Effect of graded bicycle seat pressure on perineal compression: a magnetic resonance imaging analysis

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ABSTRACT

Objective To identify a seat pressure threshold that corresponds to significant compression of the perineum.
Design Quasiexperimental crossover.
Setting Hospital radiology department.
Participants Convenience sample of six male recreational cyclists.
Intervention Compression of the corpus spongiosum and corpora cavernosa of the perineum without bicycle seat pressure (0%) and at 10%, 40% and 80% of the mean bicycling pressure was assessed using magnetic resonance imaging. Seat pressure was applied using a custom loading device.
Outcome Measure Measure Diameter measurements of the cavernous spaces at the point of peak compression.
Results The mean diameter values for the corpus spongiosum in the unloaded and 10% of load conditions were 105% and 172% greater than the 40% and 80% loaded conditions, respectively ($p=0.002$–0.004). The corpora cavernosa values displayed a similar trend.
Conclusions Substantial compression of the perineal cavernous spaces may occur with total seat pressure values of less than 40% of typical seat loads.

There is recent evidence to suggest that riding a bicycle in a seated position may cause substantial compression of neurovascular tissues within the cavernous spaces of the male perineum.[1 2] Some clinicians and researchers have argued that perineal compression is the implicit cause of many frequently occurring seat pathologies, which include discomfort, pressure sores, genital numbness and erectile dysfunction.[3] Interestingly, the loads or interface pressure that cause perineal compression are not constant during the crank cycle; they fluctuate in response to weight shifts during the crank cycle and may also change with different seat designs and postures.[4 5] It is possible these strategies will relieve perineal compression; however, the magnitude of pressure reduction to elicit this effect is unknown.

Researchers interested in reducing bicycle seat pathologies have examined how factors such as seat design and posture influence various markers of perineal compression.[1 2 6–9] For example, Bressel *et al*[1] assessed perineal compression by measuring the perineal cavernous space diameter from magnetic resonance imaging (MRI) under a no load and loaded condition that corresponded to the mean seat pressure while seated and pedalling on a bicycle. They observed perineal cavernous space diameters to be 148–252% greater in the unloaded than the loaded condition. Jeong *et al*[6] examined the effect of different seat designs on penile blood flow using a laser Doppler flowmeter. Their results were compared with a standing condition and observed a 76–119% decrease in blood flow in all seated conditions. Other researchers have reported similar findings[8] but in all instances just sitting on the saddle appreciably compressed the perineal tissues. Curiously, the amount of seat pressure change required substantially to relieve the perineum is unknown. Seat manufacturers, clinicians or cyclists may use a pressure threshold as a target value for minimising compression and the risk of seat discomfort or injury.

Accordingly, the purpose of this research was to identify a bicycle seat pressure threshold that corresponded to significant compression of the perineum. Because the perineal cavernous spaces that contain the deep penile arteries can reliably be viewed and measured using MRI[10] we chose to use this direct approach.

METHODS

A convenience sample of six male recreational cyclists from a university population was asked to participate. All participants signed an informed consent form approved by the institution's ethics committee. Participants had the following physical characteristics (mean, SD): body mass 85.2 (10.9) kg; body height 1.82 (0.06) m; and age 24.8 (1.83) years.

Participants attended two test sessions. During the first test session participants were asked to pedal a Monark ergometer affixed with a standard seat (Selle Italia Flite, Vicenza, Italy) set at 0° to the horizontal. The 2-minute exercise bout required each participant to pedal with their hands on the top handlebar position at an external work rate of 118 W (80 rpm). Interface pressures were collected using a commercially developed pressure mat designed for bicycle seats (FSA system; Vista Medical Ltd, Winnipeg, Canada). The procedures, specifications, calibration and reliability of the system have been described previously.[4]

During the second test session, participants were assessed for cavernous tissue compression using MRI collected without bicycle seat pressure (0%) and at 10%, 40% and 80% of the pressure recorded during session 1. The percentages were based on previous work[1] and the pressure means associated with these percentages are reported in the supplementary file (available online only). Percentage seat pressure values were randomly assigned and were applied in the MRI using a custom loading device described previously. The devise allowed for reliable replication of pressure patterns observed during seated cycling.[1]

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For each loading condition, images were acquired using a 1.5 Tesla MRI scanner (Gyroscan NT; Philips Medical Systems, The Netherlands) and a flexible surface coil (SENSE body coil). Imaging parameters for each scan are reported in previous work.[1]

The dependent variables included the mean of two measurements for the corpus spongiosum and corpora cavernosa spaces. Because the left and right corpora cavernosa spaces were not substantially different from each other, we computed the mean of these two spaces for inclusion in the statistical analysis. The dependent variables were compared between each condition (0%, 10%, 40% and 80% of mean seat pressure) using paired Student's t tests and a false recovery rate was used to control for inflation of the alpha set at 0.05.

