# THE IMMEDIATE BILATERAL EFFECTS OF UNILATERAL KNEE BRACING FOR THE TREATMENT OF KNEE OSTEOARTHRITIS: PRELIMARY RESULTS

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## INTRODUCTION

Knee osteoarthritis (OA) is a disease that affects more than 20 million adults in the US, with direct healthcare costs estimated to be $7.9 billion and growing [1]. Some of these costs can be attributed to the fact that many people affected by the disease in one joint, subsequently have additional joints affected, contributing to additional health care costs. If the disease were the result of systemic risk factors alone, bilateral decline would occur at similar rates. However, many patients initially present with unilateral OA, and subsequently exhibit symptoms in the contralateral limb. Studies by Shakoor et al. [2] and Spector et al. [3] reported that, following hip or knee replacement, patients typically required joint replacement in the same joint in their contralateral limb within two years. While it is unclear why this progression occurs, it is important to assess whether treatment of the involved limb inadvertently increases the rate of progression in the uninvolved limb.

Knee bracing is a commonly used conservative treatment for patients with mild to moderate knee OA. Studies have shown that knee bracing can relieve the pain associated with the disease, and that it has positive effects on function including reducing the knee abduction moment [4]. In terms of medial knee OA, a varus posture of the knee, along with large abductory moments are likely to indicate abnormal loading of the medial compartment. Characterizing the effects of a knee brace on static alignment, as well as dynamic knee kinetics and kinematics is important for understanding the potential benefits of the brace. This study sought to measure the effects of unilateral knee bracing on loading in both knees. The purpose of this study was to examine the immediate effects of unilateral knee bracing on pain levels, joint alignment, and knee kinetics and kinematics of both the involved and uninvolved sides of patients with unilateral, medial knee OA. It was hypothesized that there would be side-to-side differences, as well as differences between a braced and unbraced condition.

## METHODS

As part of an ongoing longitudinal study, the first four of twenty subjects (all male; 66 years ±9; 81±7 kg; 1.8±0.1m) with unilateral medial knee osteoarthritis were studied. All subjects were K-L grade 2 or 3 in the involved knee, as assessed by radiograph, and were asymptomatic on their uninvolved knee. Subjects were fit with a custom unloader valgus knee brace (Ossur Unloader One; Aliso Viejo, CA) and allowed a one-week accommodation period. Instrumented gait analyses were performed at baseline (without the brace) and after a one-week brace accommodation period (with the brace). The analyses were conducted in a data collection volume containing a 12-camera system (Motion Analysis Corp; Santa Rosa, CA) sampling at 100Hz and four forceplates (AMTI; Watertown, MA and Bertec; Columbus, OH) sampling at 1000Hz. The gait analyses were performed in a barefoot condition, although all research subjects were also provided with standardized footwear (New Balance 576; Boston, MA) to wear in conjunction with the knee brace outside of the lab. Subjects walked overground at a self-selected pace. Kinetics and kinematics were assessed in both the involved and uninvolved knees. Peak stance-phase knee adduction angles and (internal) abduction moments were measured from each of a minimum of 8 gait cycles per subject. At each measurement session, subjects were asked to rate their pain levels on a 100mm visual analog scale following the performance of each of three tasks: walking 50ft at a comfortable pace, walking 50ft at a fast pace, ascending and descending 5 stairs.

Radiographs of both knees were obtained at baseline with and without the knee brace applied to the involved limb. From these, the minimum

medial joint space and the tibio-femoral angle were measured. A two-way repeated-measures ANOVA was carried out to compare each dependent variable between the braced and unbraced conditions, and between the involved and uninvolved limbs. Additionally, effect sizes were calculated for the effect of both condition and limb. Due to the preliminary nature of these results, a $p\text{-value} < 0.10$ was considered significant, and an effect size $> 0.7$ was considered large.

## RESULTS AND DISCUSSION

Kinematic and kinetic results are shown in Table 1. These data showed no interaction between limb and condition, nor were there differences between baseline (unbraced) and one-week (braced) conditions. However, there were significant differences between the involved and uninvolved limbs. Conversely, as shown in Table 2, the results indicated a significant interaction between limb and condition for the pain scores for all three tasks. The brace significantly reduced the pain in the braced limb, but had virtually no effect on pain in the uninvolved limb. It is likely that this occurred because baseline scores were low in the contralateral limb, potentially limiting the ability to detect a treatment effect. Radiographic measurement results are shown in Table 3. There were no statistical differences between the involved and uninvolved limbs or between the braced and unbraced conditions. However, the large effect size ($> 0.7$) suggests a difference between the limbs for both parameters. This difference may become statistically significant with the addition of the remaining subjects.

## CONCLUSIONS

The results to date suggest that there is a difference between the involved and uninvolved sides of patients with medial knee OA. There do not appear to be any immediate (one-week) effects on the functional or structural factors measured in this study. However, the brace had a significant clinical effect in that it reduced pain in the involved limb. In light of the expectation that the brace would affect structure and function, the lack of changes for these factors is surprising. However, these findings represent only four subjects, and the differences may be more pronounced at the short-term (4-month) or long-term (12-month) follow-up.

## REFERENCES


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Table 1: The effects of bracing on knee kinematics and kinetics (knee adduction is positive)

| Variable | Baseline (Unbraced) Condition | | 1-Week (Braced) Condition | | Effect of Condition, p-value (Effect Size) | Effect of Limb, p-value (Effect Size) |
|---|---|---|---|---|---|---|
| | Involved | Uninvolved | Involved | Uninvolved | | |
| Knee Add Angle, deg | 6.5 (4.4) | 2.7 (4.2) | 6.5 (2.0) | 2.4 (4.3) | 0.84 (0.1) | 0.06 (1.1) |
| Knee Abd Mom, N-m/kg | -0.5 (0.1) | -0.4 (0.1) | -0.6 (0.1) | -0.4 (0.1) | 1.00 (0.3) | 0.03 (1.9) |

Table 2: The effects of bracing on pain scores (0 = No Pain and 100 = Worst Pain)

| Variable | Baseline (Unbraced) Condition | | 1-Week (Braced) Condition | | Interaction Between Condition and Limb, p-value |
|---|---|---|---|---|---|
| | Involved | Uninvolved | Involved | Uninvolved | |
| Stairs | 61.7 (21.2) | 1.3 (2.3) | 31.3 (24.3) | 3.7 (6.4) | 0.08 |
| 50’ Comfortable Walk | 62.7 (5.1) | 1.3 (1.5) | 19.3 (21.4) | 0.0 (0.0) | 0.05 |
| 50’ Fast Walk | 58.0 (17.3) | 1.0 (1.7) | 17.3 (9.8) | 0.0 (0.0) | 0.04 |

Table 3: The effects of bracing on radiographic measures in a braced and unbraced condition at baseline

| Variable | Unbraced Condition | | Braced Condition | | Effect of Condition, p-value (Effect Size) | Effect of Limb, p-value (Effect Size) |
|---|---|---|---|---|---|---|
| | Involved | Uninvolved | Involved | Uninvolved | | |
| TF Angle, deg (varus +) | 2.3 (4.6) | -1.4 (5.2) | 1.4 (3.9) | -2.2 (4.7) | 0.17 (0.2) | 0.26 (0.8) |
| Joint Space, mm | 1.7 (3.4) | 4.1 (2.5) | 2.0 (3.4) | 4.5 (2.3) | 0.11 (0.1) | 0.14 (0.8) |