The Effect of Prophylactic Knee Braces on Balance and Uninjured Knee Range of Motion

A.P. Schmidt, C.M. Hearon FACSM, and M.L. Daniel

Human Performance Laboratory, Department of Health & Kinesiology

Texas A&M University – Kingsville, Kingsville, TX

ABSTRACT

There has been numerous studies performed regarding the effectiveness of prophylactic knee braces (PKB) preventing knee injuries or the effect of PKB on injured knees, but minimal research is available on the effect of how PKB affect the functioning capacity of uninjured knees. **PURPOSE:** To examine the effects of two different types of PKB, hinged (HGB) and non-hinged (NHB), on uninjured preferred knee joint range of motion and dynamic balance in males and females. **METHODS:** Thirty subjects were recruited (male=15, female=15) with ages ranging from 18-28 years. Only participants with no history of any knee injuries or current knee problems were allowed to participate. Subjects were blinded to the purpose of the study, but were allowed practice trials for the dynamic balance test (Y-Balance test). Prior to experimental trials subjects were measured for body composition and knee brace size. All subjects underwent three experimental trials [HGB, NHB, and a no PKB control (CON)] on the same day in balanced cross-over design. During the treatment trials, the subjects wore the braces on their preferred leg. Each experimental trial was comprised of a test for dynamic balance and four tests for knee joint range of motion. Dynamic balance composite score, knee extension/flexion (˚), and internal/external knee rotation (˚) were compared between sex (M, F) and across PKB (HGB, NHB, CON) using an ANOVA (1 between, 1 within), α=0.05. Age and body composition differences between sex were examined using independent *t*-tests, α=0.05. **RESULTS:** M and F did not differ (p>0.05) with regard to age, but did differ significantly (p<0.05) in body mass, body stature, and percent body fat. For the sex main effect, when pooled across PKB (CON, HGB, NHG) M and F did not differ (p>0.05) in knee flexion, internal knee rotation, right/left leg balance, but did differ significantly (p<0.05) in knee extension (M=+0.8±1.8˚, F=-0.6±2.4˚) and external knee rotation (M=29.7±7.5˚, F=35.9±9.7˚). For the main effect for PKB, when pooled across sex external knee rotation and right/left leg balance did not differ (p>0.05) between HGB, NHB, and CON, but both HGB and NHB differed significantly (p<0.05) from CON for internal rotation (HGB=21.9±10.3˚, NHB=22.5±9.8˚, CON=24.8±10.0˚), flexion (HGB=126.9±17.7˚, NHB=125.7±15.9˚, CON=139.0±6.8˚), and extension (HGB=+0.7±1.4˚, NHB=+=1.3±1.8˚, CON=-1.7±2.2˚). The sex x knee brace interaction was not significant (p>0.05). **CONCLUSION:** PKB have no effect on dynamic balance, but appear to hinder the range of motion for most motions of the knee.

INTRODUCTION

Knee injuries are one of the most common injuries among people in today's society (1). Prophylactic knee braces are designed to prevent and reduce the severity of ligamentous injuries to the knee (2), but there are few studies examining how these braces affect the functioning of uninjured knees. Numerous studies have examined the effectiveness of prophylactic knee braces in the prevention of knee injuries (3), but limited information is available regarding the effect of these braces on functional performance. Two commonly measured variables to evaluate functional performance are joint range of motion and dynamic balance, and the extent to which prophylactic knee braces affect these variables has not been studied extensively. The expected degree of movement for an uninjured knee is: flexion=135°; extension=0° (hyperextension may be present up to 10-15°); tibial internal rotation=30°; and tibial external rotation=40°(4). Dynamic balance plays an integral role in functional movement, but there are no standard for measuring this variable or commonly used norms for evaluation of this variable. The Y-balance Test provides a dynamic balance measure of posteriomedial, posteriolateral, and anterior lower limb movements at the knee. There is no evidence found that suggests that prophylactic knee braces affect the dynamic balance within this test and no specific studies regarding the effect of these braces on range of motion.

PURPOSE

The purpose of the study was to examine the effects of two different types of prophylactic knee braces, hinged and non-hinged, on uninjured preferred knee joint range of motion and dynamic balance in males and females.

METHODS

IRB Approval: The study was approved by the Institutional Review Board (Human Subjects) at Texas A&M University-Kingsville.

