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*Conference Abstract*

# Acute and chronic effects of training with a fixed gear on pedaling technique

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## 1. Introduction

In cycling, the round pedaling technique is characterized by applying force as uniformly as possible throughout the entire pedal cycle (2). This involves applying more force in areas of the pedal stroke such as dead spots or the recovery phase. Although there is still controversy as to which type of pedaling technique is more metabolically efficient (1, 8), the round pedaling reduces the load on the most important muscles for propulsion in cycling, i.e. the knee extensors (3). In this way, the work necessary to maintain the intensity of the exercise is distributed among other leg muscles (3), which would translate into a greater potential to use the knee extensors in the crucial moments of the competition.

Traditionally, fixed-gear training has been considered as one of the main methods to improve the round pedaling technique (5, 6). However, this type of gear does not force the rider to pull up on the pedal during the upstroke, so its effectiveness in improving round pedaling is questionable.

Therefore, the aim of the present investigation was to evaluate the acute and chronic adaptations in the pedaling technique of a group of track and road cyclists while pedaling with both fixed gear and a freewheel.

## 2. Materials and Methods

22 cyclists (13 track and 9 road cyclists) participated in the study (height: 179.5 ± 5.8 cm and 182.3 ± 3.4 cm; weight: 75.7 ± 6.6 kg and 68.0 ± 4.0 kg; age: 21.7 ± 2.4 years and 21.7 ± 2.5 years, respectively) after giving informed consent. Track cyclists were used to train with both fixed gear and a freewheel, while road cyclists had never pedaled before with a fixed gear.

A track bike was equipped with a system for measuring the tangential and radial forces relative to the crank applied to both pedals (PowerForce, O-Tec, Germany). Two identical freewheel sprockets were used for the tests, one of which was modified to remain fixed. These sprockets were mounted on a double sprocket track wheel, so that variability due to the material used was minimized.

With each of the two sprockets, subjects pedaled on a traditional Elite E-motion roller at three cadences (60, 80 and 100 rpm) and two different resistances (low and high) for one minute. Road cyclists were tested first with the freewheel, whilst track cyclists were tested in random order. Forces applied to both pedals were recorded at 1000 Hz and the last 20 seconds of each trial were used for subsequent analysis. To quantify pedaling technique, the following variables were measured: positive impulse (IMP+), negative impulse (IMP-), positive impulse proportion (PIP), index of effectiveness during the whole pedal stroke ($IE_{360}$), downstroke ($IE_{0-180}$) and upstroke ($IE_{180-360}$).

## 3. Results

Due to the overall symmetry existing between the force applied with both legs, only the data relative to the left leg are presented. The low resistance setup of the roller was weight dependent, and increased proportionally with the riders' weight. There were no significant differences between the fixed gear and freewheel conditions in any condition or group. However, road cyclists showed smaller left leg power and IMP+ on the low resistance conditions. Table 1 shows the results at 80 rpm, as representative of the other cadences.

**Table 1.** Means ± SD for the variables in Track and Road cyclists for the left leg.

| TRACK cyclists | 80 rpm, low resistance | | 80 rpm, high resistance | |
|---|---|---|---|---|
| | Fixed Gear | Freewheel | Fixed Gear | Freewheel |
| Left Power (W) | * 86.7 ± 7.5 | * 87.3 ± 7.6 | 165.9 ± 9.0 | 163.5 ± 10.9 |
| IMP+ (N·s) | * 56.6 ± 5.1 | * 56.59 ± 5.2 | 89.72 ± 5.8 | 89.51 ± 5.9 |
| IMP- (N·s) | -11.7 ± 2.3 | -11.92 ± 2.6 | -4.27 ± 1.9 | -4.85 ± 2.0 |
| PIP (%) | 82.9 | 82.6 | 95.5 | 94.9 |
| $IE_{360}$ | 0.45 ± 0.0 | 0.44 ± 0.0 | 0.65 ± 0.0 | 0.64 ± 0.0 |
| $IE_{0-180}$ | 0.76 ± 0.0 | 0.76 ± 0.0 | 0.78 ± 0.0 | 0.78 ± 0.0 |
| $IE_{180-360}$ | -0.36 ± 0.1 | -0.36 ± 0.1 | 0.03 ± 0.1 | -0.02 ± 0.1 |
| ROAD cyclists | 80 rpm, low resistance | | 80 rpm, high resistance | |
| | Fixed Gear | Freewheel | Fixed Gear | Freewheel |
| Left Power (W) | 76.7 ± 5.6 | 76.9 ± 4.8 | 161.8 ± 6.1 | 159.4 ± 5.9 |
| IMP+ (N·s) | 51.13 ± 5.2 | 51.81 ± 4.1 | 87.84 ± 4.1 | 86.63 ± 3.1 |
| IMP- (N·s) | -11.44 ± 3.2 | -11.73 ± 3.1 | -3.82 ± 3.1 | -3.69 ± 3.2 |
| PIP (%) | 81.7 | 81.5 | 95.8 | 95.9 |
| $IE_{360}$ | 0.43 ± 0.1 | 0.42 ± 0.1 | 0.66 ± 0.1 | 0.66 ± 0.1 |
| $IE_{0-180}$ | 0.76 ± 0.0 | 0.76 ± 0.0 | 0.79 ± 0.0 | 0.79 ± 0.0 |
| $IE_{180-360}$ | -0.32 ± 0.1 | -0.33 ± 0.1 | 0.12 ± 0.2 | 0.14 ± 0.2 |

* Statistically significant between track and road cyclists ($p < 0.05$).

## 4. Discussion

There is no an acute adaptation to fixed gear pedaling, as both groups had the same values between the two pedaling systems in every condition. This is especially meaningful in road cyclists, as they had never pedaled with a fixed gear before. The differences between track and road cyclists found in this study can be attributed to the slightly higher power at low resistance induced by the higher body mass of track cyclists. The increase in PIP, $IE_{360}$, $IE_{0-180}$ and $IE_{180-360}$ in the high resistance condition is proportional in both groups, and in line with previous research (5). Therefore, it is quite unlikely that track cyclists have modified their pedaling technique due to a long term training with the fixed gear.

## 5. Practical Applications.

Cyclists willing to improve their round pedaling technique should avoid using the fixed gear and seek for other active training strategies like pedaling with independent cranks (3, 7).

**Conflicts of Interest:** The authors declare no conflict of interest.

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