Science & Cycling

4-5 Juli 2018, Nantes, France

Acute effects of cycling shoe cleat position on biomechanical and physiological variables during cycling and subsequent running performance in a simulated Olympic distance triathlon

Millour G.[1], Bertucci W.[1], Duc S.[1], Janson L.[2]

MorphoLogics

Université de Reims Champagne-Ardenne

STAPS Reims

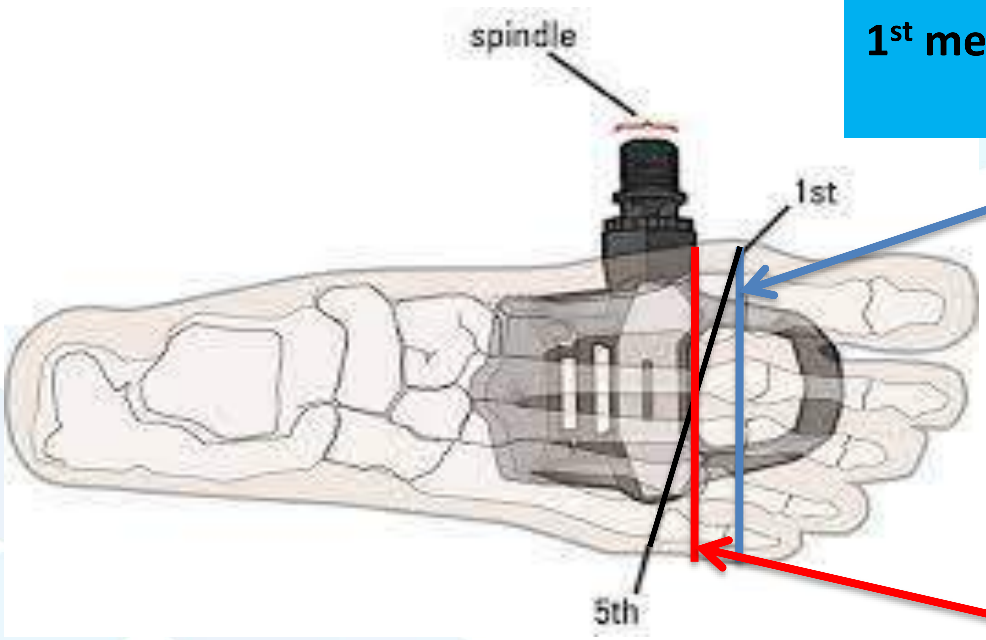
PSMS Performance, Santé, Métrologie, Société

Fédération Française de Triathlon

[1] *PSMS Laboratory (EA7507), UFR STAPS, University of Reims Champagne-Ardenne, Reims, France*
[2] *French Triathlon Federation, Reims, France*

Optimization of **cyclist's position** is essential for **health**, **comfort** and **performance** (Belluye & Cid, 2001)

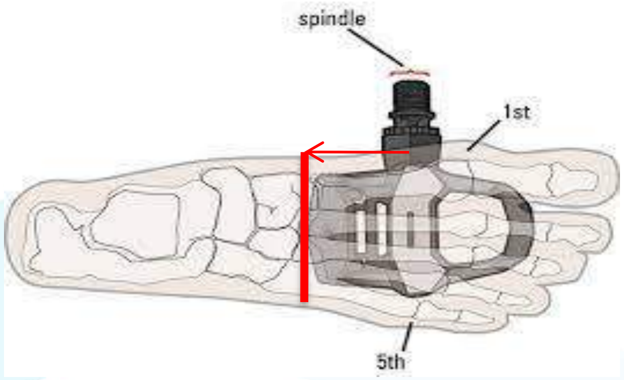
References for foot cleat pedal position



Alignment pedal spindle
1st metatarsal head (Belluye & Cid, 2001)

Center of the line which connects the **1st and the 5th metatarsal head** (Burt, 2014)

➔ **Mid-foot cleat position** improves subsequent 5.5 km TT **running performance** after 30 min of pedaling at 65% of MAP **but** without any variation in cycling physiological variables (Paton & Jardine, 2012)



