Effect of Pelvic Postural Changes on Pelvic Floor Muscle Activity in Women with Urinary Stress Incontinence

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ABSTRACT

Objective: *this study was done to investigate the relationship between passive pelvic tilting and pelvic floor muscle (PFM) activity in female with stress urinary incontinence.* ***Methods:*** *30 women were selected randomly from department of gynecology from Said Galal University Hospital in Cairo, clinically diagnosed with stress urinary incontinence. PFM activity was measured by an intra vaginal probe with surface electromyographic electrodes. An adjustable angle platform was used to set the ankle in each of the positions to create the various pelvic tilt postures.* ***Results:*** *Patients with anterior pelvic tilting created by ankle dorsiflexion had greater resting PFM activity than with posterior pelvic tilting created by ankle plantar flexion (P < 0.01). Patients showed significant changes in mean maximal PFM activity when standing with the anterior pelvic tilting and normal or in posterior pelvic tilting.* ***Conclusions:*** *A standing posture with various pelvic tilting created by various ankle positions effectively facilitates PFM activity.*
Key words: *Passive pelvic tilting; Pelvic floor muscle activity; Stress urinary incontinence.*

INTRODUCTION

Urinary incontinence is defined by the International Continence Society as the complaint of any involuntary leakage of urine. it is more common in women than in men and affects approximately 30%-40% of older women[21]. The most common type of Urinary incontinence in women is stress urinary, defined as complaint of involuntary leakage of urine on effort or exertion, or on sneezing or coughing[22]. Urinary incontinence is more common in women, but few seek medical advice, because they consider their symptoms to be slight and not worth reporting[24,25]. Although urinary incontinence is considered to be a normal consequence of childbirth and ageing that can reduce the strength of the pelvic floor musculature, many other factors are important in the development of this condition. Sex, age, ethnicity, smoking, constipation, obesity, connective tissue weakness, genital prolapse, and gynecological surgery all have been studied as potential etiological factors which interfere with the normal transmission of changes in abdominal pressure to the proximal urethra, there by predisposing the individual to SUI[23]. Pelvic floor muscle (PFM) reeducation is an effective, low risk intervention that can significantly reduce incontinence in varied populations and should be considered prior to other interventions[27].

The effectiveness of pelvic floor muscle exercises (PFME) has been demonstrated[8], with follow up at 5 years[13] and 6 years[7]. However at 15 years the results are disappointing[3]. Systematic reviews of randomized controlled trials on the conservative treatment of stress urinary incontinence (SUI) support PFME as being effective in reducing the symptoms of SUI and also urge and mixed incontinence **(Smith-Hay and Dumaulin, 2005)**. This corresponds well with the findings that vaginal and urethral pressures correlate significantly with pelvic floor muscle contractions[26] and that PFME are useful in the management of SUI. The pelvic floor muscles (PFM) form the base of the abdominal cavity and as such contract not only to maintain continence, but to augment intra-abdominal pressure (IAP)[10]. Co-coordinated co-activation of the PFM is therefore necessary in order to balance the functional demands of continence and lumbo-pelvic stability. The PFM contribute to lumbo-pelvic stability by stiffening the sacro-iliac joints[20] and indirectly the lumbar spine through contributing to rises in intra-abdominal pressure (IAP)[10,20]. Creating hyper or hypolordosis distorts the pelvic floor muscles by changing the orientation of their attachments to the sacrum, coccyx, pubic symphysis and ligamentous structures. Hyperlordosis is though to cause a posterior rotation of the coccyx relative to pubic bones and produce stretch on the pelvic floor muscles, there by lengthening the muscle fibers. Hypolordosis is though to cause a anterior rotation of the coccyx and creates a shortening of the muscle fibers. Both of these distortions affect the ability of the pelvic floor muscles to generate maximum contractility[15].

Bo et al. (2001)[4] also used dynamic magnetic resonance imaging to evaluate coccyx movement during PFM contractions and noted that the coccyx was drawn in a ventral, cranial direction during contraction. However, the relationship between PFM activity and postural changes that affect by pelvic tilt has seldom been studied.

