

# Biofeedback and other Therapies for the Treatment of Urinary Incontinence in the Elderly

E. Paul Cherniack, MD

## Abstract

Alternative therapies hold potential promise for the treatment of urinary incontinence in the elderly. Assessment and comparisons of the efficacies of such therapies have been hindered by a lack of standardized definitions of urinary incontinence in the study populations, lack of standardization of treatment protocols, inadequate sample sizes, and lack of blinding and appropriate controls. Biofeedback has been the most extensively studied therapy and may provide appropriate adjunctive or primary therapy for select individuals. Other potential therapies, such as acupuncture, hypnosis, and herbal therapies, have not been sufficiently examined to make definitive recommendations. (*Altern Med Rev* 2006;11(3):224-231)

## Introduction

The treatment of urinary incontinence (UI) in elderly individuals is a significant challenge. UI is a multifactorial syndrome caused by normal age-related changes and pathology in the urinary tract. Approximately 15-30 percent of adults over age 65 are affected, experiencing loss of health and quality of life. Women are twice as frequently affected as men until age 80, after which the prevalence is equal.<sup>1</sup>

## Pathophysiology of UI

Normal continence is maintained by nervous system control of the detrusor muscle surrounding the bladder, the muscles surrounding the urethral sphincter, and the muscles of the lower abdomen and pelvic floor.<sup>1,2</sup> Urination occurs when parasympathetic nerves from the sacral spine S2 to S4 contract the detrusor muscle, while sympathetic nerves from T11 to L2 relax the urethral sphincter.<sup>1</sup> The spinal neurons are under the control of the brain – parietal lobes and

thalamus – and receive afferent impulses from bladder receptors, the frontal lobes, and basal ganglia to prevent leakage. The pons synthesizes afferent signals and provides efferent regulation of the detrusor and sphincter muscles.<sup>1</sup>

## Classification of Urinary Incontinence

UI has been classified into three subtypes based on symptoms and pathologic mechanisms – urge incontinence (UR), stress incontinence (SI), and overflow incontinence (OI). Mixed incontinence can occur when a patient exhibits features of two different forms simultaneously; the combination of SI and UR has been reported.<sup>3</sup>

## Urge Incontinence

The most common form of incontinence is UR, characterized by a sudden urge and loss of urine with polyuria.<sup>1</sup> UR usually occurs when the detrusor muscle becomes disinhibited as the result of central nervous system disease, such as Alzheimer's dementia, stroke, or Parkinson's disease.<sup>1</sup> Denervation of bladder smooth wall muscle from increased intravesicular pressure with bladder outlet obstruction can also result in UR.<sup>3</sup> Two other theories explaining UR include increased sensitivity to the neurotransmitter acetylcholine by bladder smooth muscle receptors and abnormal leakage of neurotransmitter by efferent fibers that innervate bladder smooth muscle.<sup>3</sup>

---

E. Paul Cherniack, MD – Division of Geriatrics and Gerontology, Leonard M. Miller School of Medicine, University of Miami and the Miami VA Health Care System.

Correspondence address: Room 1D200, Miami VA Medical Center, 1201 NW 16 St, Miami, FL 33125  
Email: [evan.cherniack@med.va.gov](mailto:evan.cherniack@med.va.gov)

### *Stress Incontinence*

SI is the second-most frequent form of incontinence in women.<sup>1</sup> SI results when laxity in the muscles of the pelvic floor, loss of urinary sphincter function, or urethral closure fails to prevent urine from leaking from the bladder.<sup>1</sup> Childbirth-related trauma is a common cause of pelvic muscle injury that ultimately predisposes to SI.<sup>2</sup> SI can also occur in men who have had prostate surgery.<sup>4</sup> The incidence of SI following prostate surgery varies widely from 0.3-65.6 percent, possibly due to differences in surgical technique.<sup>5</sup>

### *Overflow Incontinence*

OI is the second-most common form of incontinence in men.<sup>1</sup> It usually results when the outflow from the bladder is blocked by structures distal to the bladder (in men usually an enlarged prostate).<sup>1</sup> Urinary pressure builds in the bladder until it exceeds the ability of the musculature surrounding the bladder to maintain continence, causing leakage.<sup>1</sup>

### **Conventional Treatment**

Conventional treatments consist of behavioral therapy, exercises to strengthen the pelvic floor muscles, medications, or surgery.<sup>1</sup>

