Case Study

Pelvic Muscle Exercises Using A Home Trainer for Pelvic Muscle Dysfunction: A Case Report

Beth Shelly

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Pelvic muscle exercises can help improve symptoms of pelvic floor muscle dysfunction. This article describes the case of a 66-year-old woman with moderate pelvic organ prolapse (POP) and mild urinary incontinence (UI) who initiated pelvic muscle exercises with the assistance of a novel, at-home trainer equipped with a vaginal sensor and accompanying smartphone app software, the PeriCoach® system (Analytica, 2015). After 8 weeks of training with the device, she showed improvements in strength, endurance, and disability, as measured by manual muscle test, electromyography, and Pelvic Floor Disability Index scores. Older women can use biofeedback technology to improve pelvic floor muscle function successfully at home.

Key Words: **Pelvic floor muscle exercise, pelvic organ prolapse, PeriCoach, biofeedback, urgency, frequency, urinary incontinence.**

Pelvic floor muscles (PFMs) support the organs in the pelvis. These muscles are subject to fatigue and injury and can also weaken with age (Smith, 2004). Weakness or dysfunction of the PFM has been associated with urinary incontinence (UI) and pelvic organ prolapse (POP) (Braekken, Majida, Ellstrom Engh, Holme, & Bo, 2009; Kepeneckc et al., 2011). The prevalence of UI in women is 45%, with lower rates for younger women, and rates up to 55% for women in the 80- to 90-year age range (Melville, Katon, Delaney, & Newton, 2005). It affects 11% of men aged 60 to 64 years, and up to 31% of older men (Dieter, Wilkins, & Wu, 2015; Shamilyan, Wyman, Ping, Wilt, & Kane, 2009). Patients with UI have a significantly poorer quality of life than continent individuals. Incontinence can be associated with sexual dysfunction, depression, psychological distress, and lost work time (Sinclair & Ramsay, 2011).

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Even though estimates of diagnosed POP range from 3% to 8%, one study documented that at least some degree of prolapse is seen in 94% of women (Dieter et al., 2015; Swift, 2000). Its occurrence is associated with advanced age, and it is nearly ubiquitous in older women (Nygaard, Bradley, & Brandt, 2004). It can cause women to feel self-conscious and less physically and sexually attractive than women without POP. In addition, it is associated with poor quality of life and can also interfere with daily activities and sexual activity (Barber, Visco, Wyman, Fantl, & Bump, 2002; Jelovsek & Barber, 2006).

Better PFM function has been found to be associated with less severe POP and urinary symptoms (Hagen et al., 2014). Individualized PFM training can significantly improve symptoms of prolapse and incontinence. This is true both overall (Hagen et al., 2014; Li, Gong, & Wang, 2015) and for older adults specifically (Wiegersma et al., 2014). It can be difficult, however, for patients to learn how to isolate these muscles to exercise them properly (Smith, 2004). Therefore, many patients who are affected by PFM dysfunctions, such as POP and UI, require skilled therapy to rehabilitate the PFMs (Berghmans et al., 2015).

This case report describes the experience of a 66-year-old woman with POP and UI who performed PFM exercises with the assistance of a novel, at-home trainer equipped with a vaginal sensor and accompanying smartphone app software, the Peri-

Coach® system (Analytica, 2015). The PeriCoach system uses force sensors on a rigid body to determine pelvic floor activity. Several pressure biofeedback PFM home trainers are available; however, these devices can be activated by increased intra-abdominal pressure as a substitution for PFM activity, thus training the wrong activity.

The PeriCoach signal is transmitted via Bluetooth™ technology to an app on the user's smartphone as real-time biofeedback. The display shows recruitment, holding capacity, and relaxation as a travelling line similar to the display of many on-screen electromyography (EMG) biofeedback devices. This provides clear information to the patient about endurance capacity. Additionally, all exercise information is available to both the user and treating clinician through an online portal, showing progress over time and session activity.

