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STRESS INCONTINENCE AND PROLAPSE (S REYNOLDS, SECTION EDITOR)

Pelvic Floor Muscle Training in the Management of Female Pelvic Floor Disorders

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Abstract

Purpose of Review We review contemporary data to understand the role of pelvic floor muscle training (PFMT) in the physiology, prevention, and treatment of stress and urge urinary incontinence, pelvic organ prolapse, and chronic pelvic pain. In addition, a review of treatment regimens and adjuvant therapies is provided.

Recent Findings A large body of literature supports the role of PFMT in the treatment of various PFD. A wide variety of treatment regimens are reported and complicate systematic analysis of related outcomes. Less investigation is available to understand the role of PFMT as an adjuvant therapy.

Summary Pelvic floor muscle training is recognized as an effective treatment for a variety of pelvic floor disorders and is supported by large body of research and expert guideline statements. Related investigation is limited by significant variety in treatment protocols, outcome measures, and study methodology and further well-designed trials are helpful.

Keywords Incontinence · Pelvic floor dysfunction · Pelvic floor physical therapy

Introduction

Issues arising from the muscles and organs of the pelvis are among the most common of all health problems in women. Combined, these problems are called pelvic floor disorders (PFD) and include urinary incontinence (UI), overactive bladder (OAB), bowel incontinence, pelvic organ prolapse (POP), sexual dysfunction, and chronic pelvic pain (CPP). Prevalence estimates suggest that 61 million women suffer from at least one PFD, making PFD more common than illnesses such as asthma, diabetes, and cancer [1–7]. Even so, PFD such as urinary incontinence are likely highly underreported, suggesting that many more women may be affected than these figures show [3].

Of these various PFD, UI is the most common with recent data demonstrating the total prevalence of any type of UI was 54% [8]. In addition, UI is associated with significant deterioration in quality of life, depression, and work disability [9, 10]. The financial cost of UI is also enormous. Direct costs to patients exceed 8B, with the remaining costs dedicated to diagnosis and treatment [11]. Moreover, more recent data estimates that UI underlies $82.6B in annual total cost as related to direct expenses, incontinence products, and nursing home admissions [12].

Pelvic organ prolapse is another common and significant PFD. The overall prevalence of POP is estimated to greater than 40% of women, although symptomatic POP is much lower [13]. Data from 1997 estimated that approximately 200,000 surgeries were annually performed for POP in the USA, with a lifetime risk of surgery for POP or UI ranging between 11 and 20% [14–16]. Given the aging US population, there is a predicted 50% increase in the number of women with POP by 2050 [17]. Similar to UI, POP greatly impacts QOL, psychological well-being, sexual function, and is associated with social isolation [18, 19].

Chronic pelvic pain CPP is a common condition with a reported prevalence in women of up to 27% [20]. Broadly, this disorder has a multifactorial etiology and relationship with urologynecologic diagnoses including interstitial cystitis (IC), disorders of sexual function, and pelvic floor dysfunction. The deleterious impact of CPP is

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well-described, with profound impacts to QOL, mental health, and work productivity [21, 22]. For the purpose of this review, CPP, and related disorders, will be discussed together.

Pelvic floor muscle training is recognized as a standard treatment for PFD and is supported by a large body of research and expert guideline statements. The AUA Guidelines for the Surgical Treatment of Female Stress Urinary Incontinence [23••], the Diagnosis and Treatment of Non-neurogenic Overactive Bladder (OAB) in Adults [24••], and the Diagnosis and Treatment of Interstitial Cystitis/Bladder Pain Syndrome [25••] each recommend pelvic floor muscle training (PFMT) at first-line management in the treatment of their respective disorders. These recommendations are further echoed by the recommendations and management guidelines of numerous other professional societies including the European Association of Urology [26, 27], Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction [23••, 28], the American Urogynecological Society [29, 30], and the American Academy of Family Physicians [13, 31, 32].

