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FEMALE UROLOGY (K KOBASHI, SECTION EDITOR)

Physical, Complementary, and Alternative Medicine in the Treatment of Pelvic Floor Disorders

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Abstract
Purpose of Review The purpose of the study was to catalog the most recent available literature regarding the use of conservative measures in treatment of pelvic floor disorders.
Recent Findings Pelvic floor disorders encompass abnormalities of urination, defecation, sexual function, pelvic organ prolapse, and chronic pain, and can have significant quality of life implications for patients. Current guidelines recommend behavioral modifications and conservative treatments as first-line therapy for pelvic floor disorders. We have reviewed the literature for articles published on physical, complementary, and alternative treatments for pelvic floor disorders over the past 5 years. Review of pelvic floor muscle physiotherapy (PFMT) and biofeedback (BF) shows a benefit for patients suffering from bladder dysfunction (incontinence, overactive bladder), bowel dysfunction (constipation, fecal incontinence), pelvic organ prolapse, and sexual dysfunction (pelvic pain). Combination of PFMT and BF has shown improved results compared to PFMT alone, and some studies find that electrical stimulation can augment the benefit of BF and PFMT. Additionally, acupuncture and cognitive behavioral therapy has shown to be an effective treatment for pelvic floor disorders, particularly with respect to pelvic pain.
Summary This update highlights beneficial conservative treatments available for pelvic floor dysfunction, and supplements the current literature on treatment options for patients suffering from these disorders.

Keywords Biofeedback · Pelvic floor dysfunction · Incontinence · Pelvic floor muscle therapy · Pelvic pain · Acupuncture

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Introduction

"Pelvic floor disorders" comprises a wide variety of clinical problems related to abnormalities within the pelvic floor compartments, including issues with urination, defecation, pelvic organ prolapse, sexual function, and pelvic pain [1]. These disorders have significant quality of life and social implications and are highly prevalent in patients of all ages. For example, a recent review on epidemiological trends for pelvic floor disorders demonstrated that approximately 25% of all women in the USA are affected and that approximately 20% of these women will undergo surgery for stress urinary incontinence or pelvic organ prolapse at some point during their lives [2]. With most treatment guidelines advocating exhaustion of less invasive

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treatments prior to consideration of surgery, the objective of this article is to review literature published within the past 5 years regarding the use of physical, complementary, and alternative treatments for pelvic floor disorders. We will focus on current literature regarding pelvic floor physiotherapy and biofeedback while also detailing our approach to pelvic floor muscle exam and pelvic floor muscle therapy (see electronic supplementary material and Fig. 1). We will also discuss electrical stimulation, behavioral interventions, acupuncture and cognitive therapies.

Pelvic Floor Physiotherapy

Abnormal function of the pelvic floor musculature has been estimated to affect 70% of women with genitourinary, bowel, and sexual disorders [3]. Pelvic floor muscle therapy (PFMT) aims to improve function and strength of pelvic floor muscles through repeated voluntary contractions of variable intensity and duration. Initially popularized by Kegel et al. in effort to improve continence in women with stress urinary incontinence, this concept has expanded over the years and has seen increasing utility across a host of pathological conditions [4]. More recently, the concept of "downtraining" has emerged as an essential approach to overactive pelvic floor muscles, involving myofascial release. PFMT is typically performed under guidance of a pelvic physiotherapist (PT), although nurses, physicians, and other healthcare professionals may receive training to perform a subset of these interventions.

Utility of PFMT in Treatment of Urinary Dysfunction

There is level one evidence that PFMT is effective for the treatment of urinary incontinence (UI) in women. Sixteen RCTs comparing PFMT to no treatment, placebo, or inactive control demonstrate its efficacy. The summary of the 5th International Consultation on Incontinence by Dumoulin et al. further recommends that supervised PFMT should be offered as first-line therapy to those with stress, urge, or mixed incontinence [5•]. Mechanistic concepts and data supporting its utility are detailed below.

There are two main cortical circuits involved with bladder control. Activation of the medial prefrontal cortex (circuit 1) results in a desire to void, while activation of dorsal anterior cingulate (circuit 2) results in urgency. In a study conducted by Griffiths et al., 62 older women with urge urinary incontinence (UUI) were treated with PFMT combined with biofeedback, and functional MRI was done to reveal associated changes in cerebral activity before and after treatment [6•]. Of those in the study, 46% responded to PFMT (defined as showing ≥50% improvement in frequency) and, with a full bladder, there was decreased activation noted in their medial prefrontal cortex and dorsal anterior cingulate cortex activation on functional MRI compared to pre-treatment studies, correlating with improvement in voiding symptoms. Non-responders showed no change: similar pre-treatment and post-treatment activation of these circuits.

In an effort to quantify characteristics of responders to PFMT and determine the strength of the pelvic floor using objective measurements, Tosun et al. evaluated 130 patients with stress and mixed urinary incontinence, randomized into control or PFMT group [7]. Using objective measurements of pelvic floor muscle strength by perineometry, PERFECT scheme testing [8], and ultrasound, they found that the PFMT group versus control showed improvement in symptoms of UI and increase in pelvic floor muscle strength. All symptoms of UI were significantly decreased in the patients who reached a pelvic floor muscle strength of power grade 5/5 and continued PFMT. After 12-week training, 36 and 57% were able to achieve strength grade 5 or 4, respectively, out of 5 on the Oxford scale. Interestingly, the majority of symptoms were greatly reduced if PFM strength of grade 5 was achieved and UI symptoms almost completely disappeared in all but two patients who achieved a strength of grade 5. Given these findings, authors suggest tailoring duration of PFMT treatment to strength of pelvic floor muscles.

