Men's health: an emerging and important role for physiotherapy

PAUL HODGES PhD MedDr DSc BPhty(Hons) FACP
Professor and NHMRC Senior Principal Research Fellow Director, NHMRC Centre of Clinical Research Excellence in Spinal Pain, Injury and Health, School of Health and Rehabilitation Sciences, The University of Queensland, Australia

Men's health is an area of global importance. More than 40% of men report continence issues, and sexual dysfunction and pelvic pain are also prevalent. Although women's health has been a major area of special interest in physiotherapy, the role of the profession in men's health is only beginning to emerge. Some randomised clinical trials have been completed that study physiotherapy management of common issues, such as pelvic floor muscle training for erectile dysfunction and incontinence after prostatectomy. Although some show promising results, recent systematic reviews question efficacy. A major issue is that rehabilitation has generally been extrapolated from women to men, without consideration that the mechanisms and most optimal treatments may be different. For physiotherapy to establish its role in this domain, it is critical for knowledge to expand regarding the underlying mechanisms for function, the mechanisms for dysfunction, and the mechanisms for efficacy of interventions. Upon this sound foundation we can then consider / reconsider the optimal path for physiotherapy in men's health.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Establish evidence-based rationale for physiotherapy interventions in the management of men's health conditions.

2 Understand the current barriers to broad implementation of physiotherapy in men's health based on limited understanding of normal function and changes with dysfunction.

3 Understand new knowledge of the mechanisms of continence in men.

4 Understand the anatomy of the pelvic floor in men and the differences with women.

5 Understand theories related to pelvic pain in men.

6 Understand the potential mechanisms for efficacy of interventions.

7 Understand the basis for subgrouping and tailoring of interventions for pelvic floor muscle dysfunction in men.

Introduction

Men's health is an area of global importance. Within the spectrum of health conditions experienced by men are the broad range of conditions and symptoms that have a potential involvement of pelvic floor muscle dysfunction (table 1) and a potential role for physiotherapy. The burden of these conditions is not trivial. More than 40% of men report continence issues, and the incidence of sexual dysfunction, and pelvic pain related to the genitalia and pelvic organs is high, but perhaps under-reported. Of particular importance is prostate cancer, which is the most common cancer in men (1 in 7) and the second most common cause of cancer death (Australian Institute of Health and Welfare 2017). Radical prostatectomy, i.e. prostate removal to prevent metastasis, is the most common treatment.

The good news is that prostate cancer has a very high, i.e. 95%, five-year survival rate (Australian Institute of Health and Welfare 2017), but the bad news is that morbidity is high; 66% of men experience post-prostatectomy incontinence (PPI), many experience PPI beyond 12 months, and more than 70% experience erectile dysfunction (Hagland *et al* 2015). Post-prostatectomy incontinence and erectile dysfunction have a major impact on quality of life. They can incur costs to the patient, as up to 33% use incontinence products (Kao *et al* 2000), and result in social isolation (Katz & Rodriguez 2007; Fowler *et al* 1995), and relationship issues.

CONDITIONS
Urinary incontinence
• Stress urinary incontinence
• Overactive bladder
• Increased frequency
• Nocturia
• Urgency / urge incontinence
• Hesitancy
• Incomplete emptying
Faecal incontinence
Erectile dysfunction
Obstructive disorders
Pelvic pain disorders (e.g. pain in genitals, perineum)

TABLE 1: Common conditions in men with potential involvement of pelvic floor muscle dysfunction

> "PELVIC FLOOR MUSCLE TRAINING PRINCIPLES FOR WOMEN ARE LIKELY TO TRAIN THE MUSCLES IN MEN IN THE WRONG WAY"

For many of these conditions there is a plausible biological role for exercise to train pelvic floor muscle function. In terms of rehabilitation of continence, although efficacy in female stress urinary incontinence has class 1 evidence (Dumoulin & Hay-Smith 2010), early optimistic outcomes for PPI (Van Kampen *et al* 2000) have been superseded by systematic review evidence of no efficacy in males (Campbell *et al* 2012).

