



Review Article

# Vaginal Laxity: Prevalence, Risk Factors, Diagnostic and Therapeutic Approaches

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## Abstract

Vaginal laxity (VL) refers to the feeling of “looseness” in the vagina. VL is considered a symptom of pelvic floor dysfunction and an indicator of poor quality of life (QoL). The mechanistic action of this condition remains elusive to date and requires more attention. VL is most prevalent among childbearing women and no standardized method for diagnosis currently exists. Moreover, there are currently no commonly accepted definitions, etiologies, and predisposing risk factors pertaining to VL. Thus, we aim to review the epidemiology, diagnosis, and management of VL. Since it has been reported in approximately 48% of women, VL is a bothersome condition that continues to remain under-reported and is associated with higher parity, vaginal deliveries, and symptoms of prolapse. Although subjective complaints and visualization of the vaginal introits are the most commonly used methods of diagnosing VL, several QoL measures may hold promise in the evaluation of VL. Moreover, there are several methods for diagnoses that are under investigation. Surgical treatment has been indicated to improve sexual function and manage the symptoms effectively. Non-surgical treatment options typically include subsets of energy-based devices, which in theory and in small short-term studies have shown minimal benefits in conjunction with pelvic physiotherapy.

**Keywords:** Vaginal laxity, pelvic floor dysfunction, sexual function, quality of life, Management

**List of Abbreviations:** VL: Vaginal laxity; QoL: Quality of Life; POP-Q: Pelvic Organ Prolapse Quantification; POP: pelvic organ prolapse; PFD: Pelvic Floor Disorders; IUGA: International Urogynecological Association; ICS: International Continence Society; BMI: Body Mass Index; IQR: Interquartile range; ePAQ-PF: electronic Personal Assessment Questionnaire-Pelvic Floor; CI: Confidence Interval; NICE: National Institute for health and Care Excellence; PROM: patient-reported outcome measure; ICIQ-VS: International Consultation on Incontinence Questionnaire Vaginal Symptoms; GH: Genital Hiatus; TLUS: Translabial Ultrasound; HA: Hyaluronic Acid; PFMT: Pelvic Floor muscle Training; EBD: Energy-based devices; USFDA United States Food and

Drug Administration; Er: YAG: Erbium: Yttrium-Aluminum-Garnet; VRS: Vaginal Relaxation Syndrome; RF: Radiofrequency; VIVEVE I: Vaginal Introitus's Viveve treatment to Evaluate Effectiveness; HIFU: High-Intensity Focused Ultrasound

## Introduction

Vaginal laxity (VL) is a poorly understood symptom of pelvic floor dysfunction and an indicator of poor quality of life (QoL) [1]. Moreover, a comprehensive and precise description of VL may lead to a better understanding and management of the condition. Therefore, consistency in the use of terminology among treating practitioners is warranted. In a recent review [2], Palacios described laxity as the anatomical and physiological features of the vagina, and that some degree of laxity is normal among healthy

women. Thus, Palacios suggests that the term ‘hyperlaxity’ should be revised and referred to as the ‘vagina’s exaggerated capacity for distension’ [2]. On the Pelvic Organ Prolapse Quantification (POP-Q), clinical examination, and diagnostic imaging, VL is found to be linked with symptoms of prolapse, issues encountered in prolapse, vaginal parity, and objective prolapse, suggesting that VL, although distinctly different, can pose as a symptom of prolapse [1-4]. The etiological association between VL and childbirth is poorly understood; however, it is now generally recognized that trauma to the pelvic floor may result from vaginal delivery [3]. Loose vaginal tissue and other organs that are not displaced or pushed against the vagina are symptoms of VL and they differ from the symptoms of pelvic organ prolapse (POP) [4]. The joint report on the terminology of sexual health assessment of women with pelvic floor disorders (PFD) released by the International Urogynecological Association (IUGA) and International Continence Society (ICS) described VL as the feeling of vaginal looseness [5]. A positive association between sexual activity and function and pelvic floor strength was reported among women with PFD [6]. Symptoms of sexual function specific to PFD include vaginal symptoms, symptoms of lower urinary tract sexual dysfunction, anorectal sexual dysfunction symptoms, prolapse-specific symptoms and pain symptoms. In addition, the IUGA and ICS described obstructed intercourse, VL, anorgasmia, and vaginal dryness as the vaginal symptoms. Factors that affect the sensations experienced during intercourse include vaginal diameter, vaginal secretions, partner-related factors, performance, and presence of dyspareunia [7]. Moreover, while some physiological changes and functional measures actually exist, most factors may not accurately reflect the assessment of the patients on their improvement. Physical examinations aim to assess different causes of VL, while focusing on the observation and evaluation of several other bodily systems including the neurologic, vascular, musculoskeletal, and hormonal systems [8-10]. The aim of this review is to provide an informative appraisal of the prevalence, risk factors, diagnostic tools, and best available treatments for VL.

