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WOMEN'S HEALTH REHABILITATION (S BENNIS AND C FITZGERALD, SECTION EDITORS)

Pelvic Floor Dysfunction in Women

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Abstract

Purpose of Review The purpose of this review is to give an overview of pelvic floor muscle (PFM) dysfunction in women including evaluation, diagnosis, and treatment.

Recent Findings The prevalence of PFM dysfunction is thought to be higher in women and may contribute to urinary, defecatory, and sexual dysfunction, as well as chronic pelvic pain.

Summary PFM dysfunction is more prevalent amongst athletes, women who have given birth, and postmenopausal women than the general population. Stress and urge incontinence, urinary frequency and urgency, functional constipation, and fecal incontinence are all symptoms that may result from PFM dysfunction. PFM dysfunction can also cause chronic pain as seen in pelvic floor myofascial pain syndrome, bladder pain syndrome, and vestibulodynia/vulvodynia. Physiatrists play a key role in the comprehensive management of these conditions via behavioral and lifestyle modifications, focused pelvic physical therapy interventions, medications, and therapeutic injections.

Keywords Pelvic floor dysfunction · Incontinence · Constipation · Pelvic pain · Dyspareunia · Pelvic physical therapy

Introduction

The pelvic floor is a historically overlooked contributor to urinary, defecatory, and sexual dysfunction, as well as chronic pelvic pain. In recent years, the role of the pelvic floor and disorders of pelvic floor dysfunction have garnered increasing attention amongst physiatrists, both clinically and as a topic of research. The pelvic floor is composed of muscles, ligaments, and fascia that function through coordinated contraction and relaxation to provide support to the bladder, reproductive organs, and rectum, to maintain continence, to stabilize the core and connecting joints of the pelvis, and to aid in sexual function.

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The prevalence of pelvic floor muscle (PFM) dysfunction is unknown as it is typically underreported and may present differently from patient to patient. The prevalence is thought to be higher in women due to the greater stability required to support the broader and shallower female pelvis, as well as increased risk of injury with pregnancy and childbirth [1, 2]. Pelvic floor dysfunction has an established association with lower urinary tract symptoms (LUTS) [3–5] which include storage symptoms (such as incontinence, urgency, frequency, and nocturia), voiding symptoms (such as abnormal stream and hesitancy), and lower urinary tract and genital pain, as well as symptoms associated with pelvic organ prolapse, sexual intercourse, and the post-micturition phase [6, 7]. Studies have shown the prevalence of lower urinary tract symptoms in women to be as high as 76% [8]. The lifetime prevalence of sexual pain disorders is estimated to be 17–19%, although providers who treat these disorders are likely to agree that these symptoms are underreported [9]. It is important to recognize the overlap of these PFM dysfunction–associated conditions, which can be witnessed clinically and is supported by the literature. For example, a 2010 study of patients with defecatory disorders found that 82% also had at least 2 urinary symptoms and 57% had 4 or more symptoms of voiding dysfunction [10].

The mechanism of PFM dysfunction is often unknown, but several plausible hypotheses have been proposed. These include the following: learned dysfunctional voiding or defecation patterns, gynecologic conditions resulting in dyspareunia leading to involuntary muscle contraction of PFMs, injury to the pelvic floor muscles and/or nervous system structures from surgery, childbirth, or trauma, visceral pain syndromes leading to central and peripheral sensitization and neuropathic upregulation, postural and gait abnormalities, skeletal asymmetry, trauma, and abuse [11–21]. While patients often desire to identify the reason they developed these symptoms, it is important to educate these patients that the initial cause of dysfunction is often never identified and is not typically necessary to initiate appropriate treatment.

Anatomy

The superficial muscles of the pelvic floor include the bulbospongiosus, ischiocavernosus, and superficial and deep transverse perineal muscles (Fig. 1). The deep PFMs include the levator ani group and coccygeus, which together with the endopelvic fascia, make up the pelvic diaphragm. The levator ani group includes three distinct muscles—the puborectalis, pubococcygeus, and iliococcygeus, which work together to close the urogenital hiatus at rest and with increased abdominal pressure [22]. Additional muscles of the pelvic floor include the obturator internus and the piriformis, which function to rotate and stabilize the thigh at the hip joint. The superficial and deep PFMs are innervated by S2–S5. The pudendal nerve arises from the ventral branches of S2–S4 and has a tortuous course. The pudendal nerve passes between the piriformis and coccygeal muscles, through the sciatic foramen, over the ischial spine, and back into the pelvis through the lesser sciatic foramen, where it enters Alcock's canal along the obturator fascia. There are three main terminal branches of the pudendal nerve which innervate the bulbospongiosus, ischiocavernosus, and anterior levator ani muscles, amongst other structures. The remainder of the levator ani group is directly innervated by the S3–S5 sacral nerve roots. The pelvic floor muscles are 70% slow-twitch, striated skeletal muscle and provide nearly constant muscle tone to the pelvic floor [23••]. These fibers sustain tone and provide endurance for contractions, which are initiated by a lesser number of fast-twitch fibers [24].