### *Conventional Treatments for Urge Incontinence*

UR is treated either by behavioral therapy or medication. Behavioral therapies, although not a cure, can decrease the incidence of incontinence. Therapies may include habit training consisting of either scheduled voiding based on a person's usual toileting schedule (which can result in at least a 25-percent decrease in episodes of incontinence) or specific interval toileting schedules every 2-3 hours (which can reduce episodes by as much as 80 percent).<sup>1</sup>

The most effective medications, including oxybutinin and tolterodine, inhibit bladder muscle contractions, reduce episodes of incontinence by approximately 70 percent, and have a cure rate of about 20 percent.<sup>1</sup>

### *Conventional Treatments for Stress Incontinence*

Conventional treatments for SI include pelvic floor muscle exercises and reparative surgery. In two studies, the combination of exercise and education about the function and anatomy of the urinary tract decreased incontinence by 88<sup>6</sup> and 94<sup>7</sup> percent, respectively. However, two other studies found no additional benefit from the combination after surgery.<sup>8,9</sup>

Success rates of surgical treatments for incontinence following prostatectomy vary widely. In a series of small studies – less than 50 patients per study – continence was restored in 36-95 percent of subjects.<sup>10-15</sup>

### *Conventional Treatments for Overflow Incontinence*

OI is typically treated with medication or surgery.<sup>1</sup> In published trials of the treatments for symptomatic relief of benign prostatic hypertrophy, the incidence of OI has been rather low – less than one event per patient per year – making evaluation of such treatments difficult. In these trials, neither surgery nor medication decreased the incidence of OI.<sup>16,17</sup>

### **Alternative Treatments**

Since no conventional therapy is completely efficacious and older individuals may be unwilling or unable to undergo surgical treatment, alternative treatments may potentially be used as primary or adjunctive therapy to reduce the number of episodes of UI. While conventional non-surgical treatments can be efficacious, the cure rate is less than 50 percent.<sup>18</sup>

Assessment and comparison of the efficacies of alternative therapies in different studies have been hindered by lack of a standardized definition of UI in the subject populations, lack of standardization of treatments and treatment protocols, inadequate sample sizes, and lack of blinding and appropriate controls.

### *Biofeedback and Pelvic Exercise for Urinary Incontinence*

Biofeedback is the most extensively studied unconventional therapy for UI. In the application of biofeedback to treat UI, surface or internal electrodes create visual or auditory signals when pelvic muscles are contracted. Using these signals, subjects can learn to augment or reduce muscle contractions voluntarily through muscle exercises to maintain continence. The techniques used in the various studies differ in regard to location of the electrodes (intravesicular, anal, or urethral sphincter), type of signal, (auditory or visual), and duration of training.<sup>19</sup>

### **Biofeedback/Pelvic Floor Exercises for Urge Incontinence**

Both controlled and uncontrolled trials have compared pelvic exercises with and without biofeedback in limited numbers of subjects with UR; no results of placebo-controlled trials have been published.

In a small study, biofeedback reduced urinary incontinence symptom scores and improved bladder muscle pressure in 10 subjects, ages 24-53.<sup>20</sup> In a second study, women (ages 16-65 years; mean age 41) were administered biofeedback for an average of five sessions with an 87-percent cure rate.<sup>21,22</sup>

Wang et al compared biofeedback-assisted pelvic floor muscle exercises to either pelvic floor muscle exercise alone or exercise aided by electrical stimulation of the pelvic floor musculature via an intravaginal electrode in 103 women (ages 15-71 years) for 12 weeks.<sup>23</sup> There was a significant improvement in symptom score in biofeedback-assisted pelvic floor exercises above that achieved by pelvic floor muscle exercises alone; however, the cure rate was not significantly different among the three groups. Although individuals in the electrical-stimulation group experienced the most improvement, the subjects in this group were significantly younger than women in the other two groups.

In a second study, 30 of 70 women who failed medication as therapy for UR were offered either biofeedback or pelvic floor muscle exercises.<sup>24</sup> Biofeedback recipients exhibited greater bladder detrusor muscle pressures, although there was no difference in cure rate.

