Saddle Sores.

The What and Why, as well as Tips on Prevention and Treatment.

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Introduction

Remember when you first started riding seriously? And remember that pain in your backside a few weeks later? None too pleasant a thought, right? Well, if you're like most cyclists, it happens more frequently than you care to remember. In one study of amateur long distance cyclists, over 60% reported buttock discomfort and approximately 50% of these cyclists had to alter their riding style, or temporarily discontinue cycling, due to the discomfort. If you're getting ready to get back on your bike this spring, or you're new to cycling, there are several things you can do to decrease your chances of developing saddle sores. But first...

What are "saddle sores"?

The term "saddle sores" should only be used to describe skin-related disorders of the area of the body in contact with the bicycle seat. Anatomically, this area includes the perineum (the skin between the base of the thighs) and the lower buttocks. The resulting skin disorders can be further categorized into four distinct clinical syndromes; ischial tuberosity, pain, chafing, folliculitis or furuncles, and skin ulceration. Although these disorders can develop independently, it is not uncommon for more than one to occur at the same time. There are other bicycle seat related problems, such as pudendal nerve neuropathy and impotence (see August 1997 issue of *Bicycling*), however as these are not skin-related disorders they should not be termed saddle sores.

1. Ischial tuberosity pain: The ischial tuberosities are your "sit bones", the 2 bony prominences on your backside which contact the seat of a chair when sitting. Since a bicycle seat is designed so that the majority of a cyclists' body weight is concentrated on these bones when seated, it's not surprising that ischial tuberosity pain occurs so frequently. In the previously mentioned study of amateur long-distance cyclists, over 70% of seat-related discomfort was reported to be due to ischial tuberosity pain. Typically, the skin overlying the ischial tuberosities becomes red, and tender, although the bone and the overlying soft tissues may also be a source of pain, since they are certainly traumatized as well. Usually, the pain gradually resolves with more 'seat time'. However, with

continued riding, persistent pain and eventual skin breakdown with ulceration may occur.

2. Chafing: Chafing results from the constant rubbing of the inner thighs and groin against the bicycle seat; the resultant friction causes skin breakdown manifest as a red, inflamed abrasion. Using a wider, larger seat tends to increase the movement of the body on the seat, and thus increases the friction, and the risk of chafing. While chafing is believed to occur more frequently in women, there is no definitive research to support this.

3. Folliculitis and Furuncles: A folliculitis is an infection of the base of a hair follicle, while a furuncle, or boil, is a walled-off collection of pus (i.e., an abscess). These infectious processes occur most commonly in areas of the body subjected to minor trauma, such as the groin. While a folliculitis is often relatively painless, and usually resolves spontaneously, a furuncle is usually painful, and may initially look, and feel, like a pimple. And, if not allowed to heal, a furuncle can become quite large and exquisitely painful.

4. Skin ulceration: This small, crater-like lesion has been reported to occur in up to 10% of cyclists completing a 500 mile, week-long ride. It can be quite painful, and may become infected. Since the outer protective layer of the skin is damaged, bacteria may gain access to the deeper layers of the skin, and the warm moist environment of this area of the body is very conducive to bacterial growth. Although it occurs relatively infrequently, a more extensive skin infection (e.g., cellulitis) may result if a skin ulcer is not treated appropriately.

Why do saddle sores occur?

Imagine, if you will, that you're sitting on a hardwood straight back chair. As previously noted, the bones in contact with the seat of the chair are your ischial tuberosities (or "sit bones"). Now imagine sitting bolt upright on that hardwood chair for an hour straight, no shifting your weight from side to side, no slouching, no crossing your legs, sounds painful, doesn't it? Well, you're doing essentially the same thing when you ride a bike for an hour. With one major difference: while you're cycling most of your body weight is concentrated on the tiny surface area of the bicycle seat, rather than spread out over the relatively broad expanse of a chair. With that thought in mind, let's consider the factors that contribute to the development of saddle sores. While, the causative mechanism for the development of saddle sores has not specifically been studied, there is a substantial amount of research examining the etiology of a related phenomenon, namely pressure ulcers, or "bed sores". Since the same factors implicated in the development of pressure ulcers are also present when a cyclist is sitting on a bicycle seat, the results of pressure ulcer research can help us to understand why saddle sores occur, and how to reduce the chances of developing them. The most significant factors implicated include pressure, shear moisture, and temperature. And the primary difference between developing a pressure ulcer and a saddle sore appears to be exposure time; saddle sores develop as a result of brief, repetitive exposures to these factors, while pressure ulcers develop due to prolonged, persistent exposure.