Personal Profile

The patient is married, living with her husband, and has retired from an office job. She describes herself as active. She babysits grandchildren, walks, and uses a treadmill several times a week.

Pertinent Clinical History And Symptoms

She is parous (G2, P2), and both were uneventful, vaginal deliveries that occurred approximately 30 years ago. She experienced stress urinary incontinence after giving birth. To treat the issue, she had bladder suspension surgery 12 years ago. The patient also reported constipation, low thyroid, and osteopenia. She has occasional neck and sacrum pain, but this is not function limiting, and she has not felt the need for treatment of these conditions. She did not report any pain upon intercourse, during urination, or with sitting. She denies diabetes mellitus or neurological disease.

Several months ago, the patient noticed a bulge at the vaginal opening. She initiated PFM exercises on her own and reported that her symptoms decreased somewhat. Her gynecologist referred her for physical therapy for further PFM training. The patient noted decreasing her walking at the gym due to perineal pressure.

Clinical Interaction

Initial Physical Therapy Examination

External visualization of the perineum showed PFM elevation upon contraction while lying down. A bulge at the vaginal opening was visible when the patient strained, indicating a moderate POP. On initial vaginal examination, the patient demonstrated 3+/5 intra-vaginal PFM strength with endurance of 5 seconds. Elevation of the PFM was also evident on vaginal palpation. In addition, her PFM measured 10/12 on the Brink scale, where higher scores indicate better muscle function. There was no evidence of vaginal atrophy.

During vaginal palpation of PFM contraction, the patient used significant accessory muscle overflow, using her gluteal and abdominal muscles instead of isolating the PFM. Further, she did not appear to relax fully. Full relaxation is important during any skeletal muscle exercise program. Fair PFM recruitment and decreased endurance were substantiated by external EMG, which revealed generation of 4.7 microvolts (μV) with a 5-second hold. After receiving verbal instructions on proper PFM contraction technique and feedback from EMG device, the patient was able to decrease overflow muscle activation and increase the quality of PFM holding, generating 5.9 μV with a 5-second hold.

Patient-Reported Outcomes

She recorded 41.6/300 on the Pelvic Floor Distress Inventory (PFDI) and 25/100 on the Pelvic Organ Prolapse Distress Inventory (POPDI). Higher scores on these inventories indicate greater symptom-related distress. Her score on the POPIQ, which measures quality of life related to POP, was 19/100. For this questionnaire, higher scores indicate lower quality of life. The patient also reported urinating every 1.5 hours, with some urgency and one episode of urge incontinence in four days. Formal bladder diary was not completed.

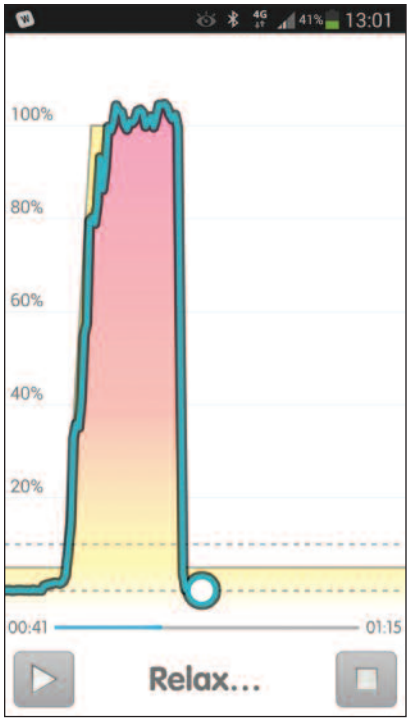
Rehabilitative Intervention

The patient began physical therapy one time per week to strengthen her PFM and alleviate symptoms of POP. She was given education on normal bladder pattern and normal fluid intake. She was also encouraged not to go "just in case." Urge suppression techniques, including sitting and relaxing, distraction, and small PFM contractions, were taught. After initial instruction the patient reported she was able to defer the urge about half the time and had not had a urine leak with urge. The patient was encouraged to gradually increase the interval between voids. Formal bladder training schedule was not initiated because the patient showed good progress with simple modifications.

