Preventing and Treating Cramps

By John Hughes

Paris-Brest-Paris ’79, ’87, ’91, ’95, ’99; Furnace Creek 508 ’89 (Course Record), ’93 (1st); Boston-Montreal-Boston ’92 (Course Record); Race Across AMerica ’96; Rocky Mountain 1200 ’04

Fabian Cancellara, favored to win, ran out of water in unseasonably hot conditions in the 2011 Tour of Flanders and was caught on a key climb near the end after a potentially race-winning solo break.

Ray was about 75 miles (120 km) into a mountainous 100-mile (160 km) ride. He’d hammered up a climb, tucked for the descent and when he started pedaling up the last climb – ouch! Severe cramp in his hip flexor. Over the next 25 miles (40 km) he had to walk several times and couldn’t pedal hard. He estimated this cost him 15 minutes.

Ted is trying to qualify for Paris-Brest-Paris; however, he hasn’t been able to ride more than 300 km (187 mi) without feeling light-headed and cramping. He thinks he’s not eating and drinking enough.

Will pushed through the first 100 miles (160 km) of a 150-mile ride feeling strong, and then the cramps hit. He got off his bike, grabbed fluids and food, and limped through the last 50 miles (80 km).

We’ve all suffered cramps – a muscle painfully locking up. What causes cramps? What can we do to prevent them? And how can we treat them once they hit?

Causes

Physiologists have two different theories to explain cramping, and some field observations support each theory. Both mechanisms probably contribute to cramps:

1. **Fatigue of nerves.** Notice in the examples above that the cramping happened later in the rides when significant fatigue was a factor.

   Muscles have nerve spindles running parallel to the muscle fibers. The spindles sense the length, change of length and rate of change of the muscles and the muscles respond. When a muscle is stretched quickly, the spindle tells the muscle to contract immediately as a protection against it stretching too far. As a muscle fatigues, the spindle becomes more excitable and is more likely to (over-) react.

   The way the spindles act also explains why you should stretch slowly, rather than bouncing, which would make the muscle contract rather than relax.

   Tendons connect muscles to bones. The Golgi Tendon Organ (GTO) at every muscle-tendon junction responds to tension, change in tension and rate of change. It prevents muscle tears by increasing muscle tension and decreasing the amount

of contraction. When the GTO fatigues it becomes less excitable and less able to prevent too much contraction. (Lapoff, 2003), (Weschler, n.d.)

2. **Sodium losses**. Sodium losses from sweating or not consuming enough sodium during exercise make the nerves more excitable, causing cramps. (Lapoff, 2003, (ACSM, 2007)

In addition, these factors contribute to cramping:

- **Shortened position.** A muscle that is tired and in an already shortened position and then contracted further, is more likely to cramp. When pedaling, a muscle never goes through the complete range of motion and extends fully, although riding out of the saddle extends the muscles farther. (Weschler, n.d.)

- **Two-joint muscle.** Muscles that cross two joints are more prone to cramping:

  - **Gastrocnemius**. The fleshy calf muscle that points your toes away.

  - **Hamstring.** The fleshy muscles at the back of the thigh.

  - **Rectus femoris.** The muscle that bends your hip and straightens your knee. (Weschler, n.d.)

- **Dehydration.** If you get dehydrated, your muscle cells work harder to contract and relax, and become more irritable. (Mayo, n.d.)

- **Hyponatremia.** Hyponatremia is low blood sodium, usually caused in athletes by drinking too much fluid. Cramps are one of the symptoms of early hyponatremia. (Mayo, n.d.)

- **Mineral depletion**. Not eating enough potassium, magnesium or calcium in your regular diet may cause cramps. Also, some diuretics such as medication for high blood pressure may flush potassium. (Mayo, n.d.)

- **ATP depletion.** The adenosine triphosphate (ATP) molecule is the source of energy in every muscular action. As ATP is used, the body generates new ATP either anaerobically from carbohydrate or aerobically from carbohydrate and fat. Riding aerobically, your body can produce about 10 times as much ATP from carbohydrate and fat as it can produce anaerobically. Thus, during a sustained intense effort such as Cancellera's, he was both depleting his glycogen stores (the source of ATP) and riding anaerobically, thus producing much less ATP per gram of glycogen.

