1 History of the Male Pelvic Floor

Key points

- In 400 BC, it was believed that air flowed into the penis to effect an erection.
- In 1519, it was first known that blood flow was responsible for penile erection.
- In AD 47, the electric eel was used to gain an anal contraction.
- In 1930, pelvic floor muscle exercises were first taught.
- In 1901, the pelvic floor muscles were first linked to penile erection.

INTRODUCTION

Our understanding of the male pelvic floor has evolved over more than two thousand years. Gradually medical science has sought to dispel ancient myths and untruths. 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 sixteenth century (Chadwick & Mann 1987; Van Driel et al. 1994). The male pelvic floor was not mentioned in the first anatomy book by Quain or in the first edition of Gray's *Anatomy* (Quain 1828; Gray 1858). Since then, anatomists have documented the anatomy and physiology of the male urogenital diaphragm, termed the pelvic floor in subsequent editions (Figure 1.1).

PHYSIOTHERAPY DEVELOPMENT

Physiotherapy treatment has evolved over the last 110 years in the UK. 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 1944, the Society in the UK 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

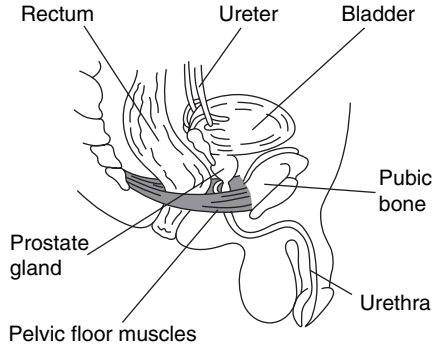


Figure 1.1. Male pelvic floor muscles (Reproduced by permission of NEEN Mobilis Healthcare Group. *Source*: Dorey, 2004b)

with the doctor' (Vidler 1964). It was not until 1977 that Chartered Physiotherapists became autonomous clinicians in the UK, 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 recognised field of physiotherapy (Gardiner 1964). Physiotherapy was extremely protective of its core skills of massage, exercises and electrotherapy (added in 1929). 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, physiotherapists confine themselves to areas in which they have had training and in which they are competent. In 1992, the profession became an all-graduate entry profession in the UK.

Physiotherapy treatment for female incontinence has gradually evolved over the last 66 years, whilst physiotherapy treatment for male incontinence has evolved more recently. Up till 1997, nurses in the UK dominated the management of male continence problems. Since then, physiotherapists have been active in teaching pelvic floor exercises and providing patients with relevant advice (Dorey 2000).

ASSESSMENT OF THE MALE PELVIC FLOOR

Before 1996, there was no recognised 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 randomised controlled trial of pelvic floor muscles for men with erectile dysfunction, Dorey (2004a) 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 (c. 3000–1534 BCE) (Ebbell 1937). 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 whilst resistance was applied to hip adduction. Eccentric work of the pelvic floor was effected when the gymnasts drew the legs out whilst the patient continued to work the hip adductors strongly (Prosser 1938).

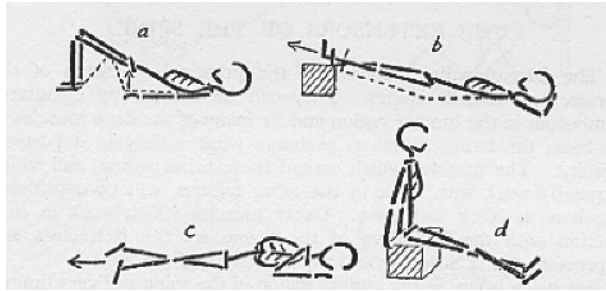
Dr Arnold Kegel has always been considered the pioneer of pelvic floor muscle exercises for women, even though Swedish Gymnastics preceded his work (Kegel 1948). In 1948, he proposed postnatal pelvic floor muscle exercises and, to his credit, pelvic floor muscles are still termed 'Kegels' in America. Gardiner (1959) demonstrated four exercises (Figure 1.2) which worked the muscles of the pelvic floor, but all these exercises worked the hip adductors and buttocks as well as the pelvic floor muscles.

