Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 181 (2017) 96 – 101

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Conference Interdisciplinarity in Engineering, INTER-ENG 2016

Multi-Criteria Analysis of Biomechanical Parameters Used for Developing Innovative Products

Deselnicu Dana Corina[a,]*, Pantazi Elena Mirela[b], Costea Mariana[c], Purcarea Anca Alexandra[a], Militaru Gheorghe[a]

[a]*University Politehnica of Bucharest, 313 Splaiul Independentei, sector 6, Bucharest, Romania*
[b]*National Research Institute for Textiles and Leather (INCDTP) - ICPI Division, 93 Ion Minulescu str., sector 3, Bucharest, Romania*
[c]*"Gh. Asachi" Technical University of Iasi, 67 Dimitrie Mangeron Blvd., Iasi, Romania*

Abstract

The article presents the methodology and results of a fieldwork study conducted in order to evaluate the biomechanical parameters, anthropometric and demographic data of elderly people. Old people are nowadays a growing and significant age group. Despite their specific needs, they are currently constrained to accept the mass footwear that they are offered. Because of their foot deformities, their biomechanical characteristics are different than the rest of the population, and constitute important indicators for a better understanding and analysis of their particular necessities. The research problem aimed at investigating the biomechanical parameters of the elderly people in Romania using the force platform. These measurements can then be translated into constructive parameters for customized footwear design. The research used a force platform hi-tech device to measure different biomechanical indicators of elderly people. The results indicate that the weight of the elderly women and with their health conditions are correlated with the ground force reaction components.

Peer-review under responsibility of the organizing committee of INTER-ENG 2016

Keywords: biomechanical parameters; elderly; ground reaction force; footwear; customized product design.

* Corresponding author. Tel.: +40-721-295347; fax: +40-21-3169644
E-mail address: dana.deselnicu@upb.ro

Peer-review under responsibility of the organizing committee of INTER-ENG 2016
doi:10.1016/j.proeng.2017.02.373

1. Introduction

According to the classification proposed by Perry [1], the stages of the gait cycle can be divided into two main phases: stance and swing. The stance phase is the period when the foot is in contact with the ground and represents 60% of the gait cycle, and the swing phase represents the remaining 40%. These two phases can be subsequently subdivided, as the reference foot undergoes different movements (Fig. 1): the stance phase begins with striking the ground with the heel (IC - initial contact), then the foot lowers to the ground (LR - loading response) and provides a stable support for the body (MS – midstance), creating the contact with the ground all over the sole, and the hip joint is located above the ankle. From the moment it begins the propulsion phase (TS – terminal stance, unilateral support ending) and the foot loses the contact with the ground by lifting the heel (PSW – the pre-swing). The ending of the support phase is the moment of the separation of toes off the ground. For a normal gait at a constant speed on a flat surface, the support phase accounts for 60% of the 100% complete gait cycle, with the left foot performing the same actions as the right foot [2].

The swing phase begins with lifting the foot off the ground (ISW – initial swing) and accelerating forward, moving the ankle below the hip joint during the middle swing (MSW – middle swing), then moving the foot into a deceleration phase (TSW – terminal swing), preparing for a new striking of the ground with the heel. The characteristics of gait are simple stride length, cadence or rhythm, pitch angle and the walking speed.

Fig. 1. Phases of the gait cycle (Source: authors' archive)

Ground reaction force derives from the principle of action and reaction, representing the force of pushing horizontal support surfaces of the body from bottom to top. Like any vector in space, the ground reaction force is the resultant of three components, which are also the most frequently used ground reaction force parameters [3]: the vertical component, the anteroposterior component and the mediolateral (transversal) component, all of them being transmitted to the foot during the support phase when walking and running:

- Y axis component is the component in the frontal plane and is marked Fy;
- X axis component is the component corresponding to the walking direction and is marked Fx;
- Z axis component is the vertical component, perpendicular to the motion plane and is marked Fz.

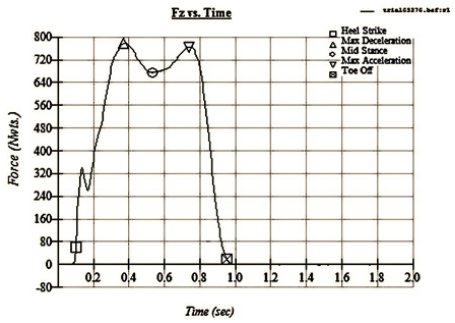

Fig. 2. Graphical representation of the Fz component by AccuGait System (Source: AccuGait software)