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Non-Emergent Orthopaedic Injuries Sustained by Soldiers in Operation Iraqi Freedom

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Background: The majority of soldiers deployed to the theater of combat operations return safely after completion of the deployment. Many of these soldiers sustain non-emergent musculoskeletal injuries that initially are treated non-operatively and ultimately require surgery following their combat tour.

Methods: A prospective evaluation of the orthopaedic surgery consultations and surgical procedures required by soldiers returning from a full combat deployment was performed. Demographic information (including age and sex) as well as information on the mechanism of injury, the reason for orthopaedic consultation, and the procedures performed was collected for each soldier. The overall incidence of non-emergent orthopaedic injuries was calculated, and multivariate Poisson regression analysis was utilized to determine the effect of age and sex on the type of orthopaedic injury sustained.

Results: There were 3787 soldiers who returned from combat operations at the end of a fifteen-month deployment without having been medically evacuated. There were 731 orthopaedic surgical consultations for the evaluation of a non-emergent musculoskeletal complaint, and 140 orthopaedic operations were performed as a result. An age of thirty years or more was an important risk factor for requiring an orthopaedic consultation ($p < 0.0001$). The most common surgical procedures were performed for shoulder stabilization, for superior labrum anterior to posterior lesion repair, for the treatment of internal derangement of the knee, and for the treatment of foot deformity.

Conclusions: Nineteen percent of all soldiers who completed a combat deployment required an orthopaedic surgical consultation on return, and 4% of soldiers required orthopaedic surgery. More than half of the surgical procedures involved the knee or shoulder. This represents a large burden of care for returning soldiers on orthopaedic surgical services and has important implications for future resource utilization.

Level of Evidence: Prognostic Level I. See Instructions for Authors for a complete description of levels of evidence.

Combat military operations can result in devastating traumatic battle injuries, many of which require medical evacuation and eventual surgical intervention[1,2]. Such battle injuries have received the majority of attention in recent reports[1,3]. In addition to battle injuries, however, the intensity of the combat environment also may lead to an increased number of non-battle injuries, including injury to the musculoskeletal system[4]. A "casualty" in customary military usage means an active-duty servicemember who is lost to the theater of operations for medical reasons[5]. The term therefore includes illness and non-combat injuries as well as combat injuries. Several previous investigations concerning the military conflicts in Iraq and Afghanistan have demonstrated that 49% to 55% of all combat injuries involve the upper and lower extremities[1,3], whereas musculoskeletal non-battle injuries in a combat environment account for 50% of all disease and non-battle-injury casualties[4].

Historically, the emphasis concerning battle injuries has been placed on the major traumatic injuries sustained during

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TABLE I Orthopaedic Consultations by Age

Age Group	No. of Service-members	No. of Combat Years	Body Region		
			Upper Extremity*	Lower Extremity*	Axial Spine*
18 to 23 yr	1354	1693	28.4 (48)	48.4 (82)	23.6 (40)
24 to 29 yr	1342	1677	38.8 (65)	72.1 (121)†	34.0 (57)
≥30 yr	1091	1364	73.3 (100)†	96.0 (131)†	63.8 (87)†
Total	3787	4734	45.0 (213)	70.6 (334)	38.9 (184)

*The values are given as the rate per 1000 combat-years, with the number of consultations given in parentheses. †The number of orthopaedic consultations was significantly different from that in the eighteen to twenty-three-year age group ($p < 0.05$).

TABLE I (*continued*)

Mechanism		Total Consultations (Unadjusted)		Total Consultations (Adjusted)	
Combat Injury*	Non-Battle Injury*	Total Consultations Rate*	Rate Ratio (95% CI)	Rate*	Rate Ratio (95% CI)
11.2 (19)	89.2 (151)	100.4 (170)		101.39	
19.7 (33)	125.2 (210)†	144.9 (243)†	1.44 (1.19 to 1.75)	146.26	1.44 (1.19 to 1.75)
19.8 (27)	213.3 (291)†	233.1 (318)†	2.32 (1.93 to 2.80)	235.48	2.32 (1.93 to 2.80)
16.7 (79)	137.7 (652)	154.4 (731)			

combat[6]. However, many soldiers sustain musculoskeletal injuries in the combat environment that may be disregarded during deployment or that are recognized but are insufficient for medical evacuation, with the servicemember being returned to duty[4,7]. At the present time, we are not aware of any reports in the literature addressing the scope of non-emergent orthopaedic injuries sustained by soldiers returning from a full combat deployment.

