
# Taking Lung Transplant Physiology and Leg Prosthesis Research to Denali

*Vulneror non Vincor*

**June – July 2011**

**An Expedition Report Prepared for**

**The University of South Florida School of Physical Therapy & Rehabilitation Sciences, the Veterans' Healthcare Administration and The Explorers Club**

**EXPLORERS CLUB FLAG #61**

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*www.scubanautsintl.org*

## Acknowledgements

The Combat Wounded Veteran Mountaineering Challenge team, Denali 2011, is especially grateful to Mrs. Carol Martin for her continued support, love and generous sponsorship of our combat wounded servicemen, particularly those returning from Afghanistan and Iraq and currently rehabilitating from amputations and other injuries; Steve Springer, Nurse Care Manager, Amputee Ward, Walter Reed Hospital; John Leonard, National Park Service Denali National Park and Preserve Lead Mountaineering Ranger at Denali and his entire rescue team at 14,200' camp; CMSgt Dave Shuman, Alaska Air National Guard, 212th Rescue Squadron, Elmendorf, Alaska, for the professional support of his PJs: SSgt Bill Cenna, TSgt Jeremy Maddamma, and TSgt Kris Abel; Colby Coombs and Caitlyn Palmer and their entire staff at the Alaska Mountaineering School (AMS), Talkeetna, Alaska, for allowing us into their home, their generosity and dedicated support of our program; Dr. Peter Hackett; Dr. Ed Coleman; the family community of Talkeetna, Alaska; The Explorers Club; Lt Col Reid Carlock, USMC (Ret) and the School of Physical Therapy & Rehabilitation Sciences, College of Medicine, University of South Florida, Tampa, for their guidance relating to prosthetic function and componentry; Tim Laird of Innovative Medical Devices, Inc; Leon Watts of Adventures Unlimited; CAPT Bob Silah, Operation Helping Hands; Andrea Trendy, Clearwater Best Buy manager; Bob Williams; Peter Wellings; Gus Salvat and our AMS mountaineering guides, Tim Hewette, Matt Montavon, Alex Stroud and Noah Ronczkowski for their professionalism and inspiration to help us meet our objective. Most of all, our thanks go out to each of our spouses and family members for their support of all of our combat wounded and military veterans, especially Teresa, Gannie, Melaney, Suzanne, Cheri, Ana and Lynne. We'd also like to thank Ben (CEO) and Laurie Hayes, John and Sonya Liston of SCUBAnauts International for their sponsorship, support and patience.

Expedition Team at the 14,200' Camp. L to R: Tim Hewette, Noah Ronczkowski, SOC SEAL Jon Cummings, SSGT Kris Abel, COL Randy Rosin, CAPT Dave Olson, Evan Olson, LCDR Gerard Coleman, Matt Montavon, Alex Stroud (Missing: LT Justin Legg, AOCM Will Wilson, SSGT Vic Thibeault)

## Summary

On June 24, 2011, lung transplant physiology and prosthetic function and componentry was tested at high altitude for the first time as a group of U.S. Combat Wounded Veterans embarked on a summit attempt of the highest peak in North America, Alaska's Mt. McKinley, also known as Denali. The eight-man team, including one lower leg amputee, was determined to demonstrate to other combat wounded veterans facing seemingly insurmountable challenges and obstacles, that anything can be overcome. *Vulneror non Vincor*, "I am wounded-not conquered", was the expedition inspirational motto that carried the team and The Explorers Club expedition flag #61 to their summit.

Among the military climbers was LT Justin Legg, a combat-seasoned U.S. Navy SEAL Platoon Commander who, in July 2010, underwent a double lung transplant for complications related to

treatment of leukemia. Since his transplant, LT Legg had been rehabilitating to take on new physical challenges as he prepares to be medically retired from the Navy. His unique challenge had been to prepare his new set of lungs for the strenuous climb and rarified air of Denali, only 11 months after surgery.

Physiological data collected on LT Legg and several control climbers included: heart rate, arterial and venous oxygen saturation, lung spirometry, severity of dyspnea (analogic score), symptoms and signs of acute mountain sickness and environmental parameters including elevation, barometric pressure, temperature and humidity. The findings will add to the very limited scientific literature examining the response of transplanted lungs to intense physiologic stress.

The team also tested and collected data associated with mechanical and non-mechanical qualities of their lower-leg BTN prosthesis to assist clinical providers to further improve performance and functionality.

Prior to undertaking this expedition, the eight-man team completed rigorous mountaineering training on the Pica Glacier in the Alaska Range in June – July, 2010 and 2011. Their training included roped team movement on glaciers, winter camping, self-arresting, avalanche and crevasse rescues and other key skills necessary for successful high-altitude mountaineering on Denali. The team members not only learned how to adapt to the limitations caused by their injuries, but also to deal with normal obstacles caused by Denali's severe weather, latitude, elevation and challenging terrain.

The Denali expedition team members consisted of four military combat wounded veterans, three Alaska Air National Guard Pararescuemen (PJs) from the 212$^{th}$ Rescue Squadron, three military veterans and one high school student and Eagle Scout for support. Four very experienced mountaineering guides from AMS guided the team. The PJs provided medical and logistical support for the team and recorded valuable medical research to capture the effects of high altitude and exertion on the double-lung transplant recipient and amputee.

# About the Mountain

Mt. McKinley is the highest peak in North America at 20,320 feet (6,194 m) above sea level. It is a huge snowy mass, flanked by five giant glaciers and countless icefalls. It dominates the horizon from as far south as Cook Inlet, 200 miles away, and as far north as Fairbanks, 150 miles away. Its steep unbroken south slope rises 17,000 feet in twelve miles. Mt. McKinley has a larger bulk and rise than Mt. Everest, although the summit of Everest is higher at 29,029 feet. Everest's base sits on the Tibetan Plateau at about 17,000 feet, giving it a real vertical rise of little more than 12,000 feet. The base of Mt. McKinley is roughly at 2,000' elevation, giving it an actual rise of 18,000 feet. Five major ridges extend from the summit, and many spurs and buttresses extend from these. The mountain is increasingly known by its native name, Denali, which means The Great One in the Alaskan Native American Athabascan language. The weather on Denali is more severe than anywhere else in the world, and many lives have been lost attempting the ascent. By 2001, the mountain had claimed the lives of 112 mountaineers since 1932. During the climbing season of 2011 alone, it has been reported that the mountain claimed the lives of 10 climbers. The numbers of attempts to the summit have increased dramatically in recent years, and a greater percentage of these are ending in failure. – *National Park Service*


West Buttress Route from Camp to Summit – *National Park Service*

# Participants

The expedition was led by Captain David Olson and guided by AMS mountaineering guides, Tim Hewette, Alex Stroud, Matt Montavon and Noah Ronzcowski. Dave was responsible for assembling the team, planning, financing, and contracting Alaska Mountaineering School to guide the team.

The military participants who comprised this particular climbing team were not only selected for the specific injury they sustained in combat or during military service, but also for their intense desire and commitment to improve upon the functionality of their condition, ultimately inspiring other wounded veterans to do the same.

One important change was the role of Gerard Coleman. His role and responsibilities were greatly increased when his brother, Dr. Ed Coleman, a Cardio Thoracic surgeon, fell ill just two days prior to their departure for refresher training on the Pica glacier with Team PICA. Rather than risk the health of the other climbers, Doc Ed regrettably flew back to his home in Green Bay, Wisconsin. Prior to his departure, he ensured that Gerard had a full grasp of the utility and operation of the medical instruments intended for use on LT Legg during their ascent. Doc Ed continued to advise throughout the expedition and authored the final medical report herein.

The combat wounded & military expedition team, excluding guides, consisted of the following persons:

| NAME | INJURY/FUNCTION | PROFESSION |
|---|---|---|
| David Olson | Head of expedition | Military (CAPT, Navy retired) |
| Gerard Coleman | Deputy head of expedition | Military (LCDR, Navy retired) |
| Will Wilson | Amputee (BTN) & evaluator | Military (AOCM, Navy retired) |
| Justin Legg | Double-Lung transplant recipient & evaluator | Military (LT, SEAL, Navy, active duty) |
| Vic “Yeti” Thibeault | Partial hand and multiple finger amputee & evaluator | Military (SSgt, Army, retired) |
| Tyler Hall | Amputee (BTN) & evaluator | Military (SSgt, Army, retired) |
| Jon “JC” Cummings | Multiple leg and spinal injuries & medic | Military (SOC SEAL, Navy, active duty) |
| Randy Rosin | Mountaineer & expedition videographer | Military (COL, Army, active duty) |
| Ed Coleman, MD | Mountaineer & expedition doctor | Cardio Thoracic Surgeon |
| Evan Olson | Mountaineer & support | High School Student |
| Kris Abel | Pararescueman (PJ) Medic & Evaluator | Military (TSgt, USAF) |
| Bill Cenna | Pararescueman (PJ) Medic & Evaluator for amputees | Military (SSgt, USAF) |

| | | |
|---|---|---|
| Jeremy Maddamma | Pararescueman (PJ) | Military (TSgt, USAF) 212th REQ |

## Objectives

Our objectives were aimed at demonstrating to other combat wounded veterans, particularly those returning from the battlefields of Iraq and Afghanistan, that despite their injuries, they can overcome seemingly insurmountable challenges and obstacles and improve their prospects to return to active duty with expanded opportunities. The study was focused on two major injuries and the limitations that lie within them at elevation: (1) double-lung transplant response to high-altitude mountaineering and, (2) below the knee amputation, specifically:

(1) Further the understanding and impact(s) of maximal exertion resulting from high intensity mountaineering at high altitude on a post double-lung transplant recipient within one year of the double-lung transplant. Never before has a double-lung transplant recipient attempted to reach these elevations.

(2) Test the mechanical and non-mechanical durability and effectiveness of selective lower limb prostheses and concomitant interfaces during high levels of performance and functionality demands, particularly while conducting extended ascent and descent in adverse weather conditions.

(3) Identify and record data associated with the above to further the development and improvement of prosthetics along three themes: (1) the fit of the socket with the residual limb, (2) the mechanical functions of the prosthesis and its components, (3) other qualities, e.g., bulk, weight, extreme cold weather functioning, etc., as recommended by the School of Physical Therapy & Rehabilitation Sciences, College of Medicine, University of South Florida.

(4) Dramatically improve the quality of life and potentially expand the prospects for amputee service members who seek to return to full military active duty with expanded vocational options. This includes potential for return to combat at high altitude terrain, i.e., the elevated regions of Afghanistan (12,000 feet).

## Findings

TAB A: ***Double-Lung Transplant Physiology at High Altitudes***, Dr. Ed Coleman, MD

TAB B: ***Step Activity and Prosthetic Related Issues of a Combat Injured Transtibial Amputee During an Arctic Mountaineering Expedition: A Case Report***, M. Jason Highsmith, PT, DPT,

CP, FAAOP; Jason T. Kahle, CPO, FAAOP; William S. Quillen, DPT, PhD, FACSM; Larry J. Mengelkoch, PT, PhD

# Equipment

AMS provided the bulk of the mountaineering gear, rope, sleds, food and expedition equipment. Each climber was responsible for carrying their own personal equipment, food and shared the load carry for cooking fuel, tents, shovels, Clean Mountain Cans (CMCs) and other miscellaneous gear. Leon Watts at Adventure Unlimited, in Tampa, was exceptionally helpful in outfitting the team with thermal undergarments and other gear.

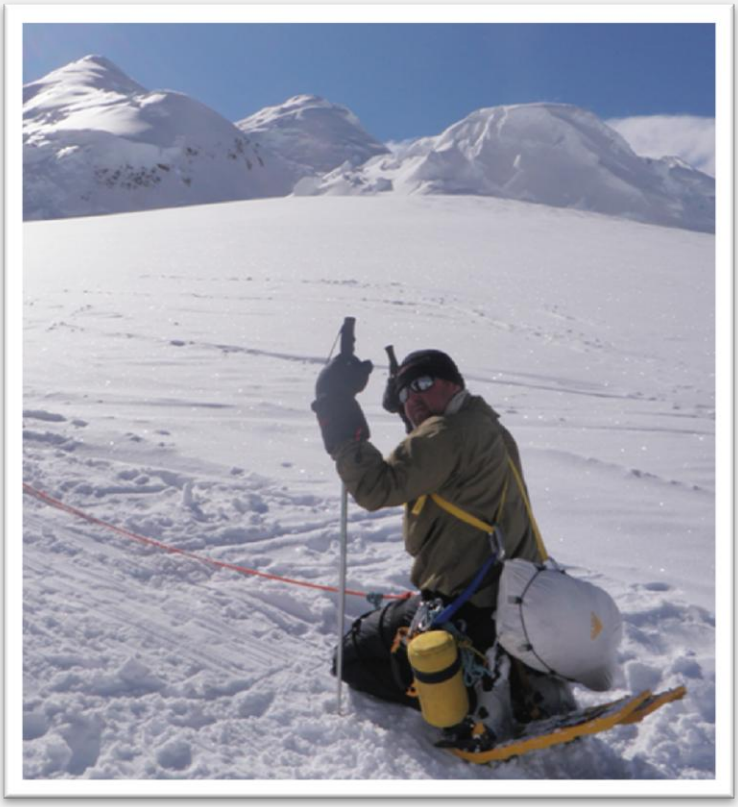
Medical gear for the collection of data relating to LT Legg's lung transplant and AOCM Wilson's prosthetic consisted of a Nonin Equanox Model 8000CA % $rSO_2$ for venous cerebral oxygen saturation; a Nonin Onyx % $SpO_2$ for arterial oxygen saturation and heart rate; a Kestral 4000 Pocket Weather Tracker for environmental conditions; and a pedometer.

# General

We chose the time of year for the expedition, unfortunately, when the lower glacier surface was at an abnormally high melt making access to the West Buttress exceedingly difficult, potentially dangerous and time consuming, particularly for our amputee service members.

In addition to climbing support, The Alaska Air National Guard- Pararescue 212th Rescue Squadron provided three (PJs) to assist and provide medical support to the Combat Wounded Veterans. TSgt Kris Abel was the PJ team lead and primary medical observer and data recorder of LT Justin Legg. During the beginning legs of the expedition, the PJ rope team was strategically placed as the fourth and last rope team. Lead mountaineering guide Tim Hewette placed LT Legg on the end of the third rope nearest to the PJ rope team. From that position, TSgt Abel, who was lead climber on the PJ rope team, could closely monitor Justin's condition from behind and assist him quickly, if need be.

Kris walked directly behind Justin a few times, most notably on the day that the team pushed from 9,200' to the 11,500' camp. This was about a 12 hour day, taxing for everyone. The pace that Justin could endure for that length of time on that difficult incline and elevation was, understandably, slow. Justin's maximal exertion was achieved at least four or five times that particular day, at which point he would go to his knees, head down, and gasp for breath. During those events, Kris would have the pulse oximeter on his finger within between 10 seconds and a few minutes, depending on how far behind the PJ's were. Justin's readings followed a pretty consistent pattern; he would be saturating in the low-70s initially, but recover relatively quickly to the high 80s, which were his baseline levels for that altitude, i.e., between 30 seconds and one



LT Legg's maximal exertion was reached about 4 or 5 times as the team pushed to the 11,500' camp

minute of deep breathing. It was notewothy that Justin's $O_2$ saturation, once recovered, was better than TSgt Abel's. The pulse reading on the instrument was unreliable based on our digital readings of his radial pulse, but that, too, tended to recover unusually quickly. TSgt Abel's impression of Justin was that his muscular fitness was the primary limiting factor, not his cardiovascular system. He felt that his lungs performed exceedingly well.

L T Legg never complained of any AMS symptoms. He was taking Diamox nightly. The increased respiratory rate generated by the Diamox may have assisted his acclimatization, allowing his lungs to take him to higher elevation than he would have gone otherwise, giving him a higher resting O2 saturation than a healthy person. Also, we believe that his innate mental/physical toughness may also have allowed him to get more out of his lungs than that of an ordinary person. Justin most certainly exceeded all of our expectations. In short, we conclude that double lung transplantation does not necessarily preclude altitude acclimatization. See Tab A for details of Justin's performance.

Pararescueman SSgt Bill Cenna was the primary medic and data recorder for BTN (Below the Knee) amputee, AOCM (Master Chief) Will Wilson. Will's residual limb, according to all observations as well as his personal comments, was healthy and relatively pain free. His prosthetic limb performed well. His only complaint was during descent where we noticed a deficiency in coordination. The plunge step was particularly difficult for him due to his concern for his knee. Will also indicated that there was not enough ankle flex when going uphill on the snowshoes and that he was limited to front-pointing with his crampons. This led him to rely solely on his quadriceps muscles which led to overexertion and an extreme level of fatigue during the move to 14,200 camp. He was never able to perform a proper rest-step, so he was never able to conserve energy or manage his heat levels very well. This may have ultimately led to, or contributed to, Will's subsequent chest pain leading to his medical evacuation off the mountain.

# Expedition Log

## Refresher Training
## 14 – 21 June

Five of the eight members ("Team PICA") of the Combat Wounded Veteran Denali Challenge Team took part in an initial 6-day mountaineering "Pre-Denali" refresher training course (16 – 21 June) on the Pica Glacier just prior to the main expedition (24 June – 05 July). A primary objective of the refresher training was to test the functionality of the testing equipment to be used on LT Legg (double-lung transplant recipient) and AOCM Will Wilson (BTN amputee) during the main Denali expedition.

"Team PICA" consisted of**:** LCDR Gerard Coleman, LT Justin Legg, Dr. Ed Coleman, SSgt Vic Thibeault and SSgt Tyler Hall. Two days prior to departure for the glacier, however, Dr. Ed Coleman fell ill and elected to return home so as not to risk the health of the other climbers for the Denali expedition. His brother, Gerard Coleman, then assumed the responsibility of testing the equipment and collecting the necessary medical data on LT Legg. SSgt Tyler Hall, a lower leg amputee and alternate for the Denali expedition, also required this initial training prior to the Denali expedition.

From Left to Right: Guide Rob Fowler, Guide Christian Marche, Guide Matt Montavon, SSgt Vic "Yeti" Thibeault, Dr. Peter Hackett (standing), LCDR Gerard Coleman, LT Justin Legg, AMS owner Colby Coombs, Guide Justin Dickens and SSgt Tyler Hall

**Date:** 14 June 2011
**Location:** Talkeetna, Alaska

Team PICA departed their respective home stations and arrived at Anchorage, Alaska, where AMS arranged for a taxi to drive them from the airport to the eccentric village of Talkeetna. Despite having arrived in Talkeetna well after midnight, it was still daylight with a beautiful rose-colored horizon that took some getting used to for those of us who live in the lower lattitudes.

