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Analysis of Vaginal Pressure and Abdominal EMG According to Delivery Method during Pelvic Floor Muscle Contraction

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Abstract. [Purpose] The purpose of this study was to compare the effect of birth history and delivery method on vaginal pressure and abdominal muscle activity during pelvic floor muscle contraction (PFMC). [Subjects] Thirty healthy female volunteers (26~39 years of age) were selected for the research. Their delivery histories were: nulliparous 10, vaginal delivery 10 and cesarean delivery 10. None of the participants had a history of incontinence. [Methods] Abdominal muscle activities and vaginal pressure were recorded in the crook-lying position. During pelvic floor muscle contraction. [Results] Pelvic floor muscle contractions induces significantly different vaginal pressures between subjects with nulliparous and vaginal delivery histories ($p<0.05$), but no significant difference in vaginal pressure was induced between the vaginal delivery group and cesarean delivery group. [Conclusion] Pelvic floor muscle contraction induced no significant differences in electromyography in each group
Key words: Pelvic floor muscle contraction, Vaginal pressure, Delivery method

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INTRODUCTION

The pelvic floor muscles have two functions, control of the urinary bladder and stabilization of the lumbo-pelvic region through the formation of pelvic floor and abdominal cavity[1)]. They also support the abdominal organs[2)], and have a sexual function[3)]. Furthermore, recent studies have found that the pelvic floor muscle perform subsidiary roles in posture control and ventilation[4)], and contribute to spinal stability[5)].

Pelvic floor muscle dysfunction means that the mutually complementary actions of the pelvic floor muscles in anatomical and physiological functions are lost. The most important cause of pelvic floor dysfunction is the weakening and dysfunction of the pelvic floor muscles. Kisner and Colby (1996)[6)] listed pregnancy and delivery, continuous overstressing to empty the intestines due to constipation, chronic cough, overweight, hormone changes in menopause, and systemic weakening of physical strength as causes of weakening of the pelvic floor muscles. Furthermore, an injured pudendal nerve, which appears in 42% of females after vaginal delivery, indicates that the small nerves of the perineum suffer serious damages due to the stretching of vaginal and pelvic floor muscles during vaginal delivery. It was reported that muscle injury which is not found in nulliparous women was found in the pelvic girdle MRI (magnetic resonance imaging) of primiparous women. Particularly in adult women, excessive elongation of the pelvic structure due to pregnancy and delivery weakens the contractile power of the pelvic floor muscles, not only affecting their sexual function but also causing urinary incontinence[7)]. As the abdominal muscle is stretched and weakened due to delivery, muscle strengthening exercise around the abdominal region is necessary[8)]. Sapsford et al.[9)] found that during the maximum contraction of pelvic floor muscles, all the abdominal muscles including the transverse abdominis, internal oblique, external oblique, and rectus abdominis were activated. When the pelvic floor muscles were lightly contracted, the transverse abdominis was most activated regardless of lumbar position. Neumann and Gill[10)] claimed that co-contraction of pelvic floor muscles and abdominal muscles showed good effects. Miller[11)] showed there is a correlation between pelvic floor muscles and abdominal muscles by demonstrating that changing abdominal pressure by breathing and moving the pelvic floor muscle were effective for treatment of urinary incontinence. The major health problems of pregnant women include suffering from back and pelvic girdle pain, dysfunction in daily life due to posture instability and imbalance, sleep disorder, long periods of immobilization, loss of enthusiasm, and anxiety[12)].

Recently, some researchers have investigated the effects of various exercises to try to overcome the problems of

pelvic floor muscle exercises, including perception training for pelvic floor muscles[13], training in various breathing states[14], and simultaneous contraction of the abdominal muscles[15].

The present study investigated the effects of delivery and delivery methods on normal women in their 20s and 30s through the comparison of vaginal pressure and abdominal muscle activities.

SUBJECTS AND METHODS

The subjects of this study were 30 female adults in their 20s and 30s. They had an average age of 32.4 ± 3.8 years, an average body weight of 54.1±5.0 kg, and an average height of 160.5 ± 4.2 cm. The vaginal and cesarean delivery groups had an average birth number of 1.5 ± 0.5 times. There were 10 subjects in each of the nulliparous, the vaginal delivery, and the cesarean delivery groups. Those who had more than two deliveries, had genital diseases currently or in the past, had a delivery within the last 12 months, had pelvic pain or back pain, could not perform the exercise due to lack of understanding, or had neurologic injuries were excluded from this study. The general characteristics of all the subjects such as obesity, height, age, weight, delivery method, and the number of deliveries were investigated before starting the experiment.

To measure vaginal pressure, the vaginal contraction pressure during contraction of pelvic floor muscles was measured using a Digital Perineometer (Peritron 9300 , Cardio design pty Ltd. Australia).

In the crook-lying position, the perineometer probe was inserted into the vagina and the pelvic floor muscle contracted. Before starting measurement, the subjects practiced the correct contraction method. As repeated measurements can tire the muscles after contraction, they were measured after resting for at least 3 seconds. To minimize the effect of errors on measurements, one skilled researcher measured each subject three times and calculated the average value.

