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Pelvic Floor Muscle Exercise by Biofeedback and Electrical Stimulation to Reinforce the Pelvic Floor Muscle after Normal Delivery

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Purpose. This study was conducted to investigate the effectiveness of pelvic floor muscle exercise using biofeedback and electrical stimulation after normal delivery.

Methods. The subjects of this study were 49 (experimental group: 25, control group: 24) postpartum women who passed 6 weeks after normal delivery without complication of pregnancy, delivery and postpartum. The experimental group was applied to the pelvic muscle enforcement program by biofeedback and electrical stimulation for 30 minutes per session, twice a week for 6 weeks, after then self-exercise of pelvic floor muscle was done 50-60 repetition per session, 3 times a day for 6 weeks. Maximum pressure of pelvic floor muscle contraction (MPPFMC), average pressure of pelvic floor muscle contraction (APPFMC), duration time of pelvic floor muscle contraction (DTPFMC) and the subjective lower urinary symptoms were measured by digital perineometer and Bristol Female Urinary Symptom Questionnaire and compared between two groups prior to trial, at the end of treatment and 6 weeks after treatment.

Results. The results of this study indicated that MPPFMC, APPFMC, DTPFMC were significantly increased and subjective lower urinary symptoms were significantly decreased after treatment in the experimental group than in the control group.

Conclusions. This study suggested that the pelvic floor muscle exercise using biofeedback and electrical stimulation might be a safer and more effective program for reinforcing pelvic floor muscle after normal delivery.

Key Words : Pelvic Floor, Exercise, Biofeedback, Electric Stimulation

INTRODUCTION

Stress incontinence in women is commonly occurred two or three times in the women as that in the men. It is occurred when pelvic floor muscles are relaxed or damaged from over stretching caused by pregnancy and delivery other than the obvious anatomical differences of urogenital systems between genders (Wilson & Herbison, 1998). Wilson, Herbison, & Herbison (1996) reported that thirty four percent of adult females had weakness of pelvic floor muscles causing urinary incontinence. Urinary incontinence have to be considered a significant health problem if it is prolonged or its symptom is severe. Moreover it influence negatively to the level of self-esteem and quality of life of the women (Palmer, 1994; Song 1999; Wagner, Patrick, Bavendam, & Martin, 1996). But early prevention and treatment of urinary incontinence were postponed because most women perceive the symptoms as "normal" results following pregnancy and childbirth. Furthermore, they sometimes tend to hide their symptoms out of embar-

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rassment due to lack of its understanding.

In 1948, Arnold Kegel originated the pelvic floor muscle exercise to control urinary incontinence by increasing function and strength of the pelvic floor muscles through contractions. Many studies have proved the effectiveness of Kegel exercise for the treatment of incontinence in middle-aged women (Bump, Hurt, & Fantl, 1991; Hong, 1997; Stein, Discippio, Davia, & Taub, 1995; Wilson et al., 1996). The pelvic floor muscle exercise is widely used to prevent and treat incontinence in middle-aged women due to its advantages such as non-invasive method and fewer side effects. However, pelvic floor muscles are hidden and not used frequently thus it is easy to target other muscle groups within the vicinity (Bump et al., 1991; Lee 1997). Recently, in response to solve this problem and to increase its effectiveness, exercise with biofeedback (Berghmans, Fredericks, Bie, Weil, & Smeets, 1996; Glavind, Walter, & Nohr, 1998) and electrical stimulation (Gorton & Stanton 1998; Stein et al., 1995) have been introduced to contract targeted muscles repeatedly while monitoring the muscles during exercise. Therefore, training is essential to demonstrate proper exercise techniques by targeting pelvic floor muscles specifically and minimize or avoid side effects all together.

There have been many studies conducted internationally on pelvis floor exercise but mainly focused on the treatment of incontinence in middle-aged women and only a few have been on the early prevention of incontinence following childbirth. In this study, postpartum women who passed six weeks after normal delivery were selected to determine if pelvic floor muscle exercise using biofeedback and electrical stimulation is effective in strengthening pelvic floor muscle thus preventing urinary incontinence. The purpose of this study was to provide the nursing intervention for the early management and prevention of urinary incontinence caused by the looseness and injuries of the pelvic floor muscle after normal vaginal delivery.