Operation Iraqi Freedom and Operation Enduring Freedom in Afghanistan represent the largest-scale American armed conflicts since the Vietnam War. Since September 11, 2001, more than 1.9 million U.S. troops have been deployed to Iraq and Afghanistan in support of these operations. Nearly 5900 U.S. military servicemembers have died in combat, and >41,000 have been wounded in action[8].

We hypothesize that a large burden of orthopaedic disease exists among servicemembers returning from a full combat deployment. While at certain military facilities orthopaedic surgical issues are addressed by military surgeons, in other centers and among activated reservists and National Guardsmen, the civilian orthopaedic community often assumes care for these conditions. The purpose of the present study was to assess the incidence and characteristics of non-emergent musculoskeletal injuries among soldiers returning from a full combat deployment.

Materials and Methods

Following approval from our institution's Investigational Review Board, membership rosters were obtained for a single brigade combat team that had been deployed for fifteen months in support of Operation Iraqi Freedom. During this period of deployment, the unit was actively engaged in the Iraq War Troop Surge, the major counterinsurgency operation of Operation Iraqi Freedom that resulted in an escalation in hostilities and a concomitant rise in American combat casualties. Prospectively, rosters were used to construct a comprehensive database that included all servicemembers assigned to the unit prior to deployment. On return, all soldiers requiring orthopaedic surgical consultation as deemed necessary by primary care managers, including physicians and physician's assistants or other physician consultants, were recorded. Demographic data (including age and sex) and information on the mechanism of injury, the reason for consultation, and whether surgical intervention was ultimately performed were compiled for each servicemember.

Soldiers were followed for a six-month period after return from deployment to capture orthopaedic conditions that presented in a delayed fashion or that were not initially reported by the servicemember at the time of return. Musculoskeletal injuries that were reported after deployment but were not incurred during time in Iraq were excluded from this analysis as were any injuries that necessitated a soldier's medical evacuation. Battle (combat) injury is defined as any casualty incurred as the direct result of hostile action sustained in combat or sustained going to or from a combat mission[9].

Surgical procedures were recorded by body region and type of procedure. Region of injury was classified according to the criteria established by Churchill[10]. The upper extremity included the clavicle and the scapula. The lower extremity consisted of all anatomic regions distal to and including the proximal part of the femur.

The overall incidence of non-emergent orthopaedic injuries was calculated by dividing the number of orthopaedic surgical consultations by the total number of at-risk individuals and was expressed per 1000 combat years. In this determination, one combat year represents a single year of exposure for one servicemember to the combat environment. In addition, the incidence of orthopaedic surgical procedures performed following completion of the deployment was determined by dividing the number of procedures by the total number of at-risk individuals and was expressed per 1000 combat years. Multivariate Poisson regression analysis was used to determine the effect of age

TABLE II Orthopaedic Consultations by Sex

Sex	No. of Service-members	No. of Combat Years	Body Region		
			Upper Extremity*	Lower Extremity*	Axial Spine*
Female	278	348	40.2 (14)	83.3 (29)	28.7 (10)
Male	3509	4386	45.4 (199)	69.5 (305)	39.7 (174)
Total	3787	4734	45.0 (213)	70.6 (334)	38.9 (184)

*The values are given as the rate per 1000 combat-years, with the number of consultations in parentheses.

