



The effect of valgus braces on medial compartment load of the knee joint – *in vivo* load measurements in three subjects

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ABSTRACT

Knee osteoarthritis occurs predominately at the medial compartment. To unload the affected compartment, valgus braces are used which induce an additional valgus moment in order to shift the load more laterally. Until now the biomechanical effect of braces was mainly evaluated by measuring changes in external knee adduction moments. The aim of this study was to investigate if and to which extent the medial compartment load is reduced *in vivo* when wearing valgus braces.

Six components of joint contact load were measured *in vivo* in three subjects, using instrumented, telemeterized knee implants. From the forces and moments the medio-lateral force distribution was calculated. Two braces, MOS Genu (Bauerfeind AG) and Genu Arthro (Otto Bock) were investigated in neutral, 4° and 8° valgus adjustment during walking, stair ascending and descending.

During walking with the MOS brace in 4°/8° valgus adjustment, medial forces were reduced by 24%/30% on average at terminal stance. During walking with the GA in the 8° valgus position, medial forces were reduced by only 7%. During stair ascending/descending significant reductions of 26%/24% were only observed with the MOS (8°).

The load reducing ability of the two investigated valgus braces was confirmed in three subjects. However, the load reduction depends on the brace stiffness and its valgus adjustment and varies strongly inter-individually. Valgus adjustments of 8° might, especially with the MOS brace, not be tolerated by patients for a long time. Medial load reductions of more than 25% can therefore probably not be expected in clinical practise.

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1. Introduction

Osteoarthritis (OA) is the most common joint disease, associated with pain and loss of mobility. When the knee joint is highly loaded, e.g. during the stance phase of gait, most of the axial force is transmitted by the medial compartment (Hsu et al., 1990; Johnson et al., 1980; Morrison, 1970; Shelburne et al., 2005; Zhao et al., 2007). This fact is believed to be responsible for the observation that gonarthrosis predominately starts at the medial compartment (Hernborg and Nilsson, 1977; Jackson et al., 2004).

Besides surgical treatments, several conservative methods, such as lateral shoe wedges, the use of crutches, weight reduction and valgus bracing are common to reduce the axial tibial force and/or to shift it laterally. Reduced loading of the affected compartment is related to pain reduction and improved function, and may thus

delay the need for joint replacement. Valgus braces induce an additional external valgus (abduction) moment at the knee joint, which counteracts the external adduction moment (EAM) in order to shift the axial force from the medial knee compartment towards the lateral one. A correlation between the medial contact force and peak EAMs was found analytically and measured *in vivo* in one subject (Shelburne et al., 2008; Zhao et al., 2007).

In previous studies the load reducing effect of braces was predicted by brace and EAM measurements. Reductions of peak EAMs of about 10–15% were reported when walking with valgus braces (Lindenfeld et al., 1997; Self et al., 2000). Studies have furthermore predicted that larger valgus angulations of the brace lead to higher load reduction of the medial compartment. Reductions of peak EAMs of up to 15% and 19% were reported when walking with a brace adjusted in 4° and 8° valgus positions, respectively (Fantini Pagani et al., 2010). Using an analytical model, Pollo et al. (2002) estimated a medial load reduction of 11% when the brace was adjusted in a 4° valgus position, and 17% for the 8° valgus position. Furthermore, several clinical studies

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