Bø, Kari (2012). Pelvic floor muscle training in treatment of female stress urinary incontinence, pelvic organ prolapse and sexual dysfunction. *World journal of urology, 30*, 437-443.

PELVIC FLOOR MUSCLE TRAINING IN TREATMENT OF FEMALE STRESS URINARY INCONTINENCE, PELVIC ORGAN PROLAPSE AND SEXUAL DYSFUNCTION

ABSTRACT

Objectives. The objectives of the present review was to present and discuss evidence for pelvic floor muscle (PFM) training on female stress urinary incontinence (SUI), pelvic organ prolapse (POP) and sexual dysfunction.

Methods. This manuscript is based on conclusions and data presented in systematic reviews on PFM training for SUI, POP and sexual dysfunction. Cochrane reviews, the 4th International Consultation on Incontinence, the NICE guidelines and the Health Technology Assessment were used as data sources. In addition, a new search on Pubmed was done from 2008-2011. Only data from randomized controlled trials (RCTs) published in English language is presented and discussed.

Results. There is Level 1, Grade A evidence that PFM training is effective in treatment of SUI. Short term cure rates assessed as < 2 grams of leakage on pad testing vary between 35 and 80%. To date there are 5 RCTs showing significant effect of PFM training on either POP stage, symptoms or PFM morphology. Supervized and more intensive training is more effective than unsupervized training. There are no adverse effcts. There is a lack of RCTs addressing the effect of PFM training on sexual dysfunction.

Conclusions. PFM training should be first line treatment for SUI and POP, but the training needs proper instruction and close follow-up to be effective. More high quality RCTs are warranted on PFM training to treat sexual dysfunction.

Key words: pelvic floor muscle training, pelvic organ prolapse, strength, sexual dysfunction, stress urinary incontinence

INTRODUCTION

It has been estimated that during a woman's lifespan there is an 11% risk of surgery for pelvic floor dysfunctions such as urinary incontinence (UI) and pelvic organ prolapse (POP) (1). Pelvic floor disorders or dysfunction has been described by Bump and Norton (2) as urinary and faecal incontinence, POP, sensory and emptying abnormalities of the lower urinary tract, defecatory dysfunction, sexual dysfunction and chronic pain syndromes. The different symptoms can exist alone, but in many cases a person has more than one symptom, and it has been proposed that the symptoms are linked together and caused by dysfunction of the ligaments, fascias and the pelvic floor muscles (PFM) (3). DeLancey et al (4) described an integrated life span model and classified pelvic floor function in 3 major life phases:1. Development of functional reserve, 2. Variations in amount of injury and recovery during and after vaginal birth and 3. Deterioration that occurs with advancing age.

According to Ashton-Miller and DeLancey (5) the anatomical structures that prevent incontinence and genital organ prolapse in females include sphincteric and supportive systems. The PFM are regular skeletal muscles and consist of several muscles and muscle layers of the pelvic and urogenital diaphragms. During voluntary contraction of the PFM there is a forward and upward lift and a squeeze constricting the levator hiatus with the pelvic openings (5). Since Kegel first described PFM training to be effective for UI (6,7), it has been the core of physical therapy interventions for pelvic floor dysfunction in both male and female populations.

The physical therapy process includes assessment, diagnosis, planning, intervention, and evaluation (8). It has been found that more than 30% of women with pelvic floor disorders may be unable to contract the PFM at their first consultation. Hence, individual instruction

and feedback of the attempt to contract is important (9). Physical therapy treatments for the pelvic floor may include bladder training, PFM training with or without biofeedback, cones, electrostimulation or other adjuncts to training. The actual training can be done individually or in groups (10,11).

The aim of this review is to address evidence for PFM training for female stress urinary incontinence, pelvic organ prolapse and sexual dysfunction based on randomized controlled trials and systematic reviews.

METHODS

This review is based on RCT and systematic reviews published from 2001-2011. The systematic reviews are Cochrane reviews on pelvic floor muscle training (12,13,14), the NICE.guidelines (15), the systematic reviews of Hay- Smith et al from the 4th International Consensus on Incontinence 2009 (11) and the Health Technology Assessment (16). A new search was retrieved on Pubmed on August 18th 2011, using the combination of pelvic floor exercise (or pelvic floor muscle training) AND stress urinary incontinence (or pelvic organ prolapse or sexual dysfunction). Limits were English language, female and RCT. Due to limitations in number of references, references to many of the RCTs of PFM training for SUI/ MUI are to published systematic reviews rather than the original publication.