- **Supplements.** Some supplements, such as creatine, can cause muscle cramps as a side effect. (Friel, 2009)

- **Genetic factors.** Approximately one in 20 Caucasians has one cystic fibrosis gene, which can lead to sweat with much higher concentrations of sodium and

> chloride. Salt that cakes on the forehead or sweat that stings the eyes is a sign of this. Riders with the sickle cell trait (one in 12 of African or Caribbean descent) may not have symptoms of sickle cell anemia. However, when exercising hard they may experience sickling, impeding the blood flow and resulting in intense pain. This usually happens at the start of a high-intensity workout. If you suspect either of these, see your health care professional. (Lapoff, 2003)

Fatigue of the muscles and nerves, and sodium depletion, are the major causes of cramps – and these other factors may also contribute to cramps. By managing these, you can reduce the probability of a cramp disrupting your ride.

Prevention

Stretching. Research suggests that muscles that get accustomed to being shorter are more vulnerable to cramping, i.e., muscles that aren't stretched and are exercised in a shortened position. (Weschler, n.d.) You can reduce the probability of cramping by stretching regularly. Stretching doesn't have to be onerous –10-15 minutes stretching with your morning coffee or in front of the TV in the evening makes a big difference. As part of your recovery program, consider using the stretching program for cyclists illustrated on my website. Also, available in RBR's eBookstore is Dr. Alan Bragman's Stretching for Cyclists. (And an article on dynamic stretching will be available there soon.)

Conditioning. Fatigue is clearly a contributing factor in most cases of cramps. Preparing adequately for a ride will help prevent cramps. As a rule of thumb, build up to 2/3 to 3/4 of the duration of your planned big ride, riding in similar terrain and conditions. If you are preparing for a hilly 100-mile (160 km) ride, train up to a 65- to 75-mile (100 to 120 km) ride in the hills or substitute training in the wind if you live in flat country. For more on training for club rides, general fitness, centuries and touring see my eArticle on *Intensity: How to Plan and Gauge the Most Effective Training Efforts.*

Diet. According to the Mayo Clinic "Too little potassium, calcium or magnesium in your diet can contribute to leg cramps." (Mayo Clinic, n.d.) The Institute of Medicine defines adequate daily intake of these minerals as follows (Institute of Medicine, 2004):

Mineral	**Adequate Intake** Mg / day	**Sources**
Sodium	1500 mg up to age 50, 1300 mg to age 70, 2300 mg upper limit	Insufficient sodium in the daily diet is rarely a problem.
Potassium	4700 mg	Fresh foods of all kinds including fruit juice, milk, raisins, melon, potato, banana and beans. Unprocessed foods are best.
Calcium	1000 mg to age 50, then 1200 mg	Milk and milk products.
Magnesium	420 mg (men), 320 mg (women)	Fresh leafy vegetables, legumes and whole-wheat products.

Note that processing of foods generally *decreases* the potassium and *increases* the sodium!

Warm up and cool down. Stretching and then warming up before a hard ride will reduce the probability of cramping. (See the upcoming eArticle by Dan Kehlenbach on Dynamic Stretching, an excellent way to warm up.) Similarly, stretch after a ride to prevent those awful leg cramps in the middle of the night.

Pacing. Ray had ridden the first 75 miles (120 km) of his mountainous 100-mile (160 km) event hard, climbing near his lactate threshold (LT). Will felt strong and climbed near his LT during the first 100 miles (160 km) of his ride. If these riders had ridden at a more sustainable pace, then cramps might not have occurred. If you are racing, you may have to ride at or over LT; otherwise, stay at least 5% below LT, and your overall time will be faster for the event!

After a hard climb, even if you stayed below your LT, spin for a few minutes to loosen up your legs at the start of the descent before tucking, and then spin at the bottom before starting to work again.

Technique. When shortened muscles fatigue, they are more likely to cramp. Varying your technique to ride part of the time out of the saddle with your heels down will stretch the hamstrings and calf muscles.

