

**THOMAS C. BOWER:** Thanks, Mike. It's a pleasure for me, as the chair division of vascular and endovascular surgery to introduce Dr. Todd Rasmussen. Todd is here as a visiting professor with the divisions of trauma and critical care general surgery in our division. He came in last night with his wife, Debbie, and is here for another day.

Todd currently holds an academic appointment as Associate Professor of Surgery at the Norman M Rich, from Health Sciences University and is actually on the short list to become chairman of that division because of contributions he's made to the care of the traumatically injured soldier in the field. Todd has writs in Kansas, having graduated from the University of Kansas pharmacy school. He's a male medical school graduate. He did a surgical training at Wilford Hall in San Antonio, Texas.

While there as an intern, he met Dr. Don Jenkins, for whom I know Todd has the utmost respect, both as a surgeon, a colleague, and literally a brother in the field. Todd completed his surgical training there. He spent one year during that time as a research fellow here in vascular surgery and cardiovascular diseases working with John Burnett-- then did our vascular surgery fellowship, where he shined. He then went on to become Chief of Vascular Surgery at Wilford Hall, Andrews Air Force Base-- Chairman of Surgery at Wilford Hall-- and he currently is the Deputy Field Commander at Houston, Texas, for surgical research.

Todd has-- from a research standpoint-- he's been very active in the field of trauma. He has two grants-- one from the United States Air Force-- one from the Department of Defense-- both having to do with traumatic injuries in the field. One is the use of a fluoroscopy-free aortic [INAUDIBLE] balloon. And most of his other work in grants have been done with the animal clinical research studies looking at extremity injury and the use of temporary vascular shots. He holds positions in all the major important societies-- both in vascular and trauma. He does a lot of consulting with the AAST. He has 52 publications-- 19 book chapters-- he's published three books. He's given 19 invited commentaries-- primarily in the area of trauma.

Todd, I think-- if you spent 10 minutes with him-- you would quickly understand how passionate he is about the care of the young men and women we have in the field. He's had five tours of duty so far-- two to Iraq, two to Afghanistan-- actually six-- one to Morocco and one to Pakistan. And I believe in the next month or two, he will be returning again to the field. He wants to give back. And I think Todd has rapidly ascended to become a leader in the military-- in our armed forces-- as it relates to surgery. And he's giving a lecture this afternoon to you all. I invite you to come to lecture that we have for our vascular surgery grand rounds tomorrow.

Todd, it's indeed a privilege to have a former trainee come back. And, no doubt, everybody knew you'd be so successful. Welcome, Todd.

**TODD E. RASMUSSEN:** Well, thank you, Dr. Bower. I'd like to thank, also, Dr. Schiller, for the invitation to return to Mayo. I'd like to thank Dr. Duchamp for his support of my visit, and the chief surgical residents here for allowing me to present this topic at their conference. I hope you find the perspective of this Mayo alum meaningful as you near the end of this phase of your career. I also thank a number of brilliant mentors, friends, and family-- many of whom are here.

Dr. Bauer mentioned Dr. Jenkins and I have seen and visited with Dr. Bower, Dr. Zitlo, and others-- just in this brief whirlwind of a day or two. It's very special for me to give this grand rounds and to be back at Mayo.

The lecture today will proceed through three phases related to the past, present, and future of military surgery and combat casualty care. First, I'd like to begin with a brief history of the Mayo family and the Mayo Clinic and their contributions to military surgery during the First and Second World Wars. Next, I'll report our knowledge of, and experience with, advances in combat casualty care over the past decade of war-- in Afghanistan and in Iraq. In this aspect of the lecture, I aim to demonstrate how military surgeons and medics have transformed global care of the injured. And, lastly, offer forethought on four fundamental capabilities that we as the US military must protect during these austere fiscal times, nationally, to assure our nation's all volunteer force that we remain committed to providing the best possible care should they be injured in harm's way.

As we enter now, an 11th year of sustained combat activities in Afghanistan, I'd like to review the wars of the previous century-- paying special attention to their duration. The US formally entered World War I on February 3rd of 1917 with President Wilson's declaration of war in front of Congress, shown here. Despite a nearly insurmountable toll on human life, this country's involvement in World War I was relatively short. With the armistice pharmacist being signed on the 11th hour of the 11th day of the 11th month in 1918.

