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Title: MULTIMEDIA DEMONSTRATION OF THE IMPACT OF THE PELVIC FLOOR ON URETHRAL FUNCTION AND CONSIDERATIONS IN MEASUREMENT TECHNOLOGY

Aims of Study:

This is a video presentation interpreting urodynamic measurements of urethral function in the light of MRI of the Pelvic Floor [PF] and the development of diagnostic techniques to objectively assess the neuromuscular integrity of the lower urinary tract. The central focus of this presentation is to consider emerging new concepts and technology that can be used to define the structure and function of the PF considering changes with increasing age and the question as to which of these changes are associated with urinary incontinence. Indeed since there is a causative relationship between the incidence of stress urinary incontinence and age, a better understanding of the mechanism of action of the PF on the urethra in preventing urinary continence can be obtained by the development of better technology. Such technology can be targeted to assess and diagnose the viability and contribution of the PF upon the urethra. Furthermore the new diagnostic tests using imaging, designed to evaluate pelvic floor function related to urinary continence, are based on the concept of examining: the anatomical integrity of the skeletal musculature of relevant muscles in terms of contractility, the adequacy of the neuronal supply to these muscles in terms eliciting an adequate recruitment secondary to the initiation of the guarding reflexes and the biomechanical properties of the interconnecting tissues and their attachment to the sacral and pelvic structures. In this video attempts to demonstrate the differences in the anatomical/functional characteristic of the PF of asymptomatic of young and older normal subjects.

Methods:

Urodynamic data were collected from a healthy young female volunteers were the pressure response of the bladder, urethral, vaginal, rectal and anal pressures to voluntary PF contraction and was measured. Corresponding MRI studies were obtained from asymptomatic volunteers having approximately the same mean age range and also a group of older peri-menopausal women. Serial MRI data were obtained in the supine position, and integrated to formulate the 3D configuration of the PF by reconstructing consecutive planes in each of the axial, sagittal and coronal dimensions. Each MRI frame was recorded in the relaxed and also the contracted state and using image processing the differences were displayed. From these visualization and the associated urodynamic measurements the design requirements of a piezoelectric biosensor (PZT) system to assess the magnitude and direction of the forces responsible in providing urethral closure are modelled and presented using computer generated graphics.

Results:

When the urodynamic measurements are superimposed upon the MRI visualizations clearly identify the

relative magnitude of the closure forces due to voluntary pelvic PF contractions. In addition the direction of variations in the path of the pubococcygeus muscle can be derived from the MRI information and a simulation of the mechanical characteristics of a device designed to measure the symmetry of contraction is modelled. Similar numerical testing will be performed to assess the relative changes produced by PF contractions on structures originating from the pubis passing along the urethra, vagina, and rectum, to the rectum, attachment to the distal half of the vagina, and inserting between the internal and external anal sphincters. It is anticipated that the 3D reconstruction will show the utility of the measuring device, as superimposed over the configuration of the bony structures, relative displacement of the pubococcygeous muscles.

Conclusions:

With this video demonstration we present the basic physiological parameters and suggest appropriate methods of developing new diagnostic techniques. It is concluded that PF function can best be assessed using current PZT technology with the minimum of diagnostic probing in the vagina. Such an approach can potentially identify the damage to the continence mechanism and assist in choosing the appropriate treatment plan.