METHODS

This study was a quasi-experimental design pre and post-test with a non-equivalent control group on postpartum women 6 weeks after childbirth to investigate the effectiveness of pelvic floor muscle exercise using biofeedback and electrical stimulation.

Subjects

The subjects were selected from postpartum women who passed 6 weeks after normal delivery at a S Hospital located in Seoul, Korea. Criteria to participate in this study was that they had no complication of pregnancy, delivery and postpartum, delivered a baby after full 37 weeks gestation, showed no urinary incontinence prior to delivery, and consented to take part in the study.

Initially, 239 postpartum women participated in this study. The subjects who wanted to participate in the pelvic floor muscle enforcement program were assigned to the experimental group (n=89) and those who didn't want to participate in the program but still wanted to check their pressure of pelvic floor muscle contraction regularly were assigned to the control group (n=150). But a number of subjects were excluded in case of having personal reasons, unfaithful participation in the two groups and insufficient performed self-exercise of the pelvic floor muscle in the experimental group and performed self-exercise of pelvic floor muscle in the control group. Only 49 postpartum women (25 in the experimental group, 24 in the control group) qualify to continue the study until completion.

Prior to treatment, there were no significant difference found in the validation of homogeneity in general and obstetrical characteristics, maximum pressure of pelvic floor muscle contraction (MPPFMC), average pressure of pelvic floor muscle contraction (APPFMC), duration time of pelvic floor muscle contraction (DTPFMC) and subjective lower urinary symptoms between the two groups (Table 1).

Description of intervention

The experimental group received pelvic floor muscle enforcement program by biofeedback and electrical stimulation and self-exercise of pelvic floor muscle by registered nurses under the coaching of an Urologist. The control group was advised to start the exercise program after the study had been completed.

The pelvic floor muscle enforcement program by biofeedback and electrical stimulation was a method by adding electrical stimulation in addition to biofeedback (Compact Elite, France), a simple pelvic floor muscle contraction program, in which biofeedback and electrical stimulation were alternatively used. Electrical stimulation was given to the subjects' vagina 3-4 cm deep in the supine position, a standard two-ring probe was inserted into vagina at the position of pubococcygeal muscle and-

was connected is to the biofeedback, and electromyogram pads were attached to the abdomen to observe whether abdominal muscles were reacted. Electrical stimulation used in the study was biphasic rectangular current at a frequency of 35-50 Hz, with which muscles can be contracted without causing muscle fatigue. The current was increased from 35 mA to a degree that patients can stand but below 100 mA. Biofeedback was applied after being induced the pelvic floor muscle contraction 3 or 4 times by electrical stimulation. When the graphs appeared on the monitor, pelvic floor muscle exercise was repeatedly performed in conformity with the figures.

Procedures and measures

The study was approved by the Medical Research Ethics Committee of the University Hospital. And verbal consents were obtained from those who agreed to participate in this study.

The experimental group received the pelvic floor muscle enforcement program by biofeedback and electrical stimulation 30 minutes per session, twice a week for 6 weeks for a total of 12 clinical visits. Self-exercise of pelvic floor muscle was done as follows: the subjects were encouraged to tighten pelvic floor muscles with full strength, and then hold and relax for five counts respectively. Three short cycles of strong contraction and relaxation were performed 50-60 repetition, 3 times per day for 6 weeks after treatment. They were checked if they were doing the pelvic floor muscle exercise properly and encouraged once a week by phone follow up. This experimental procedure based on the facts that the pelvic floor muscle exercise by biofeedback and electrical simulation is effective to apply for 15-30 minutes per session, 2-3 times a week for 3-6weeks at least (Berghmans, 1996) and self exercise of pelvic floor muscle is needed persistently to maintain and promote the effectiveness of treatment (Kim, Seo, & Lee, 1998). Also Miller, Kasper, and Sampselle (1990) reported that pelvic floor muscle exercise is required for 12 weeks at least to expect it's positive effectiveness.