William J and Charles H Mayo played a critical role in substantiating military surgery during the Great War. And it has been a real privilege for me to work with Rene Zimmer, who is a coordinator of the Mayo historical unit here. Is Rene here? Did she make the trip? Rene has been extremely helpful to me as I put this talk together, and helped me to discover several compelling documents detailing the role of the Mayo brothers in the clinic in World War I and World War II.

Shown here is a fairly well-recognized photo of the Mayo brothers toward the end of their career in the Army Reserve-- after having been promoted to the rank of Brigadier General. This rarely seen document, signed by William J Mayo, summarizes the role that the brothers played during World War I. And I'd like to take a minute to read excerpts, as I think it provides a unique insight into their experience with military surgery of the day. And it's a remarkable document, I think, to look at.

It goes to say, almost immediately-- again, this is William Mayo-- almost immediately after the Great War was declared, Dr. Charlie and I were called by President Wilson and General Gorgas, Surgeon General of the Army, to act as chief consultants for the army for the duration of the war. And we went on to Washington. Our function was to ensure and maintain the standard of character and ability of the men taken into the Medical Service and carry out ways and means for their training. We established, at Camp Greenleaf, a course of training of three or four months, so that the doctors who went overseas should be trained for some particular work in order to make them more useful.

The document goes on to say, at the same time, we established in Rochester-- at the clinic-- short courses of training-- one for medical officers and one for commissioned officers. The officers training comprise lectures on military medicine, attendance on medical and surgical clinics, hospital rounds, and assignments on laboratory work. This photo-- again, a fairly rarely seen photo-- is taken of the medical leadership at Camp Greenleaf-- which was located at Fort Oglethorpe, not far from Savannah, Georgia. In the middle is Surgeon General William Gorgas with the white hair. And then, not far-- I'm sorry, and then on the screen-- far right-- you'll recognize then Colonel Charles Mayo.

The letter concludes, we entered our assignments to Washington as majors, and soon we were made colonels and were retired as brigadier generals. I can guarantee you, we don't get promoted quite as liberally these days. We each were awarded the Distinguished Service Medal of the US Army. Again, signed WJ Mayo. It's a great-- it's a great document. And I would encourage those of you who have not spent a little bit of time on the second floor of the Plumber Building to do so. It's a unique opportunity that I recognize having been away from here.

This is a photo taken then of Colonel William Mayo-- on the screen, left-- performing a review of the medical facilities at Camp Greenleaf, again, on Fort Oglethorpe near Savannah, Georgia. Not to be overlooked was the Mayo's contributions to deployment of base hospital 26 during World War I. The hospital was deployed to Allerey France as a collaborative effort between Mayo and the University of Minnesota.

The first 10 hospitals deployed to central France-- of the first 10-- 26 became the main surgical facility and was staffed by Mayo physicians, including David Bergman, James Hayes, Oliver Melson, and Carl Fisher. The hospital treated 7,200 soldiers from the western front before being called home in May of 1919. This photograph of the medical staff is in front of the administration building-- or barracks-- of base hospital 26.

Moving on-- military involvement of US forces in World War II began soon after the day of infamy in 1941 and lasted nearly four years until the day of Japanese surrender in September of 1945. Like the First World War, the Mayo Clinic was involved early in the lead up to US involvement in World War II. In 1940, the 71st Army General Hospital was organized in Rochester as a preparedness measure. And doctors James T. Priestley-- shown on the screen, right-- and Dr. Charles W Mayo-- shown here-- were chosen to lead this unit. In 1943, the hospital was activated to Charleston, South Carolina, and its personnel assigned to either the 233rd or the 237th station hospitals. In 1944, both station hospitals were deployed to New Guinea in the South Pacific. The 233rd-- shown here-- placed its station hospital at [INAUDIBLE]. And the 237th became operational at Finschhafen, again, in New Guinea.

The 233rd was eventually expanded and redesigned as the 247th General Hospital-- a larger hospital. In 1944, both the 237 and the 247 were moved to the Philippines to treat casualties from the Okinawa campaign. The larger 247 was set up at Clark Field. And the 237-- shown here-- was made operational at Batangas, Philippines. This is a photograph, here, of Charles W Mayo at the 237 in the Philippines.