TABLE II (*continued*)

Mechanism		Total Consultations (Unadjusted)		Total Consultations (Adjusted)	
Combat Injury*	Non-Battle Injury*	Total Consultations*	Rate Ratio (95% CI)	Rate*	Rate Ratio (95% CI)
8.6 (3)	143.7 (50)	152.3 (53)		153.43	
17.3 (76)	137.3 (602)	154.6 (678)	1.01 (0.77 to 1.34)	150.01	0.98 (0.74 to 1.29)
16.7 (79)	137.7 (652)	154.4 (731)			

and sex on the type of orthopaedic injury sustained. All statistical analyses were performed with use of SAS software (SAS Institute, Cary, North Carolina). Significance was predetermined for p values of <0.05.

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Results

The brigade combat team under study initially consisted of 4122 soldiers (3797 males and 325 females) who deployed in support of Operation Iraqi Freedom for a fifteen-month period. The average age at the time of deployment was twenty-seven years (range, eighteen to fifty-two years). Thirty-five service-members died during the deployment and another 300 were medically evacuated from the combat zone. The battle and non-battle injuries for this cohort were reported previously[1,4,7]. At the end of the fifteen-month period, 3787 soldiers (3509 males and 278 females) returned after completing the combat deployment.

Orthopaedic Surgical Consultations Statistics

Table I categorizes the orthopaedic surgical consultation incidence rates for non-emergent orthopaedic injuries per 1000 combat years by age. There were a total of 731 orthopaedic surgical consultations for soldiers returning from deployment, for an orthopaedic surgical consultation incidence of 154.4 per 1000 soldier combat years, representing 19% of all soldiers completing the deployment. The incidence rate for orthopaedic surgical consultations was lowest in the eighteen to twenty-three-year age group, and rates generally increased with increasing age. The unadjusted incidence of orthopaedic surgical consultation per 1000 combat years was 100.4 for the eighteen to twenty-three-year age group, 144.9 for the twenty-four to twenty-nine-year age group, and 233.2 for the thirty-year-and-older age group. Compared with the eighteen to twenty-three-year age group as the reference category while controlling for sex, the other age groups had increased adjusted incidence rate ratios for orthopaedic surgical consultations: the ratio was 1.44 (95% confidence interval, 1.19 to 1.75) for the twenty-four to twenty-nine-year age group and 2.32 (95% confidence interval, 1.93 to 2.80) ($p < 0.0001$) for the thirty-year-and-older age group.

Among the 731 total orthopaedic consultations after the deployment, seventy-nine (10.8%) were a result of combat injuries. Improvised explosive device (IED), mortar, and rocket-propelled grenade data were grouped into the explosion category for comparison with previous conflicts. Explosive mechanism resulted in forty-six of the seventy-nine injuries sustained in combat requiring an orthopaedic consultation following the deployment. Compared with the eighteen to twenty-three-year age group, the other two age groups did not have increased adjusted incidence rate ratios for orthopaedic surgical consultations secondary to combat injuries (1.74 [95% confidence interval, 0.99 to 3.07] for the twenty-four to twenty-nine-year age group and 1.75 [95% confidence interval, 0.97 to 3.14] for the thirty-year-and-older age group).

Non-battle injuries, or exacerbation of a previous condition during the deployment, resulted in 652 of the orthopaedic consultations. Soldiers in the twenty-four to twenty-nine-year-old age group and the thirty-year-and-older age group both were at an increased risk of orthopaedic surgical consultations secondary to non-battle injuries when compared with the eighteen to twenty-three-year age group (1.40 [95% confidence interval,

TABLE III Description of the 242 Surgical Procedures Performed in 140 Operations for Non-Emergent Orthopaedic Injuries