### **Biofeedback for Stress Incontinence**

Biofeedback has also been used alone or in combination with conventional therapy to treat stress incontinence. Although the pelvic muscle exercises that are the mainstay of conventional therapy for SI bear the name of Dr. Arnold Kegel (Kegel exercises),<sup>19</sup> Kegel did not develop these exercises, but invented a biofeedback device to use with the exercises.<sup>19</sup> Using his device, he reported to have eradicated symptoms in 93 percent of incontinent individuals.<sup>19</sup>

Pages et al performed a randomized, controlled, four-week trial on 40 women (ages not reported) with SI. They compared biofeedback and physical therapy followed by two weeks of home exercises. The physical therapy group received 20 one-hour sessions of practice in pelvic muscle exercises with education on the anatomy and function of the bladder. Subjects who received biofeedback experienced decreased urinary frequency and subjective improvement on symptom scores.<sup>25</sup>

In a controlled investigation, 130 women (mean age 60) were randomized to receive biofeedback, pelvic floor muscle exercises, or no treatment for six months. Compared to the control group, both interventional arms experienced equal statistically significant reductions in episodes of incontinence.<sup>26</sup>

Thirty-five women (ages 31-69 years; mean age 50) were randomized to utilize pelvic floor muscle exercises with or without home biofeedback. After 12 weeks, the biofeedback group obtained significant improvement on a self-reported questionnaire scale of urinary leakage.<sup>27</sup>

In several small, uncontrolled studies involving 28-60 women, subjects observed both symptom reduction and improved contractility of pelvic floor musculature.<sup>28-30</sup>

Not all studies have noted positive results. In a randomized study, 103 women (ages 30-70; mean age 46.6) received pelvic floor muscle training with or without biofeedback.<sup>31</sup> No differences were noted between groups in any of the measures studied.

In another study, 44 subjects were randomized to receive six treatments of pelvic floor exercises with or without biofeedback. Both groups improved, but no statistically significant differences were noted between the groups at the end of the trial.<sup>32</sup>

Although a systematic review concluded there is no benefit to adding biofeedback to pelvic floor muscle exercises,<sup>33</sup> a meta-analysis of the same data noted a “trend” in favor of adding biofeedback to exercise; the pooled results almost reached statistical significance.<sup>34</sup>

Biofeedback has been evaluated as a treatment for patients who develop post-surgical SI. Studies adding biofeedback to pelvic floor muscle exercises have reached different conclusions as to whether biofeedback confers an additional advantage.<sup>1,35-43</sup> In one investigation, 50 post-prostatectomy subjects (mean age 65) were randomized to receive biofeedback-assisted pelvic floor muscle exercises and education for three months or to a control group who received no post-surgical intervention.<sup>35</sup> Biofeedback-trained subjects experienced a 26-percent greater continence rate at three months and 14 percent at one year.<sup>35</sup>

In two studies, individuals who utilized biofeedback regained continence sooner after prostatectomy, although the overall rate of continence was unchanged.<sup>36,37</sup> Biofeedback yielded continence rates of close to 80 percent in two other uncontrolled trials after prostatectomy.<sup>38,39</sup> Two investigations, however, did not find added benefit to the use of biofeedback after prostate surgery.<sup>40,41</sup> Differences in biofeedback training techniques, devices, and subject populations might have accounted for the variation in results.

Overall, two comprehensive reviews concluded the preponderance of evidence suggests there might be benefit to the addition of biofeedback to pelvic floor muscle exercises for SI.<sup>2,44</sup> In one, the combined relative risk of SI in biofeedback-assisted exercise was 0.74 (95% confidence interval 0.60-0.93) compared to no treatment.<sup>44</sup>

### Biofeedback for Mixed UI

Biofeedback has been utilized for individuals who exhibit features of both SI and UR – termed mixed UI. In several small, uncontrolled trials, lasting from six weeks to 26 months and involving primarily middle-aged or elderly women, improvement in symptom scores of episodes of incontinence and urgency ranged from 36-75 percent.<sup>45-49</sup>