In addition to pelvic floor muscle strength as a result of therapy, bladder neck/urethral changes are noted following therapy aimed at strengthening for stress urinary incontinence (SUI). In a study by McLean et al., 40 women with SUI assigned to either 12-week PFMT versus no treatment and ultrasound was used to evaluate urethral morphology and bladder neck positioning during coughing and Valsalva in supine/standing position [9]. Authors found that supervised PFMT resulted in reduced bladder neck mobility and increased cross-sectional area of the urethra with training. Not surprisingly, the ultrasound findings suggested that the urethra underwent muscle hypertrophy, which coincides with previous work by Bø et al. showing the urethral sphincter contracts automatically when pelvic floor muscles contract [10].

While there is evidence supporting PFMT effectiveness in the short term, its benefit in the long-term is less clear. Bø et al. performed a systematic review evaluating 19 studies in which approximately 1150 women were followed between 1 and 15 years, demonstrating variable long-term adherence to PFMT varied from 10 to 70% without incentives for continued training [11]. Patients whose short-term success with PFMT persisted in the long term varied from 41 to 85% (which one might argue is favorable for conservative intervention). Rates of surgery in the long term also varied between 5 and 58%. Given such high heterogeneity among studies, statistical meta-analyses were not conducted.

A recent 4-year outcome study by Azuri et al. examined results of approximately 165 women with overactive bladder (OAB) and incontinence randomized to four therapy protocols (drug therapy, bladder training, PFMT, or a combination of PFMT, bladder training, and behavioral

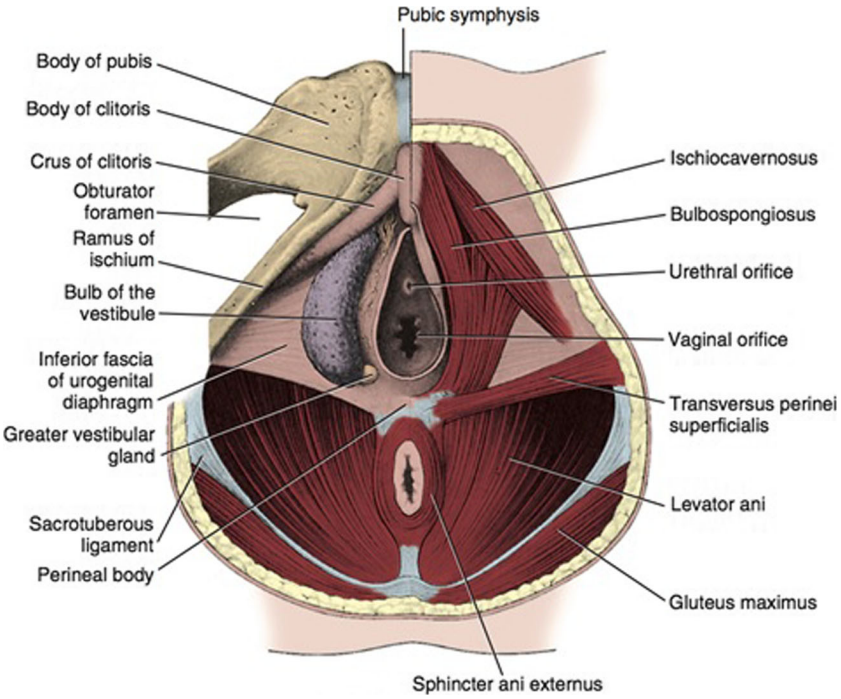

Fig. 1 Anatomy of the female superficial perineal pouch. Examination of the levator complex can be performed by inserting the finger into the vagina or rectum, then angling 45° to the left and right. In our clinical practice, levator tone is assessed as follows: first, the proximal (pubococcygeus) muscle and distal (iliococcygeus) muscles can be felt separately bilaterally. As a reference, normal firmness is equal to the resting compressibility of thenar eminence. Decreased is less. Increased firmness would be equivalent to the compressibility of the thenar eminence when the thumb is opposed to the 1st (moderate) or 5th (severe) digits (see below). Also, pain can be assessed at each point using a Likert scale. −1 [underactive] = less palpable resistance to pressure (comparable to mid-third of thenar eminence when at rest), 0 [normal] = resting compressibility of thenar eminence, 1 [overactive] = compressibility of thenar eminence when thumb is apposed to 1st or 5th digit [80]. Image adapted with permission from Williams PL, Warwick R. Gray's anatomy. 35th British ed. Philadelphia: Saunders; 1973

advice), with active treatment lasting 3 months [12]. They found that outcomes measured significantly improved in all 4 groups, with decrease in median UUI episodes/week by 1–3 events, dry rates between 25 and 44%, and improved quality of life scores. They all experienced the same degree of long-term improvement on repeat questionnaires 4 years later without significant differences between groups. It is worth noting that there was no control group, sample size was small, and there may have been other confounding factors over the 4 years that were unaccounted for.

Along with UI, PFMT continues to show benefit in women with urgency, frequency, and pain. In a prospective study by Adams et al., 31 patients with a diagnosis of OAB or painful bladder successfully completed a 10-week course of PFMT, with quality of life assessments conducted at baseline and after therapy [13]. Authors noted a statistically significant decrease in pelvic floor distress inventory short form 20 (PFDI-20) from median score of 79.2 to 50.0 with urinary and prolapse symptom subscales both decreasing significantly. Of note, their study had high withdrawal or "completed less than 5 weeks of PFMT" rate of 36.8%, further reiterating the fact that patient commitment factors play a role in utilization of PFMT.

