Male Pelvic Floor: History and Update

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Our knowledge and understanding of the male pelvic floor has been gained over many years. Anatomists have held erroneous theories for hundreds of years based on the hypotheses of great men such as Hippocrates in 400 BC and later Leonardo da Vinci in the 16th century (Chadwick & Mann, 1987; Van Driel, Van de Wiel, & Mensink, 1994). The male pelvic floor was not mentioned in the first anatomy book by Quain or in the first edition of Gray’s Anatomy (Gray, 1858; Quain, 1828). Since then, anatomists have documented the anatomy and physiology of the male urogenital diaphragm, later termed the pelvic floor in subsequent editions.

The pelvic floor muscles can be divided into a deep supportive layer, which forms the pelvic (urogenital) diaphragm and spans the opening of the bony pelvis, and a superficial layer, which is relevant to sexual function. The deep muscles consist of puborectalis, pubococcygeus, iliococcygeus and ischiococcygeus, and the external urinary sphincter. In women, the pelvic organs lie below the pelvic diaphragm whereas in men the pelvic organs lie below the pelvic diaphragm (see Figure 1).

The superficial muscles are bulbocavernosus and ischiocavernosus and the anal sphincter. The bulbocavernosus and ischiocavernosus muscles are important for penile rigidity. The bulbocavernosus muscle also pumps the ejaculate and ejects the last few drops of urine from the bulbourethra after micturition. The anal sphincter is active in retaining feces (see Figure 2).

Over 100 years of physiotherapy theory and practice have helped change and refine nurses’ perception of the intricate function of the male pelvic floor. We now know that the male pelvic floor has many functions. It plays a role in supporting the contents within the abdominal cavity, is active during breathing, enhances the local circulation, and helps to maintain good posture. Importantly, it maintains urinary and fecal continence. It plays a major role in gaining and maintaining penile erection and serves to pump the ejaculate.

Physiotherapy Development

Physiotherapy treatment has evolved over the last 110 years in the United Kingdom (U.K.). It commenced in 1894 when The Society of Trained Masseuses was founded by four nurses from The London Hospital. In 1919, this society amalgamated with The Institute of Massage and Remedial Exercises established in Manchester and in 1920 the Royal Charter was granted and the two bodies became The Chartered Society of Massage and Medical Gymnastics. In 1921, the first professional association was formed in America called the American Women’s Physical Therapeutic Association. By the end of the 1930s the American association changed its name to the American Physiotherapy Association. In 1944, the
society in the U.K. adopted its present name as the Chartered Society of Physiotherapy. In 1964, Vidler stated that “You needed a good educational background to train as a physiotherapist, but when qualified it is wit and observation that give you the ability to judge the effect of your treatment and report on it or discuss it with the doctor” (p. 19). It was not until 1977 that Chartered Physiotherapists became autonomous clinicians in the U.K., with the ability to take self-referrals, assess, diagnose, and treat without a medical referral.

In 1964, Rule 2 of the Code of Conduct stated that registered physiotherapists should confine themselves to the recognized field of physiotherapy (Gardiner, 1964). Physiotherapy was extremely protective of its core skills of massage, exercises, and electrotherapy. At this stage, it lacked the foresight and courage to develop new skills in other areas. Physiotherapists were generalists and expected to undertake all types of physiotherapy treatment. Gradually, physiotherapy skills have expanded to cover many specialist areas, such as continence. Now, it is recognized by physiotherapists in men’s health, that it is necessary to feel a contraction of the external anal sphincter and puborectalis muscle in order to assess and grade muscle strength and endurance at initial assessment and as an outcome measure. In 1994, Laycock described digital anal assessment of the puborectalis muscle and external anal sphincter in left-lateral lying position. This assessment position has now been superceded by the position of supine lying with knees bent and feet on the couch. In the supine position it is possible to observe the anal wink, penile retraction, and scrotal lift in order to ascertain that the muscles are working correctly. Also, it is possible to note any abnormalities, observe the perineal skin condition, and test skin sensation (Dorey, 2001). Before 1996, there was no recognized method of assessing the strength of the pelvic floor muscles in men. In 1996, Wyndaele and Van Eetvelde found that digital anal assessment of the pelvic floor muscles, grading from 0 (nil) to 5 (strong), was a reliable method of testing pelvic floor muscle strength in men. Dorey and Swinkels (2003) found anal manometry to be a reliable outcome measurement for pelvic floor muscle strength. Following a randomized controlled trial of pelvic floor muscles for men with erectile dysfunction, Dorey (2003a) argued the need for another digital anal grade for men, grade 6 (very strong).

