

Echoes of World War One in the Surgical World

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### Abstract

Trench warfare made soldiers' heads particularly vulnerable to bullet and shrapnel wounds. The result was an unexpectedly large number of men with penetrating brain injuries and / or mutilations of the face. Never before had surgeons had to contend with so many of such injuries, which heretofore had been considered catastrophic and almost inevitably fatal. Surgeons on both sides of the conflict stepped forward to treat these daunting cases, and in so doing, created specific principles of surgical management, previously only theorized about. The interwar period saw variable acceptance of neurosurgery and plastic / reconstructive surgery as specialties separate from general surgery, but experience in World War Two resulted in near universal agreement that neurosurgery and plastic / reconstructive surgery required such specific skill sets that they deserved their own training programs and designation as separate specialties of surgery. Today thousands of well-trained specialists carry on the heritage of the pioneers who cared for, and learned from, those grievously wounded soldiers of World War I.

## Echoes of World War One in the Surgical World

Thomas L Snyder

The Hippocratic admonition that “a man who would become a surgeon should join an army and follow it” has long been cliché in medical circles. The ancients generally attributed disease to the anger of unappeased gods. But they took a distinctly practical view when it came to the injuries of combat: sword and arrow wounds were visibly the result of human agency, and called for active human intervention instead of appeals to distant deities. The desire to help their comrades eventually saw the emergence of men who “specialized” in handling the wounds of war. The Sumerian / Akkadian (4000-1000 BCE) *Asu* was an empirical operator who wielded sharp (surgical) instruments, in contradistinction to the more spiritual sorcerer (*Barus*) and priestly (*Ashipus*) healers of disease. The Assyrians (900-600 BCE) formalized the *Asu*’s role as a military official, responsible for wound care, field hygiene (including burial of the dead), and health assessment of prisoners of war (who were prospective slaves). The Egyptian *swnw* was similarly appointed to serve in the army in war and peace; he was expected to be skilled in the management of war wounds and other injuries. In ancient India, Hindu men who practiced surgery were given the sobriquet *shalyahara* – remover of arrows. Similarly, the ancient Greek word for “physician”, *iatros*, translates as “arrow extractor” from Ionian Greek. While physicians may have been contracted by their Generals, Roman legionaries received field treatment from men called *capsarii*, binders of wounds. Roman military hospitals – an innovation that arose from the need to care for soldiers at the frontiers of the empire and a long, hazardous distance from home – were sophisticated permanent structures that featured an

elaborate surgical set-up and protected interior “pulse” space designed for the care of an influx of fresh combat injuries should local battles break out.<sup>1</sup>

Not much in the way of surgical advances occurred in the 5th through the 15th centuries after the Roman era. The Byzantines, military and medical successors to the Romans, who referred to themselves as *Romanoi* (“Romans”, but in Greek) merely perpetuated the Roman way of combat casualty care. Medieval Arabs produced advances in eye surgery and translated ancient Greek and Roman writings in medicine and surgery. Being a largely nomadic people, they also developed a form of mobile hospital for use in military and civil settings. The teaching of surgery was dropped from the curricula of French universities of the early Renaissance (the notion being that surgeons, who worked with their hands, were “laborers”, and not worthy of the scholarly tradition of medicine), though the Italians maintained a robust academic surgical tradition.<sup>2</sup> Once the Catholic Church’s abhorrence for the shedding of blood in surgery (especially by educated priests), and of dissection of cadavers for the study of anatomy was overcome, and once the rigid conservatism of the Scholastic tradition yielded to the humanism of the Renaissance, surgery began to make advances in both theory and practice. Even so, until the advent of effective anesthesia in the mid-19th Century, major surgery of any type was a fraught affair, undertaken by brave surgeons for desperate patients and done as rapidly as possible so as to finish the operation before the patient went into shock because of the pain and blood loss. European surgeons led the way, and 19<sup>th</sup> century doctors from America and other nations typically toured the famous hospitals of England, Scotland, France, Germany, Austria and Italy

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<sup>1</sup> This section is broadly based on material in Guido Majno, *The Healing Hand – Man and Wound in the Ancient World* (Cambridge, Massachusetts: Harvard University Press, 1975)

<sup>2</sup> This section is broadly based on material in Nancy G Siraisi, *Medieval & Early Renaissance Medicine – An Introduction to Knowledge and Practice* (Chicago, University of Chicago Press, 1990), 153-193. Siraisi makes a point to emphasize the importance of the surgeon’s art in the wars of the era.