One investigation added biofeedback to other treatments to reduce urge or mixed incontinence in a primarily elderly population. One hundred ninety-seven patients (ages 55-92) were randomly assigned

to utilize biofeedback-assisted pelvic floor muscle exercises, medication, or a placebo.<sup>50,51</sup> Subjects who performed the pelvic floor muscle exercises had two sessions to learn how to perform them. Biofeedback was added to the protocol for those subjects who exhibited less than 50-percent reduction in frequency of incontinence with exercise alone. Those subjects trained in combination exercise and biofeedback reduced episodes of incontinence from 15 to two episodes a week, medication-treated subjects decreased incontinent episodes from 15 to three episodes a week, and placebo recipients lowered episodes from 15 to 10 episodes a week after two months.<sup>50</sup> Biofeedback-treated subjects also reduced episodes of nocturia from 1.9 to 1.4 episodes a night, which was statistically significant and not matched in the other groups.<sup>51</sup>

### Biofeedback Conclusions

A number of problems exist in the quality of the evidence on the use of biofeedback as a treatment for incontinence: (1) there is no standardization of biofeedback devices or subject training used in different investigations; (2) the nature of the treatment makes blinding difficult, if not impossible; (3) many of the studies include a small number of subjects; (4) varying inclusion criteria are used to define incontinence; and (5) different instruments are used to assess the efficacy of treatment on outcomes.

Other important issues must be considered in a feasibility assessment of biofeedback for the elderly. Although many studies include older subjects, few trials have been performed exclusively on the elderly. It is not clear how easily elderly patients, many who might have sensory or cognitive impairment, can be trained to use a biofeedback device. Other concerns include determining the optimal biofeedback device or training method and assessing the cost of such a device.

### *Miscellaneous Therapies: Hypnosis, Acupuncture, and Botanical Medicine*

Hypnosis was the subject of one uncontrolled trial to treat UR.<sup>52</sup> The subjects had 12 sessions over one month, followed by audio-taped sessions at home for six months. Fifty-eight percent of 50 subjects who received hypnosis experienced symptom improve-

**Table 1. Potential Application of Alternative Therapies in the Treatment of Urinary Incontinence**

Therapy	Potential Uses in UI				
	UR	SI	OI	Mixed	RCTs*
Biofeedback	√	√		√	√
Acupuncture	√	√			√
Hypnosis		√			
Chinese herbs		√			
<i>Serenoa repens</i>			√		√
<i>Pygeum africanum</i>			√		√
Herbal combinations			√		
St. John's Wort	√				
Cuban Royal Palm			√		
Yoga		√			

\*Randomized controlled trials

ment, and incontinence resolved in 41 percent of subjects. Six of the symptom-free patients relapsed, and five had complete resolution of incontinent episodes after additional treatment.

Acupuncture has been studied as a treatment for SI or UR in several small trials.<sup>53-56</sup> In one study, 13 subjects with UI due to chronic spinal cord injuries received four acupuncture treatments. Incontinence was completely eliminated in two patients and reduced to 50 percent or less compared to baseline in another six patients.<sup>53</sup>

In a placebo-controlled, one-month trial of 85 elderly women, 14-percent more subjects in the acupuncture-treated group experienced reduction in urinary incontinence compared to those in the placebo group, who received acupuncture at sham points.<sup>54</sup> In one small uncontrolled investigation, 11 subjects (mean age 71) had individualized treatments of acu-

puncture between four and 12 times. Nine subjects experienced complete resolution of incontinent episodes.<sup>55</sup> In another uncontrolled series, 20 individuals were given individualized therapy according to the principles of traditional Chinese medicine;<sup>56</sup> 77 percent had resolution of incontinence.

In an uncontrolled trial, 23 subjects were given 7.5 g three times daily of a Chinese herbal formula (*bu-zhongyiqitang*) consisting of ginseng, Astragalus, *Atractylodis albae*, Codonopsis, Glycyrrhiza, Angelica, *Citrus reticulatae*, Cimicifuga, Bupleurum, *Zingiberis recens*, and *Ziziphus jujuba*. Eighteen subjects (78%) experienced decreased frequency of incontinent episodes.<sup>57</sup>

Several herbal therapies have been tested to determine if they ameliorate the symptoms of benign

prostatic hypertrophy, the most common cause of OI, although none has been specifically tested as a treatment for OI.<sup>58-78</sup> Botanicals studied for BPH include *Serenoa repens* (saw palmetto),<sup>61,62,64,66-73,77</sup> *Pygeum africanum*,<sup>74,78</sup> and *Urtica dioica* (stinging nettle).<sup>76,78</sup>

## Conclusions

Alternative medicine holds promise for the treatment of UI. Biofeedback has been the most frequently utilized and integrated into experimental regimens. Biofeedback might be an appropriate therapy for middle-aged or elderly women with stress incontinence wishing to avoid surgery and for whom pelvic-floor muscle exercise alone does not provide complete relief. Biofeedback should also be considered after prostate surgery in men who experience incontinence, despite exercise, and who wish to avoid

additional surgery. Other potential treatments, such as acupuncture, hypnosis, and botanical medicine require further research to determine effectiveness for UI.