**Pelvic Floor Exercises**

The earliest reference to muscle relaxation and muscle strengthening was found in The Ebers Papyrus (c3000-1534BCE) (Ebbell, 1937). This papyrus, comprising 110 pages, is the most lengthy of the medical papyri and was purported to be found between the legs of a mummy in Egypt. In 1899, Bruce, a great advocate of graduated exercise, stated that “the active elements of an organ grow under the influence of abundant work” (p. 217). We know now that exercise increases the blood supply to the surrounding area by bringing more oxygenated blood to the part and increasing venous return.

The earliest mention of pelvic floor exercises was found in a book dedicated to Medical Gymnastics and Massage (Arvedson, 1930). Swedish Medical
Gymnastics were used by physiotherapists in 1938 to strengthen the pelvic floor muscles in women (Prosser, 1938). Strong resisted concentric muscle activity of the hip adductors was used to work the pelvic floor muscles. Two gymnasts stood either side of the patient positioned in supported supine lying while resistance was applied to hip adduction. Eccentric work of the pelvic floor was effected when the gymnasts drew the legs out while the patient continued to work the hip adductors strongly (Prosser, 1938).

Dr. Arnold Kegel has always been considered the pioneer of pelvic floor muscle exercises for women even though Swedish Gymnastics preceded his work (Kegel, 1948). In 1948, he proposed postnatal pelvic floor muscle exercises and, to his credit, pelvic floor muscles are still termed “Kegels” in America. Gardiner (1959) demonstrated four exercises which worked the muscles of the pelvic floor (see Figure 3). These exercises worked the hip adductors and buttocks as well as the pelvic floor muscles.

Figure 3. Pelvic Floor Exercises in 1959

Key
a. Crook lying (with pelvis lifted); brace buttocks, press knees together, and pull up between legs.
b. Leg lift lying (heels supported and legs crossed); hip raising and adduction with pelvic floor contraction.
c. Side lying (legs bent); leg stretching and adduction with pelvic floor contraction.
d. Inclined long sitting (ankles crossed); brace buttocks, press knees together and contract pelvic floor.

Source: Gardiner, 1959

Today, men are trained to isolate the contraction to the pelvic floor muscles while breathing normally and without tightening the hip adductors and gluteal muscles.

Posture
In 1938, Prosser wrote that the human body in the standing position is in a state of unsteady equilibrium because the center of gravity is a long way from its base. It is currently known that the pelvic floor muscles have an important postural action. Muscle stability of the body is achieved by the action of the diaphragm working in conjunction with the pelvic floor muscles, and the transverse abdominal muscles working in conjunction with the multifidus muscles of the spine (Sapsford et al., 2001). The pelvic floor muscles are active in the sitting position and become more active in the standing position.

Detrusor Underactivity
In 1930, Arvedson recommended catheter treatment and gymnastic treatment for paralysis of the bladder. Gymnastic treatment consisted of bladder shaking and perineal shaking to stimulate contraction of the bladder musculature, back hacking and gentle sacral beating to produce a similar effect in a reflex way, crook-half-lying, and knee closing and parting with pelvis lifting to strengthen and improve the tone of the muscles of the pelvic floor (Arvedson, 1930). Now, thinking has changed. The recognized treatment for men with detrusor underactivity is intermittent self-catheterization.