## Recent Findings

### Demographics, Risk Factors, and Prevalence

The literature deduces VL as a somatic dysfunction, rather than a psychogenic condition, that is associated with younger women, vaginal parity, and symptoms of prolapse [1,8,11]. A retrospective observational study involving 324 women reported a 24% prevalence of VL. The mean age of the participants was 56.5±12.8 years (range between 19 and 84 years), and the mean body mass index (BMI) was 29.4±6.7 kg/m<sup>2</sup> (range between 16 and 59 kg/m<sup>2</sup>). Of the total women, 63% were postmenopausal, with an average menopausal age of 8.8±10.5 years, and 18% were on hormone replacement therapy. About 323 (91%) were vaginally parous with a median parity of 2 (IQR 2–3, ranging from 0 to 7).

Moreover, 81 (25%) of these women had a history of instrumental delivery, 108 (33%) had a prior hysterectomy, and 46 (14%) had a history of incontinence/prolapse surgery [1]. Another study investigated the association of VL with pelvic floor symptoms and sexual dysfunction in women attending urogynecology clinics. In this study, 2,621 women had completed an electronic and self-reported assessment, known as the electronic Personal Assessment Questionnaire-Pelvic Floor (ePAQ-PF). A total of 2394 questionnaires were included in the analysis and VL was self-reported by 920 (38%) participants. Women who had a single delivery were 5.06 (CI: 1.67-15.3, P=0.004) times more likely to report laxity than nulliparous women. The study concluded that VL is significantly (P < .0005) associated with symptoms of prolapse, parity, overactive bladder, reduced vaginal sensation during intercourse, stress urinary incontinence, and poor sex life. However, this study has reported several limitations that may confound these findings including the lack of reliable data for estimating pelvic organ prolapse, little data pertaining to the menopausal status, and scarcity of obstetric delivery details [8]. Another retrospective study was performed on 376 patients in a urogynecology clinic. The mean age of the patients was 47.8 ±11.7 years (range from 23 to 99 years), and mean parity was 3 ± 3.96 (range from 0 to 19). The study showed that 135 patients (35.9%) reported VL and the history of cesarean delivery was reported to have effective protection against VL (adjusted OR 0.39; 95% CI, 0.17–0.90). However, symptoms such as bulging (adjusted OR 3.25; 95% CI, 1.46–7.23) and vaginal wind were found to be predictors (adjusted OR 15.48; 95% CI, 6.93–34.56). No correlation was detected between VL and POP-Q measurements. Moreover, there was no significant difference in the VL prevalence between participating women belonging to the clinically significant POP (stage 2–4) and non-significant POP (stage 0–1) groups [11].

### Diagnosis

A comprehensive assessment approach of the woman including history, physical examination, and pelvic floor integrity, are the initial steps for appropriate diagnosis. Remarkably, loose vaginal tissue and other organs that are not displaced or pushed against the vagina are differential symptoms of VL in accordance with POP [4,8,12-14].

### History

To date, clinical diagnosis is mainly made on the presenting symptoms of the patient, which include an abnormal or subjectively wide vagina (with or without intercourse), or the complaint of a sensation of excessive vaginal looseness or a wide vagina. There are a number of questionnaires that may aid in the diagnosis and evaluation of VL, such as the ePAQ-PF which was used to identify self-reported symptoms of VL from women attending urogynecology clinics in the United Kingdom [8]. The ePAQ-

PF is a valid and reliable web-based clinical assessment system developed to provide self-reported symptoms and QoL data from women with PFD. Although this tool was primarily designed as a clinical assessment tool to support patient assessment, ePAQ has been recognized by the National Institute for Health and Care Excellence (NICE) and the British Society of Urogynecology (BSUG) and as a patient-reported outcome measure (PROM) [12]. Moreover, the International Consultation on Incontinence Questionnaire Vaginal Symptoms (ICIQ-VS) is another patient-reported assessment tool for VL, sexual function and distress [13]. The ICIQ-VS is composed of a set of modular questions and is designed to provide an international comprehensive and globally applicable standard for assessing several pelvic symptoms of the lower urinary tract, bowel, and vaginal dysfunctions. This set of questions mainly evaluates the symptoms and impact of POP. The ICIQ - VS is applicable to females above 18 years of age, who are treated in primary and secondary care centers [14].