The historic village of Talkeetna is the main staging area for annual climbers awaiting their Mt. McKinley ascents. The village name is derived from an Athabascan phrase loosely meaning "where the rivers converge" or "river of plenty" as it is the site where three rivers merge at the end of Main Street - the Susitna, Chulitna and Talkeetna. Talkeetna was established in 1919, four years after President Woodrow Wilson selected this area to be the construction headquarters for the Alaska Railroad. Log structures and original log cabins add to the simple character of the small village and it is not uncommon to sight a moose walking along the roadside. In fact, locals claim that the village is the inspiration behind the television series "Northern Exposure". Today, it remains a very small community of less than 500 (summer population) and has the best panoramic view of the Alaska Range and of "the Mountain" (Denali).

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**Date:** 15 June 2011
**Location:** Talkeetna, Alaska

There was a lot to accomplish today. Since tomorrow is our 'fly-off' day to the glacier, we had to complete numerous tasks, including gear fit, issue and purchase, gear pack, medical instrument review and orientation with Doc Ed as well as mountaineering refresher training at Alaska Mountaineering School (AMS). Unfortunately for all of us, Doc Ed was not feeling well and was very concerned that he might be coming down with a bad cold or flu. Consequently, he

AMS mountaineering guide, Matt Montavon, assists "Yeti" with his gear pack just prior to departing for the glacier

transferred the responsibility for collecting the data for lung transplant physiology to his brother, Gerard, and decided to rest at one of the local bed and breakfast inns in an attempt to regain his strength and join the party on the glacier in the next few days.

Team PICA prior to departure to the Pica glacier for their 6-day refresher
From Left to Right: LT Justin Legg, SSgt Tyler Hall, SSgt Vic "Yeti" Thibeault, guide Matt Montavon, LCDR Gerard Coleman, guides Justin Dickens and Christian Marche

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**Date:** 16 June 2011
**Location:** Base Camp, Pica Glacier

Today was the long-awaited departure day for our 6-day refresher training on the Pica. In keeping with our tradition, the team met at the Roadhouse Inn for breakfast. Breakfast consisted of our usual, "The Standard", so it took us awhile to return to AMS for additional crevasse rescue training. We were all a little heavier on the ropes, too!

Before the start of each expedition, all climbers must meet at the Talkeetna National Park Service Ranger Station, home of Denali's mountaineering rangers, for permitting, a mandatory safety briefing, and issue of Clean Mountain Cans (CMCs). When we entered the Ranger

Station, we were overwhelmed by the site of impressive artifacts and historical records of previous climbs, particularly with the numerous international team expedition flags that hung along the walls of the main sitting room and river rock fireplace. We hoped that, at the end of our main expedition in July, we, too, would be granted the privilege of attaching our expedition flag next to theirs.

Our safety brief was conducted by one of the mountaineering rangers. It covered the present and forecasted conditions of the glacier, the condition of our equipment and supplies, a review of safety and high altitude medical information as well as some level-headed advice. After the briefing, we were each issued our CMCs. The CMC is a rugged plastic can, about the size of a No. 10 can, and is required to be used throughout the glacial preserve to deposit our human waste for transport and eventual disposal. With CMC in hand, we made the short walk back to AMS for the final gear check, weight recording and loading onto the van for transport across the street to the Talkeetna airport where the 1950's era De Havilland Otter awaited to fly us to the glacier.

It was late afternoon when the Talkeetna Air Taxi Otter took off under clear Alaska skies and flew the team to the Pica glacier, located approximately 45 minutes away in Denali National Park. The flight and views were nothing short of spectacular, particularly the glacier landing with the snow-ski pontoons. Immediately after the landing, we off-loaded the mountaineering gear from the Otter, secured the gear on our snow sleds and hauled them approximately 300 yards uphill to the site already selected for base camp. This was the first opportunity for LT Justin Legg to test his new lungs. Justin reported that, although the elevation was only 5,500', he was definitely already winded. Prior to setting in for the night, we received refresher training on how to prepare and build tent sites, kitchens, reviewed knots (girth hitch, water knot, prusik and Flemish bends), ascender rigs (ascender above prusik), stove operations and maintenance.

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**Date:** 17 June 2011
**Location:** Base Camp, Pica Glacier

Vic "Yeti" Thibeault journal entry:

> *I woke up to Gerard cooking, a motivated man he is. I am privileged to have met such a brilliant character. Gerard is always in a motivated and productive mood. It was a beautiful and clear morning with the sun blazing. (Sun) Glasses are a necessity. The view of the glacier was majestic, to say the least. The air was crisp and the silence of the surrounding environment serene. It is truly a sight to behold; pictures will never do it justice. Our first class of the day was in ropes and knots and how to travel on a rope as a team. We hung out in camp and had several classes on different anchor systems and decided to do some rope travel. We broke down camp and simulated a camp move. We*

*descended the glacier about 1.5 miles and returned to our initial location. Tyler (SSgt Hall) stayed in camp for this particular movement, his (amputation) leg clotting again, the discomfort of the snowshoes and glacier travel impacting his decision. He seemed incredibly tired and I assumed it was related to his traumatic brain injury (TBI). Justin performed exceptionally well considering this combination of medical conditions. We did move at a "Denali Pace" which is considerably slow and painful. We reestablished camp and prepared for rest.*

Gerard Coleman journal entry:

*Full day of training and reviewing mountaineering basics, including roping-up for travel, knots/hitches, gear sling maintenance, chest and waist harnesses for glacier travel, i.e., seven points to include harness double-backed, rope on right and prusik(s) on left with locking "biners" screwed DOWN, ropes through chest harness [remove chest harness while 'prusiking' in], pack leash and mountain axe leash to rope knot, and ascender to two hard points.*

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**Date:** 18 June 2011
**Location:** Base Camp, Pica Glacier

Gerard Coleman Log entry:

*Conducted glacier travel to a col with absolutely beautiful views of the Pica landscape; practiced self-arrest; toughest is head first! Whatever position, do not cross head or body. Tyler had the misfortune of having his prosthetic leg come off while practicing our self-arrest! He got it back on in good form and plenty of smiles for all! I think Yeti particularly enjoyed the exercises; he routinely preferred not arresting, but sliding on his butt all the way to the bottom! Good tips: brush teeth in tent and spit into pee bottle; put one set of sleeper/camp socks in bag, sleep with hiking socks across chest to dry out, sleep with boot liners beneath knees. Practiced running pro with magic loops.*

Since the possibility of falling into a crevasse, particularly on the lower glacier at this time of year, was great and expected to occur during our main Denali expedition, the majority of our training was to rehearse the rescue process. Crevasses can reportedly extend downward to over 150' and are often disguised by snow bridges that give way to the weight of a climber. Many climbers sustain serious injury when they fall into a crevasse, sometimes becoming jammed head down or twisted sideways with their backpacks, and many succumb to hypothermia while awaiting rescue. Self or team rescue is always a dangerous, time-consuming and exhaustive process, particularly since our team consisted of amputees and a double-lung transplant recipient.

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**Date:** 19 June 2011
**Location:** Base Camp, Pica Glacier

The team broke camp on the col, loaded all the sleds and packs and traveled down glacier. The distance to base camp was approximately 2-miles but especially challenging for LT Legg as he was forced to stop 4-5 times on the way back up-hill. LT Legg commented that the experience was awesome for "shaking out the lungs".

Gerard Coleman journal entry:

> *Training included sled haul rigging with locking carabiner from pack to sled and non-locker at top of sled and on rear prusik. Learned self-arrest, practiced self-arrest while sliding down hill in snow, learned rescue systems and up to 3-to-1 mechanical advantage systems, rigged for crevasse rescue (put biner in Flemish bend to facilitate untying) while using meunter-mule-overhand to transfer the load. Also used a quick "wiener biner" until the load was transferred. Useful knots included: water knot, prusik, meunter-mule-overhand, and double fisherman's or barrel knot. When sport climbing, be sure to clip "back to front." If not, fall from above could open the gate. When tying a Flemish bend (figure 8 follow-thru), go "hard-easy-easy." Made 'jobs list' to include; insulate eating/drinking containers, 2 pee bottles (or pour out back), 5 pairs of socks with liners, seam seal Spantiks, plastic baggies for camp booties, large garbage bag for backpack, foam insoles for overboots when using booties/overboots, and foam foot/seat pad.*

Regrettably, Doc Ed was not able to recover from his illness and decided to return home to Green Bay so as not to risk the health of the other climbers who were soon to arrive in just a few short days for the Denali expedition. Doc Ed, however, remained in a consult capacity throughout the events leading up to and during the expedition from Green Bay. This was very unfortunate as Doc Ed is an avid mountaineer and completed the pre-Denali glacier mountaineering course with the team the previous year in anticipation of this year's attempt.

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**Date:** 20 June 2011
**Location:** Base Camp, Pica Glacier

The team conducts crevasse rescues and rehearses life-saving procedures, as logged by Gerard:

> *Crevasse rescue: set one deadman and then set wiener 'biner on the rope; set second deadman for ERNST (equal, redundant, non-extending, secure and timely); set locking biner at the focal point and tie a clove hitch with climbing rope; set pulley; prusik to edge*

*and prep edge, check victim, secure edge tools with backup anchor; set biner on pulley/prusik and haul out. Consider ascender on steep terrain.*

*Practiced fixed rope work: convert the chest harness to a shorter loop (daisy loop) with biner at end and at length easy to reach at full extension and when looped back to waist harness does not extend below knee; right-to-left on harness: rope, prusik, daisy loop and ascender girth hitched; fixed rope on left and rope team rope on right; Daisy loop/biner on rope above ascender when both ascending and descending (pass one at a time when passing pro). Practiced pulley systems. Good knots included: water knot (overhand follow-thru on webbing used to make loop; prusik with three loop passes, meunter-mule-overhand to transfer the load:*
*double-fisherman's or barrel knots used to make prusik loop (remember to go under the "x")*

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**Date:** 21 June 2011
**Location:** Talkeetna, Alaska


The team broke base camp, packed all gear onto sleds and prepared for the return flight off of the Pica Glacier. We returned to Talkeetna late in the afternoon, promptly checked into the Swiss Alaska Inn for some hot showers and prepared to meet the remainder of the Denali expedition team. Since today was Summer Solstice Day, we decided to celebrate its arrival at the Fairview Inn.

Meanwhile, the remainder of the Denali expedition team, i.e., Dave Olson, Evan Olson, Will Wilson, JC Cummings and Randy Rosin, departed their respective home stations for Talkeetna. We were still celebrating at the Fairview Inn when the rest of the team arrived around 3 a.m.

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# The Expedition – Denali Challenge

## 22 June – 05 July

**Date:** 22 June
**Location:** Talkeetna, Alaska

The remainder of the Combat Wounded Veteran Mountaineering Denali Challenge Team arrived in Talkeetna approximately 0300 hrs today (Dave Olson, Evan Olson, Will Wilson, JC Cummings and Randy Rosin). Yeti, thankfully, had prearranged to have our rooms available for us at the Swiss Alaska Inn, so we promptly settled in for the night after our long travel.

Although it was a late night for some and an early morning for all of the team, most of our team assembled in the dining room of the Swiss Alaska Inn for breakfast and a rehearsal of the upcoming events. Dave Olson began the task of delegating responsibilities to each climber and distributed some of the gear that he brought with him from Tampa. Master Chief Will Wilson took on the primary responsibility for ensuring that all of the numerous administrative issues for the entire expedition were taken care of and developed a template for recording data relating to the functional performance of his prosthetic leg. Gerard Coleman and JC took on the daunting task of recording Justin Legg's lung performance and potential emergency medical support. Randy Rosin took on the videography duties, ensuring that the entire expedition was adequately documented by the Go Pro cameras donated by Tampa Operation Helping Hands. Evan Olson's primary responsibility was tasked by his mother. He was to complete his Florida Virtual online high school Algebra course *before* we departed for the mountain…or the *whole* expedition team could not go. During the course of the next couple of days, Evan could be seen dutifully completing his online Algebra course at the Swiss Alaska Inn attached to one of the few electrical outlets in the dining room. He took advantage of our own Nuclear Physicist, Gerard Coleman, PhD, to help him with the difficult problems so we could all get to the mountain on time!

Today's main event was for our team to host an evening BBQ at Colby and Caitlyn's home so that we could show our appreciation to them, the Alaska Air National Guard 212th REQ, the Denali NPS, and for all who have generously supported our expedition for wounded veterans. Colby and

JC points to Yeti, the master butcher, while Randy and Justin struggle to match his technique. From L to R: JC Cummings, Justin Legg, Yeti, Randy Rosin

Catilyn arranged for many of their closest mountaineering friends and the surrounding community family to attend. In between tossing the football in Colby and Caitlyn's back yard, and occasionally in Caitlyn's (former) prized flower garden (that was Yeti's fault), the team spent the afternoon butchering the meat and preparing the K-Bobs. Colby had also arranged for lively acoustic entertainment that capped a truly enjoyable evening. It was refreshing to meet so many wonderful people from the community of Talkeetna.

Alaska Air National Guard Pararescuemen (PJs) TSgt Kris Abel, SSgt Bill Cenna and TSgt Jeremy Maddamma also arrived from their base in Anchorage to join the expedition team. Their primary duties are to provide medical and logistical support to the wounded veterans during the climb.

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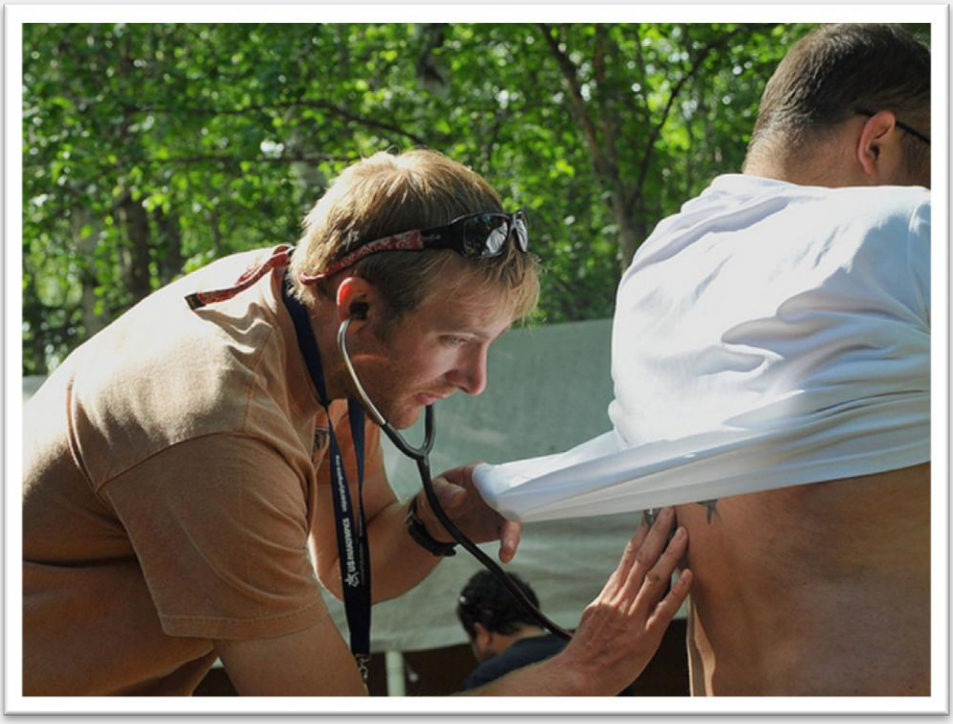


**Technical Sgt. Kris Abel, a pararescueman from the 212th Rescue Squadron, checks the lungs of double-lung transplant recipient Navy Lieutenant Justin Legg in preparation for a climb up Mount McKinley. Three members of the 212th Rescue Squadron supported a three-week, grassroots wounded-warrior project to take combat-injured veterans up Mount McKinley starting June 24.**

**Date:** 23 June
**Location:** Talkeetna, Alaska

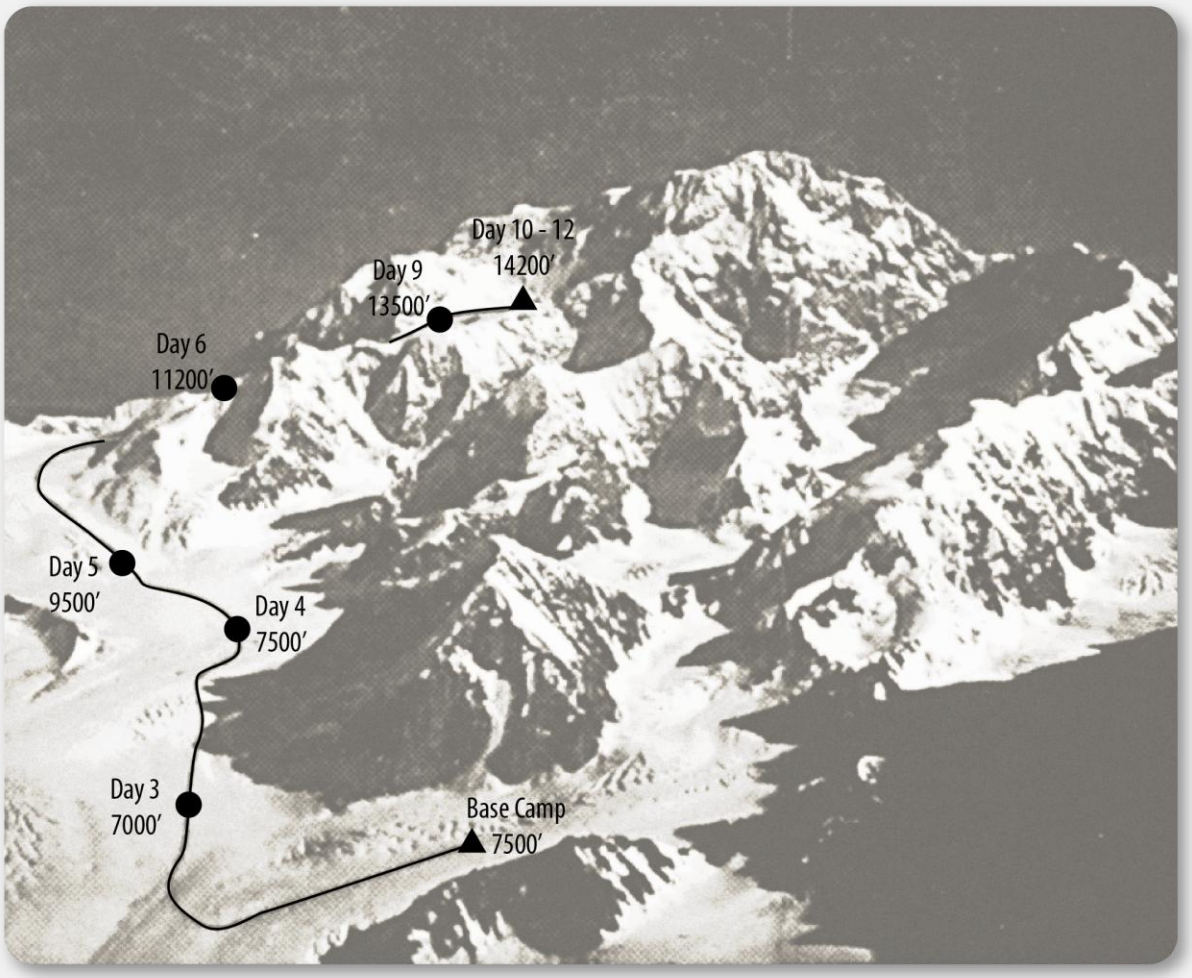
The team prepares their gear for the start of the expedition at AMS. Essential mountaineering gear is sized, purchased and/or leased for each participant. All gear destined for the backpack is inspected by the mountaineering guides after careful layout and evaluation as to the purpose and weight of each item. Of particular importance is the selection of cold weather clothing, i.e., layering options due to the extremes of temperature fluctuations expected on the mountain. Additionally, each climber was limited to personal food rations consisting of three separate gear bags of no more than 7 lbs each totaling 21 lbs. The food was to last each climber for three weeks (one bag for each week). AMS had more than enough nutritious food to select from.

