THE INFLUENCE OF A PATELLOFEMORAL KNEE BRACE ON KNEE JOINT KINETICS AND KINEMATICS IN PATIENTS WITH KNEE OSTEOARTHRITIS DURING STAIR NEGOTIATION

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Purpose: The external knee adduction moment (KAM) is an indirect measure of joint loading on the medial knee compartment and appears to be one of the most important biomechanical factors involved in the progression of the medial tibiofemoral osteoarthritis (TF OA). Stair negotiation generates a higher KAM than level walking, is physically challenging and the source of accidents in old age. Valgus knee bracing reduces the KAM during level walking, however, it is unknown whether this occurs for stair negotiation. The most common pain inducing activity in persons with knee OA is stair climbing yet there are no data on effects of bracing predominantly intended for patellofemoral (PF) OA on kinetics and kinematics of this activity. The aim of this study was to investigate effects of a patellofemoral brace with no known mechanical adaptation on gait biomechanics during stair negotiation in individuals with knee OA. We hypothesised the brace would alter knee kinematics and as a consequence reduce joint moments about the knee.

Methods: Thirty male and female participants (40-70 years) with painful PF OA and involvement of medial TF OA were recruited. The diagnosis was established by a radiograph, an MRI scan or by arthroscopy. Participants ascended and descended a 7-step staircase at a standardised speed in 2 conditions: 1) with a brace (predominantly intended for PF OA - Ossur Bioskin Q brace) and 2) without a brace. These 2 conditions were randomized. Kinematic data were obtained by tracking the movement of rigid clusters and markers placed on specific anatomical landmarks using a 10-camera motion analysis system (Vicon) and a modified 6 degrees of freedom full body model. Ground reaction forces (GRF) were measured from step-embedded force platforms. Joint moments were calculated through inverse dynamics techniques by combining kinematic and GRF data. A paired t-test was used to test for differences between conditions. Pain was assessed separately for stair ascent and descent using a visual analogue scale after each condition. Values are means ± SD.

Results: The brace significantly reduced the maximal knee flexion angle during the start of the stance phase [Brace (BR): $73.3^0 \pm 3.9^0$; Control (CTR): $76.0^0 \pm 5.3^0$], the total range of motion (ROM) at the knee [BR: $61.1^0 \pm 5.7^0$; CTR: $63.1^0 \pm 6.3^0$] and the internal peak knee extension moment [BR: 1.00 ± 0.23 Nm/kg; CTR: 1.05 ± 0.23 Nm/kg] in the sagittal plane

compared to control. Additionally, the brace significantly reduced the maximal knee adduction angle during the start of the stance phase [BR: $5.0^0 \pm 5.8^0$; CTR: $7.0^0 \pm 6.9^0$] and the total ROM at the knee [BR: $9.0^0 \pm 5.2^0$; CTR: $10.7^0 \pm 5.1^0$] in the frontal plane compared to control. During stair descent, the brace significantly reduced the maximal knee flexion angle at the end of the stance phase [BR: $94.8^0 \pm 5.6^0$; CTR: $96.6^0 \pm 6.1^0$] and the total ROM at the knee [BR: $82.1^0 \pm 5.3^0$; CTR: $83.6^0 \pm 5.6^0$] in the sagittal plane compared to control. There was no difference in pain reported between conditions for either stair ascent or descent.

Conclusions: Our results show how patellofemoral knee bracing affects knee joint angles and moments during stair negotiation. Although the brace did not influence pain, during stair ascent it reduced the flexion angle, the total ROM and the internal peak extension moment at the knee in the sagittal plane, as well as the adduction angle and the total ROM at the knee in the frontal plane. During stair descent the brace reduced the flexion angle and the total ROM at the knee in the sagittal plane. In the absence of any changes in pain, we speculate the mechanism explaining subtle changes in knee kinematics and kinetics may be related to a greater perception of joint stability with use of the brace. These changes accumulated over long term use might reduce OA condition, its severity and perhaps pain due to it.