Further research may identify other alternative treatments that alleviate symptoms of UI. For example, St. John's wort has been found in rats to inhibit contraction of the bladder, implying a possible role in treatment of UR;<sup>79</sup> a fruit extract of the Cuban royal palm, *Roystonea regia*, inhibited testosterone-induced prostate enlargement in rodents;<sup>80</sup> and yoga has been suggested as a means to improve pelvic floor musculature to alleviate SI, although no clinical trials have been published.<sup>81</sup>

Table 1 provides a summary of potential alternative therapies. More methodologically rigorous studies are indicated in order to determine safety and efficacy of these treatments for UI, particularly in the elderly population.

## References

- DeBeau CE. Urinary incontinence. In: Pompei P, Murphy JB, eds. *Geriatric Review Syllabus*. 6th ed. Oxford, UK: Blackwell; 2006:184-195.
- Norton P, Brubaker L. Urinary incontinence in women. *Lancet* 2006;367:57-67.
- Wein AJ, Rackley RR. Overactive bladder: a better understanding of pathophysiology, diagnosis, and management. *J Urol* 2006;175:S5-S10.
- Johnson TM 2nd, Ouslander JG. Urinary incontinence in the older man. *Med Clin North Am* 1999;83:1247-1266.
- Alivizatos G, Skolarikos A. Incontinence and erectile dysfunction following radical prostatectomy: a review. *ScientificWorldJournal* 2005;5:747-758.
- Cornel EB, de Wit R, Witjes JA. Evaluation of early pelvic floor physiotherapy on the duration and degree of urinary incontinence after radical retropubic prostatectomy in a non-teaching hospital. *World J Urol* 2005;23:353-355.
- Filocamo MT, Li Marzi V, Del Popolo G, et al. Effectiveness of early pelvic floor rehabilitation treatment for post-prostatectomy incontinence. *Eur Urol* 2005;48:734-738.
- Pannek J, Konig JE. Clinical usefulness of pelvic floor reeducation for men undergoing radical prostatectomy. *Urol Int* 2005;74:38-43.
- Stern JA, Clemens JQ, Tiplitsky SI, et al. Long-term results of the bulbourethral sling procedure. *J Urol* 2005;173:1654-1656.
- Moore KN, Griffiths D, Hughton A. Urinary incontinence after radical prostatectomy: a randomized controlled trial comparing pelvic muscle exercises with or without electrical stimulation. *BJU Int* 1999;83:57-65.
- Hubner WA, Schlarp OM. Treatment of incontinence after prostatectomy using a new minimally invasive device: adjustable continence therapy. *BJU Int* 2005;96:587-594.
- Castle EP, Andrews PE, Itano N, et al. The male sling for post-prostatectomy incontinence: mean followup of 18 months. *J Urol* 2005;173:1657-1660.
- Gnessin E, Livne PM, Baniel J, Gillon G. Continence and quality of life assessment after artificial urinary sphincter implantation. *Isr Med Assoc J* 2004;6:592-594.
- Jones JS, Vasavada SP, Abdelmalak JB, et al. Sling may hasten return of continence after radical prostatectomy. *Urology* 2005;65:1163-1167.
- John H. Bulbourethral composite suspension: a new operative technique for post-prostatectomy incontinence. *J Urol* 2004;171:1866-1870.
- McConnell JD, Roehrborn CG, Bautista OM, et al. The long-term effect of doxazosin, finasteride, and combination therapy on the clinical progression of benign prostatic hyperplasia. *N Eng J Med* 2003;349:2387-2398.
- Wasson JH, Reda DJ, Brusekewitz RC, et al. A comparison of transurethral surgery with watchful waiting for moderate symptoms of benign prostatic hyperplasia. The Veterans Affairs Cooperative Study Group on Transurethral Resection of the Prostate. *N Engl J Med* 1995;332:75-79.
- Weinberger MW, Goodman BM, Carnes M. Long-term efficacy of nonsurgical urinary incontinence treatment in elderly women. *J Gerontol A Biol Sci Med Sci* 1999;54:M117-M121.
- Doggweiler-Wiygul R, Sellhorn E. Role of behavioral changes and biofeedback in urology. *World J Urol* 2002;20:302-305.
- Holmes DM, Plevnik S, Stanton SL. Bladder neck electrical conductivity in the treatment of detrusor instability with biofeedback. *Br J Obstet Gynaecol* 1989;96:821-826.
- Cardozo L, Stanton SL, Hafner J, Allan V. Biofeedback in the treatment of detrusor instability. *Br J Urol* 1978;50:250-254.
- Cardozo LD. Biofeedback in overactive bladder. *Urology* 2000;55:S24-S28.
- Wang AC, Wang YY, Chen MC. Single-blind, randomized trial of pelvic floor muscle training, biofeedback-assisted pelvic floor muscle training, and electrical stimulation in the management of overactive bladder. *Urology* 2004;63:61-66.

