SEXUAL MEDICINE ORIGINAL RESEARCH

BASIC SCIENCE

Effect of Oscillation on Perineal Pressure in Cyclists: Implications for Micro-Trauma

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ABSTRACT

Background: Genital numbness and erectile dysfunction in cyclists may result from repeated perineal impacts on the bicycle saddle (micro-trauma) that occur during routine cycling.

Aim: To evaluate the relationship between oscillation forces and perineal pressures among cyclists in a simulated laboratory setting.

Methods: Participants were fit to a study bicycle to ensure all cyclists had the same torso angle (60 ± 1 degree) and maximum knee angle (150 ± 1 degree). A lever system was used to generate oscillation events of 3 progressively increasing magnitudes. Perineal pressure was continuously measured using a pressure sensor on the bicycle saddle. This process was carried out in each of the following conditions: (1) stationary (not pedaling) with the standard seatpost, (2) pedaling with standard seatpost, (3) stationary with seatpost shock absorber, and (4) pedaling with seatpost shock absorber.

Outcomes: We compared perineal pressure changes during oscillation events in the stationary and pedaling states, with and without the seatpost shock absorber.

Results: A total of 39 individuals were recruited (29 men and 10 women). As the amount of oscillation increased from an average of 0.7*g* (acceleration due to Earth's gravity) to 1.3*g*, the perineal pressure increased from 10.3% over baseline to 19.4% over baseline. There was a strong linear relationship between the amount of oscillation and increase in pressure ($r^2 = 0.8$, $P < .001$). A seatpost shock absorber decreased the impact of oscillation by 53% in the stationary condition. Men and women absorbed the majority of shock in areas corresponding to pelvic bony landmarks.

Conclusion: This study represents one of the first characterizations of cycling-associated perineal micro-trauma in a laboratory setting. We found a strong linear relationship between oscillation magnitude and perineal pressure during cycling, which was mitigated by a seatpost shock absorber. The use of shock absorption in bicycle design may reduce perineal micro-trauma and potentially improve cycling-associated perineal numbness and erectile dysfunction. **Sanford T, Gadzinski AJ, Gaither T, et al. Effect of Oscillation on Perineal Pressure in Cyclists: Implications for Micro-Trauma. Sex Med 2018;XX:XXX−XXX.**

Key Words: Perineum; Micro-Trauma; Cycling; Saddle

INTRODUCTION

Cycling is a form of physical activity that promotes health in numerous ways resulting in a reduction of all-cause mortality in individuals who cycle regularly.[1] Despite the known health benefits of cycling, overuse injuries are common, occurring in up to 85% of recreational cyclists.[2] The contact between the bicycle saddle and sensitive perineal structures results in genital numbness in 50−91% of cyclists and erectile dysfunction (ED) in 13−24% of men cyclists engaging in long-distance cycling events.[3,4] 2 Potential mechanisms have been proposed in the pathogenesis of these cycling-related urogenital disorders: decrease in blood flow to genital structures and pudendal nerve palsy from micro-trauma.[3]

The majority of the studies evaluating the mechanism of genito-urinary overuse injuries have focused on the effect of the bicycle saddle on perineal blood flow.[5−8] The palsy that occurs

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in the pudendal nerve distribution in cyclists is not as well-studied. This phenomenon has been termed the "Alcock syndrome" and is thought to be due to forces applied to the pudendal nerve within the Alcock canal.[9]

While static compression has been a proposed mechanism, the role of micro-trauma has also been postulated.[3] Micro-trauma refers to repeated low-intensity impact. The rationale for the deleterious effects of micro-trauma (as opposed to continuous compression) stems from a study utilizing a rat forelimb model in which the effect of a repetitive force of 2 N applied at a rate of 60−120 times per hour was compared with continuous pressure applied with the same force (2 N). The repetitive force condition resulted in nerve dysfunction whereas the continuous force condition did not produce nerve dysfunction.[10] Given most bicycles do not have an effective full suspension (front and rear shock absorbers), the forces created during cycling are transmitted directly to the perineum. Micro-trauma transmitted to the perineum may contribute to the genito-urinary overuse injuries including ED in men[11,12] and decreased perineal sensation in both men and women.[13,14]

In this study, we evaluated the effects of oscillation on perineal pressures in men and women in a controlled laboratory setting. We also evaluated a potential method to mitigate the effects of oscillation—a seatpost shock absorber. Our hypothesis is that with greater oscillation there is a corresponding increase in perineal pressure that would be dampened by a seatpost shock absorber. If proven correct, our hypothesis would provide a mechanism to reduce perineal micro-trauma experienced while cycling, and potentially alleviate cycling-associated ED and perineal numbness.

