BICYCLE RIDING, ARTERIAL COMPRESSION AND ERECTILE DYSFUNCTION

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INTRODUCTION

A National survey approximately estimates 57 million people rode a bicycle in 2002. Males were more likely to ride bicycle than were females¹. Another survey estimates US bicycles and accessories sales in 2010 to be 6 billion dollars. Several research studies implicated bicycle riding as risk factor for erectile dysfunction². One possible reason is ischemic injury due to compression of perennial arteries between the bony pelvis and the bicycle seat. Previous studies attempted to measure this damage employed several indirect methods including computational models³, pressure mats on a stationary bike⁴, measuring transcutaneous oxygen pressure in the penis⁵, MR imaging of the pelvic region⁶, doppler flowmetry. None of these studies measured forces exerted directly on the perennial arteries and correlated to each riders occlusion force. Most of these studies are done on a stationary bike set up inside the lab. The objective of our study is to build a device to measure the forces exerted on the perennial arteries and develop a method to correlate the forces with each riders occlusion force. Another goal is to conduct the rides on the road where actual bike riding takes place. Recent publications⁴ suggested that cutting off the nose from the saddles may help to prevent the damage to the arteries. Based on these findings several noseless seats came to market. We also wanted to test some of them in our study.

MATERIALS AND METHODS

In order to conduct our studies on road we decided to develop our own device which is portable and which does not alter the natural positioning or comfort of the rider. 1 lb Flexiforce® sensors were chosen to measure the forces on the artery because they are thin, flexible and virtually unnoticeable by the riders. Rabbit core module 4000 based device was developed which can record and store force from 8 different sensors. The device was powered by 4 AA batteries making it portable. The device was calibrated using Instron 8500 high rate system to convert the output from mV to force in newtons. A geometric template of sensor position was developed based on the anatomy of the perennial arteries so that sensors are placed on fixed locations along the artery. The four locations are marked as right proximal, right distal, left proximal and left distal according to their position on the artery. Using doppler ultrasound subject's perennial artery was identified. Then we slowly applied force on the artery using our force probe attached to our device until blood flow in the artery completely stops. The recorded force is the force required to completely close the artery and we call it as occlusion force. The procedure was repeated four times on each side so that we obtain the mean occlusion force for the right and left side. Four sensors were attached to the subject's skin over the perennial arteries as per the geometrical template using Tegaderm™. Subjects are asked to ride on a standard road course for 0.5 mile each seat. Six different test seats of varying shapes, sizes and padding are used. The seats were called by their commercial names and three of them had nose and three of them are noseless type. The subjects are asked to fill a short questionnaire about the comfort of the seats at the end. The recorded force values for each seat were downloaded and compared to the subject's mean occlusion force.

ANALYSIS

We identified the amount of time a rider spends above the occlusion force. This was done by adding up the points that had force value equal to or greater than the mean occlusion force. As time spent by the
riders on each test seat varies we decided to express this value as percentage of total ride time. For example, a rider takes 300 seconds to complete the 0.5 lap for a particular seat. 50% occlusion time for that seat denotes the rider spends 150 seconds on or above his mean occlusion force. This means his artery is completely closed for 150 seconds.

RESULTS
The study so far had 15 volunteers (mean age: 34±12 years, BMI: 24.20±2.8 metric units). The mean occlusion force required to occlude the artery for each subject varied from 7.7N to 12.12N. We observed slight difference in the right and left arterial mean occlusion force with maximum observed difference is within 1N. The average occlusion force for all the 15 subjects is 10.16±1.12N. Out of the 15 subjects 12 were significantly (more than 50%) occluding their artery during the road rides. Among them 4 subjects were only occluding in the seats with nose and were occluding less with noseless seats. The mean seat occlusion times are shown in the figure and ranged from 26% to 45%.

DISCUSSION
The mean occlusion force varied among subjects. This variation is independent of age and BMI. It more depends on the anatomy of the perineum. As expected most of the subjects showed significant occlusion on the three seats with nose. This is because the nose of the bike seat directly compresses the artery. To our surprise we observed significant occlusion times when subjects used the three noseless seats. So contrary to the popular belief the noseless seats still puts force on the arteries closing them. So they are still capable of causing erectile dysfunction. One possible reason why these noseless seats still occludes is because of the small sitting area. The subjects tend to push back further on those seats making them to sit right on their arteries instead of their pelvic bones. These noseless seats are rated poorly by the subjects for their comfort. Another interesting trend we observed is one seat which is good for a person is worse for another person in terms of occlusion time. In other words there is no single seat which we tested so far proved effective in minimizing the impact on the arteries.

REFERENCES
(1) National Survey of pedestrian and bicyclist attitudes and behaviors.