POWER To Your Pedals

Trying to pull up on the pedals may actually be reducing your efficiency. EMMA COLSON reveals how to put power to your pedals properly.

In my practice as a physiotherapist in a large sports medicine clinic in Melbourne, many cyclists present to me with a variety of injuries related quite simply to a misunderstanding of what is correct pedal technique.

Commonly, the cyclist presents with an onset of symptoms that is related to trying to increase their pedalling efficiency. Sadly, they have made their pedalling less efficient rather than more, and have often developed an injury in the meantime.

Incorrect pedal technique can cause the following injuries:

- Knee pain.
- Hip flexor (psoas) overuse syndromes.
- Lower back pain.
- Gastric irritation, ie nausea and abdominal bloating. Due to the tension of the psoas muscle on the sympathetic chain—the nerves that supply your internal organs.
- The feeling that despite the hours training, they feel like they are getting slower.

The good news is that with attention to detail during their pedalling action the symptoms disappear as quickly as they appeared.

Getting Technical

Pedal technique is as much a skill acquisition as a tennis serve. You wouldn't see a young tennis hopeful out bashing the ball as hard as possible every shot. They would spend a good deal of their training perfecting their technique, getting a feel for the racquet/ball interface. Cycling should be the same. Getting faster is not always about training harder, but doing quality training and developing a proprioceptive feel for the bicycle and power output through the pedals.

National MTB team coach Damian Grundy says the most important advice for an up and coming junior is not the hours they spend on the bike, but getting a real feeling for the pedal-stroke and their body position on the bike.

The acquisition of skill in developing power output is why a de-conditioned elite class athlete can often hop in to a club level race and blow the 'fitter' athletes away. They have spent many years developing their correct motor programs. Their fitness may not be what it should be, but they use what they have in the most efficient way.

Common Mistakes

The greatest mistake in pedalling technique lies in the following two commonly quoted statements:

- "Cleats help you generate an upstroke."
- "Pedalling should be in circles."

Be very careful about what you are thinking of with these two statements.

In 1997, French researchers put force transducers on the pedals of six cyclists. They measured the force going through the pedal at every two degrees of the pedal stroke. They found that in the back part of the stroke, there was a negative torque on the pedals (an uplift). However, the quantity of this uplift was the same with the subjects with toe cleats and without toe cleats. Hence, they concluded that the leg creating the upstroke (negative torque) at this point was the opposite leg during the down-stroke. Their conclusion was that the hamstring and hip flexor muscles were insufficient to be able to lift the leg at a greater rate than the quadriceps and gluteal muscles on the other side, which push the back crank up by pushing down on the opposite crank.

The same study concluded that the role of cleats is a proprioceptive one—cleats enable us to develop very high forces on the pedal at high cadences without slipping off the pedal (Capmal and Vandewalle, 1997).

In steady state submaximal cycling, the power output across the 360 degree cycle of the pedal stroke is NOT even, and nor should it be.

Firstly, there are muscles that are optimally placed to generate tension at various points of the pedal stroke. The major power generators during the pedal cycle are the 'antigravity' muscles, the gluteal (buttocks) and quadriceps (thigh muscles or your 'quads').

Secondly, cycling at high cadence is a type of locomotion similar to walking and running. At high velocity, the brain appears to be 'preprogrammed' with a particular motor pattern, hence it actually sorts out the best source to deliver power generation between the two legs at any instantaneous point of the pedal stroke. This power will not be equal for each leg at any given time.

Muscles have contractile components. The ability of a muscle to generate tension is dependant upon what is known as its length/tension relationship. Put simply, a muscle that is shortened or lengthened beyond optimum is no longer easily able to develop tension. As an example, try to lift a dumbbell with your biceps muscle (see Illustration 1). The easiest point of lift is at about the 90 degree or right angle position of the arm. At the extremes of range, with the arm stretched out or the arm 'close packed' the weight is harder to lift as the muscle is not in its best range of length/tension relationship. Also, the forearm is less efficient as a lever when the biceps attachment is effectively

Illustration 1. *Muscles work best within an ideal range of length—if they are over contracted or overstretched they lose efficiency.*

Illustration: Alex Arias/Make Believe Ideas

closer to the fulcrum.

Trying to develop an 'upstroke' at the back part of the pedal stroke (around the 240 degree position for the back foot) is asking the hamstring and hip flexor muscles to pull the pedal up in a shortened position, at a very quick rate. Meanwhile this position corresponds to the most powerful muscles of the gluteal and quadriceps (and the weight of the leg) pushing maximally downwards on the opposite pedal (maximum power occurs just beyond the 90 degree position of the front foot).

Damaging the Downstroke

Patients often ask me 'won't every bit help?' The answer from the research appears to be NO.

Unfortunately, it seems that by trying to develop an upstroke at this point of the stroke, there is some loss of the downstroke. In other words, a lot of work trying to make one group of muscles work results in a loss of power output in the most efficient muscle groups. This has been shown in a few research papers:

In a study by Coyle et al in 1991, the EMG (muscle activity) of elite vs subelite cyclists found that the more elite cyclists exhibited less activity in the upstroke than the subelite. The elite cyclist created, 'larger propulsive torques by creating significantly larger forces in the vertical direction on the pedal during the down stroke and by not attempting to pull up during the upstroke.' (Coyle et al 1991)

This EMG data (muscle activity recordings) correspond to the work of early researchers in the area (Jorge and Hull 1986).