Surgical Procedures	N
Upper extremity	
Diagnostic shoulder arthroscopy	38
Shoulder instability stabilization	
Bankart repair	10
Reverse Bankart	4
Capsulorrhaphy	6
Superior labrum anterior to posterior (SLAP) lesion	
SLAP repair	13
SLAP debridement	1
Rotator cuff repair	3
Subacromial decompression	7
Distal clavicle excision	6
Partial scapula resection	1
Lysis of adhesions	
Tendon adhesions	5
Capsular release	5
Diagnostic elbow arthroscopy	1
Soft-tissue debridement	1
Nerve decompression	
Median nerve	2
Ulnar nerve	4
Radial nerve	1
Digital nerve	1
Wrist ganglion excision	2
Hardware removal	4
Hand tendon repair	1
Scaphoid fracture fixation	1
Carpal bone fusion	1
Fixation of fracture nonunion	1
Total upper extremity procedures	119
Lower extremity	
Diagnostic knee arthroscopy	31
Meniscus debridement	23
Meniscus repair	1
Chondroplasty/microfracture	3
Anterior cruciate ligament reconstruction	7
Correction of foot deformity	
Hallux valgus correction	9
Hammer toe	3
Ossicle excision	7
Ankle ligament reconstruction	
Lateral ankle ligament reconstruction	6
Syndesmosis fixation	2
Posterior tibial tendon augmentation	1
Diagnostic ankle arthroscopy	4
Soft-tissue debridement	2
Microfracture/osteochondral allograft transplant	2
Diagnostic hip arthroscopy	3
Femoroacetabular impingement	3
Foreign-body removal	2
Total hip arthroplasty for osteonecrosis	1
High tibial osteotomy	1
Leg fasciotomy for chronic exertional compartment syndrome	1
Lysis of tendon adhesions	1
Nerve decompression	1
Fixation of fracture nonunion	1
Total lower-extremity procedures	115
Axial spine	
Lumbar decompression and fusion	
One level	1
Multiple levels	4
Anterior cervical discectomy and fusion	
One level	1
Multiple levels	2
Total axial spine procedures	8
Total procedures	242

1.14 to 1.73] and 2.40 [95% confidence interval, 1.97 to 2.92], respectively).

Table II categorizes the orthopaedic surgery consultation statistics and incidence rates for non-emergent orthopaedic injuries per 1000 combat years by sex. Males comprised 92.6% of the total population at risk and accounted for 92.7% of the orthopaedic surgical consultations. The unadjusted orthopaedic surgical consultation incidence per 1000 combat years was 154.6 for males, compared with 152.5 per 1000 combat years for females. Compared with females, males did not have a significantly increased adjusted incidence rate ratio for orthopaedic surgical consultations while controlling for the influence of age in the model (0.98; 95% confidence interval, 0.74 to 1.29).

Among the fifty-three orthopaedic consultations among female soldiers, only three (5.6%) were a result of combat injury, whereas seventy-six (11.2%) of the 678 orthopaedic consultations among male soldiers resulted from combat injury. Compared with males, females did not have a significantly increased risk for orthopaedic surgical consultations resulting from combat injuries (Table II). Additionally, compared with males, females did not have a significantly increased rate of orthopaedic surgical consultation due to non-battle injuries.

Orthopaedic Surgical Procedural Statistics

Table III details the description of surgical procedures performed for non-emergent orthopaedic injuries for soldiers returning from full deployment. There were a total of 140 orthopaedic operations performed during the period under investigation, accounting for 4% of all soldiers returning from the full deployment: 43.6% were performed on the upper extremity, 50.7% were performed on the lower extremity, and

TABLE IV Distribution of Body Regions Requiring Surgical Intervention by Age (Incidence per 1000 Combat Years)

Age Group	No. of Service-members	No. of Combat Years	Upper Extremity						Lower Extremity	
			Shoulder*	Arm*	Elbow*	Wrist*	Hand*	Total*	Hip*	Knee*
18 to 23 yr	1354	1693	5.3 (9)	0.0 (0)	0.0 (0)	0.6 (1)	1.8 (3)	7.7 (13)	0.6 (1)	2.4 (4)
23 to 29 yr	1342	1677	6.6 (11)	0.0 (0)	0.6 (1)	1.2 (2)	3.0 (5)	11.3 (19)	0.6 (1)	8.3 (14)†
≥30 yr	1091	1364	13.9 (19)†	0.7 (1)	1.5 (2)	1.5 (2)	3.7 (5)	21.3 (29)†	1.5 (2)	12.5 (17)†
Total	3787	4734	8.2 (39)	0.2 (1)	0.6 (3)	1.1 (5)	2.7 (13)	12.9 (61)	0.8 (4)	7.4 (35)

*The values are given as the rate per 1000 combat years, with the number of interventions in parentheses. †The number of orthopaedic procedures was significantly different between age groups ($p < 0.05$).

