Orthotics and Prosthetics

Development of a Securely Adhered Prosthesis for Service Members Following Blast-related Limb Loss

Individuals with lower limb loss often complain about liner slippage and perspiration inside their prostheses when they are active in hot and humid environments or are engaged in vigorous activities. To address this problem, these individuals must remove their prosthesis and dry their residual limb to minimize prosthesis slippage and prevent complete loss of prosthetic adherence. Service members with lower limb loss need a prosthesis that remains securely adhered despite profuse perspiration. This research compared a novel, dynamic air exchange prosthesis designed to unobtrusively expel perspiration with a standard-of-care prosthesis.

Twelve transtibial amputees who were moderately active community ambulators were fit with a modified, patellar tendon bearing socket, and two study suspensions by a certified prosthetist. The study of prosthetic suspensions included: (1) a liner with a distal PIN lock (PIN; the standard method of care) and (2) a suspension with a pump that drives dynamic air exchange (DAE) using a sock worn between the liner and residuum that removes accumulated moisture. Subjects walked on a treadmill in 50 percent relative humidity at various temperatures (20, 30, and 35 degrees Celsius). Perspiration amounts were weighed, and prosthesis slippage was determined by measuring the distance between the location of the prosthesis originally and after walking (Figures 1 and 2).

Prosthesis slippage was similar for both the PIN and DAE technology at 20 degrees Celsius, but the PIN slipped twice as much as the DAE at higher temperatures, suggesting the DAE may adhere better under more challenging circumstances. More moisture accumulated with the DAE compared to the PIN suspension at all temperatures. However, the DAE prosthesis removed up to 50 percent of the total perspiration depending on the temperature. These results suggest the DAE technology helps maintain mobility of active Service members with a lower limb amputation in a greater range of environments that require a securely adhered prosthesis.

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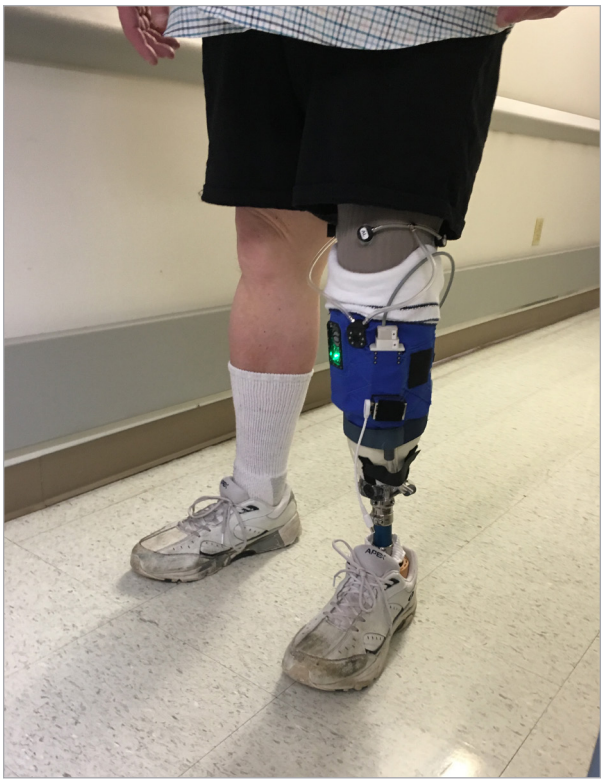

FIGURE 7-34: Dynamic Air Exchange prosthesis with blue system harness worn by a subject while standing. (Figure used with permission from the authors).

FIGURE 7-35: Dynamic Air Exchange prosthesis with black system harness worn by a subject while standing. (Figure used with permission from the authors).