

Bicycle riding as a cause for erectile dysfunction

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ABSTRACT Organic erectile dysfunction is common in elderly men but is not very prevalent in men below 40 years of age. However, recent research has implicated bicycle riding as the cause of erectile dysfunction (ED) in much younger men. Even stationary bikes can cause trauma to the blood supply to the penis, resulting in ED. Drs Randrup and Baum review the pertinent mechanism of erection and the pathophysiology of ED associated with bicycle riding and provide practical tips for the prevention and treatment of blunt perineal injury.

CASE 1 A 54-year-old attorney who never had any problems with sexual performance, suddenly became impotent after cycling almost 200 miles during a 2-day charity ride last summer. Pedaling a new road bike equipped with a racing saddle and an aero-bar, he noticed that his penis was numb during most of the event. After experiencing erection difficulties for the next 6 months, he finally visited a urologist, who, using angiography, identified arterial damage at the base of the shaft of the penis.

CASE 2 A 33-year-old computer programmer experienced pain that went beyond usual aches after a long mountain-bike ride on rough terrain. The pain epicenter was near his penis, which would not get as hard or as erect as it used to. When he eventually consulted a urologist, and after a thorough history and physical exam were conducted followed by diagnostic testing, he learned that his main penile artery had become obstructed.

CASE 3 A 55-year-old man who never had a bicycle accident or any sexual dysfunction, started riding a stationary bicycle after a heart attack. Seven years later, after pedaling nearly 50,000 miles, his heart was indeed strong, but his penis had gone soft. Special studies uncovered no abnormalities in the penis itself, but right where it attaches to the pubic bone (exactly where the bicycle seat fits), a urologist found arterial luminal obstruction that was impairing blood flow to the patient's penis.

It is well known that the incidence of impotence increases with age.¹ One of the most common causes of impotence in aging males is vascular insufficiency, usually caused by occlusive vascular disease (Table). Atherosclerotic plaque formation and resultant vascular occlusion may result in narrowing of pelvic and penile vessels, damage to vascular erectile

Practice Tips

Ask patients presenting with ED if they bicycle ride. If so, what number of hours per week do they ride? What type of terrain? What type of seat? If necessary, inform them about correct bike seats and sitting position.

Advise men who spend a considerable amount of time bicycling to follow safety precautions to relieve pressure on the perineum.

Recommend to any cyclist who has noticed a decrease in the quality of his erections to stop riding for 6 weeks.

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TABLE Common causes of erectile dysfunction

ED category	Associated disorders	Manifestations
Cardiovascular	Atherosclerosis Coronary heart disease Hypertension Diabetes type 2 Perineal trauma (bicycle riding) Peyronie's disease	Inability to produce or sustain erection due to inadequate arterial flow or impaired veno-occlusion
Drug-induced	Alcohol/drug abuse Antidepressants Antihypertensives Cigarette smoking	Decreased libido, Inability to produce or sustain erection
Hormonal	Hyperprolactinemia Hypogonadism	Loss of libido
Neurologic	Alzheimer's disease Diabetic neuropathy Pelvic injury/surgery Stroke	Loss of libido Inability to produce or sustain erection
Psychological	Anxiety Depression Relationship problems Stress	Loss of libido Performance anxiety

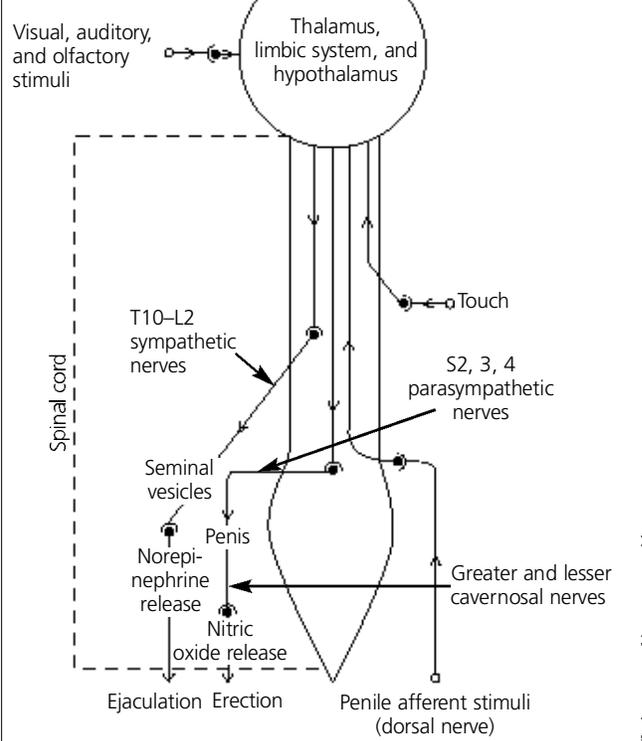
tissues and endothelium, and a secondary venous leak. Recently, a new cause of vasculogenic impotence, bicycle riding—which may cause erectile dysfunction (ED) in younger men—has been identified.