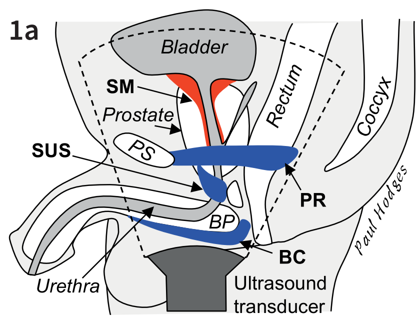
In general, rehabilitation of pelvic floor muscle function in men has followed direct extrapolation of the principles of exercise applied to women. This has occurred because of the paucity of investigation of pelvic floor muscle anatomy and control in men, and the assumption that the function and mechanisms would be similar. Our group has recently embarked on a programme of clinical and physiological research to study men using innovative methods and has questioned this approach. We contend that conventional pelvic floor muscle training fails to consider the mechanisms of continence in men or the impact of surgery, and that it is likely that pelvic floor muscle training principles extrapolated from women are likely to train the wrong muscles in the wrong way.

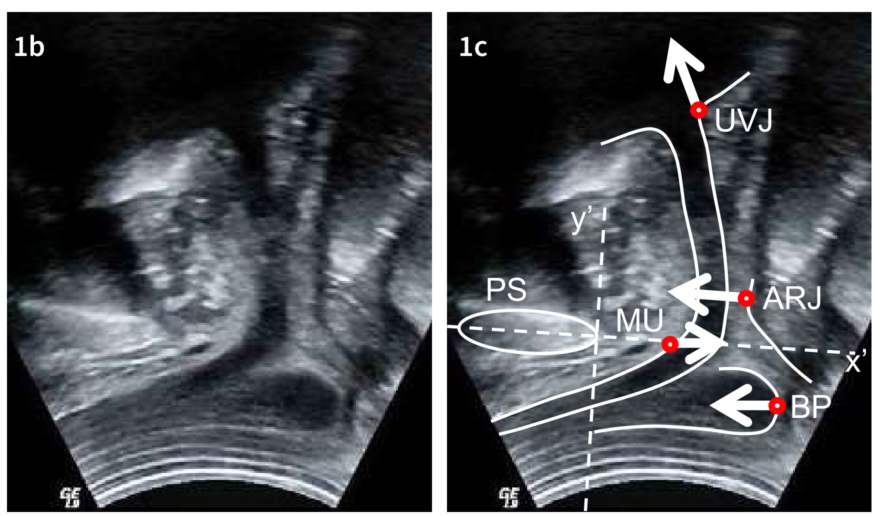
This paper presents recent evidence of anatomy and function of the pelvic floor muscles in men, the current state of understanding of dysfunction of the pelvic floor muscles in a range of conditions, new options for assessment, and considerations for individualised treatment.

New understanding of anatomy and function of the male pelvic floor muscles

The pelvic floor in men generally involves the same muscles as women, with some differences in anatomy. A major issue in the literature is the inconsistency in terminology used for different muscles. The different components of the levator ani are variously referred to as puborectalis (PR), pubovisceralis, and pubococcygeus. The smooth muscle sphincter of the urethra is referred to as the lissosphincter or internal urethral sphincter. The striated muscle urethral sphincter (SUS) is called the rhabdosphincter, the external urethral sphincter and the peri-urethral striated muscle. In addition, there are the superficial pelvic floor muscles (bulbocavernosus (BC) and ischiocavernosus) and the external anal sphincter. In most cases the anatomy is similar, but the bias in investigation in the literature has been different: the levator ani are the focus of much of the female literature because of the potential for trauma with childbirth and the ease of access for assessment via the vagina; and the SUS has been the focus in men because of the potential involvement in prostatectomy. In addition to the absence of vaginal components of the sphincter mechanism in men, the primary distinction between sexes is the anatomy of the superficial layer; in men, the BC surrounds the bulb of the penis and can assist with compression for micturition and ejaculation.