1. Pressure: Considering the above scenario, it is readily apparent that the most important factor in the development of saddle sores is the downward pressure of the cyclists' bodyweight onto the bicycle seat. As previously noted, since most of a cyclists' bodyweight is concentrated on the tiny surface area of the bicycle seat, the pressure exerted on the skin and underlying soft tissues of the perineum is significantly greater than that present while sitting an a chair. The most significant consequence of this downward pressure is the near complete compression, or occlusion, of the capillaries of the skin and underlying tissues, thus markedly decreasing the blood to these tissues. In addition, as discussed in the August 1997 *Bicycling* article on cycling and impotence, the arteries and nerves of the perineum may also be traumatized during seated cycling. However, by appropriately concentrating your bodyweight on the ischial tuberosities, the pressure on these structures can be reduced, although not completely eliminated.

2. Shear: The next most significant factor in the development of saddle sores is thought to be shear. Friction, acting parallel to the surface of the skin, results in a shearing or stretching force on the skin and underlying tissues (see Figure 1). As you're riding, your bodyweight shifts slightly from side to side with each pedal stroke. This seemingly insignificant motion causes a cyclic, repetitive shearing of the skin, that will occur thousands of times during a 20 or 30 mile bike ride. Eventually, skin breakdown, in the form of abrasions, have been demonstrated to occur as a result of these repetitive low magnitude shear forces. Blisters tend to develop with larger magnitude shear forces.

Additionally, and more significantly, the combination of shear and pressure results in an even more marked deleterious effect on tissue blood flow. It has been demonstrated that in areas of high shear, 50% less pressure is required to produce complete occlusion than in areas of low shear. Therefore, during seated cycling, when both high pressure and shear are impacting the skin and soft tissues, the combined effect may impair skin and tissue blood flow so profoundly that tissue breakdown eventually occurs. Alternatively, when riding out of the saddle blood flow returns, since the pressure and shear are no longer present.

3. Moisture. Small amounts of moisture on the skin, like that from light to moderate sweating, have been shown to additively increase the shear force on the skin.

4. Temperature: The effect of temperature on tissue metabolism is the final contributory factor in the enhanced susceptibility of the perineal skin and adjacent tissues to cycling related breakdown. The skin temperature of the body in general, and specifically of the perineum (due to seat contact), increases during cycling. With increasing skin temperature, the metabolism of the skin increases as well (about 10% for each 1 degree centigrade increase), resulting in an increased demand for oxygen and other nutrients by these tissues. The body normally responds to the increased demand by increasing the amount of blood flow to the skin. However, because of the concomitant effects of pressure, shear, and moisture, tissue blood flow is actually reduced, thus resulting in an

inadequate supply of oxygen and other essential nutrients to the skin and adjacent tissues.

Consequently, during seated cycling, the combined effect of these four factors results in a marked reduction in blood flow to the tissues of the perineum, at the same time that there is an increased demand. The end result is tissue ischemia, which occurs when the blood vessels to a tissue are blocked or occluded, thereby depriving the tissue of vital oxygen and other important cellular nutrients. For instance, ischemia of the heart muscle typically causes chest pain, or angina. Prolonged ischemia of the skin and underlying tissues also causes pain, as well as tissue breakdown and ulceration. In addition, ischemic tissues are more susceptible to infection, and can't repair themselves as well as normal tissue when injured.

Thus, the repetitive transient episodes of ischemia, of the skin of the perineum and buttocks during cycling are the inciting event in the development of saddle sores. Saddle sores (with the exception of chafing) probably become manifest as different clinical syndromes because of variations in the degree, and the location, of the ischemic tissue injury. For instance, ischial tuberosity pain may occur due to mild ischemic injury of the skin and soft tissues over this bone, while a skin ulcer may result from a more significant (more prolonged or repetitive) ischemic injury.