After the initial session, the patient was given the PeriCoach system, a novel biofeedback sensor device with accompanying smartphone app and web portal software, to assist with her PFM exercises. This application was chosen because it provides a display that clearly shows the ability of the PFM to maintain the contraction (see Figures 1 and 2). Clinically, it appears that increasing PFM endurance helps decrease symptoms of PFM laxity.

At first, she used the PeriCoach while lying down at a pre-programmed 3-second hold for 8 repetitions, with 9 seconds of rest between contractions. This program was repeated several times during each set to achieve the desired total number of repetitions. The patient was asked to perform the exercises twice per day, with 20 to 25 rep-

Figure 1.
Smartphone App Display of a Sustained Pelvic Floor Muscle Contraction



Note: The device is calibrated to the individual patient's maximum voluntary contraction (MVC). The percentage displayed on the Y axis represent a percentage of the patient's MVC. In other words, this figure shows the ability to sustain a PFM contraction at 100% of the patient's MVC.

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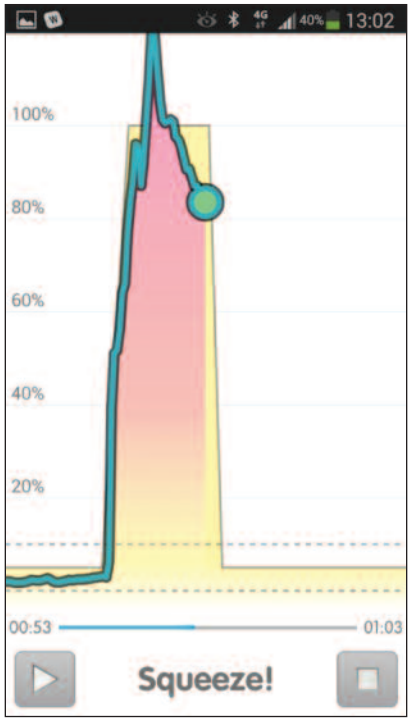
Figure 2.
Smartphone App Display of the Inability to Sustain a Pelvic Floor Muscle Contraction Often Seen in the Early Phases of Rehabilitation



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etitions in each set. She did some of these with the PeriCoach system and some on her own without the device. The frequency of use of the device was ultimately decided by the patient based on her need for feedback. The patient reported performing her exercises at home with the help of the PeriCoach system once or twice per day for 2 to 3 rounds each time for the first week. She also reported performing some active PFM exercises without the device to achieve the desired number of repetitions per day. Performing exercises lying down avoids the influence of gravity on the PFM and POP and is thought to allow more effective strengthening in the initial phases of rehabilitation. During that time, the patient reported less perineal bulging.

After a week of using the PeriCoach, the patient generated 9.4 μV on a 7-second PFM contraction using an in-office external EMG assessment. Her resting level was elevated (5.9 μV). The patient was encouraged to focus more closely on the relaxation phase to encourage full relaxation between contractions. She still exhibited using overflow muscles during the contraction, with evidence of bearing down. The patient practiced sub-maximal PFM contractions, which resulted in improved quality of contraction (no bearing down and less overflow muscle activity). The PeriCoach device was advanced by the therapist for her second week to record 5-second hold for 8 repetitions, with 7 seconds of rest in between. The patient was still required to complete a total of 40 to 50 repetitions per day and decided on her own how many of these repetitions required feedback.