### Physical Exam

a) Laxity Visualization: Women with VL often reveal broad vaginal introitus and vaginal caliber on visual and gross pelvic examination. Lack of vaginal muscle strength is usually encountered following the maneuver of interposing two fingers as an attempt to stimulate vaginal contraction. The classification of vaginal muscle strength followed the modified Oxford scale: (0: nil), (1: flicker), (2: weak), (3: moderate), (4: good) to (5: strong) [15]. b) POP-Q: Utilizing the POP-Q system seems to be a more objective measure than visualization, particularly in the case of the genital hiatus (GH). The size of the GH can be measured utilizing the POP-Q instrument.

### Ultrasound

There exists a dynamic hiatus of skeletal levator ani muscles, which contract during Kegel exercises, and its size can be measured by ultrasound. A study conducted by Manzini et al assessed the predictive value of measuring the hiatal distension during Valsalva maneuver and at rest to test for VL symptoms [16]. Participating women (n=490) went through an interview, clinical assessment, and 4-D translabial ultrasound (TLUS). Hiatal area, coronal diameter, and anteroposterior diameter were evaluated at the plane of minimal hiatal dimensions utilizing the rendered volume technique, and were blinded against clinical data [16]. In a univariate analysis, the findings showed a significant association ( $p < 0.001$ ) between VL and all the measures of hiatal distension on Valsalva [16]. Multiple logistic regression analysis confirmed these results after controlling for demographic and clinical characteristics, including BMI, age, vaginal parity, and avulsion [16]. These findings might be deemed useful however, very few existing studies have reproduced similar results.

### Vaginal Tactile Imaging

A standard instrument that assesses the biomechanical conditions of the pelvic floor and other urogynecological aspects related to female sexual dysfunction does not currently exist. Elasticity imaging or elastography is a relatively new modality that has emerged in the last decade while vaginal tactile imaging facilitates biomechanical assessment of vaginal tissues and pelvic floor muscles and is a reproducible, quantitative tool that mimics manual palpation with a pressure sensor array imitating human fingers during a digital examination [9,17,18]. A pilot study including 31 patients revealed that the evaluation of elastic properties of vaginal walls can be measured by vaginal tactile imaging through the elasticity index and can help differentiate between normal healthy tissue, and diseased tissue under prolapse condition [9]. The vaginal tactile imaging supports imaging of a vaginal wall with increased rigidity as a result of implanted mesh grafts after reconstructive pelvic surgery [9]. Nevertheless, its clinical value in VL diagnosis is yet to be determined.

### Fiber-Optic Sensor Based Devices

For women with Pelvic Organ Prolapse (POP), localized measurements of the mechanical properties of vaginal tissue in-vivovivo using skin elasticity have shown decreased elastic modulus with normal vaginal support compared to women with normal vaginal support [19]. Multiple, independent, fiber-optic pressure transducers with fabricated intravaginal probe was placed alongside its blades and during the automatic expansion of the probe, continuous pressure recording along the anterior and posterior vaginal walls allows the resistance of the tissue to be evaluated as a function of displacement, reflecting the elastic module of the tissue [19]. These steps were conducted on a simulated vaginal phantom during relaxation and exercise after being validated. The findings proved that women with POP have reduced elastic properties compared with women with normal vaginal support [20,21]. However, its use in diagnosing women with VL is not yet confirmed.

### Management

Several management modalities such as topical treatments and pelvic floor muscle training have been explored, however, there is no definitive treatment to manage VL as of yet [10,22-28].

### Fillers and Creams

There is no scientific evidence to support the safe and efficient use of over-the-counter products (e.g. topical vaginal tightening products) for treating VL and there has been no supporting evidence regarding the use of injectable volumizers like hyaluronic acid (HA), platelets rich plasma, and physical devices (such as Gore-Mycromesh and silicone threads) [22-

24]. Moreover, the expanding use of HA and collagen in genital plastic surgery and reconstructive surgery has led to increased complications, for example, anecdotal evidence has shown that a Chinese woman who underwent a poorly regulated procedure of vaginal collagen injections and HA to reduce the vaginal width experienced pulmonary complications [26].

### **Pelvic Physiotherapy**

Some accepted interventions for POP as well as VL include Pelvic Floor muscle Training (PFMT) and Kegel exercises which are a set of exercises designed by Dr Arnold Kegel to manage urinary incontinence for his patients in the 1940s [27]. Several studies have addressed the effectiveness of PFMT for VL, for instance, a multicenter randomized controlled trial (RCT) conducted in New Zealand and the United Kingdom showed that PFMT produces a small but possibly significant reduction in the symptoms of prolapse [28]. A RCT conducted at a university hospital and a physical therapy clinic in Norway revealed that PFMT improved the symptoms of frequency and POP compared to the control group [10]. A RCT, including primiparous women (n=175) with a singleton vaginal delivery conducted in Norway to assess the effect of PFMT on vaginal symptoms showed that women in the training group had 45% less risk of having VL symptoms relative to the control group (RR: 0.55, 95% CI 0.31, 0.95; P=0.03) [29]. However, till date, no studies have revealed the application of PFMT specifically for the treatment of VL, thus, indicating that further studies are needed to assess the impact of PFMT on vaginal symptoms and sexual dysfunction. In a RCT of women undergoing incontinence and/or prolapse surgery, peri-operative physiotherapy was observed to have a synergistic effect [30].