In a more general context, saddle sores probably represent an early stage in a continuum of ischemic tissue injury; at one end of this continuum there is seat-related discomfort, and saddle sores, while at the other extreme there are pressure ulcers. Supportive evidence for this ischemic phenomenon is seen in professional cyclists, where actual necrosis or death, of the connective tissue beneath the skin of the perineum occurs due to the effects of the above factors, especially excessive pressure, and shear.

In summary, the major difference, between the saddle related discomfort and saddle sores resulting from cycling, and the development of a pressure ulcer would appear to be the duration of time the tissues are subjected to excessive pressure, shear, moisture, and temperature.

How does the body respond to these factors?

Although the human body does not have specific structures that are capable of reducing pressure, there are structures, called bursae, which function to minimize shear forces. Bursae look somewhat like a partially flattened water balloon, except they have a thick fibrous wall, and are filled with synovial fluid (see Figure 2). They are typically found interposed between the skin and a bony prominence, or between a tendon and a bone, and are located adjacent to all the major joints of the body. The synovial fluid is the same fluid found in our joints, and acts like ultra fine motor oil, allowing the two opposing walls of the bursa to slide past one another with essentially zero friction. Thus, with a bursa in between reducing shear (and friction), the skin can move back and forth over a bone without being damaged. During cycling, the ischial bursa, located between

the ischial tuberosity and the skin, helps reduce the shear force on the overlying skin. While a normal bursae is unable to minimize pressure to any significant extent adventitious (or extra) bursae may be able to reduce pressure, in addition to shear, since they are filled with more fluid. These structures have been noted to develop in unusual locations within the body, such as at the end of an amputee's residual limb, in response to excessive shear and pressure. It is not known if adventitious bursae develop in competitive or professional cyclists, although a related phenomenon, discussed below, does occur. To better understand the beneficial, effects of a bursa, try this: Rub you hands together briskly for 10- 15 seconds. Then rub thorn together with a partially filled water balloon between your hands. Notice a difference? There is no heat production or friction with the balloon interposed between your hands.

Since the human body is unable to sufficiently reduce the effect of these factors, especially excessive pressure, the body must rely on another system, the nervous system, to avoid significant tissue injury. The discomfort and pain of the perineum and buttocks that is felt when riding, is a signal that the skin and underlying tissues of this region are ischemic. Since pain is a signal of ischemia, and the potential resultant tissue damage, most people avoid repetitively painful situations and allow their tissues to heal. For instance, most people who develop saddle related discomfort temporarily discontinue cycling, or change their position on the bike, or decrease the length of their rides in order to allow the injured areas to heal, and to prevent further injury. However, a significant number of cyclists tend to endure or suppress saddle discomfort. Novice cyclists are probably especially prone to this behavior since they are enthusiastic to ride, may mistakenly believe that pain is necessary to 'toughen up' their tissues, are unfamiliar with an appropriate method of gradually increasing their mileage, and may have unrealistic expectations of their ability to ride a specific distance or for a certain amount of time (e.g., doing a 70 mile ride two weeks after beginning a cycling program). These conditions may contribute to the development of saddle sores, since they result in more prolonged repetitive, exposure to the four physical factors mentioned than the individuals' tissues are ready to handle. The analgesic effect of endorphins, the body's natural pain-killer released during exercise, is probably another contributory factor. Since endorphins will minimize some of the ischemic discomfort, an individual will likely remain seated longer thus inflicting tissue damage. In addition, there is certainly some individual propensity towards developing saddle sores, since some people tend to get them regardless of how they limit their mileage, while others never develop them. For instance, the cyclists competing in the Tour de France are most certainly relatively resistant to developing saddle sores. Since the incidence of saddle, related discomfort and saddle sores tends to decline with continued cycling, some form of tissue adaptation most certainly occurs. However, since this has not been studied, the specific changes that occur during this 'toughening up' period are unknown. The thickness of the skin, or of the underlying connective tissue, may increase. It is also conceivable that the ischial bursae may become more like adventitious bursae; by accumulating more synovial fluid over time, they may be better able to accommodate the extra pressure and shear forces associated with cycling. Professional cyclists have been noted to develop fluid-

filled cysts of their perineum that may be a similar adaptation. Alternatively, individuals prone to developing saddle sores may simply quit cycling.

