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ASSESSMENT OF PELVIC FLOOR MUSCLE PASSIVE FORCES IN WOMEN

Hypothesis / aims of study

Pelvic floor muscles (PFM) play an important role in maintaining optimal position of the pelvic organs [1]. It has been shown that passive forces of the PFM, often called “tonicity”, are lower in stress incontinent women [2] and may improve following conservative treatment. To date, PFM passive forces are estimated by introducing a finger, a pressure probe or a dynamometer into the vaginal cavity. The measurements are taken at fixed vaginal apertures. Since the PFM activity at rest and hiatus diameter can influence these assessments, a more comprehensive and objective technique is needed. The goal of this paper is therefore to present a new methodology that has been developped for evaluating the PFM passive forces. The approach is based on methodology and concepts already used for the estimation of passive properties in the lower-extremity muscles [3].

Materials, methods and study design

Four continent women, aged between 25-47, were evaluated in a supine lying position with hips and knees flexed, feet flat on a conventional gynecologist’s table. A dynamometric speculum and a linear potentiometer were used to measure simultaneously the force and the vaginal aperture. Forces were recorded by the lower branch of the dynamometric speculum with pairs of strain gauges mounted differentially. The vaginal aperture can be changed by means of a crank allowing smooth and precise displacement of the lower branch of the speculum. The force and aperture values were sent to a computer for real-time monitoring of the variation of both variables. To control PFM activity, electromyographic signals were recorded through electrodes placed on the lower branch of the dynamometer. In order to measure only passive muscle forces, the participants were instructed to relax their PFM as much as they could using the EMG signals as biofeedback. The PFM passive forces were evaluated in four different conditions.

1) Initial passive resistance: The passive resistance of the PFM was registered at minimal vaginal aperture, which corresponds to an antero-posterior vaginal diameter of 15 mm. The mean force was calculated over a 5-s period.

2) Passive resistance at maximal aperture: The stretching amplitude was determined by either the patient tolerance or the increase in EMG activity (> twice the resting values) [3]. The mean forces were taken over a 5 s period.

3) Passive forces during lengthening and shortening cycles: The PFM and surrounding tissues were stretched by separating the two speculum branches at a constant speed (5 mm/s). When the maximum vaginal aperture was reached, the branches were closed at constant speed to minimal aperture. Five stretch-relax cycles were carried out. From the passive force-length curve, different parameters were extracted: a) force at maximal aperture b) force at mid-point aperture, c) passive elastic stiffness (change in forces/change in vaginal aperture) at maximum aperture and mid-point aperture, and d) reduction of passive forces after the five lengthening and shortening cycles (percentage of passive force loss between the 5th cycle compared to the 1st cycle).

4) Sustained stretch: The speculum was again opened at maximum aperture and the stretch was sustained for 1 min. The percentage of passive resistance loss after 1 min of sustained stretch was computed as the stress-relaxation properties of the PFM.

Results

An example of lengthening and shortening curve is given in Figure 1. As observed, the force during the shortening phase is lower than the force during the lengthening phase for the same aperture. From the last four cycles (2 through 5) presented in Figure 2, it can be noted that a progressive superposition of the curves appears in the last cycles. Table 1 shows preliminary data on the PFM passive parameters assessed in four continent women.

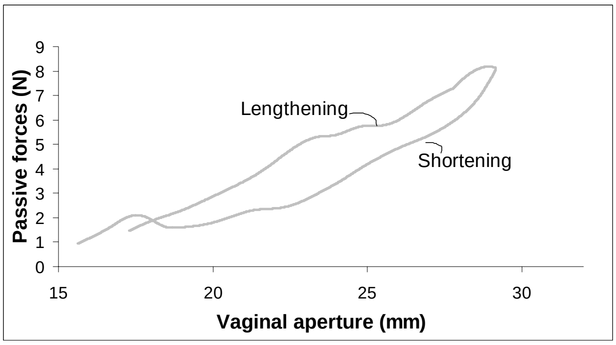

Figure 1 Lengthening and shortening conditions

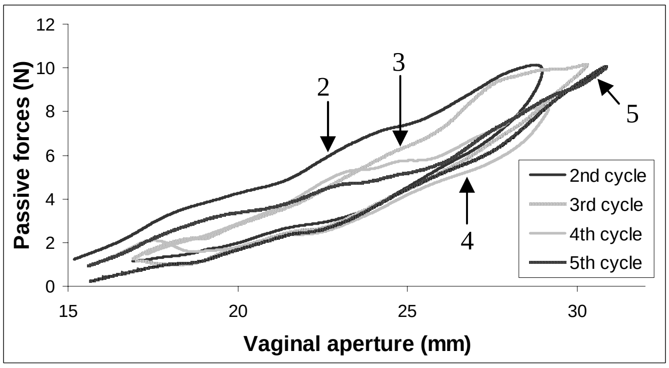

Figure 2 Lengthening and shortening curves for cycles 2 to 5

Conditions	**Parameters**	**Mean**	**Ranges**
Minimal aperture	Passive forces (N)	1.5	0.3 - 2.8
Maximal aperture	Passive forces (N)	7.8	5.5 - 9.7
	Maximal vaginal aperture (mm)	35.7	30.6 - 45.5
Lengthening and shortening (4th cycle)	Force at maximal aperture (N)	10.8	7.9 - 10.7
	Force at mid-point aperture (N)	5.1	3.3 - 6.9
	Passive elastic stiffness (N/ mm) at maximal aperture	0.7	0.6 - 0.8
	Passive elastic stiffness (N/ mm) at mid-point aperture	0.6	0.4 - 0.7
	Percentage of passive forces loss at the 5th cycle (%)	13.0	2.2 - 13.2
Sustained stretch	Percentage of passive forces loss after 1 min (%)	18.9	1.2 – 29.0

Table 1 PFM passive parameters

Interpretation of results and concluding message

This is a new and original approach to evaluating the PFM passive force. The psychometric properties of this technique applied to PFM are currently under study. However, these measurements may prove useful for better understanding stress urinary incontinence patho-physiology, evaluating the efficacy of conservative treatment and defining the underlying changes in the PFM function following treatment.

References

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