Hydration The American College of Sports Medicine recommends drinking enough during exercise to prevent both excessive dehydration (>2% of body weight) and excessive changes in electrolyte balance due to too much fluid. Dehydration of more than 2% of your body weight affects aerobic performance, particularly in hot weather. Women tend to have lower sweat rates and electrolyte losses than men, primarily because of their smaller body size and lower metabolic rate for a given workload. (ACSM, 2007). How do you maintain proper hydration?

- **Satisfy thirst.** The simple rule of thumb is to drink if you are thirsty and otherwise don't drink. That's the recommendation of current researchers on hydration and hyponatremia. (Hew-Butler, 2008, Friel, 2009).

- **Calculate your sweat rate.** For a more accurate guide to hydration, calculate your sweat rate. The day of the test make sure that you are hydrated normally by drinking adequately, but not excessively. Weigh yourself nude before and after a ride. Each pound lost equals about 2 cups (16 fl. oz.) of fluid. Each kilogram lost is 1 liter of fluid. Add in the amount of fluid that you drank during the ride and then divide the total fluid by the number of hours you rode. This is your hourly sweat rate. For greater accuracy repeat the test several days under similar conditions.

  Example: Suppose you ride for 3 hours and drink two 24-oz. bottles (6 cups) of fluid. You weigh yourself and you have lost 1.5 lbs (3 cups). Your sweat rate is 9 cups for 3 hours of cycling, or 3 cups per hour. If you rode for 3

hours, drank 2 liters and lost 1 kg, your sweat rate would be 1 liter per hour. (Clark, 2005)

If you ride in different conditions then you should test your sweat rate in those conditions as well.

Sodium balance. According to the ACSM, some studies show that heavy sweaters with large sodium losses may be more prone to cramps. (ACSM, 2007). Although it varies depending on genetics, diet, training status, heat acclimatization, gender and other factors, sweat contains roughly 500 - 1,000 mg of sodium per liter. The Institute of Medicine recommends rehydration drinks contain 460 - 700 mg of sodium per liter, which is unpalatable. (Institute of Medicine, 1994).

Sports drinks contain less than recommended:

Sports Drink	**Mg Sodium / liter**	**Mg Sodium / 8 fl. oz.**
Gatorade (original)	465 mg	110 mg
PowerAde Ion4	425	100
Cytomax Performance Plus	235	55
HEED	170	40

Because sports drinks have less sodium than sweat, drinking them during long events (four hours or more) can contribute to dilutional hyponatremia. You should supplement your sports drink to obtain more sodium and potassium. Fruit juice and solid food can provide sodium and potassium:

Juice	**Mg Sodium / 8 fl. oz. (240 ml)**	**Mg Potassium / 8 fl. oz. (240 ml)**
V-8	740 mg	510 mg
Orange juice	0	475
Apple juice	0	240

During rides dill pickles, crackers and pretzels, and sliced turkey are also good sources of sodium. Supplements (below) contain varying amounts of sodium and potassium.

Hyponatremia. Cramps are one of the early symptoms of hyponatremia, which is usually caused by drinking too much fluid. Rather than urinating the excess fluid, the body sometimes responds by retaining fluid, leading to bloating. "Drinking according to thirst and avoiding weight gain during exercise remain the most reliable strategy against developing exercise-associated hyponatremia." (Hew-Butler, 2008) Consuming additional sodium during events longer than four hours may reduce the risk of hyponatremia. (ACSM, 2007)

Supplements. Supplements, including electrolyte supplements, are a multi-million dollar business. However, the body absorbs minerals much more readily from food than from pills. Certain forms of calcium can only be absorbed with food. In general, if your diet provides sufficient minerals, then you don't need to take supplements. If you choose to use a supplement, look for one with high sodium content since that is the primary mineral lost in sweat.

