ARNIE BAKER CYCLING

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Optimum Crankarm Length

Determining the optimal crankarm length is not easy. Several studies have examined this question, but they do not help in training recommendations.

CYCLE HANDOUT

What We're Talking About

The optimal length of the crankarms. It depends upon the athlete's anatomy, the type of riding, training, and adaptation.

When I first took up track racing, I observed many different crankarm lengths on the bicycles at the velodrome. Crankarm lengths of 165 millimeters were common. Some riders rode 167.5 millimeter crankarms, some 170 millimeters. For kilometer and pursuit races I saw 172.5 millimeter and occasionally 175 millimeter crankarms. I asked riders why they rode a certain length crankarm. The most common answer was: "That's the way the bike came." There must be more to it than that, I thought.

Force and Optimal Crankarm Length

Archimedes had a physics lesson for us when he said, "Give me a lever long enough and I will move the world."

Studies of physiology have examined the force required to maintain a given bicycle speed. Not surprisingly, less force is required to turn the cranks when crankarm length is increased. Since the given bicycle speed is constant, and the gearing hasn't changed, the cadence remains the same. Many coaches and authors have mistakenly concluded that the power requirements with longer cranks are also reduced.

Power is the time rate of doing work. In a straight direction, power is the force applied times the velocity of the body to which the force is applied. Some have reasoned that the power required drops, since longer cranks reduce the force required.

But cranks rotate; they do not move in a straight line. This requires torque, which is force times the perpendicular distance from axis to line of action of force. In other words, when the crankarm length is longer, the torque required is greater for any constant force. The required force may be less, but the legs have to travel farther around a larger circle, requiring more torque, so we're back where we began. The bottom line is that the same studies that show a reduction in force with longer cranks also show that the *power requirement does not change*.

Examining power does not help us decide optimal crankarm length. In order to better study optimal crankarm length, we must study not only the forces involved but also muscle fatigability, heart rate, and oxygen consumption. I am not aware of any published studies that examine these variables.

Biomechanics

As discussed in the chapter "How Muscles Work" on page xxx, muscles have an optimal angle of function. Although longer crankarms have been traditionally favored by time-trialists, it's easy to show that in the aero position, longer cranks mean that knees rise higher, and hence closer to the chest—a worse angle of function. This results in reduced muscle power at the top of the stroke.

Acceleration

Conventional wisdom has it that shorter crankarms accelerate more quickly. This opinion is not universal. BMX riders traditionally use long crankarms. Many riders report that longer crankarms accelerate more quickly but that high rpm. cannot be maintained.

Continued

ABC Handout

Determine Your Crankarm Length

Although science may help, what we're still left with empiricism, conventional wisdom, and trial and error.

Here are some guidelines:

- Crankarm length should be longer for taller riders. Height is related to inseam or leg length. Inseam or leg length is closer to what's important than height. The length of the femur, or thigh, is even closer. As most riders know or can measure their inseams easily, recommendations will be based on inseam.
- Shorter crankarms are preferred for quick acceleration events—mass start track races and criteriums. Track riders must often limit the length of their crankarms to avoid hitting the upper banked surface of the velodrome when they turn or lean their bicycles. Small frames often require short crankarms to avoid hitting the front wheel when turning.
- Longer cranks may be more suitable for steady riding such as time trials or climbing, including mountain biking.

Start with This

For riders with an inseam less than 31 inches, start with 170 millimeter cranks. Riders with an inseam of 31 or 32 inches use 172.5 millimeter cranks. Riders with an inseam over 33 inches use 175 millimeter cranks.

Modify with This

Track riders go down 2.5 or 5 millimeters in size. Time trialists go up 2.5 millimeters; mountain bikers go up 5 millimeters.

Caution

Once you have used one crankarm length for a while, modifying the length more than 2.5 millimeters at a time is not recommended.

Although another length may be advantageous in the long run, your body, having adapted to the current length, will take time to readapt and become economical at a new length.

Changes in crankarm length more than 2.5 millimeters at a time may also make you more prone to injury.

Crankarm Summary

Lab studies of physiology have looked at optimal crankarm length. These studies have confirmed that for a given speed, longer cranks require less force.

But your legs need to go faster, and power requirements stay the same.

Most studies have been too short, considering the relatively long time riders have adapted to their chosen crankarm length.

The issues are complex. Other factors, such as frame construction and performance characteristics, may also be relevant.

Studies don't help us enough in making real-world decisions.

Conventional coaching wisdom and recommendations have been outlined here, but they are not based on a solid footing.