### **Energy-Based Devices**

Energy-based devices (EBD) may help restore the elasticity of the connective tissue of the vaginal wall at 40 °C- 42 °C [31]. Moreover, this process improves the vaginal lubrication and humidity of the vaginal mucosa. The procedures of energy-based vaginal rejuvenation are fascinating because of its noninvasive nature, with a mean treatment time of 8-30 minutes, depending on the clinical indication and method used. The procedure is generally painless, and anesthesia is not needed. Two or three sittings are recommended, spaced approximately a month apart. A touch-up sitting or repeat single session is performed after 12-18 months. The procedure is well tolerated by patients because it is generally painless or only associated with mild discomfort. Patients do not experience an interruption to daily routines, apart from abstaining from sexual activity for three days when undergoing in laser treatments. Patients with mild to moderate symptoms of stress urinary incontinence, vaginal dryness, decreased lubrication, overactive bladder, grade 1 prolapse, orgasmic dysfunction, and

VL may have the utmost short-term benefits from these energy-based procedures. The indications are increasing; however, further studies are needed to determine the true breadth of the efficacy of EBDs. In 2018, the United States Food and Drug Administration (USFDA) warned against the use of EBD for vaginal rejuvenation or vaginal cosmetic procedures and has declared that the efficacy and safety of these devices in such procedures are not yet established [32]. However, patients who underwent these treatments were encouraged to report any complications noticed to the USFDA [32].

The common treatments using energy-based technology are outlined below.

### **LASER**

Minimally ablative fractional laser therapy has been recognized as a safe, accurate and efficient approach for resurfacing and regeneration of the skin and the most widely used lasers in the vaginal tissues are the CO<sub>2</sub> (10,600 nm) and the erbium: yttrium-aluminum-garnet (Er: YAG) laser [33]. A comparative study investigated the effect of fractional ablative lasers on vaginal tightening in which one group was exposed to ablative CO<sub>2</sub> laser therapy while the other group received the non-ablative Er: YAG laser. Overall, both groups showed improvement in vaginal tightening, however, there were more complications in patients treated with CO<sub>2</sub> laser therapy [34]. A Korean study that evaluated the effects of fractional CO<sub>2</sub> laser for tissue remodeling of vaginal mucosa using a porcine model to improve VL via observation and ultrasound measurement, and histological examination of the thermal lesions using immunohistochemistry revealed a positive impact of micro-ablative fractional CO<sub>2</sub> laser on the remodeling of vaginal connective tissue without damaging the surrounding tissue [35]. The process of remodeling the mucosa under the wound dressings allows the collagen to grow and the vaginal wall to thicken and tighten [35]. A similar study examined the clinical efficacy of Er: YAG laser using two different scopes; 90° and 360° among thirty postpartum females with Vaginal Relaxation Syndrome (VRS) that were divided randomly into two groups, each receiving specific multiple micro-pulse mode treatments with the 90° and 360° scopes [36]. Both Er: YAG regimens and VRS laser therapy showed significant improvements in vaginal relaxation. With multiple shots provided via scanning scopes in multiple micro-pulse modes, the non-surgical Er: YAG laser approach is painless, safe, devoid of side effects, easily tolerated and successful [36]. In 2013, an EBD was validated by the North American Menopause Society. The society acknowledged the use of lasers as an emerging intervention and that it may offer clinicians further alternatives to treat the common distressing problems related to genitourinary syndrome of menopause [37-40]. The shortcomings of these studies are the short-term results, small sample size, and the lack of randomization.

## Radiofrequency

Non-operative, monopolar radiofrequency (RF) treatment with cryogenic surface cooling offers a less invasive ambulatory approach for treating VL. Studies have shown that the density of small nerve fibers in the papillary dermis increased following the application of RF [33]. Moreover, the post RF treatment biopsy tests of the submucosa have shown neocollagenesis and neoelastogenesis [34]. The development of new elastin, which is fairly unique to RF, may help in treating VL [36]. Among the several types of RF devices, few with specific hand pieces have been developed for the vaginal canal [41]. Transurethral monopolar RF was also used in the treatment of stress urinary incontinence, and non-ablative RF treatment were used to tighten the vaginal canal [41,42]. The Vaginal Introitus's Viveve treatment to Evaluate Effectiveness (VIVEVE I) trial was the first RCT involving RF therapy for VL management. A single RF treatment was proven to be safe and was associated with the improvement of VL and sexual function. This RCT supported the application of novel nonsurgical treatment therapies for the management of VL [43].

