THE INFLUENCE OF TWO DIFFERENT BRACES ON LATERAL PATELLAR DISPLACEMENT – A CADAVERIC STUDY

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INTRODUCTION: Patellofemoral pain syndrome (PFPS) often occurs in young and physically active athletes (Taunton et al., 2002, Adirim & Cheng, 2003). It is generally accepted that a cause of PFPS is a malalignment of the patellofemoral joint. Bracing supply is commonly used for the treatment of PFPS. Several studies have shown that patellar bracing and taping improved PFPS (Lun et al., 2005, Warden et al., 2008). Crossley et al. (2009) found a reduced lateral patellar displacement and a decreased mean pain (mean pain was recorded on a 100 mm visual analog scale during single-leg squats) after patellar taping. A more medial displacement of the patella and a decrease in patellofemoral stress could lead to less patellofemoral pain (Powers et al., 2004). A more medial patellar displacement could result in a more centered patella. Therefore, the purpose of this study was to investigate the effect of two different braces on the alignment of the patella.

METHOD: Six fresh frozen cadaveric legs (3 subjects, age 66-72 years) were thawed for 24 h at room temperature. Apart from separating the femur head from the shaft, which was armed with a fixture, the legs were not dissected. The lower leg was fixed with belts and held in a vertical position. With the aid of the fixture each leg underwent 10 flexion-extension cycles through a range of 45° to 0°. During a flexion-extension cycle the thigh muscles were strained using a tighten strap which was armed with nails (inserted in the muscles) and fixed on the jig. The legs were tested in a non-braced condition followed by two conditions with braces. Two different braces were chosen: Patella Pro (PP) (Otto Bock GmbH, Germany) and a common elastic brace (BA) (Genutrain P3 Bauerfeind AG, Germany). Kinematic data were obtained by using Vicon Nexus with 5 Cameras (100 Hz) (Version 1.4.115, Vicon Motion Systems Limited, United Kingdom). Bone pins were screwed into tibia, femur and patella to minimize the influence of skin movements. To avoid a skin-pin impingement of the patellar bone pin the skin was incised along the line of motion. Each bone pin was armed with an array of three retroreflective markers. To define anatomical reference systems anatomical landmarks were pointed using a bar of 20 cm length attached with three retroreflective markers and related to their segmental bone pin. A mathematical model was built in Vicon Bodybuilder (Version 3.6, Vicon Motion Systems Limited, United Kingdom) to calculate the lateral patellar displacement (LPD) in relation to the femurs medio-lateral axis. The LPD was quantified during extension of the knee joint relative to the non-braced condition. The mean displacement of 10 extensions was obtained close to 0° for each condition. To find differences in LPD between BA and PP conditions we used a non parametric Wilcoxon signed-rank test for repeated measurements with a significance level of $P < 0.05$.

RESULTS: In the non-braced condition the position of the patella was lateral in relation to the center of the medio-lateral axis of the femur over the full flexion-extension cycle. The patella was more medial close to the maximal knee extension. The results for the LPD in relation to the non-braced condition are shown in Figure 1. For the PP brace the average LPD close to maximal knee extension was more medial by 0.86 mm ± 0.90. For the BA condition the average LPD close to maximal knee extension was more lateral by -0.73 mm ± 1.41. Therewas a significant difference in lateral displacement between PA and BA ($P = 0.028$).

DISCUSSION: The purpose of the study was to investigate the influence of patellar bracing on the lateral patellar displacement. The motion in the knee joint is a coupled movement between the tibiofemoral joint and the patellofemoral joint (Li, 2007). Compared to the literature (Koh et al., 1992; Brossmann et al., 1993; Varadarajan et al., 2010) the lateral displacements are similar to those reported in our study. While the use of cadavers is limited due to the lack of physiological muscle contractions the result indicates a life-like patellar motion in comparison to the literature. Small differences can be explained by relating the motion to different axis systems and by the complexity of the patellofemoral joint. The aim of a brace is to center the patella in the trochlea groove. Powers et al. (1999) found no significant differences in LPD between a non-braced condition and Bauerfeind Genutrain P3 brace. Our results showed even a slight lateral LPD in the BA condition. In the PP condition the LPD was more medial. These findings are supported by Crossley et al. (2009) with similar results to our study. They reported a significant reduced lateral displacement and decreased pain after taping the patella. In agreement to this Lun et al. (2005) demonstrated less pain during wearing a patella brace.

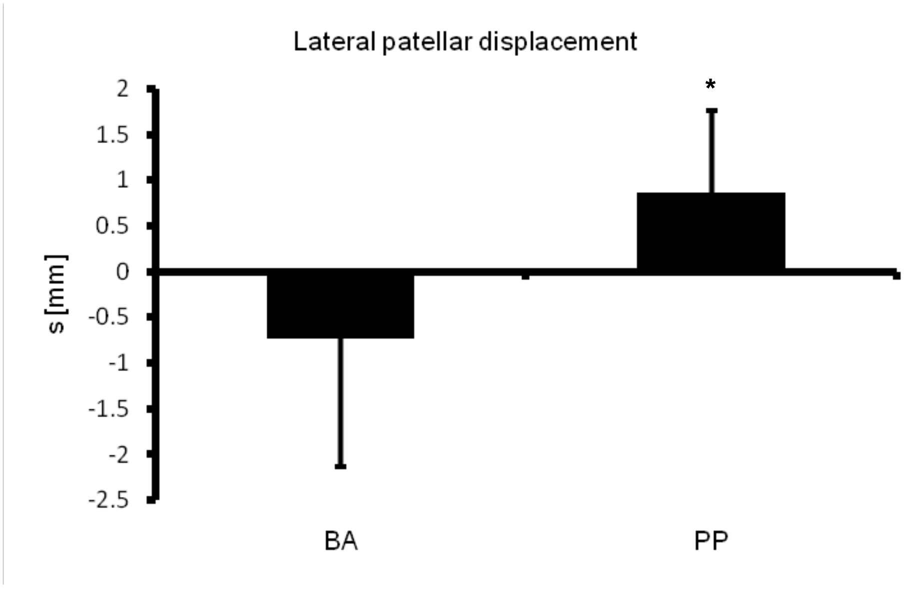

Figure 1. Positive values indicate a more medial displacement; negative values indicate a more lateral displacement in relation to the non-braced condition. The position of the patella in the non-braced condition is lateral in relation to femurs medio-lateral axis. *There is a significant difference between PP and BA (P = 0.028).

CONCLUSION: Our study showed the influence of bracing on lateral patellar displacement (LPD). We found a more medial LPD after bracing with Patella Pro (PP) (Otto Bock GmbH, Germany) and in contrast to this a more lateral LPD after bracing with the Genutrain P3 (BA) (Bauerfeind AG, Germany). Compared to studies which investigated the effect of bracing on patellofemoral pain syndrome (PFPS) our findings suggest that the use of the BA brace might not be effective in reducing PFPS and the design of the PP brace provides prerequisites to reduce PFPS. To clarify the mechanism of the PFPS and to get more insight on the influence of bracing on the PFPS in sports further studies are required.

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