Time does not permit me to list the contributions of the Mayo Clinic-- or other military surgeons-- during the Korean War and Vietnam Wars. But needless to say, surgical advances in combat casualty care-- made by the likes of then Major Karl Hughes in Korea, Frank Spencer-- shown here-- second from the left-- again, in Korea. Norman Rich-- shown here-- operating actually-- in this photograph, in the center-- Doctor Rich is operating with Tom Whalen and General Hutton, who has worked closely with [INAUDIBLE] from this institution as a surgeon of Ronald Reagan's. And then Basil Pruitt-- shown here-- I had a talk with Dr. Pruitt just a week or so ago and we had a good time looking at this photograph-- then as Major Pruitt. And Dr. Jenkins reminds me that when he was a major, he looked very similar to Dr. Pruitt. I have no such picture to confirm.

To put it into perspective the decade long combat casualty care operations-- again, decade long now in Afghanistan and Iraq-- US involvement in Korea lasted for just three years. From the Battle of Osan in July 1950, to the signing of the Korean Armistice at the end of 1953. Despite an enormous loss of life, the US declared an end to its combat operations in Vietnam following the signing of the Paris Peace Accords of 1973-- nine years after the Gulf of Tonkin Resolution in the summer of 1964.

In comparison, US combat operations in Afghanistan began 6,000 miles from our shores-- less than a month following September 11th, 2001-- approximately three months after I finished my fellowship here. While the losses of US service personnel is significantly less in number compared to previous wars, military operations continue in earnest today-- I guarantee you-- more than 10 years later. Keep in mind that during eight of those years-- eight of those 10 years-- operations were also ongoing in the country of Iraq.

The wars in Afghanistan and Iraq have resulted in over 6,000 killed, 46,000 wounded US service personnel. The sheer duration of these sustained military operations has provided military surgeons the longest time to conduct, study, and optimize combat casualty care in US history. In this context, I'd like to transition to outlining how our experiences as surgeons-- over this decade-- has resulted in knowledge that-- and the transformation of trauma care around the globe.

I appreciate you letting me read this lecture so that I don't say too much, but I say everything I intend to say. The most significant advance in combat casualty care resulting from these modern wars is the implementation of a joint theater trauma system, or JTS. For much of the decade, the system coordinated care in two theaters of war, and therefore was referred to as the joint theater trauma red system-- or JTTS. The JTS-- because we're in one theater of war now-- the joint trauma system-- works to provide rapid, coordinated movement of the injured from the battlefield to the simultaneous-- with the simultaneous performance of life preserving maneuvers through a 6,000 mile evacuation chain back in the United States. As profiled, in this piece, entitled Speed Saves, in the May VFW magazine-- the system works to get the right patient to the right place at the right time for the right treatment.

The JTS has an equally important mission of evidence based process improvement designed to optimize survival and morbidity of personnel injured in the theater of operations. This mission is led by a deployed JTS surgeon-- Don Jenkins was one of the first of these back in 2004, who leads a program of communication and coordination among medics across all echelons of care. The JTS also maintains a registry of injury information on US service personnel-- the joint trauma registry, or joint JTTR-- and a system of more than 30 clinical practice guidelines outlining evidence based care for various injury patterns or clinical scenarios.

It's important to note that we did not-- despite an understanding from the experience in the civilian trauma sector-- up until 2004-- that implementation of a comprehensive trauma system resulted in lower morbidity and mortality-- that we did not start the wars in Afghanistan and Iraq-- with a coordinated joint trauma system. Again, we started-- built the plane-- while we were trying to fly it. And Don did much of that building.

Although well intended, our doctrine of combat casualty care was based on the errant assumption that proximity to surgical capability alone resulted in improved survival. While proximity of the injured to medical capability is important, it must be the right patient matched to the right capability in the optimal time frame. This map shows an early and complicated lay down of surgical capability in Iraq. Although seemingly logical, the allocation of assets assume that care-- at the center of all of these circles-- was equal with regards to expertise and diagnostic equipment. What's more, early schemes like this did not allow for coordinated transfer of patients between these circles. They just focused on locating some form of surgical care within one hour of injury.