Urinary continence is maintained when urethral pressure exceeds bladder pressure (Elbadawi 1996). This simple equation has a surprisingly complex solution. The contemporary understanding in men has been inaccurate (Koraitim 2008; Gosling *et al* 1981) and slow to develop as it is difficult to record activity of the involved muscles because of their location deep in the pelvis (figure 1). Neuromuscular control of continence involves co-ordination of smooth muscle, i.e. muscles controlled





FIGURES 1a to 1c: Urethral striated muscle complexes (a). Transperineal ultrasound (b). Directions of motion with contraction (c). Arrows show motion for each muscle as follows: Striated urethral sphincter (SUS) – dorsal motion midurethra (MU); puborectalis (PR) – ventral motion anorectal junction (ARJ) motion, ventral-cranial motion urethrovesical junction (UVJ); bulbocavernosus (BC) – compression bulb of penis (BP). Dashed lines – pubic symphysis (PS) axis system. SM – smooth muscle

> "FEW STUDIES HAVE INVESTIGATED PELVIC FLOOR MUSCLE DYSFUNCTION IN MEN"

automatically by the autonomic nervous system to sustain urethral pressure (Elbadawi 1996), and striated muscles, those controlled by reflexes and descending input from higher centres, e.g. voluntarily inputs, that provide ongoing pressure and transient increases when challenged, such as when coughing.

Literature has been plagued by inaccurate anatomy (Netter 1989), and conflicting theories of function (Koraitim 2008; Gosling *et al* 1981). Using novel electromyography electrodes placed in the urethra (Stafford *et al* 2010) or intra-muscular electrodes inserted via the perineum (Stafford *et al* 2015), and imaging (figure 1b) through transperineal ultrasound (Stafford *et al* 2012a; Stafford *et al* 2013) methods, our work has investigated the role of the three striated muscles (figure 1a) that control urethral pressure:

- SUS (mid-urethra compression)
- PR (proximal urethra compression)
- BC (distal urethra compression).

Contrary to previous concepts, such as that considering only SUS (Strasser *et al* 2004), our data show all three striated muscles contribute to continence (Stafford *et al* 2012b; Stafford *et al* 2014). The striated muscles provide some ongoing (tonic) continence (Stafford *et al* 2015), but all muscles transiently activate during continence challenges (Stafford *et al* 2012b), whereas previous theories considered only tonic (Koraitim 2008) or transient (Gosling *et al* 1981) continence function. An observation that has potential importance for exercise design is that individual men differ in their pattern of striated muscle recruitment when challenged; some have bias to SUS, others bias to PR (Stafford *et al* 2012a). This is critical to consider as SUS is most at risk during surgery, but PR is the target of conventional treatments. In terms of other key functions, faecal continence in men involves contributions from the internal and external anal sphincter and the puborectalis, which pulls forward on the rectum. Pelvic floor muscles are considered to provide a contribution to erectile function by compression of the vasculature to assist with penile engorgement. Ejaculation is assisted by contraction of the BC and ischiocavernosus.

Pelvic floor muscles also provide a critical role in control of the spine, secondary to their role in elevation of intra-abdominal pressure. IAP is necessary for trunk muscles to control spine movement and stiffness. The pelvic floor muscles are both necessary to maintain continence when pressure increases, and to enable the pressure to increase, because if there was no floor to the abdominal cavity the pressure would not increase.

Numerous examples of postural activation of the pelvic floor muscles have been reported, e.g. activation of external anal sphincter (Hodges *et al* 2007), and SUS in association with arm movement, and stepping (Stafford *et al* 2012b). Pelvic floor muscles are also activated with breathing, again in conjunction with IAP increase associated with respiratory activation of the diaphragm and abdominal muscles (Hodges *et al* 2007).