Detrusor Overactivity
In 1960, Muellner first described bladder training for child bedwetters with detrusor overactivity. Children were encouraged to hold on for longer periods of time. Burgio, Stutzman, and Engel (1989) first used biofeedback and bladder training for detrusor overactivity. Patients were encouraged to stand or sit quietly during the urge and relax the abdominal muscles and contract the urinary sphincter muscles until the urge had diminished. They were then advised to walk at a normal pace to the toilet. Burgio et al. (1989) taught all patients to interrupt the stream of urine. This technique is not taught now as it mimics detrusor sphincter dyssynergia and may lead to urine being forced back up the ureters (Bump, Hurt, Fantl, & Wyman, 1991).

It was suggested that a pelvic floor contraction during urgency would inhibit a detrusor contraction via the perineal-pudendal reflex (Mahony, Laferte, & Blais, 1977). Now, we understand that panic makes urgency worse and causes a loss of cortical control. Patients are advised to stand still or sit down for 1 minute without tightening their pelvic floor muscles until the urge disappears when they may either walk calmly to the bathroom or continue their activities (Dorey, 2003b).

Nocturnal Enuresis
Ardveson (1930) advised the first treatment regime for nocturnal enuresis (see Figure 4). Today, treatment is based on this
early regimbut recognizes that
the patient has a medical
problem and is not at fault. Now,
treatment for nocturnal enuresis
consists of a positive attitude,
pelvic floor muscle exercises, a
reward system for children fol-
lowing dry nights, desmopressin
medication, and not drinking for
2 hours before bedtime (Nijman
et al., 2002).

Post-Prostatectomy
Incontinence

The first radical prostatecto-
myes performed by P. Johnson Freyer of the Indian
Medical Service in 1901 and
Hugh Hampton Young of the
Medical Service in 1901 and
Johnson Freyer of the Indian
Medicines. Various methods have been
to strengthen the pelvic floor muscles. Wisinski,
Rolf-Carbaugh, and Bangs (2001) used a rectal weight to strengthen
the pelvic floor muscles and is still
todamned after prostate surgery for either benign
prostatic hyperplasia or prostate
cancer when the involuntary
bladder neck sphincter is dam-
ged and continence relies on an
effective voluntary urinary
sphincter. In 1957, post-prostate-
tomy patients were prone to
chest complications and throm-
bosis and were therefore allowed
to get out of bed early (Cash,
1957). Leg massage and exercises
were of particular value. The
first estimate of urinary
incontinence (UI) following
transurethral resection of pro-
state in 1983 found an incidence of 1.5% after surgery (Habib &
Luck, 1983). Today, the inci-
dence may be greater due to sub-
jective reporting, as Emberton et
al. (1996) found an incidence of
32.5% 3 months after surgery. The first estimate of UI following
radical prostatectomy in 1984
found an incidence of 87% 6
months after surgery (Rudy,
Today, the incidence of UI after
radical prostatectomy is reduced
due to improved surgery using
nerve-sparing techniques; an
incidence of 36% 6 months after
surgery was reported in 1997
(Donnellan, Duncan, MacGregor,
& Russell, 1997).

In 1959, Gardiner taught
patients with stress incontinence
to brace the muscles before any
activity that raised the intra-
abdominal pressure, such as
coughing, sneezing, laughing, or
heavy lifting. This bracing is an
important functional use of the
pelvic floor muscles and is still
used today. In 1996 it was termed
“The Knack” by Miller, Ashton-
Miller, and DeLaceey in recogni-
tion of the learned skill needed.