We estimate that over 100,000 Americans have been left permanently impotent from cycling, a greater number than has been generally recognized. The effect can occur not only in bike racers and in those who ride bikes for prolonged periods of time, but also in men who use stationary bikes in their home or a gym.

The “bicycle connection”

A number of case reports have implicated bicycle riding as a cause of ED.²⁻⁴ Initially, two reports in the 1970s noted the relationship between perineal injuries and long-distance bicycle riding.^{5,6} Two later articles commented on the perineal injuries, one from unicycling and the other from regular biking.^{7,8} The connection between biking and ED was further elucidated in 1982, when a significant reduction was noted of the mean penile brachial index (the ratio of the penile systolic blood pressure to the radial systolic blood pressure; a ratio of <0.6 indicates impotence resulting from vascular incompetence) in 20 healthy male medical students who sat on a bicycle seat for 10 minutes, compared to the very same students who were lying in a supine position serving as the control group.⁹

FIGURE 1



Innervation of the penis

The central and peripheral nervous systems are both involved in causing an erection. The thalamus, limbic system, and hypothalamus, along with the hippocampus and other structures associated with higher cortical functions, send messages to the spinal cord, where they are coordinated with somatic pathways of the peripheral nervous system. The penis is innervated by parasympathetic and sympathetic (autonomic) and sensory and motor (somatic) nerves. The parasympathetic nerves arise from the second, third, and fourth sacral spinal cord segments. The sympathetic nerves arise from the tenth thoracic to the second lumbar spinal segments. The key nerves involved in an erection include the dorsal penile nerve, the lesser cavernosal nerve, and the greater cavernosal nerve. Penile sensation is transmitted centrally along the somatic fibers of the dorsal nerve of the penis. The lesser and greater cavernosal nerves supply the erectile tissue in the corpus spongiosum and the corpora cavernosa, respectively.

The largest series reporting a relationship between bicycle riding and impotence was in 1997, when male cyclists riding in a 540-km race had a 13% incidence of difficulties with erectile function after completing the race.¹⁰

MECHANISM OF A NORMAL ERECTION

An erection is the anatomic and physiologic result of the coordination of the neurologic, endocrine, and vascular systems (Figure 1). A normal erection requires an

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FIGURE 2 The anatomy and physiology of erection

The left and right internal pudendal arteries terminate, respectively, as the left and right perineal artery and common penile artery, which become the left and right deep artery of the penis and the dorsal artery of the penis. The dorsal artery of the penis supplies the skin, glans, and corporal capsule. The deep artery of the penis traverses the center of the corpora cavernosa on each side and supplies the erectile tissue as the helicine arteries of the corporal bodies. The helicine arteries are surrounded by smooth muscle that remains contracted in the flaccid state, limiting the amount of blood flow to the erectile tissue in the penis. During an erection there is relaxation of the helicine arteries producing an increase in the blood supply to the penis and producing the rigidity of the penis with an intracavernous pressure of approximately several hundred mm Hg. With the increased blood flow a compression of venules against the tunica albuginea occurs,

resulting in an occlusive mechanism, which causes retention of blood within the penis and a firm erection is obtained. Therefore, flaccidity is a state of arterial vasoconstriction, and erection is a state of arterial vasodilatation.¹¹

At the biochemical level, smooth muscle relaxation is mediated through the release of nitric oxide from the nerves supplying the penis. The nitric oxide activates guanylate cyclase to produce cyclic guanosine monophosphate (cGMP), which allows smooth muscle relaxation through a decrease in intracellular calcium. Phosphodiesterase catalyzes the conversion of cGMP to guanosine monophosphate (GMP), which deactivates cGMP. As cGMP is converted to GMP under the influence of phosphodiesterase, the erection subsides. The principal phosphodiesterase in human penile tissue is type 5 phosphodiesterase.¹⁴

increase in the blood supply to the penis, as blood enters faster than it leaves the paired corporal bodies of the penis (Figure 2). In many cases, impotence is the result of an inadequate arterial blood flow to the corporal bodies or failure of the veins to trap blood in the corporal bodies.¹¹