Evaluation

Clinically, PFM dysfunction is most commonly diagnosed via physical examination, with further imaging or additional diagnostic modalities utilized on an as-needed basis. The physiatric pelvic floor examination is conducted primarily to evaluate PFMs, ligaments, and nerves and should be explained as such to the patient. The examiner should also supply an additional explanation that they will not be evaluating the gynecologic, urologic, or gastroenterologic organs, which may warrant additional specialist evaluation. The pelvic floor

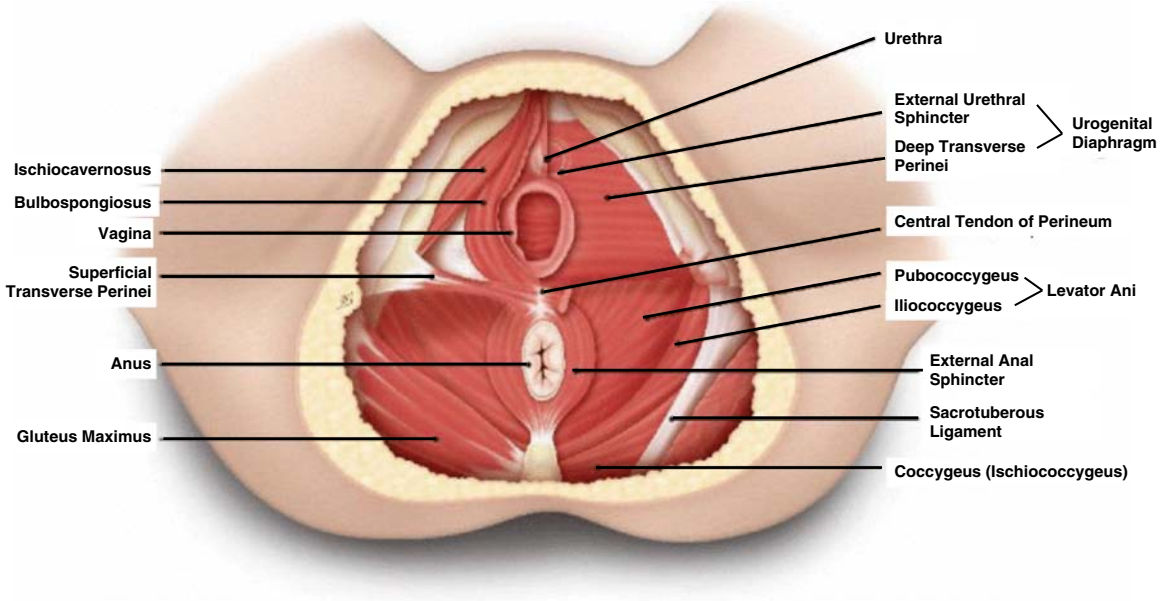

Fig. 1 Superficial (left) and deep (right) female pelvic floor musculature. Image created by Ilaria Bondi, originally published in *Management of Fecal Incontinence* [8]

neuromuscular examination is an extension of the standard physiatric neuromuscular examination and consists of the same components—inspection, palpation, sensory and reflex testing, strength testing, and special maneuvers. The goal is to evaluate for the type and severity of PFM dysfunction (typically qualified as underactive, overactive, or with attributes of both), appropriate coordination of pelvic floor activity, and neurologic compromise and to localize pain generators. When a patient has complaints of urinary or fecal incontinence (FI) or retention, it is important for the provider to rule out neurological disease such as multiple sclerosis or cauda equina syndrome [2].

The physiatric pelvic floor examination is conducted with the patient lying supine with knees bent and feet planted (hook-lying), hips externally rotated, and legs in a "butterfly" position, or with use of gynecologic stirrups, with the patient rolling to lateral decubitus for the optional rectal component of the examination. These authors have found that the hook-lying and "butterfly" positions allow for increased relaxation of the pelvic floor musculature compared with the use of gynecologic stirrups, but there is no available data to support this. External inspection of the genitals should include evaluation for vulvar tissue atrophy, scars, visible prolapse, obvious asymmetry, and hemorrhoids, which may provide further insight into the patient's diagnosis. Visualization of concerning erythema, adhesions, lesions, or swelling may warrant referral to the appropriate specialist. Next, the examiner can visualize the coordination of PFM activity via observation of several voluntary and involuntary motions. Kegel, or voluntary pelvic floor contraction, should prompt lifting of the perineal body, while relaxation should prompt perineal body descent. Patients with overactive PFMs typically demonstrate reduced perineal lift with contraction as their PFMs are already held in a contracted state, with minimal and sluggish descent upon relaxation. Involuntary contraction/lift should be seen with cough and involuntary relaxation/descent should be visualized with Valsalva. One may observe the opposite in patients with stress urinary incontinence (descent with cough) or pelvic floor dyssynergia (lift with Valsalva). Sensory examination of the sacral dermatomes and peripheral cutaneous nerved should be conducted, testing both soft touch and pinprick, as well as the anal wink reflex to evaluate the sacral reflex arc [25, 26]. Q-tip test for provoked vestibulodynia/vulvodynia is conducted by lightly applying pressure at the vaginal vestibule at the 12, 3, 6, and 9 o'clock positions to elicit pain allodynia. There is an established connection between provoked vestibulodynia/vulvodynia, which is described later in this article.