Moreover, a prospective, single-arm study of 30 premenopausal women aged between 21 and 52 years that received 30-minute office-based procedures using RF on the vaginal introitus have shown a significant and sustainable improvement in the vaginal introital laxity and sexual satisfaction after a period of 12 months. The treatment was tolerated well without any adverse effects [44]. Nevertheless, the aforementioned studies lack solid scientific evidence examining their long-term benefits.

## High-Intensity Focused Ultrasound (HIFU)

High-intensity focused ultrasound has been recently introduced in the treatment of VL, with acclaimed promising effects. However, there are no published articles to support this claim yet.

## Surgical Approach

Methods to improve vaginal skin integrity also includes surgical intervention and a number of studies have been conducted to examine its effectiveness. Table 1 provides an overview of the studies related to different surgical procedures for the treatment of VL.

Author, Year	Sample Size	Study Design	Objective	Main Finding	Conclusion
Pardo et al., 2006 [40]	n=53	Observational study	To report the post-colporrhaphy general acceptability, and satisfaction, of women with sensation of a wide vagina.	After 6 months, compared to the pre-operation status, nearly two-thirds of the women reported an improvement in sexual life, 24% indicated significant improvement, 6% had slight improvement, while two patients (4%) did not improve at all. 94% women reported they have reached orgasm and 96% felt a sufficient tightening of the vagina.	Colporrhaphy is suggested to improve symptoms and enhance sexual gratification in a majority of the women.
Ulubay et al., 2016 [41]	n=38	Retrospective study	To compare preoperative and postoperative genital hiatus length, perineal length, and total vaginal length in patients treated with perineoplasty for the sensation of a wide vagina.	At 6-month follow-up, the success rate of the procedure was 87.9%, partner satisfaction rate was 92.6%.	With low dyspareunia rates, low complication rates, high patient satisfaction, and satisfactory anatomical success, perineoplasty can be considered successful for treatment of the sensation of a wide vagina.
Jamali et al., 2014 [42]	n=79	Prospective observational study	To evaluate the long term effect of colpoperineoplasty on sexual function among women who complained of VL.	At 18 months follow up, 76 women showed significant improvement in all aspects of sexual function as measured by Female Sexual Function Index (FSFI) questionnaire.	The long term effect of colpoperineoplasty in women who suffer from VL is promising.

Robinson et al., 2003 [43]	n=34	Retrospective observational study	To determine the effect of fascial posterior colpoperineorrhaphy on bowel and sexual function over a 5-year period.	Postoperatively prolapse symptoms due to rectocele decreased (88% versus 32%). Symptoms of vaginal pain (38% versus 17%), dyspareunia (33% versus 10%) and VL (25% versus 8%) were all significantly reduced. There was no significant difference in sexual activity (57% versus 45%).	Successful correction of posterior vaginal wall prolapse is possible using a fascial posterior colpoperineorrhaphy, leading to a significant improvement in symptoms of prolapse and dyspareunia without any deterioration in bowel or bladder function.
Goodman, 2011 [44]	-	Review study	To review the procedures designed to alter genital appearance and function; investigate sexual, philosophical, and ethical issues and examine outcomes.	Majority of studies regarding patient satisfaction and sexual function after vaginal aesthetic and functional plastic procedures report beneficial results, with overall patient satisfaction between 90–95%, and sexual satisfaction over 80–85%.	The majority of patients undergoing genital plastic surgery report overall satisfaction and subjective enhancement of sexual function and body image.
Porter et al., 1999 [45]	n=125	Retrospective observational study	To evaluate the anatomic, functional, and quality-of-life effects of site-specific posterior colporrhaphy in the surgical management of rectocele.	All daily aspects of living and emotional well-being improved significantly. Sexual function was not affected but dyspareunia significantly improved or cured in 73% of patients. No significant differences in vaginal dryness, orgasm ability, sexual desire, sexual frequency, or sexual satisfaction reported.	Defect-specific posterior colporrhaphy is equal to or superior to traditional posterior colporrhaphy and is successful restoring bowel function and does not detrimentally affect sexual function.
Paul et al., 2007 [46]	n=51	Prospective study	To assess sexual function following vaginal surgery and to determine the impact on postoperative sexual function in women who undergo concurrent antiincontinence procedures, compared with those who do not.	Improvements were noted in postoperative prolapse stage, Urogenital Distress Inventory (UDI-6), Incontinence Impact Questionnaire (IIQ-7). Female Sexual Function Index (FSFI) scores were not different based on performance of anti-incontinence surgery.	No change in sexual function following vaginal reconstructive surgery despite anatomic and functional improvements which was probably due to postoperative dyspareunia.