The aim of the study was to investigate the relationship between pelvic tilting changes and PFM activity.

MATERIAL AND METHODS

A total of 30 women with SUI were selected randomly from department of gynecology from Said Galal University Hospital in Cairo, on the basis of detailed history taking, clinical examination, pelvic floor muscle testing, bladder diary, and urodynamic assessment. Their age was ranged from 40 to 50 years old. All of them were multiparous women. Their body mass index was ranged from 25 to 30 kg/m^2. Their duration of symptoms ranged from 4 to 20 years. Patients who exhibited musculoskeletal problems such as knee joint osteoarthritis, ankle joint deformities, or lower back pain in the previous 6 months were excluded. Also patients who undergone major abdominal or pelvic surgery, were unable to perform the PFM contraction, were pregnant, diabetes mellitus with insulin treatment, or severe incontinence[12], were obese (body mass index not less than 30 kg/m^2), had undergone intrauterine device implantation, or had genital protrusion beyond the vaginal hymen. The design of this study was one-group pre- test post-test design. Informed consent form had been signed from each patient before participating in the study. The study was done from July 2012 to December 2012. The investigators measured changes in PFM activity with urodynamic device **(Merkur 2000)**, which measures the electronic signals of PFM activity using a sterile intra-vaginal probe with surface electrodes. This urodynamic device has been proved reliable, and data have been reported for various SUI studies using the device. Before each measurement, the therapist instructed the patients regarding how to perform PFM testing. To prevent study error, the same therapist held the vaginal probe in an exact position (with the metal plate of the intra-vaginal probe in total contact with the PFMs), instructing the patients how to fasten the probe properly by a special strap while contracting the PFMs. Three preliminary contractions were elicited to ensure the probe was drawn inwardly on exact placement. The test patient could see the EMG activity from the electrodes displayed on the screen.

The probe was confirmed to be stable during each PFM contraction. Each patient was then asked to stand on an adjustable angle platform at 15^o with the horizontal plane[5]. Each patient was asked to perform the PFM contractions while assuming a series of three positions during which EMG recordings of the PFM were made: horizontal standing with normal pelvic tilting (NPT), standing with anterior pelvic tilting (APT) created by the ankles dorsiflexed, and standing with posterior pelvic tilting (PPT) created by the ankles plantar flexed. For the dorsiflexed ankle position, the platform was set at 15° with the forefoot lifted to facilitate a pelvic inclination angle (APT). The patients were kept in an upright standing position during all tested postures, and no trunk-forward or posterior swing was permitted, except for the natural pelvic tilt resulting from ankle dorsiflexion. Patients were urged to maintain a fixed posture during every test procedure to maintain consistent measurements. For the plantar flexed ankle position, the platform was again tilted at the same 15° angle, this time with the heel lifted, creating another pelvic inclination angle (PPT). All procedures and precautions were the same as those used in the dorsiflexion test. To ensure that each patient relaxed her PFMs while standing, the therapist observed and confirmed that the probe did not move inwardly or turn toward the coccyx. When the correct procedures were carried out, the PFMs were contracted as hard as possible. Three maximal contractions with a 10-second rest between each contraction were made, and the resting and mean maximal contraction EMG activity values were recorded. After 5 minutes of rest in the standing position, the patient was asked to stand for 5 minutes with the ankles dorsiflexed on the platform for the purpose of postural habituation to eliminate any carryover effect. The PFM rest period and maximal contraction recordings were again conducted. After another 5 minute rest period, the PFM contractions were measured in the standing position with the patient's ankles plantar flexed. All patients were asked to again maintain an upright posture without a forward or backward tilt. Electrode recording data from three contraction sequences were identified as the mean maximal PFM contraction.

The collected data was statistically analyzed by using Wilcoxon signed-rank tests, paired two-tailed t- tests and descriptive statistics: mean, standard deviation. Statistical significance level of 0.05 would be used within this study.