In addition to receiving instructions on using the PeriCoach, the patient was also guided through proper body mechanics to decrease downward pressure on the pelvic organs. Pressing outward with the abdominal muscles, relaxation of the PFM, and flexion of the lumbar spine may increase intra-abdominal pressure and POP symptoms. Co-contraction of the PFM upward and the abdominal wall inward is thought to minimize excessive pressure downward on the pelvic organs. Bending forward with neutral lumbar lordosis (as opposed to increased thoracic kyphosis and rounded lumbar lordosis) also appears to decrease undesirable downward pelvic pressure. The patient was asked to perform focused bend practice 5 to 10 times during the day and to use these techniques when performing activities of daily living as often as she could remember.

During the second week, the patient consistently performed her PFM exercises using the PeriCoach system twice a day. She also reported doing an extra set of PFM exercises without the assistance of the PeriCoach each day. All exercises were performed supine to decrease the effects of gravity on the PFM and increase exercise success.

Two weeks after initiating PeriCoach-assisted PFM training, the patient reported fewer symptoms of POP and one episode of UI. She stated she was able to exercise more at the gym. External palpation performed in a standing position revealed some perineal elevation upon contraction of the PFM muscles. She was also able to squat without bearing down. An EMG assessment with use of external perineal electrodes showed an 11.5-μV PFM contraction held for five seconds using minimal overflow.

Her PFM tone at rest was fairly normal (3.7 microvolts). Because the patient was able to elevate the perineum during standing PFM contractions, the patient was instructed to start standing exercises with the PeriCoach. Many practitioners feel standing exercises are more difficult and that they should be included as the patient improves to ensure the ability of the PFM to support organs in the upright position.

Three weeks after beginning her PFM training with the PeriCoach system, the patient reported feeling 30% better overall. She could feel a "hint" of prolapse at the end of the day, 2 to 4 days a week. Vaginal examination showed 3+/5 PFM strength, which was unchanged from the initial assessment. However, she was able to hold the contraction longer (for 7 to 10 seconds), indicating an increase in endurance. The quality of the contractions had also improved. She used less overflow, although she still showed a tendency to squeeze her gluteal muscles. The POP severity was downgraded from moderate to minimal. Assessment of her POP-related symptom distress using the PFDI revealed a score of 24.9/300, which reflects a 40.1% improvement over baseline. Her POPDI score also improved 33.6% to 16.6/100 (see Figure 3).

Mattox, Lucente, McIntyre, Miklos, and Tomezsko (2000) studied patients with POP and abnormal spinal curves and concluded that loss of lordosis was a significant risk factor for development of POP. In addition, loss of lordosis and increased thoracic kyphosis can increase risk of compression fractures in patients with osteoporosis. This patient had a posterior pelvic tilt in standing. Although there is no evidence that restoring normal lordosis benefits POP, the patient was taught to avoid flattening the lumbar lordosis for the benefit of both her POP and her osteopenia. Good posture was reinforced with education.

A telephone call with the patient after approximately 5 weeks of PFM training using the PeriCoach system revealed that the patient experienced no UI in the past 2 weeks. Her voiding interval had increased to 2 to 2.5 hours, but urgency was still a problem. After this call, the physical therapist instructed the patient to adjust the PeriCoach program to a 6-second hold for 15 repetitions, with 3-second rests between.

Figure 3.
Percent Change Calculation

Current score – initial score divided by initial score times 100 = percent change
PFDI
[(24.9 – 41.6) / 41.6] x 100 = 40.1% improved
POPDI
[(16.6 – 25) / 25] x 100 = 33.6% improved

The patient's last in-person session occurred during week 6 of her PeriCoach training. She was working on maintaining a 2-hour voiding interval. The patient was asked to grade her perineal pressure on a scale of 0 (no perineal pressure) to 10 (the worse perineal pressure you could imagine). This helps to quantify the perineal sensations that bother the patient. She reported a perineal sensation of 3/10 at the end of the day with full activity level and full exercise routines. Her external EMG reading upon PFM contraction was 34.6 μV with a 10-second hold. She felt like she was getting better and had a good understanding of the exercise program. The patient was given a urine-measuring device to collect information about bladder pattern.