As an example of how this scheme was limited, I'd like to take the time to walk through a case from 2003-- prior to the JTS. The troop, in this case, was injured outside of Kirkuk, up in the top northern part of Iraq, by an explosive device and had an extremity and severe head injuries requiring intubation. Despite the need for a CT scanner and a neurosurgeon, the medivac was constrained to returning this patient to its own level 2 facility in Kirkuk just 30 miles away-- 30 miles south. In Kirkuk, a laparotomy was performed to control hemorrhage and the extremities were stabilized. But knowing-- not knowing there was no CT scanner or neurosurgeon in Mosul, the team sent the patient there to Mosul.

The patient arrived with limited information on what treatment had been rendered in Kirkuk. And not wanting to miss anything, the team in Mosul repeated the laparotomy and scheduled the patient for transfer to the level 3 facility in Balad, where there was a CT scanner and a neurosurgeon. The intubated patient flew by rotary wing from Mosul to Tikrit-- not to Balad-- where medics took the patient to the hospital in Tikrit, so as to be able to give Mosul team back to their monitoring equipment so they could return it to their home base.

The Tikrit team readied the patient with their monitoring equipment-- their own monitoring equipment-- for the rotary flight to Balad. Now, no one of the Tikrit team had seen the patient or been involved in their care and few knew anything about the patient's injuries or past procedures because of the dynamic tail to tail-- one helicopter to another-- handoff.

The patient finally arrived at the level 3 facility in Balad-- 120 miles from the original point of injury-- more than nine hours later, where he had a CT scan-- a decompressive craniectomy. He was stabilized for 24 hours and then evacuated to the level 4 facility at Landshut, Germany. Now, the reasons behind instances of suboptimal movement and care are many, and not all are solved by a joint trauma system. However, in the absence of a joint trauma system-- as this room knows-- there is not a mechanism to perform real time review and process improvement. As such, this type of uncoordinated care was just as likely to happen again or be repeated.

In cases like these-- and mounting evidence from the civilian experience back home demonstrating the survival benefit from care within a defined system-- resulted in the development and implementation of the military's joint theater trauma system in 2004 and early in 2005. This is a photo of Balad Air Base and the 332nd expeditionary medical group, which was the largest Air Force theater hospital since the Vietnam War. The hospital operated from September of 2004-- when Don opened the doors-- until just last month-- sustained operations of just over seven years. Colonel Don Jenkins and a cadre of Air Force surgeons are shown here, late in 2004, at the height of the Fallujah campaign in central Iraq. Don, Army Colonel Brian Eastridge, Colonel Retired John Holcomb, and many others are credited with standing up the joint theater trauma system during the time of these photos-- Lieutenant Colonel Dan Jenkins, not major-- but does bear some resemblance to Dr. Pruitt, I suppose.

Part and parcel with the joint trauma system is the intra and transcontinental air medical evacuation as one of the top advances in combat casualty care over the past decade. Movement of injured US troops was recognized by David Brown in his series of reports last year in the Washington Post when he stated, the US military's ability-- not to mention its willingness to take critically ill soldiers on the equivalent of a seven hour elevator ride-- epitomizes an essential feature of the doctrine for treating war wounds in the 21st century-- keep the patient moving. As noted, in US House Resolution 1605, passed last September, recognizing airmen who support and perform this mission, the United States Air Force has flown more than 35,000 aeromedical evacuation sorties since the start of the war in Afghanistan in 2001.

In this mission, the Air Force has moved more than 85,000 patients-- the town of Rochester-- including more than 15,000 battle injured-- more than 2000 of whom have been moved using critical care air transport teams or flying ICUs as shown here. As remarkable as these numbers are, is the fact that US troops critically injured more than 6,000 miles away are back on US soil for care in an average of five days after injury. Moving on-- while the concept of tourniquets to stop extremity hemorrhage is not new, the clinical study of their effectiveness-- and now their widespread availability-- is revolutionary. As such, modern tourniquet use on the battlefield represents another of the top advances in combat casualty care over the past decade. Work led by John Craig at the Institute of Surgical Research-- the facility where I am currently stationed-- published here in the annals of surgery, demonstrated that early application of tourniquets to severely injured limbs was associated with improved survival on the battlefield.