Gerard Coleman finds an eager subject and volunteer, Vic "Yeti" Thibeault, to conduct practice field testing prior to the expedition to ensure that the gear will work properly for LT Legg's double-lung transplant data collection while PJs Kris Abel, Bill Cenna and Jeremy Maddamma look on

Will Wilson describes to the team the componentry and functionality of his prosthetic leg and the potential problems he may encounter during ascent and descent of Denali

In addition to our personal food rations, AMS packed additional main-course food items to cover breakfast and dinner meals for the entire team. Since each climber was expected to carry their own food as well as an equitable distribution of community food, it was extremely important to be weight conscious. Our backpacks averaged between 60-75 lbs. The gear that each were to haul on their sled was roughly the same weight.

In addition to gear and food preparation, the team once again rehearsed the testing protocols and data collection requirements of Master Chief Will Wilson and LT Justin Legg. Gerard Coleman instructed the pararescue medics how to use the medical testing equipment on LT Legg. The PJs devised a means to keep the equipment insulated from the extreme fluctuations in temperature and prolong the life of the batteries.




**Expedition Timeline**

**Date:** 24 June
**Day:** 1
**Location:** Talkeetna, Alaska – Kahiltna Glacier

The Combat Wounded Veteran Mountaineering team hosted the traditional send-off breakfast at the Roadhouse Inn for the AMS and NPS support team. This was the final morning to get our final checks in place before the flight to our initial base camp.


From Left to Right: SSgt Jeremy Maddamma, Lead Guide Tim Hewette, SSgt Bill Cenna, LT Justin Legg, TSgt Kris Abel, SSgt Vic "Yeti" Thibeault, Expedition Leader CAPT Dave Olson, Guide Alex Stroud, SOC SEAL Jon "JC" Cummings, COL Randy Rosin, SSgt Tyler Hall, LCDR Gerard Coleman, Guide Matt Montavon, Lead NPS Ranger John Leonard (in back), Guide Noah Ronczkowski, AOCM Will Wilson, Evan Olson

As Team PICA did on June 16 before their flight to the Pica glacier, we all attended the mandatory NPS briefing at the Ranger Station. We were privileged to have lead mountaineering ranger, Mr. John Leonard, conduct our briefing. During the 1-hour brief, John indicated that we can expect a number of 'little things' to occur that could get the best of us, if we let them, such as sunburn, condition of feet, etc. We were reminded to pay attention to the little things. John also

stressed that, at the time of this briefing, there had already been 7 deaths on the mountain this climbing season. At the conclusion of John's briefing, the NPS provided our CMCs (Clean Mountain Cans) followed by a send-off team picture with Mountaineering Ranger John Leonard.

After a spectacular flight from Talkeetna, we landed on a glacial landing strip adjacent to our initial base camp. It was a very warm 40-degrees as we off-loaded the De Havilland Otter at our destination airfield on the Kahiltna Glacier and proceeded to haul our packs and sleds to the initial base camp.

Denali peak with Lenticular cloud formation

Guides Matt and Noah started the stoves and began cooking in an open makeshift kitchen while the remainder of the team put up all five of our tents. We had a spectacular view of Mt. Foraker and Mt. Hunter as our backdrop. A massive lenticular cloud formation began to develop over Denali. Master Chief Wilson already required some assistance to tackle a 'hot spot' on his good ankle (his only ankle) and was cared for by the PJs. LT Legg recorded some good numbers for his lungs and was pleasantly surprised by them. COL Rosin prepared all the Go Pro cameras and solar chargers for the expedition days to follow. After a quick dinner of hamburgers, the team retired for the evening at 2315 hrs.

The team enjoys sliders in the makeshift kitchen before turning in for the evening

Baseline measurements for LT Legg were as follows: $MvO_2$- 51/54%, $SpO_2$- 94% and resting HR- 69. Justin indicated that he definitely noticed a greater Shortage of Breath (SOB) at 7,000' versus the SOB at 6,000' he experienced on the Pica.

**Expedition Team with The Explorers Club Flag #61**

**From Left to Right: Guide Alex Stroud, LT Justin Legg, AOCM Will Wilson, SSgt Vic "Yeti" Thibeault, SOC SEAL Jon "JC" Cummings, Evan Olson, SSgt Tyler Hall, CAPT David Olson (kneeling), Guide Matt Montavon, PJ TSgt Kris Abel, Tim Hewette (kneeling), Guide Noah Ronczkowski, PJ Jeremy Maddamma, COL Randy Rosin (kneeling), PJ SSgt Bill Cenna, LCDR Gerard Coleman (kneeling)**

**Date:** 25 June
**Day:** 2
**Location:** Base Camp, Kahiltna Glacier to 7,000'

A combination of freezing rain and snow continued to fall with low visibility and temperatures in the low to mid-30's as we departed our initial base camp. Numerous crevasses made travel slow and difficult

The team awakened at 0630 hrs and remained in tents due to heavy rain. It had rained throughout the night. The PJs and guides had decided that they would build two mid-tents for cooking and meals and to serve as an escape from the weather. Rain and snow continued throughout most of the day. After a breakfast of bagels, bacon and cheese, the team discussed rescue systems in the mid-tents with the guides and we then retired for the evening. We were scheduled to awaken at 2200 hrs to begin our trek up Denali, thus we started getting on a night schedule for overnight travel. Due to the melting conditions on the lower glacier and the numerous crevasses, it was far safer to move during the freezing periods of the early morning hours than risk travel during the peak warm periods in daylight.

We awoke at 2100 hrs to find that whiteout and rain weather conditions still prevailed. We were put on a temporary delay. Weather conditions improved within the next hour so we were then given the green light at 2230 hrs to break camp. We promptly stuffed our gear into our backpacks, broke down the tents, prepared our sleds, and collected the necessary pre-travel medical data on LT Legg and AOCM Will Wilson before we broke trail.

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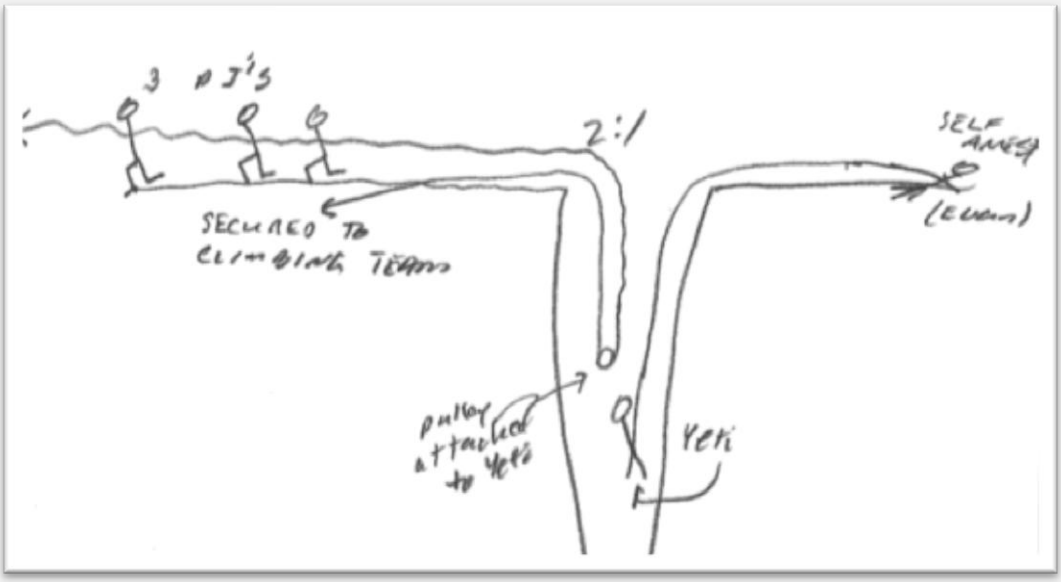
**Date:** 26 June
**Day:** 3
**Location:** Move, Base Camp to Kahiltna Glacier to 7,000'

Just prior to travel, the PJs collected the necessary data on LT Legg and AOCM Wilson. Justin's data after wakeup: $SpO_2$- 94%, HR- 78 bpm, $MvO_2$- 53/54%. Will was feeling well and his hot spot was taped over. We roped up (4 to a rope team) and departed camp at 0145 hrs. Lead mountaineering guide, Tim Hewette, led the first rope team ahead of the expedition so that he could break trail and probe for potential crevasses.

A combination of freezing rain and snow continued to fall and the temperature was in the low to mid 30s as we departed base camp. Trail and glacier conditions were soft ("terrible" as described by Hewette) with visibility deteriorating, but workable. Tim Hewette indicated that over the 10 years he has guided this portion of the route, he has never seen it in such horrible condition. There were numerous experiences of foot and leg punching with our snow shoes into crevasses. It was particularly difficult to pull our sleds as they continually fell or slid into the numerous crevasses that we crossed over. At approximately 0515 hrs, a crevasse claimed Yeti as its first victim when he fell through a snow bridge and disappeared from our sight. Visibility was already poor when we heard the call for "PJs up front" so it was difficult to ascertain the nature of the problem at first. Since the PJ's rope team was positioned last (of four rope teams), so that they would be near to assist LT Legg who was positioned last on the third rope team, we all carefully moved to our left so that the three PJs could quickly advance to the lip of the crevasse. The PJs eventually hauled Yeti out on a 2:1 system using the tail of their rope through a pulley and anchored to the rope team. Yeti came out of it cold and wet, but safe.

Gerard Coleman was on the next rope team directly behind Yeti and describes the rescue in his journal as follows:

> *Yeti's falling into the crevasse was dramatic for the team. When Yeti (280 lbs) fell in, Evan (150 lbs) was unexpectedly lurched backwards, landing on his back. Evan, however, was able to quickly wiggle around to his stomach such that his feet were dug in towards Yeti in the self-arrest position. The load on Evan was mitigated by Yeti's sled wedged in the crevasse lip. From the vantage point of the astern rope teams, Yeti just disappeared. Tim Hewette hollered, "Yeti's in a hole; PJs advance!" PJs Kris, Bill and Jeremy marched forward, probed the lip of the crevasse, informed Tim of the rescue plan, and then executed the 2:1 haul-out rescue. Vic came out in short order, but cold and wet; he had fallen about 10- 20 feet before Evan arrested him.*




Gerard Coleman's depiction of Yeti's crevasse rescue

Yeti describes his rescue in his journal entry:

The PJs rescue "Yeti" out of a crevasse while the Evan Olson conducts self-arrest, digs in his snowshoes and belays the rope

*I felt ecstatic walking down to the Kahiltna, especially after seeing old glory waving our expedition off. I punched through the snow several times when we got onto the main glacier. About four hours into the trip, I was sucked in head over heels into a monster crevasse. I fell 15-20ft, banged my face on the wall, spitting blood from a cut lip, and snow I seemed to inhale. My immediate thoughts were to stay calm; my teammates will pull me out of this hole. My arm was caught in my backpack and I was dangling by my right arm. I noticed my sled had been stuck in the snow at the edge of the lip. I was still holding my ski pole in my right hand when I decided to wiggle my hand free. The ski pole fell into the hole and I fell another couple feet. I looked down to see if I could see my ski pole, I couldn't, it was dark and*

*seemed endless. I hollered up to the team; "Get me the heck out of here!" I placed my ascender on the rope and tried ascending the line. It was extremely difficult because I only have a pinky that remains on my left hand. I also thought about my wife and kids and what would happen if I didn't make it out of here. Evan is credited with breaking my fall. Alex knocked some of the edge of the lip off; the snow bashed my head repeatedly and went down my shirt. He hollered down to me, "are you ok?" I said; "get me the f… out of here!" I was scared, wet and cold. I could feel the onset of mild hypothermia. I only had a tee shirt and wet weather top. PJs Jeremy, Chris, and Bill, were sent up to throw me a pulley, which I connected to my chest harness and they pulled me out of the hole. They immediately pulled my parka and mittens out to get me warm again when I got to the top. I was a little cold and shook up but I was content on still making the ascent up glacier. I thanked Evan for saving my life; the team too. With every step after the fall, my heart was pounding and I had an anxiety of falling again. I felt like every time my snowshoes sunk into the ground I was going to fall again. I fell in up to my waist a couple of times and Tim decided to find a safe zone to establish camp in. Some of us were taking crevasse falls neck high like JC and Justin. With safety in mind, and after nine hours of travel, we probed for a safe zone and made camp. Despite falling in holes, most of the team performed extremely well under these horrible conditions. I was scared to sleep unroped because of my earlier experience.*

**Snow bridges like this one provide the easiest means to traverse over a crevasse but can be inherently dangerous and risky. This snow bridge provided us a sturdy platform to cross but appears to be on the verge of collapse, potentially sending this crossing "PJ" falling to a depth of over 150' deep – photo by "PJ" TSgt Jeremy Maddamma**

After we safely made it to camp, Tim Hewette, indicated to the team that everyone worked together well. We decided to set up camp approximately 2.5 miles from our initial base camp at 0700 hrs. The guides conducted refresher training on camp set-up, kitchens, etc., before we settled into our tents for the evening. The PJs took the necessary medical data for Justin and Will before retiring.

**Date:** 27 June
**Day:** 4
**Location:** Move, Kahiltna Glacier 7,000' to 7,500'

Numerous crevasses like this one were prevalent on the lower glacier and difficult to traverse over necessitating travel only during the middle of the night and made movement slow and deliberate

We departed at 0200 hrs. It was slow going due to difficult glacier conditions combined with rain and snow. Shortly after we departed camp, we encountered a pair of down-climbing hikers who informed us that conditions up ahead looked really rough with open crevasses. We all looked at one another realizing that what they were yet to encounter would soon prove to be much worse!

It was another event-filled day of hole-punching and periodic falls while attempting to jump over crevasses and tightrope over snow bridges. It was exhausting. Yeti, Evan and Jeremy went in above their waist, all necessitating help to get out. Dave and JC also fell through up to their necks. Dave badly twisted his shoulder while attempting to get out. We continued to hike throughout low visibility conditions probing for crevasses with each forward step of the way.

We were still in whiteout and heavy snow conditions when we finally arrived made camp at 0830 hrs. To Gerard's surprise and alarm, while he was shoveling a hole to make a suitable latrine for the team, he suddenly came upon a crevasse within the camp.

> *While I was digging a pit for the latrine, I was surprised to dig right into a crevasse! Boy, was I surprised! After pointing the situation to Tim, we further probed around to determine the extent. Everything seemed "relatively" safe, so we used the crevasse to our advantage. Tim rigged a T-picket and sling; the technique required holding on to the sling, pulling your pants down and squatting over the crack. Very efficient!* – Gerard Coleman's journal entry.

While the rest of the team continued with camp set up, Tim Hewette called a meeting of Dave Olson (expedition leader), the PJs and guide Alex Stroud (rope team lead for Justin Legg) to be held in one of the mid-tents. Tim indicated that he was becoming concerned that we were falling further behind and, at the current slow pace of travel, we would not be able to get into a position to make the summit of Denali on the day(s) scheduled. Granted, it was a slow pace, but it was nearly impossible to keep a steady and methodical 'mountaineer' pace due to the treacherous glacial conditions. His comments, however, were extremely polite and appreciably sensitive to the unique challenge of our wounded veterans. He indicated that he respectfully understood the reasons and goals for our journey but was concerned about our progress, or lack thereof. Dave responded by indicating to Tim and Alex that, despite the objective of reaching the actual summit, everyone on our team had a personal summit of their own, that Justin's 'summit' goal was 14,200', and that we were determined to continue as a team, collect the necessary medical data on Justin, and enable Justin and others to realize their personal summit. Dave further indicated to Tim that we would not break team unity and that each of our combat wounded team members needed to go as far as they can, that this is an important part of their rehabilitation and that our mission was ultimately for the greater good of all the vets back home.

> *Tim came over to me while I was helping Evan and Randy set up our tent and asked for me, Alex and Bill (the PJ assigned to oversee Justin's progress) into the mid-tent for a meeting. I immediately knew that it was, possibly, concerning Justin and the slow pace we were making due to his intermittent stops during glacier travel (to allow him to catch his breath and for the PJs to record his vitals for the lung study). Tim first began describing our present situation and expressed a genuine concern for Justin and a great respect he had for all of the climbers on our team and indicated that, unfortunately, at the present rate of travel, we would not have the opportunity to reach the summit of Denali. He said that we needed to make a determination soon if we were to have any chance at the summit. I responded by indicating to Tim and Alex that we were not entirely focused on THAT summit, but rather on our own team 'summit', i.e., the compilation of medical and functional data intended for the greater and larger group of combat wounded military veterans. Justin set his summit at 14,200' and we were going to see to it that he gets as far as he can, no matter the duration required. Further, this expedition was an essential and important rehabilitative experience for Justin (and the other combat wounded vets) and that we would never break team integrity. Tim replied that he respected this position and that it was the first time, in all his years of guiding, that his 'clients' were team- focused and looking after each other, rather than individual goals. He turned and glanced at Alex, who also nodded, and said that it is refreshing to be a part of a meaningful team effort. We then all agreed that only when Justin himself made the call, would we guide him off the mountain. Until then, we would continue to closely evaluate Justin's condition and safety. – Dave Olson's journal entry.*

We took turns ferrying cups of pea soup, steak strips, macaroni and cheese to Will and Justin who remained in their tents, exhausted, during dinner. We retired at noon and awoke for the next leg of the journey at 2300 hrs. It snowed throughout most of the evening. Breakfast (around midnight) consisted of English Muffins with cream cheese, jelly and ham.

During our camp break-down and while we were beginning to rope-up for our next leg, we observed a solo climber who was hiking off the mountain. Oddly, he kept descending despite losing his pack sled about a quarter mile back up the mountain. When he reached our position, we greeted him with some hot spiced cider. He was wearing a "ladder"! This was his technique (typical for solo climbers) to avoid falling completely into a crevasse; he had two carabiners lashed to the middle of the ladder, one on either side. He would then step in the middle, between two ladder rungs, clip into his harness, and begin walking. He was from Turkey and was returning after a month-long journey on Denali. After we alerted him that we noticed that he may have lost his pack sled, he set down his ladder, chatted with us for another moment (he enjoyed the hot drink), and then headed back up to retrieve his sled. He commented that what appeared to be a 10-minute climb may take him most of the morning. He appeared exhausted. Colby later indicated to us that solo climbers and skiers on Denali do so 'with one foot in the grave'! Anyway, it was interesting to meet the fellow.