Prevention:

It is probably not possible to completely avoid saddle sores, particularly ischial tuberosity pain, if you plan to do any reasonable amount of cycling, however, experts recommend the following to minimize your chances.

1. Decrease ischemia: Stand up, or ride out of the saddle, every 10-15 minutes since tissue blood flow should normalize when the pressure and shear forces are removed.

2. Check your positioning: Make sure your seat height, and seat tilt are adjusted appropriately. The seat height should be positioned so that the knee is slightly bent (15-20 degrees) when the pedal is at the bottom of the stroke. This can be determined by securing your bicycle on a wind-load resistance trainer, putting on your cycling shoes, and pedaling backwards with your heels on the pedals. Adjust the seat so that your hips don't rock from side to side while your heels remain in contact with the pedals. A neutral to slight upward seat tilt is recommended for men, while for women a slight downward tilt is recommended. However, this can be adjusted if discomfort or numbness of the perineum results. If you're not sure about your positioning, any reputable bicycle shop should be able to assist you.

3. Gradually increase mileage: For most novice cyclists it is probably easier to develop a time-based workout routine rather than a mileage-based routine. During the first month of a training program, a novice can develop a good endurance base while minimizing saddle discomfort, by varying the duration of their daily rides from a minimum of about 20 minutes to a maximum of about 45 minutes. One long ride per week is sufficient and the duration of this ride can be increased 5-10 minutes each week. Trying to complete a one or two-hour ride with more experienced, better conditioned cyclists will almost certainly result in some buttock pain for the unconditioned rider.

4. Proper attire: Clean, dry cycling shorts with a natural or synthetic chamois should be worn. The chamois helps reduce the moisture in the groin region, as well as providing some padding to reduce pressure. Quality cycling shorts should not have any prominent seams of the inner thigh or groin region, and underwear should never be worn underneath your cycling shorts. In addition, applying petroleum jelly to the perineum and the skin over the ischial tuberosities may help reduce friction and shear of these tissues.

5. Maintain good hygiene: You, and your cycling shorts should be washed or rinsed after every ride; thoroughly wash both if you use petroleum jelly. There is no need to use expensive anti-bacterial soaps. Bacteria are normally and harmlessly present on our skin. Using an antibacterial soap will not prevent bacteria from recolonizing the skin to any substantial degree after you're done washing.

6. Change seats: Despite numerous recent modifications in the composition and design of bicycles, the standard racing seat remains by far the most common bicycle seat used today. However, various materials, including various types of plastic foam, fluid-filled inserts (LiquiCell), and gel substances, have been incorporated into bicycle seats, seat covers, and cycling shorts, and some have been demonstrated to reduce seat surface pressure. A recent study showed a significant difference in seat surface pressures during cycling when different bicycle seats (unpadded, foam padded, fluid-filled ["LiquiCell"], and gel filled [Spenco*]) were compared. The results demonstrated that while a foam padded seat does reduce seat surface pressure slightly during cycling, both the fluid-filled, and the gel seat were able to redistribute pressure more uniformly, resulting in an even lower average pressure over the entire seat surface (see figure 3). So using a fluid-, or gel-filled seat may be beneficial in reducing the incidence of saddle sores. The fluid-filled seat may be of additional benefit since it may function as an adventitious bursa, thereby reducing shear as well as pressure.

Treatment recommendations:

Although saddle sores can be divided into four different clinical syndromes, the treatment for each is quite similar; and all of them typically resolve spontaneously, or with minor medical therapy performed at home.

1. Modify your cycling regimen: Complete avoidance of cycling until the lesions heal is the most appropriate treatment, however you may be able to continue riding with any of the syndromes discussed. This will depend upon your pain threshold, and whether or not an infection is present. Alteration of your riding position is one option, although this may result in trauma to other areas, while a few weeks of cross training, such as cycling 2 days a week and running 3 days, and gradually transitioning back to full-time cycling, is another option. The latter option may provide enough relative relief to allow the lesions to heal without compromising your cardiovascular endurance, or your cycling skills. For maximum benefit, the alternate activity should be non-seat bearing, such as running or swimming.