In another study in California in the year 2000, subjects were asked to pedal under different circumstances. Firstly, bilateral (normal) pedalling was compared to unilateral (one sided) pedalling. It may seem obvious that unilateral pedalling recorded a much higher hamstring activity that bilateral pedalling. What was interesting is that the hamstring activity in the back part of the stroke dropped off, even if the subjects just instantaneously statically contracted their quadriceps muscles on the other leg (ie, with or without motion of the opposite crank arm). Hence, it seems that it may not be the motion of the crank arm that is the cause for the hamstring to reduce their activity, but the mere contraction of the muscles better suited to the task at hand (Ting et al 2000).

An explanation of this loss of the power in the downstroke due to the creating of an upstroke could be either (or both) of the following.

The first relates to pelvic stability. In my clinical experience of video assessment, the cyclists who use their hip flexors tend to hitch the pelvis up as they are trying to pull on the leg with the shortened hip flexor muscles at the top stroke. The result of this is that the stable pelvis base now moves and so the drive muscles are working from a moving base, and hence are working at less than optimum.

The second relates to that difficult concept of neurophysiology. Basically, the motor cortex has a stored program for power delivery to the crank arm. Trying to overcome that program may result in a deadening of the most effective part of the pedal stroke. Put simply, the brain cannot coordinate the up and downstroke as well as just the downstroke.

Correct Technique—Focus Shift

Now that I have completely confused you all, I'd just like to clarify a few points:

Is cycling just pushing like when I was a kid? The answer is NO!

Pedalling in circles is about smooth transition of power. Not the push/pull of upstroke/ down-stroke, because that will have a thud or a dead spot that we can feel or hear at the top and bottom stroke.

If you currently don't think of an 'upstroke' then good. What I am asking for is a 'focus shift' during the pedal cycle. The part of the pedal stroke that naturally happens is the push phase, especially with the dominant leg. The part that the cyclist needs to focus on is pulling across the bottom-stroke with the hamstring muscles. This will smooth out power generation at the top and bottom sections of the stroke to allow smooth transition between the right and left leg.

Have a think about your pedalling technique and consider the 'Do's and Don't's' table in this article. The trick is to be comfortable as well as efficient. Most of all enjoy your cycling because it is also my observation that the most successful athletes are the ones who really love the sport!

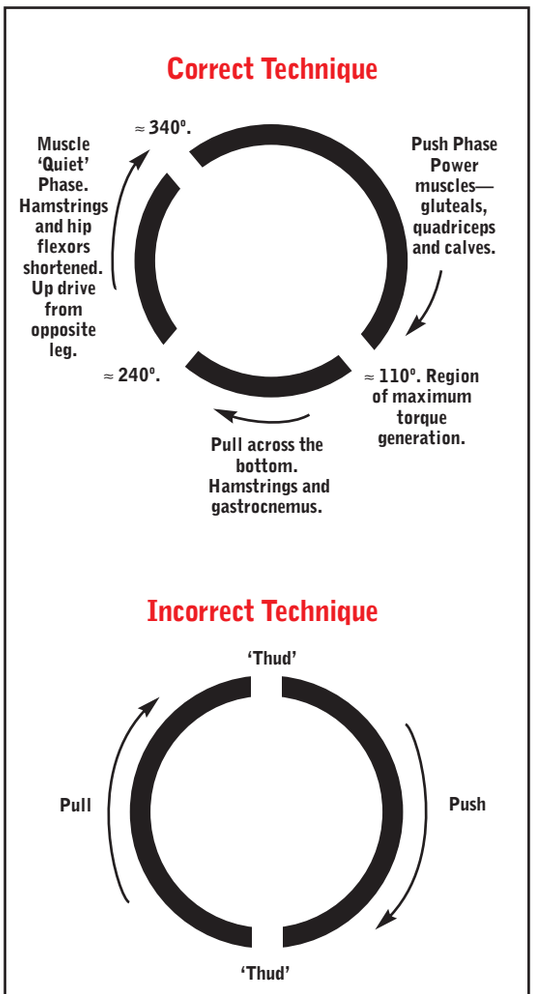

Illustration 2. *Correct Pedalling Technique versus Incorrect Pedalling Technique.*

Pedalling Pointers

Here are a few Do's and Don't's for developing an optimal pedaling style:

Don't

Do one legged pedaling exercises

Focus on developing an upstroke

Do

Think of pulling across the bottom stroke with your hamstring muscles (a coaching term is to imagine that you are "scraping chewing gum off the bottom of your shoe") You will find you automatically tap into muscles that are not being used much and have plenty left in them.

Think of the down-stroke of the non-dominant leg, as this leg will tend to be under-utilised for power generation compared to the dominant leg.

Listen to the pedal stroke and try to get rid of any rhythmical thud, thud, thud at top and bottom stroke.

Feel the pedal stroke and try to smooth it out. There shouldn't be a jolt between the left leg/right leg transition.

Concentrate on keeping a 'stable' pelvis, with a constant relationship between the saddle and your contact point on the saddle. I get patients to imagine they have a noise pressure sensor on the saddle that goes off every time they lose a little contact with the saddle.

References

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