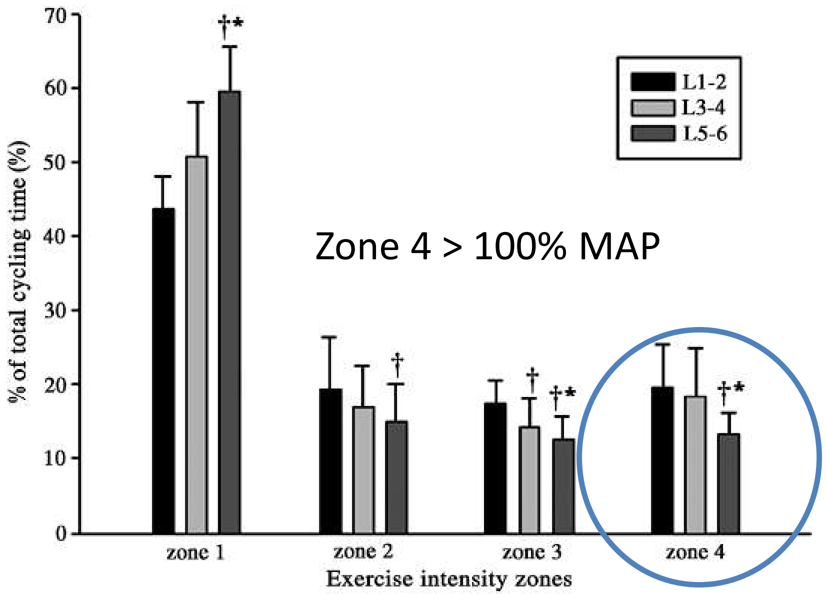
(Paton & Jardine, 2012)

➔ **Mid-foot cleat position** during cycling could lead to **muscular economy of calf muscles** (Litzenberger et al., 2008).

➔ **No benefits in draft-legal triathlon** with a mid-foot cleat position, whether for cardiovascular cycling or running performance (Viker & Richardson, 2013).

⚠ **Mid-foot cleat position corresponds to a very large displacement (-5cm), incompatible with the possible settings of the usual cycling shoes.**

➔ Power output varies greatly during Olympic triathlon because of **track characteristics and drafting**



(Bernard et al., 2009)

What is the impact of small shoe-cleat displacements on biomechanical and physiological variables of a simulated Olympic distance triathlon?

Population:

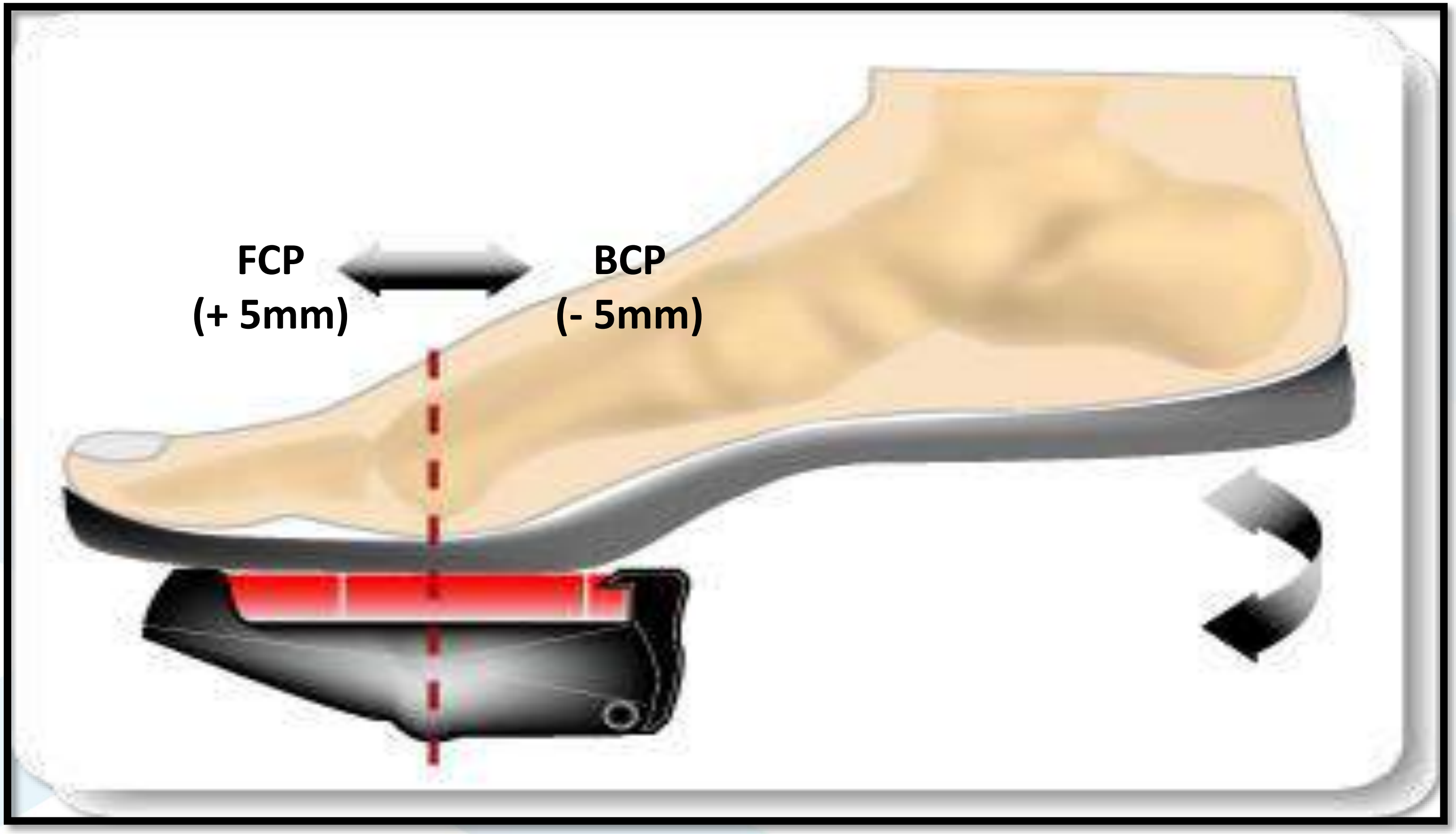
N	Age	Height	Mass	VO2max	MAP
7	22 ± 11 years old	1.73 ± 0.09 m	60.8 ± 7.7 kg	54.7 ± 3.8 ml/min/kg	267.9 ± 36.6 W