Utility of PFMT in Treatment of Pelvic Pain and Sexual Dysfunction

Chronic pelvic pain syndrome (CPPS) is a common debilitating condition that often requires a multimodal approach. PFMT in this setting typically includes stretches and myofascial release in patients diagnosed with overactive pelvic floor muscles. The Thiele method relies on digital pressure and subsequent elongation of the musculature in order to relax muscles, restoring normal pelvic tone and the ability to coordinate muscle behavior [14].

In a retrospective chart review designed to determine the prevalence of myofascial pain and outcome of PFMT for treatment of this pain, 13% of 1100 patients screened at a tertiary center via pelvic examination were noted to have myofascial pain. Of those receiving this diagnosis, and who went on to complete PFMT, 63% reported significant improvement in pain (using non-validated questionnaires), with pain scores improving proportional to number of physical therapy visits completed [15].

In a study by Zoorob et al., 29 women with pelvic floor myalgias were randomized either to transvaginal levator injections with triamcinolone/bupivacaine or to PFMT with levator massage in effort to determine treatment-related effects on

sexual function and levator-related pain [16•]. Through a series of validated questionnaires, authors concluded that both groups reported reduction in vaginal pain and overall improvement without significant differences between groups. The mean change in female sexual function index (FSFI) favored PFMT, yet this required weeks to effect overall improvement in comparison to transvaginal levator injections. This finding coincides with previous studies targeting treatment of muscle-related vaginal pain [17]. Durability of treatment was not assessed in this study, yet we hypothesize PFMT would be favored in this respect.

While there is plenty of evidence that PFMT can be effective for pelvic floor disorders, Polackwich et al. hypothesized that physiotherapy performed at specialized centers would have improved outcomes [18]. They retrospectively identified 82 males with CPPS and pelvic floor spasm with patient phenotype assessed by the UPOINT system and symptom severity by NIH Chronic Prostatitis Symptom Index (CPSI). Of these patients, 9 refused PFMT, 48 underwent PFMT at a specialized center, and 24 underwent PFMT elsewhere. Those treated at the specialized center saw the largest drop in the validated CPSI relative to non-specialized centers or no therapy at all. This translated to 11% of patients showing improvement in those who refused treatment, 42% in those treated elsewhere, and 79% in those treated at the specialized center.

Pelvic floor muscle increased tone is theorized to be an integral part of the fear-avoidance model of pain in women with sexual pain disorders. PFMT offers elements of vulvovaginal touch/pressure/movement along with other treatment elements focusing on myofascial release, increased proprioception, and control [19]. A retrospective review of 13 women with lifelong vaginismus by Reissing et al. demonstrated that PFMT was beneficial in decreasing fear and anxiety and reactive muscle guarding and desensitization to vaginal pressure and movement [19]. Results indicated that, compared to women with dyspareunia, women with frank vaginismus needed more sessions and were in treatment for a longer time in order to reach therapy goals.

In women with vulvodynia, hypersensitivity and tenderness of the pelvic floor muscles are also usually exhibited because of muscle overactivity, resulting in shortening of the muscles, inflammation, and altered neural patterns [20••]. This is theorized to produce neural constriction as well as a relative ischemia/lactic acidosis affecting surrounding structures. An expert committee as part of the 4th International Consultation on Sexual Medicine recommended pelvic floor physical therapy for management of vulvodynia, including myofascial release, stretching/strengthening exercises, and a home program involving behavioral modifications [20••].

A trial conducted by Braekken et al. randomized approximately 110 women with pelvic organ prolapse to either PFMT and lifestyle advice or lifestyle advice only and evaluated patient sexual function pre- and post-trial [21]. They found that 39% of women in PFMT group showed improvement in sexual function versus 5% of the control group. Specific improvements noted by the authors included improved self-confidence, a "tighter" vagina, improved libido/orgasms, and resolution of pain with intercourse. This was supported by statistically significant increases in pelvic floor muscle strength and endurance in women who described improved sexual function.

Utility of PFMT in Treatment of Pelvic Organ Prolapse and Pregnancy

Repeated contractions of pelvic floor muscles may provide greater support for pelvic organs and is included in the armamentarium of conservative treatments of pelvic organ prolapse (POP). Recommendations from the 4th International Consultation on Incontinence suggest that PFMT may reduce symptoms of urogenital prolapse and prevent or slow deterioration of anterior urogenital prolapse [22].

A systematic review and meta-analysis conducted by Li et al. assessed the efficacy of PFMT on POP via evaluation of 13 studies with 2340 patients, finding that women who received PFMT showed greater subjective improvement in pelvic organ prolapse symptom score (POP-SS) (mean difference −3.07 with 95% CI −3.91 to −2.23) and objective improvement in POP stage (RR 1.70 with 95% CI 1.19–2.44) [23•]. Authors noted that the studies did not report frequency, intensity, and duration of PFMT intervention. They hypothesized that a short duration of training may provide enough time for awareness of pelvic floor muscles, while a longer training regime would enhance strength and endurance for greater benefit.

In a UK-based multicenter randomized controlled trial by Hagen et al., patients with symptomatic stages I-III prolapse were randomly assigned to PFMT (five appointments over 16 weeks) or given a prolapse lifestyle advice leaflet without muscle training [24]. Women in the intervention group reported significantly greater reduction in POP-SS at both 6 and 12 months. This finding was supported by reduced prevalence of each individual prolapse symptom and of bowel, bladder, and sexual symptoms after completion of PFMT at 6 months. Furthermore, there was an increased uptake of supplementary therapies (mainly referral for PFMT) in the control group after 6 months.