MPPFMC, APPFMC, DTPFMC and subjective lower urinary symptoms were measured prior to trial, at the end of treatment and 6 weeks after treatment. A digital perineometer was used to measure the pressure of pelvic floor muscle on the supine position. After practicing to tighten anus with full strength two times, the pressure was measured 3 times and the average of them was used.

Subjective lower urinary symptoms were measured us-

Table 1. Homogeneity Test for General and Obstetric Characteristics between the Experimental and Control Group

Characteristics		Exp. (n=25)	Cont. (n=24)	t	p
		Mean±SD	Mean±SD		
Age(yr.)		29.83± 2.08	30.08± 2.98	0.34	0.74
Gestational age(wks.)		39.56± 0.58	39.13± 1.22	-1.54	0.13
Body weight change(kg.)		15.13± 4.15	15.04± 5.30	-0.06	0.95
Duration of labor(hr.)		06.00± 4.18	8.67±10.74	1.00	0.33
Infant's birth weight(kg.)		03.37± 0.42	3.32± 0.34	-0.45	0.65
Infant's head cumference(cm.)		34.22± 1.31	33.92± 1.40	-0.78	0.44
Urination time (after delivery)(hr.)		03.70± 1.02	3.50± 0.71	-0.69	0.49
Maximum pressure of PFMC(cmH_2O)		24.60±11.95	29.29±16.14	1.16	0.25
Average pressure of PFMC(cmH_2O)		17.88±10.72	21.92±14.56	1.11	0.27
Duration of PFMC(sec.)		9.88± 5.86	9.58± 4.03	-0.21	0.84
		N(%)	N(%)	Total N(%)	p
Parity	primi.	14 (56)	12 (50)	26 (53)	0.67
	multi.	11 (44)	12 (50)	23 (47)	
Job	Yes	7 (28)	3 (13)	10 (20)	0.29
	No	18 (72)	21 (87)	39 (80)	
Obstetrical operation history	Yes	2 (8)	3 (13)	5 (10)	0.67
	No	23 (92)	21 (87)	44 (90)	
Episiotomy site	Median	7 (77)	14 (74)	31 (76)	1.00
	RML	5 (23)	5 (26)	10 (24)	
Perineum laceration	Yes	1 (6)	1 (8)	2 (7)	0.66
	No	16 (94)	11 (92)	27 (93)	

Exp : experimental group, Cont : control group, PFMC : Pelvic Floor Muscle Contraction, RML : Right Medio Lateral

ing 20 questions related to lower urinary symptom in 34 Bristol Female Urinary Symptom Questionnaire that was developed originally by Jackson et al. (1996) and translated by Lee (1997). Each item consists of the five point Likert scale and higher score means seriousness of subjective lower urinary symptoms. Cronbach's alpha in this study was 0.76.

Data Analysis

Data were analyzed using SAS program; T-test and χ^2-test were used to determine homogeneity of general and obstetric characteristics between the experimental group and the control group. Wilcoxn rank sum test was used to compare changes before and after treatment, and repeated measures ANOVA was used to measure the MPPFMC, APPFMC, and DTPFMC.

RESULTS

MPPFMC in the experimental group increased significantly (F=17.32, p=.0001) prior to treatment, at the end of treatment and 6 weeks after treatment from 24.60±11.95 cmH_2O to 30.16±14.98 cmH_2O to 34.56±12.96 cmH_2O respectively. But that in the control group showed no significant difference (F=1.57, p=.22) prior to treatment, at the end of treatment and 6 weeks after treatment from 29.29±16.14 cmH_2O to 32.83±17.18 cmH_2O to 29.79±14.60 cmH_2O, respectively (Table 2) (Figure 1).