Experimental design:

1) **Incremental cycling test until exhaustion**

2) Two days **cycle-run tests** with two different cleat position in a random order.

Cycling		Transition	Running
X 8		1 min	Max distance over 20 min
3'30 at 60% of MAP and 80 rpm	*30" at 150% of MAP with free pedalling cadence*		


FCP
(+ 5mm)
BCP
(- 5mm)

Materials and data collected:

Wattbike
- PO
- Pedalling kinetics

Tunturi T90
- Distance performed over 20min
- Speed

Oxycon-Pro® system
- VO_2, VCO_2, HR VE and % of VO_2max.
- C ($mlO_2.km^{-1}.kg^{-1}$) = VO_2 – 4,98 ($mlO_2.kg^{-1}.min^{-1}$) / vitesse ($km.min^{-1}$) (Di Prampero, 1986)

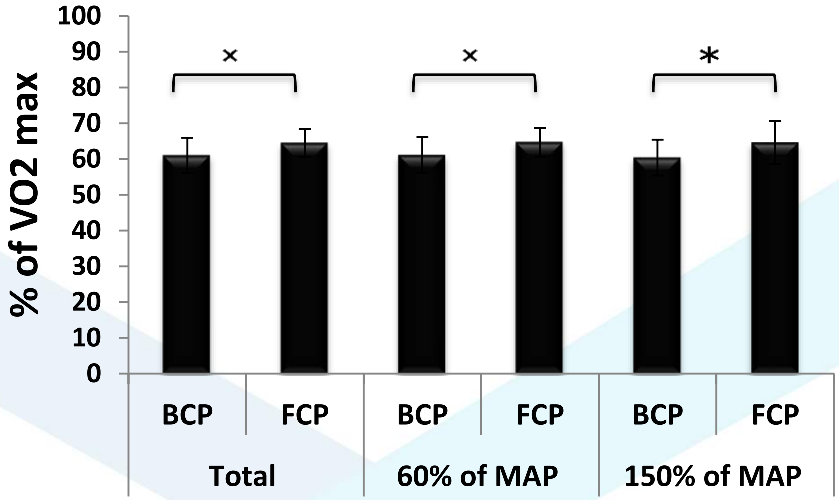
EMG sytem
- Muscular activity of vastus medialis (VM), rectus femoris (RF), du biceps femoris (BF), du semi-membranosus (SM), gastrocnemius médialis (GM), soleus (S) and tibialis anterior (TA)

