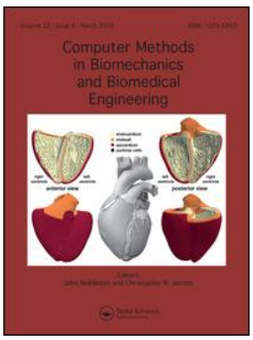

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Comparison of dynamic plantar support after a triple jump competition

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KEYWORDS Dynamic plantar pressures; triple jump; baropodometry

1. Introduction

Triple jump is an athletic event that requests specifically a balanced foot support in order to optimize the performance. The first ray of the foot (hallux and first metatarsal head) has an important function to propel the body during take off for the hop and the step. Dynamic foot pressure is a good indicator and it has been used in various studies to detect foot pathologies (Putti et al. 2010). A large consensus displays that normal feet have the greatest pressure located on the second and third metatarsal heads. Sanchez-Rodriguez et al. (2012) measured plantar pressures on 400 participants according to the type of foot with the FootScan platform (4096 sensors) operating at 150 Hz.

However, a repetitive task like take off caused biomechanical foot adaptations and could modify plantar pressures distribution (Ledoux and Hillstrom 2002, Rao et al. 2011).

The aim of the study was to investigate, during a triple jump event, the impact of the repetition of triple jump on the dynamic plantar support. We proposed to assess the likely architectural foot modification due to the repetitive hard impact and the repercussion on the kinetic of the plantar support.

2. Methods

Nine triple jumpers with national level (height 1.74 ± 0.11 m, mass 60.8 ± 8.9 kg, foot size 41.0 ± 3.1), healthy, free of pathology was requested to perform a triple jump event (at least 4 trials) and no type of foot was determinated.

Attendees were recorded first time in twice, pre-event (PRE) and second time in post-event (POST). Plantar pressure measures were recorded on a baropodometric platform (AM Cube, France) consisted of 4096 capacitance-based force transducers at a resolution of 4 sensors/cm^2 in order to highlight the likely influence of the repetition jump on dynamic plantar pressures after a triple jump event. Each subject was tested using the 2-step protocol (Bus and De Lange 2005) approach to the platform in which platform contact was made on the second step after initiation of gait. Each participant had the same time training before the first platform measure, 1minute between the first platform measure and the first jump and 1 min between the last jump and the final platform measure.

Footwork Pro software was used to analyse the pressure data. By automated masking the forefoot was divided in eight anatomical regions: medial heel (MD), lateral heel (LH), metatarsal heads (M1, M2, M3, M4, M5) and hallux (H). For each region, contact time (ms) and average pressures (kPa) were calculated. Comparisons among attendees were made using Wilcoxon test. Statistical significance was accepted at the $p < 0.05$ level.

3. Results and discussion

At the end of the triple jump event, attendees have significantly reduced the contact time of the hallux (H, $p = 0.030$) and first head metatarsal (M1, $p = 0.029$) and increased the contact time of the medial heel (MH, $p = 0.032$) in comparison with these values recorded before the event. Athletes also showed in POST-event a significant average pressure increase located on the second metatarsal head (M2, $p = 0.007$).

The main finding of the current study shows that a triple jump event has an influence on dynamic plantar support. The repetitive take off may induce a contact time higher in the medial part of the heel in opposition with the hallux and the first metatarsal head and an imbalance plantar pressures distribution in favor of the second metatarsal head. The foot pronation seems to increase after the triple jump event due to the effect of foot intrinsic muscles fatigue. Dysfunctions of muscles supporting the medial arch and the first ray