Pregnancy and birth trauma also serve as risk factors for UI, and the 4th ICI endorsed PFMT as a standard component of pre-natal and post-partum care (expert opinion without mention of how it should be offered) [22].

In a 2014 Cochrane review by Boyle et al., 22 trials involving 8500 pregnant or post-natal women who underwent PFMT versus no PFMT (or usual care, which may have included information on PFMT) were evaluated [25]. Continent

pregnant women who had intensive antenatal PFMT were less likely to report UI up to 6 months after delivery (RR 0.71, 95% CI 0.54–0.95). In terms of prevention, it is worth mentioning that these studies were conducted on women in their first pregnancies, and it is difficult to extrapolate this to multiparous women. Furthermore, post-natal women whose incontinence began perinatally who received PFMT were less likely to report UI up to 12 months after delivery (RR 0.60, 95% CI 0.35–1.03). This effect does not seem to persist in the long term, and this may be because women do not continue with PFMT exercises or they may go on to have more children. Furthermore, authors were unable to conclude whether PFMT is effective when given to a mixed population of women in the post-partum period.

In a prospective blinded clinical trial by Marques et al., primagravid pregnant and primiparous post-partum women with delivery via vagina or cesarean section were given 10 individual sessions of PFMT, three times a week, by a physiotherapist [26]. After therapy, there was an enhancement in pelvic floor muscle contractility using surface EMG and digital palpation in all groups, and this correlated with statistically significant improvement in all groups, measured by validated questionnaires by the International Consultation on Incontinence Questionnaire, namely the Urinary Incontinence Short Form (ICIQ-UISF) and the Overactive Bladder Form (ICIQ-OAB).

A recent study by Bø et al. did not find a significant effect on reducing risk of POP with PFMT in post-partum women [27•]. The authors evaluated 175 primiparous post-partum women and randomized them to either weekly PFMT for 4 months starting at 6–8 weeks post-partum or usual care (control). No significant risk difference in POP post-intervention (RR 1.62, 95% CI 0.55–4.75), bladder neck position, or symptoms of vaginal bulging were noted. In comparison, PFMT has been shown to improve POP stage versus controls in approximately 20% of women with existing POP, which argues for offering PFMT as a conservative intervention in milder prolapse [28].

In a 12-year follow-up study by Glazener et al. of 750 women with UI after childbirth, significant improvements were seen in urinary and fecal incontinence at 1 year for women who underwent nurse-lead PFMT and bladder training versus controls [29]. However, the benefits did not persist at the 6- or 12-year follow-up, irrespective of incontinence severity at trial entry. Authors suggested that the effect might have persisted if continued reinforcement had been carried out or if training had been provided by a pelvic floor physiotherapist instead of non-specialist nurses.

Utility of PFMT in Treatment of Bowel Dysfunction

Fecal incontinence (FI) is a social and hygienic problem that can significantly affect quality of life. Despite its prevalence in up to 24% in community dwelling adults, it is thought that many do not seek treatment, as they erroneously perceive this is a normal part of aging and/or that no treatment is available [29]. A recent review by Scott details aspects of pelvic floor rehabilitation in treatment of FI with approaches including PFMT, biofeedback, and volumetric training with rectal balloon catheters [30••]. Other treatment measures include dietary modifications and medications, as well as more invasive approaches including sacral nerve stimulators, perianal injectable bulking agents, or surgery (e.g., sphincteroplasty).

In a randomized single-blind controlled trial of 80 patients with FI treated with either PFMT or PFMT with rectal balloon therapy, there was no significant add-on effect in the PFMT with rectal balloon therapy group with respect to the primary outcome, improvement in the Vaizey FI score [29]. Of note, the physiotherapy program described in the study above resulted in a reduction in the Vaizey score by a mean of 5 points (95% CI −6.25 to −3.72) and 50.5% of patients overall were improved, demonstrating the importance of offering PFMT prior to contemplation of surgical therapy. On multivariate analysis, a longer time since FI onset predicted an unfavorable outcome; constipation medication usage or experiencing only minor embarrassment was associated with a favorable outcome [31].

A systematic review conducted by Lin et al. evaluated the efficacy of PFMT on patients with bowel dysfunction who have undergone colorectal cancer surgery [32]. A total of eight studies were included, six non-randomized prospective studies, and two retrospective studies. While the majority reported significant improvement in a variety of defecatory parameters and quality of life, meta-analysis was not possible given limited methodological quality and heterogeneous patient populations.

Adherence to PFMT

While there is level 1 evidence implicating PFMT's effectiveness in treating pelvic floor dysfunction in women with UI, POP, and lower bowel dysfunction, adherence is key to maintaining therapy effectiveness [33•]. In the 2014 consensus statement on improving PFMT adherence, authors concluded that, based on expert opinion given lack of high-quality studies, adherence is central to short and long-term effect. Recommendations include educating clinicians on identifying and addressing patient-related factors regarding barriers to PFMT adherence, providing evidence and feedback on PFMT benefits, and undertaking follow-up appointments to reassess barriers and facilitators to progress with care on an individualized basis.

