A New Approach to Evaluating and Treating Pelvic Floor Muscle Atrophy in Women

Daniel S. Stein, MD, FACOG; Suzanne B. Sloan, CSW

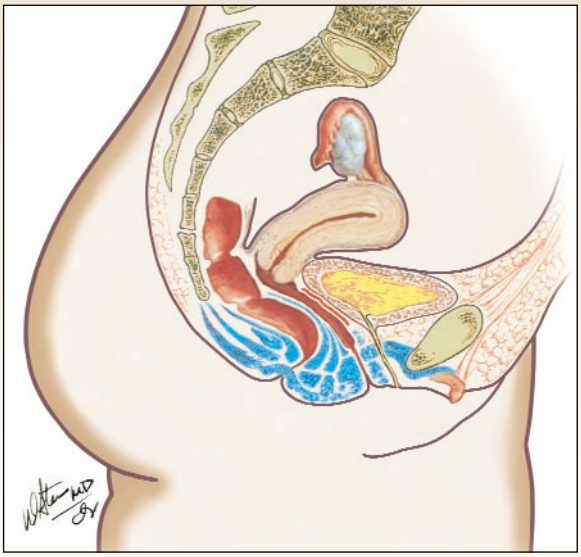
Women of all ages suffer from weakened and atrophied pelvic floor muscles (PFM).[1] In premenopausal women, PFM are typically weakened by childbirth, and for some, by years of aerobic exercise. Recent findings in sports medicine suggest that the incidence of urinary incontinence increases in women who regularly jog, run, or perform activities involving up-and-down jumping.[2] In perimenopausal women, PFM overstretching during childbirth is combined with progressive decline in tissue, vascular, and muscular support resulting from the age-related decline in estrogen and anabolic steroid levels (which promote muscle growth and are responsible for 60% of ovarian sex-hormone production).[3,4] In postmenopausal women, these effects are exacerbated by atrophy of prolonged disuse and lack of PFM resistance exercise for 50 years or more. This article proposes that women suffer from PFM atrophy because of lack of use or isotonic exercise over their lifetime. The PFM are "forgotten muscles" that atrophy over time from lack of adequate use, as was originally suggested by Kegel.[1]

CAUSES

Pelvic floor muscles are responsible for supporting the entire female pelvic structures, including the bladder, uterus, and rectum (Figures 1 through 3). Pelvic floor muscle atrophy is a natural result of aging and disuse due to lack of resistance exercise of these skeletal muscles, combined with the natural decline in estrogen and in the muscle-building and muscle-maintaining anabolic steroid testosterone. Childbirth, gravity, and added weight/obesity play a part in PFM loss of tone and strength over time.

Daniel S. Stein, MD, FACOG is a board-certified OB/GYN, founder and medical director, Foundation for Intimacy, Tampa, Fla. **Suzanne B. Sloan, CSW**, is a licensed psychotherapist and managing director of Naissance Holdings, LC.

FIGURE 1. Pelvic Floor Muscles

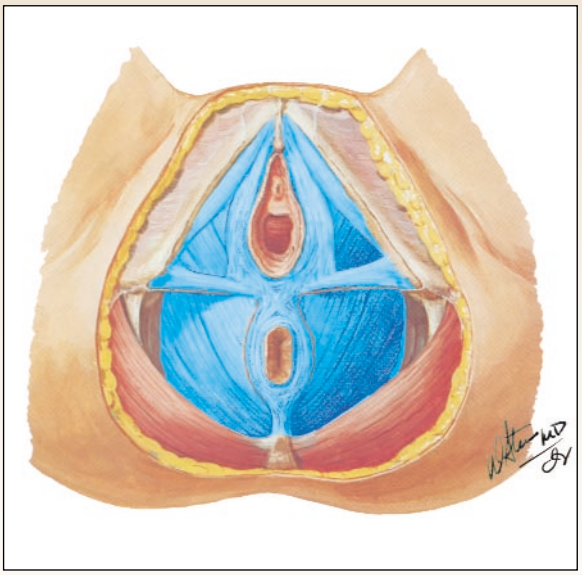


Pelvic floor muscles (shown in blue) contract together. They are increased in tone, strength and endurance by resistance exercise, which converts less effective isometric Kegels to his original idea of resistance isotonic vaginal exercise.