to learn the most up-to-date techniques. Finally, once the bacterial cause of surgical infections was elucidated, techniques to check the infections (“antiseptic surgery”) and, later, to prevent infection (“aseptic surgery”) finally made the major kinds of surgery we think of today, particularly orthopedic and abdominal operations safe. Surgery on chest organs came much later. Meanwhile, advances in medicine, especially in vaccination (especially against smallpox), but also in nutrition (for instance, scurvy was a major cause of death among siege armies in the 13<sup>th</sup> through the 15<sup>th</sup> centuries) and hygiene (for instance, the understanding that cholera, an often-fatal infection of the digestive tract, came from water contaminated by excrement provided scientific justification for careful regulation of field latrines in relation to water supplies) meant that by the time of the Franco-Prussian War, for the first time in human history, deaths from combat injuries actually outnumbered those caused by disease and contagion. By the outbreak of World War I, the only apparent significant gaps in our understanding or tools of combat casualty care involved the prevention and treatment of shock, and the treatment of infection in contaminated wounds.

In the Great War, artillery barrages and mass infantry attacks produced the expected extremity, chest and abdominal wounds. But the unique aspect of trench warfare saw men standing in trenches peering out at the enemy with just heads showing. These men suffered brain and facial injuries in unexpected numbers. Wounds of the head and neck accounted for 15 - 20% of all combat wounds during the Great War.<sup>3</sup> Grievous wounds of the brain and of the face resulted in the evolution of two new surgical specialties – neurosurgery and plastic reconstructive surgery. This is necessarily an example of “great man” history, because almost no

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<sup>3</sup> William C Hanigan, “Surgery of the Head and 70-Day Brain Surgeons,” *Neurosurgery* 53, no 3 (September 2003): 713-722.

one had practice (and certainly no one was trained) in these areas of the surgical art prior to the war. Necessarily then, brave pioneering surgeons played an outsized role in wading in where no man had gone before, to establish principles of practice that largely persist until today.

As regards neurosurgery, the great man is the American Harvey Cushing. Up until the advent of good anesthesia and aseptic (infection-preventing) surgical technique, few men had ventured into the cranium, and when they did, the complications of hemorrhage and infection, almost invariably fatal, discouraged further efforts. Cushing undertook to study and practice brain surgery at Harvard starting around 1908. While individual surgeons had written about their pioneering forays into neurosurgery<sup>4</sup>, it was by no means an established specialty, and no formal training programs existed. As Cushing himself put it, “[a]nything classified as neurological is looked upon by many of us as baffling and difficult, and a feeling prevails that the ultimate functional results after recovery from serious cranial injuries are, to say the least, forlorn. Few medical officers had received training in the surgery of the central nervous system before the war, no organized instruction has been given in the subject since; and the tools provided for the work have been inadequate and antiquated.”<sup>5</sup> Thus it was that, when Cushing arrived in Europe as a volunteer in 1915, he had opportunity to observe the work of just a few individuals who were making pioneering efforts to respond to the wounds that modern warfare had wrought. The wounds sustained by soldiers in Europe carried special risks because of the fields in which they fought had for centuries been well fertilized with manure and therefore bore a rich variety of bacteria, many of which were carried by projectiles or shrapnel into the brain, along with

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<sup>4</sup> In particular, the Latvian-German Ernst von Bergmann (the Russo-Austrian War, 1866, and Franco-Prussian War, 1870); the American William W Keen; and the Englishman Sir Victor A H Horsley.

<sup>5</sup> Harvey Cushing, “A Study of a Series of Wounds Involving the Brain and Its Enveloping Structures,” *British Journal of Surgery* 5, no 20 (1917): 558-684.

