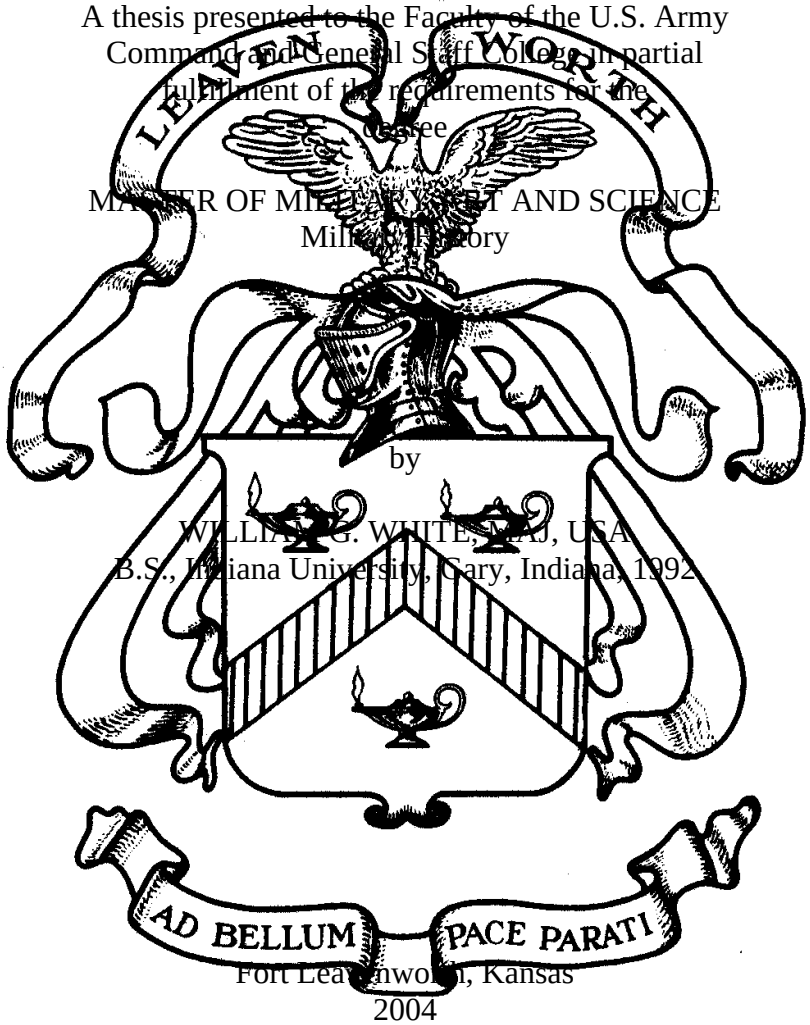
APPROPRIATE TREATMENT OF HEAD INJURIES BY SURGEONS DURING THE CIVIL WAR

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE
Military History



by

WILLIAM G. WHITE, MAJ, USA
B.S., Indiana University, Gary, Indiana, 1992

Fort Leavenworth, Kansas
2004

Approved for public release; distribution is unlimited.

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of Candidate: MAJ William G. White

Thesis Title: Appropriate Treatment of Head Injuries by Surgeons During the Civil War

Approved by:

_____, Thesis Committee Chair
Curtis S. King, Ph.D.

_____, Member
Lieutenant Colonel Paul B. Gardner

_____, Member
Lieutenant Colonel Randal Espinsoa, M.D.

Accepted this 18th day of June 2004 by:

_____, Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
17 JUN 2004		**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Appropriate treatment of head injuries by surgeons during the Civil War	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
William White	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
US Army Command and General Staff College,1 Reynolds Ave.,Fort Leavenworth,KS,66027-1352	**ATZL-SWD-GD**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

The original document contains color images.

14. ABSTRACT

Surgeons during the Civil War have been classified by soldiers from that time period as incompetent butchers. However, evidence of head injury cases from the battles of Antietam, Gettysburg, The Wilderness, and Petersburg, evidence suggests that most surgeons were competent and followed the medical standards of practice of the 1860s. The civilian method of practicing medicine was similar to that of the military, although military surgeons found that procedures such as trephining met with more fatalities than their civilian counterparts. A possible reason for a high-mortality rate with military trephining may be due to the fact that the field environment in which the procedures were done was often dirty, and the head wounds became infected. Other contributing factors may be that surgeries were undertaken on a large numbers of patients using the same unclean instruments. The small sample size of severe head injuries indicates that the survival rate was approximately 35 percent of those who survived until they arrived at a major hospital. Infection appears to have been the most significant factor which indicated whether the patient would survive or die. Even so, the surgeons were not butchers and did the best they could given technology and medical knowledge at the time.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**1**	**117**	

ABSTRACT

APPROPRIATE TREATMENT OF HEAD INJURIES BY SURGEONS DURING THE CIVIL WAR, William White, 116 pages.

Surgeons during the Civil War have been classified by soldiers from that time period as incompetent butchers. However, evidence of head injury cases from the battles of Antietam, Gettysburg, The Wilderness, and Petersburg, evidence suggests that most surgeons were competent and followed the medical standards of practice of the 1860s. The civilian method of practicing medicine was similar to that of the military, although military surgeons found that procedures such as trephining met with more fatalities than their civilian counterparts. A possible reason for a high-mortality rate with military trephining may be due to the fact that the field environment in which the procedures were done was often dirty, and the head wounds became infected. Other contributing factors may be that surgeries were undertaken on a large numbers of patients using the same unclean instruments. The small sample size of severe head injuries indicates that the survival rate was approximately 35 percent of those who survived until they arrived at a major hospital. Infection appears to have been the most significant factor which indicated whether the patient would survive or die. Even so, the surgeons were not butchers and did the best they could given technology and medical knowledge at the time.

To the memory of my loving father, who guided and supported me throughout his life

TABLE OF CONTENTS

Page

ILLUSTRATIONS

Page

TABLES

Page

CHAPTER 1

INTRODUCTION

During the Civil War, head wounds were considered to be one of the most life-threatening injuries a soldier could sustain. In the view of one Civil War artillerymen, the reason for such a high mortality rate for head wounds was because of incompetent medical care.[1] This case study investigation will suggest that Civil War surgeons were able to recognize the symptoms of cranial swelling and to treat patients that sustained head injuries according to the medical standard of care as outlined in the 1860's military field surgical manuals. The information that will be used in this investigation will include medical records of Civil War patients, autopsy reports, Union and Confederate textbooks on surgical procedures, forensic analysis, computer-generated recreations, and modern pathophysiology on head injuries.

The primary research begins with a review of information from medical records and autopsy reports of Civil War soldiers. The best source for Civil War medical records is contained in the multiple volume set of books titled *The Medical Surgical History of the War of the Rebellion,* complied in 1875 at the request of Army Surgeon General Joseph Barnes. General Barnes wanted to gather information from which to determine medical lessons learned during the Civil War. *The Medical Surgical History of the War of the Rebellion* contains thousands of medical reports from Union and Confederate surgeons and covers everything from flu symptoms to brain surgery.

A universal standard of care is necessary to assess the appropriateness of the treatment documented in the medical records. Unfortunately, there were no official medical governing bodies that addressed Civil War standards of care. The American

Medical Association, established in 1847, concerned itself mainly with ethical issues and usually did not address techniques and procedures. The American College of Surgeons, which plays a major role today in determining surgical standards, was not established until 1907. However, both the Union and Confederate surgeons attempted to standardize their own medical practices by developing military field medical handbooks. A Confederate surgeon, Dr. Edward Warren, wrote a book titled *An Epitome of Practical Surgery*, used by the Confederate Army. Dr. Stephen Smith, a Union surgeon, wrote a book titled *Hand-Book of Surgical Operations,* used by the Union Army. A third book written by a civilian, Dr. Samuel Gross, called *Systems of Surgery,* was originally written as a medical text book in 1859 and later revise in 1882. At the outbreak of the Civil War, Dr. Gross became the medical director for the Army of the Cumberland. Although none of the authors were affiliated with each other, all three books contained essentially the same information and taught the same techniques. The only notable difference seemed to be when to initiate the trephining procedure. Military surgeons believed in only using trephining as a last resort for depressed skull fractures. On the other hand, civilian practice, as outlined by Dr. Gross, used trephining early to remove bone fragments, thus preventing tissue necrosis.

The three authors used different ways to teach their readers. Dr. Warren described in detail the rationale for performing certain procedures, while Dr. Smith's book was more of a practical how-to guide and Dr. Gross gave both the practical surgical guide with an explanation as to the cause of disease processes and complications associated with surgical procedures. The books were written by three different individuals with varying educational backgrounds approximately one year apart, yet they provided

virtually the same information. It seems safe to assume that the books reflect the standard of care for the 1860s.

Among secondary sources, the book *Gangrene and Glory*, by Frank Freemon, provides a general overview of the medical conditions that were prevalent during the Civil War. Freemon explains problems hospital workers encountered by the cross contamination of wounds and spreading infections. Cross contamination is caused when one bacteria is transferred from one patient to another by a common source, usually from a health care worker who does not wash his hands between patients. The book is not specific for head injuries, although it does claim that many open head injury patients died in the hospitals primarily from infections.

Alfred Bollet's *Civil War Medicine Challenges and Triumphs* is a book that addresses survival rates of patients that suffered various injuries and wounds during the Civil War. It is broken down into different relevant medical aspects such as infections, amputations, and head injuries. The last chapter, "Re-evaluating Civil War Medicine," contains the author's analysis. It concludes that medical knowledge increased throughout the Civil War, with initially inexperienced physicians becoming battle hardened, skilled surgeons.[2]

The *Medical Surgical History of the War of the Rebellion,* along with other primary sources of information to include both the Union and Confederate surgical handbooks written by both Dr. Smith and Dr. Warren, provide the standard of medical care during the Civil War. The books written by Boyette and Freemon provide background medical information and set the scene for each particular battle that is being evaluated. This paper is different from other Civil War medical papers as it combines

both Union and Confederate medical knowledge. Also, it determines an American Civil War standard of care for head injuries in order to judge the treatment of head injuries. This thesis will utilize forensic assessments, combined with modern pathophysiology, and computer-generated recreations. These tools will assist in establishing the possible extent of the head injury and determine if the surgeon's assessment and treatment of the head injury was acceptable based on the 1860's standard of care.

The inquiry will center around four Civil War battles: Antietam, Gettysburg, The Wilderness, and Petersburg. The primary focus will be on patients that sustained head injuries from musket ball, colinderal ball (also called minie ball after its inventers), buckshot, and artillery shrapnel. The sample size will be five-to-seven cases studies per battle, and the length of each case will vary based on the type of wound and the amount of details in the physicians assessment. Although these are limited samples, they provide key case studies that allow for tentative conclusions and act as a guide to follow for future research.

Background

In order to evaluate the ability of the Civil War surgeon to assess and treat head injuries, familiarization with basic anatomy and physiology of the skull and brain are necessary. The reader will need to understand different types of skull fractures and intracranial bleeding, along with surgical procedures used during the Civil Wa,r such as trephining.

The skull is comprised of eight bones, which are the frontal, ethmoid, sphenoid, occipital, along with two parietal and two temporal bones. Each bone has three layers, a solid inner and outer layer with a cancellous bony tissue called the diploe. The outer

surface of the skull is smooth, although within the cranial vault there are many boney protrusions and ridges. When assessing head injuries, it is often found that the brain tissue injury is not in the same area as the head impact, due to the damage caused when the brain moves over these protrusions. The inner aspect of the skull is lined with thick connective tissue called the perisoteal dura, which adheres to the skull surface (fig.1).[3]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 1. Inner Aspect of the Skull

Source: Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, New Jersey: Brady/Prentice Hall Health, 2000), 110.

The brain is protected by three layers of tissue called the meningeal layers and are broken down into the dura mater, arachnoid mater, and pia mater. The outer most covering of the brain is protected by the dura mater and is made up of folds in the cranial space that assist in protecting the separate different brain components. The dura mater contains the midbrain falx cerebri and the tentorium cerebelli. The falx cerebri separates the two cerebral hemispheres, and the tentorium cerebelli divides the cerebral hemispheres from the brain stem. Above the dura mater and below the skull is the

epidural space, which is a potential space for blood to accumulate when bleeding in the brain occurs. Under the dura mater is the subdural space which is another potential area for accumulation of blood, that is located between the dura and arachnoid membrane. The middle layer of meningeal tissue is called the arachnoid, which projects into the sinus cavities. The space below the arachnoid is called the subarachnoid space, and it contains the vascular supply for the brain. The last layer is the pia mater, which is the thinnest of the membranes and lines the cerebral ventricles; it also has a role in cerebral spinal fluid (CSF) production.[4]

The meningeal membranes and the blood brain barrier protect the brain from toxins and bacteria. Oxygen and small molecules are the only metabolites that gain entrance into the brain. The meningeal membranes protect the brain from bacteria in the event the skull is fractured.[5] If the meningeal layers are torn or ruptured bacteria can easily gain access into the brain.

Intracranial pressure is defined as pressure exerted on the contents of the cranial cavity, which include the blood vessels, CSF, and the brain. An increase in any of the cranial components will result in an increase in the intracranial pressure (ICP). Increased ICP may cause compression of the brain or herniation syndrome. These symptoms include hypertension, dilated pupils, paralysis, decreased respirations, and slow heart rate. The progressive hypertension associated with slow pulse and decreased respirations is referred to as Cushing's reflex and indicates that the ICP is high enough to be life threatening.[6] The appropriate intervention to treat Cushing reflex would be to drill a hole in the skull and allow the relief of ICP. Today the process is referred as bur holes, although it was called trephining during the Civil War.

Herniation can occur after a traumatic injury, abscess formation, or expanding hematoma from a broken blood vessels.[7] Two of the most common types of cerebral herniation are the uncal and central transtentorial.

Uncal herniation is the most common type of herniation. It generally occurs in the middle fosa or the temporal lobe. The ICP increases to the point of pressing the ispilateral uncus of the temporal lobe into the tentorium and the brain is forced into the tentorium hiatus (which is the space between the cerebrum and cerebellum). Pressure is exerted on the third cranial nerve causing anisocoria (dilation of one pupil) ipislateral (same side) to the expanding mass. Contralateral hemiparesis (paralysis on the opposite side of the injury) may also develop.[8] The patient's mental status may change from calm to restless, aggressive, and confused (fig. 2).

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 2. Uncal Herniation

Source: Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, NJ: Brady/Prentice Hall Health, 2000), 340.

Central Transtentoral herniation is caused by an expanding hematoma or lesion at the frontal or occipital area of the brain. The herniation is centralized indicating that the pressure increases bilaterally in the brain. Symptoms may include bilateral extremity weakness, pinpoint pupils, increased muscle tone causing decorticate or decerebrate posturing, and slow, shallow, irregular respirations (fig. 3).[13]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 3. Transtentoral Herniation

Source: Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, New Jersey: Brady/Prentice Hall Health, 2000), 340.

Post-traumatic seizures are classified as either acute or subacute. Acute post-traumatic seizures occur relatively quickly after the injury. They last for a brief period of time and are related to a neurochemical change in the brain. Acute seizures usually only occur at the time of the initial injury. Subacute seizures can occur twenty-four to forty-eight hours after a traumatic event. They are affiliated with increased cranial swelling, a penetrating head injury or bleeding into the brain. Posttraumatic epilepsy can be a long-term concern, although usually only occurs when the dura mater is damaged.[9]

Concussion is described as a temporary and brief interruption of neurological function after head trauma. The disruption can include shearing or stretching of white matter fibers, alteration in neurotransmitters in the brain and temporary changes in cerebral blood flow with decreased oxygen usage. The symptoms include a brief, seconds to minutes loss of consciousness, headache, dizziness and amnesia concerning the traumatic event.[10]

Infections that can occur after a traumatic head injury include meningitis, brain abscess and cranial osteomyelitis. Posttraumatic meningitis is caused by a number of different bacteria and microbes. The type of injury may be helpful identifying the offending organism.[11] During the Civil War the lack of antibiotics was one of the primary reasons so many soldiers died from head injuries.

Brain abscesses or localized infections can develop for a number of reasons to include, a penetrating injury of the head, depressed skull fractures, a sinus cavity fracture or bone fragments that were not removed from as comminuted head injury. The most common symptoms are headache, nausea, vomiting, and seizures.[12] The treatment includes a surgical procedure to drain the abscess, much like the Civil War surgeons using trephining. In order to reduce the spread bacteria through the brain that is associated with cerebral abscess, modern day neurosurgeons will aggressively administer antibiotics.

Cranial Osteomyelities can occur after a penetrating injury to the brain. The bone becomes necrotic, and the infection can spread into the brain especially if the meningeal tissues are torn. Symptoms include headache, tenderness, swelling, and warmth over the

infection site. Modern-day treatment involves surgically removing the necrotic bone and as in abscess treatment, aggressive antibiotic therapy is administered.[13]

The five types of bleeding injuries to the brain include contusions, epidural hematomas, subdural hematomas, subarachnoid hematomas, and intracranial bleeding. Contusions are bruises in the brain and are usually the result of blunt trauma. The most likely area to sustain a contusion would be the inferior surface of the temporal lobes where the brain is in contact with the bony protuberances of the skull. Subarachnoid bleeding can occur and may progress to a cerebral compression syndrome. The patients may also develop post-traumatic epilepsy, focal defects, and increased ICP.
Epidural Hematomas (EDHs) are blood clots that form between the inner table of the skull and the dura mater. Over 80 percent of all EDHs are caused by skull fractures in the temporolparietal area of the brain and involve either the middle meningeal artery or the dural sinus. The classic presentation of an EDH is unconsciousness after the incident followed by a “lucid” interval, then the patient falls back into a decreased level of consciousness.[14] Modern-day EDH treatment involves surgery to remove the clot and carries an excellent prognosis if treated prior to the patient becoming comatose. During the Civil War time period, the prognosis would not be as accurate because of the complications associated with introduction of bacteria during trephining (fig. 4).

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 4. Epidural Bleed

Source: John Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River: New Jersey, Brady/Prentice Hall Health, 2000), 118.

Subdural Hematomas (SDHs) are blood clots that form between the dura and the arachnoid. The bleeding is caused from rupturing of venous blood vessels and clinical symptoms are usually slow in presenting. The prognosis is dependent on the amount of bleeding and the patient appearance. If the patient is unconscious at the time of the injury, the prognosis is poor. The SDH patients may develop increased intracranial pressure, dilated pupils, decrease mental status, and paralysis.[15] The modern treatment of choice is to surgically remove the blood clots (fig.5).

Traumatic Subarachnoid hemorrhage (TSAH) is blood within the cerebral spinal fluid and meningeal intima. It is caused by rupturing of the small subarachnoid vessels but usually has a good prognosis. The classic symptoms include headache, photophobia, with posttraumatic vasospasms occurring forty-eight hours to two weeks after the injury.[16] Today no invasive treatment is recommended for patients with minimal bleeding and no cerebral ischemia.