24. Wang AC. Bladder-sphincter biofeedback as treatment of detrusor instability in women who failed to respond to oxybutynin. *Chang Gung Med J* 2000;23:590-599.
25. Pages IH, Jahr S, Schaufele MK, Conradi E. Comparative analysis of biofeedback and physical therapy for treatment of urinary stress incontinence in women. *Am J Phys Med Rehabil* 2001;80:494-502.
26. Burns PA, Pranikoff K, Nochajski TH, et al. A comparison of effectiveness of biofeedback and pelvic muscle exercise treatment of stress incontinence in older community-dwelling women. *J Gerontol* 1993;48:M167-M174.
27. Aukee P, Immonen P, Laaksonen D, et al. The effect of home biofeedback training on stress incontinence. *Acta Obstet Gynecol Scand* 2004;83:973-977.
28. Gordon D, Luxman D, Sarig Y, Groutz A. Pelvic floor exercise and biofeedback in women with urinary stress incontinence. *Harefuah* 1999;136:593-596,660. [Article in Hebrew]
29. Pena Outeirino JM, Leon Duenas E, Romero Gil JR, et al. Unstable detrusor: usefulness of biofeedback. *Actas Urol Esp* 1996;20:640-647. [Article in Spanish]
30. Sung MS, Hong JY, Choi YH, et al. FES-biofeedback versus intensive pelvic floor muscle exercise for the prevention and treatment of genuine stress incontinence. *J Korean Med Sci* 2000;15:303-308.
31. Morkved S, Bo K, Fjortoft T. Effect of adding biofeedback to pelvic floor muscle training to treat urodynamic stress incontinence. *Obstet Gynecol* 2002;100:730-739.
32. Berghmans LC, Frederiks CM, de Bie RA, et al. Efficacy of biofeedback, when included with pelvic floor muscle exercise treatment, for genuine stress incontinence. *NeuroUrol Urodyn* 1996;15:37-52.
33. Berghmans LC, Hendriks HJ, Bo K, et al. Conservative treatment of stress urinary incontinence in women: a systematic review of randomized controlled trials. *Br J Urol* 1998;82:181-191.
34. Weatherall M. Biofeedback or pelvic floor muscle exercises for female genuine stress incontinence: a meta-analysis of trials identified in a systematic review. *BJU Int* 1999;83:1015-1016.
35. Van Kampen M, De Weerd W, Van Poppel H, et al. Effect of pelvic-floor re-education on duration and degree of incontinence after radical prostatectomy: a randomised controlled trial. *Lancet* 2000;355:98-102.
36. Mathewson-Chapman M. Pelvic muscle exercise/biofeedback for urinary incontinence after prostatectomy: an education program. *J Cancer Educ* 1997;12:218-223.
37. Parekh AR, Feng MI, Kirages D, et al. The role of pelvic floor exercises on post-prostatectomy incontinence. *J Urol* 2003;170:130-133.
38. Fanciullacci F, Franzini A, Politi P, et al. Continence problems after radical prostatectomy: role of rehabilitation of the pelvic floor. *Arch Ital Urol Androl* 2001;73:153-156. [Article in Italian]
39. Burgio KL, Stutzman RE, Engel BT. Behavioral training for post-prostatectomy urinary incontinence. *J Urol* 1989;141:303-306.
40. Franke JJ, Gilbert WB, Grier J, et al. Early post-prostatectomy pelvic floor biofeedback. *J Urol* 2000;163:191-193.
41. Wille S, Sobottka A, Heidenreich A, Hofmann R. Pelvic floor exercises, electrical stimulation and biofeedback after radical prostatectomy: results of a prospective randomized trial. *J Urol* 2003;170:490-493.
42. Sueppel C, Kreder K, See W. Improved continence outcomes with preoperative pelvic floor muscle strengthening exercises. *Urol Nurs* 2001;21:201-210.
43. Marsh DW, Lepor H. Predicting continence following radical prostatectomy. *Curr Urol Rep* 2001;2:248-252.
44. Hunter KF, Moore KN, Cody DJ, Glazener CM. Conservative management for postprostatectomy urinary incontinence. *Cochrane Database Syst Rev* 2004;2:CD001843.
45. Jundt K, Peschers UM, Dimpfl T. Long-term efficacy of pelvic floor re-education with EMG-controlled biofeedback. *Eur J Obstet Gynecol Reprod Biol* 2002;105:181-185.
46. Stein M, Discippio W, Davia M, Taub H. Biofeedback for the treatment of stress and urge incontinence. *J Urol* 1995;153:641-643.
47. Susset JG, Galea G, Read L. Biofeedback therapy for female incontinence due to low urethral resistance. *J Urol* 1990;143:1205-1208.
48. Burgio KL, Robinson JC, Engel BT. The role of biofeedback in Kegel exercise training for stress urinary incontinence. *Am J Obstet Gynecol* 1986;154:58-64.
49. Hirsch A, Weirauch G, Steimer B, et al. Treatment of female urinary incontinence with EMG-controlled biofeedback home training. *Int Urogynecol J Pelvic Floor Dysfunct* 1999;10:7-10.
50. Burgio KL, Locher JL, Goode PS, et al. Behavioral vs drug treatment for urge urinary incontinence in older women: a randomized controlled trial. *JAMA* 1998;280:1995-2000.
51. Johnson TM 2nd, Burgio KL, Redden DT, et al. Effects of behavioral and drug therapy on nocturia in older incontinent women. *J Am Geriatr Soc* 2005;53:846-850.
52. Freeman RM, Baxby K. Hypnotherapy for incontinence caused by the unstable detrusor. *Br Med J (Clin Res Ed)* 1982;284:1831-1834.
53. Honjo H, Naya Y, Ukimura O, et al. Acupuncture on clinical symptoms and urodynamic measurements in spinal-cord-injured patients with detrusor hyperreflexia. *Urol Int* 2000;65:190-195.