Subjects: All subjects were provided inform consent prior to testing. Thirty subjects (15 male, 15 female), all with uninjured knees, were recruited from the student population at Texas A&M University-Kingsville.

Pre-participation Screening/Testing: All subjects underwent a health screening according to the American College of Sports Medicine's guidelines for exercise testing and prescription. This included a questionnaire acquiring their past knee injury status. Only subjects classified as having no prior significant movement limiting knee injury were allowed to participate in the study. The following were also measured pre-participation: body mass utilizing a standard physicians scale, body stature utilizing a stadiometer, percent body fat, fat mass, and fat-free mass via air displacement plethysmography (Bod Pod) (Life Measurements Inc., Concord, CA). Subjects were also measured for thigh and calf circumference, sized for the knee-braces, and allowed to become familiar with movement in the braces. Additionally, subjects were introduced to the experiment strategies and tests including the Y-balance test and the four knee joint range of motion tests.

Experimental Design: All subjects will underwent three experimental trials [hinged-brace treatment (HGB), non-hinged brace treatment (NHB), and a no brace control (CON)] on the same day. During the treatment trials, the subjects wore the braces on their preferred leg. Each experimental trial was comprised of a test for dynamic balance and tests (4) for knee joint range of motion. A balanced cross-over design was used.

METHODS, cont.

Measurements:

Dynamic Balance- The Y-balance Test (Move 2 Perform, Evansville, IL) was used to measure dynamic balance. Following six practice trials on each leg, the subject completed the test using each leg. Standing on the Y-balance center platform, subjects were required to engage in an anterior, posteromedial, and posterolateral reach with both the left and right leg, while balancing on the center platform with the opposite leg (Figure 1). The maximal reach distance (cm) over three repetitions was recorded for the six movements. These maximal reach values, coupled with leg length, was used to arrive at a composite balance score for each leg using the following equation (5):

$$\frac{(Anterior + Posteriomedial + Posteriolateral)}{(3x\ Limb\ Length)} \times 100$$

Figure 1: Y-balance test. The three basic movements of the Y-balance test are depicted. Subjects performed each movement with the right and left leg, while balancing on the opposite leg.

Knee Joint Range of Motion- Goniometry was used to assess the range of motion in the knee joint. With the use of a goniometer (Baseline Medical, Fishers, IN), knee flexion, extension, internal rotation, and external rotation was measured in degrees (°).

Statistical Analysis: Dynamic balance composite score, knee extension/flexion, and internal/external knee rotation were compared between sex (M, F) and across knee brace (HGB, NHB, CON) using an ANOVA (1 between, 1 within), α=0.05. Age and body composition differences between sex were examined using independent *t*-tests, α=0.05.

RESULTS

Age and Body Composition: M and F did not differ significantly (p>0.05) with regard to age (M=22.4±2.4 yr, F= 21.2±1.1 yr), but did differ significantly (p<0.05) in body mass (M=87.6±16.3 kg, F=71.9±10.5 kg), body stature (M=176.8±6.6 cm, F= 167.3±5.6 cm), and percent body fat (M=18.2±8.8%, F= 31.0±7.5%).

Male vs. Female Main Effect: When pooled across the three brace trials (CON, HGB, NHG), M and F did not differ significantly (p>0.05) in knee flexion, internal knee rotation, right leg balance, and left leg balance. However, they did differ significantly in knee extension (M=+0.8± 1.8°, F=-0.6±2.4°, p=0.004) and external knee rotation (M=29.7±7.5°, F=35.9±9.7°, p=0.044).

Sex x Knee Brace Interaction: M and F did not respond significantly different (p>0.05) across the brace trials (HGB, NHB, CON) for any of the dependent variables.

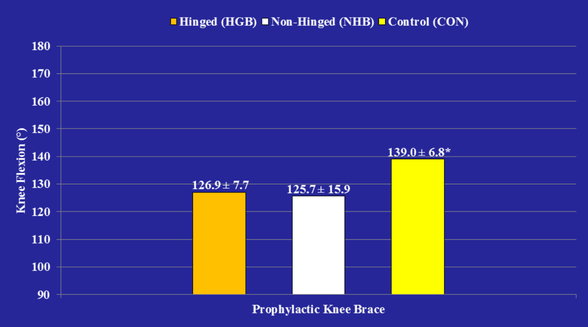

Figure 1: Knee brace main effect for knee flexion. When pooled across M and F, both HGB and NHB differed significantly (*p<0.0001) in range of motion from CON.

