BIOFEEDBACK IN ADDITION TO PELVIC FLOOR MUSCLE TRAINING

AS A TREATMENT FOR URINARY INCONTINENCE IN WOMEN

A Technology Assessment

INTRODUCTION

The California Technology Assessment Forum has been asked to review the scientific literature on the use of biofeedback in addition to pelvic floor muscle training as a treatment for urinary incontinence in women.

BACKGROUND

Urinary incontinence is the involuntary loss of urine from the urethra that is sufficient to be a social or hygienic problem.[1] It is a multi-factorial syndrome involving the intersection of neurourinary pathology, age-related factors, and co-morbid conditions. The prevalence varies with the definition used and the age and sex of the population. Overall, urinary incontinence affects about 15% of the ambulatory adult population or approximately 13 million adults in the US.[2] Risk factors for the development of urinary incontinence in women include childbirth, hysterectomy, recurrent urinary tract infections, medications such as diuretics and sedative-hypnotics and alpha blockers, the presence of two or more co-morbid diseases such as CHF and COPD, diabetes, advancing age and increased body mass index.[3, 4] Dementia is also associated with urinary incontinence. Alzheimer's and multi-infarct disease damage cortical and subcortical inhibitory centers, leading to uninhibited bladder contractions and urinary incontinence. Severely demented individuals remain continent if they have preserved mobility.[5]

Most persons with urinary incontinence are women. Up to 35% of women over the age of 60 in the US are bothered by urinary incontinence, and at least half of all nursing home residents are affected.[6] Urinary incontinence brings significant costs to the individual and to society. For the individual, it is associated with social isolation, increased depression, lower self-rated health and impaired quality of life and psychological distress.[4, 7] Urinary incontinence-related costs in the United States are estimated at $12.4 billion for women (in 1995 dollars) though all cost estimates likely underestimate the impact of the problem, as many patients remain undiagnosed. Fewer than half of individuals with urinary incontinence living in the community consult health care providers about the problem.[1] The majority of the costs associated with urinary incontinence reflect management (e.g., protective garments) rather than curative treatment.[2]

There are several different types of urinary incontinence in women including urge urinary incontinence (UUI) stress urinary incontinence (SUI), mixed incontinence and overflow incontinence. Urge incontinence is defined as the uncontrolled loss of urine that is preceded by a strong, unexpected urge to void. It is unrelated to position or activity.[8]

Urge incontinence is generally due to detrusor muscle overactivity. Stress incontinence is associated with activities that cause an increase in intra-abdominal pressure (e.g. sneezing or coughing). Laxity of the pelvic floor musculature, secondary to childbirth or surgery, is thought to result in diminished sphincter dysfunction. Mixed incontinence is a result of a combination of SI and UI. The least common type, overflow incontinence results from over-distention of the bladder usually from obstruction, or a neurological impairment such as a spinal cord injury or end stage diabetes.

Treatment of urinary incontinence can be divided into non-pharmacologic, pharmacologic and surgical. Non-pharmacologic therapies consist of behavioral interventions such a pelvic floor muscle training, biofeedback, vaginal weights, bladder training and pelvic stimulation. Of these, pelvic floor muscle training and exercises are strongly supported on the basis of multiple randomized trials[9] and were found to be an effective treatment for adult women with stress or mixed incontinence by a Cochrane review.[10] Behavioral treatment for urge urinary incontinence is based upon two general principles, frequent voluntary voiding to keep the bladder volume low and training of central nervous system and pelvic mechanisms to inhibit/ablate detrusor contractions (bladder training). Behavioral therapy for stress urinary incontinence begins with pelvic muscle exercises. Pelvic muscle exercises (Kegel exercises) strengthen the muscular components of the urethral closure mechanism. It is based on the rationale that a strong and fast pelvic floor muscle contraction will clamp the urethra, create increased intra-urethral pressure and prevent leakage of urine when the intra-abdominal pressure rises abruptly.[10]

Pharmacologic treatments mainly include anticholinergic/antimuscarinic drugs to inhibit involuntary detrusor contractions in urge incontinence and alpha-adrenoceptor agonists for stress incontinence. A variety of surgical techniques have been evaluated for stress incontinence including open retropubic colposuspension, suburethral sling procedure, and bladder neck needle suspension. Surgery is associated with a high cure rate, but is invasive and can be associated with significant morbidity. There is insufficient evidence to compare surgery with other interventions and most experts recommend that patients undergo non-surgical options first.[3, 4]

