



# Comparison of Balance Outcomes in Amputees with an Osseointegrated versus Traditional Socket Prostheses

Lucarevic JL,<sup>1,2</sup> Gailey RS,<sup>1,2</sup> Muderis MA<sup>3</sup>, Kim KJ,<sup>1</sup> Agrawal V,<sup>1</sup> Bennett C,<sup>1,2</sup> Gaunaud IA,<sup>1,2</sup>

<sup>1</sup> University of Miami Miller School of Medicine, Department of Physical Therapy, Coral Gables, FL;

<sup>2</sup> Miami Veterans Affairs Health Care System, Miami, FL; <sup>3</sup> Osseointegration Group of Australia, Sydney Australia

## INTRODUCTION

Osseointegration (OI) for bone-anchorage of an external lower limb prosthesis has become an alternative for traditional socket suspension. People with an osseointegrated prostheses (OIP) have reported a phenomenon called osseoperception, which is an improved ability to identify various sensations through their artificial limb.<sup>1</sup> Research has quantified that amputees with OIP have improved ability to detect vibrations through the prosthesis<sup>2</sup> with potential applications for improved ability to balance. The purpose of this study is to compare balance confidence and balance performance in people with lower limb amputation who use an OIP to a traditional socket prosthesis (TSP).

## METHOD

**Subjects:** A convenience sample of 15 community ambulators with unilateral OIP participated at the 2016 Amputee Coalition National Conference. All OIP subjects had surgical procedure performed in Sydney, Australia by Dr. Munjed Al Muderis. Another 15 participants with TSP were identified as case-control matches for the OIP cohort based on age (range 25-67), gender (7 male, 8 female), amputation level (4 TTA, 11 TFA), and K-Level of the OIP cohort.

**Procedures:** Subjects completed the Activities Specific Balance Confidence Scale (ABC), single limb stance, and conditions 1-3 of the Modified Test for Sensory Integration and Balance (mCTSIB). An inertial measurement unit (IMU), was attached to the sacrum with an elastic belt to measure postural sway during the mCTSIB activities.

**Data analysis:** SPSS Statistical Software was used to describe the study sample, paired t-tests were used to compare differences in the two groups.

## RESULTS

There was no significant difference in single limb balance duration between groups, but there was a trend of the OIP group to have better sound limb balance (p=.09)(Table 1). The OIP group had significantly higher ABC scores, with an average increase of 7% balance confidence over the TSP group.

All subjects (n=30) were able to maintain bipedal balance for 30 seconds in the mCTSIB conditions. There was no difference in the postural sway in the AP or ML directions between the groups for mCTSIB conditions 1-3.

	OIP (n=15)	TSP (n=15)	p
<b>Balance Confidence</b>			
ABC (%)	94.7 ± 5.68	86.97 ± 12.18	.04*
<b>Single Limb</b>			
Prosthetic (sec)	0.98 ± 0.47	1.14 ± 0.58	.44
Sound (sec)	23.13 ± 11.0	17.93 ± 13.86	.09
<b>mCTSIB conditions:</b>			
<b>1.Firm, Eyes Open</b>			
AP (cm)	1.29 ± 0.55	1.26 ± 0.45	0.86
ML (cm)	0.88 ± 0.46	0.87 ± 0.42	0.84
<b>2.Firm, Eyes Closed</b>			
AP (cm)	1.94 ± 0.99	1.63 ± 0.51	0.29
ML (cm)	0.89 ± 0.46	0.90 ± 0.36	0.26
<b>3.Foam, Eyes Open</b>			
AP (cm)	1.37 ± 0.46	1.39 ± 0.39	0.88
ML (cm)	1.63 ± 0.79	1.57 ± 0.83	0.84

**Table 1.** Comparison of Balance Outcomes for OIP and TSP; results show the mean maximal sacral excursion in AP and ML directions for mCTSIB conditions 1-3, mean single limb balance durations, and mean percentage of balance confidence. \*Significant at p<.05 level.

## DISCUSSION

Balance performance measures selected for this small study did not show any differences between subjects with OIP and TSP. Both groups demonstrated minimal sway excursion during bipedal mCTSIB conditions 1-3, whereas single limb balance performance was more variable and challenging. Subjects with OIP had higher balance confidence.

## CONCLUSION

Individuals with unilateral transtibial and transfemoral amputation with an OIP demonstrated similar balance performance compared to a matched-case control TSP group. However, the OIP group reported higher balance confidence. Because of the small sample in this study future work should determine where differences in posture during single-limb and bipedal balance activities might exist.

## CLINICAL APPLICATIONS

The osseointegration surgical procedure allows an alternative to traditional socket suspension with similar balance outcomes in bipedal and single limb stance. Moreover, there is a self-reported increased confidence by the OIP group that may be related to osseoperception or other factors related to balance not yet determined.

## REFERENCES

1. Lundberg M, et al. POI. 35(2): 207-14, 2011.
2. Haggstrom, E; et al. JRRD. 50 (10):1423-34, 2013