RESULTS

STRESS URINARY INCONTINENCE

In 1948 Kegel (6,7) was the first to report PFMT to be effective in treatment of female urinary incontinence (UI). In spite of his reports of cure rates of > 84%, surgery soon became the first choice of treatment, and not until the 1980s was there renewed interest for conservative treatment (4). Since then, several RCTs have demonstrated that PFMT is more effective than no treatment to treat SUI (11,16,17,18). In addition, a number of RCTs have compared PFMT alone with either the use of vaginal resistance devices, biofeedback or vaginal cones (11,13). Out of the RCTs on SUI, only one did not show any significant effect of PFMT on UI (13). In this study there was no check of the women's ability to contract, adherence to the training protocol was poor and the placebo group contracted gluteal muscles and external rotators of the hips; activities that may give co-contractions of the PFM (10).

It is often reported that PFMT is more commonly associated with improvement of symptoms, rather than a total cure. However, short term cure rates of 35-80 %, defined as ≤ 2 grams of leakage on different pad tests, have been found after PFMT for SUI (18,19). The highest cure rates were shown in RCTs of high methodological quality (10,15). The participants had thorough individual instruction by a trained PT, combined training with biofeedback or electrical stimulation, and had close follow up once or every second week. Adherence was high, and dropout was low.

Biofeedback

Biofeedback has been defined as "a group of experimental procedures where an external sensor is used to give an indication on bodily processes, usually in the purpose of changing the measured quality" (10). Today, a variety of biofeedback apparatus are commonly used in

clinical practice to assist with PFM training. The appratauses are based on either pressure measurements or surface EMG.

Since Kegel first presented his results, several RCTs have shown that PFM training without biofeedback is more effective than no treatment for SUI (11,15). In women with stress or mixed incontinence, all but two RCTs have failed to show any additional effect of adding biofeedback to the training protocol for SUI. Berghmans et al (10) demonstrated a quicker progress in the biofeedback group. In the study of Glavind et al (20) a positive effect was demonstrated. However, this study was confounded by a difference in training frequency, and the effect might be due to a double training dosage, the use of biofeedback, or both.

Vaginal cones

Vaginal cones are weights that are put into the vagina above the levator plate. The cones were developed by Plevnik (10) in 1985. The theory behind the use of cones in strength training is that the PFM are contracted reflexively or voluntary when the cone is perceived to slip out. A Cochrane review, combining studies including patients with both SUI and mixed incontinence, concluded that training with vaginal cones is more effective than no treatment (14). Bø et al (10) found that PFMT was significantly more effective than training with cones both to improve muscle strength and reduce urinary leakage. In other studies there were no differences between PFMT with and without cones (10,14). Cammu & Van Nylen (10,14) reported very low compliance and therefore did not recommend use of cones. Also in the study of Bø et al (10,14), women in the cone group had motivational problems. Laycock et al (10,14) had a total dropout rate in their study of 33%.

Adverse effects of PFM training

Few, if any, adverse effects have been found after PFMT (10,11,15,16,17,18). Lagro-Jansson et al (10,11) found that one woman reported pain with exercise and three had an uncomfortable feeling during the exercises. Aukee et al (10,11) reported no side effects in the training group but found that two women interrupted the use of home biofeedback apparatus because they found the vaginal probe uncomfortable. These women were both postmenopausal. In other studies no side effects have been found (11).

Long term effect of PFM training for SUI

Several studies have reported long- term effect of PFMT (10,11,16). However, the results are difficult to interpret because usually women in the non-treatment or less effective intervention groups have gone on to retrieve treatment after cessation of the study period. As for surgery, there are only few long-term studies including clinical examination (10). Klarskov et al (10) assessed only some of the women originally participating in the study. Lagro-Janssen et al (10) evaluated 88 out of 110 women with SUI, urgency urinary incontinence (UUI) or mixed urinary incontinence (MUI) 5 years after cessation of training and found that 67% remained satisfied with the condition. Only seven of 110 had been treated with surgery. Satisfaction was closely related to adherence to training and type of incontinence, with mixed incontinent women being more likely to lose the effect. SUI women had the best long-term effect

In a 5-year follow up, Bø & Talseth (10) examined only the intensive exercise group and found that urinary leakage was significantly increased after cessation of organized training. Three of 23 had been treated with surgery. Fifty –six % of the women had a positive closure pressure during cough and 70% had no visible leakage during cough at five-year follow up.

