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RELIABILITY OF A NEW APPROACH FOR ASSESSING THE PELVIC FLOOR MUSCLE TONE IN POSTMENOPAUSAL STRESS INCONTINENT WOMEN

Hypothesis/aims of study

The pelvic floor muscles (PFM) are reported to contribute to continence by providing adequate urethral support [1]. During increased intra-abdominal pressure such as coughing, the pelvic floor structures counteract the downward pressure and the urethra is therefore compressed against a supportive layer which includes the PFM. The resistance to the stretch offered by the PFM, explained by the passive properties of the PFM (also called tone), may play a key role in continence. To date, techniques to estimate the PFM tone are digital assessment, pressure perineometry and dynamometer. The measurements are taken at fixed and static vaginal apertures. Since the PFM activity at rest and the hiatus diameter can influence these assessments, a more comprehensive and objective technique is needed. A new approach was therefore developed to assess the dynamometric forces of the PFM during a stretch while electromyographic measurements are taken simultaneously to ensure that the woman is properly relaxing her PFM. The goal of this study was to investigate the test-retest reliability of the dynamometric passive properties of the PFM in postmenopausal women with stress urinary incontinence (SUI).

Study design, materials and methods

Thirty-two postmenopausal women suffering from stress urinary incontinence (SUI), ten nullipara, six primipara and 13 multipara, aged between 47 and 73, were convened to two sessions two weeks apart. The women were evaluated in a supine lying position. The PFM forces at rest were assessed with a dynamometric speculum equipped with a linear potentiometer and electromyographic electrodes for real-time monitoring of the PFM forces, the vaginal apertures and the PFM activity. The vaginal aperture can be changed by means of a crank allowing smooth and precise displacement of the lower branch of the speculum. 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 properties were evaluated in three 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.
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) 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 followed. Forces and passive elastic stiffness (PES) (change in forces/change in vaginal aperture) were evaluated at different vaginal apertures. Hysteresis was also calculated (the area between the lengthening and shortening curve).

The reliability of the data was evaluated using the generalizability theory [2]. Two reliability estimates were calculated. One is the dependability index, which is computed as the ratio of the subject variance to the total variance (similar to the classical intra-class coefficient, type 2). The second is the standard error of measurement (SEM), which gives the error of measurement in absolute units (SEM_{ABS}) or as a percentage of the mean value ($SEM_{\%}$). These estimates are reported for one measurement session involving two trials.

Results

Overall, the reliability of the passive properties was good, with indices of dependability of 0.75–0.93. The SEMs for forces and PES were 0.24-0.67 N and 0.03-0.10 N/mm respectively for mean, maximal and 20-mm apertures, representing an error between 13% and 23%. Passive forces at minimal aperture showed lower reliability (Φ=0.51-0.57) compared with other vaginal openings.

Conditions	**Parameters**	**Φ**	**SEM_{ABS} ($SEM_{\%}$)**
1) Initial resistance	Passive forces	0.57	0.34 N (87.9%)
2) Passive resistance at max. aperture	Passive forces	0.82	0.57 N (24.5%)
	Maximal vaginal aperture	0.73	1.90 mm (7.2%)
3) Lengthening and shortening cycles	Force at minimal aperture	0.51	0.27 N (150.0%)
	Force at maximal aperture	0.85	0.67 N (20.3%)
	Force at mean aperture	0.91	0.33 N (18.1%)
	Force at common aperture of 20 mm	0.89	0.24 N (18.2%)
	PES at minimal aperture	0.74	0.03 N/mm (22.7%)
	PES at maximal aperture	0.75	0.10 N/mm (23.3%)
	PES at mean aperture	0.86	0.05 N/mm (15.2%)
	PES at common aperture of 20 mm	0.93	0.03 N/mm (13.4%)
	Hysteresis	0.88	2.20 N*mm (27.8%)

Interpretation of results

The measurement of PFM passive properties showed acceptable test-retest reliability. The passive forces at minimal aperture suggested lower reliability compared to other vaginal apertures (maximal, mean and 20 mm). From these results we suggest that these parameters could be included in assessments of the pelvic floor.

Concluding message

We propose an innovative approach to dynamically assess PFM passive properties while controlling for involuntary PFM activity, features essential for assessing the viscoelastic properties of muscle tissue. This methodology may help to provide better insight into SUI pathophysiology and conservative treatment mechanisms.

References

1. Ann N Y Acad Sci (2007) 1101;266-296.
2. Generalizability Theory; Newbury Park. Sage, 1991.

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What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
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Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**