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Characterization of disability following traumatic through knee and transfemoral amputations

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ABSTRACT

Introduction: The purpose of this study is to characterize through knee and transfemoral amputations following severe traumatic injuries.
Methods: A retrospective review of all transfemoral and through knee amputations sustained by United States military service members from 1 October 2001 to 30 July 2011 was conducted. Data from the Department of Defense Trauma Registry, the Armed Forces Health Longitudinal Technology Application, inpatient medical records and the Physical Evaluation Board Liaison Offices were queried in order to obtain characteristics related to injury sustained, demographics, treatment, and disability/mental health outcome data.
Results: A total of 1631 amputations in 1315 patients were identified. Of these there were 37 through knee and 296 were transfemoral amputations. Adequate records for detailed analysis were available on 140 and 25 transfemoral and through knee amputations respectively. There were no significant differences in demographic information, injury mechanism, initial injury severity score, or associated injuries, to include contralateral amputations. There was no significant difference in average disability rating (67.9% vs 78.3%, $p = 0.46$) or number of service members determined to be fully disabled (42.2% vs 28.6% $p = 0.33$) between the transfemoral and through knee amputation groups. Whereas there was no difference between groups preoperatively, the knee disarticulation group displayed a higher rate of mental health diagnoses post-amputation (96% vs 72%, $p < 0.001$) and a higher preponderance of anxiety related disorders than the transfemoral amputees (26.92% vs 12.96%, $p = 0.0129$).
Discussion/conclusion: Among this military amputee through knee and transfemoral amputees displayed similar physical disability profiles. However, the through knee amputees displayed a higher level of anxiety related disorders and mental health diagnosis overall. While we don't believe this relationship to be causal in nature, this finding reflects the importance of paying particular attention to mental health in the final disposition of traumatic lower extremity amputees.

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Introduction

While previous literature has suggested that through knee amputees have better functional outcomes and self-selected walking velocities due to maintained residual length and prosthesis fit through an end bearing limb following amputations due to vascular disease, more recent literature has questioned this premise following high-energy lower extremity trauma [1–4]. The LEAP study demonstrated that the 18 through knee amputees with adequate outcomes were associated with the worse Sickness Impact Profile (SIP) scores out of all lower extremity amputees and were associated with a higher, 14.5%, revision amputation rate at 2-year follow-up and worse reported outcome and pain scores at 2 and 7-year follow-up [1,2,5]. It is unclear if these results were representative of complications related to prosthetic wear and weight bearing, due to the surgical technique, or due to an

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inadequate soft tissue envelope as 12 of the through knee amputees did not have gastrocnemius muscle remaining [1]. As such, the question continues as to whether preserving length in those patients undergoing amputation for traumatic lower extremity injuries is advantageous in this population versus merely predisposing these patients to future complications and compromised outcomes.

The recent military conflicts have seen over 2300 combat related amputations in over 1700 patients. These amputations are frequently due to high energy mechanisms associated with extensive soft tissue injury and are nearly universally polytraumatic injuries [6,7]. As the literature has focused more heavily on the outcomes of the more common transtibial amputation, research concentrating on high-energy lower extremity through knee amputations and transfemoral amputations is lacking. These specific populations must still be better characterized to better guide the surgeon's decision-making and counsel patients when deciding on what final amputation level is best suited to the individual patient. Consequently, the purpose of this study is to characterize the injury patterns and disability associated with through knee and transfemoral amputations in combat related high-energy lower extremity trauma necessitating an amputation.

Materials and methods

Using a protocol approved by our local Institutional Review Board, all amputations sustained by US military personnel from 1 October 2001 to 30 July 2011 were identified yielding 1631 total major extremity amputations sustained by 1315 service members. This database contains information from all US military personnel who sustained a major extremity combat amputation inclusive of all branches of service. From this database, 37 through knee amputations and 296 transfemoral amputees were identified. These patient records were then cross referenced with the Department of Defense Trauma Registry (DoDTR, Joint Base San Antonio, Ft Sam Houston, TX, USA), The Armed Forces Health Longitudinal Technology Application, inpatient hospital records and each services specific Physical Examination Liaison Office database (PEB) in order to obtain demographic information, injury characteristics, treatment characteristics, and outcome data. The PEB is the military's board who evaluates the constellation of injuries a Servicemember sustains in order to determine if the personnel is fit to continue on active duty (COAD), should be placed on temporary disabled status (TDRL), should be permanently retired (PR/PRDL), or should be separated with severance pay but without disability pay (Sep w/severance) [8]. Although not fully correlative, this is the military equivalent of the civilian disability system and helps determine a Servicemember's ability to return to work. Servicemembers who are not continuing on active duty are assigned disability ratings for each disabling condition that are then combined to calculate a total disability rating. The relative impact of the injuries sustained was calculated as previously done in previous studies characterizing amputations, where each disabling condition was determined by multiplying the average disability assigned for each condition by the frequency of each disabling condition [9,10]. Statistical analysis was performed using JMP v9.2. Descriptive statistics, Students *t*-test and ANOVA were used as appropriate. Significance was set at 0.05 for all variables.

Results

Two hundred ninety six transfemoral amputees and 37 through knee amputations were identified on the initial database query. Adequate demographic and clinical information was available on 140 and 25 transfemoral and through knee amputations, respectively. There were no significant differences in demographic information except for time of follow-up between groups (Table 1). There were no significant differences in injury mechanism, initial injury severity score, or associated injuries, to include contralateral amputations (Table 2). While there were no significant differences between groups prior to injury in their mental health diagnoses, the knee disarticulation group displayed a higher rate of mental health diagnoses post-amputation (96% vs 72%, $p < 0.001$) (Table 3). Correspondingly, the through knee amputation group showed a higher preponderance of anxiety related disorders than the transfemoral amputees (26.9% vs 13%, $p = .013$) (Table 3). Final disability ratings were available for 14 through knee amputees and 102 transfemoral amputees (Table 4). There was no significant difference in average disability rating (67.9% vs 78.3%, $p = 0.46$) or number of service members determined to be fully disabled (42.2% vs 28.6%, $p = 0.33$) between the transfemoral and through knee amputation groups. There were no differences in final PEB disposition between groups ($p = .6923$; Table 5). Whereas the presence of the amputation and contralateral amputation were the most impactful disabling conditions in both groups, mental health diagnoses were the third most impactful disabling condition in both groups (Tables 6 and 7).

Discussion

The majority of lower extremity military amputations are performed as a result of severe high-energy traumatic injuries. While the preponderance of literature has focused on transtibial amputations, this study characterized 296 transfemoral amputees and 37 through knee amputees [11]. While both groups demonstrated no differences in average disability rating or in

Table 1
Demographics.

	Through Knee Amputation**	Transfemoral Amputation**	p-value
Total Number	25	140	
Age	24.92	25.24	0.7479
Avg Rank	E-5	E-5	0.6475
Admit wt (kg)	89.88	98.73	0.6312
Current wt (kg)	86.12	120.75	0.0807
Time of f/u (yr)	2.85	3.39	0.0001*
Males	100%	97.14%	0.2484
Branch			0.719
Army	80.00%	72.86%	
Marine Corps	20.00%	24.29%	
Navy	0.00%	2.14%	
Air Force	0.00%	0.71%	

* Significant value of $p < 0.05$.
** 37 Through knee amputations identified with adequate data on 25. 296 transfemoral identified with adequate data on 140.

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