Bergman et al., 2020 [47]	n=70	Randomized controlled trial	To evaluate outcomes after pelvic floor muscle therapy, as compared with perineorrhaphy and distal posterior colporrhaphy, in the treatment of women with a poorly healed second-degree obstetric injury diagnosed at least 6 months postpartum.	Subjective global improvement was reported by 71% in the surgery group compared with 11% in the physical therapy group (treatment effect in percentage points 60% [95% CI 42–78%], odds ratio 19 [95% CI 5–69]). The surgery group was superior to physical therapy regarding all secondary endpoints.	Surgical treatment is effective and superior to pelvic floor muscle training in relieving symptoms related to a poorly healed second-degree perineal tear in women presenting at least 6 months postpartum. Although this could or could not be categorized under VL, it highlights evidence that surgical perineorrhaphy has a useful role.
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**Table 1:** Overview of studies related to the surgical treatment of vaginal laxity.

## Discussion

VL remains a multiplex medical condition that can be managed and treated by several healthcare professionals including urogynecologists, obstetricians, dermatologists, urologists, and plastic surgeons, yet there is still no clear consensus regarding the definitions of VL and the modalities of treatment that are most suitable for to treat this condition [48]. In an international survey assessing responses of physician members of IUGA, 83% of the 563 participants defined VL as under-reported by their patients [13]. A total of 58% of the respondents were urogynecologists with the majority considering VL as a self-reported inconvenient condition causing discomfort, affecting sexual function and relationships [13]. Moreover, in a study conducted on plastic surgery patients, one in six females reported VL and the authors deduced that vaginal deliveries resulted in the development of VL, and VL subsequently predisposed the studied women to the development of sexual distress [49]. Regarding the prevalence of VL, in a local study conducted at a tertiary care center in Riyadh, Saudi Arabia, the prevalence of VL among women attending the urogynecology clinics accounted for 35.9%, which is in line with a study conducted in the UK where the VL prevalence was 38% [8,11]. Standardized definitions and associations between VL, POP and sexual function need to be further studied. Evidence from RCTs are lacking, therefore, future RCTs are required to promote the therapeutic options for the newly proposed concept of VL.

## Conclusion

VL is a fairly new concept in pelvic medicine and the pathophysiology is sophisticated and not well understood yet. VL is believed to be linked to vaginal parity, younger age, a reduced vaginal sensation during intercourse and prolapse symptoms. To date, diagnosis is mainly based on the patient symptoms, confirmed by examination. Nevertheless, several QoL measures were tested

and were found to be of importance. Pelvic physiotherapy and EBDs have shown substantial therapeutic benefits, however, vaginoplasty and colporrhaphy have currently shown promising results that can improve the vaginal symptoms and sexual function.

## Declarations

**Availability of data and materials:** Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

**Authors' contributions:** NM and AB were responsible for the study concept and design. NM and MT reviewed the literature. NM, AB, and MT critically reviewed the manuscript and contributed intellectual content. All authors read and approved the final manuscript.

## References

1. Dietz HP, Stankiewicz M, Atan IK, Ferreira CW, Socha M. (2018) Vaginal laxity: what does this symptom mean? *Int Urogynecol J.* 29: 723-728.
2. Palacios S. (2018) Vaginal hyperlaxity syndrome: a new concept and challenge. *Gynecol Endocrinol.* 34: 360-362.
3. Dietz H, Wilson P, Milsom I. (2016) Maternal birth trauma: why should it matter to urogynaecologists?. *Curr Opin Obstet Gynecol.* 28: 441-448.
4. Krychman ML. (2016) Vaginal laxity issues, answers and implications for female sexual function. *J Sex Med.* 13: 1445-1447.
5. Rogers RG, Pauls RN, Thakar R. (2018) An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the assessment of sexual health of women with pelvic floor dysfunction. *Neurourol Urodyn.* 37: 1220-1240.
6. Kanter G, Rogers RG, Pauls RN, Kammerer-Doak D, Thakar R. (2015) A strong pelvic floor is associated with higher rates of sexual activity in women with pelvic floor disorders. *Int Urogynecol J.* 26: 991-996.

