Extremity Trauma Rehabilitation

Restoration of Functional Mobility Following Lower Extremity Trauma and Amputation

Clinical researchers with the Extremity Trauma and Amputation Center of Excellence (EACE; Center for the Intrepid, San Antonio, Texas) have been assessing functional mobility and novel treatment interventions during rehabilitation. Current efforts focus on validating a treatment paradigm using military-specific tasks simulated in a virtual reality environment, such as being on patrol in a mountainous combat zone in full gear. EACE (Center for the Intrepid, San Antonio, Texas) researchers successfully used real-time visual feedback in a virtual reality environment to reduce biomechanical factors commonly linked to an elevated metabolic demand of walking in individuals with amputation: center of mass sway and quadriceps activation (*Russell Esposito, Choi, et al. 2017*; Figure 1). However, reducing the magnitudes of these variables did not reduce the metabolic cost of walking, which was, surprisingly, not significantly different from able-bodied individuals. These results add to the now growing body of literature indicating that the metabolic cost of walking need not unavoidably increase after a lower limb amputation.

Restoration of gait quality plays an important role in these results. In a retrospective study, EACE (Center for the Intrepid, San Antonio, Texas) researchers found that, although Service members with unilateral transtibial amputation exhibit highly prevalent (greater than 50 percent) and statistically significant gait deviations at the ankle and knee of the prosthetic limb and hip of the intact limb, deviation prevalence was lower than previously reported in the literature (*Rabago and Wilken 2016*). This lower prevalence may result from the quality of, and access to, rehabilitative and prosthetic care received at the EACE (Center for the Intrepid, San Antonio, Texas).

A separate study funded by the Center for Rehabilitation Sciences Research (CRSR) then compared these gait biomechanics of individuals with transtibial amputation to those with lower limb reconstruction (using an Intrepid Dynamic Exoskeletal Orthosis [IDEO]) and uninjured controls (n=72) (*Russell Esposito, Stinner, et al. 2017*). Overall, both patient groups could replicate many key aspects of normative gait mechanics, but deviations were more pronounced at the ankle following reconstruction with IDEO use and at the knee following transtibial amputation. As more information on the long-term outcomes associated with these procedures is learned, additional data combined with the present results on walking may be able to provide clinical recommendations.

Although walking is often an achievable goal after severe lower limb blast injuries, many individuals strive for returning to run or competitive sports. In a case study performed at EACE (Center for the Intrepid, San Antonio, Texas), an individual with a unilateral knee disarticulation amputation desiring to return to competitive running was taught to use a forefoot striking pattern in his intact limb to reduce his risk for overuse injury (*Diebal-Lee, Kuenzi, and Rabago 2017*). The eventual adoption of this forefoot striking

pattern reduced his average intact limb loading rate three-fold. Additionally, he was able to increase his running mileage and run distances of over 10 kilometers without pain.

The metabolic cost of walking need not increase after a lower limb amputation. Adoption of a forefoot striking pattern can increase running distances without pain for amputees and may decrease the occurrence of overuse injury in the intact limb.

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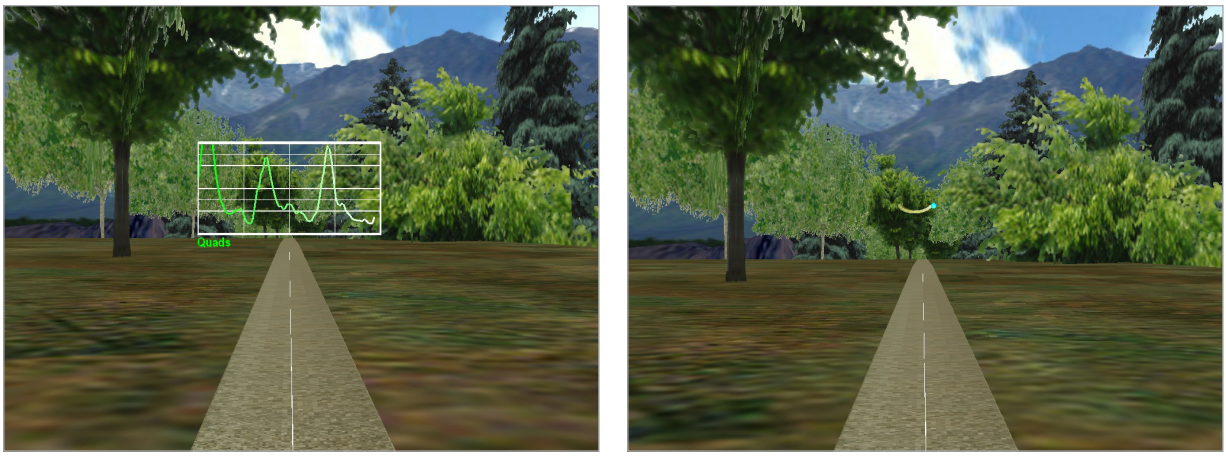

FIGURE 1: Visual display of example real-time feedback for EMG (top) and COM (bottom) within the Computer-Assisted Rehabilitation Environment. (Figure from Russell Esposito, Choi, et al. (2017) used with permission from the authors)

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