ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

GAIT INITIATION CHARACTERISTICS OF TRANSTIBIAL AMPUTEES

1Ivan S. de Avelar, 2Paula H. Lobo da Costa, 3Maria S. Silva, 1Célio A. de Paula. Jr , 1,3Viviane Soares and 1Marcus F. Vieira
1Bioengineering and Biomechanics Laboratory- Federal University of Goias, Brazil.
2Department of Physical Education, Federal University of São Carlos, Brazil.
3Fisiology and Nutrition Laboratory, Federal University of Goiás, Brazil.
isavelar2000@gmail.com, sites.google.com/site/labioengufg/

SUMMARY
Gait initiation is a transitory phenomenon and involves integration of neural mechanisms, muscle activation and biomechanical forces. Therefore, the aim of this study is to compare gait initiation of transtibial amputees using prosthesis with non-amputees, in order to prevent falls and maintain balance. Fifteen subjects participated in the study being seven unilateral transtibial (GA) amputees and eight non-amputees (GN). Inclusion criteria were: age between 18 and 55 years, walking without assistance, and no neuromotor or musculoskeletal disorders. For the GA group, unilateral transtibial amputation and use of prosthesis for over 12 months. the amputee puts all his weight on the healthy limb, which explains the similarity between the resultant COP trajectory and the COP trajectory on platform PE. The amputee has virtually no APA phase, as the medial-lateral resultant COP displacement is approximately half the medial-lateral resultant COP displacement of a non-amputee, which demonstrates that such a displacement for the amputee occurs almost entirely under the healthy foot.

INTRODUCTION
Gait initiation is a transitory phenomenon and involves integration of neural mechanisms, muscle activation and biomechanical forces. It is described as the transition from quasi-static standing position to cyclic gait movements (HENRIKSSON;HIRSCHFELD, 2005).

The study of gait initiation in amputees can contribute in understanding the strategies used by this specific population in the control of this task (ROSSI et al., 1995; FIOLKOWSKI et al., 2002; MICHEL;CHONG, 2004).

Therefore, the aim of this study is to compare gait initiation of transtibial amputees using prosthesis with non-amputees, in order to prevent falls and maintain balance.

METHODS
Fifteen subjects participated in the study being seven unilateral transtibial (GA) amputees and eight non-amputees (GN). Inclusion criteria were: age between 18 and 55 years, walking without assistance, and no neuromotor or musculoskeletal disorders. For the GA group, unilateral transtibial amputation and use of prosthesis for over 12 months, with the following specifications: KBM socket in resin and internal socket in polyform with supracondylar suspension, aluminum module, SACH foot with modular adapter, tube with titanium adapter, double titanium modular adapter (BLOHMKE, 2002).

Two AMTI force platforms – platforms PE and PD – were embedded side by side at the beginning of a 2.00 x 1.40 m walkway covered by a black rubber rug (0.003 m thickness). Kinetic data were acquired at 100 Hz and filtered by a low-pass, zero-lag, second-order 12.5 Hz Butterworth filter.

Each subject was positioned with one foot on each platform, waiting for a sonorous command to initiate gait, at a self-selected velocity. Data acquiring started 1 s before sonorous command. Analysis was carried out based on the trajectory of the center of pressure (COP), calculated from the data acquired by the platforms.

RESULTS AND DISCUSSION
Figure 1A shows a typical resultant COP trajectory of two force platforms. It can be divided in three phases: F1 – anticipatory postural adjustment (APA) between points 1 and 2, F2 – first step between points 2 and 3, and F3 – forward displacement between points 3 and 4 when COP moves forward until contact loss of the support foot with the force platform.

APA is characterized by a backward and sideward COP movement towards the swing foot (right foot in Figure 1A) even before any observable movement of this foot.

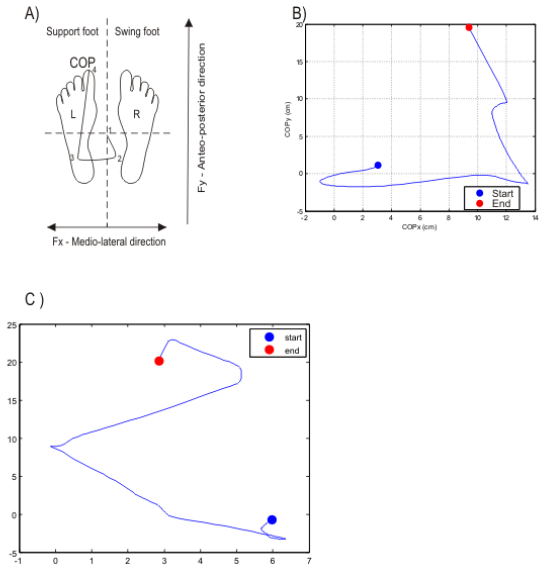

Figure 1A: Typical resultant COP trajectory of two platforms. See text for explanations.

Figure 1B shows the trajectory of the resultant COP, and the COP trajectory in each one of the platforms for a GN group subject. Note that the COP trajectory in each platform is visibly different from the resultant COP trajectory, which presents the typical characteristics of the resultant COP shown in Figure 1A.

CONCLUSIONS

After analysis of COP trajectories, the following characteristics were observed for the GA group: i) the amputee puts all his weight on the healthy limb, which explains the similarity between the resultant COP trajectory and the COP trajectory on platform PE in Figure 1C; ii) the amputee has virtually no APA phase, as the medial-lateral resultant COP displacement is approximately half the medial-lateral resultant COP displacement of a non-amputee, which demonstrates that such a displacement for the amputee occurs almost entirely under the healthy foot (compare Figures B and C).

REFERENCES

1. HENRIKSSON M.; HIRSCHFELD H. *Physically active older adults display alterations in gait initiation.* Gait Posture, v. 21, n. 3, p. 289-96, Apr 2005. ISSN 0966-6362 (Print) 0966-6362 (Linking). Disponível em: < http://www.ncbi.nlm.nih.gov/pubmed/15760744 >

2. ROSSI SA et al. *Gait initiation of persons with below-knee amputation: the characterization and comparison of force profiles*. J Rehabil Res Dev, v. 32, n. 2, p. 120-7, May 1995. ISSN 0748-7711 (Print) 0748-7711 (Linking). Disponível em: < http://www.ncbi.nlm.nih.gov/pubmed/7562651 >.

3. FIOLKOWSKI, P. et al. *Does postural instability affect the initiation of human gait?* Neurosci Lett, v. 323, n. 3, p. 167-70, May 3 2002. ISSN 0304-3940 (Print) 0304-3940 (Linking). Disponível em: < http://www.ncbi.nlm.nih.gov/pubmed/11959411 >.

4. MICHEL, V.; CHONG, R. K. *The strategies to regulate and to modulate the propulsive forces during gait initiation in lower limb amputees.* Exp Brain Res, v. 158, n. 3, p. 356-65, Oct 2004. ISSN 0014-4819 (Print).

5. BLOHMKE, F. *Compêndio otto bock - prótese para membro infeior*. 2ª Edição. Berlim: 2002. 117 ISBN 3-7949-0562-8.