Statistical analysis

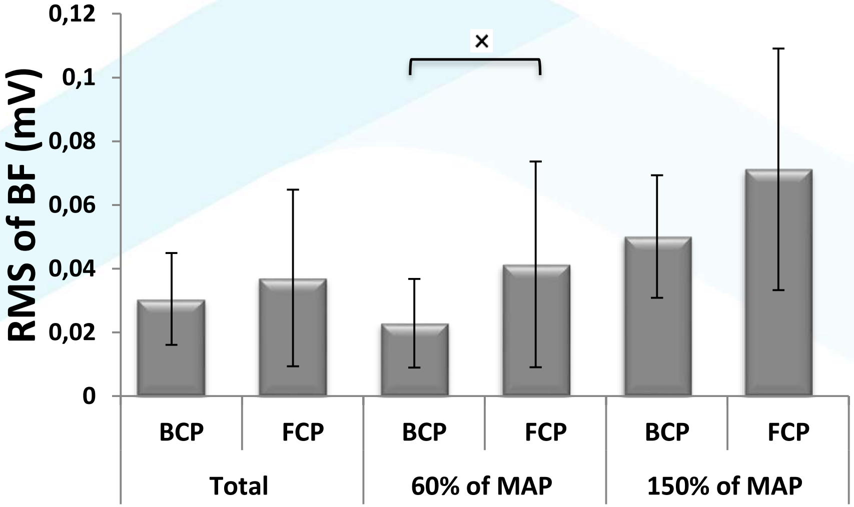
Pairwise Wilcoxon tests to establish significant differences using Past V3.18 ®

Cycling

BCP : Backward cleat position
FCP : Forward cleat position



*: significant differences ($p < 0.05$).
×: tendency ($p < 0.08$).



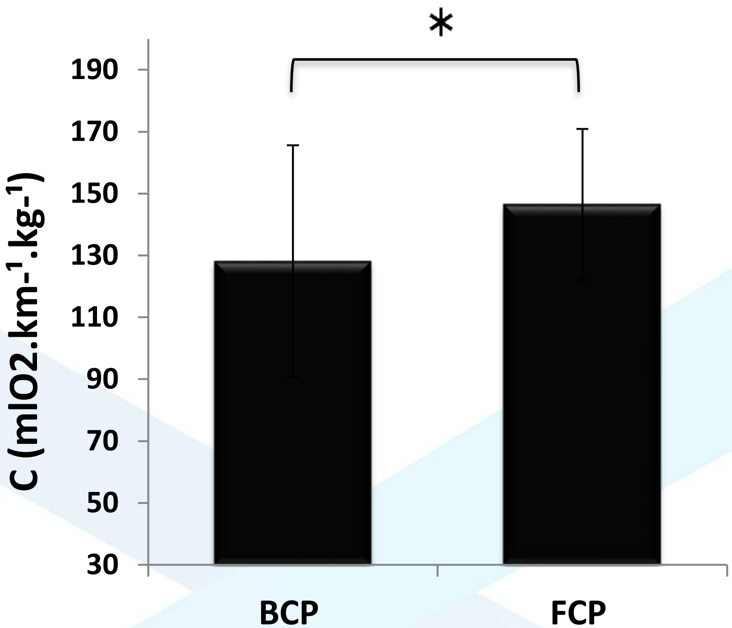
×: tendency ($p < 0.08$).

No significant differences of power output

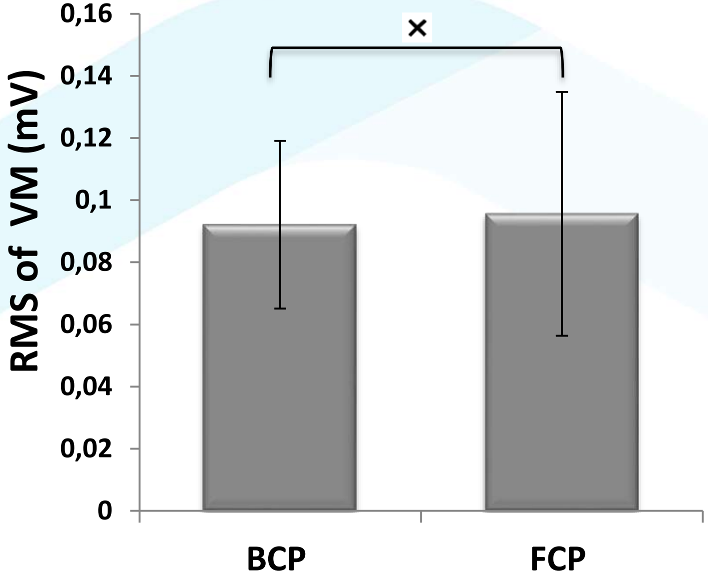
No significant differences of power output kinetics parameters and other muscle activity between the two tests

Running

BCP : Backward cleat position
FCP : Forward cleat position

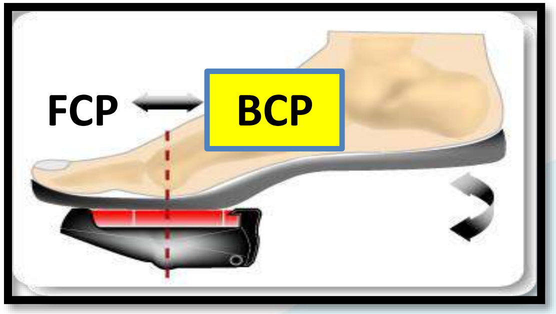


*: significant differences ($p < 0.05$).