Results of Clinical Interaction

In a telephone call at week 8, the patient reported that her largest void measured 450 mL, which was normal for her age. Her voiding interval had increased to 2.5 to 3.5 hours. She experienced one episode of nocturia per night, which was not bothersome. She did not experience incontinence, and the urgency had resolved. She also reported experiencing fewer POP symptoms. She felt "pretty normal." No prolapse was visible in the mirror while standing. She was able to exercise more at the gym and continued walking. Outcome questionnaires were reviewed with the patient over the phone. Both measures of symptom distress showed complete resolution of POP-related bother (PFDI and POPDI scores were 0).

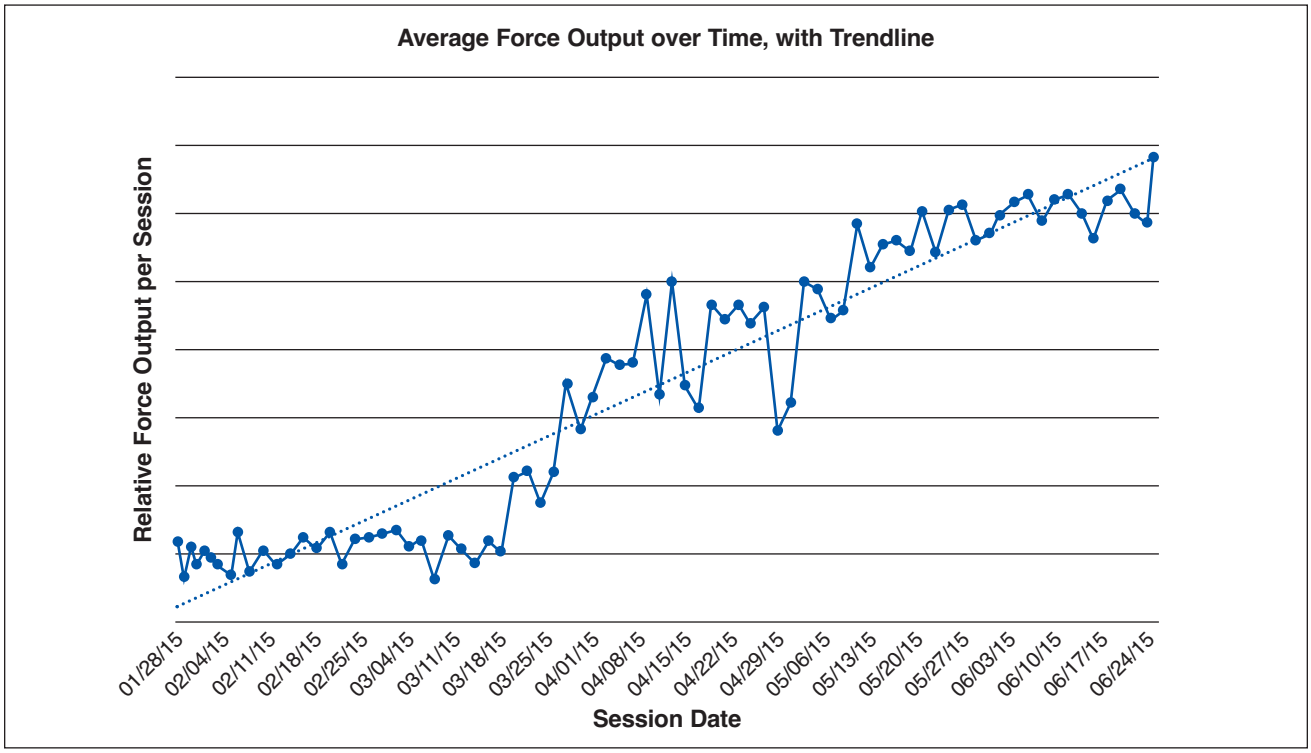
The patient was sent a customized PeriCoach system program by her therapist through the web portal. This program included 10-second hold for 15 repetitions, with 3 seconds of rest between contractions. Online portal monitoring shows the patient has continued her PFM training program with the PeriCoach system twice a day for a total of 30 repetitions a day, even after discharge. Figure 4 shows the average force output of the PFM over approximately 6 months of using the PeriCoach.