5.7% were performed on the axial spine. The most common procedures performed were for internal derangement of the knee, shoulder instability, superior labrum anterior to posterior (SLAP) lesions, and symptomatic foot deformity, including hallux valgus correction. Many soldiers required multiple procedures during each operation.

Table IV delineates the incidence rates per 1000 combat years for the distribution of body regions requiring surgical intervention by age group. The incidence rates of surgical intervention per 1000 combat years were 12.9 (61 of 3787) for the upper extremity, 15.0 (71 of 3787) for the lower extremity, and 1.7 (8 of 3787) for the axial spine. Both the thirty-year-and-older age group (27.1 per 1000 combat years; $p = 0.0001$) and the twenty-three to twenty-nine-year age group (14.9 per 1000 combat years; $p = 0.008$) were at an increased risk for requiring an orthopaedic surgical intervention on the lower extremity when compared with the eighteen to twenty-three-year age group (5.3 per 1000 combat years). Both the twenty-three to twenty-nine-year age group (8.3 per 1000 combat years; $p < 0.005$) and the thirty-year-and-older age group (12.5 per 1000 combat years; $p < 0.0015$) were at a significantly increased risk for requiring a surgical procedure on the knee when compared with the eighteen to twenty-three-year age group (2.4 per 1000 combat years).

The thirty-year-and-older age group was at increased risk for requiring an orthopaedic surgical intervention on the upper extremity in comparison with the eighteen to twenty-three-year age group (21.3 per 1000 soldier combat years compared with 7.7 per 1000 soldier combat years; $p < 0.005$). In addition, soldiers in the thirty-year-and-older age group were significantly more likely to require surgical intervention on the shoulder in comparison with soldiers in the eighteen to twenty-three-year age group (13.9 compared with 5.3 per 1000 combat years; $p < 0.0087$).

Thirty-nine (27.9%) of the 140 non-emergent orthopaedic operations were performed as a result of combat injuries sustained during the deployment. Both the twenty-three to twenty-nine-year age group ($p < 0.02$) and the thirty-year-and-older age group ($p = 0.02$) were at significantly increased risk for requiring orthopaedic surgery as a result of a combat injury when compared with the eighteen to twenty-three-year age group. In addition, the thirty-year-and-older age group had a significantly increased risk for requiring orthopaedic surgery as a result of a non-battle injury in comparison with the eighteen to twenty-three-year age group ($p = 0.0001$).

Compared with males, females were not at a significantly increased risk for requiring surgical intervention (37.4 compared with 29.0 per 1000 combat years. Table V provides a description of the incidence rates of surgical intervention by body regions for males and females. Males were not at a significantly increased risk for requiring surgical intervention than females with respect to the upper extremity (12.8 compared with 14.4 per 1000 combat years) or the lower extremity (14.4 compared with 23.0 per 1000 combat years). Only one of the thirteen surgical procedures performed on female soldiers (2.9 per 1000 combat years) was performed because of a combat injury, whereas thirty-eight (29.9%) of the 127 surgical procedures performed on male soldiers (8.7 per 1000 combat years) was performed because of a combat

TABLE V Distribution of Body Regions Requiring Surgical Intervention by Sex (Incidence per 1000 Combat Years)

Sex	No. of Service-members	No. of Combat Years	Upper Extremity						Lower Extremity	
			Shoulder*	Arm*	Elbow*	Wrist*	Hand*	Total*	Hip*	Knee*
Female	278	348	8.6 (3)	0.0 (0)	0.0 (0)	5.8 (2)	0.0 (0)	14.4 (5)	2.9 (1)	0.0 (0)
Male	3509	4386	8.2 (36)	0.2 (1)	0.7 (3)	0.7 (3)	3.0 (13)	12.8 (56)	0.7 (3)	8.0 (35)
Total	3787	4734	8.2 (39)	0.2 (1)	0.6 (3)	1.1 (5)	2.7 (13)	12.9 (61)	0.8 (4)	7.4 (35)

*The values are reported as the rate per 1000 combat years, with the number of orthopaedic procedures in parentheses.