Sotiropoulos, Yeaw, and
Lattimer (1976) used electrical
stimulation for men post-prosta-
tectomy incontinence with a
45% success rate. In 1989, Burgio
et al. treated post-prostatectomy
stress incontinence with biofeed-
back and 51 pelvic floor muscle
contractions a day with some
success. Opsomser, Castille, Abi
Aad, and van Cangh (1994)
undertook the first randomized
controlled trial of pelvic floor
exercises plus anal electrical
stimulation versus no treatment
for post-prostatectomy inconti-
nence. Results showed no signif-
icant difference but both groups
were taught pelvic floor muscle
exercises. Sueppel, Kred, and
See (2001) were the first to
demonstrate that pre-prostatecto-
micke groin floor muscle exercises
reduced post-prostatectomy in-
continence. Until 1997, nurses in
the U.K. had dominated the man-
agement of male continence
problems. Since then, physio-
therapists have been active in
teaching pelvic floor exercises
and providing patients with rele-
vant advice (Dorey, 2000).

Moore, Cody, and Glazener
(1999) produced the first Cochrane Review of randomized
controlled trials using pelvic
floor exercises for post-prostate-
tomy incontinence and conclud-
ed that it was not possible to reli-
ably identify or rule out a useful
effect. However, Van Kampen et
al. (2000) demonstrated the sig-
nificant effectiveness of pelvic
floor exercises for men post-rad-
cal prostatectomy. This study
showed that the men performing
pelvic floor muscle exercises
achieved continence sooner than
the control group.

Various methods have been
employed to strengthen the
pelvic floor muscles. Wisinski,
Rolf-Carbaugh, and Bangs (2001)
used rectal weight to strengthen
the pelvic floor muscles follow-
ing post-radical prostatectomy
incontinence in a case study of
one subject. Now, muscles can be
strengthened by maximum con-
tractions without rectal weights.
Dorey (2004) used few maximum
pelvic floor muscle contractions
to produce muscle hypertrophy,
stressed the importance of the
functional use of the muscles
during activities which may
cause urinary leakage, and
included sub-maximum muscle
work to increase muscle
endurance (see Figure 5).

Post-Micturition Dribble

In 1970, Vereecken and
Verduyn, using a pressure sensor
and electromyography at the end
of micturition, noticed an
increase in urethral pressure and
a visible contraction of the bulboc-
cavernosus muscle expelling the

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**Figure 4. Regime for Nocturnal Enuresis in 1930**

1. No evening drinks.
2. Seriously telling the patient he must try not to wet the bed. (No cor-
poral punishment must be given.)
3. Cold sponging to the perineum morning and evening.
4. Waking the patient once in the night at a regular time.
5. Gymnastic treatment.

Source: Ardveson, 1930
Pelvic Floor Exercises for Men in 2004

1. **In Standing Position**
   Stand with your feet apart and tighten your pelvic floor muscles as if you were trying to stop the flow of urine. If you look in a mirror, you should be able to see the base of your penis move nearer to your abdomen and your testicles rise. Hold the contraction as strongly as you can.

   Try to avoid holding your breath, pulling in your abdomen or tensing your buttocks. Perform 3 maximal contractions in the morning and 3 maximal contractions in the evening holding for up to 10 seconds. Each contraction should be stronger than the last.

2. **In Sitting Position**
   Perform 3 maximal contractions when sitting on a chair with your knees apart in the morning and also in the evening holding for up to 10 seconds.

3. **In Lying Position**
   Perform 3 maximal contractions when lying on your back with your knees bent and your knees apart in the morning and also in the evening holding for up to 10 seconds.

4. **While Walking**
   Try lifting your pelvic floor up about 50% of maximum when walking.

5. **After Urinating**
   After you have voided urine, while still poised over the toilet, try tightening your pelvic floor muscles strongly to eliminate the last few drops of urine and avoid the embarrassing after dribble.

6. **After Voiding Feces**
   Tighten your back passage after voiding feces. This returns any feces not voided up to the rectum and makes it easier to wipe your bottom.

7. **During Sexual Activity**
   Try tightening your pelvic floor muscles rhythmically to achieve and maintain penile rigidity during sexual activity. Slow thrusting movements generate higher pressures inside the penis.

8. **To Delay Ejaculation**
   For men with premature ejaculation, try tightening your pelvic floor muscles to delay ejaculation.