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 5. Subdural Bleed

Source: John Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, New Jersey: Brady/Prentice Hall Health, 2000), 118.

Intracerebral Hematomas are formed deep in the brain tissue and are common with the shearing or tensile force of mechanical stretch. The result is small petechial hemorrhages usually located in the frontal and temporal areas. About 50 percent of the patients that sustain an Intracerebral Hematoma has an associated loss of consciousness at the time of the incident. The prognosis is dependent on the size of the bleed and how far the ICP increases. Today, there are no surgical treatment recommendations for this type of injury (fig. 6).[17]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 6. Intracerebral Bleed

Source: John Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, New Jersey, Brady/Prentice Hall Health, 2000), 119.

Skull fractures area broken down into linear, depressed, and comminuted (fig. 7). Linear skull fractures consist of a single line that goes through the entire thickness of the skull. Linear fractures are concerning if the fracture line goes through the middle meningeal grove or major venous dural sinuses. Most liner fractures are not significant unless they cause intracranial injury.

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Linear Skull Fracture Depressed Skull Fracture Comminuted Skull Fracture

Figure 7. Linear Skull Fracture, Depressed Skull Fracture, Comminuted Skull Fracture
Source: John Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River: New Jersey, Brady/Prentice Hall Health, 2000), 120.

Depressed skull fractures are more important because of the predisposed underlying brain injury. The depressed fragments may puncture the dura mater causing a break in the protective covering of the brain. Most depressed fractures are located in the area of the temporal or parietal bone and are caused by blunt trauma. Depressed skull fractures may be easily missed due to the mobility of the scalp. The skull under the laceration may be normal and the depression could be several centimeters away. Classic symptoms include, loss of consciousness, decreased mental status, seizure activity, and increased risk for meningitis.[18]

Comminuted skull fractures are associated with multiple broken bones. This type of fracture is considered significant if the dura mater has been penetrated. Ruptured dura tissue would open a portal for bacteria to enter the brain. A skull fracture of this type requires careful irrigation and debridement. Blind probing of the wound would increase the chance of infection and possibly further compress comminuted bone fragments into the brain.

Basilar skull fractures are liner fractures at the base of the skull. The fracture usually starts at the temporal bone and causes bleeding and cerebral spinal fluid to leak out of the ears and nose. Often the fracture lacerates the subarachnoid space and opens a pathway between the sinus and middle ear, potentially allowing entrance of bacteria into the brain. Basilar fractures can entrap cranial nerves, cause damage to the otic canal and disrupt internal carotid arteries. Most CSF leaks spontaneously resolve after 1 week and no additional treatment is needed (fig. 8).[19]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 8. Basilar Skull Fracture

Source: John Emory Campbell, *Basic Trauma Life Support*, 4th ed. (Upper Saddle River, New Jersey: Brady/Prentice Hall Health, 2000), 116.

In the 1860s, the surgical procedure of trephining was used to gain access into the skull of a head injured patient. The trephining instrument was similar to a drill and was

used to cut a hole into the skull. Military and civilian surgeons were differed regarding when to implement this procedure. Most military surgeons felt that trephining was a dangerous procedure and should only be used in the cases of depressed skull fractures with impending death.[20] Civilian surgeons, prior to the Civil War, believed trephining could be used for a variety of different situations to include comminuted and depressed skull fractures. They also advocated using trephining to treat epidural and subarachnoid bleeds, draining abscesses, removing foreign bodies from wounds and curing epilepsy.[21] The survival rate for patients, who underwent this procedure in crowded, dirty military hospitals with surgeons not washing their hands between procedures, was poor. That contrasts with civilians who had a higher survival rate because patients were treated in the surgeon's office or hospital and had fresh air, fewer patients, and clean dressings. There were no absolute contraindications as to when to perform trephining, it was based on the surgeon's preference and experiences.

Overview of Chapters

Chapter 1 will cover the thesis, information on the pathophysiology and treatment of head injuries, and an overview of the basic structure of the paper. Chapters 2 through 5 will review the battles of Antietam, Gettysburg, Wilderness, and Petersburg. The medical records selected are based on the type of head injury and the amount of detail the surgeons were able to articulate about the cases. Each chapter will contain five cases. Each case will include the actual medical record, the forensic analysis of the medical record with reference to meeting the medical standard of care for 1860s, and a computer depiction of the patient's injury. The final chapter will be the summary and conclusion.

[1]John D. Billings, *Hardtack & Coffee: The Unwritten Story of Army Life* (Lincoln, Nebraska: Bison Book Press, 1993), 310.

[2]Alfred Jay Bollet, *Civil War Medicine, Challenges and Triumphs* (Tucson: Galan, 2002), 123.

[3]Peter Rosin and Rodger Barker, *Emergency Medicine: Concepts and Clinical Practice*, vol. 1, 4th ed. (St. Louis: Mosby, 1998), 432.

[4]Ibid., 432.

[5]Ibid.

[6]Ibid.

[7]Ibid.

[8]Ibid., 433.

[13]Ibid., 342.

[9]Ibid.

[10]Ibid., 433.

[11]Ibid., 435.

[12]Ibid.

[13]Ibid.

[14]Ibid., 436.

[15]Ibid., 441.

[16]Ibid., 443.

[17]Ibid.,441.

[18]Ibid., 447.

[19]Ibid.

[20]Stephen Smith, *Hand-book of Surgical Operations* (Bailliere: New York, 1862; reprint, San Francisco, California: Norman, 1990), 251.

[21]Samuel Gross, MD., *A System of Surgery*, vol. I (Philadelphia: Pennsylvania, Jefferson College printing, 1859) , 85.

CHAPTER 2

BATTLE OF ANTIETAM

The Battle of Antietam was fought on 17 September 1862, in the state of Maryland. A total of 5,410 Union and Confederate soldiers were killed and 25,860 wounded, making this the bloodiest one-day battle fought in America.[1] When the battle was over, the shear number of casualties overwhelmed the Union surgeons, yet still they were still able to assess and appropriately treat the majority of wounded soldiers, including those with gunshot wounds to the head. The battle ended with the Union Army, under General George McClellan victorious and Confederate General Robert E. Lee retreating, thus leaving the battlefield with the Union Army and its surgeons.

This chapter will focus on evaluating the treatment of head injuries sustained during the Battle of Antietam. The following five head injury cases were selected based on the severity of injury and detailed documentation written in the patient's medical records. They are a representation of the types of head injures that surgeons faced throughout the Antietam battle. The case studies will involve four Union soldiers and one Confederate solider. The sketches throughout this chapter and the remaining chapters are not necessarily the actual soldiers, although they will give an indication as to the anatomical location of the wound.

Table 1. List of Head Injury Cases for the Battle of Antietam					
Antietam	Unit	Injury	Diagnosis	Survival	Treatment
Curtis Brown	13th New York Vol	Buck shot, Frontal Eminence	Depressed Skull fracture	Died	Trephine
James Monaghan	42nd New York Vol	Minie ball Left Parital bone	Compression, hematoma	Died	Trephine
E. Harring	38th Georgia Regt	Minie Ball Right Parital bone	Depressed Skull fracture	Survived	Trephine
Charles H.K	12th Massachusetts	Musket Ball frontal bone	Depressed Skull fracture	Died	Bone removal
Charles T.	63rd New York Vol	Minie Ball Right Parital Bone	Depressed Skull fracture	Died	Bone removal

The Medical Director for the Army of the Potomac, surgeon John Letterman, wrote in his report on the operations at the Battle of Antietam, that the soldiers were well cared for although, "The surgery of this Battle-Field has been pronounced butchery. Gross misrepresentations of the conduct of medical officers have been made and scattered broadcasts over the country, causing deep and heat-rendering anxiety to those who had friends and relatives in the army. It is not to be supposed that there were no incompetent surgeons in the Army."[2] He went on to say that the few incompetent should not taint the reputation of the many surgeons who worked hard and were killed while trying to save the wounded (Letterman did not articulate the exact number surgeons killed).

The first case involves Private Curtis Brown, from Company K, 13th New Jersey Volunteers. He was wounded by buckshot, which fractured and depressed the right side of the frontal bone, above the frontal eminence (fig. 9).[3]

Private Brown's medical records annotated by Acting Assistant Surgeon Kennedy in 1863 states:

> The case was treated as a scalp wound until the 22nd of February, when convulsions supervened. On the following day, Acting Assistant Surgeon D.

> Kennedy made a crucial incision one and a half inches in length near the terminus of the frontal sinus, applied the trephine, and removed a button of bone and the missile, which was firmly imbedded in the diploic [diploe] structure.[4]

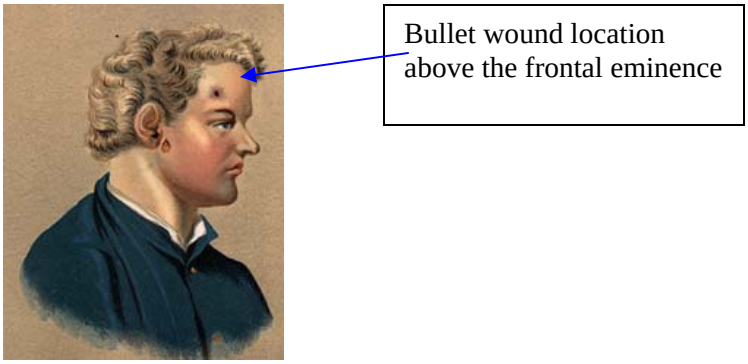


Figure 9. Bullet wound Frontal Eminence

Source: Joseph K. Barnes, MD, *Medical Surgical History of The War of The Rebellion*, vol., 2, *Wounds and Injuries of the Head*, part I (Washington, DC: Government Printing, Second Issue 1875), 367.

> Dr. Kennedy realized that Brown's depressed skull fracture, which was sustained six months earlier, might have been causing the seizure activity. Kennedy made the decision to perform the trephining procedure in order to relieve potential build up of intracranial pressure, which would possibly stop the seizures. Surgeons Smith and Warren wrote in their books that trephining was to be used only as a last resort in head injury cases, because of the high incidence of postoperative fatalities. On the other hand, according to Dr. Gross, in civilian practice, trephining can be used to treat epileptic seizures that occurred from neglected depressed skull fractures and was considered a risky but acceptable means of treatment.[5]

Kennedy performed the procedure and found a musket ball imbedded in the diploe vein, located in the frontal part of the skull (fig. 10). Review of the medical records indicates that surgical removal of the musket ball may not have been necessary, since the ball had been lodged in the skull for the past six months with no other complications.

The seizure activity that Brown suffered could have been caused by a number of different medical conditions. One of those conditions is called post concussive syndrome, which results from damaging cerebral neurons by severely shaking or jarring the brain. Once the neurons are damaged, headaches or seizure activity can persist for one year after sustaining the injury. In most cases, the seizure activity resolves without any surgical intervention.

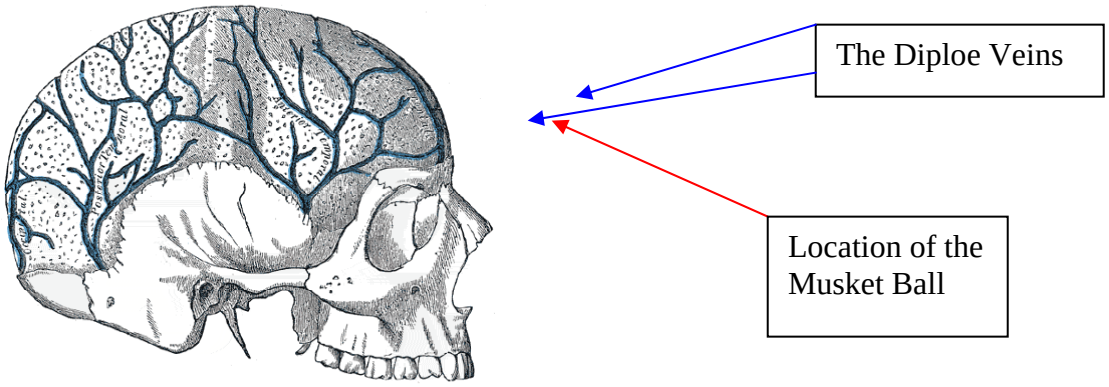


Figure 10. Musket Ball Imbedded in the Diploe Vein
Source: Barns, *Medical Surgical History of the War of the Rebellion*, 262.

The report went on to describe further treatments:

> Cold-water dressings were applied to the head and quiet enjoyed. The patient rested well during the night of the 23rd without the use of an anodyne, and on the following morning suffered but little pain; the pupils were normal, and responded readily to light; his appetite was good, but the pulse rather small and frequent.[6]

Kennedy documented that Private Brown's pupils responded readily to light indicating that the third cranial nerve was functioning appropriately. The third cranial nerve, also called the ocular motor nerve, controls the dilation and constriction of the pupil. Pressure on the third cranial nerve from brain tissue swelling or a hematoma

formation could cause the pupil to dilate unnecessarily. Private Brown's condition started to deteriorate on the morning of 25 February 1863. Kennedy wrote in Brown's medical records that: "On the morning of the 25th, he seemed to be more stupid, and the pupils were less responsive, but the pulse was the same. The bowels being costive [constipated], an injection of warm Castile soaps suds and ol. ricini [caster oil enema] was administered."[7]

Private Brown's condition continued to deteriorate, and he died on 3 March 1863. Kennedy wrote in Browns medical records as follows:

> On the 26th, he suffered a great deal of pain in his head, and seemed indisposed to talk; the pupils failed to respond to light. The wound had no inflammatory symptoms, but was suppurating quite freely. On the following day there was less pain; the wound still suppurated quite freely; the pulse was more full and regular, the tongue slightly furred and the appetite improved. Death ensured March 3rd, 1863.[8]

The symptoms of increased pain, no pupil response to light, and nonverbal behavior indicated that there might have been an expanding abscess in the brain causing an increase in the intracranial pressure. Increased pressure exerted on the ocular motor nerve could have caused the pupils not to respond to light. The wound had a large formation of pus flow or suppuration, which was thought to be a normal healthy stage in the wound healing process during the Civil War, but today we know it was a sign of infection.[9]

According to Smith's and Warren's point of view, Kennedy performed the trephining procedure prematurely. Brown had experienced only one seizure, which did not appear life threatening. Gross, although not a strong advocate for using trephining to treat epileptic seizures in depressed skull fractures, did list it as a viable treatment in civilian practice. Perhaps a more prudent method of treatment might have been to use

cold-water dressings and observe for other signs of brain compression. In any case, the aggressive treatment of trephining allowed bacteria to thrive in the brain, which probably caused Private Brown's death. An experienced Civil War surgeon probably would not have attempted trephining, opting instead for the use of bone elevators and forceps. In defense of Acting Assistant Surgeon Kennedy's actions, he was inexperienced in military medicine, having joined the military in December of 1862, only two months prior to taking care of Private Brown. He may have been under the assumption that trephining, which was very successful in the civilian environment would have the same outcomes in the military environment.

The second case involves Private James J. Monaghan of Company K, 42nd New York Volunteers. He was wounded by a missile that fractured the left parietal bone, about two inches from the sagital suture (fig. 11).[10]

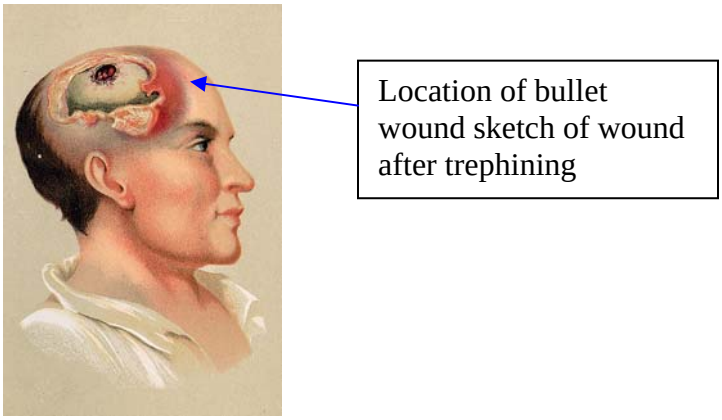


Figure 11. Bullet Wound Sketch after Trephining
Source: Barns, *Medical Surgical History of the War of the Rebellion*, 207.

The medical documentation began after Private Monaghan was evacuated from the battlefield and stated:

> He [Monaghan] was conveyed to the Hoffman hospital, where his skull was trephined. On September 25th, he was transferred to Frederick, Maryland, in a semi-conscious condition; pulse 80, tongue coated, pupils dilated, skin hot and dry; right arm entirely and right leg partially paralyzed; he passed urine and feces involuntarily.[11]

When Monaghan arrived at the hospital in Frederick, Maryland, he was exhibiting signs of compression syndrome. Which included being in a semiconscious condition, dilated pupils, incontinence, hot dry skin, and paralysis. The medical report continued as follows:

> On the following day his condition was the same; saline cathartics were ordered, which operated quite freely, and on September 27th, his pulse was 140 and weaker. He was very restless during the early part of the day; still passed urine and feces involuntarily; quite unconscious; had a chill at two o'clock P. M., and passed a very restless night.[12]

As Monaghan's condition declined, he exhibited a weaker rapid pulse, incontinence and unconsciousness. Yet, the only treatment ordered by the surgeon was to use cathartics. According to Dr. Gross, the use of cathartics was a common practice and primarily used as a counter-irritant to decrease inflammation of the head, throat, eyes, and the supradiaphragmatic portions of the body.[13] Although Gross's book never explained the pathophysiology of how cathartics reduced inflammation, it was considered to be a reliable remedy.

On 27 September Monahan's was developing signs of shock, which included an increase in heart rate to 140 beats per minute and weak. Sadly, Private Monahan did not improve and he died two days later. The medical records annotated the event as follows: "Chills recurred on the following morning; pulse 140 and easy; convergent strabismus of

right eye. Considerable hemorrhage occurred from the wound during the morning; later in the day coma supervened; the countenance became almost livid, and the patient died on September 29, 1862, in a semi-comatose condition."[14]

Convergent strabismus (crossing of the eye) is usually caused by pressure on the third and sixth cranial nerve, which controls the adduction of the eye. Monahan's right eye was crossed which indicated bleeding or pressure on the right side of the brain. Trephining was performed on Private Monaghan at Hoffman hospital, although there are no medical records documenting the patient's condition prior to the procedure. As the patient's condition deteriorated, it appears that he might have been suffering from a cerebral hemorrhaging. Without autopsy results, it is difficult to determine the actual cause of death.

Monahan's initial assessment at the hospital in Fredrick indicated that he was suffering from a potential cerebral compression syndrome. Due to the severity of the head injury, and as a last resort, trephining was an appropriate early intervention undertaken at the Hoffman Hospital. Aggressive surgeons with adequate staff, and medical supplies may have attempted to use trephining again, followed by cold water or flax seed dressings.

