What is Good Pedaling Technique?

By Michael Smartt

If you have completed a long season of road, mountain bike or triathlon racing, the fall and winter months are the time to back off from the high intensity stress of competition and focus on things like getting in those steady miles, cross training, unstructured fun rides and technique. Proper cycling technique is often touted as a critical aspect of cycling performance. Claims are made about greatly increasing economy, efficiency, power at the same heart rate, etc. if you regularly spend time doing various drills on the bike to improve technique.

But what is "good" pedaling technique in cycling anyway? Is it pedaling in circles, mashing, or somewhere in between? Does "good" pedaling technique differ between cycling disciplines? And of course, in the end how much does it all matter?

First, let's dispel the notion of realizing "huge" gains in cycling economy/efficiency simply from technique training. Unless you are literally wrestling with the bike and/or incorporating excessive upper body movement, your aerobic fitness (% MSS vs. maximal aerobic power) and genetic talents (% of type I muscle fiber) will largely determine your cycling economy (or the ratio of VO2 and watts) for a given intensity during cycling (1, 2). Also, due to the confines of being connected to the bike, efficiency and economy are essentially the same for most trained cyclists. This isn't to say that pedaling technique is not an aspect of your training you should ignore. Rather it is important to appropriately distribute training time and energy based on prospective gains.

To get some insight into what is good technique, the renowned Dr. Ed Coyle and his cohorts published a notable paper comparing "elite national class" (group 1) and "good state class" (group 2) cyclists (3). What they found from a simulated 40k time trial on a laboratory ergometer was that the more powerful national class cyclists had higher peak torque values during the down stroke compared with the other group; i.e. the slower group pedaled in smoother circles compared to the faster group that relatively mashed (Fig. 1). Similar average economy (VO2 vs. watts) was seen in both groups.

It's interesting to note that the authors felt that the technique employed by group 2 was a more effective approach based on the total effective pedal forces (what is typically referred to as a more efficient technique, better spin, smoother stroke, etc). Put another way, group 2's technique more effectively eliminated the "dead spots" at the top and bottom of the pedal stroke. However, since economy was not significantly different, group 1 demonstrated that at the intensity most highly correlated with successful road/mountain performance (2: equivalent to mid z4 for Whole Athletes) it was of primary concern to put power to the pedals as effectively as possible during the most naturally powerful part of the pedal stroke, the down stroke. Group 1 did however apply enough torque during the upstroke to keep from imparting any significant negative torque that would work against forward propulsion.

Put it all together and the foundation for good pedaling technique at race pace/long time trial intensity or higher comes down to maximizing downward force production and lifting just enough on the upstroke to un-weight the rising leg, eliminating any potential negative torque (Fig. 2). Although these concepts lay the groundwork for a powerful pedal stroke, there are other considerations to account for.

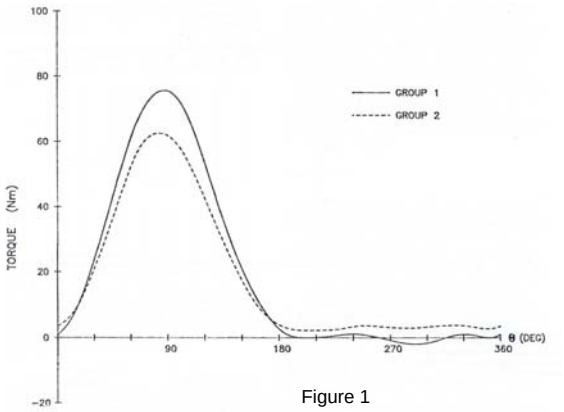

Figure 1

The Coyle (3) study looked at road cyclists ranging from top 20 performers at state ITT championships all the way to former national TT champions. But what about triathletes, mountain bikers, track racers, any cyclist with injuries to consider or lower intensities?

