

Return to Duty After Type III Open Tibia Fracture

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Introduction: Despite the high incidence of battlefield orthopaedic injuries, long term outcomes and return to duty (RTD) status have rarely been studied. Our purpose was to determine the RTD rate for soldiers who sustained Type III open tibia fractures in active combat.

Methods: One hundred fifteen soldiers who sustained battle related Type III open tibia fractures were retrospectively reviewed. The Army Physical Evaluation Board database was reviewed to determine which soldiers were able to RTD and the disability ratings of those not able to RTD.

Results: The overall RTD rate was 18%, isolated open fractures had a RTD rate of 22%, salvaged extremities had a RTD rate of 20.5%, and amputees had a RTD rate of 12.5%. Older age and higher rank were both significant factors in increasing the likelihood of RTD and amputees had significantly higher disability ratings than those with salvaged extremities.

Conclusion: Despite the severe nature of combat extremity wounds, 20% of patients with salvaged Type III open tibia fractures and 22% with isolated injuries were able to return to active duty. These rates are similar to those reported for civilian amputees. Amputees in our cohort were less likely to RTD.

Key Words: tibia fracture, return to work, return to duty, Type III open fracture, combat injury

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INTRODUCTION

Despite the high incidence of battlefield orthopaedic injuries, long-term outcomes after combat injury are scarcely reported. Return to work is a commonly reported outcome

measure after traumatic injury, and outcome data in a military population are only available for patients with a limb amputation ranging from 2.3% to 16.5%.¹ Civilian trauma patients with severe lower extremity injuries have a well-documented rate of returning to work (49–53%)², and in the military, the equivalent metric is return to active duty service after combat injury. Eighty-two percent of injured US military personnel have sustained extremity injuries during the ongoing conflicts in Afghanistan and Iraq,³ and the majority of injuries (79%) are secondary to explosions.⁴ Fractures sustained during the current conflicts are predominantly open fractures (82%) demonstrating the severity of battlefield injuries.^{3,5}

Our aim was to determine the return to duty rate for soldiers who sustained severe lower extremity trauma, specifically Gustilo and Anderson Type III open tibia fractures, and who underwent either limb salvage or amputation.

PATIENTS AND METHODS

After protocol approval by our Institutional Review Board, we identified battle wounded soldiers with Type III open tibia fractures occurring between 2003 and 2007 treated definitively in a US military medical center. We reviewed patient records to characterize the injuries and outcomes, including limb salvage versus amputation, age, rank, gender, mechanism of injury, injury pattern, associated injuries, and presence of complications. We queried each patient in the Army Physical Evaluation Board (PEB) database for disposition and disability evaluation. The PEB is a body of military and medical personnel who determine if a service member is unable to return to active duty service.^{6–8} If a soldier's condition at the time of maximal medical improvement, as determined by his physicians, is not sufficient for return to active duty, he or she requires a PEB evaluation. The PEB results indicate permanent disability retirement, separation with severance pay, temporary disability retirement list, or fit for duty. The first three dispositions indicate that a soldier is unable to return to duty and is therefore medically retired or separated (MRS). A soldier may also return to active duty with a disposition of continuation on active duty (COAD), which allows an individual to return to active duty after a PEB appeal process and a change in job status.⁹ We surveyed each patient's electronic medical record for documentation of COAD status because the PEB database does not capture COAD status as one method of return to duty.

Each soldier who is not fit for duty, as determined by the PEB, has a list of "unfitting conditions," indicating persistent disability. "Unfitting conditions" are coded using the Veterans

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This study was conducted under a protocol reviewed and approved by the Brooke Army Medical Center Institutional Review Board and in accordance with good clinical practice.

The opinions or assertions contained herein are the private views of the author and are not the construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

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Affairs System of Rating Disabilities and are assigned a percent disability.¹⁰ We calculated each soldier's overall disability rating using this system when they were unable to return to duty (RTD).

We calculated the RTD rate by combining the soldiers who were fit for duty by recovery (no PEB), those who were found fit for duty at the PEB, and those who returned to duty on COAD. We compared the demographics, injury characteristics, and disability ratings between soldiers who were MRS and those who RTD and also performed separate analyses on salvaged versus amputated extremities. Each RTD group and "medically retired" group was compared using two-tailed Fisher exact test for categorical data or *t* tests for continuous data. Statistical significance was assessed with $P \leq 0.05$.