There is nothing to say that Private Monaghan was experiencing brain compression at the time of his arrival at the Hoffman hospital. The symptoms of dilated pupils and a decrease in the level of consciousness indicated that Private Monaghan had steadily increasing intracranial pressure from possibly an expanding hematoma. The Civil War surgeons did not know of any other treatment that would have been beneficial in

Private Monaghan's case. Thus, the surgeons performed to the best of their ability, but the head injury was too severe.

The third case is that of Confederate soldier Private E. Herring, from Company E, 38th Georgia. He was wounded by a conoidal ball, which struck in the middle of the right parietal bone, carrying away portions of both the inner and outer table.[15] Private Herring was treated by Confederate surgeons on the battlefield and taken to a Confederate hospital (fig. 12).

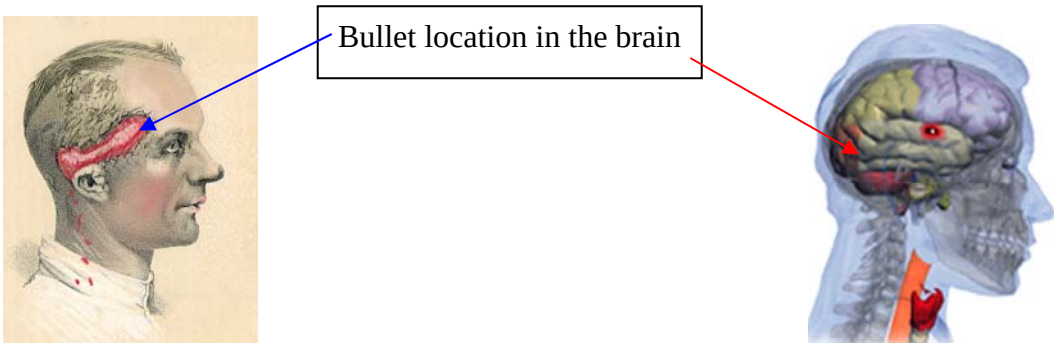


Figure 12. Wound in Middle of the Right Parietal Bone by a Conoidal Ball
Source: Left view: Barns, *Medical Surgical History of the War of the Rebellion*; Right view: Megasystem USA, *Human 3D* (Duluth: Megasystem, 2002) Computer Soft Ware available on CD Rom.

The initial medical report described Herring's care as follows: "The wound was hurriedly dressed upon the field, after which he was sent to the hospital, where his wound soon closed without having undergone any further examination for spiculae [bone fragments] or depressed portion of the bone."[16]

The medical records indicate that the surgeons initially did not assess thoroughly Private Herring's head wounds by not probing for foreign bodies (bone fragments, bullets or other debris) in the wound. Warren, Smith, and Gross all state in their books that the

first step in treating head injuries is to check the wound for foreign objects, which included bullets, bone fragments and pieces of cloth.

The medical records went on to say:

> Soon after the wound had healed, he was attacked with epileptic fits, which continued at uncertain intervals until the 18th of May, 1864, when he was again admitted to a Confederate hospital. Upon examination of the cicatrix [scar tissue over the wound], a very marked depression was found, and an elastic, yielding sense of touch beneath it. The epilepsy continuing, and the attacks becoming more frequent, it was decided to operate.[17]

Private Herring was re-admitted to a Confederate hospital on May 18,1864 when the seizure activity became more frequent and lasted for longer periods of time. Acting Assistant Surgeon R.R Ritchie reexamined Herring and found a marked depression in the right side of the parietal bone. Ritchie, decided to operate (trephine) to potentially remove any depressed bone fragments, that may be irritating the brain and causing the seizures:

> The trephine was first applied above the depressed bone; after the removal of a portion of depressed skull; it being evident that the depression extended farther; precluding the idea of elevating the depressed bone, the trephine was again applied somewhat beneath the first place, at about a one inch distance. The bone removed to the point where both tables had been destroyed by the missile; immediately beneath this was disclosed a decided convexity; the dura mater membrane was carefully divided, revealing the ball resting, point downward, on the brain. All pressure being removed, and the flow of blood arrested, the wound was closed by interrupted sutures, and cold-water dressings applied.[18]

Ritchie removed a minie ball from the dura mater and sutured the head closed using interrupted sutures, which allowed for wound drainage. Next, cold-water dressings were applied to the wound in order to decrease the inflammation, pain and swelling through vasoconstriction (constriction of the blood vessels). Although at the time, the concepts of infections and bacteria were not accepted theories, the water dressings probably played an important role in reducing infections and increasing the patient's survival rate.

Private Herring recovered with no disability and had only one seizure that occurred five days after the operation. The Union's *Handbook of Operational Procedures,* and the Confederate's *An Epitome of Practical Surgery,* states that trephining should be used for head injuries as a last resort. The civilian surgical book, *A System of Surgery* advocates using trephining as an effective means to treat seizures caused by a "neglected" depressed skull fractures.[19] Based on the high fatality rate associated with trephining, Ritchie must have understood the risk of performing the operation. However, the seizure activity was getting progressively worse and could have been considered life threatening. The patient recovered with no noted disabilities, and the seizures stopped after the bullet was removed from the dura mater. Ritchie treated the head injury appropriately and met the standard of care for the time period.

Private Charles H. K's medical report stated: "He [Charles H. K] was sent to the regimental field hospital, thence was conveyed to Baltimore, and admitted into the Newton University Hospital on the 20th. The ball, with the fragments of the external table, had been removed. The patient was suffering from slight symptoms of compression of the brain, which gradually increased [fig. 13]."[20]

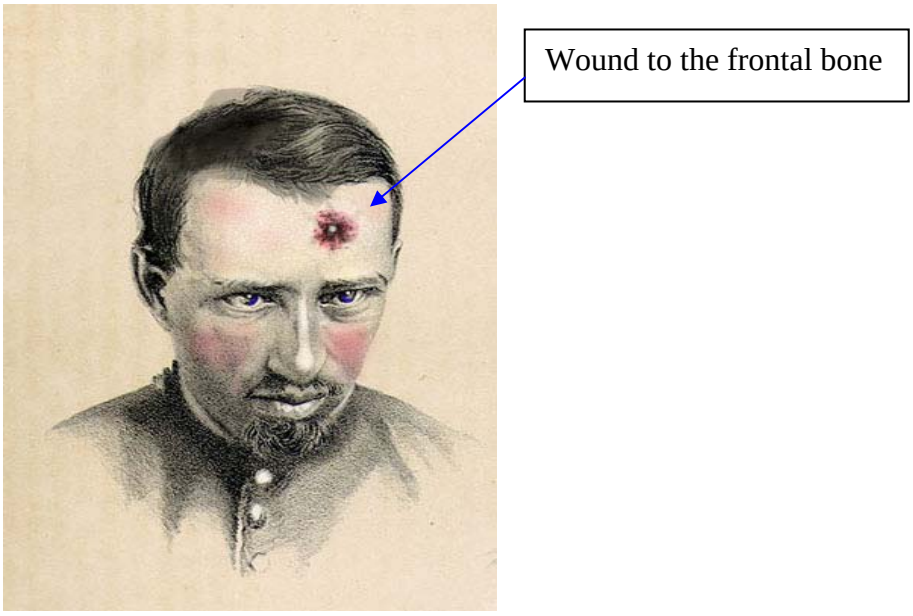


Figure 13. Frontal Bone Wound
Source: Barns, *Medical Surgical History of the War of the Rebellion*, 4.

Private Charles H. K's medical report stated: "He [Charles H. K] was sent to the regimental field hospital, thence was conveyed to Baltimore, and admitted into the Newton University Hospital on the 20th. The ball, with the fragments of the external table, had been removed. The patient was suffering from slight symptoms of compression of the brain, which gradually increased [fig.14]."[21]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 14. Bullet Path in External and Internal Tables
Source: Peter Williams and Rodger Warwick, *Gray's Anatomy* 38th ed. (Philadelphia: W. B. Saunders, 1980), 347.

Surgeon C. W. Jones removed the musket ball and bone fragments from the wound, exercising the appropriate intervention according to Smith's text: "As soon as the presence of a ball or other foreign body is ascertained it should be removed. If it is laying within reach from the wound entrance, it should be extracted through this opening. Such foreign substances as pieces of cloth can usually be brought out by fingers alone."[22] Confederate Surgeon Warren stated that "when the force of a musket ball is applied to the scalp it may be extensively lacerated and the bone bruised and broken throughout its whole extent, or through one of its tables only, and the cerebral substance beneath considerably injured; under these circumstances concussion, encephalic [brain] inflammation, or compression is likely to ensue."[23]

Private Charles H. K's surgical record stated:

> On the 23d, Surgeon C. W. Jones, U.S.V., after having enlarged the external opening, removed several large depressed pieces of the internal table, to manifest relief of the patient. During the removal of the fragments, slight haemorrhage occurred from the superficial enlargement of the wound, and at the conclusion of

> the operation, the pulsations of the meningeal artery were distinctly visible beneath he dura mater [fig. 15].
>
> Charles H.K's assessment indicated the he was suffering from symptoms of increased intercrainal pressure. Surgeon C.W. Jones enlarged the bullet entrance wound through the use of bone forceps and a chisel and then he extracted fragments of the internal table that had been missed or were not seen previously. The bone fragments were removed to relieve the compression on the brain and reduce the intercrainal pressure. Jones documented that: "The edges of the scalp were brought together by adhesive strips, and the head elevated by pillows. He [Charles H.K.] conversed coherently, his breathing was easy and natural, and the edges of the scalp commenced to adhere by granulation."[24]

Dr. Jones applied adhesive strips to the head in order to kept dirt and other foreign objects from entering into the wound. Private Charles head was elevated on pillows probably for comfort, although the elevated head would have allowed the cerebral blood vessels to drain through the jugular veins, thereby assisting to decrease the intracranial pressure. The patient's regular breathing and coherent manner were strong signs that pressure on the brain was reduced. The wound was starting to granulate which indicated a healthy healing process.

Unfortunately, Charles H. K. took a turn for the worse, as indicated by his medical records, which stated:

> Nine days after the operation the wound was slightly elevated, and in the centre could be seen the somewhat darkened dura mater. Slight compression was used; but, on the following morning, the protrusion of the brain, covered by the dura mater was greatly increased, having, in its progress, broken up all the adhesions formed at the edges of the wound. The patient was depressed, dull, and slightly comatose. Convulsions shortly after ensued, and death occurred October 3d, 1861, ten days after the operation and two days after the appearance of the hermit [*sic*, hernia] cerebri.[25]

The dura matter had begun to darken possibly indicating a subdural hematoma (hemorrhage) formation which increased the pressure inside the skull to the point that brain tissue had started to herniate (come through) from the open skull fracture. Civil War surgeons treated herniated cerebri in two ways. They could compress the brain tissue

back into the skull, which would cause in increase in the intracranial pressure compounding the problem, or they could cut the extruding brain tissue off with a knife. Compression was attempted but was not ultimately successful as the patient herniated again the next morning and died. The act of pushing the brain back into the skull probably contributed to Charles H. K's death, although it was considered appropriate for the management of cerebral herniation in the 1860s. Despite the patient's death, Surgeon Jones properly assessed and treated Private Charles H. K. according to the acceptable 1860's medical guidelines.

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 15. Minnie Ball Path through the Brain
Source: Peter Williams and Rodger Warwick. *Gray's Anatomy* 38th ed. (Philadelphia: W. B. Saunders, 1980), 347.

The final case involved Charles T, Company H, 63d New York Volunteers, aged seventeen who was wounded by a minie ball, which struck at the lower anterior angle of the right parietal bone, fracturing both tables of the cranium, and lodged under the scalp

in the occipital region.[26] The minie ball penetrated through the right side of the Charles T's head and lodged in the occipital area of his scalp. *An Epitome of Surgical Procedures* advises, "Wounds of the side of the head, especially anterior [front] to the ear, are the most dangerous followed by the vertex and occipital. Injuries to the pons and the medulla [sections of the brain located in the occipital area] are necessarily and immediately fatal."[27] This text clearly clearly indicates that such a wound little hope for recovery.

Charles T's report goes on to state:

> The scalp was lacerated, and a dark pulsating mass protruded in the wound. The left side of the body was paralyzed. The patient's mental faculties were unimpaired. On September 29th, the ball and a number of fragments of bone were removed, some of the latter being embedded in the brain substance. The inner table was found badly splintered, but the fracturing of the external table was still more extensive. The protruding cerebral mass was shaved off.[28]

The laceration exposed a dark, pulsating mass that was most likely under the dura mater. The meningeal tissue will pulsate as the blood is pumped into the brain via the rich arterial supply. The left side of the body was paralyzed indicating a disruption in the brain between the motor nerves of the body. Injury in the brain causing paralysis will usually affect one full side of the body. Injury to the spinal cord usually causes paralysis to the extremities on both sides. Charles T. had an injury on the right side of his brain, which caused his left upper and lower extremities to be paralyzed. The initial injury only affected the neural junction between the spinal cord and the brain, which explains why he did not have a decrease in his mental function.

The fracture was large enough that brain tissue was being pushed through crack in the cranium. Surgeon Warren stated:

> Hernia cerebri should be treated in its earlier stages by well conducted, systematic compression. Pressure should be made with a piece of sheet lead, a compress and a roller changed as often as may be necessary to ensure firmness and cleanliness.

> If by any accident the protrusion has attained to considerable bulk, the proper plan is to exercise all that is accessible or to destroy the brain tissue with Vienna paste [a costive agent that will destroy tissue] or the actual cautery.[29]

The protruding brain tissue was cut off, probably because a large amount of brain tissue was protruding from the wound.

The report described the wound as:

> The rough edges of the fractured bone were smoothed with cutting forceps. The following day the paralysis was more complete than before the operation. There was severe headache. The pulse was slow and weak. The left arm was powerless; the paralysis of the left leg was less complete. On October 4th, the hernia was again sliced off and gentle compression was applied. There was great irritability and restlessness.[30]

The fracture site of Charles T. cranium was filed down to smooth out the rough bone fragments. Smoothing the bones reduced the chance of brain tissue injury in the event the brain should herinate through the cranium. Additionally, it removed small bone fragments surrounding the wound that may possibly become irritating to the brain or cause an abscess. Charles T. exhibited further paralysis probably caused by the continued swelling of the brain tissue. The intracranial pressure continued to build, pushing more brain tissue through the open skull fracture. The slow weak pulse and severe headache were ominous signs that Charles T. was experiencing compression of the brain. The surgeons attempted to compress the brain tissue back into the skull, but resorted to cutting the protruding tissue off. Charles appeared to be improving with an increased appetite and some extremity function back the medical report went on to say:

> On October 21st, the patient had improved. His appetite was voracious. He was less irritable and the hemiplegia [paralysis on one side of the body] was much less complete, he was very sensitive to cold. The temperature of the left side was lower than that of the right. On November 17th, a dilatation of the left pupil was first noticed. Sensation in the left leg and partial control of the muscles had returned.[31]

The brain compression seemed to be getting better after the removal of the herniated brain tissue, until 7 December when sadly, the patient's condition became worse: "On December 7th, Charles T. had a severe chill. The discharge from the wound became watery, unhealthy, and more copious. After this the patient never regained his accustomed readiness and clearness of mind. There was an exacerbation of fever every afternoon."[32]

Charles condition progressively worsened, indicated by his decreased level of consciousness. The foul discharge from the wound, combined with fever and chills, was clearly indicative of infection. Charles T. experienced a convulsion before dying on 17 December 1862. The autopsy report described the brain as: "An irregular portion of the right parietal, four inches in diameter was found to be detached and necrosed. The dura mater was much thickened in the vicinity of the fracture, and was adherent to the margins of the healthy bone. Except in the immediate vicinity of the hernia, the brain matter appeared to be in a healthy state."[33]

Charles T's seizures might have been the result of inflammation of the brain which was potentially caused by the necrosed bone. Seizure activity may cause the patient to have decreased respirations or to respiratory arrest. During periods of inadequate respirations carbon dioxide builds up in the blood system accompanied with an increased metabolic rate in the brain. The result on the body is respiratory acidosis and hypoxia, which means the oxygen level is decreased and the injury to the brain is increased. Hypoxia is the primary concern in treating status epilepticus; (prolonged seizures). Charles most likely died during the prolonged seizure activity. The surgeons, regardless of the negative outcome, followed the appropriate treatment guidelines

established at that time. By today's standards, stuffing the brain back into the cranium or shaving off exposed brain tissue is not an acceptable practice but completely normal for the 1860's. During the Civil War there were 27 cases of cerebral hernia, of those, 22 soldiers died.[34] The medical guidance in regards to cerebra hernia is to act quickly and decisively, with the realization that 76 percent of the patients with that syndrome or diagnosis will die. Private Charles T's injury was treated appropriately according to the standards of medical practice during the 1860s.

The Battle of Antietam was one of the bloodiest battles of the Civil War. It was also a relatively early battle in the war. This was significant because the results obtained from care administered by the surgeons and medical staff was under difficult circumstances that improved in later battles. The newly developed evacuation system put into place by Jonathan Letterman, the Medical Director of the Army of the Potomac, was far from its eventual efficiency. The surgeons were ill-prepared, inexperienced with battle wounds, under equipped, and overwhelmed by the vast number of wounded. Bandages, medicine and ambulances were in short supply although better than in previous battles such as Bull Run.[35] The medical records reviewed from the Battle of Antietam indicate that for the most part surgeons did assess and treat head injuries appropriately in accordance with both the *Hand-Book of Surgical Operations* and *An Epitome of Practical Surgery.* Private Curtis Brown's case was the most notable exception.

In addition, civilian surgeons were learning that the surgical techniques they used in their private practice were not always appropriate during war. Dr. George Holston, anatomy professor at Georgetown Medical College published an article entitled *Trephining for Epilepsy* published in the *American Journal of Medical Science* Volume

XVII, in 1849. The article states that the use of trephining had been successful for stopping epileptic seizures, and the procedure had a very small complication rate. As the military surgeons became more experienced in trauma, they realized that there civilian surgical techniques were not appropriate for treating war injuries. The major difference between military and civilian surgery was the severity of the wounds and the dirty environment which can lead to infection and death.

---

[1]Alfred Jay Bollet, *Civil War Medicine: Challenges and Triumphs* (Tucson, AZ: Galan, 2002), 123.

[2]*Official Record*, series I, vol. XIX/1 [S#27] p114 No 4 Report of Surgeon Jonathan Letterman, USA, Medical Director, Army of the Potomac, of the operations of the medical department, September 2-November 7.

[3]Joseph K. Barnes, MD, *Medical Surgical History of the War of the Rebellion,* vol. 2, part I, *Wounds and Injuries of the Head* (Washington, DC: Government Printing, Second Issue 1875), 262.

[4]Ibid., 262.

[5]Samuel Gross, M.D., *A System of Surgery*, vol. 1 (Philadelphia, PA: Jefferson College Printing, 1859), 88.

[6]Barns, *Medical Surgical History of the War of the Rebellion*, 262.

[7]Ibid.

[8]Ibid.

[9]Bollet, *Civil War Medicine: Challenges and Triumphs*, 200.

[10]Barns, *Medical Surgical History of the War of the Rebellion*, 262.