Biofeedback

Biofeedback has been proposed as an adjunct to pelvic floor muscle rehabilitation for the treatment of urinary incontinence. There are many devices that have been marketed as biofeedback for urinary incontinence. For the purposes of this review, any technology that provides visual or auditory cues to the patient while she is performing pelvic floor muscle exercises will be considered biofeedback. These devices usually measure electromyographic or pressure readings of the pelvic floor. In addition, some devices concurrently measure abdominal and gluteal muscle tone, so that patients can learn to keep those muscles relaxed while increasing pelvic floor muscle tone. Pelvic floor muscle electrical stimulation is a different technology that is not specifically designed to provide feedback regarding the efficacy of pelvic floor muscle exercises. Thus, it will not be considered in this review except in one study in which

electrical stimulation was combined with biofeedback. For the interested reader, pelvic floor electrical stimulation for urinary incontinence was evaluated in a recent CTAF review (October 2005, available at www.ctaf.org).

This review considers the benefits and risks of biofeedback for urinary incontinence in women. The main types of incontinence addressed in this review are stress incontinence, urge incontinence and mixed incontinence. Biofeedback in the treatment of urinary incontinence in adults was the subject of a Blue Cross and Blue Shield Association TEC review published in 2000 that concluded that the technology did not meet the TEC criteria. This review will consider the entire peer reviewed literature but will focus on controlled trials, particularly randomized trials, published from the year 2000 to the present.

TA Criterion 1:   The technology must have the appropriate regulatory approval.

Biofeedback devices may be exempt from premarket notification requirements if they are prescription battery powered devices that are indicated for relaxation training and muscle reeducation. All other biofeedback devices are subject to premarket notification requirements. This determination was published in the January 21, 1998 Federal Register.

Several brands of pelvic floor biofeedback devices have been cleared by the FDA for marketing under section 510(k) of the Federal Food Drug and Cosmetic Act since 1991. Two recent approvals are the InCare Pressure Biofeedback Vaginal Pressure Probe (Hollister Incorporated, Libertyville, IL) and the Pathway CTS2000 Pelvic Floor Training System (The Prometheus Group, Dover, NH).

TA criterion 1 is met

TA Criterion 2:   The scientific evidence must permit conclusions concerning the effectiveness of the technology regarding health outcomes.

The Medline database, Cochrane clinical trials database, Cochrane reviews database and the Database of Abstracts of Reviews of Effects (DARE) were searched using the key words urinary incontinence/therapy, pelvic floor muscle exercises, pelvic floor muscle training, pelvic floor muscle rehabilitation, Kegel exercises or bladder training. These were cross-referenced with the keywords biofeedback and human. The search was performed for the period from 1966 through May 2006. The bibliographies of systematic reviews and key articles were manually searched for additional references. The abstracts of citations were reviewed for relevance and all potentially relevant articles were reviewed in full. The initial search identified 353 articles, of which 47 articles were reviewed in full. The inclusion

criteria for this review limited the articles to clinical trials directly comparing some form of pelvic floor muscle training plus biofeedback to pelvic floor muscle training alone. This left four non-randomized trials with concurrent controls and 13 randomized trials of biofeedback for treatment of urinary incontinence published in peer-reviewed journals.

The most commonly used measure of urinary incontinence treatment efficacy is a reduction in urinary incontinence episodes, variably measured as the reduction in mean number of daily episodes, percent reduction from baseline or reduction in leakage volume. Cure is usually defined as complete absence of urinary incontinence. Other outcome measures frequently used are total number of daytime and nighttime continent voids, bladder capacity (or mean voided volume), and post void residual volume. However, these measures may not reflect the patient's perception of improvement. Patient-based outcomes may be better assessed using general satisfaction questions, relief of most bothersome aspect of urinary incontinence or urinary incontinence-specific quality of life measures (B-FLUTS, I-QOL, etc). General health-related quality of life measures (such as the Medical Outcomes Study Short Form-36) largely have proved insensitive to changes in urinary incontinence after treatment.[7]

In spite of the large number of randomized clinical trials, it is difficult to draw conclusions from the literature about the efficacy of biofeedback for the treatment of urinary incontinence because of significant variability in their treatment protocols, the protocol followed for pelvic floor muscle training, the patient populations studied, the equipment used and the outcome measurements. Additionally, none of the trials follow patients for more than six months after the intervention, limiting our ability to conclude if the intervention had a long-term impact on continence.