APPFMC in the experimental group showed a statistically significant increase (F=33.85. p=.0001) prior to treatment, at the end of treatment and 6 weeks after treatment from 17.88±10.72 cmH_2O to 22.36±10.56 cmH_2O to 27.04±11.05 cmH_2O respectively. But that in the control group showed no significant difference (F=0.97, p=.95) prior to treatment, at the end of treatment and 6 weeks after treatment from 21.92±14.56 cmH_2O to 22.21±12.30 cmH_2O to 22.33±12.55 cmH_2O, respectively (Table 2) (Figure 2).

DTPFMC in the experimental group increased significantly (F=4.44, p=.018) prior to treatment, at the end of treatment and 6 weeks after treatment from 9.88±5.86sec to 12.28±5.16sec to 12.48±3.32sec, respectively. But that in the control group showed no significant difference (F=0.53, p=.56), prior to treatment, at the end of treatment and 6 weeks after treatment from 9.58±4.03sec to 9.71±4.64sec to 8.79±2.78sec, respectively (Table 2) (Figure 3).

Enuresis (p=.022) and the amount of urinary incontinence (p=.038) of subjective lower urinary symptoms at the end of treatment, and urge incontinence (p=.041), the frequency of incontinence (p=.005) and the amount of incontinence (p=.003) of subjective lower urinary symptoms at 6 weeks after treatment were decreased

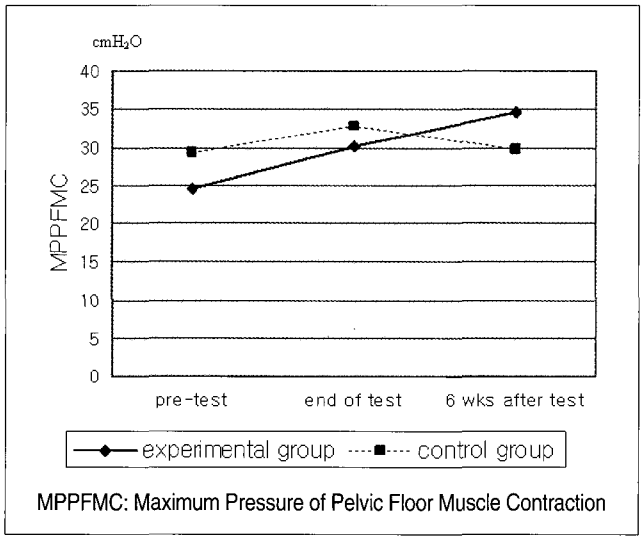

Figure 1. Effects of the treatment on the Maximum Pressure of Pelvic Floor Muscle Contraction

Table 2. Results of Repeated Measures ANOVA in MPPFMC, APPFMC, DPFMC between Experimental and Control Group

	Gr.(n)	Pretreatment	End of treatment	6 weeks after treatment	Comparision of three measurements	
		Mean±SD	Mean±SD	Mean±SD	F	p
MPPFMC	Exp. (25)	24.60±11.95	30.16±14.98	34.56±12.96	17.32	0.0001
	Cont.(24)	29.29±16.14	32.83±17.18	29.79±14.60	1.57	0.22
APPFMC	Exp. (25)	17.88±10.72	22.36±10.56	27.04±11.05	33.85	0.0001
	Cont.(24)	21.92±14.56	22.21±12.30	22.33±12.55	0.97	0.95
DPFMC	Exp. (25)	9.88± 5.86	12.28± 5.16	12.48± 3.32	4.44	0.018
	Cont.(24)	9.58± 4.03	9.71± 4.64	8.79± 2.78	0.53	0.56

Exp : experimental group, Cont : control group, MPPFMC : Maximum Pressure of Pelvic Floor Muscle Contraction
APPFMC : Average Pressure of Pelvic Floor Muscle Contraction, DPFMC : Duration of Pelvic Floor Muscle Contraction

significantly in the experimental group than those in the control group respectively (Table 3).

DISCUSSION

Stress incontinence is commonly observed in women over 40 years old. Former studies have indicated that stress incontinence is mostly associated with the number of childbirth. One study reported that 50% of women who have delivered their first baby had mild symptoms and 95% of multiple births women had severe symptom of urinary incontinence (Khan, Mieza, & Bhola, 1988). Similarly, Choi et al. (1995) reported the prevalence of incontinence was as high as 40% in pregnant women, of which 33% in primiparas and 54.7% in multiparas. They also reported that 3% of primiparas and 10.5% of multiparas were incontinent after one-year follow-ups.

