A case study with custom: a comparison of normal and altered gait with an ankle brace
Pierre Puchaud, Georges Dumont, Nicolas Bideau, Charles Pontonnier

To cite this version:
Pierre Puchaud, Georges Dumont, Nicolas Bideau, Charles Pontonnier. A case study with custom: a comparison of normal and altered gait with an ankle brace. ESB 2019 - 25th Congress of the European Society of Biomechanics, Jul 2019, Vienne, Austria. pp.1. hal-02088913

HAL Id: hal-02088913
https://inria.hal.science/hal-02088913
Submitted on 3 Apr 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
A CASE STUDY WITH CUSTOM: A COMPARISON OF NORMAL AND ALTERED GAIT WITH AN ANKLE BRACE

Pierre Puchaud (1,2,3), Georges Dumont (2), Nicolas Bideau (2,3), Charles Pontonnier (1,2)

1. Centre de Recherche des Ecoles de St-Cyr Coëtquidan, 56381 Guer, France; 2. Univ Rennes, CNRS, Inria, IRISA - UMR 6074, 35042 Rennes, France; 3. Univ Rennes, M2S - EA 1274, 35170 Bruz, France;

Introduction
The need for easy computation of biomechanical quantities is required in motion analysis routine such as joint kinematics, joint net moments and muscles forces. However, musculoskeletal softwares require expert knowledge for clinical routine. Here, we propose a kinematic analysis of a normal gait and altered gait with an ankle brace using CusToM [1] which is a modular toolbox aimed at performing inverse dynamics based musculoskeletal analysis. This study aimed at revealing compensation strategies of one subject following an ankle injury.

Materials and methods
One subject was recorded performing range of motion tasks and four left gait cycles prior to a complete tear of his right lateral ankle ligament. The subject underwent a second time the experiment with a complete ankle brace ensuring the right ankle to be immobilized. Three weeks after his injury and three months after the first session, the subject underwent the same experiment with a complete ankle brace ensuring the right ankle to be immobilized. A lower limb kinematical model was used with 3 rotational DOF at the hip, one at the knee and two at the ankle. These two last DOF were immobilized on the altered gait session. The selected model was adapted by suppressing these two DOF. For both sessions, the subject was equipped with a set of 45 markers (Figure 1). A hundred frames of the range of motion trial were chosen to calibrate the kinematic chain through an optimization-based identification. Then, joint kinematics of lower limbs was computed by multibody kinematic optimization [2]. Mean and standard deviations of the normalized joint kinematics of the right leg were compared over gait cycles between the two sessions. Paired t-test using Statistical Parametric Mapping (SPM) was applied to detect significant differences between the two sessions on each DOF.

Results

Means and standard deviations of curves exhibited different trends (Figure 2). Significant differences in hip flexion/extension at early and end stages of the gait were revealed (p=0.011 and p<0.001). Also hip abduction/adduction was significantly affected between 16% and 22% of the gait cycle (p<0.001). Internal/external rotation of the hip and knee flexion were not significantly different.

Discussion
This kinematic analysis highlighted the impact of the ankle brace, particularly on the hip joint. This compensation motion has been previously reported as a residual circumduction of the hip to allow the leg and the foot to move forward during the swing phase of the gait, as it has been reported for transtibial amputees [3]. It may explain the absence of vaulting strategy on the opposite ankle. Besides, we highlighted the ability of CusToM to perform such analysis. Further analysis of this case study at musculoskeletal level may be relevant.

References

Acknowledgements
The present study was partly funded by the chair of the enhanced soldier in the digital battlefield from the St-Cyr Foundation.