TA criterion 2 is met

Levels of Evidence: 1, 2, 3, and 5.

Table 1: Quality of the Clinical Trials Comparing Pelvic Floor Muscle Training Plus Biofeedback to Pelvic Floor Muscle Training Alone

Study	Randomization	N	Allocation concealment	Comparable groups at randomization	Loss to follow-up comparable?	Blinded outcome assessment	Patient blinding	Co-interventions equivalent	ITT (lost to follow-up included?)	Overall quality
Shepherd 1983[11]	Yes	22	NR	Poorly described	No: BF 0/11, PF 3/11	NR	No	Unclear	No	Poor
Castleden 1984[12]	Yes	19	No	Cross-over design	100% follow-up	No	No	Yes	Yes	Fair
Burgio 1986[13]	No	24	No	Yes	100% follow-up	NR	No	NR	Yes	Poor
Burton 1988[14]	No	32	No	Balanced by investigator allocation of patients	5/32 (16%) group NR	NR	No			Poor
Burns 1993[15, 16]	Yes	135	NR	Yes	12/135 (9%) group NR	Yes	No	Yes	Unclear	Fair
Ceresoli 1993[17]	No	60	No	Yes	NR	NR	No	Unclear	Unclear	Poor
Glavind 1996[18]	Yes	40	Yes		No: BF: 1/20, PF 5/20	NR	No		No	Poor
Berghmans 1996[19]	Yes	40	Yes	Yes	100% follow-up	No	Yes	Yes	Yes	Good
Sherman 1997[20]	Yes	46	NR	NR	Probably not, poorly reported 7/46 (15%)	NR	No	NR	No	Poor
Sung 2000[21]	No	60	No	NR	NR	NR	No	No	Unclear	Poor
Laycock 2001[22]	Yes	101								
Pages 2001[23]	Yes	51	NR	NR	No: BF 11/24 (47%) vs. PF 0/27 (0%)	NR	No	Yes	No	Poor
Burgio 2002[24]	Yes	222	NR	Yes	No: BF: 15%; PF 12%, SH 9%.	NR	No	Yes	Yes	Fair
Morkved 2002[25]	Yes	103	Yes	Yes	Yes: BF 5/53 (9%), PF 4/50 (8%)	Yes	No	Yes	No	Fair-good
Aksac 2003[26]	Yes	50	Yes	Yes	Follow-up NR	NR	No	Unclear	Unclear	Poor-fair
Aukee 2004[27] Aukee 2002[28]	Yes	35	NR	No, p<.001 for pad test	Yes: 100% follow-up	NR	No	NR	Yes	Poor
Wang 2004[29]	Yes	120	Yes	No, p<.005 for parity and menopause status	OK: 14% overall. BF: 4/38; PF: 6/40; ES 7/42.	No	No	Unclear	No	Poor

NR: Not reported   BF: Biofeedback   PF: Pelvic floor muscle training

Table 2: Outcomes of the Clinical Trials Directly Comparing Pelvic Floor Muscle Training Plus Biofeedback to Pelvic Floor Muscle Training Alone