Shown here is the emergency medic military tourniquet-- or EMT-- And here is the combat application tourniquet-- or cat tourniquet. Since 2004, more than 300,000 of these commercially designed and produced devices have been given to US service personnel and applied to cases like these to stop extremity hemorrhage. As part of a larger practice referred to as damage control surgery, resuscitation from shock has transformed during the past decade of war, as well. As such, a practice now referred to as damage control resuscitation, represents a fourth major advancing combat casualty care. In contrast to previous decades, when medics gave volumes of intravenous balance salt solution, such as saline and lactated ringers to normalize blood pressure in the setting of shock-- we now have learned that this is not necessary in most cases.

And, in fact, in some cases, giving saline or ringers lactate may be harmful as it artificially raises the blood pressure with these solutions-- may worsen the body's ability to make clot and may actually make bleeding worse. Instead, combat casualty care research has shown that the benefits of blood component based resuscitation-- leading with using packed red blood cells and plasma-- shown here. Studies such as this, from the joint trauma system, have shown that resuscitation with packed red blood cells and plasma improves survival in severely injured, compared to the use of saline or ringers lactate.

In refining this understanding, we have demonstrated that when using this resuscitation technique, that equal ratios of plasma and packed cells improve survival. The benefit is shown on this graph-- again, in this paper from Holcomb and Boardman-- where mortality is on the y-axis, and low, medium, and high ratios of plasma [INAUDIBLE] cells are on the x-axis. Note that mortality in the group on the far right, which received the highest ratio of plasma to packed cells, was the lowest at 19%. As an example of how findings from wartime clinical research are evaluated and then implemented, the details of this lifesaving resuscitation technique are now present in and outlined for surgeons and medics in the clinical practice guidelines, for damage control resuscitation provided and monitored by the joint trauma system-- again, a capability that was not present when we started this war.

The fifth-- and final-- major advance in combat casualty care that I'd like to mention relates to pre-hospital, or what we call tactical combat casualty care-- or TCCC. This recent paper in the archives of surgery, confirms for the first time that the joint trauma system and a tactical combat casualty care doctrine are effective at saving lives moments after injury. In this groundbreaking study, the authors conclude that a data driven approach to applying early lifesaving interventions soon after injury is the model for improving pre-hospital trauma care and casualty outcomes. Furthermore, they conclude that the TCCC doctrine has significant implications for civilian first responders, such as police, medics, and firefighters. The results of these-- and other-- advances in combat casualty care-- that time doesn't permit me to go over this afternoon-- is the highest survivability of combat injury recorded in the history of war. As illustrated on the graph to the far right, survivability of US service personnel-- following wartime injury in Afghanistan and Iraq-- is nearly 90%.

To keep with the title of this lecture, it's important to note just how these advances made by military medicine over the decade have transformed the management of the ill and injured worldwide. One example closely follows the publication mentioned by Holcomb and Bordman-- that is the reporting of a paradigm shift in clinical practice in a peer review publication. Unquestionably, knowledge from the past decade has acted as a transformational pathway through this type of academic activity. In addition to the examples of advances in combat casualty care already mentioned, publications have appeared in the literature related to hemorrhage control techniques, burn care, vascular injury management, the treatment of orthopedic injuries, and novel advances in restorative plastic surgery.

Concurrent with the reporting of benchmark findings in the literature, military medicine has disseminated advances in care through courses and seminars and dialogue with international militaries and academia. In these instances, the global transformation of care has been face to face-- or people to people. In this capacity, the military medicine has not only transformed global health care, but has also served as a source of what Joseph Samuel Nighe termed-- smart power. One entity I'd like to provide as an example of this type of transformation is the dual service organization-- the Defense Institute of Military Operations-- for DIMO. The Defense Institute of Military Operations emerged as an Air Force and Navy dual service organization in 2002 just after the beginning of the war and has as its mission statement, military medic strengthening global and medical capabilities. DIMO accomplishes its mission through offering a series of courses led by teams of military medics to less developed-- or at risk either politically or economically-- at risk countries around the globe. The categories of the one to two week long courses are emergency and trauma surgery, disaster planning, consequence management, disease prevention management, and patient transport and evacuation.