Pelvic floor muscle dysfunction in continence and pain disorders in men

Few studies have investigated pelvic floor muscle dysfunction in men. Studies that have been completed primarily focus on PPI and pelvic pain. How men recover continence after radical prostatectomy is unclear. Some research has addressed the question of why men are incontinent after prostatectomy (Constantinou & Freiha 1992), but perhaps a more critical question is how is it possible for men to regain continence after prostatectomy? Radical prostatectomy removes the prostate gland and includes removal of the urethral segment that passes through the prostate plus the associated smooth muscle, which is under autonomic control and critical for ongoing unconscious control of urethral pressure/continence. In addition, there is variable removal of, or surgical trauma to, the smooth muscle of the bladder neck at the proximal end of the prostate, which also contributes to unconscious control of continence (Constantinou & Freiha 1992), and the SUS muscle at the distal end of the prostate (Song *et al* 2007; Desautel *et al* 1997). Although the autonomic innervation of penile vasculature is more likely to be damaged, surgical trauma to the motor innervation of the SUS is possible (Desautel *et al* 1997). Robotic surgery was initially argued to reduce morbidity from incontinence because of lesser surgical trauma, but continence outcomes are no different to open surgical procedures (Yaxley *et al* 2016).

Regardless of the surgical technique, regaining continence would plausibly require adaptation of residual mechanisms to compensate for the smooth muscle removed at surgery (+/- compensation for trauma to SUS). This could be achieved through activation of the remaining striated muscles, particularly SUS if retained, and emphasis on PR/BC in case of trauma or denervation of SUS. How continence is regained is only beginning to be understood.

Previous research suggests PPI is explained by SUS insufficiency (Song *et al* 2007; Cameron *et al* 2015), overactivity of the bladder smooth muscle secondary to surgery (Constantinou & Freiha 1992), loss of urethral length (Hakimi *et al* 2011), large tumour size, or age. However, a recent review found limited evidence for any predictor of incontinence (Dubbelman *et al* 2012) and consensus opinion is that current anatomic/physiologic evidence cannot explain incontinence (Hoyland *et al* 2014). Contemporary understanding has failed to consider the complexity of control of the striated muscles or that the demand for striated muscles exceeds the demand to maintain continence prior to surgery. Our recent data from men with and without PPI (Stafford, Coughlin and Hodges, unpublished data) show that:

1. Men with ongoing PPI have impaired activation of one or more striated muscle
2. Like women with incontinence (Smith *et al* 2007), men with incontinence often generate excessive abdomen/bladder pressure from excessive abdominal muscles activity, as a counterintuitive and unsuccessful strategy to achieve continence when awareness of the pelvic floor is poor (Bump *et al* 1991)
3. Men who have regained continence have function of one or more of the striated muscles that exceeds that of healthy men who have never undergone prostatectomy.

This new data presents two major advances. First, that deficits in activation of striated muscles present differently between men, and second, that regaining continence requires enhancement of function beyond that required for men who have not undergone surgery. This has implications for rehabilitation. In particular, it is likely that for many men, emphasis should be placed on the SUS muscle rather than PR.

In terms of chronic pelvic pain, there is limited emerging evidence for changes in pelvic floor muscle activation in men. One study of electromyography of the pelvic floor muscles recorded with anal electrodes reported greater activation at rest (Hetrick *et al* 2006). An MRI study using diffusion tension imaging showed greater fractional anisotropy, which is interpreted to mean greater strength of connection from cortex to pelvic floor muscles (Huang *et al* 2016). A recent study with transperineal ultrasound imaging showed evidence of differences in orientation of specific pelvic structures that were interpreted to suggest higher activation of levator ani in men with pelvic pain (Davis *et al* 2011). Taken together, these studies imply augmented pelvic floor muscle activation in pelvic pain, but further research is required.

Considerations for management of continence and pain disorders in men

A major issue for extrapolation of effective rehabilitation for women to men is that the mechanism underlying incontinence is different, and the access for assessment of muscle function is different. In women, the major mechanism that underpins the development of incontinence is involvement of the pubococcygeus muscle during vaginal delivery, and this provides a strong foundation for focus on rehabilitation of this muscle and use of vaginal palpation to assess muscle function.