Courtesy of Daniel S. Stein, MD.

In addition, the symptoms of pelvic fullness and pressure, prolapse, decreased genital blood flow and neurosensitivity with diminished sexual arousal, weakened orgasm, and diminished sexual response all contribute to diminished sexual desire. The underlying problem is that this vital muscle group simply is not exercised regularly throughout a woman's lifetime. If women were able to effectively exercise their PFM, they could avoid many sexual and other medical conditions that have significant social, relationship, and psychological consequences.

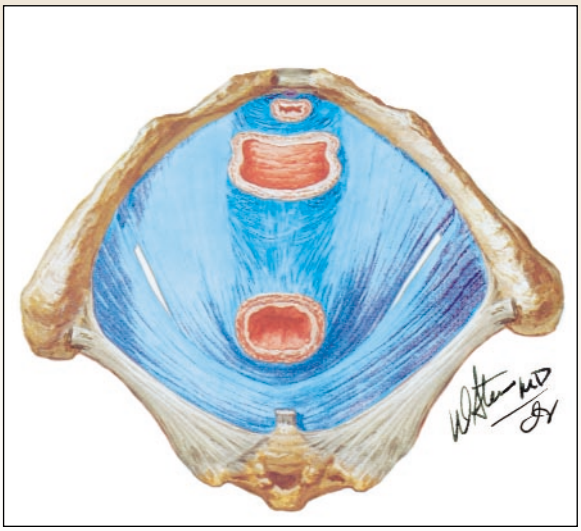
FIGURE 2. Superficial Pelvic Floor Muscles



All muscles shown in blue contract together with isometric Kegels, are overstretched by childbirth, and weakened by age and atrophy of disuse. They are increased in tone, strength, and endurance by adding resistance to isometric Kegels.

Courtesy of Daniel S. Stein, MD.

FIGURE 3. Deep Pelvic Floor Muscles



Courtesy of Daniel S. Stein, MD.

SIGNS AND SYMPTOMS

Symptoms and signs of PFM atrophy may include fatigue, back or lower abdominal pain, pelvic pressure, full bladder, stress incontinence, nervousness, and sexual dysfunction. Low-back pain and lower abdominal pain after prolonged standing or other physical activity is the result of traction on the uterosacral ligaments and round ligaments, respectively. Deep-penetration dyspareunia is caused by direct traumatic contact between the penis and prolapsed cervix. Stress urinary incontinence results from weak resting tone of the PFM and weak reaction strength of the bladder and PFM to jolting, movement, or coughing. Complaints of fatigue, back or lower abdominal pain, pelvic pressure, and fullness may also be due to the uterus prolapsing into the weakened, stretched vagina in the upright posture, or being pushed further into the vagina by weight, exercise, or lifting. In addition, nervousness or irritability can occur because of chronic urinary incontinence.

Sexual dysfunction is a common symptom of PFM that is caused by decreased PFM strength and tone, reducing the nerve and blood supply to the overlying vulva and clitoris. This in turn decreases access to arousal during the psychological and physical stimulation of foreplay, and "short-circuits" the conditioned response of arousal and orgasm. Decreased neurosensitivity due to diminished oxygen supply and circulation attenuates both arousal and orgasm. Decreased PFM blood flow impairs clitoral and vaginal engorgement of female erectile tissues, further sabotaging arousal.[5] In addition, dyspareunia contributes to the loss of desire, which is so frequently associated with the postpartum period and the perimenopausal and postmenopausal years. Finally, overstretching and weak PFM tone means less contact sensation during coitus for both partners.

Sexual Function

Sexual arousal, desire, and orgasm may be impeded by weak vaginal muscles and attendant loss of sexual sensation and response. Sexual pain may be caused by uterine prolapse and pelvic relaxation of the same origin. Optimal sexual function may be enhanced in all such cases with vaginal resistance exercise.

