



Standing balance in people with trans-tibial amputation due to vascular disease: A scoping review

Seth, M and Lamberg, E M

PhD Program, Health and Rehabilitation Sciences, Stony Brook University

INTRODUCTION

Balance control is an essential part of motor activities. The presence of a transtibial amputation (TTA) could limit the ability to control balance due to the loss of structures below the knee as compared to healthy individuals. However, depending on the cause of amputation balance control might be affected differently. Pre-existing sensory deficits, i.e. diminished sensation at the residual limb and the intact leg, in people with TTA due to vascular disease (diabetes, PVD) (TTA-vascular) could reduce the feedback coming from the lower extremities and further alter the deficit of balance control in this population as compared to people with TTA due to trauma (TTA-trauma). The literature on balance control in people with TTA-vascular is limited. The purpose of this paper is to review literature and determine if balance control in people with TTA-vascular is altered as compared to people with TTA-trauma and healthy individuals.

METHOD

Procedures: An electronic search of articles was made from Feb to Mar 2014 on PubMed, Google Scholar, Science Direct, COCHRANE and CINAHL. Key terms used: amputee, vascular, balance and prosthesis.

Data Analysis: Articles were included if they had participants with TTA-vascular, focused on balance and were peer reviewed.

RESULTS

An initial electronic database search yielded 40 articles. Upon review, 6 articles were selected. A common aim of the studies was to measure static balance by having the participants stand still on force platforms under eyes open and closed conditions. Typical parameters measured included: weight distribution, center of pressure (CoP) maximal excursion and overall postural sway (standard deviation of CoP). One of the studies made use of the composite equilibrium score from computerized dynamic posturography testing.

Four of the 6 studies (Nadollek et al., 2002, Kanade et al., 2008, Isakov et al., 1992, Quai et al., 2005) investigated weight distribution in people with TTA-vascular. These studies did not include TTA-trauma. In general, participants with TTA-vascular stood with more weight on the non-prosthetic side.

CoP excursions were investigated by 3 studies (Quai et al., 2005, Nadollek et al., 2002, Kanade et al., 2008). During both eyes open and eyes closed, participants with TTA-vascular have significantly increased anterior-posterior (A-P) CoP excursion compared to people with TTA-trauma and healthy individuals. The A-P CoP excursion occurred more

toward the non-prosthetic side in both individuals with TTA-vascular and TTA-trauma.

The 2 studies (Hermodsson et al., 1994, Isakov et al., 1992) investigating sway found participants with TTA-vascular to have significantly more sway than people with TTA-trauma and healthy individuals during both eyes open and closed testing conditions. Mohieldin et al. (2010) measured composite equilibrium score and found people with TTA-vascular have lower scores than people with TTA-trauma and healthy individuals.

DISCUSSION

Limited evidence exists on the balance control of people with TTA-vascular. However, all studies in this review had a similar conclusion; balance control is impaired in TTA-vascular population. Further, the inherent sensory deficit in people with TTA-vascular compromises their balance control more as compared to people with TTA-trauma. The postural adjustments (CoP movement, sway and weight distribution) found in this population are greater than those seen in people with TTA-trauma and healthy individuals. Diminished peripheral feedback could have caused weight distribution asymmetry in this population. However, other factors like residual limb pain, prosthesis alignment, socket discomfort and lack of confidence could also have affected weight distribution. Excessive loading of the non-prosthetic side could lead to secondary complications like osteoarthritis or amputation. Increased CoP excursion or sway in TTA-vascular could be one way of increasing proprioception from the lower extremities. However, more likely, the increased postural sway and/or CoP excursion reflects poor balance control.

CONCLUSION

People with TTA-vascular present with impaired balance control while standing still. Limited evidence suggests that balance control is affected greater in people with TTA-vascular than in people with TTA-trauma. Further research is warranted to determine if balance control in TTA-vascular differs from people with TTA-trauma during dynamic activities like walking or running.

CLINICAL APPLICATIONS

Prosthetists should be aware that people with TTA-vascular present with impaired balance control which differs from TTA-trauma. This difference may need to be taken into account when designing the prosthesis.

REFERENCES

- Hermodsson, Y. et al., *Prosthe Orthot Int*, 18, 150-8, 1994
- Isakov, E. et al., *Arch Phys Med Rehabil*, 73, 174-8, 1992
- Kanade, R. et al., *Clin Biomech*, 23, 1183-91, 2008
- Mohieldin, A. et al., *Maced J Med Sci*, 3, 138-143, 2010
- Nadollek, H. et al., *Physiother Res Int*, 7, 203-14, 2002
- Quai, T. M. et al., *Clin Rehabil*, 19, 668-76, 2005

American Academy of Orthotists & Prosthetists
41st Academy Annual Meeting &
Scientific Symposium
February 18 - 21, 2015