With societal technological advances and greater patient access to Internet resources, the Internet serves as an important source of health information. This may be a useful medium in

dissemination of PFMT materials. In a study by Sjöström et al., a randomized control trial was performed with online recruits of 250 women experiencing SUI at least one time a week [34]. They evaluated the long-term effects of non-face-to-face PFMT using either Internet-based treatment (with individualized tailored email support from a urotherapist during the treatment period) or postal-based treatment (patients working with materials on their own) for women with SUI. Both groups were offered intervention without any prior examination or face-to-face supervision. Both interventions were highly significant (with large effect sizes) with respect to symptoms of SUI and quality of life using validated questionnaires after 1 and 2 years, without significant differences between the two groups. However, after 2 years, significantly more participants in the Internet group reported "much" or "very much improved" on quality of life scores, despite 38% of patients were lost to follow-up at this time-point.

Many centers, including our own, approach pelvic floor disorders through a comprehensive and multidisciplinary approach. Favorable disease-specific outcomes have been seen with a multispecialty approach, especially with respect to chronic pelvic pain. A retrospective analysis by Starr et al. of 779 women referred to PFMT for pelvic floor dysfunction over 4 years sought to determine efficacy of a comprehensive pelvic floor rehabilitation program [3]. Elements of their approach included behavioral modification, PFMT, biofeedback, electrogalvanic stimulation, incontinence devices, and various pharmacotherapies utilized as indicated. Authors report that patients completing at least five sessions of therapy demonstrated a mean symptom improvement of 80% in each of the three main categories they evaluated (urinary, defecatory, pelvic pain), utilizing non-validated questionnaires. Clarity in expectations of outcome, recruitment of patients with ongoing efforts to maintain compliance, and well-trained staff were felt to be pivotal to program success. Interestingly, authors comment on utilization of advanced practitioners who can provide additional treatments to address pelvic floor health needs not immediately addressed by pelvic floor physiotherapists alone, such as addressing vaginal atrophy and urinary and/or bowel complaints via utilizing adjunct pharmacotherapies.

Behavioral Interventions

Behavioral interventions which may be beneficial to pelvic floor dysfunction discussed below include weight loss, dietary modifications, decreasing straining/constipation, and bladder training.

Obesity is proposed to cause SUI through an increase in intraabdominal pressure with weight gain, leading to weakening of pelvic floor musculature [35]. Likewise, an increase in BMI by 5 points is associated with 20–70% increased risk of UI [36]. A review by Osborn et al. details the multiple studies showing a link between weight loss and improved UI through lifestyle modification and bariatric surgery [37]. Likewise, the European Association of Urology offers guidelines recommending that obese women with UI be referred to weight loss programs [38].

A review by Burgio et al. focused on the relationship between behavior and lifestyle on bladder health [39•]. Dietary factors including tobacco and alcohol have been associated with increased risk of lower urinary tract symptoms (LUTS) and increased risk of bladder pain syndrome. Caffeine consumption has been reported to increase risk of urgency, frequency, and UI, with increased risk of UI with high caffeine intake. Other known food and beverage bladder irritants were detailed in this review and should be avoided or consumed only in moderation. Limiting fluid intake can be a preventative strategy by those experiencing LUTS; however, this practice can increase urine concentration and lead to irritation of bladder mucosa. Likewise, excessive fluid intake may exacerbate urinary frequency and UI. Promoting a healthy fluid intake (defined as 25-30 cm^3/kg/day) is felt to dilute urine, balance pH, and reduce bladder irritation along with prevention of urinary tract infections. Also, healthy toileting behaviors can improve storage and emptying symptoms, since fecal impaction and constipation, especially in older adults, are associated with various LUTS.

Bladder training has been proven to be beneficial with respect to UUI, and rates of resolution and improvement are reported as 12 to 73% and 57 to 87%, respectively [40]. Bladder training protocols vary widely, and data on efficacy are limited. One protocol was evaluated prospectively by Lee et al. with respect to short-term effects of systematized bladder training in 105 patients with idiopathic OAB [41]. Their 30-min program included training patients to refrain from going to the bathroom after feeling urge to void by ceasing action and thought temporarily and performing pelvic floor exercises five to six times. Voiding diaries and validated questionnaires were done at baseline and after each session. After the first session, significant improvements in frequency, nocturia, and urgency were seen, along with improvement in general health after the second session. Voiding diaries showed significant improvements in maximal voided volume after the first session and in the nocturia index after the second session.

A recent Cochrane review by Imamura et al. reviewed 11 trials investigating conservative therapies and UI, involving about 6000 participants [42]. Four trials compared weight loss with control intervention and studies suggest improvement in incontinence symptoms with weight loss that are sustained after a year and a half. The three trials that compared fluid intake saw no change in UI, but symptom-specific quality of life scores improved. Three trials comparing reduction of caffeinated drinks saw no significant change. Overall, all of these studies had low-quality evidence and authors suggest that

effect of weight loss showed most promise out of those evaluated and should be studied further.

Biofeedback

Biofeedback (BF) is the process by which physiologic feedback (e.g., pressure measurements; e.g., manometry, or averaged EMG activity) is used to teach patients how to relax the pelvic floor muscles. This was first described in 1948 by Kegel who used vaginal squeeze pressure measurements to provide BF during PFM exercises [43]. There are various techniques depending on the underlying etiology, but the basic goal of BF is to make patients aware of their muscle functioning so they may improve their muscle training. Examples of BF training include the following: EMG, ultrasound (intrarectal, intravaginal or perineal), rectal balloons, digital guidance (intrarectal/intravaginal finger or hand placed on perineum), and anorectal manometry [30••].

Utility of Biofeedback for Treatment of Urinary Dysfunction

Biofeedback therapy has been described in the treatment of the following urinary tract disorders: chronic pelvic pain (interstitial cystitis, chronic prostatitis), SUI, general "pelvic floor dysfunction," OAB, and UUI.