BLUNT PERINEAL TRAUMA

In 1990, the site of the pathologic lesion at the common penile and cavernosal arteries was identified by arteriography in a 1990 study of patients with persistent impotence.¹² Arteriography was used to identify suspected vascular lesions found in the distal internal pudendal arteries and the common penile and cavernous arteries (deep arteries of the penis).¹²

The actual pathophysiologic mechanism of hemodynamic injury leading to ED after blunt perineal trauma was established in 1995.¹³ This study documented arteriogenic and corporal veno-occlusive dysfunction in patients with a history of blunt trauma to the perineum. Factors found to be associated with this type of injury include the bike rider's weight, height of the fall, speed at contact, and surface hardness. Therefore, a rider of, say, 150 pounds traveling 7.5 miles per hour who accidentally falls 15 inches onto the top tube of the bicycle may exert up to a quarter-ton of force on the perineum, causing injury to perineal structures. The study's authors emphasized that the bicycle rider supports his body weight on the bicycle seat, which, in the male, creates the potential risk for chronic compression to the com-

mon penile artery and pudendal nerve in Alcock's canal.¹³

More recently, an epidemiologic association between bicycle riding and ED was established by comparing questionnaire data from more than 1,000 men in a bicycle riding club, 4.21% of whom experienced ED, compared with 1.12% of the control population of male runners who experienced ED with no exposure to bicycle riding.¹⁴ It was also noted that bicycle-riding exposure (hours per week, miles per week, lifetime hours, or lifetime miles) was directly correlated with the number of urologic complaints, including ED and perineal numbness.¹⁵

If excessive pressure is applied to the perineum, such as occurs when a man sits on a bicycle seat, it compresses the penile blood supply against the inferior aspect of the pubic symphysis as these vessels traverse Alcock's canal (the tunnel through which the pudendal vessels and nerves pass) and decreases blood supply to the penis (Figure 3).¹³

In addition to vascular compromise of the blood supply to the penis, excessive bike riding can also result in compression of the peripheral nerves as they traverse Alcock's canal, resulting in paraesthesias and loss of transmission from the central nervous system to the deep arteries of the penis, thus affecting the blood supply to this organ.

Prevention strategies

The best way to avoid vasculogenic impotence caused by bicycling is to take preventive measures. Advise men who spend a considerable amount of time bicycling to follow these simple and effective precautions.

FIGURE 3 Blunt perineal injury caused by a bike seat

When excessive pressure is applied to the perineum, as in the case of bicycle riding, it compresses the penile blood supply against the inferior aspect of the pubic symphysis as these vessels traverse Alcock's canal (the tunnel through which the

puddental vessels and nerves pass) and decreases blood supply to the penis. Arteriogenic and corporal veno-occlusive dysfunction has been established in patients with a history of blunt perineal trauma.¹²

THE BICYCLE SEAT

A good deal of attention should be paid to the seat of a bicycle; riders should avoid a hard narrow seat or saddle and make sure the nose of the saddle is pointed a few degrees downward. Bicyclists should consider using bike saddles and seats that are designed to minimize pressure on the midportion of the perineum. Some of these seats are wide and heavily padded; others have a hole in the middle or the middle section is removed, providing support to the ischial tuberosities at the lateral parts of the perineum only. These seats reduce compression on the midline of the perineum, where the blood vessels and nerves pass to the penis. An ideal bicycle seat for this purpose will be designed without a nose extension, or simply be wide enough to allow the rider to sit on, instead of straddle, the seat.

The bike saddle should be:

- Heavily padded (not hard)
- Wide (not narrow)
- Made with a hole in the middle or the middle section removed
- Pointed a few degrees downwards

SITTING POSITION

Advise your male patients to avoid extending the legs fully at the bottom of each pedal stroke. The rider's knees should be slightly bent to support more weight, thereby reducing the compression of the perineum. The rider should get off the seat and stand on the pedals every 10 minutes to increase the blood flow to the perineum, especially on long bike rides. Riders of stationary bikes should observe the same precautions as outdoor bicyclists, insuring proper saddle inclination and height and getting off the seat frequently to decrease the pressure on the perineum.

