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Efficacy of Pelvic Floor Training with Surface Electromyography Feedback for Female Stress Urinary Incontinence

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Hypothesis/ Aim of Study

Pelvic floor muscle (PFM) training (PFMT) is an an ideal option for women with minimal to mild stress UI (SUI). Biofeedback provides positive reinforcement during PFMT and can be achieved via several methods including electromyography, manometry, or ultrasonography. The primary aim of this study was to compare the efficacy of an 8-week bio-assisted PFMT, using surface electromyographic program in different body positions (supine, sitting, and standing) in women with SUI. The secondary aim was to identify the factors influencing the efficacy of PFMT in these different body positions.

Study design, materials and methods

This is a prospective observational study performed from from January 2014 to May 2016, involving 110 women with a diagnosis of SUI for >3 months prior to the start of the program. The diagnosis of SUI was made based on a pad test >0 g or a Sandvik severity index ≥1. The total duration of the program was 8 weeks, with 4 individual sessions provided at baseline and, subsequently, at weeks 2, 4, and 8. Participants were asked to complete 3 sets of their PFM exercises at home on a daily basis, in the most comfortable position. Electromyography of each sustained contraction, including both the PFM and synergistic abdominal muscles (SAM), was measured during each session. Because the EMG amplitude is influenced by muscle tension in the resting posture, this resting value was subtracted from the signal during contraction, with the resulting EMG signal denoted as the increased sustained voluntary contraction (ISVC, mV).

Results

Ninety-one participants completed the 4 sessions of the PFMT over the 8-week duration of the program, with average age of 53 years and 85.5% had had a vaginal delivery. We identified a significant increase in the ISVC of the PFM in all 3 positions over time (Table 1). Comparing the efficacy of PFMT at different time points for each position, the greatest increases in the ISVC of the PFM, from baseline, was achieved in the sitting position, at 2 and 8 weeks (Table 1). Training duration and vaginal delivery were positively correlated to the ISVC of the PFM in all 3 positions (Table 2). A BMI ≥30 kg/m2 was negatively correlated to the ISVC of the PFM in both the supine and standing positions, but not in the sitting position (Table 2). Participants with severe SUI, according to the Sandvik severity index score, had a significantly lower ISVC of the PFM in the sitting position (Table 2).

TABLE Increased sustained voluntary contraction (ISVC) of the pelvic floor muscles (PFM) and synergistic abdominal muscles (SAM) in different positions at the 4 time points of measurement (baseline and at 2, 4, and 8 weeks of training)

Variable	ISVC Mean (SD) (W0)	(W2)	(W4)	(W8)	*P* Value	Post Hoc
Supine						
PFM	7.13 (9.63)	12.58 (15.69)	17.68 (18.56)	22.81 (21.54)	<.01	W0 < W2 < W4 < W8
SAM	0.96 (2.02)	1.53 (4.73)	1.17 (2.44)	1.78 (6.34)	.45	
Standing						
PFM	10.29 (13.82)	14.64 (18.25)	18.53 (20.03)	23.02 (22.56)	<.01	W0 < W2 < W4 < W8
SAM	1.91 (2.59)	2.53 (6.15)	2.02 (4.90)	2.45 (4.59)	.59	
Sitting						
PFM	5.82 (8.01)	8.09 (10.54)	12.82 (13.58)	16.14 (17.00)	<.01	W0 < W2 < W4 < W8

Variable	ISVC (mean ± SD) (Baseline)	(Week 2)	(Week 4)	(Week 8)	*P* value	Post hoc
SAM	2.21 (9.71)	1.81 (3.43)	2.54 (6.40)	3.34 (5.36)	.05	Week 2 < week 8
Change of ISVC (mean ± SD)						
PFM	Week 2-baseline		Week 4-baseline		Week 8-baseline	
Supine	5.12 (13.89)		9.91 (17.14)		15.13 (19.65)	
Standing	4.15 (13.84)		7.93 (16.19)		12.23 (19.75)	
Sitting	2.02 (7.92)		6.59 (12.14)		9.96 (16.04)	
P value	*P* < .05		*P* = .13		*P* < .05	
Post hoc	Sitting < supine				Sitting = standing < supine	

Interpretation of results

In this study, we found that 2 consecutive weeks of training was sufficient to produce a clinical improvement in female SUI, with greater training effects observed after 4 and 8 weeks of training. There was a significant improvement in the ISVC of the PFM in the supine, standing, and sitting positions across time, whereas the ISVC of the SAM remained relatively constant across time. These findings support the beneficial role of biofeedback in guiding individuals to learn to selectively contract their PFMs, rather than relying on the abdominal musculature, with this improvement in selective control of the PFM leading to a decrease in UI. Of the 3 positions we used in our study, performing PFM contractions is most difficult in the sitting position, which is why SAMs are usually recruited during PFM contractions in this position and explains why the ISVC of the SAMs increased at 2 and 8 weeks of training in the sitting position only. Previous studies have identified age, vaginal delivery, and BMI as risk factors for PFM thinning and weakening, which eventually leads to SUI (1, 2). We, however, identified age and BMI as significant negative factors of PFMT efficacy, while a history of vaginal delivery was positively correlated to training outcome. Further studies with larger sample sizes are needed to fully clarify this relationship.

TABLE Increased sustained voluntary contraction (ISVC) of the pelvic floor muscles (PFM) via general linear modelling analysis

Variable	Supine ISVC ß	SD	*P* Value	Standing ISVC ß	SD	*P* Value	Sitting ISVC ß	SD	*P* Value
Time									
Baseline (ref.)									
Week 2	5.45	1.73	<.01	4.35	2.12	.04	2.27	1.25	.07
Week 4	10.55	1.94	<.01	8.24	2.22	<.01	7.00	1.45	<.01
Week 8	15.67	2.16	<.01	12.74	2.39	<.01	10.32	1.77	<.01
Age (years)									
<45 (Ref.)									
45-65	−5.30	2.16	.02	−8.45	2.67	<.01	−3.24	1.68	.06
>65	−7.79	3.26	.02	−10.92	4.03	.01	−5.51	2.54	.03
Marital status									
Single (ref.)									
Married	1.54	3.39	.65	−0.78	4.19	.85	−2.43	2.64	.36
Education level									
High school or less (ref.)									
College or more	1.60	1.67	.34	5.52	2.06	.01	1.86	1.30	.15
Employment status									
No (ref.)									
Yes	1.51	1.50	.32	0.57	1.85	.76	−0.27	1.16	.81
Body mass index (kg/m^2)									
18.5-24.9 (Ref.)									
25-29.9	2.14	1.80	.24	1.06	2.22	.64	1.80	1.40	.20
≧30	−6.52	2.23	<.01	7.28	2.76	.01	−2.50	1.74	.15
Postmenopausal status									
No (ref.)									
Yes	1.32	1.90	.49	3.40	2.34	.15	0.50	1.48	.74
Vaginal delivery									
No (ref.)									
Yes	5.14	1.94	.01	9.26	2.39	<.01	3.98	1.51	.01
Sandvick index									
Mild (ref.)									

Concluding message

PFMT, with positive reinforcement using surface EMG of the PFMs and SAMs, is effective to improve female SUI, with notable clinical improvement noted after 2 weeks of training. Moreover, it was effectively performed in sitting, standing, and supine positions, with the greatest change in PFM muscle activation obtained in the supine position with training. However, it should be noted that training outcomes are affected by duration of training, age, BMI, and history of vaginal delivery.

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