



Return to Work and Functional Outcomes Following Primary Total Knee Arthroplasty in U.S. Military Servicemembers



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ABSTRACT

This investigation sought to determine occupational outcomes after total knee arthroplasty (TKA) in a high-demand cohort. A total of 159 military servicemembers underwent 181 primary TKAs with mean follow-up of 4.1 (range, 2.0–6.6) years. Approximately 18% of servicemembers underwent medical separation from the military due to TKA-related limitations, and age <45 years (OR = 2.36; 95% CI: 1.14, 4.90) was established as the significant risk factor. Twenty servicemembers (12.6%) performed postoperative combat deployments, with age <45 years (OR = 3.10; 95% CI: 1.29, 7.47) or combat arms designation (OR = 2.75; 95% CI: 1.13, 6.73) associated with higher rates of deployment. Nine revision TKAs (5.0%) were performed at an average of 1.9 years. Following TKA, 82% of servicemembers remained on active-duty or completed their military service. Level of Evidence: IV

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Total knee arthroplasty (TKA) restores function and quality of life in knee arthritis patients once conservative measures have failed [1–4]. TKA remains one of the most common major surgical procedures performed in the United States [5], and the demand for TKA has risen dramatically over the last two decades [6]. Current estimates have projected that the need for TKA will increase by more than 600% to approximately 3.5 million TKAs annually by 2030 [7]. Particularly among young, active and working cohorts, the demand for TKA has seen over a two-fold increase in patients under 50 years old between the years of 1997–2000 to 2005–2008 [8].

U.S. Army servicemembers maintain strict physical fitness requirements and are exposed to intense occupational demands. These servicemembers regularly participate in organized aerobic exercise

training, weight training, and core military tasks, including the ability to march two miles with an additional 40 pounds of gear, to routinely wear individual body armor, to perform specialized field tasks, and to evade direct and indirect enemy fire [9]. Furthermore, all U.S. Army personnel must pass the semi-annual Army Physical Fitness Test, including a timed aerobic event (e.g.s two-mile run, 2.5 mile walk, 6.2 mile stationary bicycle, or 800-yard swim), and adhere to mandated weight and body fat composition standards. Additionally, active-duty military servicemembers regularly participate in rigorous military occupational specialty training and must demonstrate physical stamina in order to complete a combat deployment of up to 12 months. However, if a servicemember is unable to maintain these prerequisites, a medical discharge may be initiated when permanent duty limitations are not feasible.

Greater baseline levels of physical activity have previously been associated with an increased risk for developing knee osteoarthritis [10,11]. When compared with age-matched groups within the general population, U.S. active-duty military servicemembers have shown both disproportionately higher rates and earlier onset of osteoarthritis [12]. Additionally, a prospective longitudinal cohort study of over 4000 U.S. servicemembers revealed that knee arthritis and knee pain were among two of the ten most common unfitting conditions in both the musculoskeletal injury and control groups [13]. Further studies have identified that degenerative and post-traumatic osteoarthritis are among the most common disabling conditions among battle-injured servicemembers and contemporary military veterans [14,15].

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While TKA has provided reliable outcomes in elderly patients, insufficient data exist for younger patient populations regarding their postoperative function and ultimate clinical and/or occupational outcomes. Both from an individual and a socioeconomic perspective, it is imperative to understand rates of return to work following TKA. Earlier studies evaluating the effect of primary TKA on work status have been limited by one or more of the following shortcomings [16]: (1) small patient cohorts (<120 patients in total) [17–19], (2) average age >60 years old [20,21], (3) low-demand patients [21], (4) study reported in the literature >10 years ago [22], (5) patient response rates of <70% [17,20,21,23] (6) less than a two-year minimum follow-up [17,18,21–24] and (7) study not designed to examine return to work [22].

The surgical outcomes of primary TKA within a high-demand, physically-active, military cohort have only been reported in small case series of 20 or fewer TKA patients [25,26]. The purpose of this study is to determine the medical separation rates of active duty military servicemembers and rates of combat deployment after a primary TKA during the military engagements in Iraq and Afghanistan.

Methods

Following institutional review board approval, the Military Health System Management Analysis and Reporting Tool (M2) database was queried for all U.S. Army active-duty servicemembers undergoing primary total knee arthroplasty (TKA) [Current Procedural Terminology (CPT) Code 27447] for end-stage arthritis between October 2007 and March 2012 performed by military surgeons at civilian or military hospitals. Exclusion criteria were applied to individuals with less than two years clinical follow-up, bilateral TKAs which are infrequently performed and cases of miscoding.

