



Lateral wedges decrease biomechanical risk factors for knee osteoarthritis in obese women

Elizabeth M. Russell^{a,b,*}, Joseph Hamill^b

^a Biomechanics Laboratory, The Andrews-Paulos Research and Education Institute, 1020 Gulf Breeze Parkway, Gulf Breeze, FL 32561, USA

^b Biomechanics Laboratory, Department of Kinesiology, University of Massachusetts Amherst, 20 Eastman Lane, 110 Totman, Amherst, MA 01003, USA

ARTICLE INFO

Article history:
Accepted 26 May 2011

Keywords:

Obese
Lateral wedge insoles
Knee osteoarthritis
Gait
Kinetics

ABSTRACT

Obesity is the primary risk factor for the development and progression of medial compartment knee osteoarthritis. Laterally wedged insoles can reduce many of the biomechanical risk factors for disease development in osteoarthritis patients and lean individuals but their efficacy is unknown for at-risk, obese women. The purpose was to determine how an 8° laterally wedged insole influenced kinetic and kinematic gait parameters in obese women. Gait analysis was performed on fourteen obese (average 29.3 years; BMI 37.2 kg/m²) and 14 lean control women (average 26.1 years; BMI 22.4 kg/m²) with and without a full-length, wedged insole. Peak joint angles, the external knee adduction moment and its angular impulse were calculated during preferred and standard 1.24 m/s walking speeds. Statistical significance was assessed using a 2-way ANOVA ($\alpha=0.05$). The insole significantly reduced the peak external knee adduction moment (mean decrease of 3.6 ± 3.9 Nm for obese and 1.9 ± 1.8 Nm for controls) and its angular impulse in both groups. The wedged insoles also produced small changes in ankle dorsiflexion (obese: $1.2 \pm 1.4^\circ$ increase; control: $1.5 \pm 1.4^\circ$ increase) and eversion range of motion (obese: $1.3 \pm 1.9^\circ$ decrease; control: $1.5 \pm 1.2^\circ$ decrease) but did not alter peak angles of superior joints. Although the majority of obese women may develop knee osteoarthritis during their lifetime, a prophylactic insole intervention could allow obese women with no severe knee malalignments to be active while preventing or delaying disease onset. However, the long-term effects of the insole have not yet been examined.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Obesity is the primary, modifiable risk factor for both the development (Anderson and Felson, 1998; Felson et al., 1998) and the progression (Ledingham et al., 1995) of bilateral knee osteoarthritis (KOA). Obese individuals have a four-fold greater incidence of KOA than their healthy-weight counterparts because of increased loading on the joint resulting from greater body weights (Felson et al., 1998). Two-thirds of obese individuals will develop the disease throughout the course of a lifetime (Murphy et al., 2008) and the majority will be females (Felson et al., 1998).

KOA typically develops in the medial compartment because the internal knee joint contact loads are greater there than on the lateral side during the stance portion of gait (Andriacchi, 1994; Zhao et al., 2007). Although not a direct measure of loading, the external knee adduction moment (EKAM) is commonly measured due to its strong association with the medial compartment load (Hurwitz et al., 1998; Schipplein and Andriacchi, 1991; Shelburne

et al., 2008; Zhao et al., 2007). Greater EKAM values may predispose individuals to KOA (Amin et al., 2004; Astephen and Deluzio, 2005; Baliunas et al., 2002; Miyazaki et al., 2002). The angular impulse of the EKAM gives an indication of loading across the stance phase instead of at a discrete instance. It is also greater in obese individuals (Russell et al., 2010) and in individuals with KOA (Thorp et al., 2006) compared to lean and asymptomatic individuals.

During walking, forces acting on the lower extremity produce an EKAM due to the relatively large mediolateral moment arm between the knee joint center and the ground reaction force vector (Andriacchi, 1994; Schipplein and Andriacchi, 1991). The magnitude of the peak EKAM is also associated with the severity of KOA (Astephen et al., 2008) and how quickly it progresses (Miyazaki et al., 2002). Obese individuals with no KOA have greater peak EKAMs than healthy-weight individuals (Browning and Kram, 2007). Thus, even prior to diagnosis, obese individuals appear to be already at greater risk of developing KOA than lean individuals.

Orthotics and insoles are often used to modify lower extremity alignment and loading patterns. Laterally wedged insoles are designed to laterally shift the center of pressure under the foot

* Corresponding author. Tel.: +1 8509168774; fax: +1 8509168579.
E-mail address: erussell.kin@gmail.com (E.M. Russell).