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**Date:** 28 June
**Day:** 5
**Location:** Move, Kahiltna Glacier 7,500' to 9,500'

We departed at 0230 hrs and started up some serious inclines this day. The grade was greater than 25-30 degrees but felt much steeper. During the journey, Justin was finally forced to strip down the majority of weight in his pack to just a small bag that he rigged to hold his parka and water bottles. It was important to keep these particular items with him in the event he might fall into a crevasse and have to await rescue. Additionally, due to his condition and the numerous prescriptions he was taking, Justin indicated that his mouth was continually dry. He missed the previous three meals due to his mouth hurting too much to eat. Keeping Justin on his medicine schedule was a challenge. At the 8,500' mark, Justin's SATS went down to 78-79% during exercise.

**The Expedition Team takes a 10-minute break. Will Wilson seldom doffed his heavy backpack during breaks preferring to rest on his good leg to relieve the stress on his residual limb. Sometimes it was too much of an effort while roped and on snow shoes to doff and don the heavy backpack**

*Within an hour [of departure], I found myself neck high in another crevasse. I was stuck and couldn't get out of the hole. The PJs were called again to use a pulley to pull me out. They finally dragged me out. We continued and I distinctly recall having much more energy due to an adrenaline rush. I seemed to get that same burst of energy every time I punched into the snow on that glacier. I just wanted to get to Ski Hill and out of the kill zone. I was like a crevasse magnet. It quickly became the laughing point of the team. On the last crevasse just before Ski Hill, I was punching through across a snow bridge that was disintegrating beneath my feet directly over another crevasse; I dove across in a superman fashion and threw my back out at the same time. I was in a great deal of pain, but kept it to myself and continued up Ski Hill from 7800-9500' in near zero visibility. I asked Tim if he could probe a safe zone for camp because I was really hurting. We found some prime real estate on top of Ski Hill; we could see the entire Kahiltna Glacier and Kahiltna Dome once the weather cleared. It was an incredible sight.* – Yeti's journal entry.

Yeti's back pain began to set in from this latest crevasse fall and Justin slowed considerably. We arrived approximately 0930 hrs and set up camp at the top of Ski Hill. We were all exhausted but morale quickly picked up as pizza was on the dinner menu. The weather soon cleared. The PJs continued to monitor and take data recordings on Will and Justin. We set in for the 'night' at approximately 1400 hrs. The wind picks up and shakes the tents, disturbing our sleep.

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**Date:** 29 June
**Day:** 6
**Location:** Move, Kahiltna Glacier 9,000' to 11,200'

We awakened at midnight. It took us a full 4 hours to eat breakfast and break camp- this was unacceptable! We departed camp at 0400 hrs. This was, by far, the most difficult day yet. We traveled uphill for over 8 hours and arrived at the bottom of 'Motorcycle Hill' at 1300 hrs. Yeti's back was increasingly painful, forcing him to physically compensate using another method to carry the weight. He was referred to the PJs for treatment.

*We broke camp and roped up to continue our ascent. I have bruises on the lower bicep portion of my arm from trying to wiggle my backpack into a comfortable position during the ascent. I tried to ignore the pain by telling myself, this is a once in a lifetime opportunity and I can't fail my team. I pushed on. The weather cleared and the views were spectacular. The temperature was particularly cold until the sun came up over the snowcaps. I saw two fighter jets flying in formation overhead and it reminded me of marching in the mountains of Afghanistan and the comforts of air superiority we had. I was happy to be here and proud of my team for getting me this far (10,405 ft). We continued the climb up a very steep hill into the 11,200' camp. This was quite possibly one of the hardest days yet. I was in some serious pain. The trail seemed like it took forever and we had been walking for 9 hrs. We established a camp site. I was hurting and had the PJs checked me out again. My lower back was painful on palpation. I tried*

*stretching throughout the night, Ibuprofen 800mg and nothing helped, it was persistent. After a class on cold weather injuries and the risk assessment of our next stretch of mountain, I decided to tell my team I would be doing them a disservice if I continued. I feared I slipped a disk in my back and didn't want to put them in a dangerous situation by continuing. It was an extremely hard decision for me to make. I was scared my team would dis-own me and be disgusted with my decision. They were extremely supportive, and told me it was a smart decision. I came, I saw, I conquered, in my own mind. Randy told me that I made it far enough; I succeeded in my own summit, and that the mountain will always be there. He explained that mountaineering is 50/50, ask any professional mountaineer. Dave explained the goal is to survive to climb another mountain. Smart decision making skills increase chances of survival. I respect him for comforting me while I cried. We were nine days into the expedition, more than halfway to the summit. Justin was coughing up fungus in the tent. This scared us. He tried to go up motorcycle hill and decided that his summit had been reached as well. He was going back to base camp with me, Jeremy and Bill. All evening I felt like changing my mind and staying because I might regret my decision; that I may lose future opportunities with the Denali Challenge teams. I knew Justin and the PJs needed me to get to base camp, to support safe descent. A four man rope team is redundant and safer during glacier travel.* – Yeti's journal entry.

**The entire team at the 11,200' camp with The Explorers Club Flag # 61 (L to R: Randy Rosin, JC Cummings, Evan Olson, Gerard Coleman, Justin Legg, Will Wilson, Yeti Thibeault, Dave Olson**

*Today was awful!!! We went from where we were all the way to 11,200 ft. We got to somewhere above 10,000 and we had already been going for 5 hours, then Tim said if we*

*went another 4-5 hours to 11k camp that we could have a full day's rest – so I wasn't going to disappoint everyone else. Those last 4 hours blew. My sats got down to 71% while on the HILL right below 11,000'. I just completely collapsed about 6 or 7 times. I didn't faint or get woozy but my legs were just so weak that they couldn't support my weight any longer. I just learned to let them buckle when they went and fall down. I would rest and then get back up and keep going. The rest step walk was crucial but again it was our haphazard pace that forced us to go 3-5 steps at a time and it completely fouled my pace. Made it into camp and was just wrecked. Thank god that Gerard "the machine" has been my tent-mate the whole time. He has taken care of so much for me; it has really saved my ass. I was crushed and could barely move. Don't know how I made it in. Can't wait to have a rest day – that is sweet.* – Justin Legg's journal entry.

After a dinner of rice/beans/cheese tacos, we crashed at 1900 hrs.

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**Date:** 30 June
**Day:** 7
**Location:** Front Carry/Rest, Kahiltna Glacier 11,200'

Justin tests his lungs at 11,500' on Motorcycle Hill in advance of a continued ascent of Denali. After the second attempt, Justin decided that he had reached his summit

The guide staff awoke at 0200 hrs. Tim Hewette cooked. Three assistant guides and three PJs carried gear/food/fuel to 13,500' and probed a potential campsite. The remaining team rested in our tents and participated in classes. Hewette instructed the team in proper crampon use, climbing techniques, self-arrests, rest step, altitude, cold injury and packing.

Justin reached his high point and summit of 11,500' before he indicated this was as far as he could go. Yeti's back pain worsened and he, too, reached his personal summit and requested to accompany and support Justin back down the mountain.

*Rest day – everything was kicking my ass. [Going to the CMC] and just tying my boots was really getting me out of breath. The views were amazing. I want to go further so I*

*will try a little crampon walk up motorcycle hill with Will when he tests the crampons on his prosthetic leg. –My test sucked – I went down twice just getting half way up motorcycle hill… and I was fresh. It's time for me to turn back. I think I could have gotten to about 12,500' but would have had to turn back before Windy Corner because I don't think I would have been able to do it without stopping. Time to be smart and safe. What a great climb.* – Justin Legg's journal entry.

*Yeti was in obvious pain…you could see it in his eyes. I sensed that something was troubling him but waited for him to approach me. He was unusually very quiet and withdrawn for the past couple of days leading up to his decision. I knew that he had injured his back, but I did not realize the degree of the injury….he kept the pain to himself. It is difficult to judge the condition and the pain level in these wounded veterans because they NEVER complain to their team members of any ailments or associated pain with their injuries, NEVER. But Yeti was in tears when he approached me to indicate that he could not contain it any longer and that he had decided to accompany Justin back to Talkeetna. Yeti's biggest concern, he said, was that he felt others would label him a quitter and that he would live to regret his decision. I quickly dismissed such a notion and praised him for thinking of the safety of the team rather than for himself. I told him that, if he were to continue, he could possibly jeopardize the safety of the entire team. It was a very courageous decision and we all respected him for making the very difficult call himself when he did. The mountain will still be here, I said, and that he needed to survive to make another go at it.* – Dave Olson journal entry.

To top all this off, dinner was the worst so far – almond butter & noodles. Guides and PJs awoke at 2200 hrs to prepare Vic, Justin, PJ Jeremy and PJ Bill to descend to base camp. They departed just after midnight.

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**Date:** 01 July
**Day:** 8
**Location:** Move Attempt, Kahiltna Glacier 11,200’

The remaining team awoke at approximately 0300, a few short hours after Yeti and Justin departed for the lower glacier. We donned our crampons and departed camp at 0630 hrs, but encountered cold temperatures and very high wind conditions during our ascent up Motorcycle Hill. Upon reaching the top of Motorcycle Hill, the weather conditions and visibility worsened so we returned back to the 11,000’ camp and set up camp and our tents once again. We decided to make the attempt the following day.

Meanwhile, Justin and Vic reported whiteout conditions during their descent. They probed out a suitable campsite once they reached the bottom of Ski Hill.

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**Date:** 02 July
**Day:** 9
**Location:** Move, Kahiltna Glacier 11,200' to 13,500' (Windy Corner)

The team rests at Windy Corner enroute to the 13,500' camp

The team was awakened at 0300 hrs and we were on the trail by 0615 hrs. The weather was clear and cool, mildly warm in afternoon. It was a perfect move day.

We ascended Motorcycle Hill from 11,200', to Squirrel Hill, across the Polo Field, and around Windy Corner to camp at the 13,500' level. When we arrived at the campsite at 1415 hrs, it began to snow heavily. During the ascent, however, Will Wilson experienced heat exhaustion and mild acute mountain sickness (AMS) at Windy Corner.

Meanwhile, Vic and Justin made it to the initial base camp at the glacier landing strip and were fortunate to get a flight off the glacier and return to Talkeetna at approximately 2000 hrs:

*Miserable day. Took forever to get going and find trail. Wandered all over to find trail and Yeti fell into big crevasse- again. He went in about 15-20 feet down into a crevasse that was probably more than 60 feet deep. It was a pretty bad experience. I arrested Yeti and took the weight so Bill could build anchors. He dug anchors and it seemed like forever to set-up a 3-to-1 system. Once Bill finally got the 3-to-1 system built, both anchors blew right away. Luckily I just happened to catch one of the anchors between my hip and my elbow. When the anchor came flying out of the snow and hit me, I just grabbed it and jumped into the snow and wrapped everything I had around it so Yeti would not fall further. We had to dig deeper anchors and also had to dig trenches for the sling attached to the picket. SUPER DANGEROUS. Yeti was in the hole for a total of 1 hour 3 minutes (I looked at my watch when I arrested Yeti's fall and was giving Bill 10-*

*minute time hacks as I was concerned with how cold Yeti would get with only 3 of us there to tend to him. After we finally got him out, the rest of the day went fairly smooth because we found the trail not long after and just stayed on it. The walk was about 11-12 hours total and the walk back up from the bottom of the glacier, up Heartbreak Hill, was misery. I fell a bunch more times from exhaustion and finally just heaved for about 10 minutes right under the American flag at the top of Heartbreak Hill. At base camp by the landing strip I got checked out by the camp Doctor. She made sure that Yeti and I were at the front of the line to ensure we were the first 2 out of there on the first plane. Thank God we got out that night.* – Justin Legg's journal entry.

*This descent was considerably faster than our ascent. Justin looked extremely exhausted so we probed a safe zone to establish a camp at 7,700'. We rested until the next evening and decided to break camp at 0000hrs. After walking for close to two hours over the upper glacier through a white out, I took another 20' fall into a monster crevasse. This time I was scared, I couldn't see the bottom and it was twice as big as my earlier crevasse fall. This time I tried ascending the rope with two ascenders. I dropped my pack, pressed my back against the wall, pushed my snowshoes into the other side of the wall of ice and tried shimmying up. I heard Bill yelling he was building a three to one pulley system; 'we're going to get you out". Time went by as I ascended the rope, and I was three feet from the lip of the hole. Bill transferred the load to his pulley system and the protections blew out of the soft snow. I fell another ten feet; Justin caught one of the protections between his elbow and hip, wrapped himself around the rope to anchor me. He saved my life. Bill fixed the anchor system and pulled me to the edge of the hole where I got stuck and had to*

*bust the lip out with my elbows in order to exit. Bill pulled me out with his super human strength; he is strong as an ox. When I came out of the hole we decided to shift our path to the left towards the center compression zones of the glacier. The weather miraculously cleared and visibility improved to near 100%. This was our first real magnificent views of the beauty of Denali Alpenglow. It felt like a dream. As we cleared a real path to finding the main trail, we heard a wolf howling in the distance. It was a man named Vern Tajas, a 44 time Denali climber and his group of 23 climbers. He thanked us for breaking trail for everyone else. We let them pass and followed them the rest of the way down glacier to the base of Heartbreak Hill. We had no further glacier troubles. Going up Heartbreak Hill, Justin collapsed in exhaustion. We had been walking for eleven and a half hours. I belayed myself up to his position and asked him if he wanted to go with Bill in a sled the rest of the way. He emphatically denied our attempts to sled him up. He wanted to finish on his own two feet. I could see the American flag waving in the distance; I pointed it out to Justin and said focus, almost there. When we made it to the flag we took pictures, almost into base camp. When we got into base camp, we checked in with Lisa, the camp manager, and Justin was immediately inspected by the base camp doctor. She told us that if a flight came in today we would be the first two on the list; we needed to move a mile and a half up the flight line to catch the plane. Bill and Jeremy probed a safe zone at the top of the flight line and set up camp because it was snowing. Justin and I congratulated each other for getting to base camp safely. This is when we discussed coming back for another attempt, I promised I would. The weather cleared and we were notified our flight out was enroute to pick us up. We flew out.* – Yeti's journal entry.

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**Date:** 03 July
**Day:** 10
**Location:** Move, Kahiltna Glacier 13,500' to 14,200'

The team awoke at 0600 hrs. Will Wilson reported that he felt better and wanted to continue. JC's feet are still torn up with blisters and getting worse. Gerard loaned his boots to JC a second time since his boots are a couple of sizes larger than JC's.

At 0745 hrs, Will Wilson informs Tim Hewette that "he did not feel right". PJ Kris Abel diagnosed Will with a possible cardiac problem. Will described that he had heavy pressure on his chest and pain down his right arm accompanied by shortness of breath. Tim promptly notified the NPS doctors, who were located at the 14,200' camp, by satellite phone and requested a litter to be brought down for Will's evacuation and return to their medical staff at 14,200'. All of us packed Will into his sleeping bag and strapped him onto the litter for his travel up the mountain. Matt, Noah and Denali Park Service Rangers towed Will to the 14,200' camp so that he could be cared for by the NPS medical staff stationed there.

All of us packed Will into his sleeping bag and strapped him on the medical sled for his rescue to the medical camp at 14,200'

*Experienced severe fatigue, dehydration and Acute Mountain Sickness (AMS). Evacuated by the National Park Service rescue team to 14,200'. Treated for acute chest pain, shortness of breath and disorientation. Rx included nitro glycerin x 3, 12 liters of $O_2$ and Morphine IV pump injections. Treatment continued for approximately 18 hours while awaiting National Park Service (NPS) air evacuation and subsequent "Life Flight" to Anchorage Regional Medical Center. Climb terminated. Extremely disappointed in circumstance leading to climb termination. Being a certified personal trainer by the Cooper Institute of Dallas, Texas, I had trained my body at such a high level of both cardio and dynamic weight training that I felt fully prepared to summit at any cost. This "cardiac event" was certainly the last thing that would have ever entered my mind. I was comforted by the genuine concern my team displayed as I was undergoing observation at altitude and thereafter. Their decision to terminate the climb at 14,200' and to begin their decent after my evacuation was a difficult and bitter pill for me to swallow at the time since I felt I was responsible for them not reaching the true summit of Denali. We learned a lot more about ourselves than what we could withstand physically.* – Will Wilson

Meanwhile, the rest of the team broke camp and ascended to the 14,200'camp, arriving at approximately 1530 hrs. Whiteout conditions prevailed into the early afternoon.

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**Date:** 04 July
**Day:** 11
**Location:** Back Carry, 14,200'

Since our gear cache remained at the 13,500' camp, some of the team descended to recover and 'back carry' the gear back up to the 14,200' camp. Meanwhile, the rest of us took turns visiting and talking with Will who was still recovering and under observation in the medical tent. His morale soon improved with these visits. The NPS medics indicated that they were concerned about his fluctuating heart rate overnight and were hoping for the weather to clear so that they could get a rescue helicopter to transport him from the mountain to a hospital in Anchorage. The mountain makes its own weather on Denali, and on this day, Denali's weather conditions were not favorable for rescue. The following day, however, after a few aborted attempts, the weather cleared just enough by early evening to enable a rescue. At 2100 hrs, Will was finally evacuated.

*Once the decision was made to evacuate Will to the Anchorage hospital, the NPS personnel began to prepare the landing site by 'work-hardening' the snow in an area near the medical tent so that the area was relatively flat and level for landing the "Lama" helicopter. My immediate concern, however, was for Will's wife, Gannie, and how she might be handling the news of her husband. I was confident that Laura at AMS would handle all of the flight arrangements and lodging for her and that Tyler Hall and*

*Yeti would pick her up at the airport. But the immediate prognosis for Will remained serious and this weighed heavily on our decision whether to continue the ascent, or return as a team. Once the medical doctor attending Will indicated that his heart rate dropped alarmingly twice during the night, the decision for us to begin our descent was essentially made. I informed Tim Hewette of our decision. Tim responded that he understood and that he would have made the same decision. We needed to get back with Will and Gannie*. – David Olson journal entry.

*Will's rescue was very dramatic… once the decision was made to fly him out, we listened to the NPS ranger Dave Weber on the radio. He was in contact with the helicopter, which flew from Talkeetna to Base Camp to refuel. The helo then flew to the "Edge of the World" (cliff adjacent to the 14.k camp) in hopes of picking Will up. The clouds prevented his landing, but we could hear him flying around just over the glacier. Later, the clouds parted long enough for the pilot to make another run for rescue. When he landed, the snow blew everywhere. The pilot was wearing an oxygen mask, due to the altitude, and Dave wore a flight helmet as would an LSO on a helo deck. Will was loaded in short order and then the helo lifted off. Once airborne, the helo flew west and rapidly descended onto the Kahiltna Glacier and home. Decision made to all turn back on account of Will's potential condition. Good weather rolling in.* – Gerard Coleman journal entry.

