

## **A PERFORMANCE-RELATED FOOT LOADING CHARACTERS WHILE PERFORMING LUNGING STEP AMONG BADMINTON PLAYERS**

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The purpose of this study was to investigate the foot loading characteristics of badminton athletes and amateurs while performing the right-forward lunging step. Eight badminton male athletes and eight aged-matched college students participated the test in a stimulated badminton court. The Novel pedar insole plantar pressure measuring system was utilized to collect the right feet loading. As the results turn out, the peak pressure and force time integral of amateurs to the lateral rearfoot and lateral forefoot were obviously higher than that of badminton athletes, and athletes showed opposite plantar pressure distribution characteristics. This findings indicated the movement instability thus reducing performance of lunge, even reflect the ankle sprain risks of badminton amateurs.

**KEY WORDS:** badminton, lunging step, foot loading.

**INTRODUCTION:** Badminton has gained great popularities around the world in the recent years. It is a non-contact racket sports, requiring rapid turning in directions, immediate jumps and lunging steps combined with upper extremity movements (Shariff, George & Ramlan, 2009). It was reported that badminton-playing could stress and exercise the aerobic fitness, muscle strength, coordination and other body motor capacities (Cronin, Mcnair & Marshall, 2003), thus people of different ages and different levels joined into playing badminton either for competitive match or for physical activities. Previous studies about badminton were focused on the techniques and statics of badminton competitions, aiming to improve match performance (Chow et al., 2014; Masu, Muramatsu & Hayashi, 2014; Mei et al., 2014). With more people participating into badminton playing, the badminton injuries increased simultaneously (Jérgensen & Winge, 1987; Krone et al., 1990; Lee & Yoo, 2012). Lunging step was one of the most common and critical footwork in badminton, as proficient footwork enabled good commands of body balance and control for different upper limbs' movement (Kuntze, Mansfield & Sellers, 2010). The purpose of the study was to investigate the foot loading characteristics of badminton athletes and amateurs while performing right-forward lunging step.

**METHODS:** A total of 16 right-handed participants, with 8 badminton male athletes (national level) and 8 age-matched male college students (amateur level), joined in the test in a standard badminton court. The Novel pedar insole plantar pressure measuring system was

taken to record the pressure and force exerted to the insole with a frequency of 50Hz. And the insole was divided into eight anatomical parts, including medial heel (MH), lateral heel (LH), medial midfoot (MM), lateral midfoot (LM), medial forefoot (MF), lateral forefoot (LF), big toe (BT) and other toes (OT). Each participant performed six successful trials of lunge step for average and normalization to reduce experiment errors. The peak pressure and force time integral were utilized to illustrate the foot loading difference in the right foot between badminton athletes and college students while conducting right forward lunging step. The independent samples *t*-test from SPSS 16.0 were taken for the statistical analysis, and significance level was set at 0.05.

**RESULTS:** In this study, Novel pedar insole plantar pressure measuring system was taken to collect the peak pressure and force time integral in eight anatomical parts. As figure 1 and 2 indicated, the peak pressure to the lateral heel (LH), lateral midfoot (LM) and lateral forefoot (LF) and force time integral to lateral heel (LH), lateral forefoot (LF) and other toes (OT) of badminton amateurs were significantly higher ( $p < 0.05$ ) than those in badminton athletes. Conversely, the peak pressure to the medial forefoot (MF) and big toe (BT) and force time integral to the medial forefoot (MF) of badminton athletes were obviously higher ( $p < 0.05$ ) than those of badminton amateurs. Figure 3 illustrated the overall pressure distribution and centre of pressure (COP) trajectories of right-forward lunging step.