The benefits of PFMT in the treatment of PFD are multifactorial. Certainly, PFMT demonstrates clinical benefit and is the focus of comprehensive discussion subsequently throughout this review. In addition, when used as first-line therapy, PFMT can often prevent progression to pharmacotherapy or invasive therapies. This, in turn, results in patient risk reduction as well as a significant cost savings to both patient and the health care system. For example, specific to OAB, commonly used anticholinergic agents have numerous well-described side effects and increasing concern related to their association with dementia and cognitive decline [33, 34]. Furthermore, the cost of long-term anticholinergic therapy is often significant. Specific to POP, Barber et al found that only 2.6% of females with pelvic prolapse went on to surgery after PFMT [35]. Similarly, Thubert and colleagues reported that PFMT avoids surgery in half of the SUI cases at 1-year follow-up [36]. Such benefits are even more notable as related to CPP/IC. The Department of Health and Human Services declared opioid abuse a national emergency in 2017 and widespread efforts have followed focused on initiatives and guidelines to help address opioid overuse and addiction [37]. Research demonstrates that a significant number of patients with IC receive opioid prescriptions, highlighting the importance of effective non-opioid treatments such as PFMT in the treatment of CPP/IC [38, 39].

Combined, these data underscore the importance of PFMT and its role as a cornerstone first line therapy for a variety of PFD. This review provides an overview of PFMT in the treatment of PFD, with focus on outcomes as well as technical considerations.

Physiology of PFMT in PFD

Broadly, PFMT works through strengthening pelvic muscles, promoting pelvic floor support, and increasing pelvic muscle volume. PFMT also leads to elevation of the levator plate, giving rise to increased structural support [40]. The therapeutic efficacy thus relies on both passive (bulking, tone, support) and active (timed voluntary contractions or relaxations) mechanisms. In the case of SUI, these actions can result in increased urethral closing pressure and decreased bladder neck and/or urethral descent to prevent stress leakage.

It is less clear how PFMT physiologically improves UUI [41]. A proposed mechanism centers on the suppression of detrusor overactivity through voluntary quick pelvic floor contractions [42–44]. Indeed, reflex inhibition of detrusor contraction has been demonstrated with electrically stimulated contraction of pelvic floor muscles. Furthermore, pelvic floor muscle contractions have been shown to stimulate sympathetic activation of the internal urethral sphincter [44–46].

Pelvic organ prolapse results from weakness of the pelvic floor muscles and connective tissue, which allows for the descent and herniation of the pelvic organs. Through PFMT, the pelvic floor muscles can be strengthened and bulked to give better support and elevate the pelvic organs [47]. Timing pelvic floor contractions during activities that increase intrabdominal pressure can also reduce descent, which may reduce symptoms of POP.

While the role of PFPT in urinary incontinence and POP involves increasing pelvic floor strength, tone, and support, PFPT for CPP is thought to help by improving muscle relaxation, normalizing resting muscle activity, and increasing vaginal elasticity, muscle awareness, and proprioception [47]. Specific to pelvic floor hypertonicity, the goal of PFMT and myofascial release techniques are commonly to relax, elongate, and stretch the pelvic muscles. In these settings, PFMT has been shown to normalize resting muscle activity, increase vaginal elasticity and local blood flow, and relieve myofascial tender points, all of which are thought to help local and referred pain [48, 49].

PFMT Regimen

Although the general goals of PFMT are similar across the many reported programs, there are significant differences. These differences include frequency and duration of PFMT, as well as training regimen. The frequency and duration of PFMT vary widely across the literature, with

most programs commonly recommending exercise performance 3–4 days per week up to as frequent as daily [50•]. Similar variation is seen with respect to frequency of exercises during the day and vary from once daily to other regimens recommending hourly exercise repetitions [50•]. The total duration of therapy most commonly ranges between 3 weeks and 6 months [40, 51]. For example, in the treatment of SUI, the UK clinical guidelines for UI state that PFMT regimen should be at least 3 months whereas The Royal Dutch Society for Physical Therapy recommends weekly treatments for 12 weeks and not exceeding 3–6 months in duration [52, 53].