TABLE IV (*continued*)

Lower Extremity			Axial Spine			Mechanism		Total Surgical Procedures (Unadjusted)		Total Surgical Procedures (Adjusted)	
Leg*	Foot and Ankle*	Total*	Cervical*	Lumbar*	Total*	Combat Injury*	Non-Battle Injury*	Total Surgery Rate*	Rate Ratio (95% CI)	Rate	Rate Ratio
0.0 (0)	2.4 (4)	5.3 (9)	0.0 (0)	1.2 (2)	1.2 (2)	3.5 (6)	10.6 (18)	14.2 (24)		16.1	
1.8 (3)	4.2 (7)	14.9 (25)†	0.6 (1)	0.0 (0)	0.6 (1)	10.7 (18)†	16.1 (27)	26.8 (45)†	1.89 (1.15 to 3.10)	30.5	1.9 (1.16 to 3.12)
0.0 (0)	13.2 (18)	27.1 (37)†	1.5 (2)	2.2 (3)	3.7 (5)	11.0 (15)†	41.1 (56)†	52.1 (71)†	3.67 (2.31 to 5.83)	59.4	3.69 (2.33 to 5.87)
0.6 (3)	6.1 (29)	15.0 (71)	0.6 (3)	1.1 (5)	1.7 (8)	8.2 (39)	21.3 (101)	29.6 (140)			

injury. This finding, however, did not reach significance (Table V).

Discussion

Since 2001, nearly two million U.S. servicemembers have participated in combat operations in Iraq and Afghanistan, and nearly 65,000 have required medical evacuation from these conflicts[8]. Appropriately, most previous reports have focused on casualties as well as on musculoskeletal injuries sustained during combat[1,3]. The estimated initial hospitalization and projected disability benefits for soldiers sustaining combat extremity wounds in Iraq and Afghanistan between October 2001 and December 2005 are $1.66 billion (U.S. dollars)[11]. While the emergent orthopaedic burden resulting from combat operations is indeed sizable, little information is available regarding non-emergent musculoskeletal injuries that are incurred by military personnel during the course of a deployment and are reported only on return to the U.S..

Deployment-associated injuries not requiring medical evacuation during the wars in Iraq and Afghanistan are predominantly orthopaedic in nature[4,7] and potentially could represent as much of a burden to the healthcare system as musculoskeletal wounds sustained during combat. Indeed, the cost of health care for such injuries potentially could be even higher in light of the sheer number of individuals who have been deployed to the combat environment. Moreover, such injuries have important implications for the civilian orthopaedic community as many active-duty soldiers as well as reservists and National Guardsmen with orthopaedic conditions will be cared for by nonmilitary orthopaedic practitioners in their home community or at a Veterans Administration facility.

In the present investigation, we sought to prospectively define the burden of non-emergent musculoskeletal injuries among servicemembers in a single brigade combat team returning from a fifteen-month deployment to a major combat zone. To our knowledge, this is the first study to present the burden of non-emergent orthopaedic injuries that occur from the standard daily physical activity associated with the scope of combat and combat-support operations. In addition, as the brigade combat team is currently the U.S. Army's basic deployable unit, estimations for the cohort under study can potentially be extrapolated to larger military units and to the Armed Forces as a whole.

The results presented here indicate an orthopaedic consultation rate of 154.4 per 1000 combat years and a surgical rate of 29.6 per 1000 combat years. Approximately 50% of all consultations and surgical procedures involved the lower extremity, with arthroscopy of the knee and shoulder and surgery for the treatment of shoulder instability and for SLAP lesion repair being found to be the most common interventions (Table III). Significant age-associated influences were identified regarding orthopaedic consultation rates as well as surgical rates, particularly with respect to the knee and shoulder; however, sex was not found to be a significant risk factor.

