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Pelvic Floor Muscle Activity in Relation to Body Position and Breath

Monika Sorfova and Eva Tlapakova

Abstract

The aim of this work was to analyse pelvic floor muscle activity by intravaginal perineometry. We focused on the increase caused by phasic muscular activity, which, on a short term basis, rises above the basal tonic activity. The functional relationships to postural and respiratory function have been confirmed by only a few studies. Therefore, we monitored this functional connection. We confirmed a statistically significant increase in pelvic floor muscle activity at deep breathing compared to calm breathing (in other words at different breathing intensity) in the same position (lying, standing). Our measurements also showed that the phasic activity of pelvic floor muscles in deep breathing is statistically significantly higher than activity after a minute-long run on the treadmill. Cough is a specific situation, whose short-term increase in pelvic floor muscle activity clearly exceeds all other monitored situations.

Keywords: pelvic floor muscle, breathing, perineometer, body position

1. Introduction

In 1948, Dr. Kegel [1] developed an intravaginal device, a perineometer, for assessing pelvic floor muscle strength. A pressure vaginal probe was connected to a manometer to measure the intravaginal pressure induced by the contraction of the pelvic floor muscles in mmHg. Since then, pressure probes of various shapes and technical properties have been developed [2, 3]. One type of instrument used under standard conditions with a well-guided protocol is very useful for both objectifying the diagnostics and assessing the effect of therapy [4].

The pelvic floor performs two types of activities - tonic and phasic [5, 6], as confirmed by the Deindl study [7]. According to Frawley [3], manometric measurement is one of the most widespread and the advantage is that it allows the measurement of muscle contraction both when lying and standing. This advantage is that incontinence occurs especially in upright positions and therefore examination in these positions will give us information with a higher informative value. It appears that the resting pressure measurement (tonic pressure) is not as reliable in standing (ICC 0.29) and sitting position as in lying (ICC 0.77). Measurement of the pressure of phasic compression of pelvic floor muscle shows good ICC confidence of 0.91 to 0.95 in all body positions [3].

Junginger et al. [8] controlled the decline of the uterine throat and the descent of pelvic organs while increasing intraabdominal pressure, which was prevented by joint activity of the pelvic floor muscles and the transversus abdominis muscles. Iacobellis et al. also conducted a detailed study of the risk of organ descent by MR [9]. Comparing the lying and sitting situation, the difference proved to be statistically significant. This suggests that examination in lying position can underestimate the existing descent of organs.

Bø et al. [10] also ask the question whether a usual manometric examination of the pelvic floor in a lying position is sufficient or whether it is more appropriate to perform examination in a standing position. For standing persons, it has been proved that the pressure increase during will-induced contraction and dwell time have not changed, only the minimum value (tonic contraction) when standing has increased.

The pelvic floor is given responsibility for the continence of urine, stool and the supporting function of the pelvic organs. The connection between the function of the pelvic floor and respiration is rarely considered. Therefore, we wanted to contribute to the knowledge of these connections. In addition, we were interested in the difference in the functional context in the position of the body in a standing and lying position. We performed the measurements even after a minute-long run, which triggered the spontaneous deep breathing process.

2. Methods

During the actual measurement, the person was placed on the examination bed in a position with the legs bent and with the feet propped up, and a condom-protected perionometer probe was inserted. Subsequently, a trained therapist gave verbal instructions and checked the performance. In order to ensure all the required conditions and to eventually register an individual proband response, a second specialist therapist was present during the testing, as recommended by Bø [10], to ensure standardisation of the examination. The individual test manoeuvres were based on a commonly performed PERFECT SCALE examination, which is primarily designed for palpation vaginal examination, but allows the same procedure to be performed via a pressure probe and thus objectifying the results [11].

Maximum contraction and endurance at this level were tested for 10 seconds with subsequent relaxation. In addition, the test subject was asked to repeat maximum contraction and release with a duration of five seconds per phase. Subsequently, a similar situation was tested, but with a shorter duration of individual phases - 1 s contraction and 1 s relaxation. Finally, the person was asked to cough, which was repeated three times. See **Figure 1**.

The second observed phenomenon was the effect of respiration, each examination lasted one minute. We compared the activity of pelvic floor muscles with calm and deep breathing without will-induced activation of pelvic floor muscles. During deep breathing, the proband was instructed to take several deeper inhalations (3 s) and exhalations (6 s). Inhale was done through the nose, exhale through the mouth using the “S” spoken throughout the exhalation. Then the proband switched to the KETTLER TRACK 3 treadmill with the probe installed and ran for a minute on this belt with a 0% slope, i.e. flat and at a speed of 5 km/h. Subsequently, we observed changes in pelvic floor muscle pressures during spontaneous breathing after a minute of running on a treadmill.