Similarly, PFMT regimens vary considerably and are customized based on underlying PFD. Reported regimens commonly include varying contraction protocols (quick versus sustained), contraction intensity (maximal and submaximal), and exercise positions (supine, sitting, standing). The wide variety of regimens is highlighted in systematic review by Hay-Smith et al focused on amount and type of contractions utilized in the for PFMT regimens [50•]. In this review, there was great variability across the number of total contractions per set (ranged 8–75), contraction hold duration (range 1–20 s), daily exercise sets (range 3–9), and exercise session duration (range 15–60 min).

PFMT training regimens for SUI generally focus on muscle endurance. In addition, PFMT regimens commonly include additional physiotherapy techniques including posture and stretching. In a RCT of PFMT in the treatment of SUI, Bø et al demonstrated greater improvements in patients performing long-lasting contractions versus controls using short duration contractions [54]. Counterbracing or "the knack" is another regimen component commonly used in SUI PFMT. These techniques focus on contraction of the pelvic floor muscles prior to anticipated increases in abdominal pressure [40, 55]. Such techniques are thought to prevent leakage through decreasing bladder neck descent and providing additional proximal urethral support [56, 57].

Although some PFMT regimen components are common across all PFD, important differences exist. For example, PFMT regimens for UUI more commonly include quick flick squeezes focused on fast-twitch musculature and pelvic floor contractions to suppress urgency episodes [42, 43]. Training regimens for POP commonly include not only exercises focused on building pelvic floor muscle support, strength, and endurance, but also counterbracing techniques given the frequency of concurrent SUI [58••, 59]. Finally, although a wide variety of regimens exist, those focused on CPP and pelvic floor dysfunction commonly include myofascial or trigger point release techniques as well as stretching and joint mobilization [47, 49, 60–62].

Treatment Supervision

Additionally, regimens vary with respect to amount of treatment supervision, which can include intensive in-person therapy versus home programs based on educational handouts with little supervision. Most programs commonly comprise in-person PFMT under the supervision of a pelvic therapist, combined with a home exercise regimen [43, 52, 54, 63–65].

In comparison of supervised versus unsupervised PFMT, Zanetti and colleagues demonstrated greater improvements in pad test, bladder diary, and quality of life in the supervised cohort [65]. In contrast, Felicissimo et al demonstrated that both supervised and unsupervised PFMT are effective, with no observed differences across cohorts [66].

Group PFMT is another method commonly used to increase supervision. In Cochrane systematic review by Hay-Smith et al, superior outcomes were seen in women with SUI undergoing PFMT with both combined and individual supervision as compared to those receiving only individual supervision [67]. In contrast, Camargo et al investigated group versus individual PFMT for SUI and found no differences between groups [68].

Although questions regarding the role of supervision remain, it is generally shown that PFMT with regular supervision improves outcomes when compared to little or no supervision [43, 50•, 52, 54, 69].

PFMT Outcomes

A significant quantity of investigation exists to demonstrate the beneficial impact of PFMT in the treatment of PFD. This data is complicated, in part, by the great variety in outcomes used to assess PFMT and the varying definitions of success that are used. For example, in the assessment of urinary incontinence, definitions of success or continence vary greatly and include subjective absence of incontinence episodes, absence of pad use, the use of one daily pad, objective absence of incontinence based on pad or cough testing, and cure based on validated questionnaire results. The importance of outcomes definitions is highlighted by investigation demonstrating that success for MUS placement ranged between 33 and 87% depending on chosen definition of success [70]. Available investigation is also weakened oftentimes by smaller patient numbers. Within these limitations, the following sections review PFTM outcomes in the treatment of PFD.

