KNEE-JOINT ORTHOSES AND THEIR INFLUENCE ON A PLANTA R PRESSURE DISTRIBUTION – PILOT STUDY

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SUMMARY
Orthotic helps, especially the knee braces, are often used by both, doctors and patients. This study deals with the influence of knee bracing on plantar pressure distribution changes during gait in healthy individuals. The experimental group concerned 5 healthy subjects, 3 females and 2 males aged 27 ± 5 years, using a pressure platform for determination of effects of three types of knee braces on dynamic interaction between the foot and the ground. The statistical results illustrate that application of the functional knee brace increased the plantar pressure under intermedial forefoot, the use of the prophylactic knee brace increased plantar pressure under lateral forefoot and decreased under medial hindfoot, and the use of the knee sleeve decreased plantar pressure under both lateral and medial hindfoot.

INTRODUCTION
Orthotic helps, especially the knee braces, are often used by both, doctors and patients. This trend responds to lifestyle changes, to technology improvements and also to wider offer of knee braces on the trade [9]. The main purpose of the use of these braces is to support, set right and immobilize the knee [1].

Both, manufacturers and researchers that are interested in knee braces mainly concentrate on their influencing the region of knee and on their effectivity in treatment and prevention of knee disorders or injuries. Only a few studies have considered its influence on equilibrating of centre of gravity changes during standing or gait, or some of the dynamical parameters like COP (centre of pressure) process. Some previous studies dealt with the effect of artificial impulses (tape [7], [3], ice [5], prophylactic knee brace [4], knee sleeve [2]) or knee position changes [10] on the lower extremity on stand and gait characteristics.

The main purpose of this study is to verify experimentally possible changes of plantar pressure distribution during the stance phase of gait in relation to the application of three types of knee braces.

METHODS
The pre-experiment concerned 5 healthy subjects, 3 females and 2 males aged 27 ± 5 years. For the experiment we chose three knee braces – functional brace, proprioceptive brace and knee sleeve. All the braces were worn on the left knee. To detect the interaction of foot dynamics at the contact with the ground we used modular measuring system Footscan® from RSscan International company, (RSscan International, company Olen, Belgium).

Before the experiment we get basic anamnestic data and did clinical examination, which included the heel, knee, hip and pelvis position of each subject. After the familiarization with the measure process and following a few of experimental trials, each of subjects was instructed to walk across 8 m long measuring plate 10 times so that the fourth step is done with left foot and is located onto the active place of measuring plate Footscan. The gait speed was controlled by metronome. From this experiment we obtained 20 groups of dates from each subject, 5 for every status without and with each of the three orthoses.

The values of pressure under each foot region was averaged and in each ROI (region of interest) confronted for each status with every brace. The values were confronted for these 6 ROI: MF – medial forefoot, IFF – intermedial forefoot, LFF – lateral forefoot, MF – midfoot, MHF – medial hindfoot, LHF – lateral hindfoot. Then, after the application of ANOVA we revealed that 49 measures are needed for significant results.

The aim of the second experiment was to get more accurate results of plantar pressure distribution changes under every ROI during stance phase of gait in relation to the use of each of the three types of knee braces. Only one subject figured in this experiment and we carried out 60 measurements for every status without and with each of the three orthoses [8].

RESULTS AND DISCUSSION
The results of the second experiment demonstrated a slight decrease of pressure under medial forefoot and heel and an increase of pressure in the other regions, mostly under intermedial forefoot, while wearing the functional brace. With the use of the proprioceptive brace slight pressure increase under medial forefoot and midfoot was achieved, and a noticeable increase under lateral forefoot occurred. Under the regions of intermedial forefoot and medial heel the pressure decreased; there was no change under the lateral heel. The application of the knee sleeve led to an increase of pressure under medial and also lateral forefoot, and the pressure decreased under the other regions, noticeably under both, lateral and medial heel (Figure 1).

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<thead>
<tr>
<th>Regions of the foot (ROI)</th>
<th>Sum of the pressure [N/cm²]</th>
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<tbody>
<tr>
<td></td>
<td>Without any brace</td>
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<td></td>
<td>Functional brace</td>
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<td></td>
<td>Proprioceptive brace</td>
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<td>Knee sleeve</td>
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Figure 1: Total load of each ROI during stance phase of gait

<table>
<thead>
<tr>
<th>Total load of each ROI during stance phase of gait</th>
<th>MFF</th>
<th>IFF</th>
<th>LFF</th>
<th>MF</th>
<th>MHF</th>
<th>LHF</th>
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<tbody>
<tr>
<td>Sum of the pressure [N/cm²]</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>5</td>
<td>10</td>
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Figure 1. Total load of each ROI (region of interest) during stance phase of gait. MFF – medial foot, MF – midfoot, MHF – medial hindfoot, LHF – lateral hindfoot. [8].

Figure 2. The plantar pressure differences from the status without any brace [8].

To determine the significance of the results we used ANOVA and than Tukey method of mutual comparison. We found out significant difference in plantar pressure under IFF – pressure increase with functional brace, LFF – pressure increase with proprioceptive brace, MHF – pressure decrease with proprioceptive brace, MHF and LHF – pressure decrease with knee sleeve (Figure 2).

The results from the second experiment may be influenced by initial position of the foot, which is important to consider in the analysis of results. The starting clinical examination showed valgose position of the left heel and also pronation in subtalar joint of the left foot. It can lead to increased load under medial regions of the foot – MFF and MHF without the use of any brace, which is decreased with application of the brace. However, we can see the load increase under lateral regions of the foot (LFF, MF) while wearing the orthoses.

From these results we can deduce an „optimisation of plantar pressure distribution” in deeply pronated foot while wearing knee braces.

This study demonstrated that, due to its high individuality, human gait is a variable and hardly repeatable complex motion. To achieve more accurate results in the future studies it will be useful to apply additional measuring methods like force plate Kistler and 3D motion analyses.

CONCLUSIONS
The plantar pressure distribution changes were found in relation to the application of three types of knee braces. From the first experiment we revealed that 49 measures are needed for significant results. After the larger second experiment we found out following intraindividual significant differences in plantar pressure distribution: under IFF – pressure increase with functional brace, under LFF – pressure increase with proprioceptive brace, under MHF – pressure decrease with proprioceptive brace and under MHF and LHF – pressure decrease with knee sleeve.

ACKNOWLEDGEMENTS
This work was supported by grant GAČR P 407/10/1624 and grant GAUK 111 310

REFERENCES