Seventy % of the patients were still satisfied with the results and did not want other treatment options.

Cammu et al (10) used a postal questionnaire and medical files to evaluate long term effect of 52 women who had participated in an individual course of PFMT for urodynamic SUI. Eighty-seven % were suitable for analysis. Thirty-three% had had surgery after 10 years. However, only 8% had undergone surgery in the group originally being successful after training, whereas 62% had undergone surgery in the group initially dissatisfied with training. Successful results were maintained after 10 years in 2/3 of the patients originally classified as successful.

Bø et al (21) reported current status of lower urinary tract symptoms (LUTS) from questionnaire data 15 years after cessation of organized training. They found that the short term significant effect of intensive training was no longer present at follow-up. Fifty % from both groups had interval surgery for SUI, however more women in the less intensive training group had surgery within the first 5 years after ending the training program. There were no differences in reported frequency or amount of leakage between non- operated or operated women, and women who had surgery reported significantly more severe leakage and to be more bother by urinary incontinence during daily activities than those not operated.

PELVIC ORGAN PROLAPSE

While systematic reviews and RCTs have shown convincing effect of PFMT for SUI and MUI (11,12), the research on PFM training to treat POP is rather new. A survey of UK Women's Health physical therapists showed that 92% of the physical therapists assessed and treated women with POP (22). The most commonly used treatment was PFM training with

and without biofeedback. A Cochrane review on PFM training for POP concluded that there was an urgent need for guidance regarding the effectiveness of PFMT (23).

Till date five RCTs have assessed PFM training to treat POP or POP symptoms. The RCTs are all in favor of PFM training, demonstrating statistically significant improvement in symptoms (24,25,26) and/or prolapse stage (24,25,27,28). The only full-scale RCT showed a 19% improvement in prolapse stage measured by POP-Q, compared to 4% in the control group receiving lifestyle advice only (24).

SEXUAL DYSFUNCTION

According to Graziottin (29) female sexuality is complex and rooted in biological, psychosexual and context-related factors and correlated to couple dynamics and family and sociocultural issues. Female sexual disorder is classified as women's sexual interest/desire disorder, sexual aversion disorder, subjective sexual arousal disorder, combined genital and subjective arousal disorder, persistent sexual arousal disorder, women's orgasmatic disorder, dyspareunia and vaginismus.

To date, there are only a limited number of RCTs evaluating the effect of PFM training on sexual function in women. Three RCTs have been found reporting the effect of PFM training on sexual function in the postpartum period. Wilson & Herbison (30) did not find any significant differences between the exercise group and the control group in sexual satisfaction. However, 52% and 22% dropped-out of the exercise and control group, respectively, the participants had only 4 follow-up visits with a physical therapist and there was no effect of the training on PFM strength. Mørkved et al (31) asked women about sexual satisfaction 6 years after cessation of an 8 week postpartum PFM training program. They

found that 36% in the former training group compared to 18% in the control group reported improved satisfaction with sex after delivery ($p<0.01$). Citak et al (32) conducted a single blind RCT on 118 primiparous women at 4 months post partum. The training period lasted for 12 weeks and started with individual vaginal assessment to ensure correct contractions. The results showed a significant increase in PFM strength in the exercise group only, and the exercise group scored significantly higher on sexual arousal, lubrication and orgasm, but not on satisfaction.

In a RCT Bø et al (33) investigated the effect of PFM training on sexual function in a group of SUI women , mean age 50 years, and found that the exercise group was significantly better off in questions on sexlife influenced by urinary symptoms and UI during intercourse.

DISCUSSION

There is consensus that PFM training has Level 1, grade A evidence to be effective in treatment of SUI and MUI (11,14,15,16,17,18). There is growing evidence for effect on POP and one study has also shown changes in pelvic floor morphology pointing towards a possible effect at the pathophysiological level. To date the evidence for PFM training on sexual dysfunction is sparse.