[11]Ibid., 262.

[12]Ibid.

[13] Gross, *A System of Surgery*, vol. I, 81.

[14]Barns, *Medical Surgical History of the War of the Rebellion*, 262.

[15]Ibid., 174.

[16]Ibid., 262.

[17]Ibid.

[18]Ibid.

[19]Ibid.

[20]Ibid., 301.

[21]Ibid.

[22]Edward Warren, M.D., *An Epitome of Practical Surgery* (Richmond, VA: West & Johnson, 1863; reprint, San Francisco: Norman, 1989), 34.

[23]Ibid.

[24]Barns, *Medical Surgical History of the War of the Rebellion*, 301.

[25]Ibid.

[26]Ibid., 279.

[27]Warren, *An Epitome of Civil War Surgery*, 359.

[28]Barns, *Medical Surgical History of the War of the Rebellion*, 279.

[29]Ibid.

[30]Ibid.

[31]Ibid.

[32]Ibid.

[33]Ibid.

[34]Ibid., 309.

[35]Bollet, *Civil War Medicine, Challenges and Triumphs*, 2.

CHAPTER 3

BATTLE OF GETTYSBURG

The Battle of Gettysburg was the site of one of the bloodiest battles fought on American soil. Yet, based on the medical records, Union and Confederate surgeons were able to accurately assess and properly treat the majority of casualties, which included gunshot wounds to the head. The battle lasted for three days, beginning on 1 July 1863 and concluding on 3 July. More than 22,800 Union soldiers were killed and wounded, while the Confederates suffered approximately 28,000 casualties.[1] The Gettysburg battle ended with Union General George Mead as the victor and Confederate General Robert E. Lee retreating to Virginia and Union surgeons left to handle the wounded on the battlefield while the Confederate surgeons treated those that were brought in the retreat.

The number of head injuries sustained during this battle was never delineated from the total amount of casualties. Although it can be assumed, that the head injury total was high based on the shear number of wounded soldiers. Five cases selected from the Battle of Gettysburg represent the severity of injuries and the type of care received by the soldiers. Three of the patients were members of the Union Army, while two were Confederate prisoners. The medical records indicate that all the patients were treated with the best medical treatments known to surgeons in the 1860s. Unfortunately, even with having skilled surgeons at the bedside, patients still died. During the Battle of Gettysburg, even with the best possible care the primary reason many head injured patients died was probably from infections.

Table 2. The Five Head Injury Cases from the Battle of Gettysburg					
Name	Unit	Injury	Diagnosis	Survival	Treatment
Joseph Clouse	20th Indiana Vol	Minie Ball Right Frontal Emineance	gangrene	Survived	Cold-Water Dressings
William Barthaul	45th New York Vol	Minie Ball to Occipital area	Infection	Died	Flaxseed Poultices
W.F. Lancaster	3rd Virginia	Musket Ball Right Tempel	Brain Damage	Died	Cold-Water Dressings
H.Vandueson	4th Texas Regiment	Musket Ball Paritial Bone	Depressed Skull fracture	Survived	Trephine
Walter Rotherham	7th New Jersey Vol	Musket Ball Right frontal Eminence	Communated Fracture	Survived	Cold-Water Dressings

The first case involves Private Joseph H. Clouse, Co. H, 20th Indiana Volunteers, who was wounded by a conoidal ball on 3 July 1863. The ball entered his head just above the frontal eminence of the left side, and made a large flesh wound (fig. 16).[2]

Figure 16. Head Injury

Source: Joseph K. Barns, MD, *Medical Surgical History of the War of the Rebellion,* vol. 2, part I, *Wounds and Injuries of the Head,* 2nd ed. (Washington: Government printing, 1875), 4.

Clouse was admitted to Satterlee Hospital on 5 July where physicians and nurses cleaned and evaluated his head wound. The surgeons taking care of Clouse ordered cold-water dressings to be applied to his head wound. According to Dr. Gross, cold-water dressings were a remedy particularly adapted to treating external inflammation. The effect of using cold-water dressings produces two functions: it provides comfort by lowering the body temperature of a warm inflamed area, and it promotes vasoconstriction of the blood vessels, which assisted in relieving pain, decreased swelling and reducing hemorrhage. Cold-water dressings were highly effective if the treatment were started immediately after the injury, prior to effusions or abscess forming.[3] The cold-water treatment might have been used in conjunction with opium, anodyne, astringents, or antiseptics to produce better pain relief and promote the healing process. One of the most important effects of using cold-water dressing, unknown to the surgeons, was that it probably reduced the incidence of infection. On 11 July 1863 Private Clouse's treatment regime changed from using cold-water dressings to using flaxseed poultices. Poultices, or cataplasms, were used frequently to treat inflammation, abscesses, and other such injuries. The effect of poultices had a local reaction and was usually limited to the area of skin to which it was applied. If medicated poultices were used, the surgeons were cautioned that the active ingredients in the medicine could be absorbed through the skin and produce an unwanted effect on the body.[4] The effects of the poultices were dependent on the active ingredients used to make the concoction. The use of linseed and flaxseed poultice were both effective when treating gunshot wounds and are easy to make, which is probably one of the reasons it was used in Private Clouse's case.

The books written by military surgeons Smith and Warren, as well as civilian surgeon Dr. Samuel Gross, indicate that either cold-water dressings or flaxseed dressings could be used. French military physicians stated that flax or linseed dressings was the best dressing for head injuries while the Germans claimed that they had better results using cold-water dressings.[5] The medical records indicate that Civil War surgeons routinely used cold-water dressings more then any other treatment for inflammation. The use of cold-water dressings was cheap, simple, and effective, requiring only the use of cold water or ice. Private Clouse's medical report went on to say: "The wound did comparatively well until the 20th, when gangrene appeared. Tincture of the sesquichloride of iron was given, and applications of nitric acid, followed by emollient dressings, were made for a few days, when the sloughs came away, and the wound commenced to heal."[6]

The Civil War physicians also called gangrene by other names such as mortification, which in essence was the death of tissue. Mortification was a large problem when patients were crowded together in a hospital ward, military camp, or at sea in a war vessel. The disease appeared to be more common in overcrowded areas such as cities and was almost unheard of in smaller towns. The manner in which gangrene was spread indicates it was probably caused from cross contamination, equating to surgeons and nurses not washing their hands or instruments between patients. During the war, gangrene prevailed in many of the military hospitals to include New York, Annapolis, Washington, and South Mountain. Gangrene appeared usually in one of two forms: either on the unbroken surface of the skin causing cellulites or in the wound itself. It carried a 58 percent fatality rate when associated with head, neck, and face wounds.[7]

Dr. Warren advocated treating gangrene by initially using quinine, iron, and brandy, followed by remedies such as nitrate of silver, tincture of iodine, creosote, lemon juice, and nitric acid. He suggested using opium to treat the pain associated with gangrene.[8] Union surgeons practicing at West Philadelphia hospital, recommended using nitric acid to cauterize or burn the gangrenous tissue, accompanied with morphia to help deaden the pain. This treatment was very successful and used at many Philadelphia hospitals. Still other surgeons stated they did not like using the acid bath and preferred isolating the patient in a large ventilated room, and they wrapped the wound in tin foil. Although treatment of gangrene varied between hospitals and surgeons, most agreed that nitric acid, tincture of iodine, quinine, milk punch, and beef tea were the most valuable combination to treat gangrene until new discoveries were documented in 1863.[9] Private Clouse's medical records concluded with:

> On the 24th, the edges were approximating. About a square inch of the bone was visible, one-half of which was denuded of its periosteum. The patient was furloughed on August 2d, 1863; returned to his regiment, and was, on December 22d, 1863, transferred to Co. F, 20th Indiana Regiment, reorganized.[10]

Private Clouse's treatment included chemical debridement, consisting of using sesquichloride of iron and nitric acid, which caused the destruction of the necrotic tissue and caused the dead tissue to slough off. The Army did not have a definitive treatment for gangrene until late 1863 or early 1864, when Union Surgeon M. Goldsmith found that using bromine on gangrene was highly successful. In 18 cases of using nitric acid on gangrene, 13 people died when treating 154 cases of gangrene with bromide, 150 patients made a full recovery in 5 days with only 4 deaths.[11] Private Clouse's wound healed without further complications and the patient survived. The surgeons treating the gangrenous head injury chose to use both cold-water dressings and flaxseed dressings

combined with nitric acid. The combination of dressings and medication proved to be an effective treatment for the gangrenous head wound. Private Clouse's treatment was handled appropriately and can be credited for saving his life.

The second case involves Corporal William Barthaul, a 35-year-old attached to the Company D. of the 45th New York Volunteers. He was shot on 1 July 1863, by a conoidal ball and sustained a scalp laceration to the left occipital region of his head. The initial medical report indicates that the minie ball did not penetrate the skull and was thought to be a simple scalp laceration.[12] Later the surgeons noted that the minie ball actually fractured both tables of the cranium (fig. 17).

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 17. Scalp Laceration

Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 26.

The medical report began: "He [Barthual] remained in the field hospital until the 11th of the month, when he was transferred to the Turner's Lane Hospital at Philadelphia. The wound was suppurating slightly; He improved steadily until the 23d, when the parts

in the region of the wound became highly inflamed, creating considerable sympathetic fever."[13]

The medical records annotated that a small amount of pus was suppurating from the wound. Civil War surgeons viewed suppurating pus not as a normal healing process, but infection caused due to a combination of bacteria, white cells, and dead tissue.[14] Pus was placed in the category of good quality pus or laudable pus also called malignant pus, which was an ominous sign. Laudable pus was yellow in color, inodorous and had a creamy appearance. Malignant pus was blood tinged with an offensive odor and had a high mortality rate from pymeia. Pus formation was commonly observed in the healing process and occasionally a wound would heal without pus formation, this was known as healing by first intention. Healing of a wound with pus formation was called healing by second intention.[15] Corporal Barthaul was experiencing healing by second intention. The medical records went on to state that: "Flaxseed poultices were applied, and by the 27th the wound suppurated freely. Milk punch was now given during the day, the diet otherwise being restricted. The patient became prostrated, and on the 2d of August, was attacked with a slight delirium."[16]

> The surgeons initiated treatment with flaxseed poultices in an effort to reduce the inflamed tissue and promote healing. They also attempted to increase nutritional intake by giving him milk punch, which is a combination of milk and brandy. It was given to increase vitamin consumption along with being used as stimulant, which was thought to increase the healing process. Today we know that alcohol is a depressant and acts an immunosuppressant, which hinders the healing process.

Corporal Barthaul's condition deteriorated and he became irrational until his death on 6 August 1863. Acting Assistant Surgeon David Burpee conducted the autopsy and wrote: "At the autopsy a fissure of the occipital bone was discovered, one and a half inches in length, involving both tables. About one ounce of purulent matter surrounded

the line of fracture outside of the dura mater."[17] The autopsy revealed a liner skull fracture to the occipital bone, though both the inner and outer table. Corporal Barthaul died of an infection in the epidural area of the skull. Burpee, a contract surgeon on staff at Tuner Lane hospital treated Corporal Bathaul appropriately by first using flaxseed poultices. The use of flaxseed dressings was appropriate for treating gunshot wounds to the head and using milk punch as the foundation for a nutritious diet.

The treatment options were limited concerning Corporal Barthaul. The cause of death was clearly sepsis and the use of trephine would not have made a difference in this case. If the same injury would have been treated today, a form of trephining might have been used, called burr holes, if increased intracranial pressure existed. Surgeons today would treat infection and inflammation with the use of antibiotics and steroids to kill the infection and reduce the brain swelling. However, medications such as antibiotics and steroids were unknown in the 1860s.

The third case involves Confederate prisoner Corporal W. F. Lancaster, Co. F, 3d Virginia Regiment, aged 24 years' old, was wounded 1 July 1863, by a musket ball, which penetrated the squamous portion of the right temporal bone, just above and anterior to the meatus auditorius (fig. 18).[18]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 18. Musket Ball Penetrated Squamous Portion of the Right Temporal Bone
Source: Megasystem USA, *Human 3D* (Duluth: Megasystem, 2002) Computer Soft Ware available on CD Rom.

Lancaster's report stated: "The missile was extracted on the field and the patient was conveyed to the Seminary Hospital, where he remained until the 20th of the month. He was then sent to West's Building Hospital, Baltimore, being at the time irritable, as his wound was painful, and his sleep at night disturbed."[19] Corporal Lancaster was shot in the right temple in front of the ear. The surgeons extracted the bullet from a superficial location and sent the patient to the hospital. Bullet extraction in the field was considered appropriate according to Smith's text. He noted that if the bullet or foreign object could be removed, it should be done at the earliest possible time. However, one of the problems associated with removing bullets in the field was that the surgeon often used their dirty fingers to probe for the bullet. The dirt from the surgeon's finger dramatically increased

risk for infection but this was the accepted practice.[20] Lancaster's medical records described what happened next:

> Cold-water dressings and expectant treatment were used. On the 1st of August short periods of delirium occurred, with quick, small pulse, which was followed by obstinate diarrhea. By the 4th, delirium had become constant, terminating five days later in a state of partial stupor. Insensibility followed, on the morning of the 10th; his respiration becoming stertorous, pulse frequent and weak; and death occurred at five o'clock in the afternoon.[21]

Corporal Lancaster's treatment started with using cold-water dressings to decrease cerebral irritation. The surgeon knew the patient's condition was critical and that he probably would die, thereby expectant treatment was annotated in the medial records. Expectant treatment encompassed keeping Corporal Lancaster as comfortable as possible while he died. Lancaster developed delirium and was talking and acting insensibly. His pulse rate increased, and he had uncontrollable diarrhea. The delirium was probably caused by meningitis or inflammation of the meningeal layers of the brain. The rapid heart rate could be contributed shock compiled with dehydration caused from the diarrhea. The medical records indicate that on 10 August Corporal Lancaster was insensible, which is a term that typically meant he was in a coma, and died at 1700 hours that day.

The medical record concluded with:

> At the autopsy, the portions of the squamous bone immediately surrounding the upper part of the perforation were found depressed nearly a fourth of an inch. The parietal, sphenoid, and frontal bones were also involved in the fracture, which measured three and a half by two inches. In the immediate vicinity of the fragments disorganization of the brain existed, but in the other parts its structure was healthy [fig. 19].[22]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 19. Frontal, Parietal, and Sphenoid Bones
Source: Megasystem USA, *Human 3D* (Duluth: Megasystem, 2002) Computer Soft Ware available on CD Rom

The autopsy showed a depressed skull fracture at the site of the injury and fractures to the base of the skull (fig. 20). There was also disorganization or mangling of the brain tissue at the point of injury. The bullet could have caused Corporal Lancaster's brain disorganization, and it may have also been caused from the field surgeon probing the wound with his finger. In the early part of the war, both Dr. Smith and Dr. Warren advocated using a finger to probe gunshot wounds to better assess the tissue damage caused by the bullet. The surgeons preferred digital probing as appose to using an instrument because they could better "feel" the injury and projectile, as no imaging capacity existed. The exact cause of death is difficult to say, although because of the difficulty in breathing it is possible that Lancaster died from an infection or emboli in the lungs.

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 20. Fracture Location

Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 26.

The fourth case involved Confederate soldier, Private H. Vandueson, of Company C, 4th Texas Regiment, who was taken prisoner after being wounded by a musket ball on 3 July 1863. The ball fractured his anterior superior portion of the right parietal bone, making a radiated depression of the outer table.[23]

> Private Vandueson was shot on the right side of the head and sustained a depression to the outer table of the skull. The wound was allowed to heal with no further intervention and Vandueson was returned to the Confederate Army during a prisoner exchange. The following medical annotation was entered into Vandueson's medical records by the Confederate surgeon B. Roomer who wrote:
>
> After Private Vandueson returned to his command, Epileptic fits supervened in September, 1863, and gradually became more frequent and intense until March, 1864, when he was again admitted to a hospital. At that time the cicatrix was four and a half inches in length, pointing obliquely backward under an angle of 60° with the coronal suture, deepening and widening in its centre, and presenting a depression of three-eighths of an inch in depth; the scalp here is radiated, as if the covering had assumed the abnormal condition of the bone beneath.[24]

The injury was treated as a scalp laceration with minor depression and no adverse symptoms. The head wound was healing without complications. Private Vandueson was released to the Confederate Army when in September of 1863 he developed recurrent

seizures. The frequency of seizures increased over the next 7 months, then in March of 1864, Vandueson was readmitted to the hospital for seizure control. During the surgeon's evaluation it was discovered that the suture line at the top of his head was extremely wide, indicating a fracture and depression along the suture line. The medical records stated that: "The epileptic paroxysms were now composed of a number of successive convulsions. His general condition previous to an attack was marked by dejection of spirits, vertigo, and apathy, his bowels habitually costive, appetite wanting, urine scanty, pulse 60 and feeble, and face pale."[25]

Vandueson had developed status epilepticus, which meant he was having continuous seizures. The severity of reboundant seizures is directly proportional to the amount of brain tissue injured. The seizures could also be caused by infection or disruption of the cerebral cortex as with a depressed skull fracture. Dr. Warren and Dr. Gross agreed that cerebral compression would cause the patient to have constipated bowels, low urine production, weak pulse.

Roomer decided to treat Vandueson injury by using trephining. The surgical report was annotated as follows:

> Extravasations being supposed to exist, it was decided to apply the trephine. Chloroform having been administered, Surgeon B. Roomer, P. A. C. S., made two incisions in the form of a T; one nearly parallel with the coronal suture, upon the upper margin of the parietal bone, about half an inch from the cicatrix, and uniting with it; the second over the upper third of the cicatrix and behind it. The first measured three and a half inches, and the second four inches.[26]

The extravasations could have resulted for a number of reasons to include cranial bleeding, leaking cerebral spinal fluid, or pus. Blood is an irritant that can cause seizures if it comes into contact with brain tissue. Surgeon Roomer decided to use the trephining procedure under the anesthetic of chloroform. The decision was made to trephine based

on the steady decline of the patient's condition. The seizure activity, along with the decreased level of consciousness and depressed skull fracture, placed Private Vandueson in a life threatening condition. In addition to Smith's and Warren's guidance, Dr. Gross stated that trephining should be used only if fragments form a depressed skull fracture have been pushed into the brain.[27] The medical records went on to say that:

> Trephine was applied at the upper part of the depression. The bone came away with the trephine, and no adhesions of the dura mater existed. Immediately below, and almost in the center of the opening, lay a violet-colored, circular, and somewhat convex extravagation, covered by the dura mater, which was divided by a simple cut. No hemorrhage occurred from beneath the skull, and three small arteries of the scalp had been readily controlled without ligation.[28]

The violet color substance found under the dura mater indicated that the extravagation was blood, which would identify the bleed as a subdural hematoma. There was no active bleeding that took place when the dura mater was cut, thus the bleeding had already stopped. The medical report annotated Vandueson postoperative condition as follows:

> The extravasation being removed, the wound was closed with adhesive straps, and cold-water dressings and a cross-bandage applied. The patient reacted well from the effects of the chloroform, and walked about in his quarters on the second day. The wound healed by first intention. Two weeks after the operation he expressed himself as free from any unpleasant feelings. The condition of his bowels became healthy, his general aspect cheerful, and the prognosis was highly favorable to complete recovery. The operator, Surgeon B. Roomer, P. A. C. S, records the case.[29]

The extravasation--blood clot--was removed, and the head was closed with adhesives strips. Dr. Warren stated that scalp wounds should not be sutured together, although he did not give an explanation as to why sutures should not be used. In modern medicine, wounds of the head have a greater risk of infection if sutured after six hours from the time of the injury. Dr. Warren's book recommends using adhesive straps or tying the patient's hair together in order to hold the skin in place. Surgeon Roomer

treated the wound with cold-water dressings to reduce cerebral inflammation. Private Vandueson made a full recovery, and the seizure activity stopped.