×: tendency ($p < 0.08$).

No significant differences of other muscle activity between the two tests



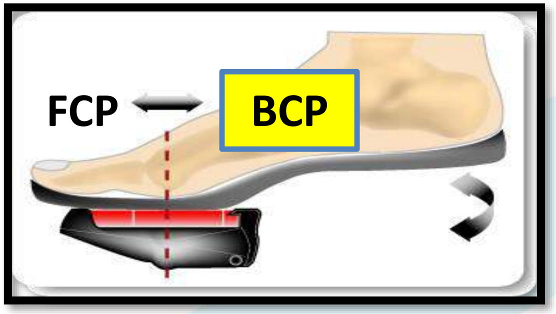
Cycling:

➔Unlike Paton & Jardine (2012) and Viker & Richardson (2013) BCP tends to **decrease oxygen consumption.**

➔ This difference could be due to the **smallest cleat position variation** (1 vs. 5 cm) (more ecological) or the presence of **supra-maximal accelerations** (more representative of draft-legal triathlon)

➔ The decrease of VO2 could be due to the **lower recruitment of knee flexor.**

➔ Calf-muscle activity is similar during the two tests (≠ Litzenberger et al., 2008).



Running:

➔**BCP** leads to **physiological economy** (= Paton & Jardine, 2012)

➔ Maybe caused by the slight **lower recruitment of knee extrensor**

➔**Disagreement with the Paton & Jardine theory** which suggest that the running economy was associated with reductions in plantar flexor muscle activity during the cycling phase of the event

Slightly backward 1st metatarsal cleat placement more appropriate in cycling as well at sub-maximal intensity as sur-maximal intensity

Slightly backward 1st metatarsal cleat placement more appropriate for subsequent running economy

Forward 1st metatarsal cleat placement would be **deleterious for health** (Belluye & Cid, 2001) but also for **cycling performance!!!**

Perspectives

- Increase the number of participants!!
- Compare the 1st metatarsal cleat position and the middle of the 1st and 5th cleat position while sub-maximal and supra-maximal intensity

Thank you for your attention

Geoffrey.millour@etudiant.univ-reims.fr

- Bernard T, Hausswirth C, Le Meur Y, Bignet F, Dorel S, Brisswalter J. Distribution of power output during the cycling stage of a triathlon world cup. *Med Sci Sports Exerc*. 2009; 41(6): 1296-1302.
- Belluye N, Cid M. Approche biomécanique du cyclisme moderne, données de la littérature. *Sci Sports.* 2001; 16(2): 71-87.
- Burt Phil. *Bike Fit: Optimise your bike position for high performance and injury avoidance*. A&C Black. 2014.
- Candotti, C. T., Loss, J. F., Bagatini, D., Soares, D. P., da Rocha, E. K., de Oliveira, Á. R., & Guimarães, A. C. S. (2009). Cocontraction and economy of triathletes and cyclists at different cadences during cycling motion. *Journal of Electromyography and Kinesiology*, *19*(5), 915-921.
- Chartogne, M., Duc, S., Bertucci, W., Rodríguez-Marroyo, J. A., Pernía, R., & García-López, J. (2016). Effect of shoes cleat position on physiological and biomechanical variables of cycling performance. *Journal of Science and Cycling*, *5*(2).
- Di Prampero PE (1986). The energy cost of human locomotion on land and in water. *Int J Sports Med*. 1986; 7(2): 55.
- Litzenberger, S., Illes, S., Hren, M., Reichel, M., & Sabo, A. (2008). Influence of Pedal Foot Position on Muscular Activity during Ergometer Cycling (P39). In *The Engineering of Sport 7* (pp. 215-222). Springer, Paris.
- Paton CD, Jardine T. The effects of cycling cleat position on subsequent running performance in a simulated duathlon. *J Sci Cycling.* 2012; 1(1): 15.
- Paton, C. D. (2009). Effects of shoe cleat position on physiology and performance of competitive cyclists. *International journal of sports physiology and performance*, *4*(4), 517-523.
- Viker T, Richardson MX. Shoe cleat position during cycling and its effect on subsequent running performance in triathletes. *J Sports Sci.* 2013; 31(9): 1007-1014.