For EMG measurements of muscle activity, Student Lab's MP-36 (Biopac System Inc, USA) was used. To reduce skin resistance, the skin was wiped with an alcohol swab before attaching electrodes at a distance of 1.5 cm apart. The EMG electrodes were positioned 3 cm outward and 5 cm downward from the xiphoid process for the rectus abdominus, at 2 cm downward from the 8th rib on the virtual line between the pubic tubercle and the 8th rib for the external oblique muscle, and 2 cm medially from the anterior superior iliac spine for the inferior phrenic part of the internal oblique muscle. For the analysis of muscle activity, we used %MVIC, which is the muscle activity relative to the value of maximal voluntary isometric contraction.

For pelvic floor muscle contraction, the subjects were asked to contract the muscle as if tightening and pulling up the muscles around their vagina. During this contraction, they were instructed not to make pelvic or lumbar motions. However, the subjects were not instructed to use or avoid using their abdominal muscles.

The study results were analyzed using SPSS version 12.0. To compare the vaginal pressure and abdominal muscle activities among the three groups, the data were analyzed with one-way ANOVA and multiple comparisons. The significance level was chosen as α=0.05.

Table 1. Vaginal pressures of the groups during pelvic floor muscle contraction

Group	Max vaginal pressure
Nulliparous	40.8cmH_2O*
Vaginal delivery	26.9cmH_2O
Cesarean delivery	39.0cmH_2O

*Significant difference ($p<0.05$). Unit : cmH_2O.

Table 2. Comparison of abdominal muscle activities by group during pelvic floor muscle contraction

Muscle	Nulliparous	Vaginal delivery	Cesarean delivery
RA	30.6 ± 7.2	32.4 ± 9.8	16.0 ± 4.2
EO	38.9 ± 5.9	49.8 ± 10.7	38.6 ± 9.6
IO	48.7 ± 11.9	32.8 ± 4.6	45.4 ± 10.8

*Significant difference ($p<0.05$). Unit: % MVIC. RA: rectus abdominis, EO: external abdominal oblique, IO: internal abdominal oblique.

RESULTS

During rest, there were no significant differences in muscle activities among the groups. As shown in Table 3, the muscle activities of the rectus abdominis and external oblique did not differ between rest and pelvic floor muscle contraction (PFMC); however, the internal oblique muscle showed a significant difference in nulliparous and vaginal delivery groups ($p<0.05$). Vaginal pressure during pelvic floor muscle contraction was 40.8 cmH_2O in the nulliparous group 26.9 cmH_2O in the vaginal delivery group and 39.0 cmH_2O in the cesarean delivery group (Table 1). The values for the vaginal delivery group and the nulliparous group were significantly different ($p<0.05$).

DISCUSSION

This study was conducted to investigate the effects of delivery experience and method on vaginal pressure and abdominal muscle activities during pelvic floor muscle contraction in females in their 20s and 30s.

In a study that measured and compared vaginal pressures in pelvic floor muscle exercise[15], pelvic floor muscle exercise was effective at functionally improving the pelvic floor muscles as it increased vaginal pressure after the exercise. Dysfunction of pelvic floor muscles is generally associated with dysuria and lumbo-pelvic pain[16]. Vaginal delivery is a major factor in the prediction of urinary incontinence regardless of age, because females who have had at least one vaginal delivery experience 2.5 times higher incidence rates of urinary incontinence than women who have not experienced vaginal delivery[17].

Sapsford et al.[9] reported contraction of all abdominal

Tables 3. Comparison of abdominal muscle activities between rest and pelvic floor muscle contraction

	Muscle	Rest	PFMC
Nulliparous	RA	24.6 ± 5.7	30.6 ± 7.2
	EO	26.6 ± 4.0	38.9 ± 5.9
	IO	21.2 ± 5.3	48.7 ± 11.9*
Vaginal Delivery	RA	20.7 ± 7.7	32.4 ± 9.8
	EO	32.7 ± 9.0	49.8 ± 10.7
	IO	14.3 ± 3.8	32.8 ± 4.6*
Cesarean Delivery	RA	13.4 ± 1.5	16.0 ± 4.6
	EO	31.9 ± 9.6	38.6 ± 9.6
	IO	28.8 ± 8.4	45.4 ± 10.8

*Significant difference ($p<0.05$). Unit: % MVIC. PFMC: pelvic floor muscle contraction, RA: rectus abdominis, EO: external abdominal oblique, IO: internal abdominal oblique.

muscles during pelvic floor muscle contraction and the contraction was particularly conspicuous in the transversus abdominis muscle and internal and external oblique muscles. In this study, too, the muscle activity of all abdominal muscles increased during the pelvic floor muscle contraction. Particularly for the nonpraous group, the muscle activity increased from 21.2%MVIC during rest to 48.7%MVIC during pelvic floor muscle contraction. The vaginal delivery group also showed a significant increase from 14.3%MVIC during rest to 32.8%MVIC during pelvic floor muscle contraction. In this study, vaginal pressures during the pelvic floor muscle contraction, were 40.8 cmH_2O in the nulliparous group, 26.9 cmH_2O in the vaginal delivery group and 39.0 cmH_2O in the cesarean delivery group. During pelvic floor muscle contraction, the vaginal delivery group showed lower muscle activities than the other groups, which seems to indicate a problem with the delivery method. The vaginal delivery method can weaken the contraction force of the pelvic floor muscles and can cause disabilities. Therefore, we recommend active pelvic floor muscle contraction exercises for women after vaginal delivery.

To address the limitations of this study, the effects of pelvic floor muscle contraction on abdominal muscle activities and vaginal pressures of patients with back pain, pelvic pain or urinary incontinence need to be studied.

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