SUI is closely associated with pelvic floor muscle dysfunction. Fitz et al. constructed a meta-analysis which offered a comprehensive overview of published studies on PFMT with or without BF for the treatment of SUI [43]. These studies were diverse and had relatively small sample sizes, making it difficult to derive statistically significant conclusions. Authors evaluated 12 studies comparing PFMT alone to PFMT with BF and did not find a statistically significant difference between the two treatment modalities in the immediate or short term. However, it was observed that BF improved pelvic floor muscle contraction. They concluded that BF increases patients' motivation to participate in treatment and improve their pelvic floor function, and allows patients to track their progress.

Focusing specifically on men who suffer SUI after radical prostatectomy, Dijkstra-Eshuis et al. designed a randomized trial to determine the effect of pre-operative PFMT with BF (once a week for 4 weeks) versus standard of care on post-operative SUI and quality of life in patients undergoing laparoscopic radical prostatectomy [44]. They did not find a difference between the two groups. This is in contrast to earlier studies by Tienforti et al., where patients undergoing open radical prostatectomy were randomized to pre-operative BF or standard of care (urologist instruction post-operatively on Kegel exercises) [45]. Those randomized to the treatment group received BF the day prior to surgery and then on a monthly basis post-operatively, and authors found a statistically significant improvement in continence and quality of life in the treatment group compared to controls.

According to the AUA and SUFU guidelines, first-line treatment for OAB is behavioral modification. There are many non-pharmacological therapies that have been attempted for the treatment of urinary urgency with or without incontinence. Resnick et al. undertook the arduous task to identify urodynamic parameters that could predict patient response to BF assisted PFMT [46]. Their data suggested that severe detrusor overactivity portends a poor response to BF-assisted PFM exercises, but they were not able to consistently show urodynamic findings that could predict response to BF therapy. They did, however, found a significant improvement in UUI after usage of BF.

The Society of Gynecologic Surgeons Systematic Review Group conducted a review of non-antimuscarinic treatments for OAB [47]. They reviewed studies comparing BF with or without electrical stimulation to PFMT. One randomized control trial found that BF-assisted PFMT was superior to electrical stimulation plus PFMT in short term regarding PFM contraction strength, while another found improvement in quality of life with BF-assisted PFMT plus electrical stimulation compared to PFMT alone. These findings contributed to the society's practice guideline recommending "pelvic floor exercises for patients with OAB symptoms, using BF or verbal feedback over written information alone (grade 2A)."

Utility of Biofeedback in Treatment of Bowel Dysfunction

Dyssynergic defecation (DD) is the inability to coordinate the abdominal wall muscles, puborectalis sling and anal sphincter for normal defecation. It has previously been shown that BF therapy is more effective than laxatives for DD [48]. Since patients with DD often have associated abdominal symptoms, Baker et al. conducted an observational cohort study to determine if abdominal symptoms and bowel symptoms would improve with BF [49]. In this study, BF included manual and verbal feedback, surface EMG, rectal catheter exercises, rectal balloon sensory therapy, ultrasound, electrical stimulation, core strengthening, pelvic floor, and abdominal massage and stretching. Not surprisingly, given the extensive intervention, authors demonstrated that 6 to 8 weeks of BF significantly improved bowel and abdominal symptoms in patients with DD.

Woodward et al. attempted to perform a Cochrane review of the use of BF to treat chronic idiopathic constipation [49]. They reviewed 17 studies on the use of BF compared to standard treatment (laxatives, dietary changes), oral medications (diazepam), surgery, and botulinum toxin injection. Due to the significant heterogeneity of the studies, a meta-analysis was not performed. Even though the reviewed studies showed improvement in constipation after BF with

minimal adverse events, due to a high risk of bias, the quality of evidence for this review was characterized as low or very low, and therefore should be interpreted with caution.

Reported rates of FI are highly variable (2–24% [50]), most likely due to the embarrassing nature of this entity and variable patient reporting. FI is associated with aging and with vaginal delivery, and first-line conservative treatment includes PFMT plus BF. BF for the treatment of FI commonly uses the rectal balloon to teach strengthening of the pelvic floor muscles and anal sphincter, to improve rectal sensitivity and compliance through balloon filling, and anal sphincter coordination also with balloon inflation [30••].

Scott nicely summarized seven studies on the use of BF for treatment of FI [30••]. Of the seven studies which varied significantly in methodology, four showed reduction in frequency of FI. This is corroborated with the findings of a review by Rezvan et al. which found that BF resulted in 50% or greater improvement, mainly in quality of life, in patients with FI [50].

Patients with multiple sclerosis (MS) may experience FI or constipation depending on the location of CNS lesions. Preziosi et al. looked at the effect of BF (using the rectal balloon) on the bowel symptoms of MS patients [51]. They found that 46% of patients had improvement in Wexner Constipation and Incontinence scores, along with improved quality of life.

Utility of Biofeedback in Treatment of Chronic Pelvic Pain

Men and women alike suffer from chronic pelvic pain. Anderson et al. analyzed the use of self-administered pelvic floor trigger point release with the Wand (an internal trigger point device) and paradoxical relaxation training (reducing nervous system arousal in the presence of catastrophic thinking and perceived pain in pelvic floor muscles) [52]. Comparing baseline NIH-CPSI scores, they found that both men and women benefited from use of the Wand over a 6-month period with statistically significant reductions in trigger point sensitivity using this protocol.