54. Emmons SL, Otto L. Acupuncture for overactive bladder: a randomized controlled trial. *Obstet Gynecol* 2005;106:138-143.
55. Kitakoji H, Terasaki T, Honjo H, et al. Effect of acupuncture on the overactive bladder. *Nippon Hinyokika Gakkai Zasshi* 1995;86:1514-1519. [Article in Japanese]
56. Philp T, Shah PJ, Worth PH. Acupuncture in the treatment of bladder instability. *Br J Urol* 1988;61:490-493.
57. Murakami Y. Clinical effect of hotyuekkito (buzhongyiqitang) on symptoms due to renal ptosis and stress incontinence. *Hinyokika Kiyo* 1988;34:1841-1843. [Article in Japanese]
58. Alsikafi NF, Gerber GS. The use of phytotherapy in the treatment of men with benign prostatic hyperplasia. In: Cherniack EP, Cherniack NS, eds. *Alternative Medicine for the Elderly*. Berlin, Germany: Springer Verlag; 2003:399-410.
59. Bracher F. Phytotherapy of benign prostatic hyperplasia. *Urologe A* 1997;36:10-17. [Article in German]
60. Madersbacher S, Schatzl G, Brossner C, Dreikorn K. Phytotherapy for BPS. Which products can still be prescribed? *Urologe A* 2005;44:513-520. [Article in German]
61. Buck AC. Is there a scientific basis for the therapeutic effects of *Serenoa repens* in benign prostatic hyperplasia? Mechanisms of action. *J Urol* 2004;172:1792-1799.
62. Gong EM, Gerber GS. Saw palmetto and benign prostatic hyperplasia. *Am J Chin Med* 2004;32:331-338.
63. Wilt TJ, Ishani A, Rutks I, MacDonald R. Phytotherapy for benign prostatic hyperplasia. *Public Health Nutr* 2000;3:459-472.
64. Wilt TJ, Ishani A, Stark G, et al. Saw palmetto extracts for treatment of benign prostatic hyperplasia: a systematic review. *JAMA* 1998;280:1604-1609.
65. Gerber GS. Phytotherapy for benign prostatic hyperplasia. *Curr Urol Rep* 2002;3:285-291.
66. Gerber GS, Fitzpatrick JM. The role of a lipido-sterolic extract of *Serenoa repens* in the management of lower urinary tract symptoms associated with benign prostatic hyperplasia. *BJU Int* 2004;94:338-344.
67. Marks LS, Partin AW, Epstein JI, et al. Effects of a saw palmetto herbal blend in men with symptomatic benign prostatic hyperplasia. *J Urol* 2000;163:1451-1456.
68. Habib FK, Wyllie MG. Not all brands are created equal: a comparison of selected components of different brands of *Serenoa repens* extract. *Prostate Cancer Prostatic Dis* 2004;7:195-200.
69. Gerber GS, Zagaja GP, Bales GT, et al. Saw palmetto (*Serenoa repens*) in men with lower urinary tract symptoms: effects on urodynamic parameters and voiding symptoms. *Urology* 1998;51:1003-1007.