Surgeon Roomer treated the head wound appropriately according to the guidelines from Dr. Warren and Dr. Smith. The patient was suffering from a depressed skull fracture with a subdural hematoma, which was probably irritating the brain tissue causing seizure activity. The expansion of the hematoma increased pressure in the brain giving symptoms of compression syndrome. The decompression or evacuation of the subdural hematoma through the use of trephining, without introducing an infection is probably the reason Private Vandueson survived.

The fifth case involves Sergeant Walter Rotherham, Company D, of the 7th New Jersey Volunteers. He was twenty-three years' old and wounded on 2 July 1863 by a musket ball. The ball penetrated his skull near the right frontal eminence, passed directly inward and lodged somewhere in the cerebral membrane of the brain (fig. 21).[30]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 21. Head Wound

Source: Megasystem USA, *Human 3D* (Duluth: Megasystem, 2002) Computer Soft Ware available on CD Rom.

Sergeant Rotherham sustained a penetrating gunshot wound to the frontal bone with the bullet embedded into the brain. The initial medical report read as follows: "On July 10th [Sergeant Rotherham] was sent to the Jarvis Hospital at Baltimore. The opening through the bone was similar to that made by a trephine, and the track of the ball could be followed on the dura mater with a probe for a considerable distance, as that membrane was detached from its natural connections with the skull."[31]

Ideally the surgeons probed the wounds with their fingers unless the wound was too deep, then a probe was used. If the bullet could be located and removed without causing more damage to the brain tissue, then this was done. If the bullet was in difficult location and was not causing any problems, it was left in place. Assistant Surgeon D.C. Peters documented his assessment of Rotherham in the medical records as:

> The patient was unable to say whether there had been much hemorrhage or not. The parts were still open, and in making expiration, the little finger could be readily inserted through the fracture, but no jagged bone pressing inward could be detected. The membranous were not lacerated at the seat of injury. The pulsations of the brain could be distinctly felt, and it was apparent that the ball had not rebounded or dropped out, but had followed a course toward the back of the skull, where it still was concealed.[32]

The medical records indicate that Sergeant Rotherham, was initially rambling and confused when he arrived at Jarvis Hospital in Maryland. Mental confusion or altered level of consciousness is a common occurrence with head injuries. Civil War surgeons usually referred to the altered level of consciousness as being stupid. The wound was described as being open and expiration meant there was fluid, probably draining cerebral spinal fluid. The surgeons evaluated the head wound for spinicals or bone fragments, which unfortunately may cause brain irritation. The meningeal membrane was assessed for any cuts or lacerations other then the path of the musket ball. The brain was pulsating

indicating that the blood flow to the brain was intact. The surgeons were able to follow the musket ball tract straight back towards the occipital area of the skull. The brain tissue closed around the bullet path, which obstructed the surgeon's view of the exact location of the bullet. The medical records reported Rotherham's progress as:

> Patient further stated that, on recovering his senses, he was not in the least paralyzed, and was able to converse, and that his surgeon said: "you cannot possibly live." After a few hours, he again became insensible, and remained so for two days, when consciousness again returned. The patient, on admission, was able to sit up, stand, and walk, but he carried his head backward, resting between the shoulders, and complained of great pain and dizziness, if he attempted to change it to an erect position. There was no perceptible loss of power, motion, or sensation on either side of his body. He was directed to be put to bed, and quiet was enjoined. His hair was then cut short, and cold water dressings were applied. There being no arterial excitement, the treatment was chiefly expectant.[33]

Sergeant Walter Rotherham was not experiencing any paralysis, but complained of pain and dizziness. The surgeons related Rotham's dizziness and pain to irritation of the brain and directed the staff to use of coldwater dressings, and maintain a non-stimulating atmosphere. The surgeons did not expect Rotherham to live due to the severity of the wounds. The final medical record note written by Dr. Peters prior to Rotherhams release from the hospital stated:

> December 19th, 1863, at which time he complained of a constant dull, heavy pain at the back of his head. At night he suffered from unpleasant dreams and hallucinations, which sometimes caused him to wake in a state of great terror. His bowels were obstinately constipated, but were readily relieved by mild cathartics. Occasionally he was annoyed by nausea and vomiting after eating his meals. His mind was not impaired to any perceptible degree. The case is reported by Assistant Surgeon D. C. Peters, U. S. Army.[34]

Sergeant Rotherham never developed paralysis or mental disorders, and the wound healed without complications. The minie ball embedded in his brain was never removed. The Civil War surgeons treated Sergeant Rotherham appropriately. The use of cold water dressings was an important treatment that helped decrease brain tissue

inflammation and expedite Sergeant Rotherham's recovery. In Rotherham's case, the surgeons had the option of locating the musket ball and attempting to remove it by using trephining. Surgeon Peters decided not to be aggressive in his treatment, which probably would have resulted in infection and death.

The review of five patients that sustained head injuries during the Battle of Gettysburg reinforces the fact that the Civil War surgeons appropriately assessed and treated head injuries. All the cases evaluated, including the two Confederate prisoners, met the standard of care set forth by Dr. Smith, Dr. Warren, and Dr. Gross. The two cases where patients died were probably related to the development of a local infection or pyemia.

---

[1]Alfred Jay Bollet, *Civil War Medicine: Challenges and Triumphs* (Tucson, AZ: A Galan, 2002), 125.

[2]Ibid., 80.

[3]Samuel Gross, M.D., *A System of Surgery*, vol. 1 (Philadelphia, PA: Jefferson College Printing, 1859), 95.

[4]Ibid.

[5]Stephen Smith, *Hand-Book of Surgical Operations* (New York: Bailliere, 1862; reprint, San Francisco, CA: Norman, 1990), 248.

[6]Joseph K. Barns, M.D., *Medical Surgical History of the War of the Rebellion,* vol. 2, part I, *Wounds and Injuries of the Head,* 2nd ed. (Washington: Government Printing Office, 1875), 80.

[7]Gross, *A System of Surgery*, 825.

[8]Edward Warren, M.D., *An Epitome of Practical Surgery* (Richmond VA: West & Johnson, 1863; reprint, San Francisco, CA: Norman, 1989), 153

[9]Ibid.

[10]Barns, *Medical Surgical History of The War of The Rebellion*, 80.

[11]Ibid., 835.

[12]Ibid., 125.

[13]Ibid.

[14]Ibid., 825.

[15]Ibid., 125

[16]Ibid.

[17]Ibid.

[18]Ibid., 204.

[19]Barns, *Medical Surgical History of The War of The Rebellion*, 204.

[20]Bollet, *Civil War Medicine, Challenges and Triumphs*, 92.

[21] Barns, *Medical Surgical History of The War of The Rebellion*, 204.

[22]Ibid., 283.

[23]Ibid.

[24]Ibid.

[25]Ibid.

[26]Ibid.

[27]Gross, *A System of Surgery*, 86.

[28] Barns, *Medical Surgical History of The War of The Rebellion*, 196.

[29]Ibid.

[30]Ibid., 196.

[31]Ibid.

[32]Ibid.

[33]Ibid.

[34]Ibid.

CHAPTER 4

BATTLE OF THE WILDERNESS

The Battle of the Wilderness was a two-day battle beginning from 5 to 6 May 1864. The Union Army was commanded by General Ulysses S. Grant, and General Robert E. Lee was commanding the Confederate Army. Minutes after the gunfire started on 5 May, the battlefield erupted in a forest fire due to muskets and cannons igniting dry grass and trees. The fire spread engulfing both Union and Confederate casualties who were unable to escape from the battlefield. At the end of the two-day battle, neither army could claim a clear tactical victory. The Union casualty rate was over 18,000 compared to the Confederate loss of over 10,000 men.[1]

Table 3. Medical Cases Studies for the Battle of the Wilderness

Wilderness	Unit	Injury	Diagnosis	Survival	Treatment
William A	11th Pennsylvania	Minie Ball Frontal Eminence	Fracture inner table	Died	Cold-Water Dressings
Lafayette Young	27th Michigan	Minie Ball to the Sagittal suture	Fractured skull	Died	Trephine
Charles C.	30th North Carolina	Minie ball Right Temple	Maxilla Fracture	Died	Detergent lotion
Owen Fitzpatrick	63rd New York Vol	Musket ball Occipital Bone	Fracture both tables	Survived	Trephine
Henry S	118 Pennsylvania	Minie Ball Frontal Eminence	Depressed Skull fracture	Died	Expectant Care

The first case involves Private A. William assigned to Company F of the 11th Pennsylvania Volunteers. On the seventh of May of 1864, Private William was wounded by a minie ball which struck the frontal bone between the eminences. The minie ball did not penetrate the skull, but denuded the outer layer of the frontal bone (fig. 22).[2]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 22. Denuded Frontal Bone of Skull

Source: James E. Anderson, *Grant's Atlas of Anatomy*, 8th ed. (Baltimore: Williams and Wilkins, 1983), 7-5.

The medical record stated: "The wound was considered slight. . . . May 18th, he [William] was transferred to the Satterlee Hospital, Philadelphia. Cold-water dressings were applied to the wound."[3]

Private William had sustained a contused frontal bone. Dr. Gross described the contusion of the skull without fracture as a wound with the potential for grave consequence. It usually occurred from a fall, being struck with a blunt object, or from the shock of a partially spent musket ball, causing damage to the cerebral tissue. One of the most severe problems is a contusion to the diploe which is the marrow of the skull bone found under the pericranium.

In the 1860s, the treatment used for a contused skull, according to Dr. Gross, was as follows, "Rest for a short time in bed, an occasional purgative, rigid abstinence and the avoidance of mental excitement. The brain is watched for serious inflammation. Operative interference is not thought of if no depression of the bone or encroachment of

the inner table is suspected."[4] Surgeons Warren and Smith concurred with Dr. Gross's treatment and also recommended an observation period with the use of purgatives. In Private William's case, the surgeons ordered cold-water dressings to reduce the swelling and irritation associated with an external wound. The cold-water treatment provided comfort by cooling down the injured area, which is normally warm or hot to the touch due to of increased inflammation. The cold water will also numb the affected area offering some anesthetic effect.

The medical records went on to explain Private William's condition and symptoms: "He [William] was in good condition and appeared to do well until May 23d, when he became irritable, and complained of severe pain in the head. The external wound still looked well. On the following day he became drowsy and suffered from nausea."[5]

The initial symptoms annotated in the medical records would indicate that Private William was suffering from a cerebral contusion, which is bruising of the brain. A cerebral contusion during the Civil War was described as a distinct lesion caused from a blow to the head or small specks of blood clots in the brain. The instrument that most likely causes a contusion was a blunt or pointed weapon and sometimes a bone fragment from a depressed skull fracture.[6]

The symptoms of cerebral contusions were vague and often overlooked. The symptoms differed based on the severity of the injury and usually presented four to six days after the initial insult. Dr. Gross stated that: "In some cases there is extreme agitation or restlessness, the patient would toss continually about the bed; there may be ridged contraction of one or more limbs, especially the fingers, and then an increase in delirium along with nausea and vomiting."[7]

Private William's medical records annotated that:

> The pain in the head continued unabated and the pulse was 110, but the mind clear. Small doses of creasote [used to induce vomiting] and lime-water were given and he was freely purged. On May 24th the nausea subsided and the pulse had risen to 120; no pain in the head, and the patient was rational though dull.[8]

The symptoms were progressively getting worse, and Private William's prognosis was becoming grave. Dr. Gross and Dr. Warren explained that as the contusion progresses more areas of the brain are affected. The patient may develop changes in his pulse and respirations then there can be a loss of consciousness. They also noted that sometimes the patient can experience both contusion and compression of the brain at the same time, which is difficult to diagnose. Assistant Surgeon Baldwin documented Private William's condition on the following day: "On the 25th the pulse was weak at 130, but the patient seemed perfectly conscious, and his mind was clear, and he declared that he felt perfectly easy, yet he died suddenly at five in the afternoon."[9]

Acting Assistant Surgeon Charles P. Tutt conducted an autopsy and reported: "The periosteum was removed, the external table of the skull was scarcely injured, except by a shaving of lead from the ball firmly imbedded beneath the outer lamina at the inner upper margin of the wound in the periosteum."[10] During the autopsy, Tutt had noticed that the minie ball broke apart and a small piece of lead was partially imbedded into the bone. He went on to document:

> On removing the calvaria a large amount of pus was found upon the dura mater of the anterior lobe of the left hemisphere beneath the seat of injury. On removing the pus a spiculum of bone from the inner table was found to perforate the dura mater and a large abscess extending into the anterior horn of the left lateral ventricle was found beneath. A large effusion of serum was found at the base of the brain.[11]

The autopsy revealed that Private William did not have a fracture of the external table of his skull, although he did have a fracture of the internal table. A sliver of bone from the skull perforated the dura mater and became necrotic. The necrotic bone caused an infection into the dura mater. The infection thrived and spread throughout the brain.

The Union surgeons realized that complications associated with gunshot contusions of the head included hemorrhage, gangrene, exfoliation of the skull, and injury to the membranes of the brain. The symptoms that were usually observed included headache at the point of injury, dizziness, chronic irritation of the brain, mental imbecility, and epilepsy.[12] The surgeons were able to recognize potential complications associated with head contusions, although the actual medical treatment was limited. Since the outer table of the skull was not fractured, the surgeons took a risk of doing further harm by opening the skull using the trephining procedure regardless of when the procedure was actually done. There was no clear guidance to surgeons on how they should treat a closed head injury with the possible complication of an abscess. Although many surgeons, both Union and Confederate, were against trephining, Dr. Warren suggested the use of trephining in the situation where the patient's condition continued to deteriorate and the abscess formation was in an accessible area such as in the dura mater. *The Medical Surgical History of the War of the Rebellion* states that the survival rate for a patient that sustained a closed head injury with exfoliation of the cranial bone was only 25 percent.[13]

The treatment Surgeon Baldwin initiated on Private William was appropriate. Dr. Gross stated that the initial treatment of a patient that sustained a contusion of the brain should be aimed at combating shock, which is done with cold air and the use of smelling

bottles or ammonia. The attendants should then oversee that the patient does not overeat, or neglect his bowels. In the event that the patient has a jerking, quick pulse, is intolerant to light and noise, becomes restless and shows increased thirst and flushed cheeks, the treatment should involve bleeding the arm or using leeches behind the temple and ear. The bowels should be given cathartics and head shaved with ice applied.[14]

Dr. Baldwin initially treated Private William with cold-water dressings, administered purgatives and maintained the patient's bowel function. The only treatment not done was bleeding the patient, probably because there was no indication that cerebral congestion was an issue. Dr. Baldwin met the standard of care practice for head injuries during the Civil War time period.

The second case from the Wilderness involves Sergeant Lafayette Young of the 27th Michigan Volunteers, who was wounded on 5 May 1864 by a minie ball and suffered a fractured skull in the left sagital suture line area (fig.23).[15]

The Medical Surgical History of the War of The Rebellion stated that fractures of the cranial sutures were uncommon and usually associated with cannon fragments, falling from a great height or being kicked by a horse. The condition was often immediately fatal although there were cases where patients have survived for a few hours to weeks. The symptoms include copious hemorrhage from the ears and ecchymosis (bruising) of the scalp and eyes, indicating the possibility of a basilar skull fracture.[16] The medical report stated: "Young was conveyed to Washington, and on May 25th admitted to the Harewood Hospital. The man's mind was sound, although strabismus of the left eye indicated symptoms of compression of the brain. The left leg was partially paralyzed."[17] One eye can be turned inward, upward, outward or downward depending on which eye muscles

are involved. The causes were numerous, with most being congenital or from a disease such as small pox, scarlet fever, whooping cough and cerebral compression.[18]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 23. Minie Ball to the Sagital
Source: Carmine D. Clemente, *Anatomy A Regional Atlas of the Human Body,* 2nd ed. (Baltimore: Urban and Schwarzenberg, 1981), figure 557.

Cerebral compression may also cause varying degrees of paralysis ranging from slight weakness to full flaccid extremities. Dr. Gross pointed out that in most cases of paralysis, the brain compression is on the opposite side of the paralysis. He also stated, that in rare cases the paralysis and compression area are on the same side.[19] Sergeant Young's condition was felt warrant trephining. As described in his surgical report: "On May 28th, he was placed under the influence of ether, and Surgeon R. B. Bontecou, U. S. V., applied the trephine to the left edge of the wound, removed the loose bone, and elevated the depressed portions."[20]

Dr. Bontecou decided to use trephining in order to remove the bone fragments from Sergeant Young's head. Dr. Smith's writing supported the use of trephining in order to remove bone fragments from the wound.[21] Dr. Gross was in favor of using trephining, based on if the patient suffered from paralysis. Some Union Surgeons, such as Dr. Hennery Hewit, Medical Director for the Department of Ohio, were against the use of trephining for any procedure stating, " Expectant treatment should be practiced for any penetrating injuries of the head. No cases occurred in which trephine promised any advantage. In a penetrating wound of the skull by a minie ball, the amount of injury inflicted is usually fatal by nature."[22]

Young's record went on the state: "The patient improved under antiphlogistic [anti-inflammatory] treatment and on June 1st healthy suppuration supervened. Two weeks later, the left leg became entirely free from paralysis."[23] The surgical procedure appeared to have worked, and the Sergeant Young was starting to recover. The paralysis was completely reversed; however there is no mention that the strabismus was corrected.

Initially Young recovered, but then he died on 21 August 1864. The surgeon wrote:

> On July 1st small pieces of bone were removed, and the wound looked unfavorable. On the 23d, Young was transferred to the St. Mary's Hospital, Detroit, Michigan, affected with strabismus of the left eye and paralysis of the left leg. He was furloughed on August 2d, but died before the expiration of his leave of absence, August 21st, 1864.[24]

Sergeant Young's wound was referred to as "unfavorable" meaning it was likely becoming infected. As Young died at home, an autopsy was not performed. It is highly probable that the head wound developed an abscess, which spread throughout his brain and caused his death.