Atrophied PFM lose the tone, strength, endurance, and ability to respond to orgasm with strong tonic-clonic contractions. Orgasm is the cognitive perception of 7 to 12 spontaneous spasms of the PFM at 0.8-sec intervals. Both the amplitude and duration of PFM orgasmic spasms are decreased with PFM atrophy.[5] This means weaker, smaller orgasms. In addition, weakened PFM also have decreased blood flow and nerve development, reducing genital engorgement. This interferes with the

ability to achieve orgasm, making it difficult to accomplish reliable orgasms and have multiple orgasms.

Dysfunctional sexual arousal, desire, and orgasm, as well as dyspareunia, may all result from weakened PFM and become more prevalent with each vaginal delivery, especially if the infant weighs more than 8 lb.[6,7]

Urinary Stress Incontinence

Mild stress incontinence results when the PFM become weakened and are no longer able to keep the urethra closed during sudden movement. Coughing, laughing, or sneezing thereby allow a small amount of urine to escape. Severe stress incontinence occurs when the PFM become so weak that there is a persistent dribble of urine with movement, necessitating the use of absorptive pads or the performance of surgery. Although surgery may appear to offer a permanent solution, there is a 15% to 30% failure rate.[8] Therefore, nonsurgical options may be preferable. Using specific exercises designed to strengthen the PFM is one such option.

CLINICAL ASSESSMENT

Risk Factors

Risk factors for PFM overstretching include vaginal delivery of infants weighing more than 8 lb, vaginal delivery of two or more infants, tearing or extending of the episiotomy during delivery, precipitous delivery (less than 4 hours of labor), and prolonged hard labor (suggesting relative cephalopelvic disproportion).

History

It is essential to discuss the patient's childbirth experience and the presence of episiotomy or childbirth injury. The sexual history should include questions about possible decline in pleasure and sensation, decrease in arousal from foreplay, increase in difficulty achieving orgasm, weaker orgasm, inability to have vaginal orgasm, dyspareunia or urine leakage on deep penetration, and loss of desire after childbirth. Urine leakage during intercourse may be due to jarring of a cystocele by the penis.

The urinary history should pay particular attention to stress incontinence. A 24- or 72-hour voiding diary is often helpful. The patient should also record fluid intake and activities that provoke urine leakage.

It is important to differentiate among stress, urge, and mixed incontinence. Urgency is frequently associated with inflammation of the bladder lining by cystitis or atrophy. It may also be associated with pelvic discomfort or pressure, fear of involuntary leakage, or fear of pain when voiding. Urinary frequency (ie, urinating more than every 2 hours or 7 times per day) is a common associated symptom.

Stress incontinence is the most common type, accounting for 82% of the total treatment cost for urinary incontinence.[9] The annual cost of treatment for stress incontinence in the United States exceeds $1 billion, excluding costs related to routine care and evaluation. The surgical cost exceeds $1.032 billion per year, with a failure rate of 15% to 30%.

Mild stress incontinence can occur with laughing, coughing, sneezing, or jumping, and usually doesn't require the use of a pad. The condition is defined as moderate when leakage during normal daily activities such as walking, stepping off a curb, or dancing require the use of a pad. Severe stress incontinence occurs when almost any movement provokes urinary leakage, and a pad or adult diaper is required.

Physical Examination

A thorough history leads to a high index of suspicion for PFM dysfunction. The diagnosis can be confirmed by observant examination using several simple techniques.

Inspection.—The first step is to carefully inspect the vulva and clitoris with the patient in the lithotomy position. Dry, thinning vulvar skin, decreased pubic hair, and loss of subcutaneous tissue are indications of atrophy often related to hormone decline and underlying PFM weakness. A gaping introitus is a common sign. The labia minora should be assessed for circumferential continuity; there is frequently a complete loss of the posterior third to half of the labia minora due to decreased oxygen and nutrition from PFM atrophy and to more superficial decreases in blood flow and nerve sensitivity as measured by Doppler ultrasonography and quantitative genital neurosensory analysis. The width of the perineal body is important, as it contains the PFM insertions and may be reduced in size or absent by PFM dysfunction.