Stress urinary incontinence

There are two main theories of mechanisms on how PFMT may be effective in prevention and treatment of SUI (34): 1. Women learn to consciously contract before and during increase in abdominal pressure, and continue to perform such contractions as a behavior modification to prevent descent of the pelvic floor and stop leakage from occuring, and 2. Women are taught to perform regular strength training over time in order to build up "stiffness" and structural support of the pelvic floor. There is basic research, case-control studies and RCTs to support both these hypotheses (34,35)

In addition to these main theories two other theories have been proposed: Sapsford (36) claimed that the PFM was effectively trained indirectly by contraction of the internal abdominal muscles, especially the transversus abdominal (TrA) muscle. There are no RCTs supporting this theory (37). However, one RCT showed no additional effect of adding TrA training to a PFMT program (38). Another concept is "Functional training of the PFM". This means that women are asked to conduct a PFM contraction during different tasks of daily living (39). There are no RCTs to support this theory (37).

Because of use of different outcome measures and instruments to measure PFM function and strength, it is impossible to combine results between studies, and it is difficult to conclude

which training regimen is the more effective. Also the exercise dosage (type of exercise, frequency, duration and intensity) varies significantly between studies (10,11). Length of the intervention varied between 6 weeks and 6 months, holding time varied between 3 and 40 seconds, and number of repetitions per day between 36 and > 200 (13).

Bø et al (10) showed that instructor followed up training is significantly more effective than home exercise. This study was the first demonstrating that a huge difference in outcome can be expected according to the intensity and follow-up of the training program, and that very little effect can be expected after training without close follow up. It is worth notifying that the significantly less effective group in this study had 7 visits with a skilled PT, and that adherence to the home training program was high. Nevertheless, the effect was only 17%. To date more intensive training has also shown to be more effective in other RCTs and systematic reviews (10,11,15,16,17). There is a dose-response issue in all sorts of training regimens (10,40). Hence, one reason for disappointing effects shown in some clinical practises or clinical trials may be due to insufficient training stimulus and low dosage.

In some textbooks the term “biofeedback” is often used to classify a method different from PFMT. However, biofeedback is not a treatment by its own, but an adjunct to training, measuring the response from a single PFM contraction. In the area of PFMT both vaginal and anal surface EMG, and urethral and vaginal squeeze pressure measurements have been utilized in purpose of making the patients more aware of muscle function, and to enhance and motivate patients’ effort during training (10). However, erroneous attempts of PFM contractions e.g. straining may be registered by both manometers and dynamometers, and contractions of other muscles than the PFM may affect surface EMG activity. Hence EMG, manometers and dynamometers cannot be used to register a correct contraction.

Very few of the studies comparing PFMT with and without biofeedback have used the exact same training dosage in the two randomized intervention groups. When the two groups under comparison receive different dosage of training in addition to biofeedback, it is impossible to conclude what is causing a possible effect. Moreover, since PFMT is effective without biofeedback, a large sample size may be needed to show any beneficial effect of adding biofeedback to an effective training protocol. In most of the published studies comparing PFMT with and without biofeedback, the sample sizes are small, and type II error may have been the reason for negative findings (11).

Any factor that may stimulate to high adherence and intensive training should be recommended in purpose of enhancing the effect of a training program. Hence, when available, biofeedback should be given as an option for home training, and the physical therapist should use any sensitive, reliable and valid tool to measure the contraction force at office follow-up.

The use of cones can be questioned from an exercise science perspective. To hold the cone for as long as 15-20 minutes may cause decreased blood supply, decreased oxygen consumption, muscle fatigue and pain. In addition, it may recruit contraction of other muscles instead of the PFM. Moreover, many women report that they dislike using cones (10). Arvonen et al (10,14) used “vaginal balls” and followed general strength training principles. They found that training with the balls was significantly more effective in reducing urinary leakage than regular PFMT.

The general recommendations for maintaining muscle strength are 1 set of 8-12 contractions twice a week (40). The intensity of the contraction seems to be more important than frequency of training. So far, no studies have evaluated how many contractions subjects have to perform to maintain PFM strength after cessation of organized training. In a study of Bø & Talseth (10) PFM strength was maintained 5 years after cessation of organized training with 70 % exercising more than once a week. However, number and intensity of exercises varied considerably between successful women. In the study of Cammu et al (10) the long-term effect of PFMT appeared to be attributed to the pre-contraction before sudden increases in intra-abdominal pressure, and not so much to regular strength training. Using pre-contractions have been found not to increase muscle strength in a recent published RCT (35).

