
**Short-Term Physical and Mental Health Outcomes for Combat Amputee and Nonamputee Extremity Injury Patients.**

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**OBJECTIVES:** The present study: (1) reports the early physical health complications, mental health outcomes, and outpatient health care utilization of patients with serious extremity injuries sustained during the Iraq or Afghanistan wars and (2) compares clinical outcomes between amputee and nonamputee extremity injury groups. **METHOD:** This was a retrospective review of clinical records in military health databases for patients injured in the Iraq and Afghanistan wars. Health outcomes of amputee (n = 382, injured 2001-2005) and nonamputee patients (n = 274, injured 2001-2007) with serious extremity injuries (abbreviated injury score ≥ 3) were followed up to 24 months post injury. This study was performed at Naval Health Research Center, San Diego. **RESULTS:** Amputee and nonamputee groups had similar injury severity scores. Amputees had nearly double the risk of certain adverse complications (infections, anemia, septicemia, and thromboembolic disease), but other complications (osteomyelitis and nonhealing wound) were similar between the 2 groups. Amputees had significantly greater odds of certain mental health disorders including mood, sleep, pain, and postconcussion syndrome. However, amputees had significantly reduced odds of posttraumatic stress disorder compared with nonamputees. Amputees used various outpatient clinics significantly more than nonamputees. **CONCLUSIONS:** Patients with serious combat extremity injuries showed high rates of adverse health outcomes in the short term. Amputees had higher rates of many but not all clinically important physical and mental health outcomes compared to nonamputees. These results are important for military orthopaedic surgeons and allied providers who care for and counsel these patients and clinicians and researchers who seek to understand and improve health outcomes in patients with extremity war injuries.

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**Functional expansion of sensorimotor representation and structural reorganization of callosal connections in lower limb amputees.**
Previous studies have indicated that amputation or deafferentation of a limb induces functional changes in sensory (S1) and motor (M1) cortices, related to phantom limb pain. However, the extent of cortical reorganization after lower limb amputation in patients with nonpainful phantom phenomena remains uncertain. In this study, we combined functional magnetic resonance (fMRI) and diffusion tensor imaging (DTI) to investigate the existence and extent of cortical and callosal plasticity in these subjects. Nine "painless" patients with lower limb amputation and nine control subjects (sex- and age-matched) underwent a 3-T MRI protocol, including fMRI with somatosensory stimulation. In amputees, we observed an expansion of activation maps of the stump in S1 and M1 of the deafferented hemisphere, spreading to neighboring regions that represent the trunk and upper limbs. We also observed that tactile stimulation of the intact foot in amputees induced a greater activation of ipsilateral S1, when compared with controls. These results demonstrate a functional remapping of S1 in lower limb amputees. However, in contrast to previous studies, these neuroplastic changes do not appear to be dependent on phantom pain but do also occur in those who reported only the presence of phantom sensation without pain. In addition, our findings indicate that amputation of a limb also induces changes in the cortical representation of the intact limb. Finally, DTI analysis showed structural changes in the corpus callosum of amputees, compatible with the hypothesis that phantom sensations may depend on inhibitory release in the sensorimotor cortex.

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Geri atric rehabilitation of lower limb amputees: a multicenter study.

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PURPOSE: The aim of this study was to determine factors independently associated with successful rehabilitation of patients with lower limb amputation in skilled nursing facilities (SNFs).
METHODS: All patients admitted to one of the 11 participating SNFs were eligible. Multidisciplinary teams collected the data. Successful rehabilitation was defined as discharge to an independent living situation within 1 year after admission. Functional status at discharge, as measured with the Barthel index (BI), was a secondary outcome. Multivariate regression analyses were used to assess the independent contribution of each determinant to the two outcome measures.
RESULTS: Of 55 eligible patients, 48 were included. Mean age was 75 years. Sixty-five percent rehabilitated successfully. Multivariate analyses showed that presence of diabetes mellitus (DM) (OR 23.87, CI 2.26-252.47) and premorbid BI (OR 1.37, CI 1.10-1.70) were the most important determinants of successful rehabilitation, whereas 78% of the variance of discharge BI was explained by premorbid BI, BI on admission, and 1-leg balance.

CONCLUSION: The presence of DM and high premorbid BI were associated with discharge to an independent living situation within 1 year after admission. Premorbid BI, admission BI, and 1-leg balance were independently associated to discharge BI.

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Dynamic Balance Control (DBC) in lower leg amputee subjects; contribution of the regulatory activity of the prosthesis side.

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BACKGROUND: Regaining effective postural control after lower limb amputation requires complex adaptation strategies in both the prosthesis side and the non-amputated side. The objective in this study is to determine the individual contribution of the ankle torques generated by both legs in balance control during dynamic conditions.

