BOOK OF ABSTRACTS

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# Accuracy and reproducibility of the new CycleOps Hammer Direct Drive Trainer

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## Introduction

The measurement of power output (PO) is an essential element in cycling. Three types of tools can measure PO: ergometers (e.g. SRM Indoortrainer), mobile power meters (e.g. SRM, Powertap G3, Powertap P1, Stages, Garmin Vector) and home-trainers (e.g. Wahoo KICKR) (Zadow, Kitic, Wu, Smith, & Fell, 2016), Cyclus (Rodger, Plews, McQuillan, & Driller, 2016), Lemond Revolution (Novak, Stevens, & Dascombe, 2015), Velotron (Abbiss, Quod, Levin, Martin, & Laursen, 2009), Axiom (Bertucci, Duc, Villerius, & Grappe, 2005). The CycleOps Hammer Direct Drive Trainer (Saris, Madison, USA) is a new home-trainer. It use the technology of Powertap G3 hub (PowerTuned) for measuring PO. The aim of this study was to determine the accuracy and reproducibility of the Hammer in comparison with the Powertap P1 pedals. We hypothesized a lower POHammer than POP1 considering the location of the two power meters on the bicycle.

## Methods

3 cyclists (age: 23 ± 1 years old, body mass: 65.3 ± 2.5 kg, height: 174 ± 3 cm) performed all testing sessions on their personal bicycle fitted with the Powertap P1 pedals and fixed on a CycleOps Hammer Direct Drive Trainer. To investigate the accuracy and reproducibility, the PO of the two power meters was recorded during a sub-maximal incremental test (150, 200, 250, 300 and 350 W). For each PO level the cyclists exercised 3 min with 3 different cadences (60, 80 and 100 rpm) (Bouillod, Pinot, Soto-Romero, Bertucci, & Grappe, 2016). The last 45s of each measurement was analyzed. Also, the cyclists performed a sprint test (3 sprints of 8 s with three different resistances) and a Wingate test. Before each test, the power meters were calibrated according to the manufacturers' instructions.

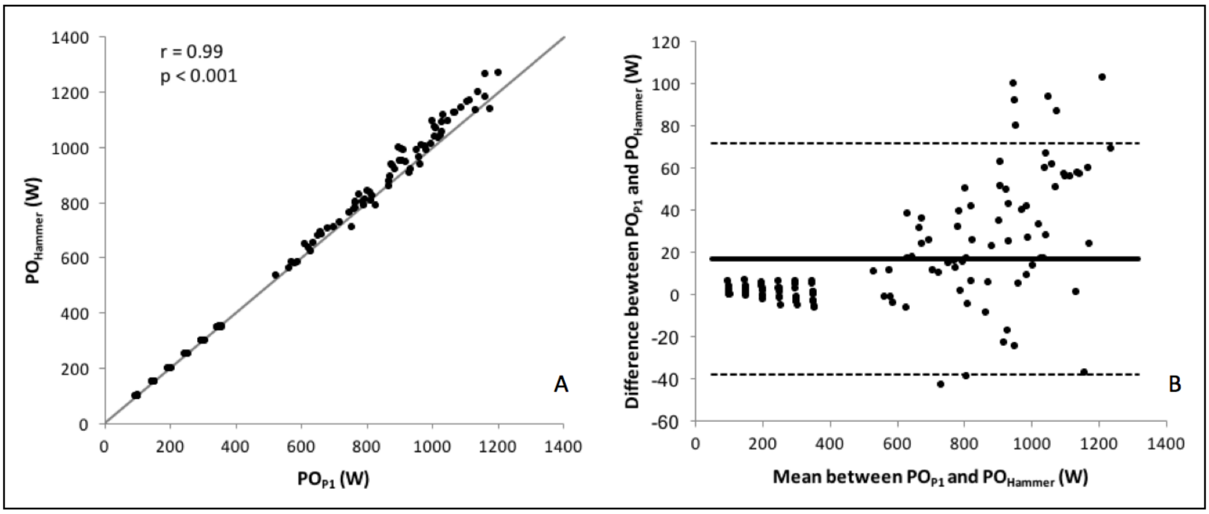


**Figure 1.** A: correlation between $PO_{P1}$ and $PO_{Hammer}$, B: Bland-Altman for the difference between $PO_{Hammer}$ and $PO_{P1}$ during the sub-maximal incremental test and the sprint test. The solid line represents the bias, whereas the dashed lines represent the high and low 95% confidence interval (CI).

## Results

For all data, there was a strong correlation between POP1 and POHammer ($r = 0.99$, $p < 0.001$) (Figure 1A). The Bland-Altman analysis (Figure 1B) showed a bias of 17 ± 28 W (95% CI: 12 and 22 W) for the Hammer. Paired t-test have shown significant difference between POHammer and POP1 for the submaximal incremental test (+0.9%, p = 0.008), sprint test (+3.4% for PO1-sec and +3.5% for PO8-sec $p < 0.001$) and Wingate test (+1.8%, $p < 0.001$). The coefficient of variation (CV, %) was 0.4% for both the Hammer and the P1 during all submaximal incremental tests. For the Wingate and sprint tests, CV was the same (0.1%) for the two systems. The reproducibility was tested for the submaximal incremental test because the PO was fixed by the Hammer. Both systems have the same intraclass correlation coefficient (ICC = 1).

### Conclusions

The main findings show that the PO provided by the Hammer must be treated with some caution concerning the accuracy whereas the Hammer has a good reproducibility. The over-estimation of the Hammer can be explained by the difference of measurement processes. Theoretically, the Hammer should underestimate PO due to drive train frictional losses. Coaches and scientists should use the Hammer with some caution because the system overestimates PO when it increases. One the other hand, the reproducibility is good. This point is valuable when coaches compare athletes with the same system. Future studies should evaluate the accuracy and reproducibility of the Hammer in comparison with a dynamic calibration rig to confirm our findings.

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