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ORIGINAL ARTICLE

# Does body mass index influence the degree of pelvic tilt produced by a Crawford wedge?

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## ABSTRACT

**Background:** A pelvic tilt of 15° is standard practice when positioning a woman for caesarean section, and is commonly produced by tilting the operating table or placing a wedge under the right hip. This study investigated whether body mass index affects the degree of pelvic tilt produced when a wedge is used.

**Methods:** Women undergoing category 3 and 4 caesarean sections were stratified into three groups according to their body mass index at antenatal booking:  $\leq 25$  kg/m<sup>2</sup>, 25.1–35 kg/m<sup>2</sup> and  $>35$  kg/m<sup>2</sup>. Twenty women were recruited into each group. Lateral tilt at caesarean section was provided with a Crawford wedge under the right hip and the degree of pelvic tilt was measured using a protractor device.

**Results:** The median [range] pelvic tilt angle for the groups in order of ascending body mass index were 15° [12–22°], 19° [11–29°] and 17° [2–28°]. There was a significant increase in the variability of pelvic tilt with increasing body mass index ( $P = 0.001$ ). The proportion of patients with pelvic tilt  $<15^\circ$  was observed to be 20%, 15% and 30% for women of body mass index  $\leq 25$  kg/m<sup>2</sup>, 25.1–35 kg/m<sup>2</sup> and  $>35$  kg/m<sup>2</sup>, respectively.

**Conclusion:** Variability in pelvic tilt increased with body mass index and was greatest with a booking body mass index  $>35$  kg/m<sup>2</sup>.  
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**Keywords:** Body mass index; Caesarean section; Crawford wedge; Pelvic tilt

## Introduction

To reduce aortocaval compression and its cardiovascular consequences for both mother and fetus, it is standard practice to position women supine with left lateral tilt after neuraxial anaesthesia has been established for caesarean section (CS). Several techniques may be used; local practice is to tilt the operating table laterally or place a wedge under the right hip. The Crawford wedge was developed with the aim of achieving consistent pelvic tilt as the upper surface of the triangular cushion is tilted at 15° to the horizontal.<sup>1</sup> The aim of this study was to assess the effect of body mass index (BMI) on the amount of pelvic tilt produced by a Crawford wedge used for CS.

## Methods

Approval for this observational study was gained from the local research ethics committee. Healthy women booked for category 3 or 4 CS<sup>2</sup> under neuraxial anaesthesia were verbally consented for the study during their

final routine preoperative anaesthetic visit. The only change from standard clinical care was the measurement of pelvic tilt once positioned for surgery. It was explained that if the tilt produced by the wedge was  $<15^\circ$ , the table would be tilted to ensure 15° tilt until delivery of the baby. Women whose initial antenatal booking appointment was later than 12 weeks of gestation were excluded.

We stratified women into three groups according to their BMI when booking for antenatal care. These were BMI  $\leq 25$  kg/m<sup>2</sup> (normal weight), BMI 25.1–35 kg/m<sup>2</sup> (overweight and class I obesity) and BMI  $>35$  kg/m<sup>2</sup> (class II obesity and morbidly obese).<sup>3</sup> In order to ensure even recruitment during the study, we did not recruit anyone into a group if it already contained two more subjects than the group with the smallest number of women.

After establishing central neuraxial anaesthesia, the patient was positioned supine with a Crawford wedge (dimensions 56 cm × 38 cm × 9 cm) under the right hip before surgery. The hips were positioned midway along the wedge, and the edge of the wedge was aligned with the edge of the operating table. To ensure uniformity of technique in patient positioning throughout the study, this was performed by only two investigators.

The amount of pelvic tilt, measured in degrees, was measured using a protractor bolted to two wooden legs secured with a wing nut from which a plumb line was

Accepted November 2012

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**Fig. 1** The protractor device used to measure pelvic tilt.