The most common cause of incontinence in men relates to the SUS, at least in the case of PPI. When exercise is extrapolated this has primarily involved contraction of the levator ani with assessment via anal examination. Although some contraction of the SUS may be expected in conjunction with the activation of levator ani (Stafford *et al* 2016), this assessment and rehabilitation is far from specific to the mechanism of incontinence in men. Further, in women the focus has been on repeated maximal contraction, yet in men the objective will involve encouragement of gentle sustained tonic activation.

> "IN MEN, THE OBJECTIVE IS TO ENCOURAGE GENTLE, SUSTAINED TONIC ACTIVATION OF THE PELVIC FLOOR MUSCLES"

Supported by extensive physiological evidence and pilot clinical data, we predict that the most optimal continence outcomes in men with PPI will be achieved by targeting the muscles that control urethral pressure and compensate for tissues removed during surgery, in a manner that individually matches the needs of each man and trains activity in function.

This will require detailed assessment of the pelvic floor muscles. This is difficult in men and digital anal examination is unlikely to provide sufficient information. New methods for interpretation of transperineal ultrasound imaging (figure 1b) have been developed and validated (Stafford *et al* 2015; 2013; 2012a), which provide unrivalled opportunity to view and understand the control in men and to identify individual strategies that may need to be addressed with specifically tailored interventions. Recent work highlights that the pattern of muscle activation can be influenced by instructions (Stafford *et al* 2016). It is also clear that excessive IAP and abdominal muscle activation is an issue for many men, and consideration of the control above the pelvic floor is critical. We propose multiple objectives of exercise that are likely to require consideration to achieve optimal outcomes from treatment (table 2).

FEATURES
Optimise pattern of pelvic floor muscle control and appropriate integration with abdominal muscle activation
Low intensity endurance training for tonic control
High-intensity strength and endurance training for demanding functions
Bladder training to increase volume and time between emptying
Integration of pelvic floor muscle control into function
High-performance training for unexpected demands

TABLE 2: Important features to address to optimal pelvic floor muscle control in post-prostatectomy incontinence

In terms of pelvic pain, consideration of normalisation of overactivity of the pelvic floor muscles will likely be required. There is some evidence for efficacy (Cornel *et al* 2005), but outcomes will likely be optimal if this is undertaken with consideration of individual variation in strategy, and in conjunction with consideration of the multi-factorial nature of chronic pain. Many different structures have been implicated, requiring differential diagnosis, and it is clear, as with other chronic pain conditions, that there will be a need to address psychosocial issues including beliefs and attitudes about pain.

There is some evidence of efficacy of pelvic floor muscle training in erectile dysfunction (Dorey *et al* 2005). This may be optimised with detailed examination of muscle activation and consideration of the potential specificity of contribution of individual muscles of the pelvic floor with greatest potential to impact erectile function.

Conclusion

There is enormous potential for physiotherapy treatment to improve the outcomes for men with a range of conditions involving pelvic floor muscle dysfunction. Effective treatment will require specific tailoring to the pathophysiology and it cannot be assumed the treatments that are effective for women will be effective for men. It is an exciting time for expansion of the role of physiotherapy in men's health.

About the author

Professor Hodges has a doctorate in physiotherapy and two in neuroscience. His research blends these skills to understand pain, control of movement, and the interaction between multiple functions of the trunk muscles including spine control, continence, respiration and balance. He leads a multi-disciplinary research centre that aims to bridge the gap between basic science and clinical practice. He has received numerous international research and leadership awards and has published more than 380 scientific papers and book chapters. Paul has received more than $AU35 million in research grants. He is the author of three clinical texts that have sold more than 30,000 copies internationally. He has been invited to present lectures at major conference in 35 countries and presented workshops for more than 5,000 physiotherapists and medical practitioners in more than 40 countries. He is the lead chief investigator on the first physiotherapy based NHMRC Program Grant and received the 2011 NHMRC Achievement Award as the highest-ranked NHMRC Research Fellow across disciplines in Australia.

