Pedaling confusion

Methods that lack sound basis show how not to train indoors

BY CHARLES HOWE

Because they allow workouts that are impractical or even impossible on the road, stationary trainers have spawned a number of dubious training methods that manifest themselves in the ephemeral quest to improve pedaling technique. Two drills in particular are often recommended: 1) isolated (one-leg) training, which supposedly results in better application of force to the crankset throughout all 360° of each pedal stroke, and 2) “spin-ups” to develop high cadence, which is claimed to be more efficient than lower pedaling rates.

First of all, any claims of “improved efficiency” are spurious unless it is defined in objectively measurable terms. Gross mechanical efficiency is the ratio of work performed (“output”) to energy produced internally (“input”); in humans, it is typically 20-25%, with the other 75-80% lost as heat through the skin. Since energy expenditure is difficult to measure, oxygen uptake is used as a proxy (the energy equivalent of 1 liter of O₂ is 20.9 kiloJoules). The result is referred to as cycling economy, and a range of 70-87 Watts per liter O₂ corresponds to 20-25% efficiency. As it turns out, economy depends not pedaling technique, but primarily on the percentage of Type I (slow-twitch) fibers present in the working muscles.

With respect to pedaling ‘smoothness,’ increased power production does not result from applying force evenly throughout the pedal stroke, but primarily by applying more of it on the downstroke (0-180°) portion – or to put it simply, more powerful riders don’t pedal smoother, they just stomp harder:

![Net average crankset torque for two groups of riders](image)

Ask most any professional or elite rider if they have done drills to perfect their pedaling form, and if so, to what extent. The answer is likely to be an emphatic “no.” Rather, their performance level progressed primarily as a result of riding as much and as consistently as possible at moderate aerobic intensities, in a variety of conditions that included spinning on the flat (into headwinds and with tailwinds), climbing, descending, and occasionally sprinting. Over the long term, this is what enables greater downstroke pedal force to be generated via higher aerobic energy production, from adaptations that include increased capillary density (allows greater removal metabolic waste products from working muscles), mitochondrial density (allows more force to be generated aerobically), and true gains in efficiency from the interconversion of some fast-twitch fibers to slow twitch.
Another mistaken claim is that “the higher cadence is, the less force you must apply at the pedals to generate the same amount of power, and by applying less force to the pedals you incur less stress to the musculature of your legs, leaving you more reserves for riding longer and faster.” To achieve this, “spin-up” drills are advocated, wherein cadence is “gradually increased each minute until it is so fast that you start to bounce on the saddle. The idea is to force you to become more efficient at the transition point and to pedal at higher cadences without bouncing.”

If this were true, then why doesn’t anyone spin at 125 rpm, rather than the 100 rpm which is typical? This would reduce pedal force for a given power output by 20%, which ought to be less fatiguing (at least according to the high-cadence theory), yet would still be low enough to avoid bouncing in the saddle. Dr. Andrew Coggan, a noted exercise physiologist, explains:

“The simple answer is that there is an excessive “cost” to very high cadence/low force pedaling, just as there is to very high force/low cadence pedaling. This suggests a balance between the two, and indeed, it has been shown that riders tend to self-select an optimal cadence close to that balance (as power increases, so does the self-selected cadence). Lower cadence/higher force pedaling (around 70 rpm) is actually more efficient, but you tend to recruit more fast-twitch fibers, which accelerates glycogen depletion and leads to higher lactate production, so a cadence somewhat higher than this helps avoid fatigue of the fast-twitch fibers. Each individual’s preferred cadence will depend partially on their muscle fiber composition, so those with more slow-twitch fibers can use lower cadences with less fatigue, but at least at a constant power, the optimal cadence is probably the lowest that activates the fewest fast twitch fibers.”

In practice, the range people typically use (80-100 rpm) is small, so improvements in power-generating ability come mainly from being able to sustain a larger pedal force, and again, it is consistent, moderate-to-high intensity aerobic training over time that enables the road cyclist to apply greater pedal force; strength training is ineffective, since it does nothing to improve muscle respiratory (i.e., aerobic) capacity. The one instance where weight training and extremely high cadence drills may be effective is for track sprinters, who put out a single, maximal effort over less than 15 seconds that may reach 200+ rpm.

References