The appropriate treatment of Sergeant Young hinges on the use of trephining in a case of nondepressed skull fracture with signs of compression. Surgeons Gross, Smith, and Warren agreed that trephining could be used to remove bone fragments from a head wound under critical circumstances. Other surgeons like Dr. Hewit, argued that patients should be treated as expectant and trephining would not help the patient. In this case, trephining provided relief of paralysis for a few weeks, and then it appears the wound became infected yet again. The surgeons treated Young appropriately by using the trephine. Additional treatment that may have been beneficial would have been to use cold-water dressings when the wound started look unfavorable.

The third case is that of Private Charles C, Company H, 30th North Carolina Regiment. This Confederate prisoner received a gunshot wound of the face on 7 May 1864. The missile entered the left temple, passing obliquely anteriorly and emerged one inch below the left eye. He sustained a severely fractured and comminuted superior maxilla with a completely destroyed nasal bone (fig.24). [25]

Figure 24. Minie Ball to Temporal Bone

Source: James E. Anderson, *Grant's Atlas of Anatomy*, 8th ed. (Baltimore: Williams and Wilkins. 1983), 7-6.

Charles C's medical record stated that:

> He was among the captured wounded sent to Carver Hospital. He was very low, and in a comatose state, requiring considerable exertion to arouse him sufficiently to partake of food and stimulants. He took a quart of milk punch daily, Detergent lotions were applied to the wound. The contents of the left orbit were evacuated, and the vision was destroyed in the right eye.[26]

The report goes on to show that Private Charles C had sustained a multitude of injuries:

> Inflammation gradually extended to the brain; but without any very violent symptoms. The patient survived twenty days, death resulting May 27th, 1864. Acting Assistant Surgeon J. E. Winants reported the case. The right malar, the bodies of both superior maxillaries, both lachrymal bones, the body of the ethmoid, with the turbinated bones, the left great wing of the sphenoid, and the left external angular process of the frontal with the orbital plate have been carried away.[27]

Inflammation of the brain can occur immediately after an incident or three to six days later. The *Medical Surgical History of The War of the Rebellion* stated common causes of brain inflammation in the 1860s included falling from a horse and blows or gunshot wounds to the head causing liner fractures. Generally, these injuries also involved brain contusion and sometimes compression. Dr. Gross described the symptoms of brain inflammation as follows: "Somnolent, or in a semiconscious state, like a man partially under the influence of liquor, is exposed to sleep and is excessively irritable, is difficult to arouse, his pulse is feeble and calm, his respirations are easy and unaccompanied by stertor, his skin is pale and moist."[28]

Private Charles C experienced the symptoms of irritation and contusion of the brain. The proper treatment associated with brain irritation was usually conservative in nature and centered around keeping the patient calm. If the symptoms worsened, especially when the blood vessels of the brain became congested, more aggressive measures were taken to include: leeches to the temples, counter irritation by blisters to

the nape of the neck, purgatives, liberal doses of morphia and aconite, with Mercury in small doses along with iodine.[29]

The medical records do not indicate any of the recommended treatments and remedies were given to Private Charles C. He was not given the proper treatment that was considered the standard of care of the Civil War time period. One rational may be because Charles C was a prisoner and the Union medical department was not going to spend needed resources on a prisoner. Another reason may be because Private Charles C was so badly injured that he was triaged as expectant and thus did not necessitate treating aggressively.

The autopsy report stated: "The left parietal is fissured (cracked) from the anterior inferior angle to the parietal eminence. The left palate bone is fractured across, the sphenoid cells are exposed, and the cranial cavity is freely opened. The edges of the fractured bones are slightly necrosed and show traces of an attempt at repair."[30]

The autopsy revealed that Charles C sustained extensive brain damage and infection. The surgeons realized he was not going to live, thus they treated his symptoms and attempted to keep him comfortable with morphia. The medical standard of care was not met for Charles C regardless of the severity of his injuries.

The fourth case is that of Private Owen Fitzpatrick, Company B, 63d New York Volunteers. He was wounded by a musket ball on 5 May 1864. It struck anterior to the superior angle of the occipital bone. Both tables of the skull were fractured and depressed approximately one-fourth of an inch The medical report went on to say that: "He was conveyed to Alexandria, Virginia, and entered the 3d division hospital on 12 May. Little,

if any, constitutional disturbance existed; the patient ate and slept well and was able to walk about [fig. 25]."[31]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 25. Musket Ball to Occupital Bone
Source: James E. Anderson, *Grant's Atlas of Anatomy*, 8th ed. (Baltimore: Williams and Wilkins. 1983), 7-9.

Private Fitzpatrick was shot in the back of the head with a musket ball and sustained a depressed skull fracture. The medical records did not distinguish what constitutional disturbances existed, although the injury did not seem to be debilitating. The use of trephining with little to no visible problems in the patient seemed extremely aggressive and foolish according to surgeons Smith and Warren. However, Dr. Gross stated that the procedure can be used to remove bone fragments associated with depressed skull fractures because the bone fragments may pose a problem with necrosis some time after the injury.[32] Fitzpatrick's surgeon wrote:

> On the 16th, he was placed under the influence of chloroform and ether, equal parts, and Surgeon Edwin Bentley, U. S. V., trephined the skull, removed a few small fragments, and elevated the depressed bone. No haemorrhage followed the

> operation. Cold water dressings were applied, the head slightly elevated, and quiet and abstemious diet strictly enjoined.[33]

According to Dr. Warren, anesthesia was contraindicated in the cases that involved using the trephining procedure. This was due to the belief that anesthesia may cause increased brain irritation; however, many surgeons did prefer to use it.[34] Surgeon Bentley decided to use a mixture of chloroform and ether as his anesthetic agent during the trephining procedure. Mixing chloroform and ether had been an established practice since the 1850s and was proven to be a safer anesthetic agent then either chloroform or ether alone. Surgeon Bentley successfully completed the procedure and cold-water dressings were applied. The use of cold-water dressings was an important treatment to reduce cerebral inflammation.

The elevation of Fitzpatrick's head was appropriate practice in the 1860s after trephining and is still used in modern day treatment of head injuries. The positioning of the patient in a sitting position will increase drainage of blood and fluid from the brain and decrease cerebral swelling.

The documentation in Fitzpatrick's medical records states that he made a full recovery: "The case progressed without any untoward symptoms. On 25 June some small pieces of skull and shreds of cloth were removed from the wound. On 26 September the wound had entirely healed and the patient received a furlough of thirty days."[35] It was common for small foreign objects such as patches of clothing, splinters of wood or debris to follow the musket ball path. The cloth probably came from the patient's hat. Private Fitzpatrick recovered without problem and was furloughed.

Surgeon Bentley had treated Private Fitzpatrick appropriately, although there was some disagreement with military surgeons Smith and Warren. Bentley worked in larger

military hospital which would more likely mirror the civilian standard of practice in regards to the use of trephining. They agreed that trephining should be used in depressed skull fractures, but cautioned the use of this procedure on a patient that did not exhibit ominous symptoms. Civilian Surgeon Gross also agreed with the use of trephining for depressed skull fractures, although it was acceptable to use trephining in non-life threatening situations. The difference in medical practice between civilian and military is probably due to the different settings in which the surgeons practice. The military surgeons environment was overcrowded and a dirty hospital, while the civilian surgeon's environment is less crowed and cleaner. The complication rate for trephining was far less in the civilian community than in the military setting. Overall, Surgeon Bentley achieved the standard of care by performing the trephining procedure on Private Fitzpatrick's depressed skull fracture.

The final case study involves Private Henry S, Company E, 118th Pennsylvania Volunteers. He was wounded by a minie ball on 9 May 1864, which fractured and depressed his forehead at the frontal eminence (fig. 26).[36] Henry's medical records state that:

> On May 15th he was admitted into the Mount Pleasant Hospital. Simple dressings only had been applied. On May 27th he was transferred to the Satterlee Hospital, Philadelphia. The day following his admission, he was attacked with a profuse diarrhea, and complained of pain in the head; was dull and drowsy, and at times delirious.[37]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 26. Minie Ball to the Frontal Bone

Source: James E. Anderson, *Grant's Atlas of Anatomy*, 8th ed. (Baltimore: Williams and Wilkins. 1983), 7-5.

Private Henry was experiencing a depressed skull fracture located at the frontal eminence. Dr. Gross described gunshot wounds to the frontal bone with brain penetration as nearly always fatal. The patients usually died from shock, hemorrhaging immediately, or within the first eight days from cerebral inflammation.[38] Extravagation of blood frequently occured was the result of blunt or penetrating trauma. The area of brain most frequently affected was the dura mater and usually involved the middle meningeal artery. When the effusion was considerably large, the blood usually presented as a dark irregular mass laying in a sac around the dura mater and the inner surface of the brain. The medical report continued:

> On June 1st his mental faculties were completely obscured, and paralysis of motion on the left side was observed, though there was hyperaesthesia of the whole surface. Convulsions of an epileptic character occurred on the 2d, and it was observed that the muscular power of the left side was now restored, and that the right was paralyzed. The pupils, which had hitherto been dilated, contracted; the tongue was dry; the lungs full of course rales. Repeated convulsions recurred on the 4th, exhibiting the same remarkable features heretofore mentioned in

> respect to the side paralyzed. No control over the sphincters remained. Death occurred in the afternoon of June 4th, 1864.[39]

Compression of the brain is often associated with extravagation of blood. The symptoms may be immediate as in the case of an arterial bleed or can slow as in venous bleeding. A venous bleed can taking up to days or weeks to present after the initial injury and these types of injuries were easily overlooked. The symptoms included a pulse that was either too fast or too slow, the mind was sluggish, the pupils were dilated, the patient complained of a headache with ringing in the ears. If not treated, the patient would slip into a coma followed by convulsions and would die of cerebritis or hemorrhagic effusions.[40] The autopsy report revealed:

> The fractured portion of bone was found to be ovoid in shape and corresponding in dimension to the external wound. There was a fracture of the inner table with depression of a portion near the longitudinal sinus to the depth of two lines, and a fissure extended into the frontal sinus. Beneath was a black slough of the dura mater, measuring two inches in length by one in width. The anterior and lateral surfaces of the right hemisphere were bathed with pus, which also filled the great longitudinal fissure and the parts in the region of the ethmoid plates. At the base of the brain was an effusion of serum. The meninges on this side presented evidence of a high degree of inflammation, and could be easily separated in large patches from the convolutions, which were slightly softened, one containing a large abscess.[41]

The results of an autopsy from a patient that has experienced extravagation of blood usually include large quantities of blood that is usually very dark in color, softening and laceration of cerebral tissue at the injury site, and formation of firm clots. The treatment for extravasation of blood in the brain was to first ascertain where the location of the bleeding had occurred. Surgical intervention would be warranted if the bleeding occurred in conjunction with a skull fracture, or the wound was located over the middle meningeal artery. In most cases the surgical operation, whether from trephining or other means (bone elevators), were seldom successful.

The patient was treated as expectant, as many severe head injury cases were, due to the lack of medical supplies and the shear number of patients following a major battle. Assistant Surgeon Keen did not intervene or at least did not document intervention. There is no absolute standard of care for this type of injury, although other surgeons, to include Warren and Smith have stated that trephining could be used in a critical case as a last resort. Dr. Keen met the standard of care based on the presumed triage category of expectant. It is interesting to point out that after the Civil War, Dr. W. W. Keen became the first neurosurgeon in the United States.

For the most part, the surgeons during the Battle of the Wilderness followed the 1860's standard of care for head injuries. The one case that did not meet the standard of care involved Confederate prisoner Charles C. Although the reason he was not treated appropriately may have noting to do with the surgeons competency, but with Charles C. being a prisoner. The physicians preformed to the best of their ability, particularly considering the differing viewpoints on trephining and aggressive verses expectant care.

---

[1]Alfred Jay Bollet, *Civil War Medicine: Challenges and Triumphs* (Tucson, AZ: Galan, 2002), 230.

[2]Joseph K. Barnes, M.D., *Medical Surgical History of the War of the Rebellion*, vol. 2, part I, *Wounds and Injuries of the Head*, 2nd ed. (Washington, DC: Government Printing Office, 1875), 161.

[3]Ibid.

[4]Samuel Gross, M.D., *A System of Surgery*, vol. 1 (Philadelphia, PA: Jefferson College Printing, 1859), 20.

[5]Barnes, *Medical Surgical History of The War of The Rebellion*, 161.

[6]Gross, *A System of Surgery*, 21.

[7]Ibid.

[8]Barnes, *Medical Surgical History of The War of The Rebellion*, 161.

[9]Ibid.

[10]Ibid.

[11]Ibid.

[12]Gross, *A System of Surgery,* 101.

[13]Barnes, *Medical Surgical History of The War of The Rebellion*, 28.

[14]Gross, *A System of Surgery,* 38.

[15]Barnes, *Medical Surgical History of The War of The Rebellion*, 227.

[16]Gross, *A System of Surgery,* 65.

[17]Barnes, *Medical Surgical History of The War of The Rebellion*, 227.

[18]Gross, *A System of Surgery,* 20.

[19]Ibid., 40.

[20]Barnes, *Medical Surgical History of The War of The Rebellion*, 227.

[21]Ibid.

[22]Ibid., 312.

[23]Ibid., 227.

[24]Ibid.

[25]Ibid., 226.

[26]Ibid.

[27]Ibid.

[28]Gross, *A System of Surgery,* 48.

[29]Ibid.

[30]Barnes, *Medical Surgical History of The War of The Rebellion*, 226.

[31]Ibid., 290.

[32]Gross, *A System of Surgery*, 88.

[33]Barnes, *Medical Surgical History of The War of The Rebellion*, 290.

[34]Ibid.

[35]Ibid.

[36]Ibid.

[37]Ibid.

[38]Gross, *A System of Surgery*, 58.

[39]Barnes, *Medical Surgical History of The War of The Rebellion*, 290.

[40]Gross, *A System of Surgery*, 55.

[41]Barnes, *Medical Surgical History of The War of The Rebellion*, 290.

CHAPTER 5

BATTLE OF PETERSBURG

The Petersburg Campaign was fought over a ten-month period from June 1864 to April 1865. The strategic significance of Petersburg was that it was the railroad supply hub for the Confederate Army. The Confederates dug trenches around the city in order to defend against the Union troops thus forcing a long siege. General Grant led the campaign that eventually culminated with Confederate General Lee's withdrawal from the area and eventual surrender at Appomattox. Union combat casualties totaled 61,500 while the Confederate casualties were estimated at about 38,000.[1]

The surgeons during the Petersburg campaign, according to the following sample cases, evaluated and treated head injuries appropriately by Civil War standards. Not all the patients survived, but many did due to the skill and experience of the surgeons.

Table 4. Petersburg Case Studies

Petersburg	Unit	Injury	Diagnosis	Survival	Treatment
Thomas Kennedy	1st Mass. Artillery	Pistol Ball Right Parietal	Contusion of Brain	Died	Simple dressing
Benjamin F. Chappel	8th New York Cav.	Minie Ball Occipital Area	Denuded Bone	Died	Trephine
John Donovan	97th Pennsylvania	Minie Ball Occipital Area	Denuded Bone	Survived	Bone removal
Allen Harrison	2nd New York Mounted Rifle	Minie Ball Frontal Bone	Sepsis/Hepatitis	Died	Bone removal
Thomas K. Rogers	5th Alabama Infantry	Saber cut Supraorbital ridge	Depressed Fracture Frontal Bone	Survived	Trephine

The first case involved Private Thomas Kennedy, Company M, of the 1st Massachusetts Heavy Artillery, who was wounded by a minie ball, fired from a pistol on

16 June 1864. He suffered a contused right parietal bone, near the descending branch of the lambdoidal suture (fig. 27).[2]

The medical records went on to say that:

> Private Kennedy was conveyed to Washington, and admitted on June 21st , into the Lincoln Hospital. Simple dressings were applied, as the injury was considered slight. He was furloughed on July 16th, but returned on the 29th of the same month. He stated that during his absence from the hospital he had suffered from ague [chills], and for the last ten days.[3]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 27. Contusion to the Posterior Aspect of Skull
Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 24.

Private Kennedy was shot in the back of the head by pistol minie ball, which travels at a lower velocity compared to a rifle or smoothbore musket ball. The slower projectile speed usually equates to less tissue damage when striking the body. The ball did not penetrate Kennedy's skull, although it did caused a contusion to the back of his head. In

most cases, the initial pain associated with a contusion was minimal, but as the inflammation progressed the pain may increase substantially. Dr. Smith stated that complications associated with contusions are sometimes difficult to see, "some head injuries might appear as simple flesh wounds, although these wounds should be observed for the occasional serious cerebral concussion, cerebral compression or pyemia (infection)."[4]

The medical report indicated that Private Kennedy experienced chills. Although not mentioned, the symptoms may have indicated the presents of a hectic fever. Dr. Warren defined hectic fever as some type of serious organic disease, especially an abscess formation. The symptoms included purulent discharge (wound that expresses pus), debility (lack of energy), red tongue, disposition to diarrhea, profuse perspiration, frequent small pulse, slight chills, and flushed cheeks. Dr. Gross added that hectic fever always presents itself after the formation of an abscess in an important area of the body to include the brain, lung, or liver.[5]

Dr. Gross outlined the priority of treatment that was most effective in treating an abscess. The first included making an incision and draining the offensive area to relieve the pus. Second was using a myriad of treatments to include; medications, tonics, nutritious foods, anodynes, suppression of unnatural discharges, change of air, and attention to cleanliness. Dr. Gross suggested the use of quinine, aromatic tincture of bark, and different preparations of iron. He also recommended using opium and small doses of calomel for pain associated with hectic fever.[6] He noted that the tongue of hectic fever patients were nearly always clean although they were very red at the edges and tip. The

tongue, in some cases also had a mucus coating over it, giving it a glazed red appearance.[7]

The medical records continued:

> A careful examination of the wound was now made, and a roughness of the external table of the skull was detected, he was much prostrated [depressed, lack of energy], but complained of no pain or uneasiness about the head. His pulse was frequent and feeble, tongue dry and red, and the abdomen tympanitic and painful. Three grains of calomel, with one-fourth of a grain of opium, were ordered every three hours, until the third dose had been taken; in the meantime, tonics and stimulants were given, and afterwards contained in liberal doses. Sinapisms [pain relief poultice] were applied to the epigastric region and extremities.[8]

The surgeons examined Private Kennedy's head wound and found roughness or denuding of the skull at the point of the bullet impact. In these cases the damaged bone may become necrotic and cause the tissue around it to become infected. Infected tissue may create pus formation (an abscess) and increase pressure in the brain, causing cerebral compression. Private Kennedy was experiencing symptoms of cerebral compression as described by Warren, which included weak pulse and warm dry skin.9 Kennedy's abdominal assessment revealed a tympanic sound on percussion. The tympany can be the result of a number of different problems to include, rupture of the intestines, or slowing of the normal bowel movements as in constipation. Private Kennedy was probably being treated for the constipation because of the calomel use, a popular cathartic or laxative. Cathartics also constituted an important class of remedies in the treatment of inflammation. It ranked higher then even bleeding because of its universal applicability. Cathartics were given for a number of reasons, two of which included bowel evacuation and it reportedly reduced swelling. The 1860's rationale was that the intestinal mucus membrane is responsible for absorption of fluids back into the body, and thus irritation of the mucus membrane via cathartics would decrease absorption of fluids, promoting a

fluid volume deficit or dehydration. The theory was that swelling was due to excess fluid in the body, decreasing the body fluid would decrease swelling.[10]

Cathartics were also used as a means to reduce inflammation in the brain, much the same way it was used to reduce swelling in the body.[11] Through the processes of dehydration, the excess fluid, which causes swelling in the brain, is reabsorbed into the body thus reducing cerebral compression. In the case of Private Kennedy the cathartics were given for two reasons, to relieve constipation and reduce the possible brain irritation caused by the abscess formation.