Pelvic organ prolapse

The same two hypotheses proposed for treatment of SUI also apply for prevention and treatment of POP (34). Research on basic and functional anatomy supports conscious contraction of the PFM as an effective maneuver to stabilize the pelvic floor (34). However, to date, there are no studies on how much strength or what neuromotor control strategies are necessary to prevent descent during cough and other physical exertions, nor how to prevent gradual descent due to activities of daily living or over time.

The theoretical rationale for intensive strength training of the PFM to treat POP is the same as for SUI. As described by DeLancey (41) in the “boat in dry dock” theory, the connective tissue support of the pelvic organs fails if the PFM relax or are damaged, and organ descent occurs. This underpins the concept of elevation of the PFM and closure of the levator hiatus as important elements in conservative management of POP. Till date, Brækken et al (24) found a significant and huge increase in strength in the PFMT group only. They also found

statistically significant increases in muscle volume, shortening of the muscle length, constriction of the levator hiatus, and lifting of the bladder neck and rectal ampulla (35), factors that may be essential in prevention and reversion of POP.

Use of POP-Q as a measure of improvement after PFM training can be questioned. During the POP-Q the investigator tries to make the women strain as much as possible, a manouver that should be discouraged and by itself is a risk factor for developing prolapse. Measurement of the resting position of the organs before and after PFM training may be a much better way of measuring improvement. A lift of the organs to a higher resting position of approximately 0.5 cm was found in the study by Brækken et al (35). Given the strong effect on POP symptoms in the same study (24), we suggest this to be the recommended effect measure for future studies.

All RCTs on PFM training on POP are in favour of PFM training. To date, there is only one full-scale RCT evaluating both stage of prolapse and symptoms (24). This examiner-blinded trial found significant improvement in a group of women with stage I, II, and III POP receiving supervised PFMT compared to a group receiving advice not to strain while defecating, in addition to encouragement to pre-contract the PFM before an increase in intra-abdominal pressure.

The published studies on POP reported short-term effects. To maintain the effect, it is expected that PFM training must be continued, although to a lesser degree, to avoid relapse (42).

Sexual dysfunction

From the understanding of the complexity of these disorders and the numerous different conditions with complex causality, one could argue that it is unlikely that PFM function or PFM training alone could influence all sexual disorders, and one could also question the theoretical framework for how it could influence the different aspects of female sexuality. In general, physical therapy has been recommended for sexual disorders when clinical assessment of the pelvic floor has demonstrated either "overactive" (hypertone) muscles or weak PFM (29). However, to date there are limited evidence for the association between PFM dysfunction and sexual disorders.

In a comparison study of 32 women who delivered vaginally, 21 women who underwent caesarean section and 15 nulliparous women, Baytur et al (43) found that PFM strength was significantly lower in women delivering vaginally. Nevertheless, there was no difference between the groups regarding sexual function and no correlation between sexual function and PFM strength. Schimpf et al (44) assessed 505 women with POP-Q and the Female Sexual Function Index (FSFI). The results showed that there was no association between vaginal size and sexual activity. Contradictory to this, Lowenstein et al (45) found that among 166 women, women with strong or moderate PFM scored significantly higher on the FSFI orgasmatic and arousal domains than women with weak PFM. Ability to hold the PFM contraction was also correlated with orgasmatic and arousal domains.

To date there are only few studies on the influence of PFM function on female sexuality and the effect of PFM training on sexual function. A few RCTs with supervised training show some promising results. However, it is not yet possible to make clinical recommendations. There is an immediate need for further high quality research in this important area of women's health.

CONCLUSION

PFM training has support from several high quality RCTs and systematic reviews for SUI and MUI, and five RCTs show favourable results for PFM training to treat POP. PFM training has no known serious adverse effects and should therefore be offered as first line treatment for these conditions. There is some data from RCTs supporting an effect also on sexual function. However, more research is needed on PFMT and sexual disorders in addition to prevention studies. It is unlikely that weak interventions without supervision will be effective. Hence, low cost interventions with non-supervized training can be costly in the long term, as they most likely do not provide a worthwhile effect size.

The author declares that she has no conflict of interest.