   Exercise routines now are moving much more towards using the pelvic floor muscles during functional activities such as those shown in exercises 4, 5, 6, 7, & 8.

Source: Dorey, 2004

Constipation

In 1899, Bruce treated constipation with a “habitual pill of aloe and strychnine until they regain the muscular tone which they have lost” (p. 216). Elliman (1903) listed the causes of constipation (see Figure 6). Today, there are many diverse causes of constipation. Constipation may be due to the side effect of medication, reduced fluid intake, a sedentary lifestyle, and certain neurologic conditions (Dorey, 2004). Severe constipation may cause fecal overflow incontinence.

In 1903, the treatment for constipation consisted of “massage of the belly daily” using Elliman’s embrocation for 20 minutes or rolling a 4 lb to 6 lb metal ball over the abdomen for 5 to 10 minutes every morning (Elliman, 1903). Also, alternate douching of the abdomen with hot and cold water was used to excite bowel activity. In 1938, treatment for chronic constipation consisted of massage with colon frictions to increase the flow of blood to the gut and stimulate peristalsis (Prosser, 1938).

Today, constipation is best avoided by medication review, a balanced diet, attention to fluid levels, not putting off a call to pass a motion, sitting on the toilet in a good position, and avoiding enemas and laxatives as they may cause constipation after use (Dorey, 2004).
Fecal Incontinence

Historically, prolapsed anus and fecal incontinence were treated with electric shock treatment to gain a contraction of the anal sphincter. The first use of electrotherapy was recorded in 47 AD by Scribonius Largus, who described the use of the electric eel for prolapsed ani (Gadsby, 1998). In 1601, William Gilbert discovered materials termed “electra” and coined the term “electricity” (Gadsby, 1998). Johann Krueger, professor of philosophy and medicine, published the first medical electricity textbook entitled Thoughts about Electricity in 1744 (Gadsby, 1998). Faradism, a low frequency current used to gain a muscle contraction, was used in 1898 by Dommer in Germany for bedwetting, using one electrode over the urethra and one over the anus (Stainbrook, 1948). In 1920, a physician named Eberhart used high frequency current for a variety of rectal diseases. He used a mild spark for treating prolapsed rectum to cause an immediate contraction, and used a spark and then a rectal tube for relieving the itching of pruritus ani. Men with paralysis of the anal sphincter were given rectal applications and spark to the spine. Gardner (1959), a physiotherapist, performed anal faradic stimulation using an anal electrode so that patients could feel an anal contraction with the instruction “draw up the back passage.”

Today, faradism has been replaced by electrical stimulation, which is a more comfortable form of treatment. The anal electrode commonly used approximates well with the puborectalis muscle. A mild prolapsed rectum may benefit from pelvic floor muscle exercises. Severe rectal prolapses are treated surgically. Pruritus ani is treated with skin medication. Men with fecal incontinence and fecal urgency may be helped with pelvic floor muscle training (Dorey, 2004). These muscles can be trained to work functionally to prevent feces escaping while walking to the bathroom, and after passing a motion in order to return any feces not voided back up the anal canal to the rectum.

Erectile Dysfunction

In 400 BC, Hippocrates believed that erections were generated by air and “vital spirits” flowing into the penis. He also believed that the testes were connected to the penis by a pulley system of erectile cords which facilitated erection, as damage to these cords profoundly affected penile erection (Chadwick & Mann, 1987).

Leonardo da Vinci (1452-1519) found that men executed by hanging developed a reflex erection and that dissection of the penis showed it to be full of blood, not air (Van Driel et al., 1994). After dissecting more than 30 corpses, da Vinci believed that semen came from the brain, along the spinal cord to the penile tube. Michelangelo (1475-1564) practiced anatomical dissections to perfect his knowledge of the human form. However, not everyone shared his views. His nude statue of David was stoned by a Florentine mob in 1504, and 30 years later Pope Paul IV ordered another artist to paint over the penises in “The Last Judgement” in the Sistine Chapel (Friedman, 2003).

