BICYCLE SADDLE WITH A NEW GEOMETRICAL CONCEPT TO MAINTAIN GENITO-PERINEAL VASCULAR PERFUSION

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ABSTRACT

Objectives: Identification of a bicycle saddle model suitable for bikers that ride on long distances, able to limit to a minimum the compression on the structures of the pelvic floor, thus protecting penis perfusion and avoiding possible consequences on erections.

Materials and methods: Comparison between a saddle with a new geometrical concept (SMP) and one of the models most frequently used by professional bikers.

Evaluation of the degree of compression exerted by the two saddles, on the vascular structures of the perineum, by measuring the partial pressure of transcutaneous penile oxygen in 29 volunteer bikers in good physical shape.

Observation of the transcutaneous pressure of O_2 carried out at 3 and 10 minutes in static sitting conditions. Following determination of the $PtcO_2$ values for 15 minutes while pedaling with the subject at 60° and in stable hemodynamic conditions.

Results: The data was analyzed statistically (T-student test, examination of the confidence interval). Demonstration of the net superiority of the SMP saddle in preventing a vascular compression of the perineal structures with statistically significant results.

Conclusions: validation of the efficiency of the SMP saddle in limiting the compression of the pelvic floor even if its size, mainly in width, is compatible with the needs of bikers that cover long distances.

INTRODUCTION

The professional sports world frequently avails itself of the contribution of medical science to supply athletes with ever more efficiently working tools.

The final objective is to obtain improved performances and at the same time, to limit to the minimum the possible harmful effects on the athlete's physiological anatomy.

In bikers that cover long distances, we observed an increase of erectile dysfunctions of the penis (1-2-3-4).

There are two theories from an etiopathogenic point of view. Certain authors attribute a fundamental role to the compression of the pudendal nerve (5-6). According to others, an important role is carried out by the hypoperfusion of penile blood (4-7), which may cause a fibrosis of the corpus cavernosum (8-9-10).

All these theories converge, nevertheless, in identifying the perineal region as a critical point in which a compression of these structures takes place.

Research was therefore oriented towards the realization of a bicycle saddle model that would be able to prevent an excessive perineal compression. An important contribution was granted by Schwarzer et al. in 2002 (11).

These authors have proved that to protect penis blood perfusion the important factor is not so much the extent of the saddle padding as its width.
A wide saddle furnishes enough support to the pelvic bones and limits the compression of the perineal tissues. Furthermore, the absence of the saddle beak prevents
clipping the perineal blood vessels around the pubic arch.
A saddle with these characteristics, however, is not suitable to professional bikers, which are the target of our attention.
The aim of our work has been to identify a product that had the characteristics to preserve penis blood perfusion and at the same time had a geometrical design compatible with the biker's requirements.
The SMP saddle seems to possess many of these requirements, because it has a seat that is uniformly distributed over the gluteal muscles, the ischial tuberosity and the ischium and it keeps the perineal plane free. Furthermore, the saddle beak made, which has an eagle beak shape, leaves the outside genitalia free from compression. These advantages have been obtained by maintaining the dimensions, which are appreciated by the athletes. As a matter of fact, this model, presents a rear width of 140 mm, which narrows in front to 45 mm, while the structure slants with a 60° inclination. At the center the width is 75 mm and the geometry of the saddle follows the shape of the thigh muscles. This precaution avoids the friction of the gracile and adductor muscles that could cause annoying problems to the lower limbs while pedaling. It is in fact typical of professional bikers to pedal with their knees turned medially towards the bike frame with the purpose of increasing the strength and the sports performance.
The effectiveness of this new ergometric concept has been demonstrated by comparing the SMP saddle to one of the models most frequently used by professional bikers, similar to the so-called narrow type, already tested by Schwarzer in his work (11).
In order to verify our hypothesis we have chosen to evaluate the changes of the penis arterial blood perfusion, secondary to the compression on the perineal structures exercised respectively by the two bike saddle models, through the measurement of the partial transcutaneous penile oxygen pressure ($PtcO_2$) (7).
The characteristics of non invasiveness and the proven effectiveness in the sphere of this research field (4-7-11) made us choose this measurement technique.
In this respect it has been proved that the $PtcO_2$ reflects the changes in the blood flow (12/13), whose values are correlated to the values of arterial PO_2 (PaO_2) (14) and that there is a strict relation between the levels of (PO_2) obtained by the blood contained in the corpus cavernosum and those recorded transcutaneously at penis level (11).

MATERIALS AND METHODS

35 healthy volunteer bikers were included in the study, 29 of which have been deemed as appraisable.
All of them signed an informed consent and have obtained a score greater than 21 in the IIEF modified questionnaire. The average age, weight and height were respectively: 25.14 years of age (range 18-35); 68.58kos (range 58.8-80); 177.2 cm (range 162-188).
All the participants were continuously monitored for their heart rate and oxygen saturation, while arterial blood pressure was taken every 3 minutes (Diana MP400N).
To measure partial transcutaneous penile oxygen pressure, we have utilized a device belonging to the TCM4 series (Radiometer Copenhagen), which utilizes a Clark type electrode. This includes a platinum micro cathode and a silver anode submerged in an electrolytic solution insulated by a film that is permeable to oxygen. After going through