The U.S. Department of Defense electronic health record, Armed Forces Health Longitudinal Application (version 3.3), was extensively reviewed for each servicemember previously identified in the M2 database to confirm accuracy of CPT coding and the occurrence of a primary TKA within the study period. Additionally, demographic information was extracted, including sex, age, branch of military service, military occupational specialty, unilateral versus staged bilateral TKA, and history of combat deployment (Table 1). Military occupational specialty designations were categorized as either combat arms or combat support. Combat arms military occupational specialty denotes military service branches including infantry, armor, engineers, artillery, air defense artillery, and aviation, in which servicemembers conduct direct combat operations and have significantly greater functional demands when compared to those serving in combat support or combat service support roles. Additionally, the Pentagon Defense Manpower Data Center database was cross-referenced to determine the presence of both preoperative and postoperative combat deployments.

The primary outcome was the current military status of the servicemember two years or more following TKA. Specifically, servicemembers were categorized as active-duty with combat deployment, active-duty without combat deployment, no longer with the service due to retirement or expiration of term of service, or having been classified with knee-related medical separation. Standards for medical fitness are delineated within Army Regulation 40–501 (Headquarters, Department of the Army, Washington, D.C.) and encompass the functional abilities required of all Army servicemembers for deployment. Accordingly, any physical duty limitation is recorded on a Physical Profile (DA 3349) within the e-Profile electronic profiling system (version 3.17, Medical Operational Data System, Falls Church, VA), and this information is integrated into the electronic medical record and the Pentagon Defense Manpower Data Center database. Every Army soldiers' ability to deploy is tracked by the Army's Medical Protection System.

Poisson regression analysis was used to determine the association between the independent patient demographic variables and the outcomes of a soldier either being medically separated or performing a combat deployment. Odds ratios (OR) and 95% confidence intervals

Table 1

Demographics of Active Duty Servicemembers Undergoing Primary Total Knee Arthroplasty.

Identifier	Total (%)
Sex	
Male	121 (76%)
Female	38 (24%)
Diagnosis	
Osteoarthritis	158 (99%)
Rheumatoid arthritis	1 (1%)
Deployment history	
Yes	111 (70%)
No	48 (30%)
Bilateral procedure	
Yes	22 (14%)
No	137 (86%)
Combat arms	
Yes	31 (19%)
No	128 (81%)
Mean age (SD) years	45.7 (6.9)

(CI) were reported for the analyses. Significant independent predictor variables were determined to be those that maintained *P*-values <0.05 with OR and 95% CI exclusive of 1.0. Calculations were performed using SAS software, version 9.2 (SAS Institute, Cary, NC).

Results

There were a total of 181 primary total knee arthroplasty procedures, including 137 primary unilateral TKAs and 22 bilateral staged primary TKAs, identified among 159 active-duty U.S. Army servicemembers between October 2007 and April 2012. The average age of the patients in this study at the time of primary TKA was 45.7 (S.D. 6.9, range 24.4–61.3) years. The majority of patients were male (76%), ≥45 years old (72%), and combat support designation (81%) who had a primary unilateral TKA (86%) with a history of a previous combat deployment (70%) (Table 1). The average follow-up from time of surgery was 4.07 (S.D. 1.35; range, 2.0–6.6) years. The average time interval between primary total knee arthroplasties in the patients with bilateral staged primary TKAs was 7.0 (S.D. 6.6, range 3.3–27.5) months.

At minimum two-years postoperatively, the final occupational outcome of servicemembers undergoing a primary TKA was 18% who medically separated and 82% who either returned to active-duty or completed their remaining service commitment (Table 2). The average time for servicemembers undergoing a medical separation was 1.6 (S.D. 0.88, range 0.13–4.08) years from the initial primary TKA.

Multivariate analysis evaluated several demographic risk factors for a soldier undergoing medical separation from active-duty following a primary TKA. When compared with the ≥45 years age group, the <45 years age group had a significantly increased odds ratios for being medically separated (OR = 2.36; 95% CI: 1.14, 4.90) (Table 2). A servicemember's sex, military occupational specialty, isolated primary unilateral TKA, and previous history of combat deployment were not significant predictors for medical separation following primary TKA.

Poisson regression analysis also identified significant demographic variables associated with successful completion of a combat deployment following primary TKA (Table 3). When compared with the ≥45 years age group, the <45 years age group was a significant predictor for serving a postoperative combat deployment (OR = 3.10; 95% CI: 1.29, 7.47). Servicemembers with a combat arms military occupational specialty, when compared to those with a combat support designation, were significantly more likely to serve a postoperative combat deployment (OR = 2.75; 95% CI: 1.13, 6.73). The demographic variables of sex, unilateral TKA, and previous history of combat deployment were not associated with performance of a postoperative combat deployment. Table 4 contains pertinent demographic information and clinical course for all 20 servicemembers who performed a combat deployment

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