The superficial PFMs are evaluated first via palpation, either externally or with vaginal insertion of the examiner's lubricated, gloved first digit to the proximal interphalangeal joint. The deep PFMs are most readily palpated via the vaginal introitus in female patients. Visualizing a clock-face with the pubic symphysis at 12 o'clock and the perineal body at 6 o'clock can help to identify the anatomic position of these muscles [2]. The levator ani group is palpated from 3 to 5 o'clock on the patient's left and 7 to 9 o'clock on the patient's right with the pubococcygeus located more anteriorly and the iliococcygeus posteriorly (deep). The arcus tendineus is palpable at approximately 3 and 9 o'clock with the obturator internus just above. Palpation of obturator internus can be facilitated by asking the patient to externally rotate the thigh of the ipsilateral leg against resistance, which causes the muscle belly to bulge medially towards the examiner's finger [2]. All muscles are assessed for tenderness, trigger points, and taught bands. Strength and 10-s endurance testing of the musculature should be conducted in all 4 quadrants, utilizing the Modified Oxford Scale (MOS) as outlined in Table 1. Of note, inter-rater reliability is shown to be fair to poor for pelvic floor muscle testing using the MOS [27], with more objective measures such as pressure dynamometry [28] and palpometry [20] typically reserved for the research setting. Internally, a Tinel sign of the pudendal nerve is evaluated by tapping just inferior to the ischial spines bilaterally. If additional information is needed, a rectal examination can be performed to assess anal sphincter tone, coccyx tenderness and alignment, the coccygeus muscle, and puborectalis function [25, 26].

It is worth noting that there is a variation amongst providers as to how the pelvic floor musculoskeletal examination is conducted as there is currently no standardized musculoskeletal women's health curriculum as part of Physical Medicine and Rehabilitation Accreditation Council for Graduate Medical Education (ACGME) requirements. Many current providers are self-taught [29].

Imaging studies should be ordered on a case-by-case basis if clinical concern warrants. This may include plain film X-rays to assess bony anatomy, ultrasound examination of pelvic floor neuromuscular anatomy, or MRI. As the utility of ultrasound exam is largely user-dependent and as ultrasound evaluation of the pelvic floor is highly specialized, MRI evaluation may be preferred. The soft tissue resolution offered by MRI

Table 1 Modified Oxford Scale (modified from Prather, 2009)

Scale:
0/5 = No discernable muscle contraction
1/5 = Flicker or pulsation only, no discernable lifting or tightening
2/5 = Weak contraction, no discernable lifting or tightening
3/5 = Moderate contraction, some lifting of the vaginal wall with tightening around the examiner's finger
4/5 = Good contraction, elevation of the vaginal wall against resistance with drawing in of the perineum, able to be maintained for 5 or more seconds
5/5 = Strong contraction, as above with endurance sufficient to maintain hold for 10 or more seconds

allows for an accurate and detailed assessment of pelvic floor anatomy including the integrity of ligaments and muscles and may identify anatomic defects that correlate with functional abnormalities [30]. Delancey and colleagues have proposed MRI to be an effective way to evaluate levator ani damage, with appreciable differences in PFM bulk and symmetry in postpartum women compared with nulliparous women [31]. Addition of dynamic maneuvers including Valsalva maneuver and instructed Kegel offers the additional benefit of real-time visualization of pelvic floor function and pelvic organ prolapse. In general, however, advanced pelvic floor imaging is not routine. These imaging modalities may be restricted to highly specialized academic centers and require collaboration with radiology colleagues to determine the most appropriate imaging protocol to best evaluate specific areas of concern.

Discussion of additional advanced diagnostics including MR neurography, anorectal manometry, defecography, urodynamic studies, and electromyography is outside the scope of this article.

Urinary Dysfunction and Lower Urinary Tract Symptoms

Specific populations of women have been found more affected by PFM disorders and especially urinary incontinence. This includes athletes, those who have given birth, postmenopausal women, and smokers.