The first doctors to hypothesize that pelvic floor muscles were instrumental in gaining penile erection were Poirier and Charpy (1901), who correctly believed that contractions of the ischiocavernosus and bulbocavernosus muscles were necessary to attain a full erection. In 1909, Gray’s Anatomy published a lithograph of the male urogenital diaphragm. The ischiocavernosus muscle was aptly labelled erector penis, and the bulbocavernosus muscle was labelled ejaculator urine. In 1973, Beckett, Hudson, Walker, Reynolds, and Vachon found that there was increased pelvic floor muscle activity in the stallion during coitus. In 1983, Karacan, Aslan, and Hirshkowitz (1983) investigated the activity of the ischiocavernosus and bulbocavernosus muscles during nocturnal erections using electromyography. They concluded that these muscles played a role in the erection in man. Lavoisier, Courtois, Barres, and Blanchard (1986) demonstrated an increase in intracavernous pressure in the penis during contractions of the ischiocavernosus and bulbocavernosus muscles.

For the last 10 years, the term impotence was considered offensive and was gradually replaced with the term erectile dysfunction (ED). In 2004, the International Society for Sexual and Impotence Research eventually changed its name to International Society for Sexual Medicine.

Kawanishi et al. (2000) devised a novel method of giving resisted exercises to the ischiocavernosus muscle. They strapped a spring balance to the coronal groove of the penis to measure the maximum strength of this muscle and found that potent men were significantly stronger than impotent men. In 1993, Claes and Baert compared 78 patients who were randomized to pelvic floor exercises with 72 patients who were randomized to surgical suturing.
of the deep dorsal vein. At 4 months, after pelvic floor muscle exercises, 36 were cured and 22 improved, and after surgery, 44 patients were cured and 17 improved. In 1999, Colpi, Negri, Nappi, and Chinea, using electromyography found that the pelvic floor muscles in potent men were significantly stronger in sexually active men that men with ED.

Two randomized controlled trials demonstrated significant improvement of erectile function with pelvic floor exercises. In 2002, Sommer et al. studied 124 men with ED due to proven venous leakage. The men were randomized into three groups: pelvic floor exercises, Viagra®, and placebo. Results at 3 months showed that 80% improved in the pelvic floor exercises group, 74% improved in the Viagra group, and 18% improved in the group taking a placebo. This result is similar to the research by Dorey et al. (2004), who showed that 40% of men with ED attained normal erectile function and a further 35.5% improved following 6 months of pelvic floor exercises.

Now, almost 100 years after the function of the ischiocavernosus and bulbocavernous was known, men are instructed to actively strengthen these muscles to treat both ED and post-micturition dribble. A pelvic floor exercise regime is advised to prevent and treat ED (see Figure 5) (Dorey, 2004). These same exercises are used to treat urinary and fecal incontinence.

Anal Pain

The first recorded use of electro-anesthesia was in 47 AD by Scribonius Largus, who described the use of the electric eel for headaches and prolapsed ani (Gadsby, 1998). Now, proctalgia fugax, a spasm of the pelvic floor muscles, is a recognized cause of anal pain. It is treated with relaxation and biofeedback techniques. Men who suffer from episodic anal spasm may find it helpful to sit on the toilet and bear down in order to relax the anal sphincter and alleviate the spasm.

Conclusion

The conception of the male pelvic floor has altered considerably over time. Early erroneous assumptions have been dispelled with diagnostic techniques such as anatomical dissection, electromyography, videocystography, manometry, digital anal assessment, and surgery. Recent good research has added considerably to our fund of knowledge. The pelvic floor muscles in men are active in posture, the control of urine and feces, and in normal erectile function. Weak pelvic floor muscles can contribute to urinary and fecal incontinence, post-micturition dribble, and erectile dysfunction. Pelvic floor muscle training may alleviate each of these conditions. Spasm of the pelvic floor muscles may produce anal pain, which is treated with relaxation techniques. More research is needed to add further evidence to this growing knowledge base.

References


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