The rescue helicopter that transported Will was an SA 315 Lama, the ultimate high-altitude, high-temperature helicopter. It holds the world record for altitude gained by a helicopter and is ideal for air ambulance rescue on mountains such as Denali and Mt. Everest. The NPS contracts the Lama during the climbing season.

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**Date:** 05 July
**Day:** 12
**Location:** Move, 14,200’ to 7,200’ (Base camp)

We prepared ourselves for the long descent back to our initial base camp. But before we retired to our tents for a few hours of sleep, we all assembled to take our final group pictures nearby the “edge of the world”. The most difficult and dangerous leg of our journey was just ahead of us as we still had to make the long and difficult descent to the lower glacier and through that menacing crevasse field once again. The descent proved to be more challenging than the ascent and required careful balance.

It was 2100 hrs when we departed the 14,200’ camp for return to our initial base camp and glacial landing strip. The sun was still out but hung low in the sky, hidden just below the crest of the mountains. The view of the alpenglow against the snow packed mountains was mesmerizing.

The route was fairly steep in some locations and sled management was often the biggest problem. It was important for each of us to manage the rope and the sled in front of us, constantly paying attention and holding back the sled to keep the rope and sled from running into

the back of the person directly in front. It was necessary to alternate our downhill step technique often so as to avoid over-exerting one particular leg. There was a good freeze and conditions on the glacier were much better for travel to base camp.

After over 9 hours of travel, we finally arrived at our original base camp. The time of our arrival was 0630 hrs. Departed base camp for Talkeetna via glacier flights between 0800 hrs and 1000 hrs., arriving in Talkeetna between 0900 – 1100 hrs. Our mission was successfully completed.

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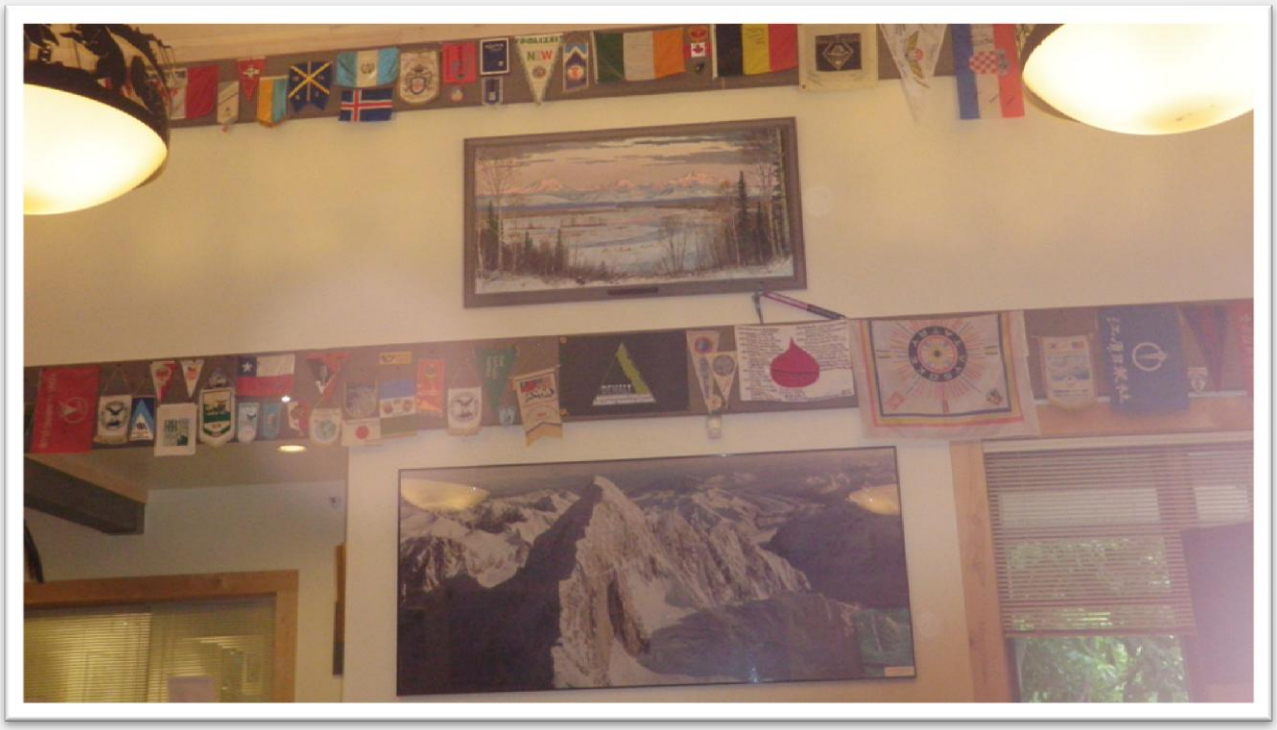
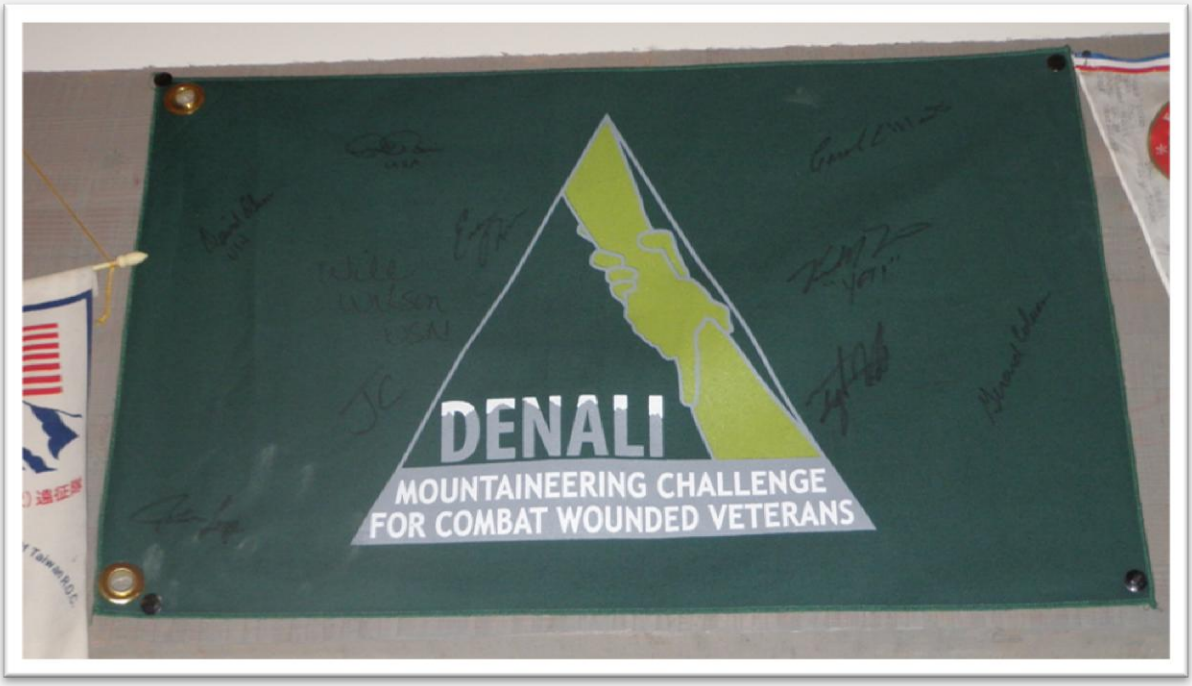
We are hopeful that our Expedition's data and findings will add to the increasing body of knowledge in support of expanded opportunities for combat wounded veterans and their potential to return to active duty service. We believe that our Denali Challenge expedition did much to advance the realm of the possible in this area and to open the eyes of both the wounded veterans and their brothers in arms. Those of us who had the great privilege to participate with and learn from these selfless American heroes have come away inspired and humbled by their commitment to serve each other, their fellow wounded comrades and their country.

***Vulneror non Vincor***



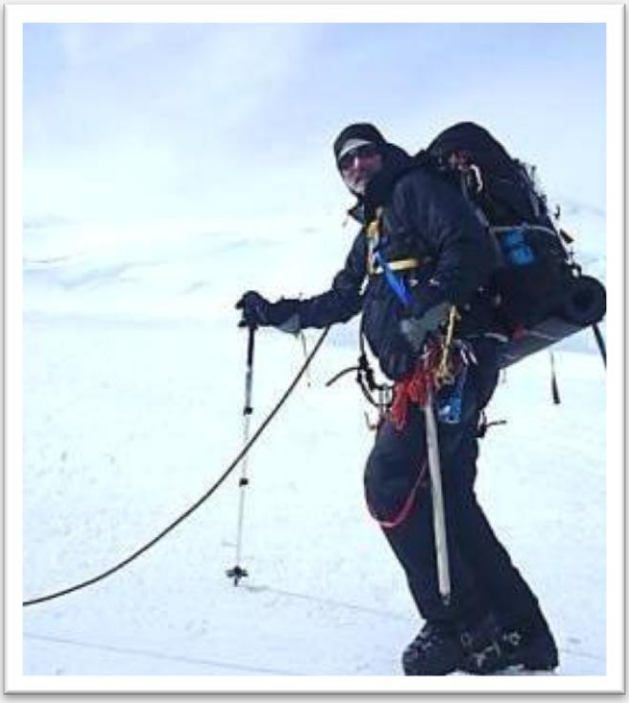
The Combat Wounded Veteran Denali Challenge expedition flag is proudly and prominently displayed among the expedition




flags of many other nations in the Talkeetna National Park Service Ranger Station

## AOCM Will Wilson, U.S. Navy (Ret)

Master Chief Ordnanceman James "Will" Wilson was seriously injured while serving aboard the USS Enterprise, in May of 2003, when he broke his neck and both legs. Due to the serious damage to his right leg, he chose amputation in December 2007 and has not let this setback stop his return to a full schedule of athletics ever since. After long periods of hospitalization and rehabilitation at Portsmouth Naval Hospital, Virginia, and Walter Reed Army Medical Center in Washington, D.C., Master Chief Wilson has beaten the odds and now competes in a full regimen of athletics.



Master Chief Will Wilson marks his sled with his spare leg

Will was raised in Lomita, California, just south of Los Angeles and entered Naval service in January, 1977. He now resides in Arlington, Tennessee with his wife Gannie and their two children, Bear (17) and McKenna (14), and serves as Program Manager for the Navy Wounded Warrior Adaptive and Paralympic Sports Program, a newly established department of Navy Safe Harbor.

## SOC SEAL Jonathan Cummings, U.S. Navy

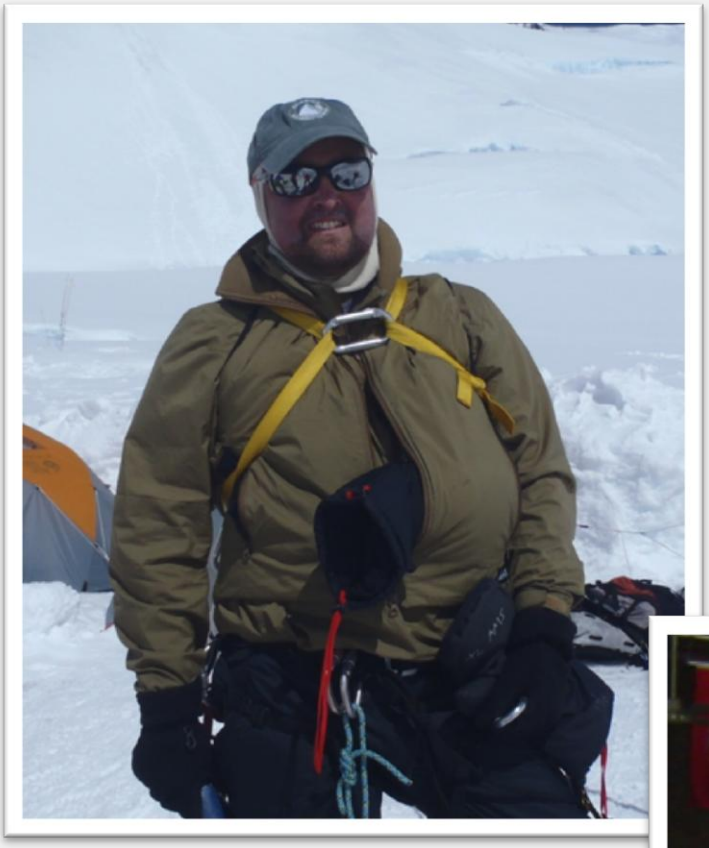
Navy Special Operations SEAL Chief Jonathan "JC" Cummings survived an IED blast in Afghanistan in 2009 and has since been recuperating from surgeries to repair his back, neck and leg injuries.

Yeti best describes JC: *"Jon Cummings, my good friend. I look forward to seeing him at any available occasion. JC is my hero. A Navy SEAL who believes that quitters never win. He is the epitome of an American Patriot; he consistently inspires me to be a better person. I'm almost certain he is my brother from another mother."*

## SSgt Tyler Hall, U.S. Army

SSgt Tyler Hall, Combat Engineer from the 14th Combat Engineers at Ft Lewis, WA, was attached to the Northern Engineer Task Force. He was wounded in Baji, Iraq, on August 23, 2003, while enroute to secure an ammunition holding area. Tyler's five ton mobility transport vehicle was destroyed by an improvised explosive device resulting in his severe injury. Tyler suffered a left leg Below the Knee (BTN) amputation, Traumatic Brain Injury (TBI), severe burns, and a broken back. As a combat engineer, Tyler was routinely tasked with clearing roads of IED's, VBED's, and munitions as well as developing infrastructure for the local Iraqi population, 101st Airborne Division and the 4th Infantry Division. Tyler spent three years recovering from his injuries at Walter Reed Army Medical Center and now lives in Wassilla, Alaska. He serves as a Jr.Vice Commander for the Military Order of The Purple Heart of Wassilla and volunteers with multiple veterans non-profit service organizations.

## LT Justin Legg, U.S. Navy



Navy SEAL, LT Justin Legg graduated from the U.S. Naval Academy in May of 2000 and completed BUD/S as a member of Class 234, the entire training regimen captured on the documentary "Navy SEALs: Class 234" produced by the Discovery Channel. Justin deployed twice with SEAL Team SEVEN to include a seven month combat tour during Operation IRAQI FREEDOM. Afterwards, he moved to Special Boat Team TWENTY-TWO located at the John C. Stennis Space Center in Mississippi.

On June 2nd, 2006, Justin was diagnosed with Acute Lymphocytic Leukemia. With several rounds of Chemotherapy behind him and his cancer in remission, he went to Seattle to receive a Bone Marrow Stem Cell Transplant that was necessary to ensure his Leukemia would stay in remission.

Justin recovered from the immediate side-effects of the transplant and then moved to Virginia Beach, Virginia, with his wife, Suzanne. While performing administrative duties, he began rehabilitating himself to get into shape to become an operational SEAL Platoon Commander. In February 2009, only 5 short months after becoming a platoon

commander, Justin again suffered a physical setback. In the two years after the transplant, Justin developed a condition called Graft Versus Host Disease (GVHD), a condition where the immune system that develops from the donor bone marrow begins attacking parts of the host's body. The severity of the condition forced LT Legg to resign from his command position in order to fight the disease. Inevitably, the disease destroyed his lungs making a double lung transplant a necessity for survival. He received his new lungs on 22 July 2010, and since then, has been rehabilitating himself to take on new physical challenges as he prepares to be medically retired from the U.S. Navy. Justin is the first double lung transplant patient to have attempted the summit of Denali, reaching 11,500 ft only 11 months after his surgery.

## SSgt Victor Thibeault, U.S. Army (Ret)

Staff Sergeant Vic "Yeti" Thibeault was critically wounded in Afghanistan, along with his battle buddy SSgt Dan Swank, after his convoy was ambushed in a crowded marketplace where a terrorist threw a grenade through the window of his military vehicle. Vic immediately grabbed the grenade from under SSgt Swank and tucked it in the center console of the vehicle rather than throw it back outside into the crowded marketplace, mitigating and shielding the effects of the blast from other Afghan civilians that assembled in the square. After the blast, Vic applied his own tourniquet and dragged his unconscious partner to the nearest casualty collection point where both were evacuated. For his heroic actions, Vic received the Silver Star, the Army's third


Vic has the honor of affixing the team expedition flag in the Talkeetna National Park Service Ranger Station

highest award for "gallantry in action" and Purple Heart for military merit. Vic spent the subsequent 18 months at Walter Reed Army Medical Center in Washington, D.C. for rehabilitation after having lost the majority of his left hand. After a brief break in service, SSgt Thibeault reenlisted in the Field Artillery and was honorably retired in March of 2008. Vic is now a certified EMT in Vallejo, California, where he lives with his wife, Maleney and children, Delilah and Thomas, and is currently pursuing a degree in Psychology.

## *Supporting Team*

### Evan Olson

Evan is entering his senior year at Palm Harbor University High School in Palm Harbor, Florida, and is Captain of his high school varsity swim team and Captain of the Palm Harbor area high school sailing team where he competitively races Collegiate 420s. He also races lasers for SailFit in Clearwater, Florida. He became an Eagle Scout in 2010 and is a member of the Order of the Arrow, Boy Scouts of America. Since he was 12 years old, Evan participated as a Projects Leader in several underwater marine science field studies as a SCUBAnaut for SCUBAnauts International, an international marine sciences youth organization conducting underwater data collection and coral reef restoration activities in Tampa Bay, Bahamas, Florida Keys and Gulf of Mexico. Evan is a student member of The Explorers Club.

In 2007, Evan participated in his first climbing adventure when he reached the summit of Mauna Kea, Hawaii, as part of a SCUBAnauts International – Explorers Club expedition, *Operation: DEEP CLIMB*. During this expedition, Evan and his youth expedition team had the privilege of carrying with them Explorers Club Flag #61 as they ascended along an ancient Hawaiian trail to the summit of Mauna Kea, the

world's "tallest" mountain as part of a combined undersea submersible experience – overland summit of the world's tallest mountain – and space exploration (Shuttle STS 131) expedition intended to inspire other youth to explore their world.

In the summer of 2010, Evan participated in this program's first combat wounded veteran mountaineering challenge and assisted the military veterans during mountaineering training on the Pica Glacier in the Alaska Range.

## LCDR Gerard Coleman, U.S. Navy (Ret)

Gerard Coleman attended the U.S. Naval Academy, and graduated with a degree in Ocean Engineering and was a three-year all-American in sailing. In the Naval Fleet, Gerard served in the Naval Nuclear Propulsion Program aboard several cruisers, destroyers and aircraft carriers. During his active duty career, Gerard and his brothers competed in the Olympic Trials for the US Sailing Team, making the team as alternates.