A sinapism is a poultice with vinegar and mustard employed to increase the flow of blood and spirits to the weak part of the body. Smith advocated not using surgical means immediately when treating head injuries, rather using long continual constitutional or less invasive treatments first.[12]

The medical records stated:

> No perceptible improvement in his condition, however, was obtained. He died on the afternoon of the 31st, remaining fully sensible and able to answer questions intelligently until within two or three hours of his death. At the autopsy, the seat of the injury was found to be near the middle of the posterior edge of the right parietal bone. The missile had glanced downward and forward, and was found lying against the skull, two inches from the point of injury. The meninges, for some distance around the seat of the injury were very much thickened and blackened. The brain substance was softened and the vessels very much congested.[13]

Private Kennedy's case would have been difficult for Civil War surgeons to diagnose because the classic symptoms of cerebral compression involve dilated pupils and a decrease in the level of consciousness, which did not occur. The patient remained alert and oriented until shortly before his death. After the patient's death, an autopsy revealed that the initial tissue and bone damage caused by the contusion bone denuding

resulted in the brain tissue infection and was probably responsible for Private Kennedy's death.

Private Kennedy died from an infection of the brain that was most likely caused by a contusion or denuding of the skull. The two main treatments used were cathartics and opium for pain control. During the autopsy, a dissection of the meningeal layers revealed that the dura mater was free of disease but the arachnoid and pia mater contained a good quantity of pus. The only other treatment regime that could have been used, would have been using cold water dressings at the first sign of cranial inflammation. The surgeons taking care of Private Kennedy took a non-aggressive approach to his case, which met the standard of care for treatment of head injuries during the Civil War. The bullet ricocheted off the posterior aspect of the skull causing denuding of the bone.

The second case involves, Sergeant Benjamin F. Chappel, Company H, of the 8th New York Cavalry. On 1 April 1865. Chapel was wounded by a pistol minie ball which entered the scalp left of the occipital protuberance and exited on the right side of the protuberance (fig. 28). The minie ball ricocheted off the skull, damaging the pericranium (outer layer of the skull).[14]

Sergeant Chappel was shot in the back of the head with the bullet grazing the outer layer or the pericranium of the external table. Surgeon Smith had written that bullet wounds to the pericranium were usually inflicted at such an acute angle that direct injury to the brain is minimal. In some cases, these wounds may appear simple but can have serious consequences of cerebral concussion and contusion.[15]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 28. Bullet Injury Pattern

Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 26.

Chappel's medical report stated:

> On the evening of the 18th, the patient complained of considerable pain in the region of the cerebellum. On the following day considerable gastric irritation manifested itself, and at intervals, there was slight delirium. Ether was administered, and Surgeon R. B. Bontecou, U.S.V., made an incision two and a half inches in length, just below and parallel to the lambdoidal suture, retracted the scalp, applied the trephine, and removed a disk of bone, giving exit to a quantity of pus.[16]

The medical report refers to the cerebellum, which is attached to the brain stem and is essential for coordinated movement, as well as the maintenance of muscle tone and equilibrium. The medulla oblongata is continuous with the spinal cord and controls the vital functions of respiration and heart rate (fig. 29).

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 29. Location of the Cerebellum and Medulla Oblongata
Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 26.

Sergeant Chappel had started developing signs of cerebral compression as indicated by the considerable headache accompanied with the classic sign of delirium. Surgeon Bontecou evaluated Chappel and decided to use the trephine procedure, to possibly locate and drain an abscess if found. Dr. Gross described the diagnosis of a brain abscess as the progression of encephalitis and presents itself as either draining of pure pus or a mix of pus lymph and serum. One of the most common sites for this type of abscess is in the supercrainal surface or the epidural space. Large accumulations of blood and pus form here accounting for over several ounces of fluid. The fluid is thick of a yellowish green color and has a quite offensive smell. The abscess is usually associated with necrosis or the cranial bone and brain tissue, along with serious disease of the dura mater and ulcerations, softening of brain tissue and the development of gangrene.[17]

Bontecou wrote:

> The patient reacted promptly, after the operation, and seemed to be much relieved, but in the evening he began to sink, and died on the morning of April 21st, 1865. The autopsy revealed a large abscess in the left lobe of the cerebellum,

> which contained four or five ounces of pus. The medulla oblongata was also implicated.[18]

Sergeant Chappel died from an abscess that affected the cerebellum and medulla oblongata. The trephining procedure was initially helpful in relieving the excess intracranial pressure. The infection had spread to a large area of the left cerebella lobe and was not visible during trephining. Surgeon Bontecou recognized the symptoms of cerebral compression and correctly decided to perform the trephining procedure. Dr. Gross states, that "when there is reason to believe, from the state of the scalp and the appearance of the skull at the site of injury, that the matter (abscess) lies immediately beneath the bone its evacuation with the trephine will, of course, be initiated and the sooner it is resorted to, the better the chance will be of saving life."[19]

Surgeon Bontecou was able to rapidly assess, diagnose and intervene in this case. Even so, due to the abscess being close to the medulla oblingota, Chappel's prognosis was poor from the start. The standard of care for Civil War medicine was met by trephining which was used as a diagnostic approach associated with the classic symptoms of cerebral compression.

The third case is Private John Donovan, Company I, of the 97th Pennsylvania Volunteers, aged eighteen, who was wounded on 14 July 1864. He was struck by a minie ball, which abraded the scalp over the occipit (fig. 30).[20]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 30. Posterior View of Skull

Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed., (New York: Benjamin Cummings, 2001) , 26.

Donovan's medical record stated:

> On August 31st, Private Donovan entered the Broad and Cherry Streets Hospital and came under the charge of Acting Assistant Surgeon H. M. Bellows. Private Donovan was anemic, feeble, and very much emaciated, complained of constant chilliness and of headache. Over the right branch of the lambdoidal suture there was a wound presenting a healthy granulating surface at the edges, while in the middle, denuded bone was revealed. A tonic regimen was prescribed, and emollient dressings were applied to the wound. For the next two months these measures were unchanged and the general health of the patient steadily improved.[21]

The surgeons were aware that the denuded or damaged bone might become necrotic and caused an abscess. In the case of Private Donovan, the ricocheting bullet scraped the pericraineum of the occipital bone.

Suppuration of the external surface of the bone was a common occurrence caused by various injuries to include fractures or denuding of the bone. In Private Donovan's case the denuded bone brought about an infection. The symptoms associated with infection include pain at abscess site, throbbing, boring, and tearing in nature. The patient often becomes shallow, (lethargic) hectic (febrile) chills and rigors, with offensive perspiration usually at night.[22]

The surgeons applied a tonic emollient that helped heal the bone. Smith mentioned that tonic emollients were beneficial in treating gunshot wounds to the head, and was used extensively by respected French military surgeon L. Velpeau.[23]

The denuded bone became necrotic and was removed by using forceps; no infection of the dura mater was found under the bone. Private Donovan had been experiencing inflammation and infection of tissue around the fractured bone. The emollient that was placed on the wound assisted healing and may have slowed the infection process. Removal of the necrosed bone probably prevented further infection in the brain. The patient recovered and was released from the hospital, but he had frequent attacks of vertigo that rendered him unable to do physical activity. Acting Assistant Surgeon H. M. Bellows was able to accurately diagnose the problem and used emollients to treat the abscessed bone. Dr. Gross also recommended the use of trephine in a situation where the entire necrotic bone could be removed. The use of trephine to remove necrotic bone had been introduced in 1757 by Dr. Walker in Virginia and met with tremendous success.[24] It is important to note that trephine routinely had been successful when preformed in clean conditions and not subject to the battlefield environment, with crowded hospital wards and dirty bandages.

The fourth case involves Private Allen Harrison, Company L, of the 2d New York Mounted Rifles, aged thirty-four was wounded on 8 July 1864, by a minie ball, which struck the frontal bone in the upper portion, causing two linier fractures and a small portion of lead imbedded in the outer table [fig. 31]."[25]

DUE TO COPYRIGHT RESTRICTIONS,

IMAGES ARE NOT INCLUDED

IN THIS ELECTRONIC EDITION.

Figure 31. Skull Fractures
Source: Wynn Kapit and Lawrence M. Elson, *The Anatomy Coloring Book*, 3rd ed. (New York: Benjamin Cummings, 2001), 25.

Harrison's medical records stated:

> On November 23d the denuded bone was movable, Dr. Bellows extracted the fragment, which measured an inch and a half long. The dura mater beneath the fragment, through which the pulsations of the brain could be distinctly perceived, was perfectly normal in appearance.[26]

Private Harrison was shot in the front part of the head and sustained two frontal linear skull fractures. The bullet fragmented on impact and a portion remained embedded on the outside of the skull.

The medical records went on to say:

> Private Harrison was admitted to the hospital of the 2d division Ninth Corps, and on July 16th was sent to the Mower Hospital, Philadelphia. On July 24th, a severe attack of acute pleuritis was followed by symptoms of hepatitis. His respiration became short and labored, and the conjunctivae [area surrounding the pupil and iris of the eye] and skin tinged with yellow; the tongue was dry and coated, and he complained of severe pain in the liver.[27]

Private Harrison had been in Mower Hospital for 8 days when he developed pleuritis, or difficult, painful breathing. Pleuritis is inflammation of the covering over the lungs and can be associated with a number of disease processes, including pneumonia. Private Harrison also developed jaundice or yellow discoloration of the skin and conjunctiva, as well as pain to the upper right quadrant of the abdomen. These are the classic signs of hepatitis. Hepatitis is the medical term for inflammation of the liver. The liver could be irritated for a number of reasons to include typhoid fever or certain medications.

The surgeons at Mower Hospital were faced with a patient who had multiple medical problems to include skull fracture, difficulty breathing and hepatitis. Private Harrison's condition was deteriorating quickly. "A blister plaster was applied to the side of the chest, and squills and solution of morphia and stimulants prescribed."[28]

Acting Assistant Surgeon W.P. Moon wrote:

> Private Harrison sank rapidly and died on July 28th, 1864. At autopsy, an abscess was found directly under the point of injury, over the longitudinal sinus, containing half an ounce of dark green offensive pus. The liver was pale. There was inflammation of the lower lobe of the right lung. One pint of serum was found in each side of the pleural cavity. Symptoms of compression, if present, were so masked by pleuritic and hepatic indications as to escape notice. Acting Assistant Surgeon W. P. Moon. Reported this case from notes furnished by Dr. Felt.[29]

During the autopsy an abscess was discovered, the dark green offensive pus possibly indicating a gangrenous infection, which was commonly associated with

abscesses of the head. Surgeon W. P. Moon was dealing with a complicated case involving three different body organs. The abscess from the head injury had developed into a pyema or infection of the blood and spread throughout the body affecting the head, lungs, and liver.

Pyema was a phenomenon that was recognized in the 1820s by surgeons in France and Germany. The surgeons had noticed that abscess, which started in one area of the body could later affect other vital organs. A common example would be to have a patient who sustained a head injury and the wound developed purlent offensive drainage. The patient later would die of suppuration of the liver. This observation was made by some of the world's foremost military surgeons to include surgeon's Guthrie, Schumucker, and Larrey. It was French surgeon, Velpeau who investigated why and how pymea occurred primarily with head injuries. The analysis was that unhealthy pus was thrown into the blood supply, thus transporting the pus to different organs in the body allowing septicemia and multiple abscess to grow throughout the body. Treatments included the use of stimulants like brandy, wine, champagne, camphor, iron, and quinine. Opiates were given freely to induce sleep and decrease the rigors and chills. Gross goes on to say that bleeding the patient and the active use of purging agents must be avoided at all cost.[30]

Assistant Surgeon Moore appropriately cared for Private Harrison by treating the most life threatening condition first, which was his lung. The head injury symptoms never presented as brain compression so further treatment such as trephining or cold-water dressings did not appear warranted. The patient died from pyemia that started in the head and spread to the liver and lungs. The surgeons may not have known why the

patient was getting worse or perhaps realized that Private Harrison was suffering from pyemia or infection in the blood. At this time period, there was no cure for pyemia and only treatment was just to address the symptoms that were exhibited. Surgeon Moore did treat the symptoms appropriately, giving morphine and counter irritants such as blister plaster. The actual treatment of pyemia would not be realized until the development of antibiotics.

The last case is of a Confederated prisoner named Private Thomas K. Rogers, Company C, 5th Alabama Infantry, aged forty-one. He was wounded by a sabre cut over the left supra-orbital ridge on 2 April 1865, suffering a fractured frontal bone (fig. 32).[31]

Figure 32. Sketch of Private Thomas K. Rogers
Source: Joseph K. Barns, *Medical Surgical History of the Ware of the Rebellion,* 4.

Rodgers medical records state that:

> On April 8th, he was admitted to Lincoln Hospital, Washington and on April 20th, the patient showed symptoms of compression. Surgeon J. Cooper McKee, U. S. Army, applied the trephine about one inch above the supra-orbital ridge and elevated the depressed bone.[32]

Private Rodgers, a Confederate soldier, was captured by the Union Army and transported to Lincoln Hospital, Washington on 8 April 1965. Twelve days later he started developing signs of brain compression; however, the medical records do not describe the specific symptoms. The Union Surgeon assigned to treat Private Rodgers was J. Cooper McKee who decided to use the trephining procedure to relieve the symptoms of compression. The depressed bone was elevated during the trephining procedure, and the medical records indicate that the scalp wound had penetrated into the dura mater--the injury was clearly a depressed skull fracture. A patient with a depressed skull fracture was a high risk for cerebral compression and infection, especially with an injury that occurred eight days prior to intervention.

The records went on to say:

> By May 27th, the patient was recovering rapidly, having manifested no bad symptoms since the removal of the bone. The large incision in the integument was cicatrizing [covering with scar tissue] favorably, covering the dura mater, so that pulsation was no longer visible. On June 14th, 1865, the patient had completely recovered, and, upon taking the oath of allegiance, he was released.[33]

The trephining procedure was performed and a portion of the decaying frontal bone was removed. The head wound healed favorably and scar tissue covered the dura mater with no further complications. Private Rodgers recovered from the saber injury and surgical procedure without any complications. Although his documentation was lacking, it does appear that Surgeon J. Cooper McGee met the standard of care for head injuries by recognizing the symptoms of cerebral compression and performing the trephining procedure.

The Petersburg Campaign was fought late in the Civil War. The surgeons were far more battle experienced with trained staff to assist in patient care. Other factors that influenced the improved medical care received at Petersburg were a vastly improved evacuation system, adequate beds available for evacuation of the wounded, and plentiful supplies. All in all, medical treatment was competent and generally successful at Petersburg.

---

[1]Alfred Jay Bollet, *Civil War Medicine, Challenges and Triumphs* (Tucson, AZ: Galan. 2002), 134.

[2]Joseph K. Barns, M.D., *Medical Surgical History of The War of The Rebellion,* vol. 2, part I, *Wounds And Injuries of the Head,* 2nd ed. (Washington: Government Printing Office, 1875), 112.

[3]Ibid., 112.

[4]Stephen Smith, *Hand-Book of Surgical Operations* (New York: Bailliere, 1862; reprint, San Francisco, CA: Norman, 1990), 250.

[5]Samuel Gross, M.D., *A System of Surgery,* vol. 1 (Philadelphia, PA: Jefferson College Printing, 1859), 88.

[6]Ibid., 135.

[7]Ibid.

[8] Barns, *Medical Surgical History of The War of The Rebellion,* 112.

[9]Edward Warren, M.D., *An Epitome of Practical Surgery* (Richmond, VA: West & Johnson, 1863; reprint, San Francisco, CA: Norman, 1989), 34.

[10]Gross, *A System of Surgery,* 80.

[11]Ibid.

[12]Smith, *Hand-Book of Surgical Operations*, 252.

[13]Barns, *Medical Surgical History of The War of The Rebellion,* 113.

[14]Ibid., 125.

[15]Ibid.

[16]Ibid.

[17]Gross, *A System of Surgery*, 50.

[18]Barns, *Medical Surgical History of The War of The Rebellion*, 125.

[19]Gross, *A System of Surgery*, 52.

[20]Barns, *Medical Surgical History of The War of The Rebellion*, 64.

[21]Ibid., 164.

[22]Gross, *A System of Surgery*, 844.

[23]Smith, *Hand-Book of Surgical Operations*, 248.

[24]Gross, *A System of Surgery*, 846.

[25]Barns, *Medical Surgical History of the Ware of the Rebellion*, 164.

[26]Ibid.

[27]Ibid.

[28]Ibid.

[29]Ibid.

[30]Gross, *A System of Surgery*, 148.

[31]Ibid.,168.

[32]Ibid.

[33]Ibid.

CHAPTER 6

SUMMARY AND CONCLUSION

There have been books written, such as *Hardtack and Coffee: The Untold Story of Army Life,* that refer to medical care during the Civil War as barbaric and that consider surgeons to be butchers.[1] Local newspapers after the Battle of Antietam blamed incompetent surgeons for the high death rates. In fact the research conducted by reviewing five medical case studies from the battles of Antietam, Gettysburg, Wilderness, and Petersburg indicates that Civil War surgeons were proficient with their medical skills, followed the medical practice of the 1860s, and adapted postsurgical interventions that were beneficial in saving lives under many conditions. When comparing the four researched battles throughout the Civil War, there did not appear to be any one significant practice or procedure that significantly enhanced the survivability of head-injured patients, aside from the use of cold-water dressings post-operatively.

An estimated 600,000 Union and Confederate soldiers died during the five-year war.[2] Their deaths were not related to incompetent surgeons, but primarily from wound infections, which was not fully understood in the 1860s.