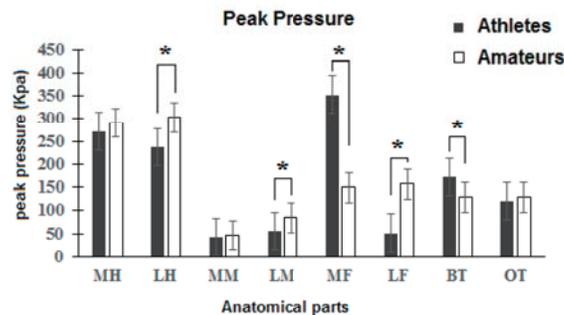


Figure 1: The peak pressure in the right foot while perform lunging step (\* indicates significance,  $p < 0.05$ )

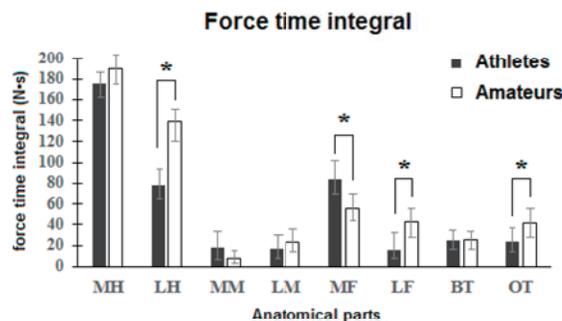
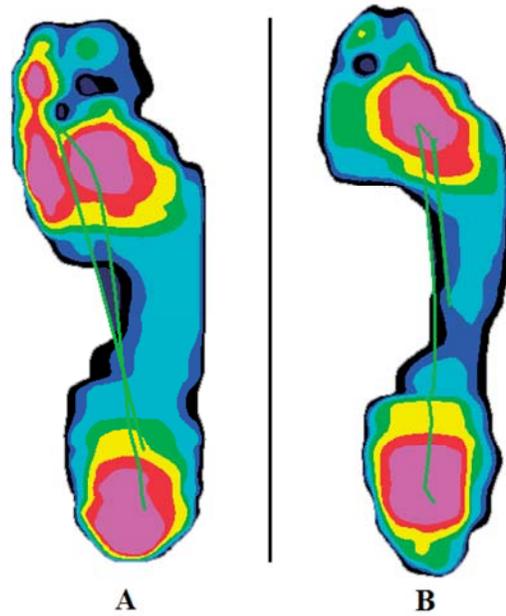


Figure 2: The force time integral in the right foot while performing lunging step (\* indicates significance,  $p < 0.05$ )



**Figure 3: The overall pressure distribution and centre of pressure (COP) trajectories of badminton athletes and amateurs while performing right-forward lunging step.**

**DISCUSSION:** Badminton has gained its great popularities and wide participation among people of different ethnicities, genders, ages and technique levels, and the badminton-related injuries increased at the same time (Lee & Yoo, 2012). Apart from age or gender difference, one specific reason for this was that the right techniques or skills participants acquired differed from different badminton performance levels. Among all those techniques, footwork was the most fundamental and critical skills in badminton competitions (Kuntze, Mansfield & Sellers, 2010). An excellent and proficient footwork skills enabled players quickly move into a best position for shot with balance maintenance and body control for the next movement (Cabello & González-Badillo, 2003). Combining with the peak pressure, force time integral and COP trajectory of right foot while conducting the right forward lunging step, the badminton athletes showed a medial foot loading shift while the right leg supporting in the lunging step, with significantly higher peak pressure and force time integral in MF and BT (Figure 3-A). It may be the reflection of excellent body balance maintenance and control (Masu, Muramatsu & Hayashi, 2014), which was a basis for competition performance. The lateral shift of foot loading among badminton amateurs showed the supporting leg instability leading to poor balance control, and even implied the sprain injury risks of right ankle (Krone et al., 1990) (Figure 3-B). Future study shall focus on the lower limb kinematic characteristics of badminton athletes and amateurs to explain the plantar pressure distribution difference.

**CONCLUSION:** This study identified the foot loading characteristics between badminton athletes and amateurs through plantar pressure collection and analysis. The badminton athletes showed a medial shift of foot loading to the medial forefoot and big toe, which was crucial for balance maintenance and body control. However, amateurs showed a lateral shift of plantar pressure to lateral forefoot and other toes, which may be one reason for poor

balance control and potential risk of ankle sprain. In the training or exercising course, the emphasis on the right lunging footwork should be paid not only to improve performance, but also to minimize the injury risks.

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#### *Acknowledgement*

This study is supported by the Scientific Research Foundation of Graduate School of Ningbo University (G15005) and Outstanding (Postgraduate) Dissertation Growth Foundation of Ningbo University (py2014008).