REFERENCE LIST

1. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL (1997) Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 89:501-506

2. Bump RC, Norton PA (1998) Epidemiology and natural history of pelvic floor dysfunction. Obstet Gynecol Clinics North Am 25:723-46

3. Wall L, DeLancey JO 1991 The politics of prolapse: A revisionist approach to disorders of the pelvic floor in women. Perspect Biol Med 34: 486-496

4. DeLancey JO, Low LK, Miller JM, Patel DA, Tumbarello JA (2008) Graphic integration of causal factors of pelvic floor disorders: An integrated life span model. Am J Obstet Gynecol 199:610.e1-5

5. Ashton-Miller J, DeLancey JO (2007) Functional anatomy of the female pelvic floor. Ann N.Y Acad Sci 1101:266-296

6. Kegel AH (1948) Progressive resistance exercise in the functional restoration of the perineal muscles. Am J Obstet Gynecol 56:238-249

7. Kegel AH (1952) Stress incontinence and genital relaxation. Ciba Clinical Symposium 2:35-51

8. Bø K (2007) Overview of physical therapy for pelvic floor dysfunction, in Evidence based physical therapy for the pelvic floor: Bridging science and clinical practice, Bø K, Berghmans B, Mørkved S, van Kampen M (eds), Elsevier, Churchill Livingstone, pp 1-8

9. Bø K, Mørkved S (2007) Motor learning, in Evidence based physical therapy for the pelvic floor: Bridging science and clinical practice, Bø K, Berghmans B, Mørkved S, van Kampen M (eds), Elsevier, Churchill Livingstone, pp 113-119

10. Bø K: Pelvic floor muscle training for stress urinary incontinence, in Evidence based physical therapy for the pelvic floor: Bridging science and clinical practice, Bø K, Berghmans B, Mørkved S, van Kampen M (eds), Elsevier, Churchill Livingstone, pp 171–187

11. Hay Smith J, Berghmans B, Burgio K, et al (2009) Adult conservative management: Committee 12, in Incontinence: 4th International Consultation on Incontinence, 4th Edition, Abrams P, Cardozo L, Khoury S, Wein A (eds), Health Publication Ltd, pp. 1025-1108

12. Dumoulin C, Hay-Smith J (2010) Pelvic floor muscle training versus no treatment for urinary incontinence in women. Cochrane Database Syst Rev 20:CD005654

13. Hay-Smith EJ, Bø K, Berghmans LC, et al (2001) Pelvic floor muscle training fur urinary incontinence in women. Cochrane Database Syst Rev Issue 1:CD001407

14. Herbison GP, Dean N (2002) Weigthed vaginal cones for urinary incontinence. Cochrane Database Syst Rev Issue 1:CD002114

15. Welsh A. Urinary incontinence – the management of urinary incontinence in women. National Collaborating Centre for Women's and Children's Health. The National Institute for Health and Clinical Excellence (NICE). RCOG Press. Royal College of Obstetricians and Gynaecologists, London 2006

16. Imamura M, Abrams P, Bain C et al (2010) Systematic review and economic modelling of the effectiveness of non-surgical treatments for women with stress urinary incontinence. Health Technol Assess 14: 1-118, iii-iv

17. Hay-Smith EJC, Dumoulin C (2006) Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. Cochrane Database Syst Rev 25:CD005654

18. Bø K (2002) Is there still a place for physiotherapy in the treatment of female incontinence? EAU Update Series1:145-152

19. Felicissimo MF, Carneiro MM, Saleme CS, Pinto RZ, da Fonseca AMRM, da Siva-Filho AL (2010) intensive supervised versus unsupervised pelvic floor muscle training for the treatment of stress urinary incontinence: a randomized comparative study. Int Urogynecol J 21: 835-840

20. Glavind K, Nøhr SB, Walter S (1996) Biofeedback and physiotherapy versus physiotherapy alone in the treatment of genuine stress urinary incontinence. Int Urogynecol J Pelvic Floor Dysfunct 7:339-343

21. Bø K, Kvarstein B, Nygaard I (2005) Lower urinary tract symptoms and pelvic floor muscle exercise adherence after 15 years. Obstet Gynecol 105:999-1005

22. Hagen S, Stark D, Cattermole D (2004) A United Kingdom-wide survey of physiotherapy practice in the treatment of pelvic organ prolapse. Physiotherapy 90:19–26

23. Hagen S, Stark D, Maher C, Adams E (2006) Conservative management of pelvic organ prolapse in women. Cochrane Database Syst Rev 4:CD003882