Pelvic floor muscle exercise is widely recommended to postpartum women due to its effectiveness as well as non-intrusive manner and fewer side effects. However, incorrect method of exercise using abdominal or buttock muscles instead of pelvic floor muscle will increase discomfort and can worsen the symptoms of stress incontinence. Thus, the proper technique must be implemented to minimize side effects and optimize the effectiveness of restoring the pelvic floor muscles during postpartum (Cosner, Dougherty, & Bishop, 1991; Morkved & Bo, 1997).

There are lots of studies reporting problems related to pelvic floor muscle exercise instructions. Bo, Oseid, and Kwastein (1988) reported that a third of 60 incontinent patients could not contract the pelvic floor muscles. Moreover, Bump et al. (1991) also reported that 50% of subjects could not perform correct muscle contraction after receiving education of pelvic floor muscle exercise and 25% of them exercised in a way that aggravated incontinence. Currently pelvic floor muscle exercise using biofeedback and electrical stimulation has been intro-

Table 3. Comparison of Lower Urinary Symtoms between two groups on two occasions (pre-treatment to end of treatment vs pre-treatment to 6 weeks after treatment)

Symptom	Pre- treatment to end of treatment			Pre- treatment to 6 weeks after treatment		
	Exp.	Cont.	p	Exp.l	Cont.	p
	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Enuresis	-.24±0.52	.17± .64	.022	-.42±0.58	-.17± .48	.096
Urge incontinence	-.12±0.33	0.00±0.00	.087	-.17±0.38	0.00±0.00	.041
Frequency of incontinent	-.13±1.01	.04± .56	.532	-.58±1.08	.09± .60	.005
Amount of incontinent	-.32±0.85	0.00± .29	.038	-.48±0.96	.21± .59	.003

Exp : experimental group, Cont : control group

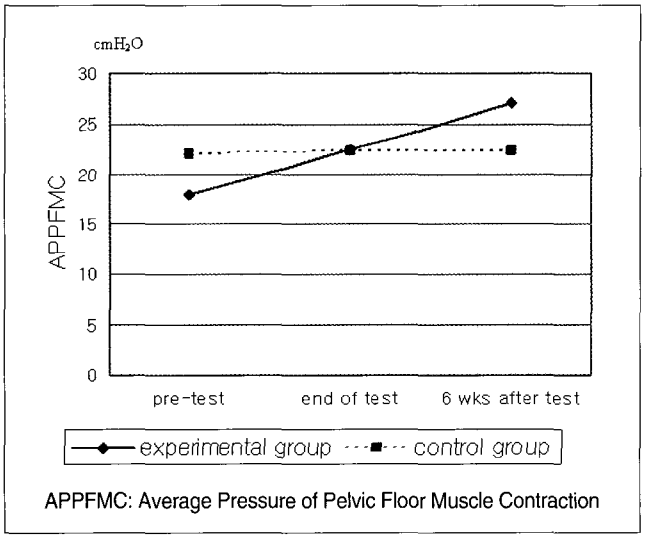

Figure 2. Effects of the treatment on the Average Pressure of Pelvic Floor Muscle Contraction

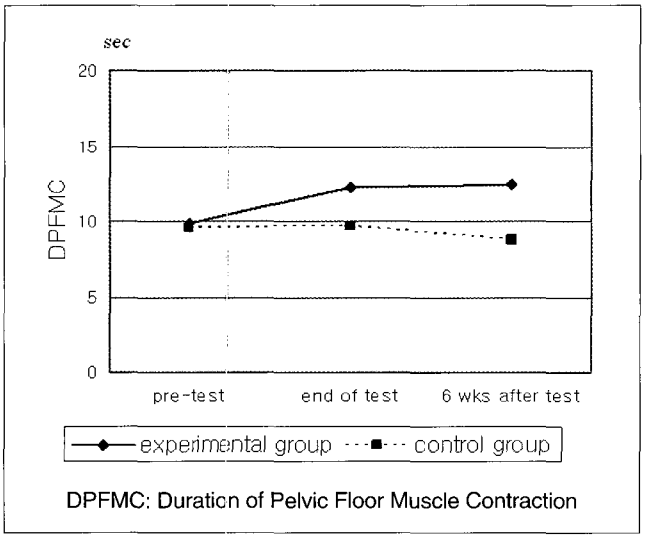

Figure 3. Effects of the treatment on the Duration of Pelvic Floor Muscle Contraction