2. Skin care: In general, keep the skin clean and dry. Moisturizing creams can be used for mildly inflamed tissues, while topical antibiotic gels may promote healing, and prevent infection of skin ulceration or chafed regions. Avoid using rubbing alcohol, or topical steroids for any saddle-related skin lesions. Tight fitting clothing should be avoided as well, as this helps minimize the elevated temperature and moisture which promote bacterial growth. Warm compresses, or sitting in a warm tub, may be helpful in accelerating the resolution of a furuncle or folliculitis, while large or persistent furuncles usually requite minor surgery and antibiotics.

3. Medical attention: Seek medical attention for any lesions which are worsening, particularly if they are increasing in size, or those that don't seem to be improving. In addition, any infection that is increasing in size, with which

there is an accompanying fever should be evaluated by a physician or other health care professional.

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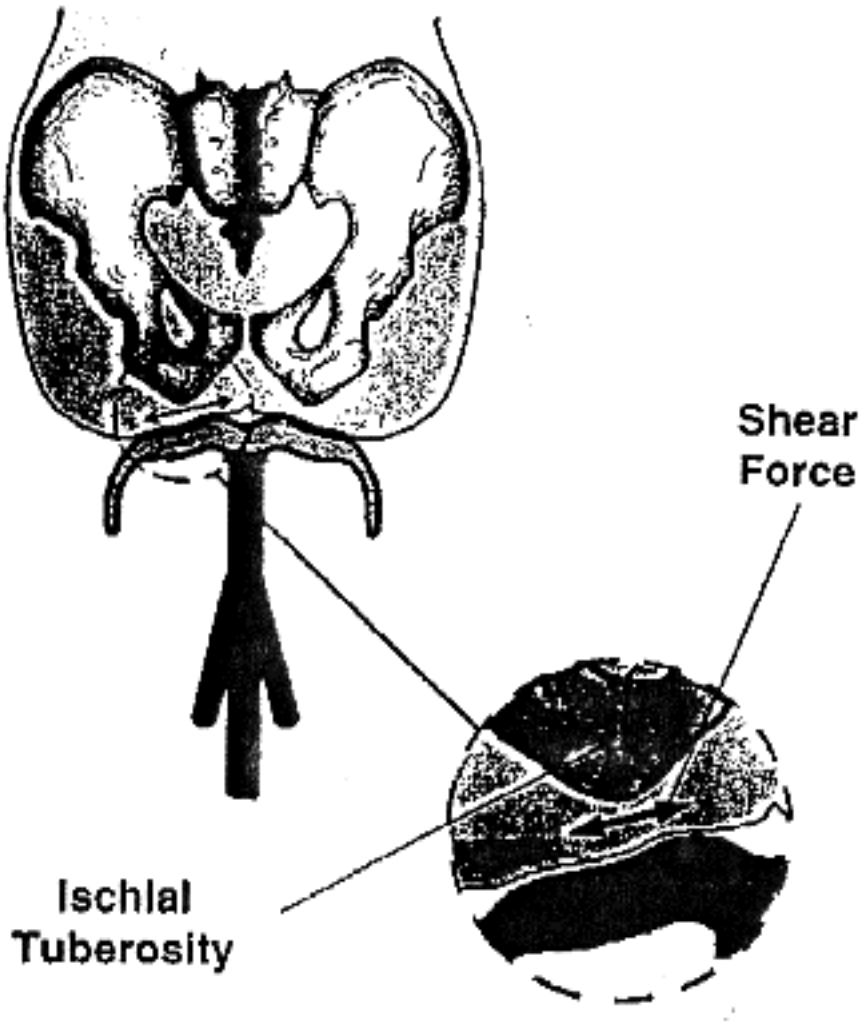

Figure 1. Shear forces (depicted by the black arrow) act parallel to the skin surface, stretching the skin, as a person sits on a bicycle seat.