CONTACT DETAILS

Centre for Clinical Research Excellence in Spinal Pain, Injury and Health
The University of Queensland
Brisbane Qld 4072 Australia
p.hodges@uq.edu.au

References

Australian Institute for Health and Welfare. *Cancer in Australia 2017*. Canberra 2017

Bump RC, Hurt WG, Fantl JA, Wyman JF. Assessment of Kegel pelvic muscle exercise performance after brief verbal instruction. *American Journal of Obstetrics and Gynaecology* 1991;165:322-327

Cameron AP, Suskind AM, Neer C, Hussain H, Montgomery J, Latini JM, DeLancey JO. Functional and anatomical differences between continent and incontinent men post-radical prostatectomy on urodynamics and 3T MRI: A pilot study. *Neurourology and Urodynamics* 2015;34:527-532

Campbell SE, Glazener CM, Hunter KF, Cody JD, Moore KN. Conservative management for post-prostatectomy urinary incontinence. *Cochrane Database Systematic Review* 2012;1:CD001843

Constantinou CE, Freiha FS. Impact of radical prostatectomy on the characteristics of bladder and urethra. *Urology* 1992;148:1215-1219

Cornel EB, van Haarst EP, Schaarsberg RW, Geels J. The effect of biofeedback physical therapy in men with Chronic Pelvic Pain Syndrome Type III. *European Journal of Urology* 2005;47:607-611

Davis SN, Morin M, Binik YM, Khalife S, Carrier S. Use of pelvic floor ultrasound to assess pelvic floor muscle function in Urological Chronic Pelvic Pain Syndrome in men. *Sexual Medicine* 2011;8:3173-3180

Desautel MG, Kapoor R, Badlani GH. Sphincteric incontinence: the primary cause of post-prostatectomy incontinence in patients with prostate cancer. *Neurouroly and Urodynamics* 1997;16:153-160

Dorey G, Speakman MJ, Feneley RC, Swinkels A, Dunn CD. Pelvic floor exercises for erectile dysfunction. *British Journal of Urology International* 2005;96:595-597

Dubbelman YD, Groen J, Wildhagen MF, Rikken B, Bosch JLHR. Urodynamic quantification of decrease in sphincter function after radical prostatectomy: Relation to post-operative continence status and the effect of intensive pelvic floor muscle exercises. *Neurourology and Urodynamics* 2012;31:646-651

Dumoulin C, Hay-Smith J. Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. *Cochrane Database Systematic Review* 2010;CD005654

Elbadawi A. Functional anatomy of the organs of micturition. *Urology Clinic of North America* 1996;23:177-210

Fowler FJ Jr., Barry MJ, Lu-Yao G, Wasson J, Roman A, Wennberg J. Effect of radical prostatectomy for prostate cancer on patient quality of life: results from a Medicare survey. *Urology* 1995;45:1007-1013

Gosling JA, Dixon JS, Critchley HO, Thompson SA. A comparative study of the human external sphincter and periurethral levator ani muscles. *British Journal of Urology* 1981;53:35-41

Hagland E, Carlsson S, Stranne J, Wallerstedt A, Wilderang U, Thorsteinstdotir T, Legerkvist M, Damber JE, Bjartell A, Hugosson J, Wiklund P, Steineck G. Urinary incontinence and erectile dysfunction after robotic versus open radical prostatectomy: a prospective, controlled, nonrandomised trial. *European Urology* 2015;68(2):2016-225

Hakimi AA, Faleck DM, Agalliu I, Rozenblit AM, Chernyak V, Ghavamian R. Pre-operative and intra-operative measurements of urethral length as predictors of continence after robot-assisted radical prostatectomy. *Endourology* 2011;25:1025-1030

Hetrick DC, Glazer H, Liu YW, Turner JA, Frest M, Berger RE. Pelvic floor electromyography in men with chronic pelvic pain syndrome: a case-control study. *Neurourology and Urodynamics* 2006;25:46-49

Hodges PW, Sapsford R, Pengel HM. Postural and respiratory functions of the pelvic floor muscles. *Neurourology and Urodynamics* 2007;26:362–371

Hoyland K, Vasdev N, Abrof A, Boustead G. Post-radical prostatectomy incontinence: etiology and prevention. *Reviews in Urology* 2014;16:181-188