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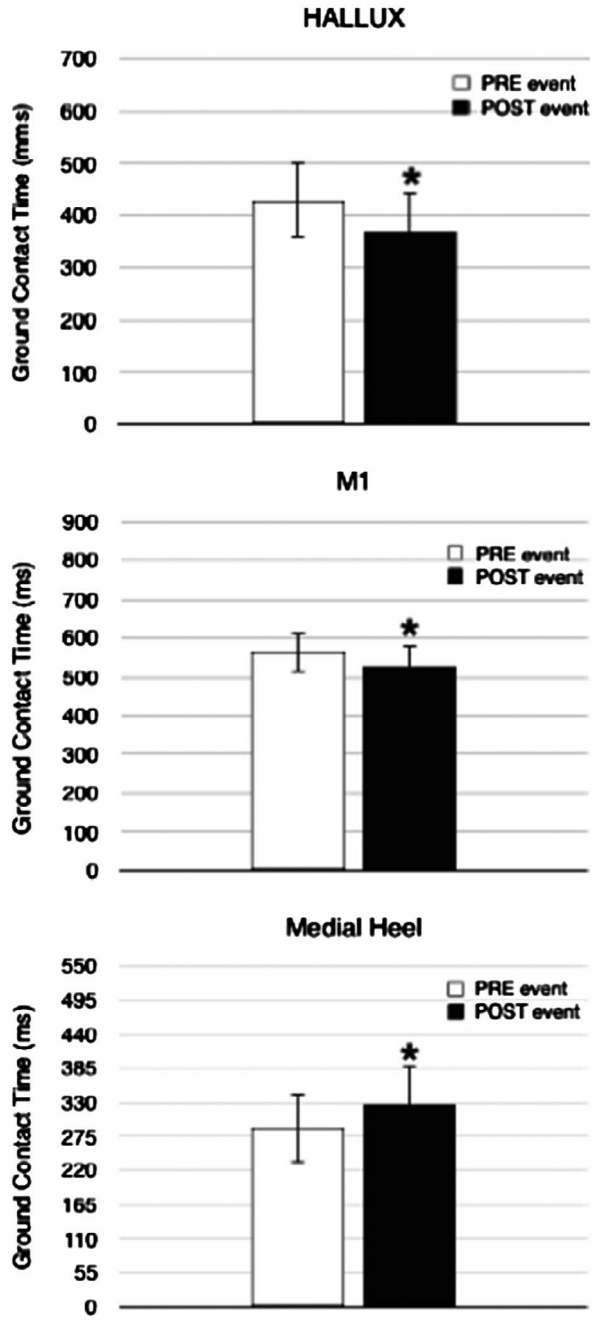

Figure 1. Variations (ms) of contact time for hallux, first metatarsal head (M1) and medial heel after a triple jump event.

predispose individuals to a larger pronation related overuse injuries (Headlee et al. 2008). These modifications may affect the dynamic stability of the foot and increase potentially the risk of overuse injuries (Weist et al. 2004). Further investigation assessing the effects of a repetitive take off during a triple jump event may be important in improving the capacity of the neuromuscular medial arch system to handle potential harmful adaptations.

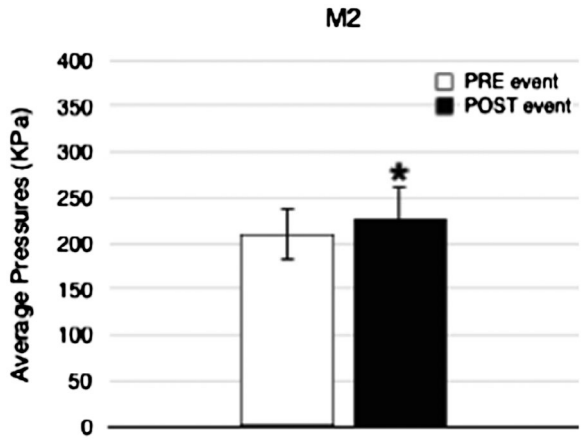

Figure 2. Variations of average pressure (kPa) for the second metatarsal head (M2) after a triple jump event.

4. Conclusions

A triple jump competition may have an influence on the dynamic plantar support. A biomechanical adaptation of the repetitive take off seems to occur and modify time contact and plantar pressures distribution. Following these results, a study focus on first ray muscles could be relevant to identify and analyze more precisely the mechanisms for support the first ray after a triple jump event.

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