BODY WEIGHT

Heavy riders may be at increased risk of arterial compression damage because of the greater weight transmitted to the perineum. Men in this category should

Correct sitting position

- Use a bike with a proper seat
- Point seat downwards
- Do not fully extend legs while pedaling
- Occasionally stand while riding
- Stand on pedals over rough terrain

be particularly careful to avoid prolonged and undue pressure on the perineum.

When to suspect ED secondary to bicycle riding

Query patients presenting with ED about their habit of bicycle riding. If the answer is positive, we suggest further questioning about the number of hours riding per week, type of terrain ridden on, type of seat, and riding preference. Any cyclist who has noticed a decrease in the quality of his erections and may be suffering the consequences of prolonged compression of the delicate pudendal nerves or penile arteries should be advised to stop riding for approximately 6 weeks. In most instances, cessation of the trauma to the perineum will result in resolution of the ED. If no improvement in potency is evident after 6 weeks of conservative measures, it is appropriate to prescribe sildenafil (Viagra®) for vasculogenic impotence.

Is sildenafil useful?

Sildenafil has a role in the treatment of sexual dysfunction of any origin, especially in cases where blood supply to the penis may be compromised. If the bicycle rider is withstanding chronic trauma to the arteries or to the nerves supplying the erectile bodies, it will be imperative to make changes in his lifestyle or his bicycle-riding style so as to discontinue the injury to the vulnerable area in the perineum. But additional pharmacologic treatment with sildenafil would be an appropriate therapeutic measure, along with the recommendation to avoid the traumatic compression of the blood and nerve supply to the penis.

Sildenafil is available in three tablet sizes—25 mg, 50

mg, and 100 mg. The usual initial dose is 50 mg before intercourse. Instruct the patient to titrate his dose up or down, depending upon efficacy and side effects. We recommend that you initially prescribe your patient six 50-mg tablets, with instructions to try the 50-mg dose at least twice. If the 50-mg dose produces desired results, he may try half a tablet (25 mg). If 50 mg is not adequate, he could take two tablets, to reach the 100-mg dose. If the two attempts with 100 mg do not produce the desired results, it is appropriate to assume that sildenafil is probably not the proper choice for this patient. For men who have developed impotence after blunt perineal trauma, we recommend that treatment with sildenafil be maintained for a period of 4 to 6 weeks. Many men will find that spontaneous erections will return and they will achieve erections during sexual encounters without requiring any additional medication.

Sildenafil should be taken approximately 30 to 60 minutes before engaging in sexual intimacy, to enable the drug to exert its optimal effect upon the penile vasculature. Although studies in most men demonstrate absorption and measurable serum levels within 30 minutes after oral administration of this drug,¹⁶ many men indicate that the greatest benefits occur 2 to 4 hours after dosing. Some patients even notice that beneficial effects can last 10 to 12 hours. To promote gastrointestinal absorption, sildenafil should be taken without earlier consumption of alcohol and without foods high in fat. Sildenafil is a selective inhibitor of phosphodiesterase type 5 (PDE 5), an enzyme present mainly in the human corpus cavernosum, that is responsible for the degradation of cyclic guanosine monophosphate (cGMP). cGMP leads to smooth muscle relaxation within the corpus cavernosum, including arterial vasodilation and relaxation of the trabecular smooth muscle, allowing a shift of the penis from the flaccid to the erect state. Since PDE 5 opposes erection by limiting the tissular concentration of the erection enzyme (cGMP), the inhibiting action of sildenafil on PDE 5 greatly increases the effect of sexual stimulation on patients using this drug.

If abstinence from bike riding and sildenafil does not result in a return of a man's potency, it is appropriate to refer him to a urologist or a physician who is familiar with the evaluation and management of sexual dysfunction.

Testing

Tests that may be used to investigate the functional status of the patient's erection mechanism may include Doppler ultrasound of the penile vasculature, penile nerve conduction studies, evaluation of spontaneous nocturnal erections with a nocturnal penile tumescence monitor, or use of an injectable medication—usually prostaglandin—which is expected to create an erection if there is no impairment of the blood supply to the penis.¹⁷

Patients with ED who do not respond to drug treatment should undergo a diagnostic work-up. If evidence of a traumatic arterial occlusive lesion is found by angiography, the patient may be a candidate for vascular repair surgery, a vacuum constriction device, or implantation of a penile prosthesis.

Conclusion

Bicycle riding has become a very popular activity for people of all ages. It is a low-impact activity associated with increased aerobic metabolism and stimulation of the cardiovascular system. With appropriate equipment, bicycle riding can be a safe exercise. ♣

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