Stress Urinary Incontinence

PFMT in the treatment of SUI has been widely studied and shown to be of significant benefit. Specific to symptom

evaluation, PFMT has been demonstrated to decrease daily SUI episodes and pad use [71–73]. Bø et al reported a reduction in mean urine loss from 27 to 7g in women with SUI who underwent home PFMT supplemented by weekly supervised PFMT [54]. Similar findings are seen in study assessing SUI outcomes with validated questionnaires. Cavkaytar et al demonstrated significant improvements in IIQ-7 and UDI-6 scores following 8 weeks of PFMT [74]. Similarly, Asklund et al demonstrated symptom improvement on ICIQ-UI SF evaluation, with a reduction of 3.9 points after 3 months of PFMT [75].

In addition to mean improvement in symptom outcomes, PFMT is reported to result in benefit or cure in a significant percentage of patients receiving therapy. Lagro-Jansen et al demonstrated that 85% of patients had subjective improvement after 3 months of PFMT versus 0% improvement in controls. Notably, the control patients were then switched to 3 months of PFMT and subsequently 90% of the previous controls reported improvement or cure [76]. Moreover, systematic review of conservative management of SUI demonstrated that patients who underwent PFMT were 8 times more likely to report a cure of symptoms than controls [72].

Furthermore, objective improvements to muscle strength and other physiologic outcomes are seen following PFMT [77, 78]. PFMT leads to increased objective pelvic floor muscle strength and increased maximal vaginal squeeze pressure [54, 71, 79]. Additionally, PFMT also results in improvements to maximum resting urethral pressure [54]. These objective improvements are demonstrated to be significant and also superior to other active treatments including vaginal cones and electric stimulation [71]. The type of PFMT performed by the patient can also determine the extent of strength improvement with Bø et al showing that patients performing long-lasting contracts had greater improvements as compared to those performing short duration contractions [54].

Finally, PFMT also is shown to improve the QOL of SUI patients, with significant improvements to QOL demonstrated in numerous studies across a variety of validated QOL instruments [72, 80, 75].

Urge Urinary Incontinence

PFMT has been demonstrated to improve UUI outcomes across a variety of reported studies. Accordingly, Greer et al performed a systematic review of PFMT in UI, including four studies with PFMT for UUI. Each of these studies found significant improvements to UUI following PFMT [44]. In the setting of UUI, PFMT leads to decreased leakage episodes due to urgency [77, 78, 81]. The degree of benefit is notable, with Nygaard et al reporting a decrease in UUI episodes from 2.8 to 0.5 per day in prospective RCT [82]. In addition to incontinence events, PFMT has also been demonstrated to reduce frequency and nocturia [77].

Similar to SUI, PFMT for UUI is associated with cure or improvement in a notable proportion of patients and compares favorably to other active treatments. For example, a RCT by Wang and colleagues demonstrated subjective improvement or cure in 38% and 50% of OAB patients undergoing PFMT or biofeedback-assisted PFMT, respectively [83]. Furthermore, Burgio et al demonstrated that PFMT resulted in an 81% reduction in incontinence episodes, which was significantly more when compared to oxybutynin therapy (68.5%) or placebo (39.4%) [84].

PFMT in the treatment of UUI is also associated with improved QOL and patient satisfaction [78, 85]. Burgio et al showed complete patient satisfaction ranging between 56 and 86% across groups undergoing PFPT with various forms of feedback and supervision [85]. These patients also demonstrated significant improvements in QOL with 3 different QOL questionnaires. Notably, this study also demonstrated physiologic improvements, with increased bladder capacities seen across all treatment groups.

Pelvic Organ Prolapse

PFMT is shown to improve subjective POP symptoms [86, 87]. Outcomes are complicated by the variety of symptoms that can be associated with POP, including not only the subjective sensation of a vaginal bulge, but also more broad symptoms related to vaginal comfort, pelvic pain, voiding and defecation functions, and urinary and fecal incontinence.

