DIRECTION SENSITIVE SENSOR PROBE FOR THE EVALUATION OF VOLUNTARY AND REFLEX PELVIC FLOOR CONTRACTIONS

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INTRODUCTION

Reliable measurement of the ability of pelvic floor muscles (PFM) to contract voluntarily can be of clinical value in the assessment of women with urinary incontinence. Currently available devices, expected to measure PFM strength such as surface EMG or periniometry, are of limited anatomic specificity. Digital palpation, although more specific and reliable remains a subjective measurement. In this presentation we demonstrate the development of a novel sensor system to be used for the reliable measurement and recording of PFM strength emulating palpation.

METHODS

Prototype probe is equipped with 4 pairs of contact-force sensors and displacement transducers, each designed to move independently. For patient protection, probe is inserted in the vagina using a female condom placed over the sensor. By inserting the device into vagina, the movement and the force of PFM in the different four directions (anterior, posterior, right and left) were measured at a sample rate of 25Hz and presented on the computer screen as feedback to the patient. This system was used in the evaluation of 12 incontinent patients (mean age 63.2) recruited for this study. The PFM strength was first assessed in the lithotomy position using manual muscle testing and subsequently employing the probe of the sensor system. During the measurement, the patients were asked to perform 3 times voluntary pelvic floor muscle contractions (VPFMC) and 3 times coughing (CPFMC).

RESULTS

Figure 1 shows the typical force (a) and movement (b) measured in the middle of the vaginal wall of a patient with urinary incontinence (UI). The measurements in the anterior direction and in the posterior direction are shown by the solid line and the dotted line respectively.

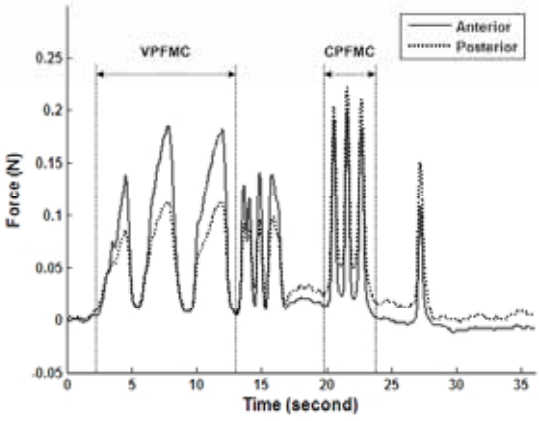

Figure 1a: Typical recording of force of contraction.

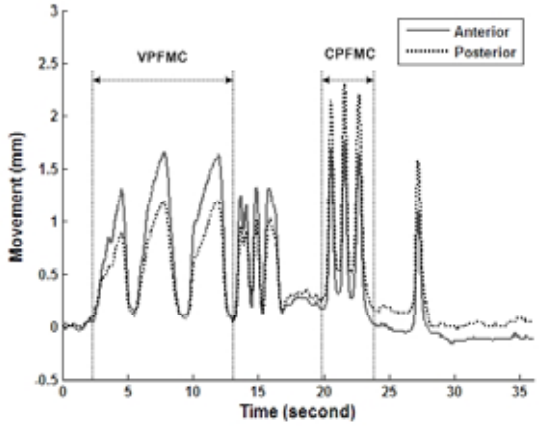

Figure 1b: Typical recording of displacement produced.

Force signals, Fig 2 during CPFMC have high-frequency components (0.5Hz to 4.4Hz). In contrast, VPFMC have much more the low-frequency components (0.25Hz to 0.5Hz).

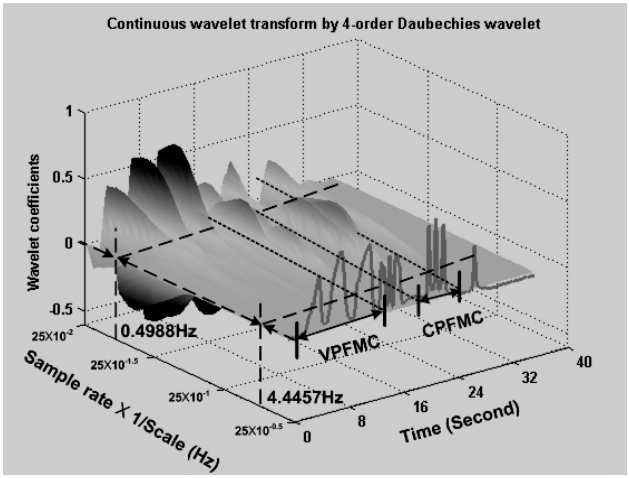

Figure 2: Time-frequency distribution of the force signals in the anterior direction of the middle vaginal wall. Y-axis is the product of sample rate and the reciprocal of the scale of Continuous Wavelet Transform CWT.

CONCLUSIONS

Sensor system provides direct measurements PFM strength and displacement. Analysis suggests that the modes of PFM contraction are different between voluntary PFM contraction and cough induced reflex PFM contraction.

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