METHODS: Subjects (6 transfemoral and 8 transtibial amputees) stood on a force platform mounted on a motion platform and were instructed to stand quietly. The experiment consisted of 1 static and 3 perturbation trials of 90 s duration each. The perturbation trials consisted of continuous randomized sinusoidal platform movements of different amplitude in the sagittal plane. Weight distribution during the static and dynamic perturbation trials was calculated by dividing the average vertical force below the prosthesis foot by the sum of forces below both feet. The Dynamic Balance Control represents the ratio between the stabilizing mechanism of the prosthetic leg and the stabilizing mechanism of the non-amputated leg. The stabilizing mechanism is calculated from the corrective ankle torque in response to sway. The relationship between the prosthetic ankle stiffness and the performance during the platform perturbations was calculated.

FINDINGS: All patients showed a (non-significant) weight bearing asymmetry in favor of the non-amputated leg. The Dynamic Balance Control ratio showed that the contribution of both legs to balance control was even more asymmetrical. Moreover, the actual balance contribution of each leg was not tightly coupled to weight bearing in each leg, as was the case in healthy controls. There was a significant positive correlation between the prosthetic ankle stiffness and the Dynamic Balance Control.

INTERPRETATION: The Dynamic Balance Control provides, in addition to weight
distribution, information to what extent the stabilizing mechanism of the corrective ankle torque of both legs contributes to balance control. Knowledge of the stiffness properties may optimize the prescription process of prosthetic foot in lower leg amputee subjects in relation to standing stability.

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BACKGROUND: Femoral osseointegrated implants represent a new development in amputee rehabilitation, eliminating socket pressure discomfort, improving hip range of movement and facilitating prosthetic limb attachment. A clinical aspect that has not previously been reported on is the function of muscles in the residuum with implications concerning energy expenditure, hip-hiking and viability of the electrogram as a myoprocessor. Typically, amputees fitted with osseointegrated fixation have shorter residuums and weaker attachment of cleaved muscles. Function of muscle can be assessed by surface electromyography through changes in amplitude and median frequency of the signal.

METHODS: Five male transfemoral amputees with osseointegrated fixations participated together with a control group comprised of ten adult males. Electrodes recorded surface electromyographic activity of five residual limb muscles or left lower limb muscles of control subjects. Isometric contractions were performed against resistance. The increase in mean rectified amplitude from resting to maximally contracting was calculated and median frequencies estimated.

FINDINGS: The amputees were unable to maintain a maximum voluntary contraction of constant amplitude. Amplitude increase was lowest for rectus femoris and adductor magnus. The median frequency of adductor magnus was significantly greater (P=0.02) for the amputees than intact subjects and there was a significant difference (P<0.01) between gluteus maximus and adductor magnus for amputee subjects.

INTERPRETATION: High electromyographic amplitude variability suggests that using residuum muscles singly as a myoprocessor might be challenging. Adductor magnus displayed a different sEMG profile compared to intact subjects indicating decreased function and neuromuscular changes. Further work into optimal muscle anchorage is required to ensure maximal mechanical performance.

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Immediate effects of a new microprocessor-controlled prosthetic knee joint: a comparative biomechanical evaluation.

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OBJECTIVE: To investigate the immediate biomechanical effects after transition to a new microprocessor-controlled prosthetic knee joint.

DESIGN: Intervention cross-over study with repeated measures. Only prosthetic knee joints were changed.

SETTING: Motion analysis laboratory.

PARTICIPANTS: Men (N=11; mean age ± SD, 36.7±10.2y; Medicare functional classification level, 3-4) with unilateral transfemoral amputation.

INTERVENTIONS: Two microprocessor-controlled prosthetic knee joints: C-Leg and a new prosthetic knee joint, Genium.

MAIN OUTCOME MEASURES: Static prosthetic alignment, time-distance parameters, kinematic and kinetic parameters, and center of pressure.

RESULTS: After a half-day training and an additional half-day accommodation, improved biomechanical outcomes were demonstrated by the Genium: lower ground reaction forces at weight acceptance during level walking at various velocities, increased swing phase flexion angles during walking on a ramp, and level walking with small steps. Maximum knee flexion angle during swing phase at various velocities was nearly equal for Genium. Step-over-step stair ascent with the Genium knee was more physiologic as demonstrated by a more equal load distribution between the prosthetic and contralateral sides and a more natural gait pattern. When descending stairs and ramps, knee flexion moments with the Genium tended to increase. During quiet stance on a decline, subjects using Genium accepted higher loading of the prosthetic side knee joint, thus reducing same side hip joint loading as well as postural sway.

CONCLUSIONS: In comparison to the C-Leg, the Genium demonstrated immediate biomechanical advantages during various daily ambulatory activities, which may lead to an increase in range and diversity of activity of people with above-knee amputations. Results showed that use of the Genium facilitated more natural gait biomechanics and load distribution throughout the affected and sound musculoskeletal structure. This was observed during quiet stance on a decline, walking on level ground, and walking up and down ramps and stairs.

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