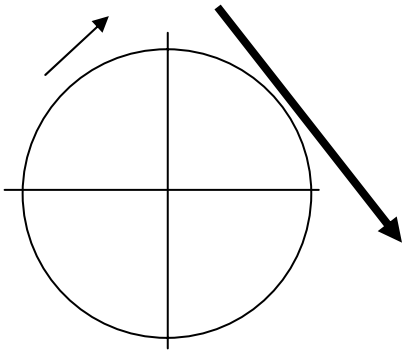

Figure 2

In a recent visit to the Olympic Training Center in Colorado, I had the pleasure of attending a presentation by Dr. Jeff Broker. From his 10 years of testing cyclists at the OTC, Dr. Broker was able to show us some subtle but key differences between cyclists of different disciplines. Sprint track racers were the biggest mashers of all, followed by triathletes, roadies and finally mountain bikers. What we can draw from his information is that cyclists of different disciplines will and should make subtle changes in their technique, depending on the demands of their particular sport. For example, track sprinting demands huge amounts of power that can only be accomplished by maximizing the most powerful part of the pedal stroke (and the most powerful muscles of the legs, the glutes and quads), generating much higher peak torque than noted by Coyle and his colleagues (3).

Continued on page 11...

Pedaling Technique

Continued from page 10

However, this applies to the constant accelerations of road and crit riding/racing that most cyclists experience as well; moments of cycling performance where high power output, rapid acceleration and high torque are similar to track sprinting. At the other end of the spectrum, mountain bikers showed a smoother technique (i.e. lower peak torque, similar to group 2 above), presumably to deal with traction issues while climbing since it has been demonstrated that low peak torque per se does not positively effect performance or cycling economy. However, the technique exhibited by the cyclists of different disciplines above is also likely to vary simply due to positional changes. For example, the aerodynamic position of a triathlete or time trialist, whose upper thighs are too close to the torso to have much leverage, makes it more difficult to apply upward torque than it would be for a mountain biker who has a more upright position. So although the Coyle study (3) demonstrated the basis for effective pedaling technique in a steady state situation and at a fairly high intensity, the specific demands of your sport and position will influence the technique you should adopt.

One issue that has not been directly studied is the potential for a "low peak torque" technique (like group 2 above) to minimize the use of type II muscle fibers during lower intensities than was studied in Coyle, et al (3). In general, the body wants to recruit type I (or strictly aerobic) muscle fibers to do any job as they are far more economical than type II muscle fibers. However, as the demands (force or speed) placed upon the muscle increase, the body must recruit type II muscle fibers to so the job since they can provide far more power and strength. In cycling, we want to be as economical as possible, but as intensity increases, our bodies will recruit more and more type II fibers that rapidly diminish our glycogen stores. However, since type II recruitment is driven by the force (and speed) demands place upon the muscle, keeping the peak torque down and cadence moderate (80-100rpm) during low intensity riding can potentially help to save those type II fibers for when we need them the most. This is not a proven concept and the force demands of low to moderate intensity cycling are relatively low, but it is certainly a tactic that will help ensure the most powerful muscles are saved for high intensity moments such as the finishing sprint of a race.

There are other issues related to pedaling technique that are not directly measurable from a performance perspective in the manner above. Those include injury and core stability. Cycling is often one of the last bastions of exercise for those with knee injuries. This is because in general, riding a bicycle does not impart high levels of torque about the knee as compared with ground impact sports that involve running and/or quick changes of direction. However, steps should be taken to minimize any potential deleterious effect from cycling since a cyclist will execute anywhere from 3600 to 6000 repetitions every hour they are on the bike. Aside from a proper bike fit, utilizing the pedaling technique of group 2 from the Coyle study above, with a relatively "circular" pedal stroke and lower peak torque, can be more appropriate for limiting the demands placed on the knee, potentially making the difference in enjoying the benefits of cycling over the long term.

Core stability, posture and overall alignment have their place in pedaling technique as well and apply to cyclists of all levels. The confines of being attached to the bike may limit the potential influence of pedaling technique on racing performance, but it also opens the body to tightness and weakness, emphasizing a singular posture. Spending time working on core strength and posture off the bike (e.g. engaging in yoga) will help ensure pedaling technique is not compromised by excessive upper body movement, weakness in the supporting muscles of the body or subsequent injury.

Remember that pedaling technique is an important aspect of cycling but is limited in its overall effect on performance. Technique will also change slightly depending on position, demands of a specific discipline and any current or predisposition to injury. Good rules of thumb are: for high-power demands (z4 and up), maximize the down stroke and simply unweight the upstroke; for bike handling and traction demands, make efforts to slightly increase power to the upstroke, reducing peak torque to stabilize the real wheel; and low peak torque can be advantageous for limiting the demands on the knee.

References

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