

March 2013

FINAL REPORT New Zealand Artificial Limb Board

Topic: Quantification of balance and postural demands during functional activities in unilateral trans-tibial geriatric amputees fitted with prostheses.

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FINAL REPORT The primary aim of this study was to quantify the balance and postural strategies used by the fitted amputee with diabetes and/or peripheral vascular disease (*hence forth mentioned as 'dysvascular'*) relevant to the execution of activities of daily living when tested in the upright standing position and during selected dynamic tasks.

As detailed in the previous report (July 2010) and the funding application (Nov 2008), the project was planned to be undertaken in 3 stages. I am pleased to report that completion of all three stages of the project.

Stage I: A systematic review of the literature.

Outcome: The systematic review entitled "*Instrumented measurement of balance and postural control in persons with lower limb amputation – a critical review*" has been accepted for publication in the *International Journal of Rehabilitation Research*.

Reference

Stage II: The pilot study

A brief detail about the participants, details of recruitment and the related cost of this pilot study was submitted in the previous report. To summarize, the aim of the pilot study was to identify any difference in the dynamic balance measures between persons with amputations due to dysvascular disease (n=7) and trauma (n=8) when performing a range of functional balance tasks and to determine their reliability.

Output

The main findings from the pilot study are detailed five peer-reviewed journal articles and four conference platform presentations.

Journal publications:

- Turning performance in persons with a dysvascular transtibial amputation – Accepted for publication in *Prosthetics and Orthotics International*, March 2013
- Instrumented measurement of balance and postural control in persons with lower limb amputation: Critical review - *International Journal of Rehabilitation Research* 35(3): 187-196, September 2012
- Concurrent validity of the Sensory Organisation Test in transtibial amputees- *online first*, “*Prosthetics and Orthotics International*” (July 2012) doi:10.1177/0309364612448391
- Reliability and concurrent validity of Step Quick Turn in older unilateral transtibial amputees *American Journal of Physical Medicine and Rehabilitation* 90(10): 798-804, October 2011
- Test retest reliability of Sensory Organisation Test in older persons with unilateral transtibial amputation *PM&R* 3(8): 723-729, August 2011

Peer-reviewed Conference/Symposium presentations:

- Postural responses in traumatic and dysvascular transtibial amputees- A pilot investigation - A platform presentation in the *Physiotherapy New Zealand’s 6th Southern Physiotherapy Symposium held in Queenstown from 4th to 6th November 2011 and Prasath won the “Best Presenter” award*
- Is the Step Quick Turn test a valid alternative to the timed up and go test in older transtibial amputees? – A platform presentation in the *Australian Physiotherapy Association Conference 2011 held in Brisbane from 27th to 30th October 2011*
- Is there a difference in turning performance between older traumatic and dysvascular transtibial amputees as measured by the Step Quick Turn test? – A platform presentation in the *Australian Physiotherapy Association Conference 2011 held in Brisbane from 27th to 30th October 2011*
- Does turning performance differ between traumatic and dysvascular amputees? – A poster presentation in the *Health Sciences Forum, University of Otago, Dunedin, 18th October 2011*

The results exhibited a significant difference between the traumatic and dysvascular disease amputees in turning task and the 6 balance sensory testing conditions. The inference was that traumatic amputees employ a different strategy to that of the dysvascular amputees. These findings led to the design of the main study.

Stage III: Main study

The study aimed to further describe the differences observed when comparing the balance performance of the two groups of amputees with their age matched counter parts without amputation. This study included 4 groups of participants traumatic amputees (n=9), dysvascular amputees (n=10), age matched healthy adults without an amputation (n=9) and age matched healthy adults with a dysvascular limb i.e. with diabetes and peripheral vascular disease (n=8).

Participants without an amputation (control subjects) were recruited through word of mouth from the Dunedin city region. In the amputee group 15 participants were recruited from the Otago/Southland area through the Dunedin Artificial Limb Centre. In order to improve the statistical power of the study an additional 4 participants were recruited from the Canterbury region. All participants (including control subjects) from the Otago/Southland were reimbursed with a \$30 grocery voucher for their time and involvement. Participants from Canterbury region were flew into Dunedin and provided overnight accommodation. The return travel including flight and shuttle were pre-booked by the School of Physiotherapy admin staff. The participants were reimbursed for their food and any other costs associated with their visit to take part in the study. The average cost incurred per participant from the Canterbury region was \$500.

After initial screening all participants completed the six balance testing conditions standing with eyes open and closed on a platform that can move. Participants also completed three other novel tasks that were specifically designed to understand the observed turning difficulties. The three tasks were shifting weight to one side, rotating the upper trunk to one side and, shifting and rotating to gather. To further the understanding of muscle strategies, a 6-channel electromyography (EMG) was included to record the muscle activity of major muscles of the sound and residual limb.

Results:

The main outcome measures were the centre of pressure (COP) variables and the average muscle activity from the EMG. The preliminary analysis demonstrated that the amputees with dysvascular limb exhibited poor balance abilities (*measured by COP*) as opposed to their traumatic counterpart when compared with the people without an amputation. No significant difference was observed between the traumatic and dysvascular amputees. The EMG data

demonstrated that all four groups follow a similar trend in the muscle strategy across the six balance testing conditions. A higher magnitude/amplitude of muscle activity was expected in the dysvascular group to compensate for the poor abilities exhibited in the COP. However the muscle activity was much lesser in the dysvascular amputees than the other groups which suggest that they would have difficulty in balancing under dynamic conditions.

With regard to the three voluntary tasks there was no significant difference between the groups in their balance abilities (*COP measures*). However the dysvascular amputees had taken a longer time than the other groups to complete each of the tasks. This perhaps is a balance strategy employed by the dysvascular amputees to compensate their impairments and thereby prevent falling.

The findings confirm the findings from the previous study that dysvascular amputees are more compromised in their balance abilities. This further implies that the dysvascular amputees are different group cannot be considered to be a single entity when retraining balance.

Outcomes:

Potentially there are more than three publications possible from this study and hopefully be submitted at least by end of this year (2013).

Acknowledgements

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The assistance of Mr. Mark McDowall (Manager), Ms. Sue Kennedy (Receptionist) of the Dunedin Limb Fitting Centre and Ms. Pauline Afitu (Receptionist) of the Christchurch limb fitting centre are acknowledged for greatly facilitating the smooth recruitment of amputee participants.

A letter of appreciation along with season's greetings was sent to all of the participants in December 2011.

Please find the final cost sheet of expenditure incurred to date from the funds received from the New Zealand Artificial Limb Fitting Board.