RESULTS

The mean diameter values for the corpus spongiosum in the unloaded and 10% of maximum load conditions were 105% and 172% greater than the 40% and 80% loaded conditions, respectively (p=0.002–0.004; figure 1). Similarly, the corpora cavernosa values for the unloaded and 10% of maximum load conditions were 115% and 175% greater than the 40% and 80% loaded conditions, respectively (p=0.001–<0.001; figure 1). Diameter values were not different between the other conditions; that is, unloaded versus 10% of maximum load (p=0.11–0.12) and 40% versus 80% of maximum load (p=0.13–0.23) were not different.

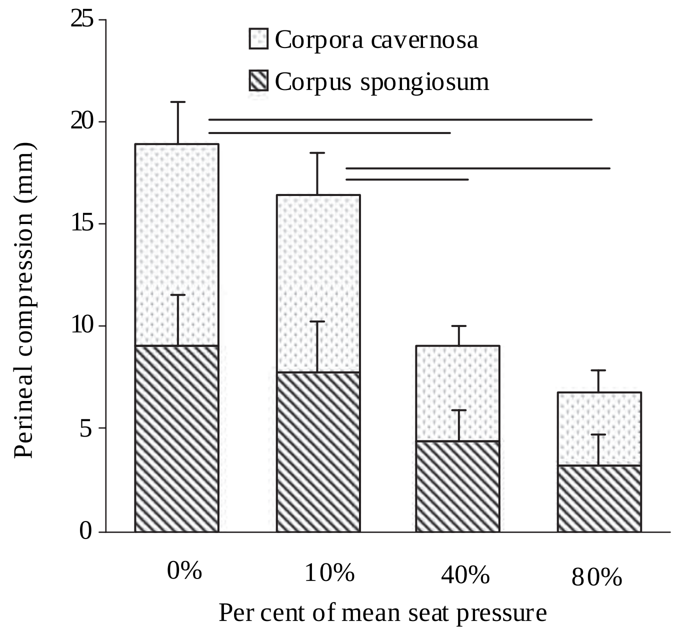

Figure 1 Mean compression values (mean, SD) for the corpus spongiosum and corpora cavernosa at 0%, 10%, 40% and 80% of mean seat pressure loads collected during stationary bicycling. Horizontal bars indicate that perineal compressions at 40% and 80% of seat loads were significantly different from the 0% and 10% load conditions.

DISCUSSION

Our compression values (eg, 2.5–9.0 mm) were consistent with previous work[1] and the seated pressure measurements used for baseline measurements support those previously reported.[7] The original finding of this study was that significant compression of the perineal cavernous spaces occurs with total seat pressure values of less than 40% of typical seat loads. In previous work we reported anterior seat pressure fluctuations of up to 12% during the crank cycle,[4] and studies examining how seat designs influence seat pressure have reported differences in total seat pressure of up to 24%.[7] From these previous reports it appears unlikely that total seat pressure differences, observed during pedalling and between seat designs, will elicit a meaningful reduction in perineal compression.

However, researchers have noted that pressure over the anterior seat region may be a better indicator of perineal compression,[1 2] and as some saddles with no protruding nose reduce anterior pressure by more than 40%,[7] these saddle designs may be helpful in reducing some seat injuries. Unpublished data from our laboratory have supported this contention but we also observed that these saddles compromise the handling characteristics of the bicycle.

The question remains: are seat pressure and perineal compression markers for potential seat injuries? As the relationship between seat pressure and injury is unclear, future longitudinal studies that examine the relationship are warranted.

CONCLUSION

It may be concluded that optimal seat loads for reducing perineal compression occur when seat loads are below 40% of typical seated pressure. Stated differently, seat manufacturers or clinicians interested in reducing internal perineal compression should strive for a 60% reduction in either total or anterior seat pressure.

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Competing interests None.

Ethics approval Ethics approval was obtained from Utah State University.

Patient consent Obtained.

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