Electrical Stimulation

Electrical stimulation is often used in conjunction with PFMT with or without BF therapy. It involves the delivery of electrical impulses via surface electrodes or internal probes to improve muscle contraction. Muscle endurance is thought to be improved by the transformation of fast-twitch to slow-twitch muscle fibers, and electrical stimulation can help the patient identify the location of the pelvic muscles and what a muscle contraction should feel like [30••].

Utility of Electrical Stimulation for Treatment of Urinary Dysfunction

Olivera et al. conducted a systematic review which included studies on transvaginal stimulation for treatment of OAB [47]. As a result of their findings, studies suggest that transvaginal electrical stimulation for at least 8 weeks is needed for subjective improvement of OAB symptoms and urodynamic parameters. The benefits must be weighed against the potential adverse events with such treatments such as stimulator discomfort and back pain (grade 2B evidence).

Utility of Electrical Stimulation for Treatment of Bowel Dysfunction

Cadeddu et al. conducted a prospective randomized trial of BF with electrical stimulation via an endorectal probe once weekly for 6 weeks versus standard care (diet, exercise, laxatives) for treatment of patients with idiopathic constipation [52]. They found a statistically significant improvement in defecation scores and quality of life in the BF with transanal electrical stimulation group compared to standard treatment. Also of note, the standard therapy was largely ineffective with respect to changes in Wexner score and Obstructed Defecation Score.

Scott reviewed published studies on the use of BF with electrical stimulation versus electrical stimulation alone for the treatment of FI. Most patients studied had FI as a result of obstetrical trauma [30••]. Regarding the groups with combined treatment, electrical stimulation did not appear to afford a statistically significant benefit when added to BF, but both treatments resulted in patient-reported improvement in FI or quality of life. The same was true for studies of electrical stimulation alone. It is worth mentioning that trials conducted had widely divergent treatment protocols and not enough evidence to suggest a more superior technique or training regimen. Electrical stimulation in particular is an area where more research is needed.

Acupuncture

Acupuncture therapy can include needling, auricular point, and moxa moxibustion (warm acupuncture). It has been studied with respect to pelvic pain and pain related to endometriosis. Eighteen articles relevant to the topic were available in PubMed from the last 5 years.

Utility of Acupuncture for Treatment of Urinary Dysfunction

A study of 29 patients with UI who completed traditional Korean medical therapy (needle embedding therapy and "pharmacopuncture" therapy) demonstrated improved pelvic floor muscle contraction [53]. A statistically significant improvement in pressure and duration of contraction was noted

after two sessions. Urinary symptoms were not evaluated in this study.

In a systematic review of non-antimuscarinic agents for OAB, Olivera et al. failed to identify any studies comparing acupuncture to another therapy (medication, physiotherapy) for OAB [47]. They did, however, report that acupuncture versus control demonstrated improvement in validated urinary symptom scores, urodynamic testing parameters, and quality of life, with some minor side effects reported.

One randomized sham-controlled trial of acupuncture after hysterectomy showed significantly improved bladder function by urodynamic parameters: maximal cystometric capacity, first voiding desire, maximal flow rate, residual urine, and bladder compliance, as well as decreased bladder sensory loss, incontinence, and urinary retention at 15 and 30 days post operatively [54].

Utility of Acupuncture for Treatment of Bowel Dysfunction

Acupuncture has been recently studied in patients with FI [55]. Eighteen patients with FI confirmed by anorectal manometry underwent 10 weekly sessions of acupuncture and patients were followed by the Fecal Incontinence Quality of Life (FIQL) survey and visual analogue scale. Of 18 patients, 11 complained of severe FI, and all improved to either moderate FI, light FI, or resolved FI. Overall of the 18 patients, 17 improved with acupuncture treatments and resolution of symptoms entirely was noted in 7.

Utility of Acupuncture for Treatment of Sexual Dysfunction

A prospective pilot study followed 15 pre-menopausal women with hypoactive sexual desire disorder undergoing twice weekly acupuncture for 5 weeks [56]. Significant improvements were seen after treatment in desire, arousal, lubrication, and orgasm. Of note, no control group was employed in this single arm study.

Utility of Acupuncture for Treatment of Chronic Pelvic Pain

Acupuncture is thought to impact pain via activation of endogenous descending pain inhibitory systems, efferent quieting of regions of the brain that augment pain and its associated unpleasantness, interaction between nociceptive impulses and somato-visceral reflexes, and induction of the expectation of symptom relief [57]. Authors reviewed 3 studies meeting STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) criteria [58], totaling 99 patients from an original group of 121. In all three studies, pain improved after acupuncture regardless of the acupuncture technique. Pain disability, analgesic use, and quality of life also improved.

A randomized controlled trial by Ay et al. of 80 patients with myofascial pain syndrome was conducted, 40 of which underwent dry needling to 40 of which had myofascial trigger point injections with lidocaine [59]. Authors found statistically significant improvement in both groups at 4 and 12 weeks, without any significant differences between the groups. It should be noted, however, that lidocaine is short-acting, and thus injections with a longer-acting agent may show additional benefit. Along these lines, a randomized study conducted by Amin et al. of 117 parous patients with idiopathic chronic pelvic pain assessed acupuncture ($n = 55$) versus inferior hypogastric plexus block ($n = 62$) [60]. Whereas both interventions were successful and statistically significant according to VAS scales, the inferior hypogastric plexus block was superior with immediate and durable pain relief in a higher proportion of patients. No complications were reported despite the multiple organs innervated by this plexus.

In a prospective cohort of 699 women with CPPS presenting for non-cancerous pelvic problems, 57 reported having used acupuncture [61]. Of these, 61% reported feeling a lot better, 40% a little better, and 9% reported no effect. Of these 57, 4% reported side effects.