The clitoris and interior labia minora should be inspected with the labia majora gently spread apart. Is the clitoral hood agglutinated and stuck to the clitoris, or is it freely retractable? Has it shrunk together to obscure the clitoris? Are there labial varicosities lateral to the clitoris and running in an anteroposterior direction parallel to the labia minora? Varicose veins in younger women are frequently associated with family history and PFM atrophy.

Palpation.—The clitoral hood should be retracted and inspected for white epithelium, suggesting carcinoma in situ, atrophy, agglutination, or scarring. The labia minora should be spread and checked from front to back for skin color and tone; varicosities in a non-hair-bearing area of the labia minora; and urethral caruncle, polyp, or white epithelium suggesting intradermal pathology. The vaginal vestibule should be inspected for the presence or absence of hymenal

caruncles, visible subcutaneous spider capillaries in the epithelium of the posterior fourchette (suggesting atrophy), thin, friable skin (suggesting estrogen deficiency), or a painful fissure. The labia should also be palpated between thumb and index finger for old, nontender bartholin cysts and urethral tenderness.

Speculum Examination.—A clear speculum is recommended for good visualization of the vaginal walls. After inserting the speculum obliquely and rotating it to horizontal, a Papanicolaou test should be obtained. While gently depressing the thumb, the speculum should be removed slowly while observing the anterior, posterior, and lateral vaginal sidewalls for a Wolffian duct cyst, abundant horizontal wrinkles (indicating good estrogen effect), or smooth, flat, friable, atrophied mucosa. Gentle abrasion with a cotton-tipped applicator resulting in subcutaneous petechiae is a sure sign of PFM atrophy and fragile blood vessels. Cervical depth can be marked using a finger as the speculum is withdrawn; if the cervix has dropped due to prolapse, it may be less than 3 inches from the introitus and even less in the upright posture during normal activity.

Posterior Perineal Test (PPT).—The index and middle fingers should be inserted into the vagina with the palm down, and gentle pressure applied posteriorly toward the rectum. With the perineal body thus depressed, the patient should perform a Valsalva maneuver. If the bladder and urethra rotate posteriorly and come down between 15° and 45°, or even up to 90° into the introitus, the presence of cystocele, cystourethrocele, and/or PFM atrophy are confirmed.

V-Test.—The index and middle fingers are inserted palm up into the vagina, and the fingers spread wide apart. When the patient is asked to squeeze and pull up, there should be immediate pressure from the PFM. Weak PFM will produce only a twitch or slight elevation.

Cotton-tipped Applicator Test.—This confirmatory test may be performed if there is suspicion of cystocele and/or urethrocele. After preparing the urethral meatus with cleansing solution, a sterile, lubricated applicator is inserted approximately 0.5 cm into the urethra. When the patient bears down, the applicator should not move. If the applicator rotates upward, then the bladder and the urethra are dropping down and rotating posteriorly (ie, cystourethrocele).

Biannual Examination.—The index and middle fingers are inserted into the vagina palm up to feel for tenderness along the urethra and base of the bladder. Bladder tenderness is then assessed by compressing the bladder between the suprapubic and vaginal hands. Positive findings may suggest bladder mucosa atrophy or urinary tract infection, necessitating urinalysis and culturing for antibiotic sensitivity. Tenderness or low-back pain on pressing the cervix upward and anteriorly may indicate prolapse, which can be reproduced by downward or anterior traction with a cervical tenaculum. In either case, PFM atrophy causing low back pain is confirmed. Similarly, lower abdominal discomfort on one or both sides may be reproduced by downward suprapubic pressure, causing a prolapsed uterus to exert traction on the round ligaments.

Rectovaginal Examination.—No pelvic examination is complete without a careful rectovaginal check. One finger is inserted into the vagina while a pressing a second finger gently on the external anal sphincter. After the sphincter relaxes and the patient gives permission to continue, the thickness of the perineal body should be noted, confirming a clear separation by 1.5 cm or more between the posterior vaginal fourchette and anus. The perineum contains the median naphé and Hun-Yin acupressure spot, which is normally very sensitive. There should be no irregular thickening of the septum, suggesting an abscess or tumor. The rectal finger should be moved in a 360° sweep to look for nodules or polyps, which warrant endoscopy and biopsy. With the palm up, and the index finger removed, the rectal finger should be flexed to check for rectocele. The use of a mirror can help the patient to see and understand the findings. The rectal finger smear can then be used to test for hemoccult testing.