METHODS

Subjects

Healthy subjects with no known co-morbidities and no urinary/sexual dysfunction were recruited for participation. All subjects filled out a basic health questionnaire and demographics form. Informed consent was obtained for all subjects (University of California, San Francisco Institutional Review Board Number 14−14,946). Subjects were provided clean, fitted cycling shorts with no chamois for use during the study. All subjects wore athletic shoes. Subjects were given a $20 gift certificate for participation.

Laboratory Bicycle

The study bicycle (Tuono; Vilano, Elkton, FL) and associated equipment are shown in Supplemental Figure 1. Small, medium, and large sizes were available to fit cyclists of various sizes. The stem was replaced with a bicycle sizing stem (Purely Custom, Twin Falls, ID) to allow the bicycle to be fully adjustable. The rear wheel was removed and the bicycle was attached to a Kicker trainer (Wahoo Fitness, Atlanta, GA). The bicycle saddle model (Regal; Selle San Marco, Rossano Veneto, Italy) was chosen for its standard teardrop shape with minimal padding to allow for measurement of pressure throughout the perineum.

Pressure/Oscillation Measurement

Perineal pressure measurements were obtained using the F-Socket VersaTek 1-cuff system with a 9833E Large F-Socket Sensor (Tekscan, South Boston, MA). This system measures pressure via individual sensors embedded in a thin plastic sheet. To ensure appropriate sensor fit to the saddle, the F-Socket sensor was divided into strips that were secured to the saddle with double-sided tape and fine suture (Supplemental Figure 1). Accelerometer data were obtained using the application Vibration V3.53 (Diffraction Limited Design, Southington, CT) on an iPhone 5 (Apple Inc, Cupertino, CA). The iPhone was mounted to the seatpost using the BIKE+BAR mount (LifeProof, Fort Collins, CO). Oscillation was created using a custom-fabricated lever system attached to the trainer. 2 Seatposts were used—the stock Tuano aluminum seatpost and a seatpost suspension. For the seatpost suspension system, we utilized the SP12-NCX Suspension Travel Seatpost (27.2 × 350 mm) (SR Suntour, Madison, WI).

Position/Fit

Due to the known effects of cyclist position on perineal pressures,[15,16] the bicycle was adjusted such that all cyclists had a standardized torso and maximum knee angle (Supplemental Figure 2). Bicycle adjustments were made until each participant had a maximum knee angle of 150 degrees (±1 degree) and a torso angle of 60 degrees from horizontal (±1 degree). The Bike Fast Fit application (Double Dog Studios, Fort Myers, FL) was used to ensure these measurements were maintained while the cyclist pedaled (Supplemental Figure 2). Using software (Tekscan), we evaluated the pressure points associated with the ischial tuberosities (ITs) and ensured the distance between ITs was consistent with our measurements. We adjusted the saddle in the horizontal plane until the ITs of each cyclist were located within the rear portion of the saddle and confirmed this with visual examination of the pressure readings in real time. The saddle angle was set at 0 degrees for all participants.

Measurement of Perineal Pressure and Oscillation

To ensure consistent measurements between cyclists, the trainer was set at 100 W for all cyclists, which was maintained regardless of cadence or gear. Pressure sensors were calibrated for each cyclist during a 2-minute warm-up period. Oscillation was measured in the vertical plane in *g* (the average acceleration due to gravity at surface Earth, 9.8 m/s^2). The acquisition rate for pressure sensors and oscillation was set to 100 Hz.

There were 4 conditions tested: (1) stationary (not pedaling) with the standard seatpost, (2) pedaling with standard seatpost, (3) stationary with seatpost suspension, and (4) pedaling with seatpost suspension. Each condition lasted 40 seconds. The 40-second condition trial was split into 5-second intervals.