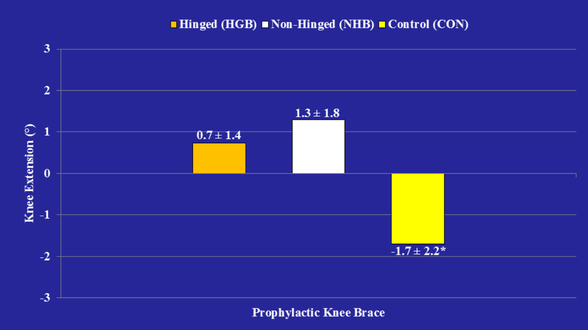

Figure 2: Knee brace main effect for knee extension. When pooled across M and F, both HGB and NHB differed significantly (*p<0.0001) in range of motion from CON.

RESULTS, cont.

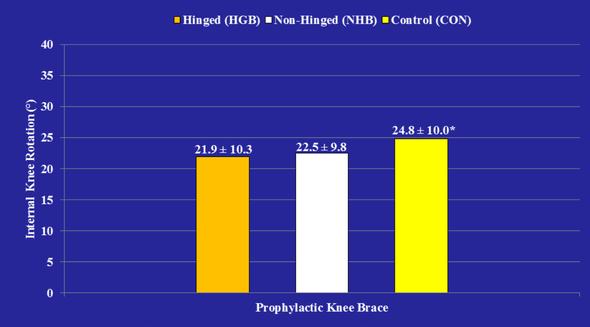

Figure 3: Knee brace main effect for internal knee rotation. When pooled across M and F, both HGB and NHB differed significantly (*p=0.001) in range of motion from CON.

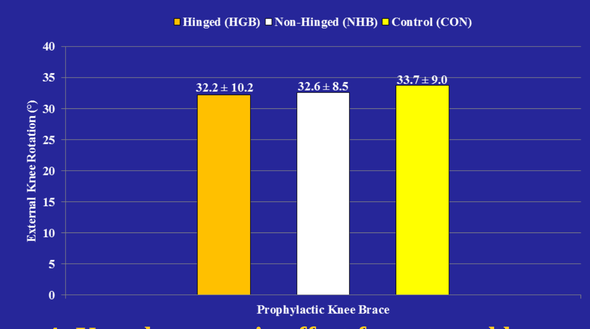

Figure 4: Knee brace main effect for external knee rotation. When pooled across M and F, range of motion did not differ between significantly (p>0.05) between HGB, NHB, and CON.

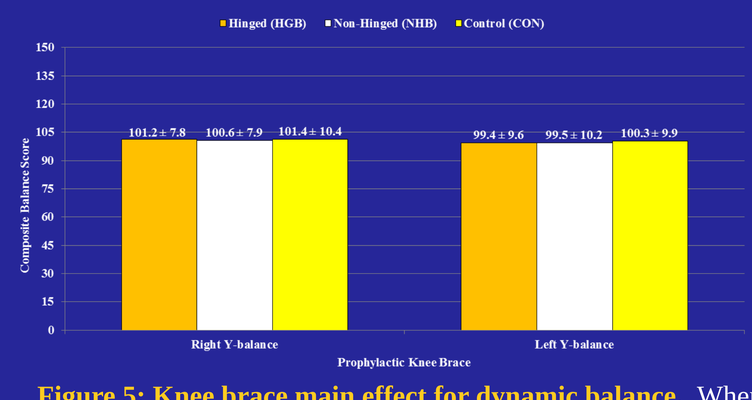

Figure 5: Knee brace main effect for dynamic balance. When pooled across M and F, balance did not differ between significantly (p>0.05) between HGB, NHB, and CON for either leg.

CONCLUSIONS

The research regarding the effects of prophylactic knee bracing on performance is limited, resulting in minimal available information on how these braces affect range of motion and dynamic balance. The results of this study rendered valuable information with regard to these variables. As presented in the results, knee range of motion, excluding external rotation, was hindered when wearing the braces. However, dynamic balance was not altered. Many people, especially athletes, use prophylactic braces to reduce the risk of knee injury during performance while not knowing the effects that the braces can have on their performance. Further investigation should be made into whether or not the mobility limitations introduced by these braces are offset by the injury risk reduction they provide. Additionally, further investigation is needed to determine whether this decreased range of motion is detrimental to performance or function in day-to-day activities.

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