Huang L, Kutch JJ, Ellingson BM, Martucci KT, Harris RE, Clauw DJ, Mackey S, Mayer EA, Schaeffer AJ, Apkarian AV, Famer MA. Brain white matter changes associated with urological chronic pelvic pain syndrome: multi-site neuroimaging from a MAPP case-control study. *Pain* 2016;157:2782-2791

Kao TC, Cruess DF, Garner D, Foley J, Seay T, Friedrichs P, Thrasher JB, Mooneyhan RD, McLeod DG, Moul JW. Multi-center patient self-reporting questionnaire on impotence, incontinence and stricture after radical prostatectomy. *Urology* 2000;163:858-864

Katz G, Rodriguez R. Changes in continence and health-related quality of life after curative treatment and watchful waiting of prostate cancer. *Urology* 2007;69:1157-1160

Koraitim MM. The male urethral sphincter complex revisited: an anatomical concept and its physiological correlate. *Urology* 2008;179: 1683-1689

Netter FH. *Atlas of Human Anatomy*. Summit, New Jersey: Ciba-Geigy Corporation 1989

Smith MD, Coppieters MW, Hodges PW. Postural response of the pelvic floor and abdominal muscles in women with and without incontinence. *Neurourology and Urodynamics* 2007;26:377-385

Song C, Doo CK, Hong JH, Choo MS, Kim CS, Ahn H. Relationship between the integrity of the pelvic floor muscles and early recovery of continence after radical prostatectomy. *Urology* 2007;178:208-211

Stafford RE, Ashton-Miller JA, Constantinou C, Coughlin G, Lutton NJ, Hodges PW. Pattern of activation of pelvic floor muscles in men differs with verbal instructions. *Neurourology and Urodynamics* 2016;35:457-463

Stafford RE, Ashton-Miller JA, Constantinou CE, Hodges PW. A new method to quantify male pelvic floor displacement from 2D transperineal ultrasound images. *Urology* 2013;81:685-689

Stafford RE, Ashton-Miller JA, Constantinou CE, Hodges PW. Novel insight into the dynamics of male pelvic floor contractions through transperineal ultrasound imaging. *Urology* 2012a;188:1224-1230

Stafford RE, Ashton-Miller JA, Sapsford R, Hodges PW. Activation of the striated urethral sphincter to maintain continence during dynamic tasks in healthy men. *Neurourology and Urodynamics* 2012b;31:36-43

Stafford RE, Coughlin G, Lutton NJ, Hodges PW. Validity of estimation of pelvic floor muscle activity from transperineal iltrasound imaging in men. *PLoS One* 2015;10:e0144342

Stafford RE, Mazzone S, Ashton-Miller JA, Constantinou C, Hodges PW. Dynamics of male pelvic floor muscle contraction observed with transperineal ultrasound imaging differ between voluntary and evoked coughs. *Applied Physiology* 2014;116:953-960

Stafford RE, Sapsford R, Ashton-Miller J, Hodges PW. A novel transurethral surface electrode to record male striated urethral sphincter electromyographic activity. *Urology* 2010;183:378-385

Strasser H, Pinggera GM, Gozzi C, Horninger W, Mitterberger M, Frauscher F, Bartsch G. Three-dimensional transrectal ultrasound of the male urethral rhabdosphincter. *World Journal of Urology* 2004;22:335-338

Van Kampen M, De Weerdt W, Van Poppel H, De Ridder D, Feys H, Baert L. Effect of pelvic-floor re-education on duration and degree of incontinence after radical prostatectomy: a randomised controlled trial. *Lancet* 2000;355:98-102

Yaxley JW, Coughlin GD, Chambers SK, Occhipinti S, Samaratunga H, Zajdlewicz L, Dunglison N, Carter R, Williams S, Payton DJ, Perry-Keene J, Lavin MF, Gardiner RA. Robot-assisted laparoscopic prostatectomy versus open radical retropubic prostatectomy: early outcomes from a randomised controlled phase 3 study. *Lancet* 2016;388:1057-1066