DIMO has been a capstone of the military's medicines capacity to act as a transformational pathway for global health care over the past decade. As marked by the stars on this map, in 2011 alone-- just one year-- DIMO sent military medical teams to 18 countries around the world and hosted three resident courses in the United States. I have personally participated in the translation of our trauma care experiences to civilian and military medics at courses at the Afghan Army Hospital-- shown here in Kabul-- a hospital that was built in the 1970s by the Russians. At the military medical Academy in Rabat, Morocco-- and the Armed Forces Institute in Rawalpindi, Pakistan-- shown here.

I'd like to transition now to the final segment of this lecture, entitled Forethought. Synonymous with the word forethought are listed here-- consideration, planning, prudence, and precaution. And I believe the word, forethought, is appropriate as we take stock of the surgical accomplishments of the past decade. Specifically, we must recognize that the effective and sustained delivery of trauma care to our all volunteer force-- following 9/11-- was not by chance or was no mistake. But, instead, it was a product of specific military surgical education training, planning, and preparation. In short, we hit the ground running with a sharp scalpel.

And a fascinating rebuke-- this was one of my favorite papers-- and I need to get this to Don-- in a fascinating rebuke of the military surgical preparedness, prior to World War I, Will Mayo cited complacency among military leaders prior to the war. In a speech-- of all places, at a commercial club-- which I believe is sort of like the Toastmasters at the local Methodist Church here in 1919-- and is reported here by the Rochester Daily Bulletin-- not Post Bulletin, the Daily Bulletin-- reported that Will Mayo gave an honest-- and as I said, rebuke-- and honestly, as I read this article-- assessment of his experience in the war where he also cited the nation's complete lack of medical men with trauma and military experience.

And I would encourage you all to visit-- again-- the historical unit to find these sorts of documents. I think it's interesting. To avoid the mistakes of the past, and to maintain our nation's capability to act as a leader in care of injured-- and to assure our volunteer force of commitment to optimal care should they be injured in harm's way-- there are four capabilities that have to be protected and expanded in the coming years. One, is military specific medical education and training at the nation's uniformed Services University. Two, is level one trauma centers stood up and operating at select military medical centers within the DOD. Three, is the joint trauma system-- it has to be plugged up, put in the federal budget, and sustained. And four, combat casualty care research.

Military specific medical education-- and training at our nation's military medical Academy-- was and continues to be a foundation of our military surgical capability. The motto of the Uniformed Services University is learning to care for those in harm's way. In having this institution educate physicians with subsequent extended service commitments-- and a propensity to lead-- is a win-win for this country. It's joint from the beginning-- meaning the medical students that attend this Academy are of all the services-- joint service-- so Navy, Army, and Air Force. And, finally, the uniformed services is the focal point for the military's interface with civilian academia-- national and international. While all other aspects of the military medicine and surgery-- combat casualty care can be operational-- meaning going forward and down range. USCIS is the one military institution whose focus is academic medicine and surgery.

In what, for me, is another captivating find from the Mayo archives is this Western Union Telegraph from Charles Mayo in February of 1918 to then surgeon-general Gorgas-- and calls for, in here, establishing a national military medical school. And you can see it as one of the subject line-- in fact, it's the lead of the subject line.

In the text of the telegram, Charlie Mayo noted that, out of necessity, medical men at Camp Oglethorpe were receiving some form of military training. But this should be organized and codified in the form of a school of medicine, including formation of a strong board with the heads of departments of military medicine, surgery, and laboratories. Now, to provide an example of why maintenance of level one trauma capability at select military medical centers is the second capability to protect and expand-- I'd like to present two cases to you as we close the day.



The injuries in these two cases are of the most common pattern seen in war-- extremity trauma. And as I present the cases, I want you to consider which was done at our level one military trauma center shown here in San Antonio-- and which was done at the level three surgical hospital in Afghanistan. With the first case, I was asked by colleagues if I'd assist in reimplementation of this left upper extremity following a traumatic amputation one hour prior. Because this was an isolated injury-- and a fairly clean amputation-- we proceeded to place temporary vascular shunts in the arteries and veins-- and of the extremity-- to restore flow into and out of the arm.

