

Chapter 6 War Wounds and the Evolution of Wound Care

Many medical innovations resulted from the Spanish Civil War which just a year or so later became critical in the treatment and management of war wounds in the Second World War. The period from the end of the 19th century to the end of World War II saw radical developments, innovations, discoveries, and changes in medical treatment of trauma. Much has been written about the devastating casualties of World War I and the ways in which technological innovations—airplanes, mustard gas, among them—resulted in wounds, casualties, and trauma unknown in previous wars. Much too has been written about the medical innovations coming out of the World War II which have contributed to the avalanche of medical discoveries of the past 60 years. Much less has been written about what was learned or confirmed during the Spanish Civil War. A variety of circumstances led to Dr. Ponseti finding himself in the midst of these changes in medical practice.

Even before World War I there were glimmers of hope for open orthopedic injuries. Precedents regarding the treatment of compound fracture appeared in the American medical literature before the turn of the 20th century.

Frederic Dennis, an American orthopedist, had published the principles of treatment of compound fractures during the period between 1876 and 1884. Dennis had reported in 1884 that death and poor results need not be the expected outcomes of an open orthopedic injury (that is, a bone sticking out through the skin). Practicing in a civilian environment, Dennis showed that cleaning wounds and then casting could save limbs. He used ether anesthesia to bring about fracture reduction and cleaning and resection of some bone. He used the antisepsis available during that time, including iodoform gauze, carbolic acid, and mercuric bichloride (a particularly poisonous compound) to keep wounds clean. Dennis reported only three deaths among 118 patients. Unfortunately, he reported his results only as “recovery” and did not report on disability or limitation of the trauma.

In World War I, according to historian Lyn McDonald, the typical wounded British soldier had to be carried by stretcher-bearers or had to crawl out of no-man’s land between German and English lines. The English would typically “soften up” the enemy with an artillery barrage before the troops went over the top of the trench. When the soldier was wounded, he hid in a shell hole until night when, hours later, he could crawl back to the safety of the British lines

(McDonald, 289-90). That individual might be 24 to 48 hours in the field before coming to medical attention.

Basil Hughes describes events in the medical facility closest to the front: the casualty clearing station. A certain physiologic triage occurred here. Persons with wounds through the great vessels, brain tissue, or heart, did not reach a clearing station. Those wounded soldiers who made the trip to a field hospital would have wounds that could be treated. Surgeons of the time recognized that early management within three hours of injury was ideal. They provided triage and initial care like splinting, sending troops to base hospitals where additional surgical care could be given. Wood or cardboard splints were used but plaster casting was not available in forward clearing stations. Fortunately, by World War I carbolic acid and mercury compounds had passed out of the medical armamentarium in favor of Dakin's solution (a dilute form of bleach) to obtain antisepsis. Early surgical intervention and casting of wounds was not part of the management of gunshot wounds.

Dr. Winnett Orr practiced orthopedics as part of the American Expeditionary Forces in 1918 at Savenay, in France. He published his surgical results in five articles over nine years, between 1919 and 1928, including case studies advocating immobilizing extremity wounds, and debriding¹ wounds to remove dead tissue and foreign cloth, dirt, and debris. Writing in 1921 and 1922 at the conclusion of his war experience, Orr reported his ideas about wound care:

Careful splinting and sound healing will give the same results or better [than keeping joints in motion]. On the other hand, experience taught us the great danger of keeping infected joints moving under any except ideal conditions. I saw during the war, and have seen since, many cases of serious disability and severe deformity in which attempts were made to maintain motion in joint cases, which should have been protected and allowed to become stiff in better position.

Even from one of the most brilliant procedure that came out of the surgery of the war—debridement—there are negative as well as positive lessons to be learned. Certainly we saw that lives and limbs were saved by the early and complete removal of badly damaged and infected tissues. That such procedures should be done by skilled surgeons, however, is attested by the frequency with which principal peripheral nerves were sacrificed and serious disabilities resulted owing to bony and soft part defects. (Orr, "The Fundamental Principles of Orthopedic Reconstruction and Industrial Surgery," 256-7)

¹ Debridement is a technical medical term used by surgeons to describe removal of dead or injured tissues. Gunshot wounds can carry dirt and cloth into the flesh. The impact of the shrapnel fragment causes vibration injury to skin, muscle, blood vessels, and bones. The surgeon removes this dead and injured tissue until fresh oozing tissues are seen. This surgical process allows wounds to heal faster.