fragments of filthy clothing. The combination of the physical damage and contamination demanded a vigorous surgical response. Early in the war, individual French, German, Austrian, Russian and British surgeons took up the gauntlet. They gradually, through experience, established guidelines and techniques that improved outcomes, but much of this work was unpublished. When Cushing returned to Europe with a Harvard team of fourteen surgeons and four nurses in March, 1917, as director of American Base Hospital #5, he soon was detached to a BEF receiving hospital, where he and his team operated full time on neurosurgical cases. By late April, they started the work of consolidating the experiences of their European predecessors by carefully and systematically utilizing, then adjusting their techniques to lay down principles of traumatic brain surgery. As he and his associates gained experience, their results steadily improved so that by war's end, the survivorship of brain surgery for war wounds had increased from around 45% to 71%. One of his earliest learnings was that sticking a finger into the brain to find a bullet or fragment was a bad idea (he referred to this as "Little Jack Horner" surgery); rather, Cushing adopted the use of soft rubber tubes snaked into the wound track. By applying gentle suction, he could remove damaged brain tissue, bone fragments and other wound debris. He even adopted a technique using a magnetized steel nail to extract metal fragments from deep inside the brain. One other surgical innovation that Cushing adopted was to layer Dichloramine T, referred to as a chlorine antiseptic at the time, but really an early sulfa antibiotic precursor, into the brain wounds. Combined with careful surgical technique and an insistence on operation as soon after wounding as possible, this approach reduced the rate of brain infections to near zero by war's end.<sup>6</sup>

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<sup>6</sup> Harvey Cushing, "Notes on Penetrating Wounds of the Brain," *British Medical Journal* 1(2982) 23 February 1918: 221-226.

Before the U.S. entered the war, and based on Allied experience, Army Surgeon General Gorgas concluded that we would need something like 200 neurosurgeons. In response to a national survey, about 50 men stepped forward, claiming experience. At this point, Gorgas established crash 70-day programs in Philadelphia, Chicago, New York, St. Louis and Camp Greenleaf, GA to train selected surgeons in the art of brain surgery. Ultimately, about 190 neurosurgeons served in Europe. Only a few of them continued in the specialty after the war. Cushing returned to Harvard after the war. He published his learnings and expanded a training program in neurosurgery that he had started before the war. Perhaps in part because of an ongoing debate between non-surgeon neurologists and neurosurgeons over their respective bailiwicks, training of the surgical specialists seemed to languish in the United States,<sup>7</sup> and an official certifying body, the American Board of Neurological Surgeons didn't even come into existence until 1940. Only a few training programs, in New York, Virginia, San Francisco, St Louis, Cleveland the Mayo Clinic in Rochester, Minnesota, the Johns Hopkins Hospital in Baltimore and at the University of Pennsylvania, and perhaps a few others operated in the interwar period. A similarly desultory effort at neurosurgical training appears to have obtained in France and Britain, while the dictatorial regimes of German and the Soviet Union seem to have done a better job of planning for the contingencies of war.<sup>8</sup> As a result of this dearth of residency programs, the Army could count on a pool of only about 200 trained neurosurgeons at the beginning of World War II. Once again, short training programs were established to teach the rudiments of brain surgery to promising young general surgeons. These programs produced about 250 brain surgeons and went

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<sup>7</sup> Delia Gavrus, "Men of Dreams and Men of Action: Neurologists, Neurosurgeons, and the Performance of Professional Identity, 1920-1950," *Bulletin of the History of Medicine* 85, no. 1 (Spring 2011): 57-92.

<sup>8</sup> B. L. Lichterman, "The Factors of Emergence of Neurosurgery as a Clinical Specialty," *Medical History [Russia]* 2014, no 2 (2), [www.historymedjournal.com/volume/number\\_2/2-2014\\_english\\_likhterman\\_b.l..pdf](http://www.historymedjournal.com/volume/number_2/2-2014_english_likhterman_b.l..pdf) 9 accessed 14 October 2018.

far to meet the demand. By war's end, there had been nearly 61,000 neurosurgical admissions to U.S. Army hospitals. After the war, training programs proliferated both in the United States (110 in 2018) and abroad so that today, most major medical schools train neurosurgeons, of whom about 3500 practice in the United States.<sup>9</sup> Postwar neurosurgery in a divided Germany presents an interesting story, as robust development produced a growth in neurosurgical centers from 18 in 1950 to 85 by the early 21<sup>st</sup> century; in Eastern Germany, a struggling economy and regressive regime limited gains to just a few talented individuals who gained worldwide notoriety. By 2006, 1200 fully trained neurosurgeons were serving the entire German population, performing nearly a quarter million neurological surgeries yearly.<sup>10</sup> Many advances in the years since World War I, including antibiotics, CT scanning, electrocautery for control of bleeding, and the use of medications to reduce the brain swelling that accompanies brain injuries have led to ever safer and more successful brain surgery. Today, surgery for traumatic brain injuries represents about 18% of all brain operations in the U.S. (2011 statistics, the most recent year for which statistics are available).<sup>11</sup> 18% of traumatic brain injuries are caused by firearms (the majority being suicides); of those, 90% are fatal, the patients dying usually even before reaching hospital.<sup>12</sup> Cancer surgery, such as that offered to the late Senator McCain, represents another 21% of brain surgery.<sup>13</sup>

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<sup>9</sup> Neurosurgery Match, "Overview of Neurosurgery". <http://www.neurosurgerymatch.org/overview/>, (accessed 2018October10).