The notable POPPY trial was a 23-center RCT comparing PFMT versus a POP lifestyle education pamphlet in women with POP [58••]. Superior validated questionnaire score improvements were seen with PFMT at both 6 and 12 months. Similarly, a RCT by Kashyap et al demonstrated that PFMT resulted in significantly improved POP-SS, PFIQ-7, and VAS scores as compared to patients receiving a self-instruction manual [88]. Finally, a meta-analysis by Li and colleagues found a mean difference of improvement in POP-SS of 3.07 points in the PFMT compared to controls [86]. Similar to other PFD, PFMT for the treatment of POP is shown to result in significant benefit to QOL [89].

PFMT has also been shown to result in objective improvement (POP-Q) in limited study. The previously described meta-analysis by Li et al showed significant improvement in POP-Q stage in addition to symptomatic benefit [86]. The systematic review by Hagen et al demonstrated that PFMT increased the chance of an improvement in the prolapse stage by 17% [90]. Finally, Braekken et al demonstrated that 19% of PFMT patients improved 1 POP-Q stage as compared to 8% of controls [59]. In general, PFMT in the treatment of POP is focused on low-grade POP and, although objective

improvement is possible, focus is more so on improvement to pelvic symptoms and QOL.

Chronic Pelvic Pain

Compared to UI, there is more limited research to understand the role of PFMT in the treatment of CPP. Furthermore, available literature is much more heterogeneous given the multifactorial nature of pelvic pain and related disorders such as pelvic floor dysfunction and dyspareunia. Related outcomes will be reviewed together in this section and include discussion of common PFMT adjuncts such as myofascial release techniques.

A 2005 systematic review including 29 RCTs and observational studies reported improved pelvic pain in 59–80% of women following therapy [91]. Similarly, Weiss et al reported that 83% of patients with IC had decreased urgency, frequency, and/or pain following treatment [92]. A retrospective review by Bedaiwy et al reported that 63% of patients had significant improvement in pain score following transvaginal pelvic floor physical therapy. Notably, pain score improvements were proportional to the number of therapies completed [60].

Similar benefits are seen in studies focused on sexual dysfunction. A RCT by Schvartzman et al demonstrated significant reductions in pain scores in women randomized to PFMT with myofascial release [93]. Significant symptom improvement and satisfaction is reported in women undergoing pelvic therapy in the treatment of vaginismus symptoms [47, 61]. Schvartzman et al found that PFMT combined with myofasical release improves sexual function and the QOL in patients with dyspareunia [93]. Not surprisingly, these symptomatic benefits to both CPP and sexual function are associated with significant improvements to QOL and well-being [94, 95].

Adjuvant Techniques and Therapies

Many adjuvant techniques and therapies have been studied in combination with PFMT. Biofeedback is a common tool used to facilitate proper muscle identification and recruitment during PFMT for a variety of PFD. Research evaluating biofeedback in the treatment of PFD is conflicting. A RCT by Hagen et al compared PFMT to PFMT with biofeedback in patients with SUI or MUI and demonstrated no difference in incontinence improvement between groups [58••]. In contrast, Mørkved et al demonstrated that PFMT with biofeedback yielded better improvements to pad testing and cure rates for SUI when compared to PFMT alone [73]. Liu et al demonstrated that PFMT with EMG biofeedback significantly improved a variety of outcomes in OAB or SUI patients with or without concomitant POP, including subjective SUI and OAB symptoms, pad testing, and POP-Q staging [96].

Specific to UI, a variety of adjuvant therapies have been utilized alongside PFMT. These include tibial nerve stimulation, electrical or magnetic stimulation, weighted vaginal cones, weight reduction, continence pessaries, and pharmaceuticals (e.g., tolterodine or duloxetine) [47, 97]. The previous UI adjuvant therapies, except for tibial nerve stimulation, were evaluated in a systematic review by Ayeleke et al including 13 trials that compared PFMT with a single adjuvant treatment to the same adjuvant treatment alone in patients with SUI, UUI, or MUI. Due to small numbers, the authors were unable to find sufficient evidence of additional benefits by adding PFMT [97].