To this measurement project were involved 10 women. Their average age was 38 years (range 25–47 years), average height 166.8 cm (range 159–178 cm), average weight 66.9 kg (range 50–85 kg), average BMI 23.9 kg/m² (range 19.0–29.8 kg/m²). There were no births in 3 women, one birth was performed by one woman, two and

Figure 1.
 Subtraction of parameters from measured data - tonic basis of muscle activity (value B). Increase in pressure by A-value in phasic muscular activity (here at the therapist's instruction to repeat will-induced contraction of 5 s and 1 s of pelvic floor muscles and in coughing - three reps).

three births each by two women, and only one woman had 4 births. Only probands who excluded respiratory diseases, abdominal or gynaecological operations, except births, lumbar spine pain, were included in the measurement. No proband is an active athlete.

All statistical calculations were performed using the software OriginPro 8.5.1 (<http://www.originlab.com/Origin>). T-tests were used to test hypotheses to determine if there was a significant difference between the averages of the two groups of measurements under the given test conditions. Spearman's rank correlation coefficients were calculated to evaluate the associations between variables. The significant at an alpha level of 0.025 (at least) or it is specified in the Results chapter for the specific situations.

3. Results

The achieved increase in perionatal pressure (amplitude) was to be maintained for 10 seconds. This was ideally achieved by one person only. Six persons experienced a gradual decrease in the achieved maximum value by an average of 45% (values 31 to 78%).

As expected, a statistically significant difference can be demonstrated for the tonic activity of the pelvic floor muscles in the lying and standing positions, on average the standing values are 7.5 to 10 mm Hg higher (**Figure 2**). This result fully corresponds to the research of Bø et al. (Bø & Finckenhagen, 2003).

The results are not conclusive for the phasic activity, the amplitude increased statistically significantly only for cough (**Table 1**). The amplitudes of the 1 s and 5 s tests were comparable. Basal tonic pressure values - especially the critically low values observed in three individuals - do not condition the low values achieved in short-term amplitudes.

In the test of pelvic floor muscles reaction to cough, we investigate reflex functions in contrast to will-induced contractions in previous tests (5 s and 1 s). In this case, we clearly find higher amplitudes of contractions in cough, on average, the values are doubled, for one person, the cough pressure is up to 10 times the values of the person's deliberately induced amplitude. The t-test values are statistically significant when comparing cough with all will-induced activities at a significance level of 0.001. As expected, the difference in tonic muscle activity was not detected (**Figure 2**).

Comparison lying-standing body position				
Evaluated				
	Phasic activity		Tonic activity	
	t-test	Significance level	t-test	Significance level
Cough	2,271	0,025	3,995	0,002
Calm breathing	3,554	0,003	5,275	0
Deep breathing	3,636	0,003	4,531	0,001

Table 1.
The t-test values significancy - comparing cough with breathing activities fulfilling experimenter's instruction.

In an effort to understand more deeply the above-described morphological-functional interconnections and behaviour of the system during the will-induced and reflexive (or spontaneous) changes, we extended the tested functional situations. We were wondering what the functional response to deepened breathing would be, which we invoke not spontaneously but based on the instructions of the therapist. In addition, a short-term anaerobic load lasting several tens of seconds was chosen.

A statistically significant increase in pelvic floor muscle activity during deep breathing was demonstrated. Comparing this activity with consciously induced deep breathing while standing, with the spontaneous breathing caused by the previous running activity can be considered a very interesting result (**Figure 3**). Phasic activity of pelvic floor muscles in deep breathing is statistically significantly higher than that measured in deepened breath after physical exercise of the tested person for a minute of running on the treadmill.

The statistical comparison shows that the increase in the pelvic floor muscular phasic pressure due to cough differs significantly in all the situations tested, i.e. it differs in relation to the position (lying, standing) and to three types of breathing (quiet, deep, after running) (**Figure 4** and **Table 2**).

While in deep breathing we find large variations of values, in spontaneous breath after a minute-run, the values are scattered minimally, similarly to calm breath in both monitored positions, which we consider an interesting result.

If we monitor the variability of the observed values within the measured group, we can see that while in deep breathing we find large variations of the values of physical pressure increase, in spontaneous breath after a minute run, the values are scattered to a minimum extent, similarly to calm breath. Everything applies to both standing and lying position (**Figure 4**).

Figure 3.
Phasic muscle activity in deep breathing after running and fulfilling experimenter’s instruction.

Figure 4.
Values of arithmetic means and determinative deviations for observed situations.

Comparison calm and deep breathing		
Evaluated is phasic muscle activity		
	t-test	Significance level
Lying - calm vs. deep breathing	−2,443	0,019
Standing - calm vs. deep breathing	−3,636	0,003
Standing - calm vs. after running	−3,563	0,003
Standing – deep vs. after running	3,209	0,005

Table 2.
Comparison calm and deep breathing and situation after a minute run.

4. Discussion

The aim of our work was to assess how the degree of functional involvement of the pelvic floor changes based on breathing of the tested person, depending on the position of the body in an upright position or lying down.

Our results showed statistically significant differences in tonic activity of pelvic floor muscles in lying and standing position. At the same time, however, we found in the initial study that the will-induced - that is, the phasic muscular contractions of the pelvic floor muscles are not different when comparing measurements taken while standing or lying down (**Table 3**). In other words, the amplitude increase (the value of the short-term pressure increase referred to as phasic action) was approximately the same for both lying and standing position, only when lying down there was a lower level of tonic contraction than when standing (the value of sustained tonic activity).