<sup>10</sup> Hartmut Collmann & Hans-Ekkehart Vitzthum, "Neurosurgery in Germany after World War II," *Neurosurgery* 63, no. 5 (1Nov2008): 989-999.

<sup>11</sup> American Association of Neurological Surgeons, "AANS National Neurosurgical Procedural Statistics – 2012 Survey Based on 2011 Data", 11-13. [https://myaans.aans.org/MyAANS/resources/proceduralstatistics.aspx?p\\_cust\\_id=488301&grp=Reso](https://myaans.aans.org/MyAANS/resources/proceduralstatistics.aspx?p_cust_id=488301&grp=Reso). (accessed 2018October11.)

<sup>12</sup> American Association of Neurological Surgeons, "Gunshot Wound Head Trauma", <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Gunshot-Wound-Head-Trauma> (accessed 2018October11)

<sup>13</sup> See footnote 12

Trench warfare also saw a huge increase in facial wounds, compared with previous wars. The lore of plastic surgery has Hindu surgeons performing nose reconstructions for men who've had their noses cut off as punishment. But the reality is that "[w]hen we entered World War I, there was a total ignorance of plastic surgery in the army, but it must be said, that even in civil hospitals and medical schools of that time, 1917, the appreciation of this branch of surgery as a special subject was also lacking."<sup>14</sup> Interestingly, the first major influx of facial wounds on the British side came from the Royal Navy after the Battle of Jutland. Up to this point, any reconstructive surgery of the face was in the bailiwick of the otolaryngologists (ear, nose, throat specialists) and dental surgeons, and both Germany and France had put together teams of dentists and surgeons to deal with these problems. As fate would have it, another "great man" of his surgical art, Harold Gillies, a New Zealander trained in otolaryngology (ear, nose and throat surgery), serendipitously fell in with August Valadier, a French-American dentist in France in 1915. Valadier had set up a unit to care for soldiers with jaw injuries, and Gillies, intrigued by the challenges of facial reconstructive surgery, went back to England to lobby for a hospital dedicated to these cases.<sup>15</sup> Once granted, Gillies and a team of surgeons, dentists, anesthetists, and technicians he gathered around him, set out - initially "by trial and error"<sup>16</sup> - to work out techniques of reconstruction that gave grievously wounded men – men with noses and jaws blown off - functional and cosmetically satisfactory results. Like Cushing, Gillies acknowledged that when he set out to repair the horribly wounded faces he saw, "...the principles laid down by the fathers of surgery [were] found to be of general application... But our work [was] original in

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<sup>14</sup> John Staige Davis, "Plastic Surgery in World War I and in World War II," *Annals of Surgery* 123, no. 4 (April 1946): 610-621.

<sup>15</sup> Andrew Bamji, "Sir Harold Gillies: Surgical Pioneer," *Trauma* 2006 8, <http://www.gilliesarchives.org.uk/traumahdg.pdf> (accessed 18October2018).

<sup>16</sup> John Staige Davis, op. cit.

that all of it had to be built up again *de novo*. ...The earlier months, then, were spent in a very thorough trial of the then known methods. It has been illuminating to discover the impracticability of many of these, which would appear to have been put forward on the study of only one case, or even on purely theoretical grounds.”<sup>17</sup> Major accomplishments by Gillies and his team included the successful use of “tube grafts”, by which skin can, in stages, be transferred from, say, the chest to fill large facial defects; and the transplant of cartilage from the ribs into the face to rebuild noses, and more. By the time America came into the war, Gillies and his team had such an extensive experience that our medical officers who spent time with them were prepared to provide knowledgeable care to American doughboys wounded in combat. The U.S. Army set up several centers in France specifically for the care of men with facial wounds. The Army also established Plastic Surgery Centers in 9 hospitals stateside where these men received definitive care, being retained in the Army until they had received “maximal benefit” from the surgeons’ hands.<sup>18</sup> After the war, interest in plastic surgery varied. In England, just four men continued with development and practice of the specialty and these same four were the only experienced plastic surgeons available to British military forces at the outset of World War II.<sup>19</sup> In the U.S. on the other hand, interest was greater, promoted at least in part by increasing numbers of automobile accident victims needing skin grafting and other specialized care. One result was that the U.S. could provide 60 well experienced specialists to the army and the navy