Servings to Approximately Replace Sodium in Sweat

	Sweat	Nuun	Succeed	Thermotabs	Endurolytes	Gatorade
Servings to equal sweat	1 liter	2 tablets	2 tablets	4 tablets	20 capsules	34 fl. oz.
Serving Size	1 liter	1 tablet	1 tablet	1 tablet	1 tablet	8 fl oz
Sodium	800 mg	360 mg	341 mg	184 mg	40 mg	110 mg
Potassium	115 mg	100 mg	21 mg	No	25 mg	30 mg
Calcium	23 mg	12.5 mg	No	No	50 mg	No
Magnesium	18 mg	25 mg	No	No	25 mg	No

Treatment

Relieving a cramp requires breaking the spasm and then flushing the muscle. Here's how to do it both off and on the bike:

Breaking. Stretch the affected muscle gently. *For any on-bike stretching, be very careful.* Practice on-bike stretches in a parking lot before trying them under duress on the road. Hold the bar next to the stem for the most control, and if you're near any fellow cyclists, drop to the rear or pull to one side to maintain a safe distance.

Gastrocnemius. To stretch the left gastrocnemius off the bike, stand with your left leg straight and your left foot several feet away from your bike or a wall, right foot forward and right knee bent. Slowly bend your right knee more and lean toward the bike to stretch the left gastrocnemius and Achilles.

To stretch on the bike, put the pedal at the bottom of the stroke, slide back in the saddle and push down with your heel.

Hamstrings. To stretch the left hamstring muscles off the bike, rest your left foot on a low wall, bench, etc., with your left knee locked. Bend forward at the hips until you feel a stretch in the left hamstrings.

To stretch on the bike, put the left pedal at the bottom of the stroke, slide back in the saddle, lock your left knee and bend forward at the hips.

Rectus femoris. The rectus femoris is the quadriceps muscle that crosses both the knee and hip joints. Breaking this cramp is tricky because its stretched position is the cramping position for the hamstring. To stretch the left rectus femoris grab your left foot or ankle, stand on your right foot and pull your left foot up toward your butt. You may need to hold onto your bike for balance.

On the bike unclip the cramping leg, grab your foot or ankle and pull it backward and up toward your butt, keeping straight upright at the hip. If your hamstring starts to cramp, get off the bike to stretch.

Flushing. After you've broken the cramp, move the affected muscle gently through its range of motion without making it work enough to excite another cramp:

- **Gastrocnemius.** Use the same position as for breaking the cramp on the bike – slide back in the saddle and pedal with your heel down. Pedal with the muscle working slightly at the bottom of the stroke but otherwise just going along for the ride.

- **Hamstring.** Slide back in the saddle and bend forward at the hip, stretching the muscle. Then pedal gently, working the hamstring easily in the 3-4 o'clock position.

- **Rectus femoris**. Sit up as straight as possible, pedal and work the muscle easily in the 12-1:30 o'clock range of motion.

The same procedure can be applied to other muscles, e.g., the intrinsic muscles of your feet that cause the toes to point down and sideways. First, try *gently* to stretch the affected muscle to break the cramp. Then move it *easily* through the range of motion to loosen it.

If you follow a progressive conditioning program, stretch regularly and eat a diet rich in minerals, you'll lay the foundation for avoiding cramps. Then, while on rides, pace yourself judiciously, get enough sodium and avoid significant dehydration – and you won't be the one walking your bike painfully up a hill while your buddies race to the top!

Resources

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John Hughes earned coaching certifications from USA Cycling and the National Strength and Conditioning Association. He enjoys coaching riders with a variety of goals and fitness backgrounds. For more information, visit www.coach-hughes.com.

John lives in Boulder, Colorado, where he served for 12 years as Managing Director of the UltraMarathon Cycling Association and editor of *UltraCycling* magazine.

John's cycling career includes course records in the Boston-Montreal-Boston 1200 km randonnée and the Furnace Creek 508, a Race Across America qualifier. He has ridden solo RAAM twice and is a 5-time finisher of the 1200 km Paris-Brest-Paris. Much of this was accomplished during a 24-year career at Stanford University where he balanced a professional career, family and cycling.

His other publications available from RoadBikeRider.com include:

Mastering the Long Ride: Riding and Finishing 100 km and Longer Events

Nutrition for 100K and Beyond: Detailed Nutrition (and Hydration) Guidance for Successful Distance Riding

Beyond the Century: How to Train for and Ride 200 km to 1,200 km Brevets

Intensity: How to Plan & Gauge Your Most Beneficial Training Efforts

Stop Cycling's Showstoppers: Sharing 35 Years of Experience to Keep Your Riding.