Manometry.—An additional test of PFM strength is manometry, which is a quantitative assessment of contractions (1 cm H_2O = 0.736 mm Hg). Cystoscopy and cystourethrography may be appropriate for patients with recurrent urinary tract infections, persistent hematuria, or urinary incontinence.

NONSURGICAL OPTIONS

Kegel Exercises

The oldest form of PFM exercise are the Kegel exercises, which are simple, isometric contractions/relaxations of the PFM.[6] However, Kegel himself noted that "physiologic therapy of genital muscle relaxation is divided into two phases or steps: (1) specific muscle education, and (2) resistive exercises of the pubococcygeus and its visceral extensions."[7] The specifics of focusing on muscle identification and education are paramount, as some patients will be unable to contract their PFM voluntarily.[7] Furthermore, women who cannot identify their PFM may recruit their abdominal, gluteal or quadriceps muscles instead, deriving no benefit. Establishing awareness of the function of the PFM is essential for clinical results.[7]

The Kegel Perineometer

The most important factor in therapy is *resistance* PFM exercise. All skeletal muscles must perform work to gain strength. This means that muscle fibers must shorten against resistance. Muscle strength and resting tone are increased only by resistance (isotonic) exercise. Only exercises that produce muscle work are able to increase strength, tone, and endurance. Work alone stimulates new muscle cell development and associated increases in nerve and blood supply. Isometric (Kegel) exercises (a sustained contraction of muscles at fixed length or meter) are far less effective than isotonic exercises in stimulating muscle growth.[10,11]

In 1946, Kegel developed the perineometer, an intravaginal compressible chamber attached to a handheld pressure gauge, which measured PFM contraction strength in mmHg. In addition to visual feedback during PFM contraction, this instrument provided a means of contracting the perivaginal muscles against resistance. Such resistance exercise strengthen all components of the pubococcygeus, especially the minute end-fibers that atrophy in patients with genital relaxation.[7] The Kegel perineometer has not been available for many years, however, so now a vaginal manometer is used to measure PFM contractions. Poor muscle tone and tissue resistance will read at about 15 to 20 cm H_2O, or even 5 to 10 cm H_2O. Good muscle tone and tissue resistance will yield a reading of 40 cm H_2O or greater.

No vaginal resistance exerciser has been studied since Kegel's perineometer, so there is no direct comparison for other PFM resistance exercises. However, there are substantial clinical data available supporting the benefits of vaginal isometric exercise, so isotonic exercise should only produce further improvement.

A NEW APPROACH

A recently developed, medically designed isotonic vaginal resistance exerciser, the GyneFlex, now offers a nonsurgical option for treating and preventing weak PFM. GyneFlex is based on the principles first established by Kegel, which have not been medically revisited until now. The device comes in sets of two, and is available in three resistance strengths: light, regular, or firm. GyneFlex assists women in performing isotonic exercises to strengthen their PFM.

As with any progressive exercise program, the patient begins at the lowest resistance level and works her way up to the highest level. Correct muscle identification and isolation, and frequent repetition are critical. Kegel described the following characteristics in patients who used a resistance exerciser correctly and regularly:

- Awareness of the pubococcygeus muscle function
- Appreciation of muscular contractions in areas where none could be demonstrated previously, especially in the anterior and lateral quadrants of the vaginal wall
- Progressive strengthening of contractions of the PFM
- Improvement of tone and texture in all of the pelvic floor musculofascial tissues of the outlet
- Increased bulk of the PFM and their visceral extensions
- Changes in the position of the perineum, introitus, urethra, bladder neck, and uterus relative to an "ideal line" between the os pubis and coccyx
- Tightening and lengthening of the vaginal canal
- Improved tone and firmness in flaccid vaginal walls.[12]

