

# The need for a link between bike fitting and injury risk

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Bike fitting is a growing industry with many options in terms of devices for fitters and clinicians who wants to offer a high quality service to their clients. Among these options, some offer two or three-dimensional assessment of body motion during pedaling using either inertial sensor technology (e.g. <http://bit.ly/29cgnlg>) and video cameras (e.g. <http://bit.ly/292wqmr>). These options are somewhat expensive for a general purpose application which have been tackled by relatively less costly equipment (e.g. [www.retul.com](http://www.retul.com)). Assuming that all these options would offer similar accuracy, their main goal is to track segment motion during pedaling (most often using a wind-trainer). The main benefit of assessing cyclists during motion rather than the more traditional assessment of static poses is that static poses do not reflect the angles that cyclists elicit during pedaling (Bini and Hume 2016).

Once motion has been determined, it is important to compare a given set of joint/segment angles with a reference. At this stage, other variables start playing a role, like power output (Peveler et al. 2012), pedaling cadence (Bini et al. 2010) and fatigue (Sanderson and Black 2003). Assuming again that all these variables are controlled, a “default motion” is warranted. For road cycling, many studies provided reference values for upper (Bressel and Larson 2003; Sayers and Tweddle 2012) and lower limb angles (Bini and Diefenthaler 2010; Sanderson and Black 2003). However, few studies provided reference values for triathletes (Bini et al. 2014) or track/time trial configurations (García-López et al. 2008).

After comparing the motion from a given client to a data base taken from the literature, very often fitters try to “match” their client into an “ideal” position in order to optimize cycling performance and to reduce the risk of overuse injuries. This is an intuitive approach but is generally based on practical experience because there are no sufficient high quality studies linking the most used bike fitting method to improvements in performance or reductions in injury risk. In order to state clearly, bike fitting methods will consider small changes (e.g. few millimeters) in configuration of bicycle components as critical to improve performance and reduce injury risk. However, we all know that research does not support this practice. Studies from the 60s and 70s observed that non-cyclists are not affected, in terms of energy cost for pedaling, when saddle height is changed less than 3 cm (Hamley and Thomas 1967; Nordeen-Snyder 1977; Shennum and

DeVries 1976). This is a very large change for bike fitting standards and has been reinforced by other studies assessing trained cyclists (Connick and Li 2013; Price and Donne 1997). The main rationale for that is the larger number of muscles in relation to the degrees of freedom at the lower limb joints. This redundancy provides room for changes in muscle recruitment, when saddle height is changed, in order to sustain a given energy cost (Yoshihuku and Herzog 1996). Therefore, our body is capable to arrange the way we recruit our muscles in order to minimize as much as possible the energy cost for moving our legs during pedaling.

For injury prevention, Dettori and Norvell (2006) stated that the effectiveness of prevention and/or treating injuries was not supported by experimental studies. Ten years after that, it is impressive that cycling research has not taken the way that other sports (e.g. running) has improved the link between altered motion and injury risk (Noehren et al. 2011; Roper et al. 2016). A very recent Editorial published at the British Journal of Sports Medicine challenged the use of screening tests as a preventive strategy to treat overuse injuries (Bahr in press). Although rash, this review provides an outline that has been followed in other sports for strengthening the link between altered body motion and injuries: 1) Prospective cohort studies to identify the risk factors; 2) Validity of preventive tests; 3) Randomized controlled trials to treat injured athletes using the intended screening tests. In my view, only a couple of studies provided a rationale link between altered motion in cycling and the risk of developing injuries (Bailey et al. 2003; Van Hoof et al. 2012). Only one non-randomized trial provided a potential benefit for changes in saddle incline as a way to reduce low back pain (Salai et al. 1999).

Therefore, we still have a long way to go before stating that injuries can be effectively treated by following a high-tech bike fitting session looking at few millimeters of changes in bike components. Other issues like bilateral asymmetries (Carpes et al. 2010), muscle-tendon stiffness (Ferrer-Roca et al. 2012) and training habits (Marsden and Schwellnus 2010) are still on the need for assessments in order to provide a potential multivariate link with overuse injury risk.

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