We are not aware of any previous studies among military personnel to which comparisons can be made. However, in the manner of training and physical performance associated with occupational activities, the groups that most closely approximate military servicemembers are elite athletes in professional leagues and in the National Collegiate Athletic Association (NCAA). A number of investigations have indicated a similar spectrum of injuries among elite college

TABLE V (*continued*)

Lower Extremity			Axial Spine			Mechanism		Total Surgeries Unadjusted		Total Surgeries Adjusted	
Leg*	Foot and Ankle*	Total*	Cervical*	Lumbar*	Total*	Combat Injury*	Non-Battle Injury*	Total Surgeries Rate*	Rate Ratio (95% CI)	Rate	Rate Ratio (95% CI)
0.0 (0)	20.1 (7)	23.0 (8)	0.0 (0)	0.0 (0)	0.0 (0)	2.9 (1)	34.5 (12)	37.4 (13)	1.29 (0.73 to 2.29)	36.0	1.36 (0.77 to 2.41)
0.7 (3)	5.0 (22)	14.4 (63)	0.7 (3)	1.1 (5)	1.8 (8)	8.7 (38)	20.3 (89)	29.0 (127)		26.3	
0.6 (3)	6.1 (29)	15.0 (71)	0.6 (3)	1.1 (5)	1.7 (8)	8.2 (39)	21.3 (101)	29.6 (140)			

football and basketball players[12-15]. In the current study, nineteen cases of first-time anterior shoulder dislocation or subluxation along with eighteen cases of anterior cruciate ligament disruption were found in the brigade combat team under study during combat deployment[4,7]. Eighty-four percent of soldiers with shoulder instability were returned to duty within seventy-two hours after injury, whereas 55% of soldiers with anterior cruciate ligament disruption were kept in theater[4]. Although true comparisons cannot be made between groups, it should not be surprising that a high incidence of injuries is found among military personnel, especially in light of the number of exposures within a year of deployment as well as the degree of occupational demands. Prior research involving the Defense Medical Epidemiology Database (DMED) has identified uniformed servicemembers as being at greater risk of shoulder and knee injuries when compared with their civilian counterparts[16,17]. Owens et al.[16,17] found the incidence of anterior cruciate ligament disruption among active-duty personnel to be 3.09 per 1000 person-years and to be 1.69 shoulder dislocations per 1000 person-years.

The present study had limitations that should be recognized. Foremost, in light of the number of U.S. military personnel who have been deployed in support of the conflicts in Iraq and Afghanistan over the last nine years, the population under study represents a small sample of servicemembers. The greatest advantage of studying a single large combat unit is that the number of soldiers in this longitudinal cohort was known and comprehensive orthopaedic consultation and surgical rates could be calculated. An additional limitation is the paucity of literature concerning the incidence of non-emergent orthopaedic injuries in soldiers within a brigade combat team while in a non-combat environment and the absence of data that could facilitate a reasonable comparison. The conclusions presented in this report regarding the incidence and epidemiology of injuries is only truly valid for the population under study. However, in light of the fact that, to our knowledge, no prior research has been conducted in this regard, the cohort under study may serve as a reasonable approximation on which subsequent calculations can be made. In addition, the findings of the present study may serve as an initial benchmark with which the results of subsequent larger investigations may be compared.

In conclusion, the results of the present study have important implications for the military and civilian orthopaedic communities. Our findings indicate that a substantial number of orthopaedic injuries not requiring medical evacuation were incurred over the course of a deployment, which has not been previously highlighted in studies that focused on combat-related orthopaedic trauma. In terms of overall numbers, the volume of non-emergent orthopaedic injuries arising in personnel who complete their deployments far exceeds that of personnel medically evacuated for musculoskeletal combat trauma. For example, if the findings of orthopaedic consultation and surgical rates of 154.4 and 29.6 per 1000 soldier combat years, respectively, were extrapolated to all soldiers deployed since 2001, one-half million orthopaedic surgical consultations and 68,000 surgical procedures could be anticipated. Such facts are important for projected military resource utilization but also should be recognized by civilian practitioners, many of whom will treat American soldiers on return from deployment and former servicemembers receiving care within the Veterans Administration system[18]. ■

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