70. Zlotta AR, Teillac P, Raynaud JP, Schulman CC. Evaluation of male sexual function in patients with lower urinary tract symptoms (LUTS) associated with benign prostatic hyperplasia (BPH) treated with a phytotherapeutic agent (Permixon), Tamsulosin or Finasteride. *Eur Urol* 2005;48:269-276.
71. Willetts KE, Clements MS, Champion S, et al. *Serenoa repens* extract for benign prostate hyperplasia: a randomized controlled trial. *BJU Int* 2003;92:267-270.
72. Al-Shukri SH, Deschaseaux P, Kuzmin IV, Amdiy RR. Early urodynamic effects of the lipido-sterolic extract of *Serenoa repens* (Permixon®) in patients with lower urinary tract symptoms due to benign prostatic hyperplasia. *Prostate Cancer Prostatic Dis* 2000;3:195-199.
73. Pytel YA, Vinarov A, Lopatkin N, et al. Long-term clinical and biologic effects of the lipido-sterolic extract of *Serenoa repens* in patients with symptomatic benign prostatic hyperplasia. *Adv Ther* 2002;19:297-306.
74. Wilt T, Ishani A, MacDonald R, et al. *Pygeum africanum* for benign prostatic hyperplasia. *Cochrane Database Syst Rev* 2002;(1):CD001044.
75. Katz AE. Flavonoid and botanical approaches to prostate health. *J Altern Complement Med* 2002;8:813-821.
76. Sokeland J. Combined sabal and Urtica extract compared with finasteride in men with benign prostatic hyperplasia: analysis of prostate volume and therapeutic outcome. *BJU Int* 2000;86:439-442.
77. Preuss HG, Marcusen C, Regan J, et al. Randomized trial of a combination of natural products (cernitin, saw palmetto,  $\beta$ -sitosterol, vitamin E) on symptoms of benign prostatic hyperplasia (BPH). *Int Urol Nephrol* 2001;33:217-225.
78. Melo EA, Bertero EB, Rios LA, Mattos D Jr. Evaluating the efficiency of a combination of *Pygeum africanum* and stinging nettle (*Urtica dioica*) extracts in treating benign prostatic hyperplasia (BPH): double-blind, randomized, placebo controlled trial. *Int Braz J Urol* 2002;28:418-425.
79. Capasso R, Borrelli F, Capasso F, et al. Inhibitory effect of the antidepressant St. John's wort (*Hypericum perforatum*) on rat bladder contractility *in vitro*. *Urology* 2004;64:168-172.
80. Arruzabala ML, Carbajal D, Mas R, et al. Preventive effects of D-004, a lipid extract from Cuban royal palm (*Roystonea regia*) fruits, on testosterone-induced prostate hyperplasia in intact and castrated rodents. *Drugs Exp Clin Res* 2004;30:227-233.
81. Ripoll E, Mahowald D. Hatha yoga therapy management of urologic disorders. *World J Urol* 2002;20:306-309.