24. Brækken IH, Majida M, Ellstrom-Engh M, Bø K (2010) Can pelvic floor muscle training reverse pelvic organ prolapse and reduce prolapse symptoms? An assessor-blinded, randomized controlled trial. Am J Obstet Gynecol 203:170.e1-7

25. Hagen S, Stark D, Glazener C et al (2009) A randomized controlled trial of pelvic floor muscle training for stages I and II pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct 20:45–51

26. Ghroubi S, Kharrat O, Chaari M (2008) Effect of conservative treatment in the management of low-degree urogenital prolapse. Ann Readapt Med Phys 51:96–102

27. Piya-Anant M, Therasakvichya S, Leelaphatanadit C, Techatrisak K (2003) Integrated health research program for the Thai elderly: Prevalence of genital prolapse and effectiveness of pelvic floor exercise to prevent worsening of genital prolapse in elderly women. J Med Assos Thail 86:509–515

28. Stupp L, Resende APM, Bernardes BT, et al (2010) Pelvic floor muscle training for treatment of pelvic organ prolapse: Randomized controlled trial. Int Urogynecol J 21:236-237

29. Graziottin A (2007) Female sexual dysfunction, in Evidence based physical therapy for the pelvic floor: Bridging science and clinical practice, Bø K, Berghmans B, Mørkved S, van Kampen M (eds), Elsevier, Churchill Livingstone, pp 266-287

30. Wilson PD, Herbison GP (1998) A randomized controlled trial of pelvic floor muscle exercises to treat postnatal urinary incontinence. Int Urogynecol J 9:257-264

31. Mørkved S, Rømmen K, Schei B, Salvesen KÅ, Bø K (2007) No difference in urinary incontinence between training and control group six years after cessation of a randomized controlled trial, but improved sexual satisfaction in the training group. Neurourol Urodyn 26:667

32. Citak N, Cam C, Arslan H, et al (2010) Postpartum sexual function of women and the effects of early pelvic floor muscle exercises. Acta Obstet Gynecol 89:817-822

33. Bø K, Talseth T, Vinsnes A (2000) Randomized controlled trial on the effect of pelvic floor muscle training on quality of life and sexual problems in genuine stress incontinent women. Acta Obstet Gynecol Scand 79:598-603

34. Bø K (2004) Pelvic floor muscle training is effective in treatment of stress urinary incontinence, but how does it work? Int Urogynecol J Pelvic Floor Dysfunct 15:76-84

35. Brækken IH, Majida M, Ellstrom-Engh M, Bø K (2010) Morphological changes after pelvic floor muscle training measured by 3-dimensional ultrasound: A randomized controlled trial. Obstet Gynecol 115:317-324

36. Sapsford R (2001) The pelvic floor: A clinical model for function and rehabilitation. Physiotherapy 87:620-630

37. Bø K, Mørkved S, Frawley H, Sherburn M (2009) Evidence for benefit of transversus abdominis training alone or in combination with pelvic floor muscle training to treat female urinary incontinence: A systematic review. Neurourol Urodyn 28:368-373

38. Dumoulin C, Lemieux M, Bourbonnais D, et al (2004) Physiotherapy for persistent postnatal stress urinary incontinence: A randomized controlled trial. Obstet Gynecol 104:504-510

39. Carriere B (2001) Fitness for the pelvic floor. Georg Thieme verlag 2002

40. Haskell WL, Lee IM, Pate RR (2007) Physical activity and public health: Updated recommendations for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc 39:1423–34

41. DeLancey JO (1993) Anatomy and biomechanics of genital prolapse. Clin Obstet Gynecol 36:897–909

42. Bø K, Aschehoug A (2007) Pelvic floor and exercise science: Strength training, in Evidence based physical therapy for the pelvic floor: Bridging science and clinical practice, Bø K, Berghmans B, Mørkved S, van Kampen M, Elsevier, Churchill Livingstone, pp. 119–132

43. Baytur YB, Deveci A, Uyar Y, et al (2005) Mode of delivery and pelvic floor strength and sexual function after childbirth. Int J Gynecol Obstet 88:276-280

44. Schimpf MO, Harvie HS, Omotosho TB, et al (2010) Does vaginal size impact sexual activity and function? Int Urogynecol J 21:447-552

45. Lowenstein L, Gruenwald I, Gartman I, Vardi Y (2010) Can stronger pelvic muscle floor improve sexual function? Int Urogynecol J 21:553-556