In addition, it is likely that PFM strengthened by resistance exercise will increase the neurologic feedback of orgasm. Physically stronger PFM can produce higher-amplitude contractions and more contractions per orgasm (ie, 7 to 12 contractions at 8- to 10-sec intervals). Furthermore, as Kegel noted, "With physiologic therapy, complete relief from simple stress incontinence has been consistently obtained in a series of over 700 cases of this type."[12] There is conclusive evidence that muscle education and repetitive, coordinated resistance exercise can prevent or treat urinary stress incontinence and improve sexual response.[13,14]

In the authors' experience, patients who were properly instructed in exercising with the GyneFlex, including use of a mirror to check their technique, have been able to strengthen the contractions of the PFM over 2 to 3 months with regular repetition. These patients also experienced elimination or significant improvement of problems such as urinary stress incontinence, sexual dysfunction, dyspareunia, and poor arousal and orgasmic response.

Risks and Side Effects

There are no known risks associated with exercising the PFM. Side effects may include soreness after exercising, especially in the lower abdomen. This is usually due to use of the inadvertent recruitment and exercise of the abdominal, gluteal, or quadriceps muscles rather than correct isolation of the PFM. In addition, women who exercise the PFM should understand that once they have achieved adequate strength and tone, they must continue the vaginal exercise program for maintenance. Exercising PFM at least three times per week is mandatory to prevent recurrence of atrophy.

CONCLUSION

Repetitive PFM resistance exercise is essential for women of all ages.[15] Isotonic exercise should begin as early as possible to optimize sexual function and prevent urinary incontinence, especially in female athletes. Through correct muscle identification and consistent application of a regular resistance exercise program, patients can obtain lasting results in terms of building new vaginal muscles and increasing their tone, strength, and endurance.

REFERENCES

1. Kegel AH. Progressive resistance exercise to the functional restoration of the perineal muscles. *Am J Obstet Gynecol.* 1948;56:238-248.
2. Asp K. *American Fitness Magazine*. July/August 2001:30-32,69.
3. Kobashi K, Leach G. Better prospects for stress urinary incontinence. *Contemp Urol.* 2000;164(6):1879-90.
4. Bacho C, Winandy A. Preliminary study of the hormonal effect on various parameters of the pelvic floor in genitally active women without hormone therapy and in menopausal women. *Acta Urol Belg*. 1992;60(2):45-60.
5. Hoon PW. Physiologic assessment of sexual response in women: the unfulfilled promise. *Clin Obstet Gynecol*. 1984;27(3):767-780.
6. Kegel AH. The nonsurgical treatment of genital relaxation. *West Med & Surg*. 1948;31:213-216.
7. Kegel AH. Active exercise of the pubococcygeus muscle. In: Miegs JV, Sturgis SH, eds. *Progress in Gynecology,* vol II. New York: Grune & Stratton; 1930;778-792.
8. Lightener DJ, Itano NM. Treatment options for women with stress urinary incontinence. *Mayo Clin Proc*. 1999;74 (11):1149-1156.
9. Wilson L, Brown J, Shin G, et al. Annual direct costs of urinary incontinence. *Obstet Gynecol.* 2001;98(3):398-406.
10. Cammu H, Van Nylen M, Amy JJ. A 10-year follow-up after Kegel pelvic floor muscle exercises for genuine stress incontinence. *Br J Urol Int.* 2000;85(6):655-658.
11. Johnson VY. How the principles of exercise physiology influence pelvic floor muscle training. *J Wound Ostomy Continence Nurs*. 2001;28(3):150-155.
12. Kegel AH. A Nonsurgical Method of Increasing the Tone of Sphincters and their Supporting Structures. *Annals of Western Medicine and Surgery*. Los Angeles, Calif: University of Southern California School of Medicine; 1948:213-216.
13. Morkved SBK. Effects of postpartum pelvic floor muscle training in prevention and treatment of urinary incontinence: a one year follow-up. *Br J Obstet Gynaecol.* 2000;107 (8):1022-1028.
14. Halvorsen JG, Metz ME. Sexual dysfunction, part II: diagnosis, management and prognosis. *J Am Board Fam Pract*. 1992;5(2):177-192.
15. Fourcroy J. Pelvic floor muscle resistance exercise from adolescence for life. Paper presented at: The International Society for Women's Sexual Health Annual Meeting, State of the Art Symposium, October 2001; Boston, Mass.