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Editorial Open Access

Ergonomic Strategies Related To Health and Efficiency in Mountain Biking

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Editorial

Cycling is a popular recreational and competitive sport with many physical and cardiovascular benefits. While many turn to cycling for its rehabilitative potential in comparison to impact sports such as running, the rate of injury in cycling is still rather high [1] and especially so in mountain biking (MTB) [2-6]. While traumatic injuries often receive the most attention, instances of overuse injuries are of particular concern in mountain biking as symptoms can often go unnoticed [2,3,5].

In this respect MTB participants are subjected to vibrations from the grounds that are transferred from terrain surface-bicycle-rider [7,8]. These movements have the potential for causing disturbances to the central nervous system and have been linked to transient vertigo [6]. However, it is understood that the human body adopts an autonomic strategy to dissipate the majority of these vibrations, apparent by reductions in accelerations prior to reaching the lumbar spine and head [7]. While safer for the user, this reduces overall metabolic efficiency by demanding more energy from the body without contributing to propulsive work [9-15].

Anecdotally, MTB participants stand on their pedals during passage over bumpy terrain in order to alleviate discomfort and presumably to improve performance. While it is known that cyle ergometry in the standing position is energetically more demanding than sitting [16,17] due to the additional demand for postural support, little is understood about such mechanics during MTB where standing could negate the cost of damping impacts and vibrations that occurs.

With this in mind, a recent pilot study was completed to assess the efficacy of riding over bumpy terrain in both seated and standing positions. Accelerations in the horizontal and vertical planes were measured in accordance with previous investigations [7,9] across fifteen trials each at a controlled speed with two participants on a rigid MTB. The trials showed greater vertical vibration exposure at the handlebar, wrist and seat post during the standing compared to seated condition (Figure 1).

Similar to other studies [7,9], these accelerations were significantly attenuated prior to reaching the lower back and head but interestingly, accelerations were greater for both lumbar and head during the seated trial. This indicates that the body is subjected to greater accelerations whilst negotiating bumpy terrain in a standing position when compared to seated position highlighting some interesting points worth discussing. However, the standing bicyclist is better able to dissipate the energy transferred from surface-terrain and thus reduces the risk of damage to the central nervous system or brain.

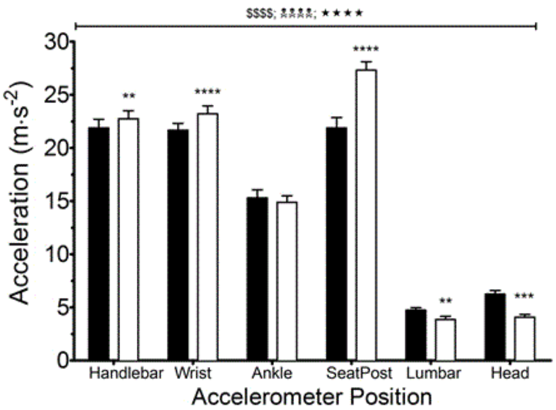

Figure 1: Mean ± s amplitude (RMS) for vertical accelerations during seated and standing trials. signifies seated position. ⊠ signifies standing position. $$$$ (P<0.0001) main effect of body position; ☠☠☠☠(P<0.0001) main effect of accelerometer location; ★★★★ (p<0.0001) interaction between body position*accelerometer location. Post-hoc analysis ** (P<0.01), *** (P<0.001), **** (P<0.0001) significant difference when compared with seated position.

While, increases in accelerations at the bike-body interface for standing could be explained by the body adapting to provide greater axial body protection, there would still be an increased risk of overuse injuries at those sites and a potential reduction in long term performance compared with the seated position [4]. Additionally, the magnitude of difference between accelerations was much higher at the seat post in the standing position. However, as these are not increased at the lower back in the same condition, this suggests that the bicycle is able to dampen vibrations best when not in contact with the body. As such the MTB industry should focus on systems enabling riders to remain seated while riding and absorbing energy from surface-terrain irregularities.

Interestingly, top athletes in cross-country MTB have begun to understand this. During 2014 many top cross country MTB athletes abandoned the weight saving hard tail (including a two-time Olympic gold medallist and multiple World Champion) in favour of full suspension model bikes. Purportedly, this is due to increased rider efficiency and comfort during off-road riding due to the equipment's increased ability to dampen vibrations. Currently, it is not known whether full-suspension can help protect against overuse injuries and future research needs to investigate suspension systems capability of damping energy transference from surface-terrain to the body.

As safety and participant adherence should be a main concern in any activity, manufacturers and researchers must work together to provide retailers, coaches and participants scientific information regarding best ergonomic practises. Therefore, it is suggested that future research focus on determining the efficacy of equipment in regards of comfort and performance.

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