Although Orr described his techniques, he unfortunately gave no statistical information on patient results to substantiate his claims that this was the superior management of such wounds. His case histories suggested improved results but he did not report the end results for any group of patients treated according to his principles, so the data is very limited. In his 1928 article “The Treatment of Infected Wounds without Sutures, Drainage Tubes or Antiseptic Dressings,” Orr presented his opinions with one case illustration from his civilian practice. By modern standards of scholarship this article would be considered a case report. It can only be understood in the context of his earlier 1922 article outlining his vast experience in World War I. These principles would become the standard for orthopedic gunshot wounds in the Spanish Civil War.

One crucial change was the length of time between the wounding of the combatant and obtaining medical care. According to Wallace, the average interval was 8-10 hours during the Great War. He also reports that general mortality rates were appallingly high—between 50 and 60%.

Trueta described a military field setting with casualty clearing aid stations no more than 60 minutes away from the battlefield in the Spanish Civil War (*Principles and Practice*, 181). At these stations patients received morphine sulfate and had their wounds cleaned. Ponseti and Puig-Guri reported in 1943 that tetanus antitoxin was given, eliminating this dreaded complication seen in the war to end all wars. Carrel-Dakin’s solution was known from WW I, so that early cleansing to avoid gas gangrene and tetanus was accepted practice by the time of the Spanish conflict. In addition, the terrain allowed the wounded to get away from the firing line to the aid station faster in the Spanish Civil War.

Dr. Trueta’s 1940 *Treatment of War Wounds and Fractures* makes clear that medical treatment during the Spanish War depended on Orr’s treatment methods and principles. Trueta reported the early adoption of Orr’s principles—early casting of fractures, debridement, but no closure of the wound. Like most of his colleagues, Trueta developed his war credentials “on the fly.” They knew all the medical literature; all the retrospective military experiences were published and available to surgeons in 1936. But the accepted principles of orthopedic care developed by Orr, considered authoritative at that time, were accepted only on faith, not on evidence from a clinical series of patients and not substantiated by any acceptable research data. Perhaps readers of the time assumed that because any orthopedic surgeon such as Orr serving in the Great War would have observed countless numbers of casualties with poor results, therefore anything such surgeons developed would have represented an improvement.

Trueta had had extended industrial accident experience, and applied this to the situations he encountered during the war. Although he was not an orthopedist, his experiences led him later to write about orthopedic war surgery. Eventually he was to publish a much larger statistical study on wound infections and mortality from wounds (1,073 patients), which confirmed Orr's method and the Republican Medical Services recommendations for improved wound care. Trueta writes, "The Chief Surgical Consultant to the Republican Army, Colonel D'Harcourt, gradually introduced these principles of wound treatment throughout the army medical service, and during 1938 the treatment was almost universally employed. The total number of cases was about 20,000" (*Treatment of War Wounds*, 16). After the Civil War, Trueta reported his wartime orthopedic experience as having a 0.5% mortality rate and an 8% unfavorable outcome. Thus 91% of his patients did well—an astounding change in military surgery (*Treatment of War Wounds and Fractures*, 135).

Ponseti and Puig-Guri also acknowledged the value of Orr's treatment methods in a 1942 publication based on their front-line experiences of the Spanish Civil War. The all-important administration of tetanus antitoxin, initial cleaning of the wound, removal of dead tissue and foreign bodies (dirt, and clothing particles), and casting were provided at the first contact with surgeons. In contrast to the situation in World War I, Spanish surgeons had blood available for transfusion, portable X-ray equipment, and an operating room so that rapid surgical care could be provided to casualties.

Most orthopedic and surgical writers of the World War I and Spanish Civil War period report the use of anesthetic agents during reparative surgery but say little about its life-saving potential. During both conflicts, local anesthesia with novocaine injection was available; for general anesthesia, ether and chloroform had been available for about 50 years.

Ether anesthesia had many characteristics that made it the best available choice in dealing with battle casualties.² It was portable in metal-capped containers, for one thing. Nursing personnel in most instances used an Open Ombrédanne method to administer it for surgery: a piece of gauze over a wire mesh, which fit over the nose and mouth, allowed the patient to breathe in anywhere from .5 to 2% ether, mixed with the oxygen available in room air (roughly 20%). The importance of anesthesia was that it both relieved pain and relaxed the muscles, so that bones could be reset in position. This ability to re-align the bone structure was essential before placing the patient in a cast, as Orr, Trueta, D'Harcourt, Jimeno, and Ponseti desired.