7. Haylen BT, de Ridder D, Freeman RM. (2010) An international Urogynecological association (IUGA)/International continence society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J*. 21: 5-26.
8. Campbell P, Krychman M, Gray T, Vickers H, Money-Taylor J, et al. (2018) Self-reported vaginal laxity prevalence, impact, and associated symptoms in women Attending a Urogynecology clinic. *J Sex Med*. 15: 1515-1517.
9. Van Raalte, H. (2012) "Tactile Imaging for Quantifying Vaginal Elasticity in Prolapse." *Nat. Rev. Urol*.
10. Braekken IH, Majida M, Engh ME, Bø K. (2010) Can pelvic floor muscle training reverse pelvic organ prolapse and reduce prolapse symptoms? An assessor-blinded, randomized, controlled trial. *Am J Obstet Gynecol*. 203: 170.e1-170.e1707.
11. Talab S, Al-Badr A, Alkusayer GM, Dawood A, Bazi T. (2016) Correlates of vaginal laxity symptoms in women attending urogynecology clinic in Saudi Arabia. *Int J gynecol Obstet*, 145: 278-282.
12. Jones GL, Radley SC, Lumb J, Jha S. (2008) Electronic pelvic floor symptoms assessment: tests of data quality of ePAQ-PF. *Int Urogynecol J Pelvic Floor Dysfunct*. 19: 1337-1347.
13. Price N, Jackson SR, Avery K. (2006) Development and psychometric evaluation of the ICIQ Vaginal Symptoms Questionnaire: the ICIQ-VS. *BJOG*. 113:700-712.
14. Millheiser LS, Pauls RN, Herbst SJ. (2010) Radiofrequency treatment of vaginal laxity after vaginal delivery: nonsurgical vaginal tightening. *J Sex Med*. 7: 3088-3095.
15. Laycock JO, Jerwood D. (2001) Pelvic floor muscle assessment: the PERFECT scheme. *PHSIAO*. 87: 631-642.
16. Manzini C, Friedman T, Turel F, Dietz HP. (2020) Vaginal laxity: which measure of levator ani distensibility is most predictive? *Ultrasound Obstet Gynecol*. 55: 683-687.
17. Egorov V, van Raalte H, Sarvazyan AP. (2010) "Vaginal Tactile Imaging". *IEEE Trans Biomed Eng*. 57: 1736- 1744.
18. Egorov V, van Raalte H, Lucente V, Sarvazyan A. (2016) Biomechanical characterization of the pelvic floor using tactile imaging. *In Biomechanics of the female pelvic floor 2016*: 317-348.
19. Parkinson LA, Rosamilia A, Mukherjee S, Papageorgiou AW, Melendez-Munoz J, et al. (2016) A fiber-optic sensor-based device for the measurement of vaginal integrity in women. *Neurourol Urodyn*. 38: 2264-2272.
20. Epstein LB, Graham CA, Heit MH. (2007) Systemic and vaginal biomechanical properties of women with normal vaginal support and pelvic organ prolapse. *Am J Obstet Gynecol*. 197: 165.e1-6.
21. Röhrnbauer B, Betschart C, Perucchini D. (2017) Measuring tissue displacement of the anterior vaginal wall using the novel aspiration technique in vivo. *Sci Rep*. 7: 16141.
22. Qureshi AA, Tenenbaum MM, Myckatyn TM. (2018) Nonsurgical vulvovaginal rejuvenation with radiofrequency and laser devices: A literature review and comprehensive update for aesthetic surgeons. *Aesthet Surg J*38: 302-311.
23. Aguilar P, Hersant B, SidAhmed-Mezi M, Bosc R, Vidal L, et al. (2016) Novel technique of vulvo-vaginal rejuvenation by lipofilling and injection of combined platelet-rich-plasma and hyaluronic acid: A case-report. *Springerplus*. 5:1184.
24. Park TH, Whang KW. (2015) Vaginal rejuvenation with Gore-Mycromesh. *Aesthet Plast Surg* 39: 491-494.
25. Park TH, Park HJ, Whang KW. (2015) Functional vaginal rejuvenation with elastic silicone threads: a 4-year experience with 180 patients. *J Plast Surg Hand Surg*. 49: 36-39.
26. Yang Y, Sheng H, Gu Q, Su L, Tong H, et al. (2020) Death Caused by Vaginal Injection of Hyaluronic Acid and Collagen: A Case Report. *Aesthet Surg J*. 40: NP263-NP268.
27. Kegel AH. (1948) Progressive resistance exercise in the functional restoration of the perineal muscles. *Am J Obstet Gynecol*. 56: 238-248.
28. Hagen S, Glazener C, McClurg D, Macarthur C, Elders A, et al. (2017) Pelvic floor muscle training for secondary prevention of pelvic organ prolapse (PREVPROL): a multicentre randomised controlled trial. *Lancet*. 389: 393-402.
29. Kolberg Tennfjord M, Hilde G, Staer-Jensen J, Siafarikas F, Engh ME, et al. (2016) Effect of postpartum pelvic floor muscle training on vaginal symptoms and sexual dysfunction-secondary analysis of a randomised trial. *BJOG*. 123: 634-642.
30. US Food and Drug Administration. (2018) FDA warns against use of energy-based devices to perform vaginal 'rejuvenation' or vaginal cosmetic procedures: FDA safety communication.
31. Kwon TR, Kim JH, Seok J, Kim JM, Bak DH, et al. (2018) Fractional CO2 laser treatment for vaginal laxity: A preclinical study. *Lasers Surg Med*. 50: 940-947.
32. Lee MS. (2014) Treatment of Vaginal Relaxation Syndrome with an Erbium:YAG Laser Using 90° and 360° Scanning Scopes: A Pilot Study & Short-term Results. *Laser Ther*. 23:129-138.
33. Gold M, Andriessen A, Bader A, Alinsod R, French ES, et al. (2018) Review and clinical experience exploring evidence, clinical efficacy, and safety regarding nonsurgical treatment of feminine rejuvenation. *J Cosmet Dermatol*. 17: 289-297.
34. Leibaschoff G, Izasa PG, Cardona JL, Miklos JR, Moore RD. (2016) Transcutaneous Temperature Controlled Radiofrequency (TTCRF) for the Treatment of Menopausal Vaginal/Genitourinary Symptoms. *Surg Technol Int*. 29: 149-159.
35. Tadir Y, Gaspar A, Lev-Sagie A, Alexiades M, Alinsod R, et al. (2017) Light and energy based therapeutics for genitourinary syndrome of menopause: Consensus and controversies. *Lasers Surg Med*. 49: 137-159.
36. Sadick NS, Malerich SA, Nassar AH, Dorizas AS. (2014) Radiofrequency: an update on latest innovations. *J Drugs Dermatol*. 13: 1331-1335.
37. Dillon B, Dmochowski R. (2009) Radiofrequency for the treatment of stress urinary incontinence in women. *Curr Urol Rep* 10: 369-374.
38. Krychman M, Rowan CG, Allan BB, DeRogatis L, Durbin S, et al. (2017) Effect of Single-Treatment, Surface-Cooled Radiofrequency Therapy on Vaginal Laxity and Female Sexual Function: The VIVEVE I Randomized Controlled Trial. *J Sex Med*. 14: 215-225.
39. Sekiguchi Y, Utsugisawa Y, Azekosi Y, Kinjo M, Song M, et al. (2013) Laxity of the vaginal introitus after childbirth: nonsurgical outpatient procedure for vaginal tissue restoration and improved sexual satisfaction using low-energy radiofrequency thermal therapy. *J Womens Health (Larchmt)*. 22: 775-781.