Several studies have reported the successful use of multidisciplinary therapy programs for treating CPP and sexual dysfunction. These programs include the use of psychological skills training, patient education, and cognitive therapy [82, 98, 99]. Pharmaceutical therapies have also been used as adjuncts to PFMT, with both vaginal diazepam and botulinum toxin being successfully used with PFMT to successfully treat pelvic and sexual pain [100, 101]. Finally, electrotherapy combined with PFMT and manual therapy has been shown to be successful in the treatment of dyspareunia [102].

The Role of PFMT with Surgery

Given the common use of surgery to treat SUI and POP (11–20% estimated lifetime risk), the role of PFMT as a surgical adjunct is frequently reported [14, 15]. The literature is heterogeneous and includes the use of PFPT in pre- and post-operative settings. Specific to UI, the ESTEEM trial compared the use of pre- and post-operative PFMT with midurethral sling (MUS) to MUS alone and reported larger UDI score reductions with combined therapy, although this difference did not meet the minimal clinically important difference. Compared to sling alone, the combination group also had a significantly greater reductions in UUI and total incontinence episodes, improvement in IIQ scores, and greater time to additional treatment [103••]. Harvie et al performed a prospective economic evaluation concurrently with the ESTEEM trial which found the combined PFMT and sling therapy not to be cost-effective, as it is more expensive and there was no difference in QALYs between the combined group and sling only group [104]. In another RCT by McLean et al, women with SUI were randomized to PFMT or a handout after MUS and reported that the PFMT cohort had significantly lower reported UI symptoms; however, there was no difference in pad test and total FLUTS score [105].

Specific to POP, Jarvis et al reported significant improvement in the QOL, urinary symptoms, and maximal pelvic floor muscle strength in comparison of women with POP undergoing surgical repair with versus without pre-operative PFMT [106]. In contrast, Duarte and colleagues randomized women with POP to surgery versus PFPT (pre- and post-operative) and reported no difference in POP symptoms, pelvic strength, QOL, or sexual function [107]. Similarly, Frawley et al reported a RCT comparing pre- and post-operative PFMT in combination with POP surgery to surgery alone. This group found no difference in bladder and prolapse symptoms as measured through multiple validated questionnaire assessments [108]. In a RCT by McClurg et al, patients were randomized to preoperative and postoperative PFMT with prolapse surgery or to surgery alone and reported no difference across a variety of validated questionnaires assessing POP, QOL, and bowel symptoms at 6-month follow-up. However, at 12-month follow-up, the PFMT cohort had significantly fewer POP symptoms than the control group [109].

Finally, the notable OPTIMAL trial randomized 374 women undergoing surgical repair for both apical vaginal prolapse and SUI to surgery and PFMT (pre- and post-operative) versus surgery alone. At 6-month and 2-year follow-up, they reported no difference in urinary symptom improvement and POP outcomes, respectively [35]. Further 5-year follow-up of these cohorts demonstrated no difference in anatomic failure or prolapse symptoms [110••].

Combined, these studies highlight the heterogenous and conflicting data assessing the use of PFMT as an adjunct to surgical therapies for SUI and POP. This is underscored by additional systematic reviews that report conflicting results and cite the limited research and variability across programs and outcomes measures as factors limiting the ability to provide conclusive recommendations [86, 111].

Future Avenues and Conclusion

A large body of literature supports the role of PFMT in the treatment of various PFD. Furthermore, PFMT is recognized as a standard treatment for many PFD and recommended as first-line treatment across many expert society guideline statements. However, reported studies are considerably limited by significant variety in treatment protocols, outcome measures, and lower patient numbers. The impact of the treatment regimen is unclear and a variety of protocols exist. Nonetheless, benefits to a variety of pelvic floor symptoms (urinary, bowel, sexual, and pain) and QOL are seen across a wide number of studies. Additional larger studies are needed to more extensively assess the role of PFMT in PFD treatment, with focus on the role of adjunctive PFMT in combination with surgical therapies. Most importantly, efforts to standardize recommended protocols, and improve the delivery of PFMT and related educational resources, are needed.

Declarations

Conflict of Interest Dr. Rapp is a consultant for Johnson and Johnson.

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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