

Review Article

What's the Role of 3D Pelvic Floor Ultrasound in the Evaluation of Female Pelvic Floor Disorders?

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Abstract

The pelvic floor consists of a morpho-functional unit, with important functions such as the support of the pelvic organs. It consists of predominantly striated muscle, with different bundles grouped together, serving as passive support for the bladder, uterus, rectum and anus. One of the most relevant factors involved in defects resulting from pelvic floor injuries is the gravitational force of pregnancy and childbirth. The most pronounced alterations are easily identified, both by the patients and by the physicians. However, when the symptoms are mild, they generally go unnoticed and undiagnosed. With the purpose of standardizing the impact of Sexual Dysfunction (SD), Anal Incontinence (AI), and Urinary Incontinence (UI) on quality of life, questionnaires validated for different cultures have been applied, in order to obtain more information beyond what women superficially report. With regard to the diagnosis, three-dimensional ultrasound of the pelvic floor (3D US pelvic floor) has proven to be an excellent diagnostic tool in pelvic floor damages. It can detect muscle avulsions after delivery and likewise details of Hiatal Area (AH), Transverse Diameter (TD) and Anteroposterior Diameter (AP), particularly in cases of underreported complaints and with minor injuries. Efforts must be combined in the prevention of pelvic floor damage in multidisciplinary teams.

Keywords: Anal incontinence; Delivery mode; 3D pelvic floor ultrasound; Flatus incontinence; Sexual dysfunction; Urinary incontinence

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Anatomy of the Pelvic Floor

The pelvic floor consists of predominantly striated muscle, with different bundles grouped together, serving as passive support for the bladder, uterus, rectum and anus [1]. It comprises amorpho-functional unit, with important functions, such as the support of the pelvic organs, activation of the muscle strength during physical and sexual activity, urination, evacuation, labor, and control posture [2]. The levator ani is the most important muscle that occupies the perineal region and provides support for the pelvic organs [3]. It's divided into three bundles called pubovisceral (composed of the pubovaginal, puboperineal and puboanal muscles), iliococcygeal and puborectalis [4,5].

The knowledge of the insertions, innervations, and different functions of the components of the levator ani muscle, turns easier to understand the different clinical manifestations, that result from possible damage, secondary to injuries to the endopelvic fascia [6]. Regarding classification, the pelvic floor is divided into anterior and posterior compartments. The anterior compartment contains the bladder, urethra, and anterior vaginal wall, and the posterior compartment the rectum and anal canal. This classification is based on the Integral Theory, which considers the pelvic floor as a biomechanical interconnected system, composed of connective tissue, muscles, fascia, and nerves, associated with intra-abdominal pressure and atmospheric pressure performs the function of suspension and support system [7,8]. The maintenance of the pelvic floor integrity is also dependent on the diaphragmatic statics and breathing, whose dynamics are important in Valsalva and contraction movements [9,10].

Functional anatomy of the pelvic floor

The integration between the abdominal muscles, diaphragm, and pelvic floor complex leads to balance in posture and, in the opposite, when injuries occur, lumbar and sacroiliac pain may arise [10,11]. On the other hand, regarding the female pelvis, excessive strain on the pelvic ligaments and fascia imply prolapse, which happens most frequently in association with collagen defects and genetic predisposition [6]. One of the most relevant factors involved in defects resulting from pelvic floor injuries is the gravitational force of pregnancy and childbirth. The most pronounced alterations are easily identified, both by the patients and by the physicians. However, when the symptoms are mild, they generally go unnoticed and undiagnosed. In this way, women suffer discomforts that compromise their quality of life, such as Urinary Incontinence (UI), Sexual Dysfunction (SD), Anal Incontinence (AI) including Flatus Incontinence (FI). It's not an easy task for the gynecologist to identify small ruptures in the physical examination, as well as to inquire about the patient's sexual intimacy [12].

Sexuality in general is impaired in the postpartum period, but several authors have observed that there is an improvement over time. One study showed an 80% reduction in libido and the presence of dyspareunia in 3rd postpartum month; however such symptoms persisted in only 1/3 of the women at the end of the 6th month [13]. On the other hand, another study showed 29.3% of dyspareunia and 21.1% of lack of desire in the female population, suggesting the

existence of a sexual problem among couples regardless of the postpartum period [14]. Anal Incontinence (AI) comprises the involuntary loss of flatus, liquid, and/or solid stools and has multifactorial and risk factors including age, depression, vaginal parity, and operative delivery, that led to sphincter injury and pudendal neuropathy. It has been reported in 5-26% of women during the first year following vaginal delivery [15]. UI can occur during stress; due to urgency, known as urge incontinence, and mixed incontinence, in this case, due to simultaneous loss during stress and urgency. A recent meta-analysis identified an incidence of 32% in the 1st postpartum year with a predominance of the stress UI [16].

Quality of life questionnaires in diagnostic

Collecting data about women's intimate issues is not an easy task, but is important to obtain the diagnosis, allowing the adoption of the most suitable therapies and preventive care. With the purpose of standardizing the impact of SD, AI, and UI on quality of life, questionnaires validated for different cultures were created. Among the most popular questionnaires the FSF-I (Female Sexual Function Index) [17] evaluates sexual dysfunction; the St Mark's Incontinence Score [SMIS] [18] evaluates AI and, the I-Qol, or ISIQ-SF or King's Health Questionnaire KHQ [19] evaluate UI. These questionnaires facilitate the diagnosis, since most of women are shy to complain and doctors find it difficult to ask.