After his Navy career, Gerard became a professor in the engineering department at Texas A&M University at Galveston, teaching such courses as thermodynamics and naval architecture, among others. Additionally, he became the sailing coach for the intercollegiate team. During his tenure as sailing coach, his sailing team was involved in an underwater rescue of five drowned victims inside a submerged vehicle. Each victim was administered lifesaving resuscitation by members of the sailing team and survived despite original medical prognoses. His team has one national championship to its record.

Gerard provides instruction to the Pararescuemen (PJs) from the Alaska 212th Rescue Squadron. "Yeti" Thibeault volunteers to be the subject.

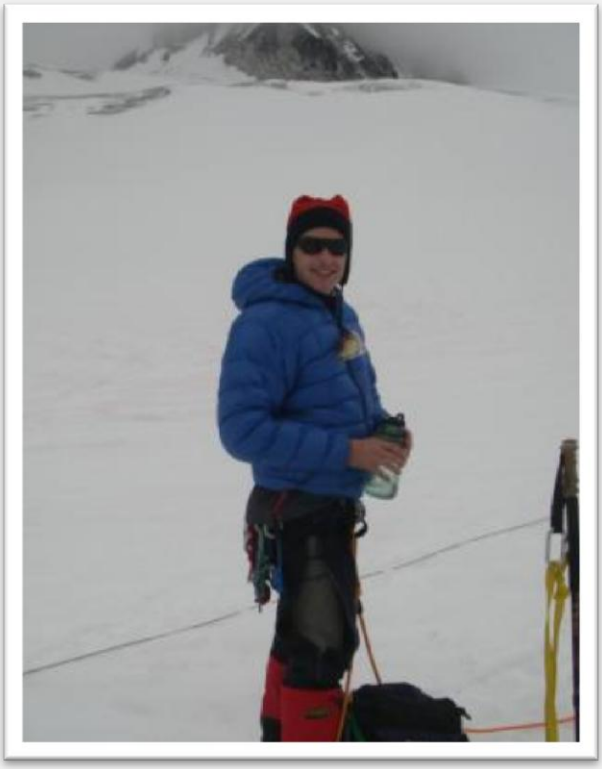
Gerard has been active in mountaineering, primarily backpacking in New Hampshire's White Mountains, which were first introduced to him by his parents. Climbs have included Alaska, Mexico, and volcanoes in the Pacific Northwest. Gerard lives with his wife, Cheri, in Galveston, Texas, along with their son, Ryan, and daughter, Rose.

## Colonel Randy Rosin, U.S. Army

Originally from Watertown, CT, Colonel Randolph Rosin enlisted in the U.S. Army in 1979. A 1985 graduate of West Point, Randy became an Armor Officer who has since served in a variety of command and staff positions in Psychological Operations, Information Operations, and as a Middle East Foreign Area Officer. Currently, Randy is the Chief of Information Operations Division at U.S. Central Command, MacDill AFB, Florida.

An aspiring Alpinist, he has humbly undertaken climbs of Mt. Whitney, Longs Peak, Mt. Shasta, Mt. Ranier, Grand Teton, Kilimanjaro and others. He is married to his wife, Lynne, of 24 years. Lynn serves as a government RN in the Tampa Bay area. They have a 21-year old daughter, Lauren, who is also a climber and working her way through college.

## Ed Coleman, MD, LCDR, U.S. Navy (Ret), Cardio Thoracic Surgeon



"Doc Ed" received his medical degree at the State University of New York at Buffalo School of Medicine in 1983. After completing his internship and Resident Surgery at the University of Rochester School of Medicine & Dentistry, Ed was commissioned as a LCDR, U.S. Navy Reserve Medical Corps in August of 1987. He then became Senior & Chief Resident at Columbia University College of Physicians & Surgeons followed by Resident in Cardiothoracic Surgery at the State University of New York at Buffalo.

Doc Ed is currently the Attending Physician at Bellin Memorial Hospital, St. Vincent Hospital, St. Mary's Hospital and Door County Memorial Hospital in Green Bay, Wisconsin. Ed and his wife, Ana, have 6 children and reside in Green Bay.

## CAPT David Olson, U.S. Navy (Ret)

Dave graduated from the United States Naval Academy in 1979, received his Navy pilot designation and served 8 years on active duty before transferring to the Navy Reserves in 1987. He retired from the Navy in May of 2009 and remains at U.S. Central Command (USCENTCOM) where he has been assigned since 1999. Dave and Teresa have four children and reside in Florida.

## *Alaska Air National Guard- Pararescue 212th Rescue Squadron*

### TSgt Kristopher Abel, USAF, Pararescue Medic

Technical Sergeant Kristopher Abel is assigned to the 212th Rescue Squadron (RQS), 176th Wing, Alaska Air National Guard. He is a key member of the storied Alaska Pararescue Team and, as one of the senior Guardsmen, is responsible for mentoring and leading the younger Pararescuemen. He graduated Cum Laude with a degree in Sociology from the University of Colorado in 2001 and completed his Master of Arts Degree in International Relations from the University of Oklahoma. TSgt Abel completed his 24-month long Pararescue training in December of 2004 and received the Jason D. Cunningham Award as the top graduate from the Paramedic portion of the training. During his first assignment with the 56th Rescue Squadron in Keflavik, Iceland, he provided over 2,000 hours of sustained Icelandic Search and Rescue (SAR) coverage, launching three times on real world civil SAR missions and participated in deployments in support of the NASA space shuttle program. In February of 2007, TSgt Abel graduated from Mathis Airman Leadership School as a Distinguished Graduate, earning top Academic honors. He was the 2006 56th RQS Airman of the Year, was part of the 56th RQS Aircrew of the Year, the US Air Forces Europe (USAFE) Pararescue Airman of the Year, and became the US Air Force Pararescue NCO of the year (2007). In June of 2008, TSgt Abel completed his active duty service and joined the Alaska Air National Guard. He has deployed to Bagram Air Base, Afghanistan, as an Element Leader and flew over 30 combat sorties. He has also been involved in multiple Alaska SAR missions and reached the summit of Denali as a member of the National Park Service Denali rescue patrol in 2009. Presently, TSgt Abel continues his required upgrade and refresher training as a SCUBA Dive Master, Rescue Jumpmaster, Pararescue Recovery Team Leader…all while enrolled in the Physician Assistant Program at the University of Alaska.

## SSgt Bill Cenna, USAF

After Graduating from Colorado State University and serving six years in the Colorado Army National Guard as a traditional Guardsman, Bill traveled Europe, Japan, and Hawaii before finding himself training for the demanding career of USAF Pararescue. Enlisting in the USAF Reserves at Patrick Air Force Base in Cocoa Beach, Florida, in April of 2007, he completed his "Pararescue Pipeline" training in June of 2009. Upon his return to home station at Patrick Air Force Base, he completed a year of on-the-job training before transferring to the 212th Rescue Squadron in Anchorage, Alaska. Bill deployed to Afghanistan from December 2010 until May 2011. Upon his return he volunteered to assist Alaska Mountaineering School and the Combat Wounded Veterans to climb Denali. Bill enjoys all aspects of the outdoors and thoroughly enjoys working for the 212th Rescue Squadron.

## TSgt Jeremy Maddamma, USAF

Technical Sergeant Jeremy Maddamma is a Pararescue Craftsman assigned to the 212th Rescue Squadron, 176th Wing, Alaska Air National Guard. He is a key member of the storied Alaska Pararescue Team and, as one of the full time technical rescue experts on the team, is responsible for mentoring and leading younger Pararescuemen to meet the wide ranging and challenging needs of the Guardian

Angel Weapons System. TSgt Maddamma is 29 years old and was born in Cleveland, Ohio on August 27th 1981. He graduated from Normandy High School in 1999. While in high school he volunteered for the delayed entry program to enter the Air Force and departed for Basic Training after graduating. Jeremy graduated from the DOD Louis F. Garland Fire Academy in the spring of 2000 and was stationed on Elmendorf AFB, AK. His next assignment was NORAD, Cheyenne Mountain AFS, Colorado Springs, CO as a Fire Protection Journeyman. In 2004, he attended the Peterson AFB Airman Leadership School and was awarded the Commandant's Leadership Award for the course. Following completion of his active duty career, Jeremy enlisted in the Alaska Air National Guard. He subsequently completed the demanding 24-month long Pararescue training pipeline in March 2007. Within four years of becoming a Pararescueman, Jeremy attained the qualification and responsibility of Pararescue Recovery Team Leader (RTL). He deployed twice to Afghanistan and has flown on numerous combat sorties in support of OEF. He has also been involved in multiple civilian search and rescue missions resulting in numerous lives saved in the State of Alaska as well as during hurricanes Gustav and Ike in the Gulf of Mexico. Jeremy has a passion for alpine style climbing, ice climbing, back country skiing and Nordic skiing with his family. TSgt Maddamma is married to Nicole Maddamma of Santa Fe, NM. They have 2 children Giuliano age 3 ½, Isabella age 1 and a third child due in October.

# *AMS Mountaineering Guides*

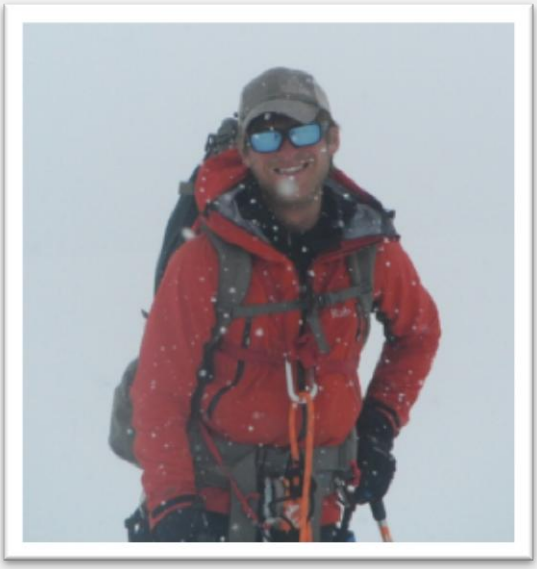
## Tim Hewette

Tim Hewette first came to AMS through the internship program with Alaska Pacific University, where he obtained a Bachelors Degree in Outdoor Studies. He is a veteran guide of multiple Denali expeditions and even guided the oldest man to reach the summit of McKinley in 2004 (along with fellow AMS guide Zach Schlosar). When he's not guiding mountains in the Alaska Range or on Aconcagua, he can be found teaching mountaineering courses, guiding hunting, providing bear protection for field consultants, or working as a guide/instructor in Antarctica, where he spends the off-season. Tim enjoys the ever-humbling experiences provided by the beautiful but challenging obstacles found in the mountains of Alaska and can't seem to stay away for too long. Tim has WFR Medical Certification, Avalanche I Certification, and speaks ghetto Spanish. (AMS Biography)

## Alex Stroud

On his first birthday, Alex climbed up the slide in the back yard and has been climbing ever since. Those long childhood summers from the tumbled rocks of Devil's Lake Wisconsin to vacations in the Big Horns of Wyoming to mountain biking in Moab and hiking in Arches, every kind of terrain was a challenge. Once Alex moved to Missoula for college, every place was measured in "miles from Missoula" and he added ice climbing to his repertoire that was steadily growing. He loves to know how things work, mechanical or otherwise, and he thinks through the route before he sets out, always ready to adapt to new situations with his calm, confident and assertive presence.

## Noah Ronczkowski



Noah has been climbing since 2001 and began guiding with AMS in 2011. He brings solid technical skills, a great sense of humor and a clear teaching style to all of his expeditions and courses. He is an avid skier, climber and backpacker. Noah's first Denali expedition was in 2010 when he also made a ski descent, a feat rarely achieved. His notable climbs include Moratorium, WI 6 route in Cody, WY, Angels Landing NE Buttress, 5.11a in Zion, UT and Aquarian Wall on El Cap, A3 in Yosemite, CA. His western climbs and ski descents are numerous, most notably; Grand Teton, Gannett Peak and Denali. In the field, Noah immediately demonstrates his effective teaching and team building skills.

Originally from Chicago, Noah holds a BA in Biology and spends his winters in Bozeman, Montana where he works as a ski patroller for Big Sky Ski Resort. His certifications include an EMT-B, AMGA and Avalanche level 1. If you are lucky enough to climb with Noah, you will enjoy his sense of humor and prodigious memory for one liners from movies. He is a strong, smart and positive person who is a treat to be around.

## Matt Montavon

Matt is a recent outdoor studies graduate of Alaska Pacific University and has been an intern at AMS for a couple of years before he became a full time guide. Just before this Denali expedition, Matt completed a run of over 1,100 miles over 30 days from Deadhorse to Homer, Alaska.

Matt has been running to help raise awareness for the recognition of combat wounded veterans and financial support for the Wounded Warriors Project. Upon his return to Talkeetna, Matt was scheduled to lead our mountaineering trip on the West Buttress of Denali made up of wounded warriors and their fellow soldiers; his second such trip in the last two years with the Alaska Mountaineering School.

## Award History of Explorers Club Flag #61

## Combat Wounded Veteran Mountaineering Challenge: Denali 2011 June 14th to July 5th 2011

The Explorers Club flag represents an impressive history of courage and accomplishment and has been carried by many noted members on their expeditions. Since 1918, the flag has been carried to all of the Earth's continents, as well as under the sea and into the stars. To date, 850 explorers have carried the flag on over 1450 expeditions. The Combat Wounded Veteran Mountaineering Challenge expedition has become a part of the rich history attached to this flag. Earlier expeditions include:

| | | |
|---|---|---|
| A.J. Durlacher | 1935 | Columbian Petroleum Expedition |
| Dr. Wilson A. Swanker | 1954 | Swanker-Rogers Cayman Islands Expedition |
| Dr. Wilson Swanker | 1954 | American Polar Expedition |
| Robert P. Teten Jr. | 1992 | 1992 Texas Antarctic Expedition |
| Gregory Deyermenjian | 1993 | 1993 Patiti Expedition |
| Charles E. Rawlings III, M.D. | 1994 | Photo Survey of the Cephalopods of New Guinea |
| Dr. Cato Holler Jr. | 1995 | U.S. Cuban Speleological Expedition |
| William Klimack | 1995 | Mt. Ranier Steam Cave Expedition |
| Gregory Deyermenjian | 1996 | 1996 Pyramids of Paratoari/Pantiacolla Expedition |
| Charles E. Rawlings II | 1996 | Photographic Survey of the Cephalopods of Palau |
| Gregory Deyermenjian | 1997 | The 1997 Lake Parime/El Dorado Expedition |
| William K. Klimack | 1997 | Mount Ranier Steam Caves Expedition |
| Sylvia A. Earle | 1998 | Aquarius 9806 Mission |
| William Klimack | 1998 | Mount Ranier Steam Cave Expedition 1998 |
| Shane Lundgren | 1998 | Trans-Polar Flight 1998 |
| Patrick J. Scannon, Ph.D. | 1999 | Palau-Marine, AAF, Navy Expedition, P-Man |
| Steven Van Beek | 1999 | Lancang Headwaters, Xinghai Province, China |
| William N. Rom, M.D. | 2000 | Shackleton Crossing of South Georgia |
| Gregory Deyermenjian | 2000 | The Paititi Expedition |
| Sylvia A. Earle | 2002 | Sustainable Seas Expedition 2002 |
| Patrick J. Scannon, M.D., Ph.D. | 2003 | P-MAN (Palau-Marines + Army Air Force + Navy) |
| James Westerman | 2004 | Abydos Research Project |
| Peter J. Foley | 2005 | Gonshan, Yunnan trek to a mountain Nu Village |
| Peter J. Foley | 2006 | Nu villages Yunnan Tibet Borders |
| Mark Fowler | 2007 | Operation Deep Climb |
| Luc Hardy | 2008 | PAX ARCTICA |

# TAB A

## Physiological Response in a Double Lung Transplant Patient to Extreme Exertion while Exposed to High Altitude and Cold Temperatures

This study analyzed the unique physiological response in a double lung transplant patient to extreme exertion while exposed to high altitude and cold temperatures. A lung transplant includes connecting three structures: arteries, veins, and bronchus. However, the critical lymphatic system is not connected. Fluid buildup during edema is therefore not removed by the lymphatic system and is unique in this study. The purpose of this study was to measure the effectiveness of a lung transplant patient's ability to acclimatize to high elevations during a mountaineering expedition, undergoing extreme exertion under conditions of high altitude and arctic cold temperatures. This study included both the ability of the pulmonary system to saturate the blood with oxygen as well as to effectively preclude the onset of edema. Because the lymphatic system is not connected, a lung transplant patient is suspected to be particularly susceptible to pulmonary edema during high altitude mountaineering.

Common high altitude illnesses in any individual range from uncomfortable problems to dangerous conditions and are related to the decreased oxygen concentration in the blood caused by lower atmospheric pressure. High altitude illnesses commonly afflict those ascending from low altitudes to 7,000 feet and above. High altitude illnesses are caused by ascending too high too rapidly and all climbers are at risk. Acute mountain sickness (AMS) is the most common of altitude illnesses, and is characterized by headache, nausea, dizziness, disturbed sleep and a feeling of fatigue. AMS is not life threatening. However, AMS may progress into life threatening high altitude pulmonary edema (HAPE) or high altitude cerebral edema (HACE). HAPE is a form of high altitude illness whereby the lungs fill with fluid, and HACE is when the brain fills with fluid. HAPE is more common than HACE, although both can occur together. The primary symptoms are a noticeable decrease in the ability to exercise, a dry cough that progresses to a cough productive of frothy sputum, a feeling of air hunger and gurgling in the chest. HAPE results in the impairment of oxygen diffusion from the lungs to the blood, and the lips and fingernails may have a bluish color because of a lack of oxygen. HAPE is severely life-threatening. [i] AMS progressing to HAPE would therefore be of particular concern for a transplant patient during high altitude exposure.

During June and July of 2011, the double lung transplant patient and expedition teammates climbed Mt. McKinley (Alaska), the summit of which is 20,320 feet and stands the tallest mountain on the North American continent. This is the first ever attempt by a lung transplant patient to climb the mountain. The mountain's terrain, elevation, latitude and arctic temperatures render it similar to Mt. Everest. The patient's team and support crew included three "pararescue

jumpers" specifically trained in wilderness and high altitude rescue and medical care, four professional mountain guides, three combat wounded veterans of the US military, and four support climbers. The climbing team was sponsored by private donors and the Explorers Club.

Expedition Teammates at 14,200 feet on Mt. McKinley, Alaska

The patient is a 33-year old male who developed leukemia. His treatment required intensive chemotherapy and a subsequent bone marrow transplant. A rare complication of a bone marrow transplant is the development of graft versus host disease (GVH). In GVH the transplanted donor stem cells immunologically attack and destroy the recipient's tissue. Our patient's lungs were destroyed by the donor stem cells necessitating the lung transplantation (11 months prior to the climbing expedition). Prior to the disease, the patient exercised vigorously for over 20 years, and served in military special forces operations. Since his transplant, his level of exertion has been severely limited but has worked up to walking 13 miles in three hours and 20 minutes. At commencement of the expedition, he was 195 lbs, 5'8'' with an estimated body fat of 20-23%. Data were recorded on the patient and on two control subjects. The first control subject was a 53 year old male, fit but not acclimatized to high altitudes, residing at sea-level. His fitness training included two to four hours per day for one year, focusing on aerobic and strength fitness. The second control subject was a professional, male mountain guide in his 20s, very fit (ran across Alaska only weeks before the climbing expedition for 1000+ miles, averaging over 30 miles per day), experienced in high altitude environments, but not acclimatized.