Military orthopedic colleagues aligned the bones of the reimplementation using fixator devices. And shown here is the arm reattached with two remaining loop shunts in the veins of the arm. And one can see in the middle-- one can see in the middle-- the shunt has been removed and the brachial artery has been repaired. During the operation, military surgeons were assisted by military technicians and military nurses and military anesthesiologists-- used damage control resuscitations-- damage control resuscitation in close coordination with military blood bankers. Although tenuous, the operation was successful and attention turned towards management of the complex soft tissue wound. And once the external fixture devices were removed, and the wound healed, the patient underwent physical therapy and occupational therapy offered by military physicians and military therapists. The photo shows the patient 12 months following the injury with a viable and increasingly functional left arm.

In the second case, I was asked by colleagues if I'd assist in repair of this nearly amputated right upper extremity injured one hour prior. Because this was an isolated injury-- and the median nerve was visualized intact-- we proceeded with attempts at limb salvage. In this case, military orthopedic colleagues aligned the bones using fixer devices-- and shown here is the initial and temporary vascular repair performed with gore-tex alongside the intact median nerve. A military plastic and reconstructive surgeon-- a USCIS graduate, by the way-- performed a latissimus dorsi flap several days after the wound had been cleaned up to allow coverage of the vascular repair and soft tissue wound. You can see here that we've taken the gore-tex out and put in a vein in her position graft.

During the operation, military surgeons were assisted by military technicians and nurses-- and military anesthesiologists used damage control resuscitation techniques in close coordination with military blood bankers. The vascular repairing flap was successful-- as shown here-- and the patient had successful early management of the complex soft tissue wound-- with closure of all of his wounds. Because this was a fairly recent case, I don't have follow up image of the patient currently in rehab. The question is, which patient was it? A civilian level one trauma center in San Antonio? And which one was the wounded troop in Afghanistan? You really can't tell the difference. It's hard to overstate the parallels between these types of cases and the value of seeing major civilian trauma at a select number of our military medical centers-- its real readiness-- and it involves military surgeons, ICU physicians, anesthesiologists, technicians, blood bankers, and even military residents, and military medical students. I'd argue it's exactly what Will and Charlie Mayo argued for nearly 100 years ago.

We've already spent considerable time with the third capability. I feel it's imperative to protect and expand as we move to the next decade. The joint trauma system mission should maintain and expand the DOD trauma registry to capture data and provide information on care and outcomes of military trauma patients. The system should expand its research strategy that supports reduction of morbidity and mortality following war time injury. It should provide those injured in harm's way the best possible chance of meaningful survival.

The JTS should maintain and expand the trauma outcome's database to analyze and evaluate decision making and major outcomes from proving different treatment modalities. It should continue to provide the DOD, and other authorized interests, with timely, relevant information about care and outcomes of military and civilian injuries. And, finally, the JTS should continue to provide activities of each of the services with full data resident to the trauma registry. In essence, the JTS should continue to grow in its capacity to be the go to entity for all services when it comes to planning, projecting, and evaluating care of military service personnel in harm's way.

The fourth capability to protect and expand is combat casualty care research. This capability has been intertwined with nearly all aspects of this lecture. As summarized in the recent article in Science, combat casualty care research has resulted in significant advances in critical care air transport, combat, medicine training, tourniquets, soft tissue injury in response to mass casualty events. The article continues noting that the joint combat casualty care research has made strides in damage control resuscitation, compartment syndrome, pre-hospital lifesaving interventions, vascular injury, and traumatic brain injury. The manuscript-- and others like it-- underscore the unique responsibility-- obligation, frankly-- of the military to place-- together basic scientists and clinicians-- a model that I learned well here, frankly, a number of years ago-- to advance research and development of these unique injury patterns.

To conclude, military surgeons must-- military surgeons have a centuries old heritage from which to draw as we contemplate care for those injured in harm's way today and in the future. The knowledge gained from made over 10 years of war in Afghanistan and Iraq have transformed care of the injured worldwide. To maintain our nation's ability-- capability to be a leader in-- and as a translational pathway for-- global care of the injured will require forethought and protection of our nation's military medical Academy, level one trauma capability at military medical centers, the joint trauma system, and combat casualty care research.

Thank you, again, Dr. Bower and Dr. Duchamp and others-- for the privilege of presenting this perspective to the chief residents. And I'd be glad to take any questions. Thank you. Yes, sir?