RESULTS

The mean values and standard deviation of the PFM tension obtained from three different postures are shown in Table 1. PFM tension in the resting posture while standing with the ankles dorsiflexed to create APT showed a greater value (8.99 µv) than that with horizontal standing with NPT (8.91 µv) or while standing with the ankles plantar flexed which create PPT (7.17 µv). The mean maximal PFM activity in any posture was greater than that during the rest periods ($P < 0.001$) (Table 1 & Fig. 1).

Table (1): Mean values of PFM activity of resting and maximal contraction in various pelvic postures.

Position of the pelvis	Resting contraction(µv)	Maximal contraction(µv)	P value
NPT (Normal pelvic tilting)	8.91±3.84	19.67±6.55	< 0.001
APT (Anterior pelvic tilting)	8.99±3.19	20.92±5.81	< 0.001
PPT (Posterior pelvic tilting)	7.17±2.05	18.04±6.01	< 0.001

NPT (Normal pelvic tilting), APT (Anterior pelvic tilting), PPT (Posterior pelvic tilting)

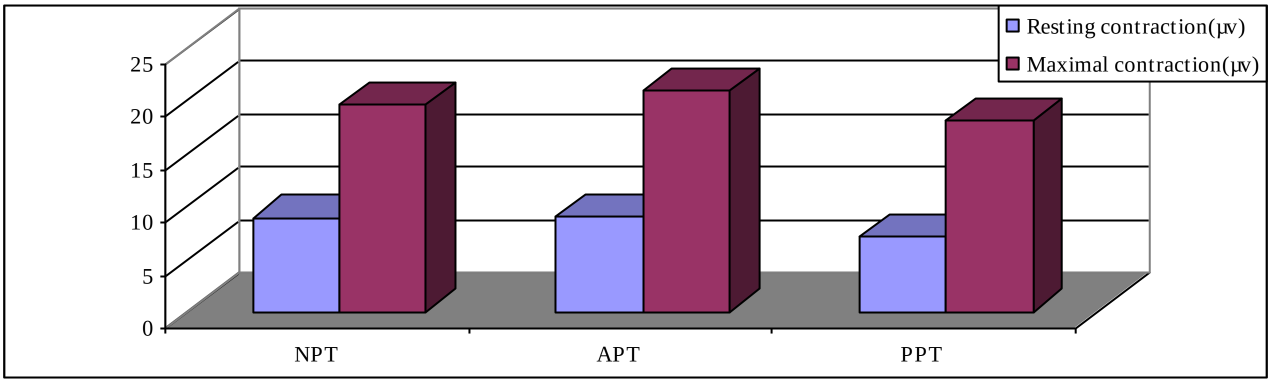

Fig. (1): PFM activity of resting and maximal contraction in various pelvic postures.

Table 2 shows the significant differences found in resting PFM activity during NPT compared with PPT ($P = 0.01$) and in the APT compared with PPT ($P < 0.01$). No significant PFM activity differences were noted between the NPT and APT ($P = 0.46$). Patients produced more mean maximal PFM activity while standing with the APT and while NPT than while standing with the PPT ($P < 0.001$ and $P = 0.006$, respectively). Also, a significant difference was noted in the mean maximal PFM contractions between APT and NPT ($P = 0.013$).

Table (2): P- values of difference in PFM activity among three postures of resting contraction and mean maximal contraction.

	Resting contraction	Mean Maximal contraction
APT-NPT	0.46	0.013
NPT-PPT	0.01	0.006
APT-PPT	< 0.01	< 0.001

NPT (Normal pelvic tilting), APT (Anterior pelvic tilting), PPT (Posterior pelvic tilting)

DISCUSSION

An earlier study of urethral pressure showed that maximal urethral closure pressure was greater in a standing than in a sitting posture[6]. However, Bo and Finckenhagen, (2003)[2] found no difference in PFM strength between the supine and standing positions. The relationship between different pelvic positions during standing and PFM activity in women with SUI has not been investigated[1]. The pelvic tilt range and direction can be easily and passively triggered using various ankle positions[4]. Therefore, this study sought to explore the role of various pelvic tilt angles and their effect on the PFM activity of women with SUI. The results of this study also showed that greater resting PFM activity occurred in horizontal standing which create normal pelvic tilting or when standing with (APT) created by ankle dorsiflexed than when standing with (PPT) created by the ankles plantar flexed.

