

The effect of saddle nose width and cutout on saddle pressure distribution and perceived discomfort in women during ergometer cycling



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ABSTRACT

The objectives were 1) to design and produce two novel unpadded bicycle saddles with a wide/medium width and partial nose cutout; 2) to investigate the responses on pressure distribution and perceived discomfort in female cyclists. For comparison, a standard saddle was also tested. Nineteen female cyclists pedaled on an ergometer cycle for 20 min with each saddle in a counterbalanced order. A pressure mat measured saddle interface pressure. Discomfort ratings were collected using a visual analogue scale. Total mean saddle pressure remained similar across saddles. The wide saddle increased anterior and decreased posterior mean saddle pressure as compared with the standard ($p < .002$) and the medium saddle ($p < .001$). Significantly increased ischial tuberosity discomfort was found for the novel saddles ($p < .001$), while crotch discomfort was not significantly different between saddles. The medium width saddle appeared to be the best compromise since increased crotch discomfort was avoided and saddle pressures were redistributed. Such design may be suggested as an alternative to traditional saddles for women reporting discomfort in the perineal region.

1. Introduction

Cycling is a popular recreational activity with a number of associated health benefits including reduced all-cause mortality, risk of cardiovascular diseases and cancer (Hallal et al., 2012). For competitive cycling, cyclists adopt a more sportive position and spend more time on the saddle. This can lead to discomfort and injuries in the perineal region (Hermans et al., 2016). Frequently reported saddle-related complaints and injuries among women (Table 1) include urinary complaints, sexual dysfunction, vulvar hypertrophy, pain, tenderness and numbness in the perineal region (Hermans et al., 2016; Trofaier et al., 2016). Perineal pain, tenderness, numbness and sexual dysfunction are believed to be caused by compression of the pudendal neurovascular bundle (Dettori and Norvell, 2006; Partin et al., 2014; Trofaier et al., 2016). Particularly, pressure below the pubic symphysis (Gemery et al., 2007) has been suspected to cause compression of the pudendal nerves and arteries in females during cycling (Leibovitch and Mor, 2005). Urological dysfunction, skin lesions, vulvar hypertrophy, and genital and perineal discomfort are likely to be caused by increased pressure on the genitals from sitting on a saddle (Leibovitch and Mor, 2005). However, the existing knowledge regarding the cause of complaints and injuries is still limited (Trofaier et al., 2016).

Saddle manufacturers have presented various innovative saddle

designs as alternatives to the traditional standard saddle. The aims have been to decrease discomfort and the risk of non-traumatic saddle-related injuries by reducing pressure on the perineal area. Saddles with partial (fully removing middle section of the saddle nose) or complete (saddle without protruding nose) cutout design have been produced (Asplund et al., 2007). Several studies have compared innovative and standard saddle designs (Bressel and Larson, 2003; Chen and Liu, 2014; Keytel and Noakes, 2002; Bressel et al., 2009b). Complete nose removal obviously entails a reduced saddle area to compress the perineal area, thereby reducing the perineal pressure and reduced discomfort compared with other saddle designs (Bressel et al., 2009b; Chen and Liu, 2014). On the other hand, removing the saddle nose impairs the perceived riding stability (Bressel et al., 2009a; Chen and Liu, 2014). This is perhaps the reason why a complete cutout saddle is often unpopular among competitive cyclists (Schwarzer et al., 2002).

Cycling with saddles using a grooved or partial cutout saddle design (partially removing middle section of the saddle nose, leaving a hollow section or fully removing middle section of the saddle nose), has led to equivocal results. Studies have shown that with a partial cutout design it is possible to decrease numbness (Taylor et al., 2002) and increase comfort (Keytel and Noakes, 2002). Additionally, Gemery et al. (2007) found that a grooved saddle design similar to a partial cutout design entailed better preservation of the symphysis space and reduced

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Table 1
Articles reporting types and prevalence of non-traumatic saddle related discomfort and injuries in female cyclists.