RESULTS

One hundred twenty-three soldiers with 138 tibia fractures met our inclusion criteria. Six soldiers were excluded from final analysis as a result of an incomplete medical record and two soldiers were dead. The remaining 115 subjects with 127 tibia fractures comprised the study cohort. The cohort demographics are listed in Table 1. A majority of soldiers were injured by explosions (Table 2), and no soldiers with Gustilo and Anderson Type IIIC fractures or with bilateral open tibia fractures returned to duty (Table 3). The RTD group was 6 years older ($P < 0.0001$) and held ranks three positions higher (E-8 vs E-5) than those who did not return to duty ($P < 0.05$). The average Injury Severity Score was 13.4 (range, 4–43) and Abbreviated Injury Score was 3.5 (range, 0–9) and showed no statistical difference between the two groups.

Twenty-one soldiers within the entire cohort were able to RTD (18.3%). Fourteen of those achieved osseous union and were able to return to duty by recovery without requiring a PEB, whereas two who salvaged their limbs required a PEB and were found fit for duty. Five soldiers were medically retired by the PEB but appealed their disposition and remained on active duty on COAD status (Fig. 1). The remaining 94 Soldiers were MRS. One soldier had bilateral injuries, a Type IIIB open tibia fracture and contralateral traumatic amputation, RTD with COAD. Soldiers who RTD experienced significantly more revision surgeries and greater time to union compared with those who were MRS ($P < 0.05$). Eighty-three soldiers salvaged their fractured limbs and had a RTD rate of 20.5%, 76 soldiers with isolated fractures salvaged their limbs and had a RTD rate of 22.4%, and the he RTD rate for

TABLE 1. Demographics

	Entire Cohort	MRS	RTD	Limb Salvage	Amputees
Age*	27	25	31	26	26
Median rank†	E-5	E-5	E-8	E-5	E-5
Percent male	94%	94%	95%	94%	94%
Injury Severity Score	13.4	14.1	11.8	14.3	14.6
Abbreviated Injury Score	3.5	3.6	3.1	3.6	3.9

* $P < 0.0001$; † $P < 0.05$ between those medical retired or separated (MRS) and return to duty (RTD).

TABLE 2. Injury Characteristics, RTD Rates and Percentages of Those With Limb Salvage Versus Amputation

	No.	MRS	RTD	Limb Salvage	Amputees
Mechanism of injury					
Explosion	90	82%	18%	79%	88%
Motor vehicle collision	17	76%	24%	7%	9%
Gunshot wound	8	88%	13%	14%	3%
Gustilo and Anderson					
Type IIIA	74	84%	16%	64%	50%
Type IIIB	47	81%	19%	32%	39%
Type IIIC	6	100%	0%	4%	11%
Segment injured					
Proximal	30	83%	17%	29%	25%
Middle	54	80%	20%	41%	22%
Distal	43	88%	12%	30%	53%
Nerve injury	45	89%	11%	26%	50%
Vascular injury	6	100%	0%	4%	11%
Bilateral fractures	12	100%	0%	9%	16%

RTD, return to duty; MRS, medical retired or separated.

amputees was 12.5%. Of the soldiers with salvaged limbs who were able to RTD, 94% were by recovery (no PEB) or by being found fit for duty at the PEB (Table 4). In contrast, all amputees required a PEB appeal for COAD status and each had documentation of vocational training or job reassignment, indicating that a true change in job status occurred for them to RTD on COAD. The COAD exception was therefore used significantly more by amputee soldiers than subjects with salvaged limbs ($P < 0.05$).

PEB results for the MRS group included 208 "unfitting conditions" and an average disability rating of 50%. One hundred forty-three of the unfitting conditions (69%) resulted directly from the soldiers' open tibia fractures (Fig. 2). Psychiatric conditions (including posttraumatic stress disorder) and traumatic brain injury were present in 17% and 6%, respectively, of MRS soldiers. The disability ratings associated

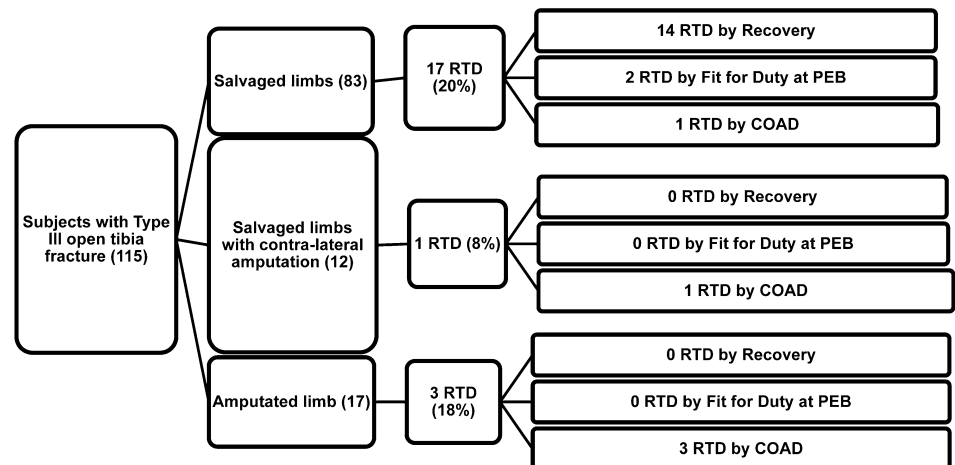
TABLE 3. Treatment/Outcome and RTD Rates

