ORIGINAL RESEARCH—ANATOMY/PHYSIOLOGY

Dynamic Clinical Measurements of Voluntary Vaginal Contractions and Autonomic Vaginal Reflexes

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ABSTRACT

Introduction. The vaginal canal is an active and responsive canal. It has pressure variations along its length and shows reflex activity. At present, the prevailing idea is that the vaginal canal does not have a sphincter mechanism. It is hypothesized that an active vaginal muscular mechanism exists and might be involved in the pathophysiology of genito-pelvic pain/penetration disorder.

Aim. The aim of this study was to detect the presence of a canalicular vaginal "sphincter mechanism" by measuring intravaginal pressure at different levels of the vaginal canal during voluntary pelvic floor contractions and during induced reflexive contractions.

Methods. Sixteen nulliparous women, without sexual dysfunction and pelvic floor trauma, were included in the study. High-resolution solid-state circumferential catheters were used to measure intravaginal pressures and vaginal contractions at different levels in the vaginal canal. Voluntary intravaginal pressure measurements were performed in the left lateral recumbent position only, while reflexive intravaginal pressure measurements during slow inflation of a vaginal balloon were performed in the left lateral recumbent position and in the sitting position.

Main Outcome Measures. Intravaginal pressures and vaginal contractions were the main outcome measures. In addition, a general demographic and medical history questionnaire was administered to gain insight into the characteristics of the study population.

Results. Fifteen out of the sixteen women had deep and superficial vaginal high-pressure zones. In one woman, no superficial high-pressure zone was found. The basal and maximum pressures, as well as the duration of the autonomic reflexive contractions significantly exceeded the pressures and the duration of the voluntary contractions. There were no significant differences between the reflexive measurements obtained in the left lateral recumbent and the sitting position.

Conclusion. The two high-pressure zones found in this study, as a result of voluntary contractions and, even more pronounced, as a result of reflexive contractions on intravaginal stimulation, support the hypothesis that the vaginal canal has an active and passive canalicular sphincter mechanism. Further investigation of this sphincter mechanism is required to identify its role in the sexual response and genito-pelvic pain/penetration disorder. **Broens PMA, Spoelstra SK, and Weijmar Schultz WCM. Dynamic clinical measurements of voluntary vaginal contractions and autonomic vaginal reflexes. J Sex Med 2014;11:2966–2975.**

Key Words. Intravaginal Pressures; Vaginal Reflexes; Vaginal Sphincter Mechanism; Vaginal High-Pressure Zone(s); Female Sexual Pain Disorders; Genito-Pelvic Pain/Penetration Disorder; Pelvic Floor

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Introduction

The vagina does not simply act as a passive conduit for the passage of the penis, fetus, semen, and menses, but it is also a responsive, active canal with pressure variations along its length and contractile muscular activity [1]. The anal canal and the urethra both have sphincter mechanisms [2]. Shafik presented anatomical evidence on the existence of a vaginal sphincter; however, he could not provide physiological evidence because the vaginal sphincter was inaccessible and too thin to place electrodes in for testing [3].

The vaginal wall consists of outer longitudinal and inner circular smooth muscles. Contraction of the longitudinal smooth muscles shortens and widens the vagina, whereas contraction of the circular smooth muscles constricts the vagina [4]. This motility is under the influence of the autonomic nervous system and is known to increase around menstruation, in order to evacuate the contents of the uterus and vagina. However, most women do not consciously feel these spontaneous contractions [5]. At present, it is not clear whether the vaginal wall itself is composed of striated muscles.

The vaginal canal is anchored within a bed of powerful striated muscles, which can be divided into four groups. From superior to inferior, these layers are (i) the endopelvic fascia attached to the superior fascia of the levator ani muscle; (ii) the pelvic diaphragm/the levator ani muscles, suspended from the fascia of the internal obturator muscle: the puborectalis muscle and the pubovisceral muscles (= the pubococcygeal muscle and the iliococcygeal muscle); (iii) the urogenital diaphragm/perineal diaphragm: the deep transverse perineal muscle (perineal membrane) and external urethral sphincters; and (iv) the superficial transverse perianal muscles and the muscles of the cavernous bodies: the bulbospongiosus muscles and ischiocavernosus muscles and the external anal sphincter [6]. There is wide interindividual variation in the size, power, and voluntary control of these striated muscles [7].

Intravaginal pressure variations occur along the length of the vaginal canal. The intravaginal pressure is a key parameter in the strength of the pelvic floor muscles in women [8]. Kegel was the first to measure this intravaginal pressure. In the 1950s, he introduced the "perineometer" to improve the strength of the pelvic floor muscles for the treatment of urinary stress incontinence in postpartum women. He observed that after the patients had completed his pelvic floor physiotherapy exercises, they not only reported relief from urinary incontinence but also improvement in sexual satisfaction [9].

Over the next 30 to 40 years, the perineometer was the gold standard to measure intravaginal pressure and hence pelvic floor strength. Although several different new devices were introduced to measure intravaginal pressure [10–12], these techniques did not correct for the pressure created by the device itself. In the late 1960s and early 1970s, it became clear that infusion manometry, after correction for the balloon, was the only technique that could measure absolute pressure [8,13,14].

In 1992, Bø was the first to attempt to distinguish variations in pressure along the vaginal canal. She found the highest intravaginal pressure 3.5 cm from the vaginal introitus, using a vaginal balloon. However, this balloon measured an average pressure at only one level. Therefore, it was not possible to provide a pressure profile along the vaginal canal [15]. In 2005, Guaderrama et al. used infusion manometry to obtain vaginal pressure profiles in 14 asymptomatic women. They concluded that the intravaginal pressure was highest in the mid-zone over a length of 3–4 cm. Peak pressure occurred in the vaginal canal approximately 2 cm cranial to the hymen. In this vaginal high-pressure zone, the maximum pressure during voluntary contraction was significantly higher than the maximum pressure at rest. Guaderrama et al. suggested that the vaginal high-pressure zone is related to the contraction of the pelvic floor musculature, but they did not indicate which particular muscles were involved [16]. In 2007, Jung et al. assessed the shape and characteristics of the vaginal high-pressure zone described by Guaderrama et al. In nine asymptomatic women, they performed ultrasound imaging of a compliant fluid-filled bag that had been placed in the vaginal high-pressure zone. When the bag volume was increased, the vaginal high-pressure zone opened with lateral vaginal wall extension first, followed by anteroposterior vaginal wall extension. Based on these observations, Jung et al. concluded that the puborectalis muscle was responsible for the vaginal high-pressure zone [2]. In 2010, Raizada et al. performed a study on 16 asymptomatic women, using a side-hole infusion manometry technique to measure contact pressure at point locations. Ultrasound and magnetic resonance imaging revealed a vaginal high-pressure zone in the distal part of the vagina [8].