POSTURE

In 1938, Prosser wrote that the human body in the standing position is in a state of unsteady equilibrium, as its centre of gravity is a long way from its base. In 2001, Sapsford et al. reported that muscle stability of the body was 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.

DETRUSOR UNDERACTIVITY

In 1930, Dr Arvedson recommended catheter treatment and gymnastic treatment for paralysis of the bladder. Gymnastic treatment consisted of bladder shaking, perineal shaking, back hacking and gentle sacral beating to stimulate



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.

Figure 1.2. Early pelvic floor exercises (*Source*: Gardiner, 1995)

contraction of the bladder; and crook-half-lying, knee closing and parting with pelvis lifting to strengthen and improve the tone of the muscles of the pelvic floor (Arvedson 1930).

DETRUSOR OVERACTIVITY

In 1960, Muellner first described bladder training for child bed-wetters with detrusor overactivity. Children were encouraged to hold on for longer periods of time. Burgio et al. (1989) first used biofeedback and bladder training for men with 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 normal pace to the toilet.

In 1977, Mahony et al. suggested that a pelvic floor contraction during urgency would inhibit a detrusor contraction via the perineal-pudendal reflex.

NOCTURNAL ENURESIS

In 1930, Dr Ardveson advised the first treatment regime for nocturnal enuresis consisting of banning evening drinks, telling the patient not to wet the bed, cold sponging to the perineum morning and evening, waking him once during the night and gymnastic treatment. In 2002, Nijman et al. treated this condition by using a positive attitude, pelvic floor muscle exercises, a reward system for children following dry nights, desmopressin medication, and not drinking for 2 hours before bedtime.

POST-PROSTATECTOMY INCONTINENCE

The first radical prostatectomies were performed in India by Freyer in 1901 and in the UK by Young in 1904 (Garrison 1917). Sir Eardley Holland coined the term 'stress incontinence' to describe exertional incontinence in women (Millin & Read 1948). In 1957, post-prostatectomy patients were prone to chest complications and thrombosis and were therefore allowed to get out of bed early (Cash 1957). Physiotherapists performed leg massage and leg exercises.

The first estimate of urinary incontinence following transurethral resection of prostate in 1983 found an incidence of 1.5 % after surgery (Habib & Luck 1983). In 1966, the incidence increased to 32.5 % at three months after surgery, possibly due to subjective reporting (Emberton et al. 1996).

The first estimate of urinary incontinence following radical prostatectomy in 1984 found an incidence of 87 %, six months after surgery (Rudy et al. 1984). In 1997, the incidence reduced to 36 % at the same assessment time owing to improved surgery using nerve-sparing techniques (Donnellan et al. 1997).

In 1959, Gardiner taught patients with stress incontinence to brace the pelvic floor muscles before any activity which raised the intra-abdominal pressure, such as coughing, sneezing, laughing or lifting heavy weights. This bracing was termed 'The Knack' in 1996 by Miller et al. in recognition of the fact that the skill needed to be learned.

In 1976, Sotiropoulos et al. used electrical stimulation for men with post-prostatectomy incontinence with a 45 % success rate. In 1989, Burgio et al.

treated post-prostatectomy stress incontinence with biofeedback and 51 pelvic floor muscle contractions a day with some success. In 1994, Opsomer et al. undertook the first randomised controlled trial of pelvic floor exercises plus anal electrical stimulation versus no treatment for post-prostatectomy incontinence. Results showed no between-group significant difference, but both groups were taught pelvic floor muscle exercises. In 2001, Sueppel et al. were the first to demonstrate that pre-prostatectomy pelvic floor muscle exercises reduced incontinence after radical prostatectomy.

