



Validity and reproducibility of the Powertap P1 power meter when compared with SRM device

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Purpose: The use of power meters allows the assessment of cycling performance according to the record power profile [1]. Some power meters allow the measurement of power output (PO) in the pedals such as Look Keo Power (Look, Cedex, France) [2] and Garmin Vector (Olathe, USA) [3]. However, the results about these two systems [2, 3] should be treated with some caution given the presence of mean differences between them and the SRM (Schoberer Rad Messtechnik, Julich, Germany) who is the most widespread device due to his high validity, sensibility and reproducibility. The usefulness of the Look Keo Power pedals may be limited by the poorer agreement of the data compared with those of the SRM [2]. Also, it has been shown that the Garmin Vectors pedals 1) under estimated the PO during sprints with low gear ratio and 2) does not have acceptable sensitivity. Powertap P1 (PP1, CycleOps, Madison, USA) is a newer power meter located in the pedals for which the usage characteristics have not been analysed. The aim of this study was to assess the validity and reproducibility of the PP1 power meter during laboratory cycling tests compared with SRM device.

Methods: 5 cyclists (age: 20.8 years old, body mass: 69.8 ± height: 1.81m) performed all testing sessions on a SRM ergometer (SRM Indoortrainer, Julich, Germany) fitted with PP1 power meter. The validity and reproducibility were investigated in the laboratory during 1) a sub-maximal incremental test and 2) a sprint test. The sub-maximal incremental test was performed with five 3-min duration PO levels (150, 200, 250, 300 and 350 W) and three 1-min duration pedalling cadences for each PO level (60, 80 and 100 rpm). The sprint test consisted of three 7-s sprints performed with three different resistances (low, middle and high gear ratios of 0.7, 0.9 and 1.1 N.kg⁻¹) to determine maximal PO (PO_{max}) and maximal 5-sec PO (PO_{5-sec}). Each participant was required to come in the laboratory on 3 separate occasions separated by 1 week to make the tests.

Results: During the sub-maximal incremental test, there was a strong correlation between PO_{SRM} and PO_{PP1} ($r = 0.99$, $p < 0.001$). The mean PO from 150 to 350 W was not significantly different between the two systems. The Bland-Altman analysis shows that the mean bias between PO_{SRM} and PO_{PP1} was -3.7 ± 2.8 W (95 % CI: -9.2 and +1.9 W). There was no significant difference in PO_{max} and PO_{5-sec} between the two power meters. However, the pedalling cadence had a significant effect ($p < 0.05$) on PO_{PP1} during the sub-maximal incremental test. Indeed, the more the cadence was high the more the PO decreased for PP1 compared with SRM (from -0.8 % at 60 rpm to -2.4% at 100 rpm when compared with SRM device). The coefficient of variation (CV, %) was 0.7 % for PO_{PP1} and 0.6 % for PO_{SRM} during all the sub-maximal incremental tests whereas it was 0.8 % for PO_{PP1} and PO_{SRM} during the sprint test.

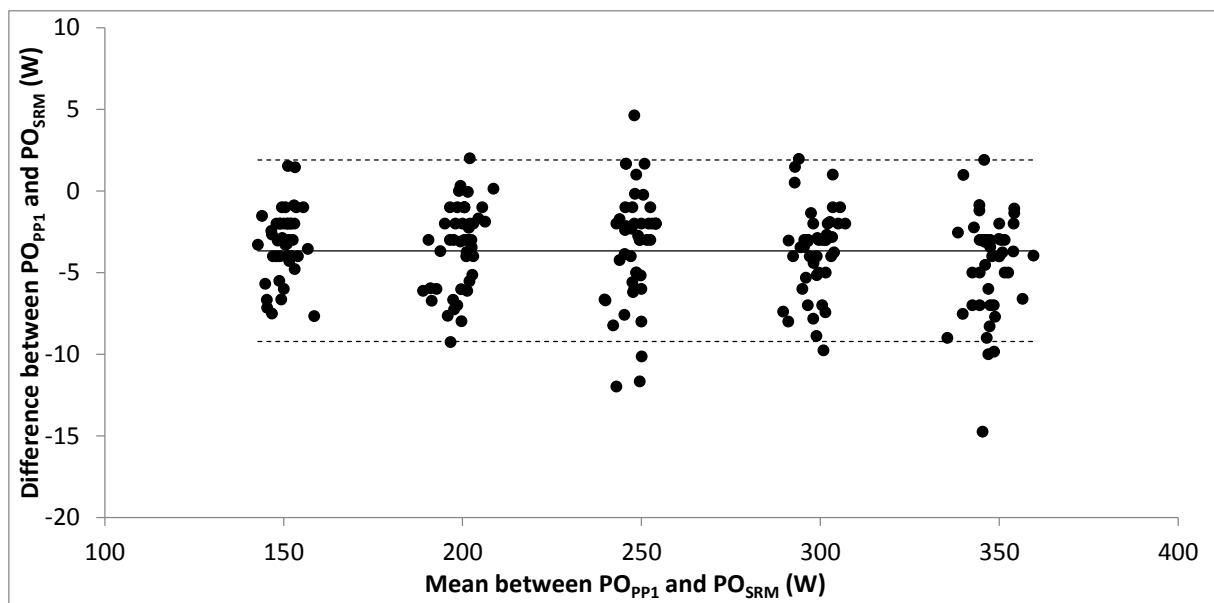


Figure 1. Bland-Altman plots for the differences between PO_{SRM} and PO_{PP1} during sub-maximal incremental test. The dashed lines represent the high and low 95% confidence interval (CI), whereas the solid line represents the bias.

Conclusions: The main results show that the PP1 provided a valid PO during sub-maximal incremental and sprint tests in laboratory. A low CI (11.1 W) was measured during the sub-maximal incremental test whereas previous studies reported higher CI for both Garmin Vector (CI = 24.3 W) and Look Keo Power pedals (CI = 29.8 W) [2, 3]. The PP1 underestimates non-significantly the PO during the sub-maximal incremental test (-1.5 %) while this power meter should theoretically slightly overestimate PO by considering a small mechanical loss between the pedals and the crankset. The study shows that an increase of the cadence induces a decrease in PO_{PP1} . The mean CVs obtained with the PP1 system was lower than 1% and there was no significant difference between the three sessions. Despite a significant effect of the pedalling cadence on PO_{PP1} , this power meter can be considered as a useful PO measurement tool for researchers, coaches and athletes. This is the first power meter in the pedals who presents valid and reproducible values in laboratory condition. Future investigation should compare the PO between PP1 and SRM in real cycling locomotion on the field to assess the sensitivity of the power meter in standing position and taking into account the road vibrations.

References:

1. Pinot, J. and F. Grappe, *The record power profile to assess performance in elite cyclists*. Int J Sports Med, 2011. **32**(11): p. 839-44.
2. Sparks, S.A., et al., *Validity and reliability of the look Keo power pedal system for measuring power output during incremental and repeated sprint cycling*. Int J Sports Physiol Perform, 2015. **10**(1): p. 39-45.
3. Bouillod, A., et al., *Validity, sensitivity and reproducibility of Stages and Garmin Vector power meters when compared with SRM device*. ISBS15, 2015.