Studies have been performed on different populations of female athletes and have found between a 15 and 73% prevalence of urinary incontinence (UI) in female athletes [32•]. The exact etiology of this increased prevalence is unknown. However, there are several proposed theories to explain the increased incidence of PFM dysfunction in female athletes, including a common theory explaining this phenomenon as a result of increased intra-abdominal force while landing from a jump or running. Another theory, the hammock hypothesis, proposes that PFMs are weakened by an increased force that causes muscle stretching [33, 34]. This leads to tissue fatigue and eventually damage, resulting in abdominal pressure overpowering the urinary sphincter and stress incontinence. Meanwhile, the neural hypothesis proposes that increased force causes pudendal nerve stretching which results in denervation of the urinary sphincter [22, 33, 35, 36]. Other researchers attribute the increase in PFM disorders in athletes to the pathologically increased strength of the muscles, most notably the levator ani, which MRI reviews have found to be hypertrophied in studied female athletes [32•].

Postpartum pelvic floor dysfunction is thought to be a result of a similar mechanism to the hammock hypothesis and neural hypothesis. Studies estimate a 4.8–35.6% prevalence of stress urinary incontinence in the postpartum period [37]. Vaginal delivery is highly correlated with PFM disorders due to direct trauma to the pelvic floor. In particular, forceps assistance, increased BMI or fetal birth weight, and a prolonged second stage of labor are associated with PFM dysfunction [38].

Pelvic floor dysfunction is also more common in postmenopausal women than the general population. Barlow and colleagues found 48.5% of studied postmenopausal women to be affected by urogenital symptoms of PFM dysfunction at some point since reaching menopause [39]. This is thought to be a result of menopause decreasing the production of not only estrogen but also estrogen (β) and progesterone receptors [40]. For example, estrogen inhibits calcium from entering detrusor muscle cells when muscarinic receptors are activated [40]. This causes decreased contractility and increased involuntary contractions of the detrusor muscle, resulting in urinary incontinence [40, 41]. In addition, weakened pelvic floor muscles contribute to urinary incontinence in this population and decreased sexual function [42].

Smoking and obesity have also been linked to urinary incontinence. The increased number of cigarettes smoked in a lifetime was seen to increase the likelihood of stress urinary incontinence (SUI) as compared with nonsmokers [43]. Other studies have found a higher prevalence of urge incontinence in heavy smokers, defined as a lifetime tar consumption of 100–1500 g or lifetime nicotine consumption of 15.84 to 240 g [44]. Smoking over 20 cigarettes per day is associated with an increased incidence of any type of incontinence [45]. It is thought this is due to increased intra-abdominal pressure due to chronic cough. Fuganti and colleagues found both smoking and obesity led to increased maximal intravesical peak pressures generated by cough, correlating with an increased incidence of UI in smokers and those with a BMI over 30 [46].

Lower urinary tract symptoms (LUTS) are commonly experienced with urinary dysfunction. LUTS consist of urinary incontinence or complaints of involuntary loss of urine, bladder storage symptoms including increased frequency and urgency, sensory symptoms or a change in normal sensation with bladder filling, and voiding, and post-micturition symptoms including changes in stream or pain with urination, as well as sexual dysfunction [7].

Stress Urinary Incontinence

SUI is defined as a complaint of involuntary loss of urine on effort or physical exertion and is classically seen with laughing, coughing, sneezing, jumping, and other activities where intra-abdominal pressure is increased [7]. Stress urinary incontinence (SUI) is a result of intra-abdominal pressure exceeding urethral sphincter strength [47]. Decreased urethral sphincter strength may result from increased urethral mobility due to decreased strength of pelvic floor muscle contraction or decreased urethral support [48].

SUI is commonly diagnosed based on patient report. Screening tools like the International Consultation of Incontinence Questionnaire Urinary Incontinence (ICIQ) and Bristol Female Lower Urinary Tract Symptoms (BFLUTS) are used not only to screen for incontinence but also assess the quality of life and possible causes of UI. Other tests like the International Continence Society Uniform Cough Stress Test (ICS-UCST) can be used to further evaluate the severity of SUI. The Cough Stress Test (CST) should be done in the supine or lithotomy position during the vaginal examination when the patient has between 200 and 400 mL of urine present in the bladder. The patient is then instructed to cough as hard as possible until they are incontinent, coughing a maximum of 4 times. A positive test result is obtained when urine dribble is seen synchronized with the cough. Results of the CST are reported with the bladder volume [49]. If the CST does not result in a positive result, the 1-h and 24-h pad tests can be done for further evaluation of SUI [50].