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<sup>17</sup> Harold Delf Gillies, *Plastic Surgery of the Face Based on Selected Cases of War Injuries of the Face Including Burns, with Original Illustrations* (London: Oxford University Press, 1920), reprint by Andesite Press / Creative Media Partners 2015

<sup>18</sup> Davis, op.cit.

<sup>19</sup> Richard Battle, “Plastic Surgery in the Two World Wars and in the Years Between,” *Journal of the Royal Medical Society* 71 (November 1978), <http://journals.sagepub.com/doi/pdf/10.1177/014107687807101115> (accessed 21 October 2018).

prior to our entry into the war.<sup>20</sup> As in the Great War, the Army established a series of short training courses to bring other surgeons up to speed in assessment and technique, and so well did the program work in providing needed talent, that the “short course” system was discontinued before war’s end.<sup>21</sup>

When peace finally came, the value of plastic and reconstructive surgery had been nearly universally appreciated, and training programs found their way into almost all medical schools in the west. Plastic surgery in the Soviet Union languished and was generally performed by general surgeons. Specialty practice existed only in Moscow and Lenigrad, and access there limited largely to the political elite, movie stars and the security services.<sup>22</sup> Plastic surgery as a distinct specialty was recognized in Russia only in 2008, and specialty training centers established the same year.<sup>23</sup> China, on the other hand, established training programs in plastic / reconstructive surgery after World War II, and the profession has flourished, especially in the 21<sup>st</sup> century as the nation has become more wealthy, and demand for aesthetic surgery has grown. The International Society of Aesthetic Plastic Surgery estimates that more than 23,000,000 cosmetic procedures

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<sup>20</sup> Lihani du Plessis, *The Influence of World War I on the Development of Reconstructive Plastic Surgery*. 2016. Honors Baccalaureate of Science thesis, Oregon State University.

<sup>21</sup> Davis, op. cit.

<sup>22</sup> “Soviet Plastic Surgery: When the USSR Went Under the Scalpel,” *The Calvert Journal* (22 March 2017), <https://www.calvertjournal.com/articles/show/7971/soviet-plastic-surgery-ussr-under-scalpel> (accessed 22 October 2018).

<sup>23</sup> Alexander V Melerzanov, “Plastic Surgery in Russia,” *Prime – International Journal of Aesthetic and Anti-Aging Medicine* (17 January 2014), <https://www.prime-journal.com/plastic-surgery-in-russia/> (accessed 22 October 2018).

were performed world-wide in 2016.<sup>24</sup> Nearly 6,000,000 reconstructive surgical operations were performed in the United States in 2017.<sup>25</sup>

### **Conclusion**

Two surgical specialties, for which there had been virtually no antecedent experience, emerged from the unique injuries soldiers in the Great War experienced in high numbers due to their exposure in trench warfare. The experience gained from treating these patients permitted surgeons to lay down principles of practice that inform the practice of neurosurgery and plastic / reconstructive surgery even today. Acceptance of these as separate surgical specialties was not universal until experience in World War II confirmed their value. Every major nation except the Soviet Union saw their advancement in the later 20th century. This progress and acceptance has only expanded in the 21st century.

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<sup>24</sup> International Society of Aesthetic Plastic Surgery, "International Study of Aesthetic / Cosmetic Procedures Performed in 2016 (Summary)," <https://www.isaps.org/wp-content/uploads/2017/10/GlobalStatistics.WorldWide.Summary2016s-1.pdf> (accessed 22 October 2018).

<sup>25</sup> American Society of Plastic Surgeons, "2017 Plastic Surgery Statistics Report ' 2017 Reconstructive Surgery Statistics," <https://www.plasticsurgery.org/documents/News/Statistics/2017/reconstructive-procedure-trends-2017.pdf> (accessed 22 October 2018).