A review by Selva et al. assessed eight systematic reviews (SR) and nine randomized controlled trials (RCTs) regarding utility of acupuncture for back pain during pregnancy, pain during labor, primary dysmenorrhea, and menopausal symptoms [62]. Low back pain was improved in one SR and four RCTs but not in the studies comparing acupuncture to sham. Pain during labor, dysmenorrhea, and menopausal symptoms were not conclusively benefitted by acupuncture when compared to sham. Three RCTs showed improvement for hot flashes. Alternately, a review of acupuncture for endometriosis pain showed efficacy between 77 and 95% in three studies; however, it should be noted that none of these compared acupuncture to sham [63].

A meta-analysis of 10 randomized controlled trials of acupuncture versus sham or placebo for chronic prostatitis and CPPS was recently performed [64]. Acupuncture versus control and sham was superior for NIH-CPSI, response rate, pain symptoms, and quality of life. It also demonstrated decreased IL-1β in prostatic fluid. However, medication significantly improved urinary symptoms compared with acupuncture.

Cognitive Behavioral Interventions

This section focuses on cognitive interventions for improvement of pelvic pain, as behavioral therapy for urinary and bowel symptoms is reviewed above.

Central sensitization (CS) is an emerging concept essential to the approach for patients with chronic pelvic pain as well as fibromyalgia syndrome, irritable bowel syndrome, vulvodynia, and headaches. CS is defined as an amplified response of the

central nervous system to peripheral input, and is thought to begin with the A-delta fibers and C nociceptive fibers, ascending all the way to the thalamus, hypothalamus, limbic system, and somatosensory cortex [65].

In patients with endometriosis versus controls, the former have myofascial trigger points, anxiety and depression, and were more likely to demonstrate CS as measured by regional allodynia and hyperalgesia [66]. Women with dysmenorrhea ($n = 10$) demonstrated increased pain evoked by distension of the cervix compared to controls ($n = 10$) [67]. Giamberardino et al. performed a review of pain threshold testing in multiple CPPS conditions, finding decreased pain threshold testing in visceral, somatic, and remote sites in women with CPPS [68]. It is unclear whether the sensitization is due to a central or peripheral factor (top down or bottom up), whereas there is a great deal of literature supporting the presence of CS, it has not been determined whether the sensitization is primary or secondary to CPPS [69].

Some authors have sought a propensity to pain—for example, one group found higher gray matter changes in 32 patients with primary dysmenorrhea versus 32 age-matched controls in the regions involving pain transmission, higher level processing, and affect regulation. These correlated with the severity of pain [70]. Identification of CS not only explains the patient's amplified response to pain and reduces the stigma inherent in the old organic/psychogenic model, but also allows expansion into a breadth of treatment interventions [71].

As chronic pelvic pain requires a multidisciplinary approach, one center studied the impact of a comprehensive approach to treating CPPS on pain threshold testing via transcutaneous electrical nerve stimulation on the anterior surface of the non-dominant arm. The mean pain threshold increased after multidisciplinary intervention for the various etiologies of pain [72]. Vagus nerve stimulation has been used for its antinociceptive effects. One group applied respiratory-gated auricular vagal afferent nerve stimulation in CPPS patients with CS, showing improved deep tissue pain intensity, temporal summation of pain, and anxiety ratings in 15 patients (compared to non-vagal auricular stimulation) [73].

Since medical intervention alone cannot address the symptoms associated with CS, a "biopsychosocial" approach is recommended in which psychosocial factors are seen as modifiers and perpetuators of symptoms [74]. Not only is it important to understand the role of these factors (post-traumatic stress disorder, anxiety, catastrophization, social support) when evaluating patients with CS, but also there is evidence that behaviorally based therapies, cognitive-behavioral therapy, and mindfulness-based therapy benefit pain control [75]. Cognitive behavioral therapy (CBT) is most commonly used to impact pain, in the context of a comprehensive medical management approach for pain. It can impact not only the pain itself but also the role of pain in a patient's life (adjustment, activity, isolation, maladaptive beliefs), and therefore quality of life [76, 77].

One study of patients with vulvodynia randomized women to CBT versus supportive psychotherapy. Both treatments improved pain and improved sexual and emotional functioning, but CBT led to greater improvement in sexual functioning and cotton swab testing. Of those patients studied, 42% of women demonstrated a clinically significant improvement in pain severity, defined as a 33% or more reduction in pain [78]. Interestingly, the generalized hyperalgesia as measured by VAS, ischemic pain test, and electrical pain test decreased in 100 patients with endometriosis after surgical intervention [79].

Overall, it is important to recognize that patients with refractory pelvic pain who are lacking a treatable local etiology can benefit from CBT.

Conclusion

Beneficial conservative treatments available for management of pelvic floor dysfunction include pelvic floor physiotherapy augmented with or without biofeedback, electrical stimulation, acupuncture, and cognitive/behavioral therapies. While the quality of evidence evaluated is heterogeneous, all of the described treatment modalities have shown at least modest benefit for patients with pelvic floor dysfunction with minimal adverse events and thus should be incorporated into the armamentarium of treatments clinicians can offer to patients.

Literature within the past 5 years reviewed supplements current knowledge on treatment options for patients suffering from pelvic floor disorders.

Compliance with Ethical Standards

Conflict of Interest Alex Arnouk, Elise De, Alexandra Rehfuss, Carin Cappadocia, Samantha Dickson, and Fei Lian each declare no potential conflicts 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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- • Of importance
- •• Of major importance

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