BOOK OF ABSTRACTS Open Access

Relationship between leg length and trunk orientation in cycling

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Abstract

Background: Rider position for a time trial will depend on several variables, including aerodynamics and sporting regulations set by the international governing body of cycling, the Union Cycliste Internationale (UCI). At 50kph, aerodynamic drag accounts for 90% of the resistance experienced by a rider (Grappe et al., 1997: Ergonomics, 40, 1299–1311). Between 60-70% of aerodynamic resistance is accounted for by the cyclist's position (Kyle and Burke, 1984: Mechanical Engineering, 106(9), 34-45.). Reducing a rider's trunk orientation makes them more aerodynamic and therefore able to go faster for the same effort (Defraeye et al., 2010: Journal of Biomechanics, 43(7), 1262-8).

Purpose: A better understanding of segment orientation during time trials may also allow for further optimisation and improvements in sporting performance.

This study investigated segment orientation across a range of different leg lengths (LL), focusing on minimum trunk orientation when hip flexion at the top of the pedal stroke is limited to 140 degrees. This study was designed to assess the hypothesis that trunk orientation is negatively correlated with LL and as such there may be a performance advantage as LL increases.

Methods: Fifteen recreationally-active and competitive male cyclists (age 37.2 ± 4.8 years, height 1.77 ± 0.06 m) were recruited from local cycling and triathlon clubs.

A cross-sectional experimental design was employed consisting of one independent variable, LL, and one dependent variable, trunk orientation. An adjustable fitting jig was set for each participant to optimize a UCI-legal time trial position with saddle set-back fixed at 5cm to comply with UCI regulation 1.3.013. The following variables were also set within industry standard ranges: sagittal plane joint rotations at the knee, hip and shoulder.

Results: Trunk orientation was measured as an indicator of aerodynamic performance. Its correlation with LL was moderate and negative, $r(13) = -0.61$, $p = 0.015$, which shows that as LL increases, trunk orientation decreases. Correlation between LL and trunk orientation was significant at the 0.05 level, with a mean of 11.5 degrees and standard deviation of 3 degrees.

Discussion: Trunk orientation was found to have a moderate negative correlation with LL. This implies that riders with a longer LL gain a performance advantage through being able to rotate further forwards in a sagittal plane, which previous studies have shown helps riders become more aerodynamic and therefore achieve higher speeds for the same effort (Defraeye et al., 2010: Journal of Biomechanics, 43(7), 1262-8).

Crank length is a variable that could explain this correlation. As crank length was fixed, proportional crank length varied from a minimum of 18.9% to a maximum of 21.9% of LL.

This study could have significant implications for sporting regulations, bicycle design and racing time trial positions.

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