	No.	MRS	RTD
Irrigations and débridements (average)		6.15	6.14
Revisions (average)		1.38	2.05*
Coverage			
None required	42	88%	12%
Split-thickness skin graft	29	79%	21%
Flap	32	72%	28%
Unknown	25	96%	4%
Tibia union	105	83%	17%
Time to union (months)		8.9	13.2*
Malunion	13	85%	15%
Osteomyelitis	25	92%	8%

* $P < 0.05$.

RTD, return to duty; MRS, medical retired or separated.

FIGURE 1. One hundred fifteen subjects met inclusion criteria. Each subset may have return to duty (RTD) by recovery of the limb, being found fit for duty at the Physical Evaluation Board (PEB), or by continuation on active duty (COAD). RTD by COAD required a true change in job status in this cohort as indicated new vocational training or reassignment.



with a salvaged limb averaged approximately two thirds of those with an amputation ($P < 0.05$) (Tables 5 and 6).

DISCUSSION

Although return to work data for civilian trauma patients are well established, this is among the first evaluations of military personnel with severe lower extremity injuries.^{11–15} Stinner et al demonstrated RTD rates during the current conflicts, reporting an overall rate of 16.5% for amputees and 20% for those with a single extremity amputation.⁷ This is much higher than what was previously reported by Kishbaugh et al during the 1980s.¹ Our overall RTD rate for salvaged limbs was 20%, it was 22% for isolated salvaged injuries, and 12.5% for amputees. Although our RTD rate for amputees was lower than that reported by Stinner et al, this was not significantly different than the rate for our salvaged limbs resulting from the small number of amputees in our study. A majority (14 of 17) of the soldiers who did RTD in the limb salvage group did so without requiring a PEB evaluation, and this did not occur for any soldiers with an amputation. This finding is similar to the Stinner et al publication, which demonstrated that soldiers with amputations require the COAD program to RTD a majority of the time.⁵ When we compare the Stinner cohort who were found fit for duty after

a transtibial amputation (nine of 130) with our cohort of isolated salvaged tibia fractures who either RTD by recovery or were found fit for duty (16 of 76), our cohort RTD at a significantly higher rate.

Our study demonstrated a lower return to duty rate compared with what is available in the civilian literature for unilateral and bilateral lower extremity injuries. Civilian trauma patients are most often injured in motor vehicle collisions and falls, whereas explosions are the most common mechanism of injury for today's wounded soldier.^{2,4} Combat-injured soldiers have sustained an average of 4.2 wounds at the time of medical evacuation,³ and it is likely that the soldiers in our cohort have more severe injuries compared with the average civilian trauma population. This difference may also be explained by the physical demands associated with military service compared with less physically demanding civilian jobs. One factor that the LEAP study group identified as a negative predictor for return to work was a subject's involvement in disability compensation litigation.¹⁴ Although such systems do not exist in the military, receiving a disability rating and retiring or separating from the military does have implications for long-term disability payments and healthcare benefits. Return to work rates in the civilian work force for combat veterans have not been reported.

Our study suggests that a soldier's age and rank may potentially be used to help predict whether or not he or she may RTD after a combat injury. This cohort's data on age and rank are consistent with that found by Stinner et al. Soldiers of higher enlisted ranks generally have more administrative job descriptions compared with younger enlisted soldiers who perform a majority of the physically demanding jobs. It is not surprising, therefore, that the younger soldiers of lower rank are not able to return to the physically demanding positions they typically hold on active duty, whereas the older senior enlisted soldiers can more easily transition back to administrative work, even if disability persists.