40. Pardo JS, Solà VD, Ricci PA, Guiloff EF, Freundlich OK. (2006) Colpoperineoplasty in women with a sensation of a wide vagina. *Acta Obstet Gynecol Scand.* 85: 1125-1127.
41. Ulubay M, Keskin U, Fidan U, Ozturk M, Bodur S, et al. (2016) Safety, Efficiency, and Outcomes of Perineoplasty: Treatment of the Sensation of a Wide Vagina. *Biomed Res Int.* 2016: 2495105.
42. Jamali S, Abedi P, Rasekh A, Mohammadjafari R. (2014) The Long Term Effect of Elective Colpoperineoplasty on Sexual Function in the Reproductive Aged Women in Iran. *Int Sch Res Notices.* 2014: 912786.
43. Robinson D, Wadsworth S, Cardozo L, Bidmead J, Balmforth J. (2003) Fascial posterior colpoperineorrhaphy: a five year follow-up study. *Female Pelvic Med. Reconstr. Surg.* 9: 279-283.
44. Goodman MP. (2011) Female genital cosmetic and plastic surgery: a review. *J Sex Med.* 8:1813-1825.
45. Porter WE, Steele A, Walsh P, Kohli N, Karram MM. (1999) The anatomic and functional outcomes of defect-specific rectocele repairs. *Am J Obstet Gynecol.* 181: 1358-1359.
46. Pauls RN, Silva WA, Rooney CM, Siddighi S, Kleeman SD, et al. (2007) Sexual function after vaginal surgery for pelvic organ prolapse and urinary incontinence. *Am J Obstet Gynecol.* 197: 622.e1-7.
47. Bergman I, Westergren Söderberg M, Ek M. (2020) Perineorrhaphy Compared With Pelvic Floor Muscle Therapy in Women With Late Consequences of a Poorly Healed Second-Degree Perineal Tear: A Randomized Controlled Trial. *Obstet Gynecol.* 135: 341-351.
48. Newman R, Campbell PC, Gooneratne ML, Lowenstein L, Mu G, et al. (2018) Genito pelvic vaginal laxity: classification, etiology, symptomatology, and treatment considerations. *Curr Sex Health Rep.* 10: 222-236.
49. Qureshi AA, Sharma K, Thornton M, Myckatyn TM, Tenenbaum MM. (2018) Vaginal Laxity, Sexual Distress, and Sexual Dysfunction: A Cross-Sectional Study in a Plastic Surgery Practice. *Aesthet Surg J.* 38: 873-880.