Treatment for SUI can range from conservative management to injections and surgery. As obesity is a risk factor, weight loss of 5% or more of total body weight can result in significant improvement in SUI and may be the only intervention needed for dramatic quality of life improvement [51]. Pelvic floor physical therapy, including the practice of pelvic floor strengthening exercises and coordination of PFM contraction and relaxation, has also been shown to improve symptoms of SUI [22]. A meta-analysis of four studies comparing PFM physical therapy with no treatment showed women were 17 times more likely to report improvement or cure after physical therapy [52]. Electrical stimulation and biofeedback are commonly used in therapy sessions, as well as weighted vaginal cones. However, the use of weighted vaginal cones in therapy results in similar improvement rates as therapy focused on behavioral interventions alone [53]. The Ambulatory Treatments for Leakage Associated with Stress Incontinence (ATLAS) trial showed continence pessary use results in similar satisfaction rates as pelvic floor physical therapy with a 91% pessary satisfaction rate and an 87% satisfaction rate with therapy [54]. In addition, the ATLAS trial showed an 85% satisfaction rate in those using both treatment modalities, showing no benefit in both participating in PFM physical therapy and using a pessary as compared with using one treatment alone [54]. However, many women do not find continence pessaries comfortable and become noncompliant [47].

If patients fail to improve with pelvic floor therapy and pessary management, they should be referred to a urogynecologist or urologist for further evaluation and consideration for medication or surgical management options, further discussion of which is outside the scope of this article.

Urge Urinary Incontinence

Urge urinary incontinence (UUI) is defined as the complaint of involuntary loss of urine associated with urgency [7]. UUI is caused by detrusor muscle or PFM contractions and spasms, which can result from hyper-excitability or a disruption to the innervation of these muscles [41]. Obesity, parity, chronic constipation, and aging are risk factors for urge incontinence [41, 55]. When using electron microscopy to examine detrusor biopsies in adults ages 65–96, Elbadawi and colleagues found dysfunctional structural changes of the detrusor muscle to be correlated with symptoms of overactivity of the detrusor and symptoms of urge incontinence [56].

UUI can be seen transiently in conditions such as a urinary tract infection (UTI). Other common causes include habitual urge suppression during childhood or adulthood, sexual abuse, and anxiety [57]. Diagnosis and exam is similar to SUI, with the addition of urinalysis to rule out UTI [41, 48].

PFM PT for UUI consists of education about PFM anatomy and function, and behavioral modifications such as fluid management and urge suppression techniques [58]. Urge suppression involves encouraging patients not to rush to the bathroom as the act of rushing increases the likelihood of incontinence, but to relax and suppress the urge and not make way to the toilet to void until the urge has been suppressed [59]. Bladder training is another behavioral modification that involves scheduled voids throughout the day with progressive prolongation if voiding intervals [47]. Myofascial release and exercises focused on PFM coordination as well as electrical stimulation and Kegel exercises are utilized to strengthen PFMs involved in urge suppression [58]. Women who do not improve with PFM PT and behavioral modification should be referred to a urogynecologist or urologist for further evaluation and consideration for medication or surgical management options.

Urinary Urgency and Frequency

Urinary frequency and urgency are common symptoms, especially as women age. Urinary frequency is defined as the complaint that micturition occurs more frequently during waking hours than previously deemed by the woman [7]. Urgency is the complaint of a sudden, compelling desire to pass urine which is difficult to defer [7]. Also related is overactive bladder (OAB), which is defined as urinary urgency, with or without UUI, frequency, and nocturia, without another identifiable cause [7].

Urinary frequency varies in prevalence, but it has been reported in at least 15.5% of women over the age of 60 [60–63]. Both urinary urgency and frequency can be caused by a variety of factors including medical, psychosocial, sexual, neurological, urological, gynecologic, endocrine, and pharmacologic variables [60, 64]. In addition, the experience of

urinary frequency and urgency is commonly compounded by other symptoms including urinary incontinence, bladder and lower abdominal pain, and dysuria [60] which are all commonly associated with PFM dysfunction in women [57].

A positive exam includes tenderness or reproduction of bladder pressure or urge with palpation of the PFMs [57]. It is important to specifically palpate the obturator internus and levator muscles as those are commonly involved. If an exam is positive, treatment for OAB, urinary urgency, and frequency is similar to UUI and can be referenced above. This includes PFM physical therapy with urge suppression, bladder training, biofeedback, and myofascial release [58–60]. Refractory cases should be referred for urology or urogynecology for further evaluation and treatment.

Defecatory Dysfunction

Defecatory dysfunction encompasses a broad range of symptoms related to dysfunction of evacuation of the rectum, including constipation and fecal incontinence (FI) [65]. Pelvic floor disorders are associated with and may be the cause of defecatory dysfunction in some women [65]. Symptoms of constipation, straining, sense of incomplete emptying, splinting, and FI are more commonly seen in those with urinary incontinence and pelvic organ prolapse than in the rest of the population [66, 67].

