**Background:** Footdrop is one of the most disabling sequelae of multiple sclerosis (MS). Research has shown that people with MS and footdrop have shorter stride lengths, slower free-speed walking rates, and higher cadence than those without MS. The current standard of care to correct footdrop is an ankle-foot orthosis (AFO), which restricts ankle movement, allows muscle wasting, limits choice of footwear, can promote skin breakdown, and offers poor cosmetic appearance. In contrast, the functional electrical stimulation (FES) neuroprosthesis uses electrical stimulation of muscles around the calf to produce dorsiflexion and eversion of the ankle at appropriate times while eliminating the negative effects of AFOs. **Objectives:** To compare the energy cost and efficiency of walking in ambulatory patients with MS between the AFO and the FES neuroprosthesis. **Methods:** Twenty ambulatory community-dwelling adults aged 18 to 75 years diagnosed with MS (Expanded Disability Status Scale [EDSS] score ≤6.5) resulting in footdrop were enrolled in a randomized, crossover, controlled, proof-of-principle pilot study. On each of two testing days, subjects underwent two 10-minute walking trials. The order of device presentation, AFO or FES, for each of the two walks was counterbalanced. The open-circuit method was used for metabolic monitoring. A heart monitor was used to collect heart rate, and a face mask was used to measure oxygen consumption. Walks were at a self-selected pace and separated by 1 hour of rest. Participants rated their perceived exertion after each walk trial. Testing was repeated between 1 week and 1 month later with the testing device order during walking trials reversed. **Results:** Averages were calculated for the two testing days. Significant results were seen in the following measures of velocity, energy cost, caloric expenditure, and metabolic efficiency between the AFO and FES. The perceived exertion for the AFO was increased compared with the FES. **Conclusions:** We found the FES to be more metabolically efficient and have decreased energy cost, decreased caloric expenditure, and less perceived exertion compared with the AFO. On average, subjects had increased speed when using the AFO versus the FES, which may be due to small sample size, familiarity with the AFO device, and increased time to adjust to FES use. Our preliminary results suggest that the FES may be more efficacious compared with the AFO.

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