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DETERMINATION OF PELVIC FLOOR MUSCLE OSCILATION FREQUENCY IN HEALTHY WOMEN USING A MULTIDIRECTION VAGINAL PROBE

Hypothesis / aims of study

Pelvic floor muscles training aims to change all muscle function impairments, in a way that women can develop urogynaecological function adequately and enhance quality of life. To better understand the biomechanics of pelvic floor muscle contraction, it is necessary knowledge about pelvic floor muscle oscillation frequency. The frequency in witch the PFM oscillate can contribute to the prescription of different physiotherapy modalities of treatment, such as electrical stimulation and pelvic floor muscle exercises. The aim of this study was to determine the frequency in with the pelvic floor muscle of healthy women oscillates, using a multidirectional vaginal sensor probe (MVP).

Study design, materials and methods

A measurement system composed of a vaginal sensor probe, a data acquisition system and analysis software was developed. The multiderection vaginal probe (MVP) consists of three parts: the dome, the sensitive element and the handle. The dome has an anatomical, rounded shape in order to allow the insertion of the device into the patient's vaginal canal with a minimum level of discomfort. The sensitive portion is formed by eight force-resistive sensors (8.0 mm in diameter and 0.1 mm in height, model SENM-08A, China) assembled in pairs in a hollow cylinder with four longitudinal flat orthogonal faces (Saleme et al, 2007). The vaginal sensor probe was connected to a USB data acquisition system of the National Instruments©.

Clinical procedures

A clinical protocol was developed and has the authorization to be conducted with human beings.

Twenty nine women were submitted to the pelvic floor muscle assessment. Data was collected with women in the supine position, hips and knees flexed and supported by a pillow. The vaginal probe was prepared for insertion by covering it with a latex condom and lubricating it with a hypo-allergen gel. The probe was inserted into the vaginal canal by a physical therapist; contractions were asked to the woman so that could be visualized where the maximal force points were located. The probe was then stabilized by the therapist to prevent the movement of it inside the vaginal canal. In this position, it was possible to measure the passive and active force of pelvic floor muscle.

The signal collected by the system was stored in a computer and subsequently processed using the mathematical tool MATLAB® 2008. Firstly, the signal went through a 60.0 Hz Notch filter of 6th order, so that the interference of the power grid could be filtered. After that, the signal was split up in order to separate the signal with contractions and signal with no contraction. To eliminate the interference of the frequency of the exercise, only the signal with contraction was analyzed. This signal was then processed by Fast Fourier Transform (FFT). The continuous components of the signal were cut off and only the frequencies over than 40% of the frequency with biggest amplitude were considered..

Results

The signal analysis procedure in frequency domain obtained through the Fast Fourier Transform (FFT) showed an oscillation frequency for each pelvic floor wall of 0.07937 Hz in the population of women studied.

Figure 1 shows a histogram of the most prevalent frequencies obtained separated by each vaginal wall of all participants.

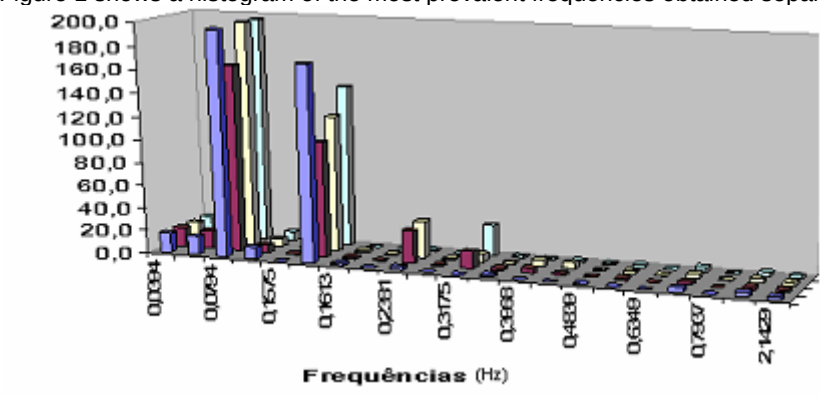

FIGURE 1: Frequencies distributions acording to vaginal wall (Blue: anterior vaginal wall; Red: Lateral vaginal wall; Yellow: Posterior vaginal wall and green: left vaginal wall).

Interpretation of results

The frequency in which the PFM oscillate can contribute to the prescription of different physiotherapy modalities of treatment. The clinical point of view of Fourier analysis could collaborate with function diagnosis of pelvic floor muscles dysfunctions, because information such as, control (muscle activation and deactivation), coordination (influence of different frequencies, such as the ones found in the anterior vaginal wall), resistance (between a woman with and withough pelvic floor muscles dysfunctions) could make clinical physical therapist diagnosis and prognosis more quantitative.

Constantinou and Omata (2007) presented the design of a directionally sensitive multi-sensor probe, which had circumferential spatial resolution. The probe was constructed to identify the distribution of anisotropic forces that acted on the vagina following voluntary and reflex pelvic floor contractions. The results obtained from their time-frequency distribution of the force and displacement data in the anterior direction of the vaginal wall, indicated that the dynamic response of this probe configuration is sufficiently high to show that enough pelvic floor muscle contraction, contains significantly higher-frequency components (0.5– 4.4 Hz) compared to voluntary pelvic floor muscle contraction, whose range was 0.25–0.5 Hz. In this paper, similar oscillation frequencies to the work of Constantinou and Omata (2007) were found for voluntary pelvic floor contraction.

Concluding message

The analyzed frequency signal obtained by the MVP may be different from a normal woman to one that has some kind of pelvic floor impairment. Higher muscles frequency oscillations, a decrease in resistance and the presence of a great variability of frequencies range could indicate that women have any pelvic floor muscles dysfunctions. Thus, using the MVP, it would be possible through frequencies analyses document and monitor the patient evolution considering parameters of pelvic floor muscle activation. However, future works are necessary, with a great number of samples, in a way not only to confirm the population (with and withough muscles pelvic floor dysfunctions) frequency oscillation, but also perform a statistical analysis between them.

References

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Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**