Only in reflex muscle activity (i.e. cough simulation), differences were detected not only in tonic muscle activity, but also in phasic muscle activity. Thus, it can be argued that this spontaneous response of the system to a cough maintains a tendency to higher amplitudes. This happens both when lying and standing. To evaluate the associations between lying or standing activity, Spearman correlation coefficients were calculated for the same breath type (**Table 4**).

Our results show that the instruction to deepen breathing led to a different increase in the phasic muscular activity of these muscles. Phasic activity of pelvic floor muscles in deep breathing is statistically significantly higher than that measured in deepened breath after physical exercise of the tested person for a minute of running on the treadmill.

Comparison lying-standing body position		
Experimenter's instruction	Evaluated	
	Phasic activity	Tonic activity
Intentionally contracted	no	yes
Deep breathing	yes	yes
Cough	yes	yes

Table 3.
Comparison of the response of the phasic and tonic activity of the pelvic floor muscles to the experimenter's instruction ("yes" means an increase in standing activity confirmed by mathematical statistics).

Spearman's correlation - lying-standing body position				
	Evaluated			
	Phasic activity		Tonic activity	
	Correlation coefficient	Significance level	Correlation coefficient	Significance level
Cough	0,761	0,05	0,892	0,01
Calm breathing	0,233	no	0,902	0,01
Deep breathing	0,86	0,01	0,914	0,01

Table 4.
Test of the relationship between the increase of tonic and phasic activity of muscles by changing the position of the body.

The functional relationships of postural and respiratory function of the pelvic floor is known. But many clinical procedures rely on only one of these areas. It is more advantageous for the patient to undergo therapy linking the functional influence of the whole respiratory system and the pelvic floor system.

Not only in the direct treatment of pelvic floor dysfunctions, but also in the treatment of widespread low back pain. In routine clinical practice, the pelvic floor, in a patient with back pain, is not examined. If we remove all the pathologies found in the patient - muscle spasms, trigger points, joint blockages, muscle contractions, etc., without treatment of the pelvic floor, the patient will have temporary relief, but the pain will return.

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References

- [1] Kegel, A. H. The nonsurgical treatment of genital relaxation; use of the perineometer as an aid in restoring anatomic and functional structure. *Ann West Med Surg*, 1948; 2(5), s. 213-216. ISSN 0002-9378
- [2] Bø, K., Raastad, R., & Finckenhagen, H. B. Does the size of the vaginal probe affect measurement of pelvic floor muscle strength? *Acta obstetricia et gynecologica Scandinavica*, 2005; 84(2), s. 129-133. ISSN 1600-0412
- [3] Frawley, H. C., Galea, M. P., Phillips, B. A., Sherburn, M., & Bø, K. Reliability of pelvic floor muscle strength assessment using different test positions and tools. *Neurourology and urodynamics*, 2006; 25(3), s. 236-242. ISSN 1520-6777
- [4] Rahmani, N., & Mohseni-Bandpei, M. A. Application of perineometer in the assessment of pelvic floor muscle strength and endurance: a reliability study. *Journal of bodywork and movement therapies*, 2011; 15(2), s. 209-214. ISSN 1360-8592
- [5] Sapsford, R. Rehabilitation of pelvic floor muscles utilizing trunk stabilization. *Manual therapy*, 2004; 9(1), s. 3-12. ISSN 1356-689X
- [6] Peschers, U. M., Vodusek, D. B., Fanger, G., Schaer, G. N., Delancey, J. O., & Schuessler, B. Pelvic muscle activity in nulliparous volunteers. *Neurourology and urodynamics*, 2001; 20(3), s. 269-275. ISSN 1520-6777
- [7] Deindl, F., Vodusek, D., Hesse, U., & Schuessler, B. Activity patterns of pubococcygeal muscles in nulliparous continent women. *British Journal of urology*, 1993; 72(1), s. 46-51. ISSN 1464-410X
- [8] Junginger, B., Baessler, K., Sapsford, R., & Hodges, P. W. Effect of abdominal and pelvic floor tasks on muscle activity, abdominal pressure and bladder neck. *International Urogynecology Journal*, 2010; 21(1), 69-77. ISSN 0937-3462
- [9] Iacobellis, F., Brillantino, A., Renzi, A., Monaco, L., Serra, N., Feragalli, B., . . . Cappabianca, S. MR Imaging in Diagnosis of Pelvic Floor Descent: Supine versus Sitting Position. *Gastroenterology Research and Practice*. 2016; ISSN 1687-6121
- [10] Bø, K., & Finckenhagen, H. B. Is there any difference in measurement of pelvic floor muscle strength in supine and standing position? *Acta obstetricia et gynecologica Scandinavica*, 2003; 82(12), s. 1120-1124. ISSN 1600-0412.
- [11] Laycock, J., & Jerwood, D. Pelvic floor muscle assessment: the PERFECT scheme. *Physiotherapy*, 2001; 87(12), s. 631-642. ISSN 0031-9406