Defecatory dysfunction is commonly seen postpartum, due to increased stretching of the pubococcygeal muscle when compared with other structures. This can cause weakening or rupture of the pubococcygeus, which most likely contributes to the high rate of PFM dysfunction, or specifically levator ani injury postpartum [68]. Urbankova and colleagues found 43% of postpartum women were found to have levator ani muscle injury, while forceps assist made women 3.2 times more likely to have a levator ani muscle avulsion [38]. Hafsa and colleagues found similar results with forceps delivery, tripling levator ani avulsion 10 years post-delivery when compared with vacuum assist [69].

Constipation

Constipation is defined by the Rome III criteria as having two or more of the following: straining, feelings of incomplete defecation, sensation of obstruction, or having lumpy/hard stools in 25% or more of defecations, less than three bowel movements per week, and no loose stools without laxative use. In addition, one must experience these symptoms throughout the last 3 months and not meet irritable bowel syndrome criteria [66].

Constipation is present in 2 to 28% of Americans and accounts for over 2.5 million physician appointments each year [66]. There are many causes of constipation including endocrine, metabolic, mechanical, structural, psychological, and pharmacologic disorders. Constipation can be further classified into subtypes including slow transit and evacuation disorders [70]. Evacuation disorders are separated into structural disorders, including structural outlet obstruction, and functional disorders, including dyssynergic defecation [70]. Prevalence studies have reported slow transit constipation in 4.3–13% of patients experiencing constipation, and outlet obstruction in 25–27.3% [71]. Dyssynergic defecation is the inability of the PFM, specifically the external anal sphincter and puborectalis, to relax during defecation [67]. Dyssynergic defecation commonly leads to obstructive constipation in 25–50% of adults with constipation and 50% of children who suffer from constipation [72–74]. Additionally, a shortened puborectalis muscle makes evacuation more difficult and painful by making the anorectal angle more acute and less open for stool to pass through. Constipation due to PFM dysfunction can be diagnosed through a physical examination, balloon expulsion test, or manometry imaging [67]. If a patient has yet to have a thorough medical workup of constipation, consideration should be given for referral to gastroenterology for evaluation and medical management [75].

Increasing water intake is recommended for those suffering from constipation. A high-fiber diet has not been seen to improve constipation due to PFM dysfunction or dyssynergia [76]. Constipation due to dyssynergia can be effectively treated with PFM physical therapy. Sessions should consist of biofeedback, which teaches the abdominal muscles to coordinate with the PFMs. Beginning sessions focus on patient education, then move to include training in straining and pelvic floor relaxation, and later sessions involve simulated defecation and sensory retraining [70]. In addition, intra-rectal balloons can be used to help with coordination as well as an anal dilator and myofascial release to further help with PFM relaxation [2, 75]. Therapists will also be able to instruct the patient on breathing techniques and proper posture. Hip flexion achieved by a forward lean, squatting, or placing feet on a stool is efficacious due to the straightening of the anorectal angle, which decreases the need for straining [77].

Pharmacological treatment of constipation involves use of stool softeners, laxatives, and laxative enemas and is typically managed collaboratively with the patient's primary care physician or gastroenterologist [2].

Fecal Incontinence

Non-neurogenic fecal incontinence (FI) is the involuntary loss of solid or liquid stool, which can cause hygienic, social, and quality of life issues for patients [66]. A 2009 study estimated that 9% of US women suffer from FI [66]. Pathology of the anal sphincter, neural input, and PFM function, as well as stool consistency, can lead to FI [65]. There are two theories regarding PFM involvement in FI. The first states PFM

contraction can counteract defecation, causing incomplete defecation and the resulting post-defecation residual can lead to FI. Others believe there are similar mechanisms of FI and defecatory disorders. For example, decreased ability to defecate due to decreased strength or neural input causes the rectum to become distended and sensations blunted. This decreased strength and sensation could also affect the sphincter, leading to FI [78]. FI can be staged by the St. Mark's Scale, also known as the Vaizey Scale, in order to evaluate the severity and help guide treatment [79].

Conservative treatment can be initiated after history and physical examination. For FI, this includes absorbent pads and increasing fiber in the diet. Treatment options also include pelvic floor physical therapy with PFM exercises, electrical stimulation to the puborectalis in order to increase the strength of contraction, and biofeedback to improve duration, timing, coordination of contraction, and relaxation [80]. These treatments as well as use of an intra-rectal balloon are used to help PFMs build endurance, improve sensitivity, and coordinate with the anal sphincter [2]. However, use of a rectal balloon in pelvic floor physical therapy is controversial as some studies showed no improvement in FI when compared with pelvic floor physical therapy alone [81].

If a patient with constipation or FI does not improve with behavioral modifications and PFM PT, then referral to a gastroenterologist should be considered in order to obtain a comprehensive workup including motility studies and MR defecography, as well as discuss further options for management including medications and mechanical inserts. A referral to colorectal surgery is also encouraged to further evaluate for utility of sacral nerve stimulation or surgical intervention [66, 67].