The following data were recorded on the patient and on the two control subjects prior to, and during the climb of Mt. McKinley: heart rate (bpm), arterial oxygen saturation (%$SpO_2$), venous cerebral oxygen saturation (%$rSO_2$), and cognitive assessments (i.e., orientation, registration, recall, and apraxia), commensurate with elevation, atmospheric pressure, temperature, and relative humidity. Lung sounds were evaluated as necessary using a stethoscope. The data were recorded using a Nonin Equanox Model 8000CA %$rSO_2$ for venous cerebral oxygen saturation; a Nonin Onyx %$SpO_2$ for arterial oxygen saturation and heart rate; and a Kestral 4000 Pocket Weather Tracker for environmental conditions. The Nonin Onyx pulse oximeter reflects arterial $O_2$ saturation of hemoglobin and represents $O_2$ delivered to tissues, while the Nonin cerebral oximeter reflects venous $O_2$ saturation at the surface of the brain after oxygen extraction from the tissue. Data were recorded before and after physical exertion, as well as during peak exertion when trail and climbing conditions permitted.

Nonin Equanox Model 8000CA cerebral oximeter in use. Note padded cover (made from sleeping pad material and duct tape) for insulation and impact resistance

The data results are presented in the following graphs:

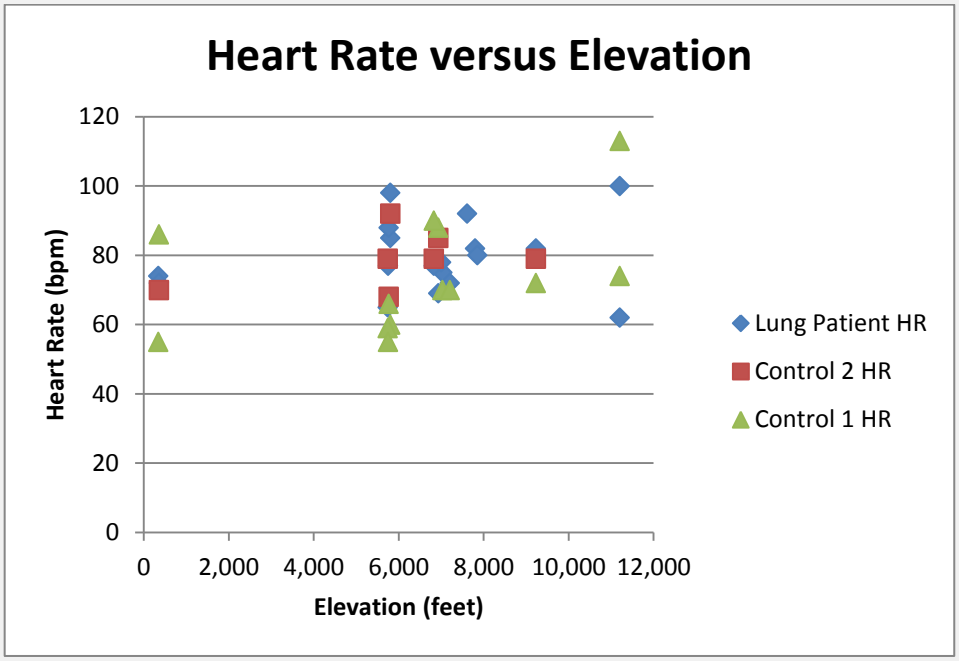



Figure 1

Figure 1 describes the changes in the climbers' heart rates as a function of elevation. The data show heart rate (both resting and during exertion) to be directly proportional to elevation. The exerted heart rate demonstrated the more pronounced increase from sea level to higher elevations, and this trend was comparable between climbers.

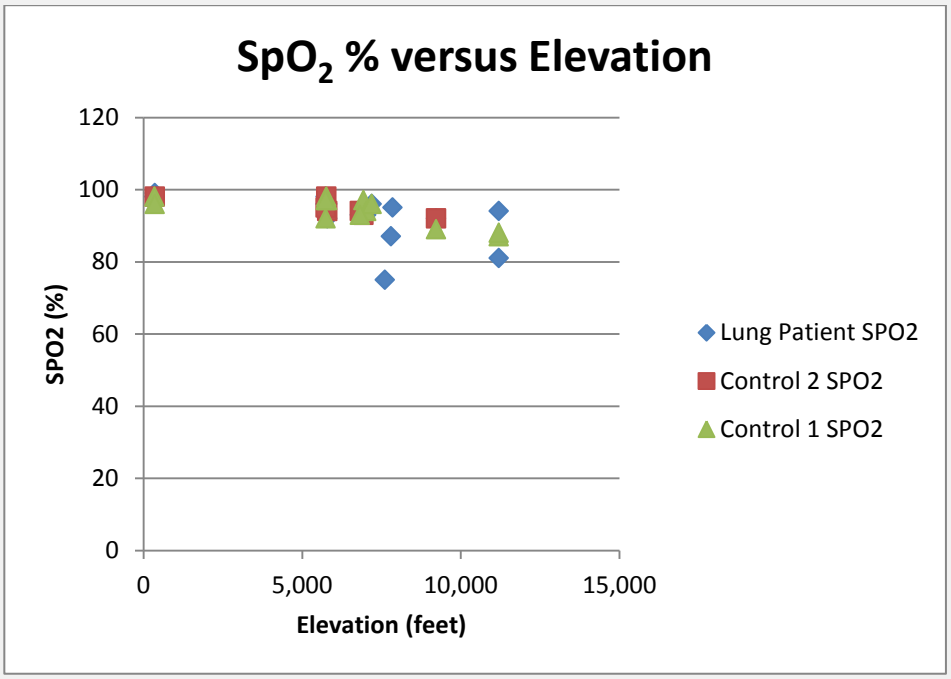



Figure 2

Figure 2 illustrates that the pulse oximeter readings were indirectly proportional to elevation, and this trend was comparable among climbers. The data and trend analysis indicate that the lung patient's arterial oxygen saturation was comparable to those of the control climbers, verifying that the patient's lungs were functioning satisfactorily.

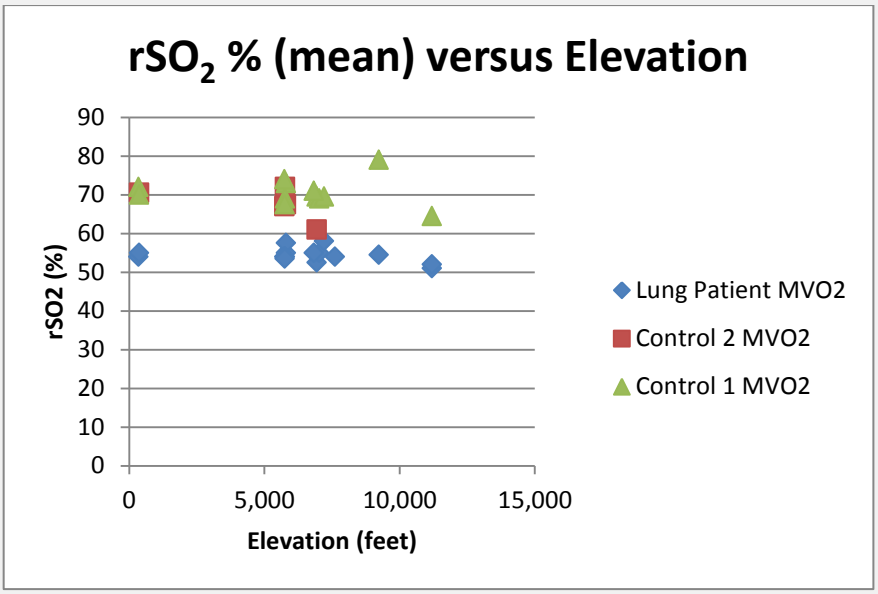



Figure 3

Figure 3 provides the clearest indicator of respiratory deficiency for the lung patient. This person's cerebral venous oxygen levels were significantly lower than those of the control climbers. Of equal note is the relative stability of $\%rSO_2$ values among all three climbers. The stability of the values indicates the successful efficiency of the pulmonary system. However, the marked lower average values for the lung patient indicates a deficiency in the oxygen carrying hemoglobin, indicative of anemia.

Because of various physiological similarities and differences between the three climbers, the trends of the respective values plotted in figures 1 through 3, and not the absolute values, are most important. The data illustrated in figures 1 and 2 indicate that the lung patient successfully absorbed the limited oxygen at high elevations, comparable to control subjects one and two. All three climbers had comparable heart rates and arterial oxygen saturation. These figures validated the successful performance of the double lung transplant patient to climb at altitude. However, figure 3 indicates that the lung patient had significantly lower venous oxygen leaving the brain. He is noted to be anemic and this may account for the lower cerebral oximetric readings. Blood tests conducted on the lung patient indicated hemoglobin of 10.5 to 11 and a hematocrit of 34-38. Four fungi were identified in the subject's lungs as a result of the immunosuppression. During the expedition, the cerebral oxygen levels for the lung patient ranged from a high of 58% when at 6,800 feet to a low of 52% at 11,200 feet (a decreasing trend). The patient's cerebral oxygen at sea level was 54%. The cerebral oxygen levels for the control climbers varied from a high of 73-75% at 5,800 feet to a low of 67% at 11,200 feet. Mild AMS symptoms, other than being out of breath, were not detected. Additionally, the lung patient successfully climbed to 11,200 feet before any indications of pulmonary edema. Only after approximately 36 hours at 11,200 feet did

the lung patient develop preliminary indications of the pulmonary edema onset; i.e., coughing up flem, labored breathing during light camp chores, and the lower right lobe demonstrated slight rhales measured through a stethoscope. Cognitive tests indicated that neither cognitive degradation nor cerebral edema developed.

Errors or misleading data could be caused by low skin or appendage temperatures common in the arctic conditions, and recordings not taken at precise exertion moments for the climbers. While significant effort was expended to ensure consistent conditions during data sets, trail conditions (e.g., crevasses, steepness of terrain, and risk of rock fall) often precluded the recording of data at precise moments during exertion (e.g., immediately after specified period of exertion). Additionally, medications and potentially concomitant blood disorders (e.g., anemia) may mask or compromise the patient's acclimatization abilities. The lung patient takes prednisone, prograf and Cellcept as immunosuppressants and marrow production suppressants. With respect to spirometry, the patient's fraction of exhaled volume (FEV1) and forced vital capacity (FVC) were approximately 50% of normal and the diffusion of carbon monoxide in lung (DLCO) (i.e., gas rate of exchange across the alveoli) was approximately 45%. Finally, the $\%rSO_2$ data recorded on the lung patient may very well be normal for that individual and not considered problematic.

Further future studies should include the Nonin 4-wavelength cerebral oximeter (so as to provide greater precision in recording cerebral oxygen levels), in addition to the aforementioned testing devices. Additional tests should be conducted after normalizing the lung patient's hemoglobin. Erythropoietin may be administered to stimulate red blood cell production and correct anemia. Future data sets should include blood tests measuring hematocrit, absolute arterial and venous oxygen concentration (i.e., not simply percent), spirometry, lactic acid levels, and arterial blood gases. This should be conducted on all subjects prior to, during and after climbing at precise times relative to exertion.

As a result of the study of the physiological response in a double lung transplant patient on Mt. McKinley during extreme exertion while exposed to high altitude and cold temperatures, it was found that there was no adverse impact of high altitude and extreme exertion beyond that on a normal, healthy individual. The pulmonary system in the lung patient performed well under the extreme conditions. However, the hematocrit levels and the potentially concomitant cerebral oximetry readings were consistently low in the lung patient. These and the early indication of pulmonary edema onset (as indicated by the slight rhales in the lower right lobe) may have affected the patient's ability to successfully acclimatize. The study successfully analyzed the potential for pulmonary edema in a lung transplant patient. The patient's lungs performed very well in this regard; i.e., good arterial saturation. However, low cerebral $O_2$ caused by anemia significantly affected the patient's ability as a climber to acclimatize.

[1] "Mountaineering in Denali National Park and Preserve," National Park Service Alaska, US Department of the Interior, 2005

# TAB B

## Spatiotemporal Parameters and Step Activity of a Specialized Stepping Pattern Used by a Transtibial Amputee During a Denali Mountaineering Expedition.
## A Case Report

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Keywords: Extreme Athletics, Gait, Leg Amputation, Recreation, Prosthesis, Rehabilitation, Physical Therapy

**Abstract**

There are numerous mountain climbing stepping patterns including the *French Technique*. The *French Technique,* reportedly eases the ability to ambulate in ice, snow and sloped terrain. Specialized step patterns for mountaineering expeditions have not been studied in transtibial amputees (TTA). Therefore, the purpose of this report was to describe spatiotemporal differences between French and traditional stepping in a TTA and report his step activity during an climbing expedition on Mt. Mckinley in Denali, Alaska, USA. A well conditioned 51yr old male with right TTA was provided a step counter, daily journal and event log to utilize and complete during a summit attempt on Mt. McKinley's West Buttress Route. Following the climb, the subject traversed a Gaitrite portable walkway while demonstrating the French Step technique and traditional stepping in a laboratory setting to compare spatiotemporal differences in the stepping patterns. Ultimately, the case climber completed 8 days on the trail, which included three crevasse falls and a total step count of 62,421. The average daily step count for active climbing days was 10,404. An estimated 27% of steps were taken with the French Step technique. Five total events were logged; one dermatologic, three musculoskeletal events and the culminating event was cardiovascular in nature where the climber reported overheating and exertion and ultimately "bonking" requiring climb cessation and evacuation. For velocity, the French stepping technique was significantly slower than traditional stepping. Stride, step and double support times were all greater in French stepping compared to traditional stepping. Spatially, stride and step lengths were greater in traditional stepping compared to French stepping. The width of the base of support was significantly wider in the French Step than in traditional stepping. We hypothesized dermatologic and prosthetic issues would predominate the event log. Instead, musculoskeletal issues predominated. A fatigue issue ultimately concluded the climb warranting further investigation into balancing component durability and mass in terms of prosthetic foot selection. Regarding stepping techniques, as the altitude got progressively higher, the French Step was selected as the preferred strategy. The French Step is ultimately a slower stepping technique with qualities suggestive of heightened stepping stability as opposed to mobility.

## Background

There are numerous mountain climbing techniques and stepping patterns such as the *French Technique* and the *Rest Step*.[1] The *French Technique,* is described as easing the ability to traverse ice, snow and gentle to steep mountain grades (0-60˚ pitch). French Stepping is also known as *Flat Footing* because one of this pattern's goals is to keep the soul of the footwear parallel to the snow/ice. The rest step is a mountaineering stepping pattern reportedly used to ascend steep slopes. It incorporates a pause on the fully extended trailing leg, while the front leg is relaxed except as needed for postural adjustment and balance. The rest step is so named as it is believed to relieve leg muscle exertion in an alternating pattern throughout the ascent. Specialized gait patterns and their potential benefit or detriment for mountaineering expeditions have not been studied in persons with transtibial amputation (TTA). Therefore, the purpose of this case report was to 1) describe spatiotemporal differences between the French Step and typical walking patterns of a TTA in a laboratory setting and 2) to report the qualitative and quantitative step activity of a TTA during an actual climbing expedition on Mt. Mckinley in Denali, Alaska, USA.

## Methods

*Subject and Prosthesis*

The subject was a 51yr old male (height 183 cm and weight 96 kg) with right transtibial amputation. On the five level functional ambulation scale where level 0 are non-ambulators, level 1 is supervised prosthetic use for transfers and therapy, level 2 are household ambulators, level 3 are community ambulators and level 4 classifies prosthetic use beyond basic ambulation, he was a functional level 4 ambulator.[2] He received a score of 45/47 on the amputee mobility predictor which corroborates his clinically determined level 4 ambulation skills.[3] During medical evaluation he was found to have comorbid but pharmacologically controlled hypertension, gastroesophageal reflux disease and phantom limb pain. The subject's primary care physician cleared him to participate in an expeditionary summit attempt on Mt. McKinley in Denali, Alaska, USA. His amputation was of traumatic etiology 4 yr prior to this report. His cylindrically shaped residual limb was 28cm long (53% length of sound tibia- Figure 1.) with bone bridging procedure,[4] posterior flap closure and its characteristic anterior-distal scar. The subject had 5/5 extensor and flexor strength (manual muscle test)[5] bilaterally in the hips, knees and sound side ankle. Subject's range of motion was normal for age at all lower extremity joints.[6] The subject's prosthesis included a carbon fiber laminated total surface bearing socket with a uniform Alps cushion liner (St. Petersburg, FL, USA) Otto Bock Derma ProFlex suspension sleeve (Duderstadt, Germany) and an Ossur Vertical Shock Pylon (VSP) foot component (Reykjavik, Iceland). The subject reported having his current socket for 2 yr and his foot component for 4 yr with no modifications, repairs or adjustments. He further reported that he routinely fluctuates between 10 sock plies (achieved via two, 5-ply socks) and 12 plies (achieved by adding two additional one-ply socks) in a given day. His weekly activity was self-described as "highly active", including 6 days per week of circuit training exercise with primary emphasis on large muscle groups of the lower extremity (such as the quadriceps femoris, gluteal group, hamstrings and sound plantar flexors). In preparation for the Denali expedition, this

training routine was highly consistent for 7 months. Prior to this time, the subject's exercise preference was biased toward upper extremity strengthening. Additionally, the subject self-reported an estimated daily 2500 to 3000 kCal diet consistent with caloric output paying attention to avoid caloric deficit given the increased metabolic demands for the aforementioned circuit training. The subject specifically increased protein and reduced carbohydrate intake while maintaining a variety of fruit and vegetable intake.

*Data Form & Step Activity Monitor*

A daily data journal was developed to include the day of the week/date, daily step count, peak daily altitude, duration spent climbing, an overall daily rating of perceived exertion (0-10 scale) [7] and notes for freeform comments. In addition to the daily journal, an event log was provided that prompted the subject to capture any event of consequence (such as dermatologic, prosthetic, musculoskeletal issues, etc.), the pedometry count and time at the instance such an event was recognized, the day of the climb, a description of both the problem and solution and a prompt to take a photo of the issue. Step count was monitored both daily and at events (as previously described) using a Sportline ThinQ XA Model 305 Pedometer (Yonkers, New York, USA). The pedometer was hung on a lanyard around the climber's neck such that the climber's core temperature would keep the instrument within its described operating temperature range and such that clothing and gear strapping would minimize extraneous instrument movement that could erroneously be counted as steps.