The Battle of Antietam was one of the first major battles that exposed military surgeons to mass casualties with devastating wounds. Table 5 indicates that of the surgical case studies evaluated only one patient survived. The majority of deaths were due to severely wounded soldiers and a high incidence of wound infection. One such case involved Private Curtis Brown who was shot in the frontal eminence and survived over six months after the injury. Dr. Kennedy preformed the trephining procedure on him and within two weeks Private Brown died. Brown's death was probably due to an infection

introduced through the trephining procedure.[3] According to military medical practice, trephining was only to be used as a last resort. In the case of Private Brown, it would appear that Kennedy did not meet the standard of care of medical practice for the 1860s. Although, Trephining was the one procedure over which military and civilian surgeons had opposing views. The military surgeons believed that trephining should only be used to treat depressed skull fractures when death was imminent.[4] Civilian surgeons used trephining for a number of reasons to include draining cerebral abscess, removing foreign bodies from the wounds, and curing epilepsy.[5] Dr. Kennedy, who had only been in the military for approximately eight weeks, probably was treating Brown based on the civilian standards of care, in which case the patient was treated appropriately. Civilian trephining was somewhat more successful then the military procedures primarily because the civilian environment was clean and the instruments were more then likely not utilized on different patients without being cleaned. The Battle of Antietam illustrated how at the beginning of the Civil War, surgeons were using techniques that had been proven effective during civilian practice, but turned out to be less effective when used in a field environment.

Table 5. Case Study from the Battle of Antietam					
Antietam	Unit	Injury	Diagnosis	Survival	Treatment
Curtis Brown	13th New York Vol	Buck shot, Frontal Eminence	Depressed Skull fracture	Died	Trephine
James Monaghan	42nd New York Vol	Minie ball Left Parietal bone	Compression, hematoma	Died	Trephine
E. Harring	38th Georgia Regt	Mini Ball Right Parietal bone	Depressed Skull fracture	Survived	Trephine
Charles H.K	12th Massachusetts	Musket Ball frontal bone	Depressed Skull fracture	Died	Bone removal
Charles T.	63rd New York Vol	Minie Ball Right Parietal Bone	Depressed Skull fracture	Died	Bone removal

The Battle of Gettysburg was fought over a three-day period and was considered to be the bloodiest battle fought in the America. The combined casualty rate for both the Union and Confederate Armies was over 50,000 dead and wounded (table 6).[6] During the battle, military surgeons were transitioning from using invasive procedures such a trephining to less aggressive techniques such as cold-water dressings. The less aggressive techniques proved to increase the survival rates. Cold-water dressings provided continual irrigation of water over the wound, which kept the wound clean and washed out bacteria, thus preventing infection.

The five medical record case studies of Gettysburg show that two of the soldiers died, Union soldier Corporal William Barthaul and Confederate prisoner, Corporal W. F. Lancaster (table 6). Barthaul sustained what was thought to be a simple scalp laceration, although it turned out to be a linier fracture. The fracture was undetected by the surgeons and only diagnosed during the autopsy. The soldier died from an infection that was probably introduced through the fracture site.

Table 6. Case Study from the Battle of Gettysburg					
Name	Unit	Injury	Diagnosis	Survival	Treatment
Joseph Clouse	20th Indiana Vol	Minie Ball Right Frontal Emineance	gangrene	Survived	Cold-Water Dressings
William Barthaul	45th New York Vol	Minie Ball to Occipital area	Infection	Died	Flaxseed Poultices
W.F. Lancaster	3rd Virginia	Musket Ball Right Temporal	Brain Damage	Died	Cold-Water Dressings
H.Vandueson	4th Texas Regiment	Musket Ball Paritial Bone	Depressed Skull fracture	Survived	Trephine
Walter Rotherham	7th New Jersey Vol	Musket Ball Right frontal Eminence	Communated Fracture	Survived	Cold-Water Dressings

The second death was that of a Confederate prisoner Lancaster who suffered a musket ball injury to the right temporal region. The surgeons routinely used their fingers to probe the wound in an attempt to extract any foreign objects that by be imbedded.[7] This technique potentially introduced bacteria into the wound and the finger might have caused tissue damage each time it was inserted. Lancaster died four weeks after the initial injury. The documentation in the autopsy report stated that Lancasters brain tissue was disorganized at the wound site, which was probably caused by the musket ball or possibly from the surgeons probing fingers. Even so, the standard of the day was to probe with the surgeon's fingers.

The Battle of The Wilderness was challenging for a number of reasons. First, the battle took place in a wooded area and caused a number of fragmentary injuries due to cannon fire and shattering trees. Second, a number of casualties were burned to death when a large brush fire swept through the forest. The Wilderness case studies involved the evaluation of five medical records. Four of the five soldiers in the case study died from devastating injuries.

The wounded soldiers in the case studies of the Battle of The Wilderness sustained extensive injuries from being struck with minie balls (table 7). Private Owen Fitzpatrick was the only patient in this set of case studies to survive. He was shot in the back of the head by a musket ball, which traveled at a lesser velocity then the minie ball. The decreased velocity causes less tissue damage giving the soldier a greater chance of survival. Fitzpatrick sustained a depressed skull fracture to the back of the head. The wound was trephined and cold-water dressings were applied. The combination of trephining with cold-water dressings was probably the key to the soldier's surviving. Trephining raised the depressed bones and the cold-water dressing probably irrigated foreign bodies and bacteria out of the wound. The Battle of the Wilderness showed that the right combination of surgical intervention combined with the post-operative treatment of cold-water dressings proved to be a successful combination.

Table 7. Case studies for the Battle of the Wilderness

Wilderness	Unit	Injury	Diagnosis	Survival	Treatment
William A	11th Pennsylvania	Minie Ball Frontal Eminence	Fracture inner table	Died	Cold-Water Dressings
Lafayette Young	27th Michigan	Minie Ball to the Sagittal suture	Fractured skull	Died	Trephine
Charles C.	30th North Carolina	Minie ball Right Temple	Maxilla Fracture	Died	Detergent lotion
Owen Fitzpatrick	63rd New York Vol	Musket ball Occipital Bone	Fracture both tables	Survived	Trephine
Henry S	118 Pennsylvania	Minie Ball Frontal Eminence	Depressed Skull fracture	Died	Expectant Care

The last case study involved the Petersburg campaign, which was trench warfare that lasted over ten months (table 8). The surgeons during this battle were getting away

from using the aggressive trephining procedure; instead they were waiting for denuded bone cases to become necrotic and then attempted to remove the infected bone by using bone forceps. The procedure seemed more successful when it was used in combination with poultices. The French had been an advocate of using poultices over cold-water dressings throughout the Crimea War. The Civil War surgeons usually preferred using cold-water dressings possibly because it was simple to use and did not require mixing other ingredients. Both were improvement over earlier treatments.

Table 8. Petersburg Case Studies

Petersburg	Unit	Injury	Diagnosis	Survival	Treatment
Thomas Kennedy	1st Mass. Artillery	Pistol Ball Right Parietal	Contusion of Brain	Died	Simple dressing
Benjamin F. Chappel	8th New York Cav.	Minie Ball Occipital Area	Denuded Bone	Died	Trephine
John Donovan	97th Pennsylvania	Minie Ball Occipital Area	Denuded Bone	Survived	Bone Removal
Allen Harrison	2nd New York Mounted Rifle	Minie Ball Frontal Bone	Sepsis/Hepatitis	Died	Bone Removal
Thomas K. Rogers	5th Alabama Infantry	Saber cut Supraorbital ridge	Depressed Fracture Frontal Bone	Survived	Trephine

During the Petersburg campaign, John Donovan sustained a minie ball injury to the occipital aspect of his head. The surgeon used bone forceps to remove the necrotic bone along with poultices dressings. Donovan's treatment regime was successful and he made a full recovery. Benjamin Chappel, sustained a similar injury at Petersburg, having been shot in the occipital area by a minie ball. The trephining procedure was done and a large amount of pus was drained. No post-operative care in the form of cold-water dressings or poultices were applied. Benjamin Chappel died three days after the surgery from infection.

Civil War surgeons were using different treatment techniques throughout the war in order to find the best method of taking care of these devastating head wounds. One intervention that effected patient improvement after an open head injury was the use of cold-water dressings. Cold-water dressing provided irrigation, which helped remove bacteria from the wound. Other more complex treatments that had been used to for head wounds included the use of poultices. The concoction provided an acidic environment in the wound that was not conducive for bacterial growth, although they did not have a full understanding of why it worked, they just knew it worked.

Civil War surgeons were given the daunting task of treating wounded soldiers on the battlefield with little to no equipment. Even so, they were able to successfully treat horrific head injuries with a certain degree of success. If the Civil War medical community had known about antibiotics and asepses, thousands of lives could have been saved.

In the course of researching this paper, it became clear that the Civil War surgeons had two standards of practice when implementing the trephining procedure. The military medical practice was an adaptation of civilian techniques that work in an unclean environment. Today's medical professionals have been trained and practice in mostly clean hospital settings, using highly technologically advanced diagnostic equipment, with adequate supplies. Unfortunately the field environment is far from clean, most of the diagnostic equipment does not fair well in an unclean environment, and supplies in the combat zone may not be available. Adapting and amending civilian medical practices will be necessary when providing care during current and future military engagement.

[1]John D. Billings, *Hardtack & Coffee: The Unwritten Story of Army Life* (Lincoln, NE: Bison Book Press, 1993), 310.

[2]Alfred Jay Bollet, *Civil War Medicine: Challenges and Triumphs* (Tucson, AZ: Galan, 2002), 454.

[3]Ibid.

[4]Stephen Smith, *Hand-Book of Surgical Operations* (New York: Bailliere, 1862; reprint, San Francisco, CA: Norman, 1990), 251.

[5]Samuel Gross, M.D., *A System of Surgery*, vol. 1 (Philadelphia, PA: Jefferson College Printing, 1859), 85.

[6]Bollet, *Civil War Medicine, Challenges and Triumphs,* 125.

[7]Edward Warren, *An Epitome of Practical Surgery* (Richmond, VA: West & Johnson, 1863; reprint, San Francisco, CA: Norman, 1989), 360.

GLOSSARY

Ablepsy. Blindness

Ague. Malarial Fever, fatigue

American plague. Yellow fever

Aphonia. Laryngitis

Apoplexy. Paralysis due to stroke

Arterial excitement. Active Arterial bleeding

Arteries. Oxygenated blood supply under pressure from the heart

Asphycsia/Asphicsia. Cyanotic and lack of oxygen

Atrophy. Wasting away or diminishing in size

Bad Blood. Syphilis

Bilious fever. Typhoid, malaria, hepatitis or elevated temperature and bile emesis

Biliousness. Jaundice associated with liver disease

Blood poisoning. Bacterial infection; septicemia

Bone shave. Sciatica

Brain fever. Meningitis

Cachexy. Malnutrition

Cacogastric. Upset stomach

Cacospysy. Irregular pulse

Caduceus. Subject to falling sickness or epilepsy

Camp fever. Typhus; aka Camp diarrhea

Catalepsy. Seizures / trances

Cerebritis. Inflammation of cerebrum or lead poisoning

Chloroform. a volatile liquid haloform (CHCl3); formerly used as an anesthetic; "chloroform was the first inhalation anesthetic’

Cicatrix. A mark left (usually on the skin) by the healing of injured tissue

Cold-water dressings. Dressings kept moist by dripping a bucket of cold water or Ice water over It

Compression Syndrome. Swelling of the brain causing increased blood pressure, dilated pupils and unconsciousness

Denude. Without the natural or usual covering

Diploe. The soft, spongy, or cancellated substance between the plates of the skull

Encephalitis. Swelling of brain; aka sleeping sickness

Extravasation. The process of exuding or passing out of a vessel into surrounding tissues; said or blood or lymph or urine

Falling sickness. Epilepsy

Fatty Liver. Cirrhosis of liver

First intention. Healing by fibrous adhesions without suppuration or granulation

Fits. Sudden attack or seizure of muscle activity

Flux. An excessive flow or discharge of fluid like hemorrhage or diarrhea

Hemiplegia. Inability to move on one side of the body, caused by brain of spinal injury

Hemorrhage. Bleeding

Insensibility. Decreased level of consciousness

Jaundice. Condition caused by blockage of intestines, causing skin color to turn yellow, Liver inflammation

Laudable pus. Good quality, yellow, part of healing process, inodorous, creamy appearance

Ligation. Applying a ligatature, the act of binding

Malignant pus. Ichorous pus, thinner, blood tinged, offensive odor and often lead to death

Medulla Oblongata. The most vital part of the brain because it contains centers controlling breathing and heart functioning

Meningitis. Inflations of brain or spinal cord

Milk punch. Vitamin supplement consistent of milk and brandy

Mormal. Gangrene

Occipital. Of or relating to the occiput; "occipital bone" Back of skull

Parietal bone. Either of two skull bones between the frontal and occipital bones and forming the top and sides of the cranium

Periosteum. A dense fibrous membrane covering the surface of bones

Second intention. Wound site is not closed, heals by granulation

Septicemia. Blood poisoning

Shakes - Delirium tremens

Shaking. Chills, ague

Stertourous. Rapid labored breathing

Stupid-Unable to answer questions appropriately

Suppuratin. Cause to ripen and discharge pus; "The oil suppurates the pustules"

Trephine. A surgical instrument used to remove sections of bone from the skull

Vertex. Covering the crown of the head

Vinna paste. A caustic application made up of equal parts of caustic potash and quicklime; called also Vienna caustic

Voracious. Desire or consuming food in great quantities

BIBLIOGRAPHY

Anderson, James E. *Grant's Atlas of Anatomy*. 8th ed. Baltimore: Williams and Wilkins. 1983.

Barnes, Joseph K., M.D. *Medical Surgical History of the War of the Rebellion.* Vol. 2, part I, *Wounds and Injuries of the Head.* 2nd ed. Washington, DC: Government Printing Office, 1875.

Billings, John D. *Hardtack and Coffee: The Unwritten Story of Army Life.* Lincoln: NE, Bison Book Press, 1993.

Bollet, Alfred Jay. *Civil War Medicine: Challenges and Triumphs.* Tucson, AZ: Galan, 2002.

Campbell, John Emory. *Basic Trauma Life Support.* 4th ed. Upper Saddle River, NJ: Brady, Prentice Hall Health, 2000.

Clemente, Carmine D. *Anatomy: A Regional Atlas of the Human Body,* 2nd ed. Baltimore, MD: Urban and Schwarzenberg, 1981.

Gross, Samuel, M.D. *A System of Surgery*. Vol. 1. Philadelphia, PA: Jefferson College Printing, 1859.

Kapit, Wynn, and Lawrence M. Elson. *The Anatomy Coloring Book*. 3rd ed. New York: Benjamin Cummings, 2001.

Megasystem USA. *Human 3D.* Duluth: Megasystem, 2002. Computer Soft Ware available on CD Rom.

Official Record. Series I., Vol. 19/1 [S#27], p114. No 4, Report of Surgeon Jonathan Letterma Bollet, n, USA , Medical Director, Army of the Potomac, of the operations of the medical department, September 2-November 7.

Rosin, Peter, and Rodger Barker. *Emergency Medicine: Concepts and Clinical Practice.* Vol. 1. 4th ed. St. Louis: Mosby, 1998.

Smith, Stephen. *Hand-Book of Surgical Operations.* New York: Bailliere, 1862. Reprint, San Francisco, CA: Norman, 1990.

Warren, Edward, M.D. *An Epitome of Practical Surgery.* Richmond VA: West and Johnson, 1863. Reprint: San Francisco: Norman, 1989.

Williams, Peter, and Rodger Warwick. *Gray's Anatomy.* 38th ed. Philadelphia: W. B. Saunders, 1980.

INITIAL DISTRIBUTION LIST

Combined Arms Research Library
U.S. Army Command and General Staff College
250 Gibbon Ave.
Fort Leavenworth, KS 66027-2314

Defense Technical Information Center/OCA
825 John J. Kingman Rd., Suite 944
Fort Belvoir, VA 22060-6218

Dr. Curtis S. King
CSI
USACGSC
1 Reynolds Ave.
Fort Leavenworth, KS 66027-1352

LTC Randal Espinosa
Munson Army Hospital
USACGSC
1 Reynolds Ave.
Fort Leavenworth, KS 66027-1352

LTC Paul B. Gardner
CSI
USACGSC
1 Reynolds Ave.

CERTIFICATION FOR MMAS DISTRIBUTION STATEMENT

1. Certification Date: 18 June 2004

2. Thesis Author: MAJ William G. White

3. Thesis Title: Appropriate Treatment of Head Injuries by Surgeons During the Civil War

4. Thesis Committee Members: _____

Signatures: _____

_____

5. Distribution Statement: See distribution statements A-X on reverse, then circle appropriate distribution statement letter code below:

(A) B C D E F X SEE EXPLANATION OF CODES ON REVERSE

If your thesis does not fit into any of the above categories or is classified, you must coordinate with the classified section at CARL.

6. Justification: Justification is required for any distribution other than described in Distribution Statement A. All or part of a thesis may justify distribution limitation. See limitation justification statements 1-10 on reverse, then list, below, the statement(s) that applies (apply) to your thesis and corresponding chapters/sections and pages. Follow sample format shown below:

EXAMPLE

Limitation Justification Statement	/	Chapter/Section	/	Page(s)
Direct Military Support (10)	/	Chapter 3	/	12
Critical Technology (3)	/	Section 4	/	31
Administrative Operational Use (7)	/	Chapter 2	/	13-32

Fill in limitation justification for your thesis below:

Limitation Justification Statement	/	Chapter/Section	/	Page(s)
	/		/	
	/		/	
	/		/	
	/		/	
	/		/	

7. MMAS Thesis Author's Signature: _____

STATEMENT A: Approved for public release; distribution is unlimited. (Documents with this statement may be made available or sold to the general public and foreign nationals).

STATEMENT B: Distribution authorized to U.S. Government agencies only (insert reason and date ON REVERSE OF THIS FORM). Currently used reasons for imposing this statement include the following:

1. Foreign Government Information. Protection of foreign information.

2. Proprietary Information. Protection of proprietary information not owned by the U.S. Government.

3. Critical Technology. Protection and control of critical technology including technical data with potential military application.

4. Test and Evaluation. Protection of test and evaluation of commercial production or military hardware.

5. Contractor Performance Evaluation. Protection of information involving contractor performance evaluation.

6. Premature Dissemination. Protection of information involving systems or hardware from premature dissemination.

7. Administrative/Operational Use. Protection of information restricted to official use or for administrative or operational purposes.

8. Software Documentation. Protection of software documentation - release only in accordance with the provisions of DoD Instruction 7930.2.

9. Specific Authority. Protection of information required by a specific authority.

10. Direct Military Support. To protect export-controlled technical data of such military significance that release for purposes other than direct support of DoD-approved activities may jeopardize a U.S. military advantage.

STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors: (REASON AND DATE). Currently most used reasons are 1, 3, 7, 8, and 9 above.

STATEMENT D: Distribution authorized to DoD and U.S. DoD contractors only; (REASON AND DATE). Currently most reasons are 1, 3, 7, 8, and 9 above.

STATEMENT E: Distribution authorized to DoD only; (REASON AND DATE). Currently most used reasons are 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

STATEMENT F: Further dissemination only as directed by (controlling DoD office and date), or higher DoD authority. Used when the DoD originator determines that information is subject to special dissemination limitation specified by paragraph 4-505, DoD 5200.1-R.

STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals of enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25; (date). Controlling DoD office is (insert).