Disability within our cohort was substantial with the MRS group rated, on average, 50% disabled. Those with amputation were rated significantly higher than both the cohort as a whole and those with salvaged limbs, and this finding is contrary to LEAP data that suggests subjects with amputations

TABLE 4. RTD Rates for Comparison Groups

	RTD Rate	Percent RTD With Recovery or Fit for Duty	Percent RTD With COAD
Entire cohort	18.3%	81.0%	19.0%
Retained fractured limbs	20.5%	94.1%	5.9%
Amputated fracture limbs	17.6%	0.0%	100.0%*
Retained, isolated injury	22.4%	94.1%	5.9%
Amputated, isolated injury	27.3%	0.0%	100.0%*
All subjects without amputation	20.5%	94.1%*	5.9%
All subjects with an amputation	12.5%	0.0%	100.0%*

* $P < 0.05$.

RTD, return to duty; COAD, continuation on active duty.

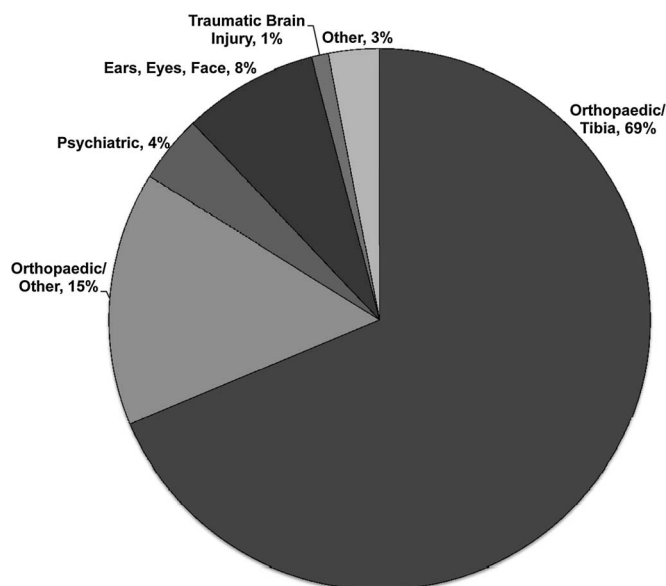


FIGURE 2. Sixty-nine percent of unfitting conditions in this cohort are directly related to the subjects' Type III open tibia fracture.

and subjects with limb salvage are equally disabled. It is possible that the statistically significant difference in disability ratings reflects the perceptions and bias of the PEB. Psychiatric conditions, including posttraumatic stress disorder, occurred in 17% of our retired cohort, and although psychologic distress may be prevalent, the long-term disability impact relates mostly to orthopaedic injuries. Although the actual incidence of posttraumatic stress disorder and other psychiatric conditions may be higher than reported in our cohort, the frequency at which these conditions cause permanent disability is lower than expected when considering rates reported in the civilian trauma literature.¹⁶ Furthermore, orthopaedic conditions directly resulting from the open tibia injury cause the largest percentage of permanent disability in our study.

The current study is retrospective in nature and retains the associated weaknesses, potential biases, and limitations of retrospective studies. In addition, this review evaluated a soldier's chance of returning to active military service without capturing those that left military service to enter the civilian workforce. The PEB status is also an ongoing process

TABLE 5. Average Percent Disabilities

Entire cohort	50%
Retained limbs	46%
Any amputation*	66%
Retained, isolated injury†	40%
Amputated, isolated injury	56%

*Percent higher than all other groups, $P < 0.05$.

†Percent lower than all other groups, $P < 0.05$.

TABLE 6. Characteristics of Bilateral Lower Extremity Injuries

	No.	Average Percent Disability
Bilateral lower extremity injuries	28	69%
Bilateral tibia fractures with		
Both salvaged	7	53%
One salvaged	3	63%
Both amputated	2	100%
Tibia fracture plus contralateral		
Traumatic amputation with		
Tibia salvaged	12	63%
Tibia amputated	4	100%

because soldiers are able to appeal their disposition or disability rating. Although these data may provide valuable information to the treating physicians counseling patients on limb salvage versus amputation, our findings do not suggest that limb salvage should be attempted for every person sustaining severe lower extremity trauma. In addition, it is possible that there were factors not documented in the medical records that led to the decision to amputate, thus potentially selecting higher energy injuries into the amputation group.

Despite the severe nature of combat extremity wounds, 18% of patients with Type III open tibia fractures and 22% of these with isolated injuries and salvaged limbs were able to return to active duty. For those not returned to duty, their orthopaedics injuries caused the greatest amount of permanent disability, and patients with an amputation were rated as significantly more disabled than those with salvaged limbs. Future studies are required to determine how often the medically retired wounded soldier is employed in the civilian workforce and why there is a discrepancy between amputees and limb salvage in the civilian and military populations.

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