Maximal pelvic contraction activity was greater than resting activity in any pelvic posture, but the values differed in the specific pelvic postures corresponding to the specific ankle positions.

When patients stand with the ankles plantar flexed, the pelvis tilts posteriorly, the promontory moves superiorly and posteriorly, and the tip of the coccyx moves anteriorly[11]. Therefore, the lateral attachments of the vaginal wall can also weaken when iliac bones move apart[14]. It seemed that a posterior pelvic tilt was easily produced with ankle plantar flexion, but decreased PFM activity was also noted in this posture. As a part of the human body's natural shock absorption mechanism during activities such as standing, walking, running, or jumping, the impact forces created from the feet can transmit to the pelvic floor, providing information to the PFM for tension adjustment[17] **(Nygaard et al., 1996)**. With the ankles dorsiflexed, the pelvis tilts anteriorly. This movement results in the pelvic outlet increasing and the ischial tuberosities moving apart[6]. Also, the coccyx moves in a backward and upward direction, resulting in the closure of the urethra, bladder neck, and suburethral vaginal wall, and urethral support is also elevated[19]. The pelvic anterior rotation provided increased PFM activity during ankle dorsiflexion. Some women with incontinence presented with effective results after self-treatment through postural changes to help decrease SUI[16].

This study found that pelvic tilt could change PFM activity and thus be used as an adjunctive technique for PFM training in women with SUI. Because PFM training is always the mainstay in managing SUI, so it is recommended as a first-line treatment[18] **(Nygaard et al., 1996)**.

A major limitation of our study was the small size of the group, recruiting subjects for this type of study was difficult because few seek medical advice and treatment. Other limitations were the psycho physiological, social and culture level of each woman.

Conclusion

It could be concluded that posterior pelvic tilt (PPT) is not a good position to increase PFM contraction compared to anterior pelvic tilt (APT) and normal pelvic tilt (NPT). PPT should be avoided for patients with SUI.

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الملخص العربي

أثر تغيرات وضع الحوض على نشاط عضلات قاع الحوض في سلس البول الإجهادي لدى السيدات

الهدف : تمت هذه الدراسة للتحقيق في العلاقة بين إمالة الحوض السلبية و نشاط عضلات قاع الحوض مع سلس البول الإجهادي في الإناث . وقد تم اختيار 30 امرأة بشكل عشوائي من قسم أمراض النساء بمستشفى سيد جلال الجامع ي في القاهرة ، شخصن اكلنيكيا بسلس البول الإجهادي . تم قياس نشاط عضلات قاع الحوض بواسطة قضيب مهبلي مع أقطاب رسم العضلات السطحية . تم استخدام منصة زاوية قابلة للتعديل لضبط أوضاع الكاحل وذلك لإنشاء أوضاع مختلفة لامالة الحوض . **النتائج :** المرضى الذين يعانون من إمالة الحوض الأمامية التي أنشأتها عطف ظهري الكاحل لديهم المزيد من نشاط عضلات قاع الحوض أثناء الراحة أكثر من إمالة الحوض الخلفي والت ي تم إنشاؤها بواسطة انثناء أخمصي الكاحل ($P < 0.01$) . وأظهرت النتائج تغييرات كبيرة في متوسط نشاط عضلات قاع الحوض القصوى عند الوقوف مع إمالة الحوض للأمام وللطبيعي أو إمالة الحوض للخلف . **الاستنتاجات :** وضعية الوقوف مع إمالة الحوض المختلفة التي أنشأتها أوضاع مختلفة للكاحل تؤثر بشكل فعال على نشاط عضلات قاع الحوض .

الكلمات الدالة : إمالة الحوض السلبية ، نشاط عضلات قاع الحوض ، سلس البول الإجهادي .