Clinical Implications

This case study illustrates an older woman whose symptoms of POP and UI resolved with 6 physical therapy sessions over the course of 8 weeks with the help of daily home PFM exercises using the PeriCoach system. She showed improvement in the muscle recruitment, endurance, and quality of her PFM contractions after using the device. The patient's voiding urgency and frequency also resolved with informal bladder training and the use of the PeriCoach system.

This patient already had some knowledge about PFM exercises, but she required skilled interven-

Figure 4.
Average Force Output of Pelvic Floor Muscle Training Sessions Over 12 Weeks



Notes: The force measurements collected from the PeriCoach® sensors are an analogue to digital conversion output. The units shown on the Y axis are a relative measure of these A to D conversions. The relative measure demonstrates muscle function in a clear understandable manor for the medical professional. These measurements cannot be compared to millimeters of mercury or microvolts.

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tion and feedback to perform the PFM contraction correctly to achieve maximum benefit and symptoms resolution. She had initiated PFM exercises on her own at first observation of POP, but examination revealed that she was using significant overflow of gluteal and abdominal musculature with PFM contraction, and was still contracting the PFM while at rest. When she was given verbal instructions on proper contraction technique and use of visual feedback of the in-office EMG reading, the quality of her PFM contraction improved significantly within the same visit. This observation resulted in the recommendation of the PeriCoach home PFM trainer, which provides similar visual feedback.

The PeriCoach device detects muscle contraction activity in the PFM through force sensors. Information from the device is immediately transmitted wirelessly via Bluetooth technology to a smartphone. The patient can then see a visual display of her muscle activity on the screen. The data can be uploaded and shared with her health care provider through a web portal to help monitor progress between visits. The PFM exercise prescription can be advanced as the patient improves; once a patient consistently performs well with a given program, the device can be recalibrated to her new patient's maximum voluntary contraction (MVC), thus increasing the difficulty of the exercises.

Even though older women may sometimes have difficulty adapting to new technologies, it is important to note that this 66-year-old woman had no such difficulty using the PeriCoach system. She was not frustrated or confused by the device, the app, or the software. Nor was it painful or difficult for her to insert the device. She had no evidence of atrophic vaginitis from the start of physical therapy that could have limited her ability to use a vaginal sensor.

Over the course of her PeriCoach-assisted PFM regimen, consistent improvements were seen. The exercises were begun in a lying down position, but she was later able to progress to standing. The symptoms of her POP disappeared, as did the distress caused by them. The strength, quality, and duration of her contractions improved greatly, as confirmed by external EMG scores and physical examination. Her voiding interval also increased and her incontinence and urgency to void resolved. As she progressed with her PFM exercises, the calibrations of the PeriCoach

device steadily increased so that she was continuously challenged by the exercise program.

Figure 4 shows the change in average force output of the PFM over time, clearly showing the initial period of about three months in which the force output is quite variable. This represents muscle learning and can be verified with vaginal palpation. Continued training after this time resulted in significant increase in force output. Continued adherence to PFM exercises should be encouraged in all patients even after in-clinic treatment ends.

Conclusion

This older woman experienced significant decrease in her POP symptoms and UI by performing PFM exercises with the help of the PeriCoach system, along with lifestyle changes taught by a physical therapist. Home trainers can be helpful in treating pelvic floor dysfunction. The patient was able to use the device easily and was not limited by vaginal insertion or technology difficulties. It is important to offer technology to older patients if they would clinically benefit from the treatment.

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