this film, oxygen reduces at cathode level producing ions and freeing electrons that generate a recordable electric current. The electrode was applied by means of an adhesive ring to the penis of all bikers, interposing a special electrolytic solution between the film and the penis.
As a general rule, we have to remember that the $PtcO_2$ depends on the oxygen content at cutaneous capillary level and on oxygen diffusion through the epidermis. The oxygen content in the cutaneous capillaries directly depends on the local circulatory condition. To obtain the PaO_2 starting from the $PtcO_2$, it is necessary that the cutaneous capillary oxygen content is independent from the local blood flow.
Local temperature increase is an essential factor that increases cutaneous blood flow. The maximum flow is expected at a value of 45°C. In order to avoid risks of burns, the temperature of the analyzer is usually enabled to reach 43-44°C; therefore we have set our device at 44°C.
The experiment was carried out inside a room with an adequate exchange of fresh air.
Each athlete was requested to use his own bike in order to respect personal anatomical characteristics; furthermore everyone wore unpadded shorts in order to put in evidence the direct compressive effect of the saddle.
The subjects were randomly divided in two groups (A and B). Group A was studied utilizing the SMP saddle first, whilst group B started with the comparison saddle. Afterwards, the test was repeated by exchanging the saddles that were mounted on the static bikes one by one, respecting the height measurements typical of the subject.
Each biker was evaluated individually.
After the calibration of the device and the application of the electrode on the penis, we started the continuous measurement of the $PtcO_2$ with the subject in static upright position for a 20 minute period, necessary for stabilizing the values.
The data visualization was updated every two seconds.
The biker was then requested to sit on the saddle mounted on the static bike, in a 60° position without pedaling.
After 3 minutes the $PtcO_2$ was recorded, relevant to the acute impact with the saddle.
We went on afterwards with the continuous measurement for a 10 minute period with the subject sitting at 60° without pedaling.
Finally the athlete started to pedal pushing a 53:19 constant gear until he stabilized the hemodynamic conditions compatible with his personal training parameters. Always maintaining the 60° position, the $PtcO_2$ was evaluated for another 15 minutes.
For each single test, the total recording time of the $PtcO_2$ values were 45 minutes, stabilization period included.

RESULTS

The study was carried out comparing the averages of the $PtcO_2$ transcutaneous penile values, obtained with the two saddle models under examination at 3, 10 and 25 minutes from the initial stabilization of the values.
The statistical processing was carried out by means of a T-Student test and examining the confidence interval associated to the tested measurements.
From the analysis of the data obtained with the 3 series of measurements, there was a statistically significant difference between the two saddle models with a net advantage in favour of the SMP saddle.

In particular, after 3 minutes, the average values of $PtcO_2$ for the SMP saddle (49,38276 mm Hg) were approximately double compared to the values of the comparison saddle

(25,3448 mm Hg). The T-Student test with P-value calculated at 0.0008951 (less than P>0.05) and the T value obtained (-3.5096) outside the confidence interval (IC = -38.24690:-10.44966), statistically confirmed the superiority of the SMP saddle.
Even after 10 minutes the SMP saddle proved to be the best with a distribution of the data on a higher average level and with a symmetrical trend (comparison saddle = 32.61379 mm Hg; SMP saddle = 50.63448 mm Hg) (difference = 35%).
The statistical confirmation was given by the P-value = 0.006747 and by the T value = -2.8136 (IC = -30.851306; -5.190073).
The checks carried out at 25 minutes, only confirmed the previous results once again displaying an average value of 52.17103 mm Hg for the SMP saddle and 28.5048 mm Hg for the comparison saddle. P-value) 0.0001545 and T = -4.0598 (IC = -35.34455; -11.98786).

DISCUSSION

The true innovation brought by the SMP saddle is that it hardly interferes with penis blood perfusion, yet maintaining small dimensions, especially in its width. A parameter that up to now has been considered as an essential factor for the protection of the compression on the perineal structures (11).
It is the geometry of this saddle that, redistributing the body weight on the gluteus, on the ischial tuberosities and on the ischium leaving the perineal plane free, avoids compressing the neurovascular structures that run medially to the ischial tuberosities. Furthermore, the depression in its rear part relieves the coccyx, which does not touch the saddle, avoiding rebounds caused by ground unevenness that could affect the rachis.
In our study, the SMP saddle clearly proved to be the most efficient in protecting penis blood perfusion, compared to one of the models most frequently used by professional bikers.
It is interesting to note, however, how the average values of $PtcO_2$ obtained with the SMP during the 15 minute pedaling time result being, as far as the comparison is possible, noticeably better than those obtained by Schwarzer (11), with a so called wide saddle (SMP = 52.17 mm Hg; wide saddle = 25.3 mm Hg), which had given the best results in that study, not considering the values obtained with a saddle that was studied specifically for women.

CONCLUSIONS

The compression on the perineal plane causes a significant decrease of the penis blood vessel perfusion, with possible consequences on erections.
The geometry of the saddle is the most important parameter to be considered in the intention of reducing the compression on the neurovascular structures of the pelvic floor.
The SMP saddle unquestionably represents a true innovation in this sense, proving its superiority in a statistically significant manner respect to the saddle that is usually most used by bikers that cover long distances every year.

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