*Mt. McKinley Denali Mountaineering Plan*

The 15 member expedition team included professionally trained mountaineering guides and emergency medical personnel. The team planned to traverse the 26.7 km (16.6 mile) trail along Denali's West Buttress route. Once on the trail, the expedition was scheduled to take approximately 17 days to reach the summit notwithstanding inclement weather. The planned ascent would start at 2,195 m (7,200 ft) and elevate to 6,194 m (20,320 ft) of altitude at the summit. The team planned to encounter perilous crevasses and thus trained and equipped to rescue fallen climbers. Because the snow covered ground would soften during the daylight hours due to increased temperature and ground-thaw, the team planned to travel at night. Specific training immediately preceding and during the climb occurred daily and included vital topics ranging from knot tying, crevasse rescue, acute mountain sickness (AMS) symptom recognition and varied gait patterns to accomplish such goals as team stepping synchrony.

*Spatiotemporal Gait Data Collection*

Two weeks following the climbing expedition, the climber with amputation reported to the University of South Florida's Human Functional Performance Laboratory for a debriefing interview and to demonstrate French Stepping, self-selected walking speed ([SSWS] and gait pattern) and fastest possible walking speed ([FPWS] and gait pattern). At debriefing, investigators and climber reviewed the daily climbing journal and event log. Following debriefing, the subject traversed a7.92 m (26 ft) GaitRite portable walkway (Haverton, PA) three times each with the stepping patterns and velocities previously described. The GaitRite portable walkway is a valid and reliable instrument for recording spatiotemporal parameters of gait which has been used in the amputee population. [8] While all of the spatiotemporal gait parameters captured by the GaitRite walkway were collected, the following variables were selected *a priori* for analysis:

1. velocity
2. stride length
3. step length
4. base of support (BOS) width
5. stride time
6. step time
7. double support time (time with both feet on the ground)

It is known that side to side asymmetry exists with unilateral TTA.[8] However, the purpose of this report is to gain a preliminary understanding of spatiotemporal differences between these particular gait patterns. Therefore, left and right side data (i.e. unilaterally recorded data) were averaged together to describe the given stepping pattern's bilaterally averaged parameter (e.g. stride time, stride length, etc.). Between pattern differences were compared with a repeated measures ANOVA and statistical significance was set at $p \leq 0.05$. Statistical analyses were performed using SPSS 2011 (Armonk, New York, USA).

**Results**

*Daily Step Activity Data and Event Journal*

The daily step count revealed 8 days on the trail (Table 1), 2 of which were predominated by rest (day 2) or inclement weather (day7). The subject reported three crevasse falls through ice (days 2 and 3). The total step count on the trail was 62,421 (days 2 and 7 not included). The average daily step count for the 6 active climbing days was 10,404 (range 6,640 to 12,540). Of active climbing days, the climber estimated that 27% of steps (17,095 steps) were taken with the French Step technique. The event log documents five total events (Table 2). Of these, one was dermatologic in nature, three musculoskeletal events were documented and the culminating event was cardiovascular in nature where the TTA climber reported overheating, exertion and ultimately, "hitting the wall" or "bonking" requiring cessation to his climb and evacuation from the summit attempt. The climb terminated at 4,115 m (13,500 ft) of altitude which is greater than half of the total trek.

*Spatiotemporal Gait Data*

Figure 2. demonstrates that gait velocity was $185 \pm 1.1$cm/s (FPWS), $140 \pm 5.4$cm/s (SSWS) and $20 \pm 9.8$cm/s (French Step) and each value was significantly different from both others ($p \leq 0.01$). *A priori* selected temporal parameters were also all significantly different ($p \leq 0.05$) from the respective measures from the other stepping patterns (Figure 3). These measures included stride time ($1.1 \pm 0.0$sec [SSWS], $1.0 \pm 0.0$sec [FPWS] and $4.7 \pm 1.7$sec [French Step]), step time ($0.6 \pm 0.0$sec [SSWS], $0.5 \pm 0.0$sec [FPWS] and $2.4 \pm 0.8$sec [French Step]) and double support time ($0.3 \pm 0.0$sec [SSWS], $0.2 \pm 0.0$sec [FPWS] and $3.7 \pm 1.9$sec [French Step]). Two of three of the selected spatial parameters (stride and step length) were also all significantly different ($p \leq 0.01$) from the respective measures from the other stepping patterns (Figure 4). Stride lengths were $157.9 \pm 2.3$ cm [SSWS], $176.1 \pm 0.9$ cm [FPWS] and $81.7 \pm 5.1$ cm [French Step]. Step lengths were $79.0 \pm 1.1$ cm [SSWS], $88.0 \pm 0.6$ cm [FPWS] and $40.4 \pm 2.6$ cm [French Step]. The width of the base of support (BOS) was significantly wider in the French Step ($24.9 \pm 1.9$cm) than in both SSWS ($13.2 \pm 0.6$cm) and FPWS ($12.9 \pm 1.7$cm) typical walking. The BOS in SSWS and FPWS typical walking patterns were not different.

**Discussion**

The purpose of this case report was to 1) report the qualitative and quantitative step activity of a TTA during an actual climbing expedition on Mt. Mckinley in Denali, Alaska, USA

and 2) to describe spatiotemporal differences between the French Step and typical walking patterns of a TTA in a laboratory setting.

Based on laboratory measured step length of traditional stepping at SSWS (79cm) and the French Step (40cm), we estimate that with a step count of 62,421 steps where 27% were taken with the French technique and 73% with traditional stepping, approximately 46.9 km were covered in total. We recognize that this is potentially an overestimation as it is likely that the step length of traditional stepping during the climb was shorter due to a number of factors including ground inclination, depth of snow, pack load, adverse weather, etc. Nonetheless, this seems to coincide with the climbing team's reported stopping location. The case climber reported utilizing the French Stepping technique as the rest step of choice as the altitude of the climb got progressively higher.

The daily step count averaged 10,404 steps on active climbing days. This is greater than the typical daily step count measured in community ambulating lower limb amputees which is 6,000 steps.[9, 10] This is of course expected given the nature of the expedition where destinations must be reached for critical reasons such as safety. Interestingly however, the average daily step count on the trail is only slightly greater than the 10,000 daily steps recommended for a healthy lifestyle.[11] This highlights a considerable limitation with step counting. That is, step counting provides no information about the intensity of stepping (i.e. the step rate).[10] Therefore, in order to understand the difficulty of stepping, choices would be journaling, rating exertion or utilizing more sophisticated instruments to capture step rate, bout duration and other parameters associated with ambulation. In this case, more sophisticated instrumentation was cost prohibitive and presented potential reliability challenges in terms of thermal affects regarding equipment function. Therefore, we opted for both journaling and rating exertion.

**Table 1. Daily Step Activity**

| Day # | Steps | Predominant Gait Pattern (FS or TS) | Altitude (m) | Time on Trail (hr) | RPE (0-10) |
|---|---|---|---|---|---|
| 1 | 10,688 | TS | 2,195 | 1 | 3 |
| 2 | 1,292 | TS | 2,195 | 0* | 1 |
| 3 | 11,640 | TS | 2,080 | 6† | 4 |
| 4 | 12,540 | TS | 2,320 | 5 | 6 |
| 5 | 10,458 | TS | 2,813 | 8 | 6 |
| 6 | 10,455 | FS | 3,566 | 9 | 7 |
| 7 | 1,100 | FS | 3,566 | 0** | 3 |
| 8 | 6,640 | FS | 4,115 | 3 | 10 |

French Step (FS); Not Tested (NT); Rate of Perceived Exertion for cumulative daily effort (RPE: 0 to 10 Scale where 0 is no exertion at all and 10 is equivalent to a maximal effort); Traditional Step (TS); *Planned rest day and one fall through ice; †Two falls through ice; **Inclement weather.

It is obvious that stepping in this environment is more challenging, regardless of step count but it is important to gain an understanding of what the stepping demands are, in terms of volume of activity, so that appropriate prosthetic components can be selected to minimize potential durability issues. In the case climber, a durable foot was selected, which by the event log, presented no issues. Conversely, the climber bonked and was evacuated. It is therefore attractive to speculate if a foot component with less mass could meet the durability challenge while simultaneously being less fatiguing allowing for greater distance on the climb to be achieved. Though this is a difficult environment in which to conduct such study, the information is vital for select populations. For instance, military personnel who have sustained service related amputations may need to perform with minimal impairment in comparable environments in order to continue service. Ecologically valid data such as these provide some insight into human performance under these circumstances.

**Table 2. Event Log**

| Day # | Event: Cardiovascular, Dermatologic, Musculoskeletal, Prosthetic | Description of Problem | Description of Solution |
|---|---|---|---|
| 1 | Musculoskeletal | Pain due to excessive lateral knee pressure. | Concentrate on even weight distribution and knee flexion. Use sound leg maximally to ensure equal line tension and prevent damage to residual limb/prosthesis. |
| 2 | 1) Dermatologic<br>2) Musculoskeletal | 1) Skin breakdown left (sound side) ankle.<br>2) Fall thru ice strained right knee. | 1) Friction from boot. Taping to ankle as barrier remedied issue.<br>2) Rest. |
| 4 | Musculoskeletal | Experienced compression to lumbar spine on landing from crevasse jump. | Following experience, no problems noted so no solution required. |
| 8 | Cardiovascular | Bonked and overheated. | Climbing cessation. Rest. Oxygen. Routine vital sign monitoring. Evacuation. |

Finally, we presented spatiotemporal differences between traditional and French Stepping. The French Step technique incorporates decreased velocity, step & stride length and an increased BOS relative to traditional stepping at comfortable and fast speeds. Relative to temporal differences, French Stepping utilizes increased stride, step and double support time. Ultimately, the French Step is a slower more deliberate gait that takes on similarities to populations that utilize more stable stepping patterns such as the gait observed in toddlers, geriatric persons and bilaterally involved amputees of dysvascular.[8, 12, 13] Each of these groups have the tendency to walk slower, increase step width and double support time, all parameters that decrease mobility, in order to improve the stability profile of their gait pattern.

Cumulatively, in the laboratory setting, the distance traversed by the French Step is approximately half that covered by traditional SSWS. Furthermore, the duration required to complete steps and/or strides were 4 to 5 times greater in French stepping than traditional stepping. Finally, the velocity was also 4 to 5 times slower in French stepping. Taken in total, this quantitative spatiotemporal profile of French stepping agrees with aspects of the qualitatively outlined description which describes a stepping pattern that favors stability and optimizes rest.[1] Other means of study are necessary to determine if ground reaction forces approximate joint centers minimizing environmental influence on joints and whether or not muscles are less active using the French step technique relative to other stepping patterns.

*Limitations*

This project had several limitations that must be considered. To begin with, data collected on an expedition such as this is justifiably at risk of being a secondary responsibility and thus at risk of being of sub-optimal quality and/or incomplete. Potential sources of such error include the journal and exertion ratings. Step counters as an instrument have potential error associated with extraneous movement despite attempts to minimize them. Finally, making field inferences from laboratory collected data will have obvious limitations in terms of precision.

**Conclusion**

We hypothesized that dermatological and prosthetic component issues would predominate the case climber's event log. In fact, musculoskeletal issues predominated and the only skin issue was not associated directly with the prosthesis. Similarly, the prosthesis presented no failure issues. However, a fatigue issue ultimately concluded the climb which warrants further investigation into balancing component durability and mass in terms of prosthetic foot selection. In terms of stepping techniques, as the altitude got progressively higher, the French Step technique was selected by the climber as the strategy of choice. The French Step technique is ultimately a slower stepping techniques with qualities suggestive of heightened stepping stability as opposed to mobility.

**Acknowledgements**

This project was unfunded and authors declare no conflict of interest.

**Figure Captions:**

Figure 1: A) Anterior view of case climber's residual limb. B) Posterior view of case climber's residual limb. C) Case climber wearing prosthesis used during his summit attempt on Mt. McKinley.


**Figure 1**

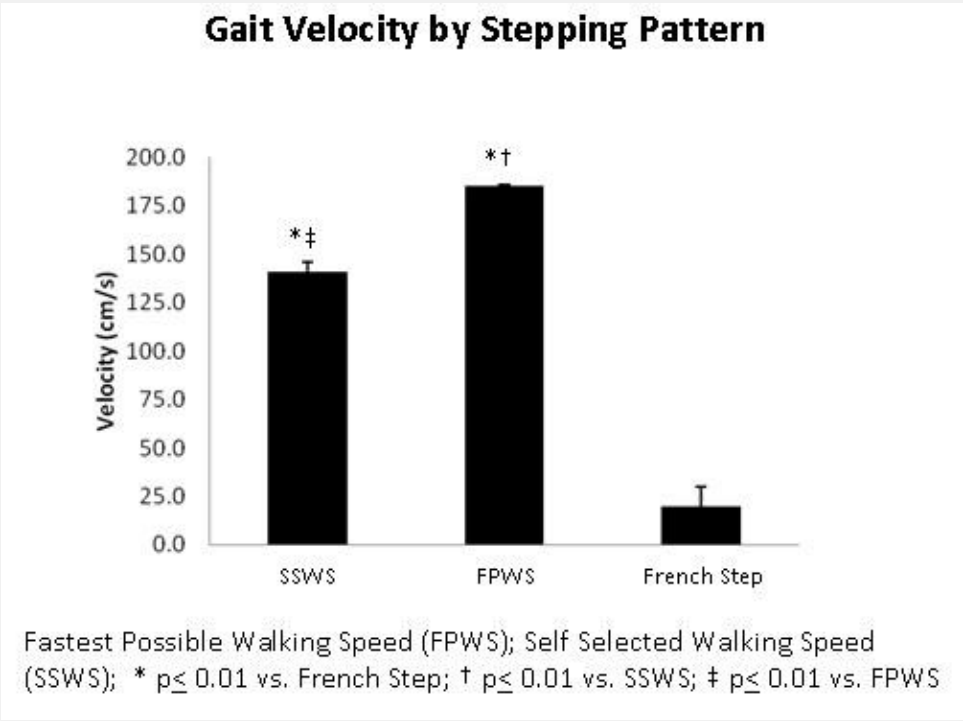
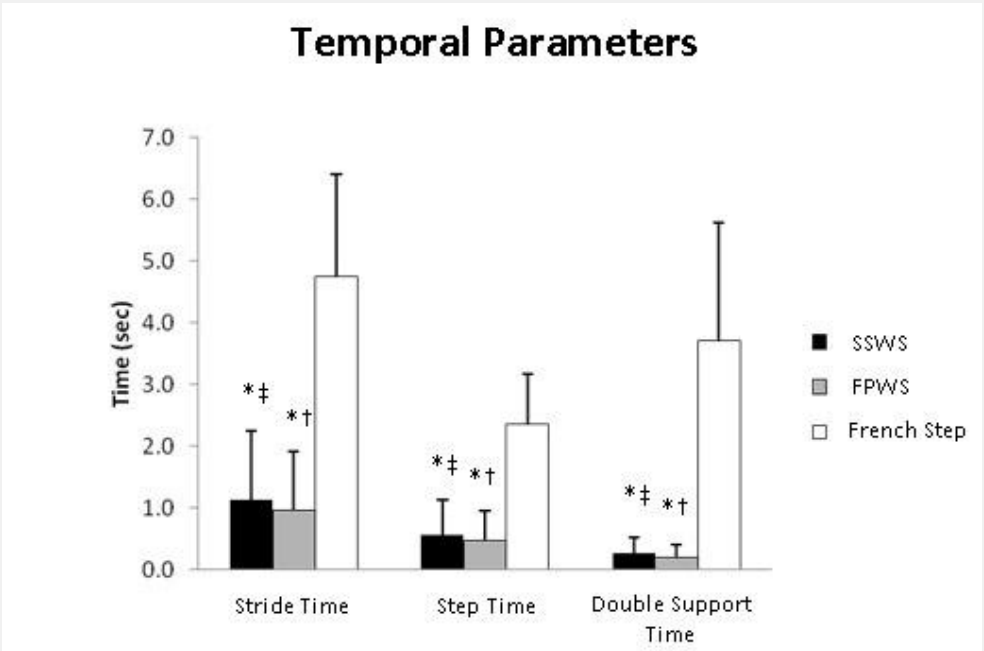
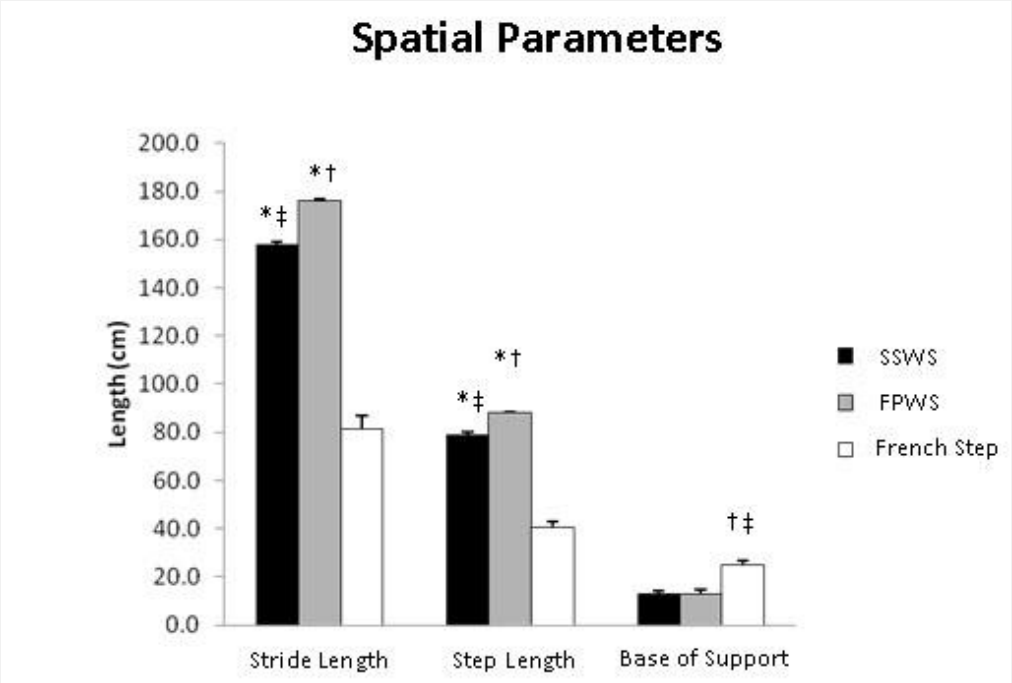



**Figure 2**




Fastest Possible Walking Speed (FPWS); Self Selected Walking Speed (SSWS); * p≤ 0.05 vs. French Step; † p≤ 0.05 vs. SSWS; ‡ p≤ 0.05 vs. FPWS

**Figure 3**




Fastest Possible Walking Speed (FPWS); Self Selected Walking Speed (SSWS); * p≤ 0.01 vs. French Step; † p≤ 0.01 vs. SSWS; ‡ p≤ 0.01 vs. FPWS

**Figure 4**

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