² In civilian practice, ether was a commonly used agent. Lundy used a punch card system to keep records on anesthesia at the Mayo Clinic in the U.S. For the war period 1936-39, he reported roughly a third (33%) was ether, 20% cyclopropane, and the rest local or spinal agents. (Lundy, 655.)

Being wounded tended to put the patient into a shock-like state, lowering his blood pressure. The valuable asset of ether as an anesthetic agent was that it tended to keep the blood pressure in a normal range during the manipulative procedures of wound cleaning, debridement, alignment of bones, and plaster casting. Keeping a record of the patient's blood pressure was helpful in keeping him alive;³ watching for pink skin and a slow full pulse told the anesthetist that the patient was stable and tolerating the surgery.

Ether anesthesia and the ability to replace blood in wounded patients were life-saving developments during the Spanish Civil War.

There was a readily available blood donor pool in the Republican war effort. Trueta reported that Dr. Durán-Jordá had some 27,000 donors available in Barcelona and that he supervised some 10,000 transfusions during the Civil War. It was a short distance from Barcelona to the active military front. Just as trains could bring casualties to the rear so also blood could be transported in a refrigerated state to the front. The stable population of donors close to the military combatants made for significantly improved surgical outcomes for the wounded.

Even selected chest and brain injuries were treated in the field if patient survival was deemed possible as the result of the triage system. Ponseti emphasized the preservation of skin and skin covering over wounds with adequate resection of dead muscle tissue, and preservation of bone, which is nourished by its peri-osteal blood supply. Ponseti emphasized the importance of unsutured or open closure of wounds avoided many problems of gas gangrene and other infectious complications of wound management. These factors, which were not well articulated by Orr in his writings, are well outlined by Ponseti indicating a new understanding of the principles outlined by his orthopedic predecessor. All these successful treatments preceded the antibiotic era. Ponseti also acknowledged Trueta's work and the importance of D'Harcourt's pronouncement as chief of surgeons in the Republican Army enforcing Orr's treatment protocol for compound missile fractures.

Patients then moved onto the train and ambulance systems, where a more definitive management of the fracture and open wounds could be provided. Trueta emphasizes the necessity of having these initial care stations within an hour of the battlefield. The clear advantage is indicated in the statistical success rates in the Spanish Civil War: only six fatalities among his 1,073 patients or 0.6% of his population. Movement of the casualties to safe, secure

³ In 1908, Harvey Cushing advocated the graphing of pulse and blood pressure throughout surgical procedures as a means of monitoring patients under chloroform and ether anesthesia. (Cushing, 262.)

locations for the best care and the least movement of the wounds after primary care were innovations of the Spanish conflict.

In 1943, Trueta expanded his observations in a second book setting the standards for that “new” war experience of World War II. These were truly important new outcomes for surgical wound management particularly because they were not associated with the use of sulfonamide, which became available in 1937.

Early immobilization of fractures by plaster casting, early wound care (within an hour or so), blood transfusion, the operating room facilities called auto-chir mobile surgical units, and hospital trains all represented unique advances in military medicine over the surgical experiences in World War I. These advances contributed to a decline in bad surgical results to 8%, from 50% (*Principles and Practices*, 135). While Trueta’s data was not published until after the war, the principles of wound management were nevertheless apparent to Dr. Ponseti and his orthopedic colleagues. These surgical results are clearly exceptional in an era when there was no antibiotic coverage for open wounds.

It is interesting to review the illustrations in Trueta’s *Principles and Practice of War Surgery*. Photographs taken during World War II suggest how dependent England was on the experience of Republican officers in the Spanish Civil War. Trueta reports that principles used in Spain were used in the evacuation of Dunkirk a few years later. In World War II, sulfa preparations were placed in wounds; penicillin became available at the end of the war in 1944-5. Even without these antimicrobial agents, Spanish surgeons provided superior care for their troops.

Today’s antibiotics and the extensive use of intramedullary rods, internal plates, screws, and external fixation apparatus have changed the treatment of fractures even further. These methods may be superior in some circumstances but do not detract from the sound principles used in the Spanish military conflict. While plaster may be replaced in part by fiberglass cast material, today’s fiberglass lacks the plasticity and flexibility of plaster. The sheer number of wounded in the Spanish Civil War would preclude the use of modern fixation equipment in the war setting even if it had been available at this time before antibiotics.