duced to resolve those problems and to enhance the effectiveness.

In the study on practicing pelvic floor muscle exercise using biofeedback and electrical stimulation in urinary incontinent patients were showed the success rate of 40% by Stein et al. (1995), 64% by Susset, Galea, Manbeck, and Susset (1995), 75% by Kim, Seo, and Lee (1998) and 75.5% by Yun, Kim, and Lee (2000). The success rate was higher in subjects who well complied with the treatment process than any other subjects.

In this study, all the measurements of MPPFMC, APPFMC and DTPFMC were significantly increased at the end of treatment and 6 weeks after treatment compared with before treatment. The increase rate could not be compared because there were no studies of biofeedback and electrical stimulation on women who had normal delivery. However, the results were consistent with Kim et al. (1998) on biofeedback in subjects of primiparas with relaxed pelvic floor muscles and the studies of Park & Lee (2000) on urinary incontinence patients. These studies reported that pressure of vaginal and pelvic floor muscle contraction were increased after pelvic floor muscle exercise. Furthermore, the study of Kim et al. (1998) on urinary incontinence reported that the pressure of perineal muscle contraction was increased significantly after the application of pelvic floor muscle exercise using biofeedback and electrical stimulation.

The subjective lower urinary symptoms such as enuresis, the amount of urinary incontinence, urge incontinence and the frequency of incontinence in the experimental group were decreased significantly after treatment. These results were consistent with the study of Stein et al. (1995) reported that perineal muscles exercise reduced frequent urination and enuresis and the study of Choi, Sung, & Hong (1999) reported that the pelvic floor muscle exercise using biofeedback reduced the frequency and the amount of incontinence significantly. However, due to some restrictions, pelvic floor muscle exercise using biofeedback and electrical stimulation are difficult to implement. The devices are costly, complex, time consuming and inconvenient (Payne, 1996; Stein et al., 1995). In addition, many women are reluctant to seek medical advice because of embarrassment caused by vaginal insertion. There are several alternatives to overcome these problems. The various supplementary methods are available such as less expensive portable biofeedback device that people can readily use at home, including standardized educational videos and audiotapes, vaginal cones or rental devices provided by hospital. In combination with supplementary methods, pelvic floor muscle exercise using biofeedback and electrical stimulation after delivery is considered to be an effective nursing intervention to prevent complications of urinary incontinence or pelvic organ prolapse resulted from childbirth.

CONCLUSION

Stress incontinence is mostly associated with a large number of childbirth. Pelvic Floor muscle exercise is widely recommended to postpartum for preventing urinary incontinence. However, the incorrect method of exercise will increase discomfort and can worsen the symptoms of stress incontinence. Thus, proper technique must be implemented to minimize the side effects and to optimize the effectiveness of restoring the pelvic floor muscles during postpartum.

The pelvic floor muscle exercise using biofeedback and electrical stimulation in this study was improved to effective in increasing maximum pelvic floor muscle contraction pressure, average pressure of pelvic floor muscle contraction and duration time of pelvic floor muscle contraction and also in reducing enuresis, the frequency of urinary incontinence and the amount of urge incontinence after normal delivery. This result suggested that the pelvic floor muscle exercise using biofeedback and electrical stimulation might be a safer and more effective program for reinforcing pelvic floor muscle.

Thus, this intervention could be applicable to nursing practice as an effective measure for the prevention of urinary incontinence following childbirth and would be contribute significantly to women's health and wellbeing.

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