Author(s)	N	Participants	Average training	Saddle related discomfort and injuries
Baeyens et al. (2002)	6	Competitive female cyclists	463 km/week	Unilateral chronic swelling of the labium majus, typical unilateral lymphoedema and regularly inflammatory skin prevalence.
Battaglia et al. (2009)	6	Horseback and mountain bike female riders	6.6 h/week	Clitoral micro-calcifications (83%) and perineal tenderness or discomfort.
Buller (2001)	52	Female cyclists	Not reported	Burning sensation or pain in the perineum (81%) and perineal numbness (70%).
Christiaans and Bremner (1998)	56	Cycling conference female attendants	Not reported	Discomfort when riding (74%) and saddle soreness (29%).
Guess et al. (2006)	48	Female cyclists	Minimum 16.1 km/week	Genital pain, tingling or numbness during the last month (60%).
Hermans et al. (2016)	114	Female recreational cyclists	Per season: < 1000 km: 6/114 (5.3%) 1000-3000 km: 63/114 (55.3%) 3000-5000 km: 23/114 (20.2%) > 5000 km: 22/114 (19.3%)	Vulvar discomfort (40%), numbness of external genitals (35%), numbness of perineum (6%) and perineal pain (4%).
Humphries (2002)	4	Female competitive cyclists	Not reported	Unilateral vulvar hypertrophy.
LaSalle et al. (1999)	333	Female cyclists	Not reported	Perineal numbness (34%).
Wilber et al. (1995)	224	Female recreational cyclists	103.2 km/week	Perineal pain, numbness, soreness, swelling of soft tissue, skin irritation and “pain in the butt”.

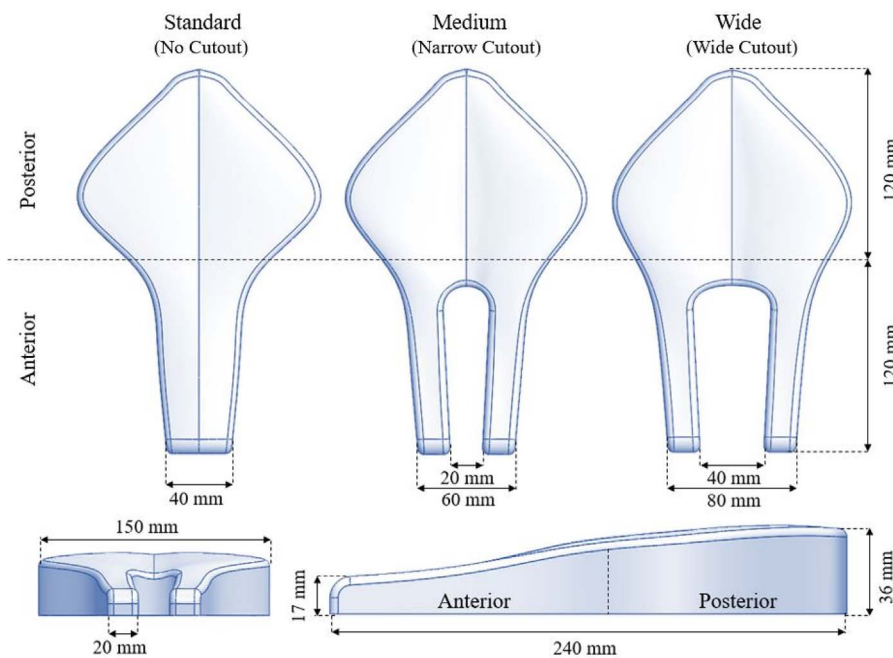


Fig. 1. Geometry top part specifications of the three saddle designs; a standard saddle without a partial cutout (standard), a saddle with a narrow partial cutout (medium), and a saddle with a wide partial cutout (wide). The top part of the saddles was made of obomodulan® 500 (OBO-Werke, Stadthagen, Germany) mounted on a custom aluminum alloy base.

compression of the pudendal arteries and nerves. Further, Sommer et al. (2010) argued that a wider partial cutout is more protective of perineal compression. In contrast, others have reported that partial cutout saddles increase pressure around the cutout, resulting in increased perineal pressure (Partin et al., 2012; Froböse et al., 2003). In a review by Partin et al. (2014), it was concluded that partial cutout saddles do not offer a protective effect of the female perineum. However, the partial cutout saddles might have been too narrow to show a protective effect. Thus, increasing the width of the saddle nose and cutout could decrease the pressure applied to the perineal area and thereby reduce discomfort and risk of injury (Sommer et al., 2010). The equivocal results found may be explained by geometric differences among the tested saddles. To our knowledge, no study has (i) designed and produced saddles of similar surface areas with different saddle nose and partial cutout width and; (ii) subsequently investigated the influence on pressure and discomfort

in female cyclists.

The purpose of the present study was to fill that gap. Therefore, we designed, produced and investigated the acute effects of two novel saddle nose cutout designs (medium and wide) on pressure distribution and perceived discomfort compared with a standard saddle design (standard). It was hypothesized that 1) changing the saddle nose design from a standard design to a cutout design would change pressure distribution and size of center of pressure (COP) variability in anterior-posterior direction, 2) a cutout saddle design would decrease crotch discomfort without changing the ischial tuberosity discomfort compared with a standard saddle.

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