Pelvic Floor Dysfunction–Associated Pain

Pelvic Floor Myofascial Pain

PFM dysfunction can lead to myofascial pain complaints via persistent muscle spasm, formation of trigger points, and dyssynergia of the PFMs. Most commonly, painful pelvic floor musculature is widely attributed to the functional demand of these muscles and occurs through overuse injuries, repetitive strains, and postural dysfunction [82]. PFMs may also be painful due to pelvic visceral disorders causing dysfunction via the viscerosomatic reflex, prior injury and scar tissue, or iatrogenic causes including mesh erosion, scarring, or infection [83].

Studies have found at least 22% of women with chronic pelvic pain to have pelvic floor myofascial pain on exam [84]. The nomenclature used when discussing pelvic floor myofascial pain is varied and can be a point of confusion for patients and providers. Terminology used includes spastic pelvic floor syndrome, pelvic floor tension myalgia, and high-tone pelvic floor dysfunction. These terms describe PFMs that tend towards overactivity, consistent with findings that patients with chronic pelvic pain often have overactive PFMs on physical examination [83]. Patients may report associated symptoms of urinary urgency, frequency [57, 60], or hesitation, vulvar pain [85, 86], dyspareunia (pain with vaginal penetration) [87], or difficulty in defecating (dyschezia) [88]. Physical examination often reveals PFMs that are hypertonic, shortened, in spasm, tender to palpation, and/or with trigger points [83]. Physiatric treatment of pelvic floor myofascial pain consists primarily of pelvic physical therapy with a focus on "downtraining," judicious use of medications, and therapeutic injections.

Several other complex pelvic pain complaints, such as interstitial cystitis/bladder pain syndrome (IC/BPS) and vestibulodynia/vulvodynia, have been found to be strongly associated with PFM muscle dysfunction [57, 82, 85, 86, 89–93]. Recent studies have found a prevalence of pelvic floor myofascial pain in patients with IC/BPS to be as high as 78.5 and 87% [57, 89]. In their 2005 study, Reissing and colleagues found that 90% of women diagnosed with provoked vestibulodynia demonstrated PFD [85]. This finding has been supported by multiple studies since including the 2015 Evidence-Based Vulvodynia Assessment Project, which showed that 90% of women with vulvodynia had muscular abnormalities in the pelvic floor [86]. In-depth discussion of these conditions is beyond the scope of this article.

Physiatric Treatment of Pelvic Floor Dysfunction

Patients experiencing pelvic floor dysfunction and the associated discussed symptoms most often benefit from multidisciplinary, collaborative care. This should include a physiatrist-led trial of conservative, rehabilitation-focused management focused on functional improvement. This includes patient education, behavior modification, bowel and bladder management, specialized pelvic floor physical therapy focused on neuromuscular re-education and restoring appropriate biomechanical function, judicious medication use, and therapeutic injections when appropriate. Given the complexity of pelvic floor dysfunction, these patients may benefit from evaluation and management by a multidisciplinary physician team including specialties such as physiatry, urogynecology, urology, gastroenterology, colon and rectal surgery, and pain psychology.

Pelvic Floor Physical Therapy

The most effective pelvic floor physical therapy, as with other neuromuscular physical therapy interventions, maximizes

active patient engagement and education while utilizing passive treatment tools as an adjunct. Treatment regimens are customized to each patient's specific symptoms, patterns of dysfunction, and functional goals. Treatment tools include behavioral modification, neuromuscular re-education, pelvic floor relaxation techniques ("downtraining"), strengthening of weak muscles, soft tissue mobilization/myofascial release, dilator training, biofeedback, ultrasound, and electronic stimulation [82, 91, 92, 94–97].

Many patients have been led to believe that Kegel exercises are the answer to all pelvic issues when, in actuality, many patients would benefit from release and lengthening of overactive pelvic floor muscles followed by a functionally focused strengthening program when, and if, appropriate [82]. Patients should be instructed in a home exercise program to maximize the benefit of individual therapy sessions. As appropriate treatment of complex pelvic floor dysfunction patients often takes months to years of coordinated care, it is recommended that physicians establish relationships with their therapy team and maintain a culture of open communication and collaboration between physician and therapist.

Studies evaluating the effectiveness of pelvic physical therapy intervention are often limited by sample size and lack of a standardized physical therapy protocol. Several high-quality qualitative studies exist that emphasize the efficacy of pelvic physical therapy as part of the multidisciplinary approach for PFM dysfunction with concurrent sexual dysfunction [93, 98–101]. This is thought to be due to improved muscle tone and circulation physically [98] with the added benefit of patient self-empowerment [95].

In 2013, the 5th International Consultation on Incontinence compiled a current reference source on the conservative management of UI and pelvic organ prolapse which proposes that pelvic floor muscle training be the first-line treatment for UI with high levels of evidence and grades of recommendation [52]. These findings are supported by a 2015 retrospective chart review of 271 women with UI found 54% of women to report successful control of symptoms with pelvic floor physical therapy. Poorer initial incontinence scores were associated with poorer outcome and less success with pelvic floor physical therapy [102].