3D ultrasound of the pelvic floor

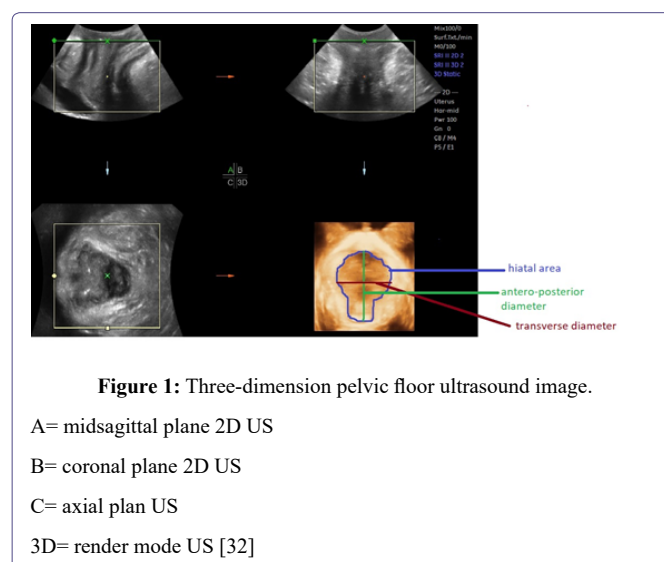
In recent years, 3D US pelvic floor has been proven to be an excellent tool for the diagnosis of pelvic floor damage. It is a reproducible and accessible method, that provides the identification of pubovisceral muscle injuries, which cannot be seen on clinical examination. It is a method that allows the obtention of the measurements of the thickness of this muscle, as well as the Hiatal Area (HA) and its larger diameters: Transverse (TD) and Anteroposterior (AP) [Figure 1] [20-23].

The first studies published on this subject referred to the technique itself [24] or the reproducibility intra and interobserver of the method [25,26]. Other authors evaluated the pelvic floor shortly after childbirth [27] and up to 2 years after this obstetric event [28]. A study involving 53 women between 12 and 24 months postpartum identified, through the 3D pelvic floor US a higher frequency of pubovisceral muscle avulsion in women who had vaginal deliveries, as opposed to those with cesarean section [29]. Another study that followed 231 women from pregnancy to the sixth month postpartum, demonstrated, through 3D pelvic floor US, up to 40% of avulsion in the group of vaginal delivery and increasing in HA of all participants, regardless of the mode of delivery [30].

A recent study also used 3D pelvic floor US to assess the outcome of the second birth among 195 Chinese women. Were evaluated four different groups, according to the order of the mode of delivery, concluding that groups with two VD or at least one VD had HA significantly larger than those who had two CS [31]. In a recent publication, 203 women in late postpartum (5-15 years) were evaluated using 3D pelvic floor US, whose data were crossed with the scores obtained through quality-of-life questionnaires. None of them had spontaneous complaints. Nonetheless, after answering questionnaires (KHQ, SMIS and FSFI), higher-than-expected incidences of dysfunctions were identified. A frequency of 35% of mild UI, 28,1% of FI, and 46,3% of SD was observed. Possibly the study participants did

not spontaneously complain because of some kind of embarrassment or by considering it normal, for example, to have urinary losses on fitness or during intercourse [32].

Still in this study, the 3D pelvic floor US identified important muscle avulsions, responsible for deleterious symptoms for a woman's general health and sexual quality of life. Using multivariate statistical analysis, it was observed that in relation to age, every year of life a woman has a 6% chance of worsening her sexual function, and with each delivery event, whatever the type, this chance rises to 45%. A patient who had a Forceps Delivery (FD) is 6,42 times more likely to have SD than a Nulliparous Woman (NU), which means, the forceps injures the levator ani muscle fibers, resulting in increasing AH and TD [Figure 1] and consequently worsening in sexual performance. On the other hand, non-instrumented Vaginal Delivery (VD) leads to a 3.02 times greater chance of SD compared to nulliparity. The association of UI and FI leads to a 5.80 times greater chance of SD, and it happens to be more prevalent in women with larger HA [32].



These results drew attention to the high percentage of women with underreported complaints in gynecological consultations. This opens a range of discussions on how doctors should approach their patients in consultations and when deciding on the mode of delivery, in difficult cases of large fetuses, for instance. In addition to labor, other conditions can also deteriorate pelvic floor functions, such as obesity, work activities, chronic constipation, lung diseases with chronic cough [33], and heavy physical activities such as bodybuilding and long-distance running [34]. Despite the association of SD and IU with VD, no scientific society recommends performing cesarean sections exclusively for perineal protection, but some authors suggest that the conduct of vaginal delivery could be revised to minimize damage to the pelvic floor [35].

Efforts must be combined in the prevention of pelvic floor injuries. The work of stretching the muscle fibers of the pelvic floor during pregnancy is very important to avoid their random rupture during childbirth; this is already being practiced in some prenatal care services. This kind of physiotherapy promotes distensibility of the pelvic floor muscles, facilitating the second labor stage, and preventing future dysfunctions [36]. Finally, it is worth pointing out and making clear the importance of using imaging exams such as 3D/4D ultrasound, a tool that allows early diagnosis of muscle lacerations. In this

way, therapies can also be applied early, to restore the anatomy of the pelvic floor. Thus, the option for motherhood cannot come to be related to loss of quality of life.

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