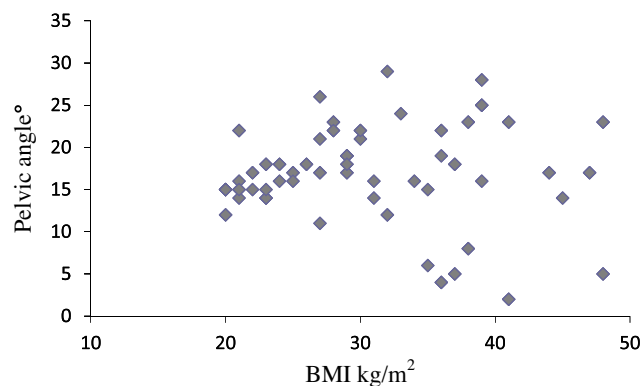
suspended, the legs being adjustable for distance apart.<sup>4</sup> The base of each arm of the protractor was initially placed on the patient's anterior superior iliac spines to fix the width. The device was then calibrated by placing the fixed arms on a horizontal surface and adjusting the protractor so that the plumb line passed over the 0° mark, before reapplying it to the anterior superior iliac spines to allow the angle of tilt to be read on the protractor (Fig. 1).

### Statistical analysis

No comparable investigation was found in the published literature and so a formal power calculation was not performed. We empirically decided to study 20 women in each group. Data were analysed post hoc using Levene's test for homogeneity of variance with Graphpad Prism (GraphPad software, La Jolla, CA, USA).

### Results

The median [range] pelvic tilt angle in the three groups was 15° [12–22°] in BMI  $\leq 25$  kg/m<sup>2</sup>, 19° [11–29°] in BMI 25.1–35 kg/m<sup>2</sup> and 17° [2–28°] in BMI  $> 35$  kg/m<sup>2</sup>. The regression equation relating these was, angle = 17.0–0.0046 BMI, indicating a clinically insignificant reduction in angle with increasing BMI. A scatter



**Fig. 2** Relationship of pelvic angle to body mass index.

graph suggested that there was increasing variability of pelvic tilt with higher BMI values (Fig. 2). A post hoc analysis was therefore applied using Levene's test for homogeneity of variance. This supported the observation of increased variability with greater BMI at  $P = 0.001$ . The proportion of patients with pelvic tilt  $< 15^\circ$  were observed to be 20%, 15% and 30% for BMI groups  $\leq 25$  kg/m<sup>2</sup>, 25.1–35 kg/m<sup>2</sup> and  $> 35$  kg/m<sup>2</sup> respectively.

### Discussion

The prevalence of obesity in pregnancy is increasing.<sup>5</sup> Obesity increases the risk of both maternal and fetal complications,<sup>6,7</sup> and has a major impact on anaesthesia.<sup>8–10</sup> During late pregnancy, inferior vena cava compression may lead to the supine hypotensive syndrome but there are no data to suggest that obesity influences a woman's susceptibility to this syndrome.<sup>11</sup> However, the amount of lateral tilt at CS is an important factor in the development of hypotension after spinal anaesthesia.<sup>12</sup> In an abstract, Johnstone and Brown suggested that there is no correlation between booking BMI and the amount of tilt tolerated by women,<sup>13</sup> and we therefore aim to achieve the same degree of pelvic tilt in obese women as in women with normal BMI.

Our results show that the most predictable and reproducible pelvic tilt with the Crawford wedge occurs in women of normal weight at booking, although even in this group a 15° pelvic tilt was not achieved in 20% of women. The range of pelvic tilt measured in our BMI  $> 35$  kg/m<sup>2</sup> group [2–28°] shows that the use of a wedge in this group is highly unpredictable and in nearly a third of cases the recommended 15° pelvic tilt was not achieved. We do not know the cause of this but speculate that it may be due to the variability in the pattern of distribution of adipose tissue. No patients complained of feeling uncomfortable or unstable, despite pelvic tilt of up to 29°. In contrast, Johnstone and Brown reported that the mean tilt comfortably tolerated by women was only 13.3° when the whole table was tilted.<sup>13</sup>

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