THE EFFECT OF LUMBOPELVIC POSTURE ON PELVIC FLOOR MUSCLE ACTIVATION AND INTRAVAGINAL PRESSURE GENERATION IN CONTINENT WOMEN

Angela C Capson, Joseph Nashed, Linda McLean
School of Rehabilitation Therapy, Queen's University
email: mcleanl@queensu.ca

INTRODUCTION

This study was undertaken to determine the effect of changing standing lumbopelvic posture on pelvic floor muscle (PFM) activity and resultant intravaginal pressure.

Recruitment of the PFMs is essential in stabilizing the urethra and enhancing urethral closure to maintain continence and in supporting the pelvic organs. It is also believed that the PFMs play an important role in spinal stabilization during postural perturbations and may enhance the stability of the sacroiliac (SI) joints by generating stiffness of the joint through force closure [1,2]. Because of their synergy with the abdominal muscles and their attachments to the lumbopelvic structures, dysfunction of the PFMs may increase the likelihood of lumbopelvic injury by impairing spinal and pelvic stability mechanisms during postural tasks that require spinal stiffness.

It has recently been suggested that lumbopelvic posture may influence the ability of the PFMs to contract effectively [3]. The PFMs have anatomical connections on the pelvis and coccyx, and PFM fibres cross the SI joints, making them susceptible to stretch or shortening during changes in lumbopelvic posture. Accordingly the length-tension relationship of the PFMs may be affected by postural adjustments. The aim of this study was to determine whether postural changes (1) induce differences in the contractile activity of the PFMs in response to postural or other perturbations, and (2) result in differences in vaginal closure force produced by the PFM contraction.

METHODS

Nulliparous, continent women between the ages of 22 and 40 years were recruited and provided written informed consent. Each participant performed two sets of five tasks (quiet standing, maximal effort cough, Valsalva maneuver, maximum voluntary contraction (MVC) of the PFMs, and a standardized load-catching task) in three different standing postures (normal lumbopelvic posture, hyperlordosis, and hypolordosis). During the first set, electromyographic activity was recorded from the PFMs bilaterally using a Periform™ vaginal probe coupled to Delsys™ D.E.2.1 electrodes and Bagnoli-8 EMG amplifiers. During the second set, intravaginal pressure was recorded using a Peritron™ perineometer. During both sets, pelvic angle was recorded simultaneously with EMG or intravaginal pressure using an Optotrak™ 3D motion analysis system to ensure that subjects maintained the required posture throughout the three trials of each task.

All data were filtered using a moving 200ms RMS window with 199ms overlap, and peak values were determined for each trial and each task after removing baseline activation levels. One-way repeated measures analyses of variance (ANOVAs) were performed on the peak PFM EMG and intravaginal pressure amplitudes to determine the effect of posture. One way ANOVAs were also performed on the lumbopelvic angles to ensure that the three postures were significantly different during all tasks.

RESULTS AND DISCUSSION

Sixteen women participated, with mean age 27.1 (5.48) years and mean body mass index 22.8 (1.57) kg/m^2. The women were generally active, the majority reporting 5-10 hours of physical activity performed per week. None of the women had signs or symptoms of incontinence.

There was significantly higher resting PFM activity in the hypolordosis as compared to the normal and hyperlordotic postures. During the MVC (Figure

1), coughing, Valsalva, and load-catching tasks, subjects generated significantly more PFM EMG activity when in their normal posture than when in hyper- or hypolordotic postures ($p<0.05$ in all cases). Conversely, higher peak intra-vaginal pressures were generated in the hypolordotic posture for all tasks ($p<0.05$ in all cases). The lumbopelvic angles were significantly different between the three postures for all tasks ($p < 0.001$).

It is postulated that the contractility of the pelvic floor is affected by postural changes due to alterations in the length-tension relationship of the PFM fibres. Creating a hyper- or hypolordosis distorts the PFMs by changing the orientation their attachments to the sacrum, coccyx, pubic symphysis and ligamentous structures. An anterior pelvic tilt (hyperlordosis) is thought to cause a posterior rotation of the coccyx relative to the pubic bones and produce stretch on the PFMs, thereby lengthening the muscle fibres. A posterior pelvic tilt (hypolordosis) causes an anterior rotation of the coccyx and creates a shortening of the muscle fibres. Both of these distortions decrease the ability of the PFMs to generate maximum contractility.

Despite maximal PFM EMG activation in the neutral posture, this posture is not the ideal position for intra-vaginal pressure generation. It is hypothesized that higher pressures are produced in a hypolordotic position due to the orientation of the pelvic floor musculature relative to the vagina. In hypolordosis, the PFMs are oriented approximately parallel to the vaginal canal. Although the PFMs are not contracting as strongly in this position, intra-vaginal pressure may be maximized due to optimal closure pressure created whereby the vagina (and urethra) are effectively pinched closed between the pelvic floor and the pubic symphysis. In a normal or hyperlordotic posture, the PFMs are oriented obliquely relative to the vagina, creating lower resultant closure forces.

These results have important implications for individuals with urinary incontinence, as postural interventions may decrease urine leakage during increases in intra-abdominal pressure by utilizing positions of maximal squeeze pressures (ie hypolordosis). Conversely, deviations from normal standing postures may adversely affect spinal stability. Maximal PFM contractility will generate the greatest force closure at the sacroiliac (SI) joints and provide the strongest base for the abdominal cavity, through which intra-abdominal pressure and the resultant spinal stability are produced. This supports the idea that function is maximized and the risk of injury is minimized when tasks are performed in a neutral spine position [4].

CONCLUSIONS

The results of this study suggest that the contractility of the PFMs is dependent on lumbopelvic posture and that postural intervention may be an important adjunct therapy in the treatment of stress urinary incontinence in women. Conversely, postural changes (both anterior and posterior pelvic tilt) may impede the ability of the PFMs to generate maximum intra-abdominal pressure for spinal stability and maximum closure force at the sacroiliac joints.

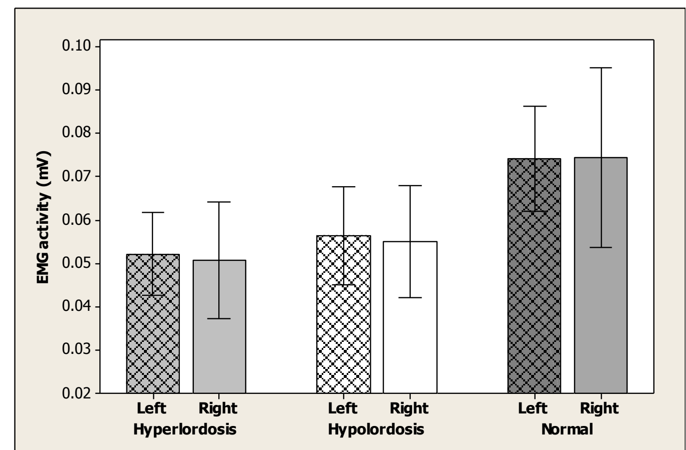

Figure 1: EMG activity of the PFMs during MVC.

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