Moore et al. (2000) produced the first Cochrane Review of randomised controlled trials using pelvic floor exercises for post-prostatectomy incontinence and concluded that it was not possible to reliably identify or rule out a useful effect. Van Kampen et al. (2000) demonstrated the significant effectiveness of pelvic floor exercises for men after radical prostatectomy. Various methods have been employed to strengthen the pelvic floor muscles. Wisinski et al. (2001) used a rectal weight to strengthen up the pelvic floor muscles following post radical prostatectomy incontinence in a case study of one subject.

POST-MICTURITION DRIBBLE

In 1970, Vereecken and Verduyn, using a pressure sensor and electromyography, noticed an increase in urethral pressure and a visible contraction of the bulbocavernosus muscle expelling the last drops of urine at the end of micturition. In 1977, Stephenson and Farrar, using videocystography during mid-stream stopping, demonstrated that men with post-micturition dribble failed to milk urine back into the bladder during contraction of the external urethral sphincter. They suggested that men apply manual compression to the bulbar urethra in the perineum after micturition. Paterson et al. (1997) were the first to show in a randomised controlled trial that pelvic floor exercises or bulbar urethral massage was significantly effective for post-micturition dribble. Dorey et al. (2004b) demonstrated that pelvic floor muscle exercises were significantly effective in curing post-micturition dribble and superseded bulbar urethral massage for this condition.

CONSTIPATION

In 1899, Bruce treated constipation with a ‘habitual pill of aloes and strychnine until they regain the muscular tone which they have lost’. In 1903, Elliman treated constipation with ‘massage of the belly daily’ using Elliman’s embrocation for 20 minutes or rolling a 6lb metal ball over the abdomen for 5 to 10 minutes every morning. Also, alternate douching of the abdomen with hot and cold water was used to excite bowel activity. In 1938, Prosser treated

chronic constipation with abdominal massage and colon frictions to increase the flow of blood to the gut and stimulate peristalsis.

FAECAL INCONTINENCE

Historically, prolapsed anus and faecal incontinence were treated with electric shock treatment to gain a contraction of the anal sphincter. The first use of electrotherapy was recorded in AD 47 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 was used in 1898 by Dommer in Germany for bed-wetting, applying 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 pruritis ani. Men with paralysis of the anal sphincter were given rectal applications and spark to the spine. Gardiner (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'. Since then, faradism has been replaced by electrical stimulation, which is a more comfortable form of treatment.

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. 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 (Friedman 2003). After dissecting more than 30 corpses, Leonardo believed that semen came from the brain, along the spinal cord to the penile tube.

In 1901, Poirier and Charpy first reported 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 labelling the ischiocavernosus muscle 'erector penis' and the bulbocavernosus muscle 'ejaculator urine'. In 1973, Beckett et al. found that there was increased pelvic floor muscle activity in the stallion during coitus. In 1983, Karacan et al. 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 et al. (1986) demonstrated an increase in intracavernous pressure in the penis during contractions of the ischiocavernosus and bulbocavernosus muscles.

For the last ten years, the term 'impotence' has been considered offensive and has gradually been replaced with the term 'erectile dysfunction' and, in 2004, the International Society for Sexual and Impotence Research (ISSIR) eventually changed its name to the International Society for Sexual Medicine (ISSM).

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 the potent men were significantly stronger than impotent men. In 1993, Claes and Baert compared pelvic floor exercises with deep dorsal vein suturing in men with erectile dysfunction and obtained similar results in both groups. In 1999, Colpi et al. using electromyography found that the pelvic floor muscles were significantly stronger in sexually active men than men with erectile dysfunction. Two randomised controlled trials have demonstrated significant improvement in erectile function with pelvic floor exercises. In 2002, Sommer et al. found pelvic floor exercises to be superior to Viagra and in 2004, Dorey et al. found that pelvic floor exercises were significantly more effective than lifestyle changes for men with erectile dysfunction (Dorey et al. 2004a).

CONCLUSION

Our 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.