**AUDIENCE:** I thought that was that. Can you comment, briefly-- I know this is going to be a broad question-- what impact has weapon type capability of tissue destruction had, and what you all are doing [INAUDIBLE]?

**TODD E. RASMUSSEN:** So the question was the impact of weaponry-- and weapon type-- and I think Don could speak to this as well as anyone, I think, and many in the room may be aware-- but we really lived through this, I believe, in Iraq-- the early phases of the insurgency in Iraq with the IUDs and our need to change force health protection measures, including body armor-- up armored Humvees. And now, in Afghanistan, force health protection measures, such as development of MRAPs or mine resistant vehicles-- to protect-- again, force health-- or force protection measures. And, so, it starts with that. I think we have to protect those in the front lines from the injuries as best we can with those sorts of innovations.

From a surgical standpoint, I think the odyssey of damage control surgery that Bill Schwab described at the AAST is born out to be just tremendously important. And I think it's the weaponry and the severity of injuries that has really allowed us to fall back on what Dr. Schwab and others-- Rotondo and others have developed as damage control surgery. Not persisting for long operations-- we call it now abbreviated operating. And I really think, whether it's the extremities or torso, bowel injuries-- vascular injuries-- we've learned ways to not persist for the perfect definitive operation-- but for abbreviated operating to maintain a live patient, if you will.

And I think all of that's been really put on fast forward because of the severity of injuries. And, frankly, we're fortunate to have had the lessons in damage control surgery from Dr. Rotondo-- and then the group at UPenn and others prior to the war. So-- any others? Yes? Yeah, absolutely.

**AUDIENCE:** [INTERPOSING VOICES]

**TODD E. RASMUSSEN:** Well, we have comments and data that we're generating now. I think-- 10 years-- I think the focus of the Institute of Surgical Research, now, I think, is going to change from-- at least to a degree-- from damage control resuscitation and outcomes assessment. And we have-- in our patients with extremity vascular injury, for example-- we have a cohort of 200 patients with 60 month follow up-- this is unpublished data-- but in the follow up, we have SF36 scores and SMFA-- skeletal muscle functional assessment scores-- of these injured troops 50 months after injury.

And we're able to, now, look at the-- at least using SF36 and other survey techniques-- try to characterize their state of mind-- their quality of life. Now, I will say, that at least as the first look when this data-- or this cohort-- of 200 patients with an injury severity score of over 20-- mean injury severity score over 20-- they have an SF30 score mental of almost 50, which is almost the national average. So five years after the injury-- it speaks to the robustness, I believe, of the troop. And then the support that our country has afforded them after their injury-- meaning, you know, these are guys that had an injury so severe, they had an ISS of over 20-- five years ago-- and SF36 mental score is almost the national mean, you know, of civilians.

So, I mean, the toll is-- there's certainly-- there are very dramatic anecdotes in cases of three or four limb amputees and severe burns that one wonders what quality of life you're preserving. But, I think, we, as military surgeons-- and I believe everybody in the room can appreciate this-- it's really not our decision. And we don't define that quality of life that they will have. We try to provide them the opportunity with their family to define that later. But it is-- it's very difficult-- that's true.

So, Don, did you have any comments?

**THOMAS C. BOWER:** I was going to tell folks that your real expertise is going to be the talk that you give tomorrow. This is sort of, like, the hobby part of what you do in your current job-- is to talk about the trauma system of things. Tomorrow morning at 7:00 in the Alfred Maine 459-- Todd will be giving a talk on vascular injury. That's where the bulk of his 50 publications comes from-- has taken what Norm Rich started with the National Registry-- and expanded on that like you can't believe. He's been helping us figure out how to take care of our vascularly injured patients through a series of case studies we've been putting them through here today-- and some patient management discussion. So I'd like to thank Debbie and the rest of Todd's family for allowing him to do this work-- and to be able to come here and present this for us today.

And we do have a little token of appreciation around here somewhere-- I was told-- yes-- yes we do. So, on behalf of the Division of Vascular Surgery-- and trauma and TCGS-- I'd like to give you a couple of mementos of your visit here for the Chief Resident Lecture. And I'm sure there will be people that want to come ask you questions when we're all done.

**TODD E. RASMUSSEN:** OK.

**THOMAS C.** Thanks.

**BOWER:**