DOES SIDE OF AMPUTATION AFFECT 200- AND 400-M RACE TIME IN SPRINTERS USING RUNNING-SPECIFIC PROSTHESES?

Hiroaki Hobara, Yoko Sano, Yoshiyuki Kobayashi, Thijs A Heldoorn, and Masaaki Mochimaru

National Institute of Advanced Industrial Science and Technology (AIST), Tokyo, Japan

Current Paralympic guidelines for track events are generally based on level of amputation, not side of amputation. Since 200- and 400-m sprint races are performed in a counter clockwise direction, the effects of amputations side on sprint race performance in athletes with unilateral lower limb amputation should be investigated. Forty-five unilateral transtibial amputees participating in elite-level 200- and 400-m races were analysed from publicly available Internet broadcasts. For each athlete, official race time, and amputation side were determined. We found no significant difference in official race time between left and right side amputees during the 200- and 400-m sprint, indicating that sprint performance on a standard track in amputee athletes is not affected by amputation side.

KEY WORDS: prosthetic sprinting, Paralympic games, regulations.

INTRODUCTION: For athletes using running-specific prostheses (RSPs), current Paralympic guidelines for track events are generally based on level of amputation, such as unilateral/bilateral transfemoral or transtibial amputations, not side of amputation. In 200- and 400-m sprint events, races are performed in a counter clockwise direction, beginning on the curve and ending on the home straight. A previous study (Chang and Kram, 2007) demonstrated that during sprinting on a curved track, the inner leg consistently generates smaller peak forces compared with the outer leg, leading to a reduction of maximum performance of the entire locomotive system. Furthermore, it has been demonstrated that ground reaction forces of the RSPs are smaller than those of the intact leg during straight running (Grabowski et al., 2010; Hobara et al., 2013). Moreover, starting from the inner track lane could induce apparent disadvantages in sprint races due to a tighter bend radius of the track (Usherwood & Wilson, 2006). Therefore, the goal of this study was to test the hypothesis that athletes using RSPs on their left leg would have slower race times than those using RSPs on their right leg in 200- and 400-m sprint.

METHODS: We analysed the race of 45 athletes with unilateral transtibial amputees (T44 class) from publicly available Internet broadcasts. These races included Athens, Beijing and London Paralympics, and IPC Athletics World Championships in 2011 and 2013. We determined official race times and the amputation side of each athlete from the official Website of the Paralympic Movement. In this study, athletes who did not use RSPs were excluded from analysis.
To determine whether there is a significant difference in number of subjects between right and left side amputees, the chi-square test was used. Further, two-way ANOVA (race × side) was performed for race time to determine significant differences between sides of amputation. If a significant main effect was observed, the Bonferroni post-hoc multiple comparison test was performed. All statistical significance was set as $p < 0.05$.

RESULTS: We found no significant differences in official race time between left and right side amputees in both 200- and 400-m sprint (Figure 1-A). Although there was no significant difference in number of subjects between left and right side amputees in 200-m sprint, while right side amputees were more dominant than left side amputees in 400-m sprint (Figure 1-B).

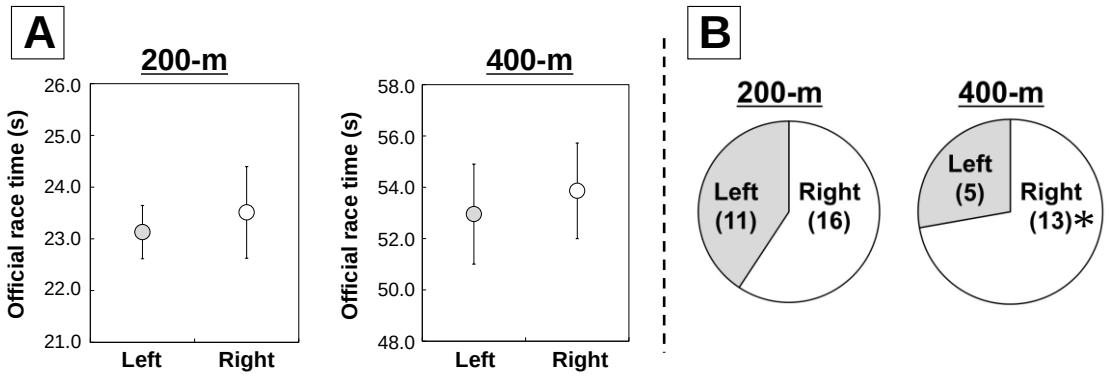

Figure 1: Comparison of official race time between left and right side amputees (A) and distribution of number of subjects in 200- and 400-m sprint (B). An asterisk indicates a significance at $p < 0.05$.

DISCUSSION: As shown in Figure 1, there was no significant difference in race time between left and right side amputees in all classes. These results contrast with our initial hypothesis that athletes with left side amputation would have slower race times than those with right side amputation. A possible explanation for the similar race times between left and right side amputees may be the radius of curvature of a standard 400-m track. It has shown that the inside leg consistently generates smaller peak forces compared with the outside leg during curve sprinting (Chang and Kram, 2007) and this leads to a reduction of maximum performance on the curved track. However, this previous study investigated circular tracks with radii of 1, 2, 3, 4, and 6 m (Chang and Kram, 2007), whereas a standard 400-m track has a radius of 36.5 m (IAAF, 2011). Therefore, the radius of a 400-m track might be too large to observe the same effect as in a previous study.

CONCLUSION: The results of the present study suggest that 200- and 400-m sprint performance on a standard track in athletes using RSPs may not be affected by amputation side. Therefore, current IPC regulations are valid to ensure fairness in 200-and 400-m sprint events regardless of amputation side. However, a significant difference in number of subjects to 400-m sprint between left and right side amputees may be indicative of an inherent bias that left side amputees would be disadvantageous than those of right side.

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