A 2018 systematic review and meta-analysis assessing the efficacy of pelvic floor muscle training on prevention and treatment of pelvic floor disorders in postpartum women was unable to conclude if pelvic floor muscle training is beneficial for pelvic organ prolapse symptoms, due to lack of high-quality data [103]. Pelvic floor muscle training was suggested to slightly improve postpartum women's sexual function within 1 year postpartum and likely improves UI, particularly SUI symptoms [103].

There continues to be a dearth of well-powered randomized controlled trials supporting the effectiveness of pelvic floor physical therapy for various symptoms of pelvic floor dysfunction. However, sufficient qualitative and retrospective data exists to support initial trial of physical therapy as a low-risk first-line treatment.

Pharmacologic Management

The use of medications in the management of pelvic floor dysfunction is to treat pain, relax overactive muscles, improve sleep, and support improved tolerance of pelvic floor physical therapy interventions. Commonly used first-line treatments include NSAIDs and acetaminophen followed by low-dose oral skeletal muscle relaxants such as cyclobenzaprine, baclofen, and methocarbamol [82]. There are a number of compounded suppository medications used for the treatment of symptomatic overactive pelvic floor dysfunction, many including diazepam ± an array of additional agents such as baclofen, gabapentin amitriptyline, and ketamine. While the literature is minimal [46], it is important to note that, while the serum plasma concentration of vaginally administered diazepam is low, the half-life is prolonged [104]. Additional commonly used medications include neuromodulators such as gabapentin and pregabalin, tricyclic antidepressants such as amitriptyline and nortriptyline, and selective serotonin and norepinephrine reuptake inhibitors such as duloxetine [82, 105]. Comprehensive management of pelvic floor dysfunction often includes management of lower urinary tract and bowel symptoms, the pharmacologic management of which may be coordinated with appropriate specialists as needed.

Therapeutic Injections

Patients with significantly painful and/or overactive PFMs may benefit from therapeutic injections as an adjunct to pelvic floor physical therapy or in order to better tolerate pelvic floor physical therapy. Many patients with overactive pelvic floor muscles develop painful trigger points due to abnormal muscle activation patterns leading to an abnormal increase in acetylcholine release at the motor endplate nerve terminal with subsequently sustained muscle fiber contractions, ischemia, and pain [106•]. Dry needling and local anesthetic trigger point injection may play a role in inactivating these myofascial trigger points via mechanical disturbance of muscle fibers, disruption of the positive pain feedback loop, and endorphin release [107]. Literature evaluating the effect of dry needling compared with local anesthetic trigger point injections suggest that the needle effect may be more important than the substance injected [108, 109], while other studies suggest that infiltration of local anesthetic is preferable in order to reduce the intensity and duration of post-injection soreness [107, 110, 111].

Neuromodulation via botulinum toxin injections may also be effective in treating these myofascial trigger points as well as addressing overactive muscles that are

unresponsive to more conservative approaches. The mechanism of action in these patients is the decrease of acetylcholine release at the neuromuscular junction which leads to decreased resting tone and contraction strength [107]. Several studies have demonstrated botulinum toxin injections to be effective in treating persistent pelvic floor muscle spasm as measured by both subjective measures (such as quality of life, pain, sexual function, and constipation scores) and objective measures such as vaginal and anorectal manometry [106•, 107, 112–115]. Studied dosing ranges from 40 to 300 units with localization techniques including palpation and needle electromyography (EMG) and ultrasound guidance [106•, 112–116]. Administration under needle EMG guidance confers the benefit of being able to more accurately target myofascial trigger points, which have been found to have an area of increased EMG activity in the 1 to 2 mm surrounding the nidus of the trigger point [117]. Risks include local pain and infection, malaise, bowel and bladder incontinence or retention, rare life-threatening toxic effects with distant spread, and atrophy of the pelvic floor muscles with repeated exposure [107, 114, 116].

Referral to the appropriate specialist, such as urogynecology, urology, or colorectal surgery, may be considered for additional injection-based management such as urethral and anal sphincter bulking agents and intra-vesicular botulinum injections.

Conclusion

Pelvic floor dysfunction and associated urinary, defecatory, pain, and sexual complaints often have a significant negative impact on patient's quality of life and ability to function in their chosen activities and societal roles. Providers who treat these issues frequently find that patients have been suffering for quite some time before seeking care or being offered appropriate treatment options. Diagnosis can often be made via a comprehensive history and targeted physical exam, with imaging used to rule out potentially more sinister etiologies. These patients often benefit from multidisciplinary, collaborative care, which should include a thorough trial of conservative, rehabilitation-focused management.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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