Study	Incontinence type	Biofeedback device	PFMT	N	Follow-up for primary outcome	Age, yrs (range)	Primary outcome	Diaries (leaks/week) % improvement	Pad test (grams), % improvement	Comment
Shepherd 1983[11]	Stress	Home EMG biofeedback with vaginal probe and visual tracing	1/week x 6 weeks with PT, home exercises	BT: 11 PF: 11	6 weeks	48 (23-67)	Patient diaries	BF: 6.5 to 1.1, 85% PF: 5.5 to 4.1, 25%	ND	No statistical comparison made.
Castleden 1984[12]	Stress	Daily biofeedback with pressure perinometer	PT daily teaching PF, urine stream interruption, home exercises	BT: 19 PF: 19	2 weeks + 2 weeks	55 (23-85)	VAS for incontinence	ND	ND	Crossover design, all improved significantly, no difference between groups.
Burgio 1986[13]	Stress	EMG biofeedback, 4 session + home exercises	PT with vaginal palpation, 4 session + home exercises	BT: 13 PF: 11	6 months	48 (29-64)	Patient diaries	BF: 6.9 to 1.8, 76% PF: 5.8 to 2.5, 51%, p<.05	ND	Not randomized
Burton 1988[14]	Urge 20; stress 7. 4 men included.	NP lead EMG biofeedback – bladder, anal, and rectal problems, 6 sessions over 12 weeks	6 sessions over 12 weeks by NP.	BT: 13 PF: 14	9 months (6 months after end of therapy)	73 (64-83)	Patient diaries	BF: 15 to 3, 79% PF: 20 to 4, 82%	ND	Not randomized. 5 dropouts not clearly accounted for in analysis.
Burns 1993[15, 16]	Stress	EMG biofeedback with vaginal probe and visual and auditory feedback x 8 sessions	8 visits with NP	BT: 40 PF: 43 Control: 38	6 months	62	Patient diaries	BF: 13 to 5, 61% PF: 18 to 8, 54% Ctl: 18 to 20, -9%	ND	
Ceresoli 1993[17]	17 Stress, 14 urge, 28 mixed	EMG biofeedback		BT: PF:	NR	NR	Pad test	ND	BF: 52 to 20, 62% PF: 25 to 10, 60% NS	Not randomized.
Glavind 1996[18]	Stress	Biofeedback using perianal surface electrodes and pressure manometry for abdominal muscles, 4 sessions in addition to PF	2-3 visits with provider, home exercises	BT: 20 PF: 20	4 weeks training + 3months follow-up	45 (40-48)	Pad test at 1 and 3 months	ND	1 month BF: 9 to 2.5, 72% PF: 12.8 to 19, -48% 3 months BF: 9 to 0.8, 91% PF: 12.8 to 10, 22%, p<.02	
Berghmans 1996[19]	Stress	EMG biofeedback with vaginal probe and visual and auditory feedback	3/week x 4 weeks with PT for education, support, vaginal palpation, home exercises	BT: 20 PF: 20	4 weeks	48	48 hour pad test, diaries and symptoms	BF: 3.0 to 1.4, 53% PF: 2.0 to 0.8, 60% NS	BF: 27 to 12, 54% PF: 29 to 12, 57% NS	
Sherman 1997[20]	Stress + mixed	Biofeedback with visual tracings for pelvic floor contractions and timing	1/week x 8 weeks with PT, home exercises, device without feedback	BT: 23 PF: 16	8 weeks	33 (22-46)	Not specified.	Not by diary BF: 7.3 to 2.9, 60% PF: 15.7 to 5.2, 67%	ND	Large baseline difference in incontinence frequency.

Study	Incontinence type	Biofeedback device	PFMT	N		Follow-up for primary outcome	Age, yrs (range)	Primary outcome	Diaries (leaks/week) % improvement	Pad test (grams), % improvement	Comment
Sung 2000[21]	Stress	Office ES alternating with pressure biofeedback 2x/week for 6 weeks	PT once/week+ exercise videotape. Daily home therapy.	BT: PF:	30 30	6 weeks	NR	Incontinence frequency	BF: 2.7 to 1.7, 37% PF: 2.2 to 2.0, 9% P<.001 without adjustment for pre-treatment differences	ND	
Laycock 2001[22]	Stress	Home EMG biofeedback with vaginal probe and visual tracing	PT for 5 sessions	BF: PF:						NS	
Pages 2001[23]	Stress	EMG biofeedback with vaginal probe and visual and auditory feedback in clinic 5x/week x 4 weeks.	Group therapy 5x/week x 4 wks.	BF: PF:	13 27	4 weeks and 3 months.	51 (27-80)	Subjective improvement	NR No incontinence at 3 months: BF: 62% PF: 69%	ND	Exclusion of 46% of BF group after randomization makes between group comparisons impossible
Burgio 2002[24]	Urge	Pressure and BF with 3 balloon anorectal device for 1st visit	4 visits over 8 weeks with NP, vaginal palpation for teaching 1st visit	BF: PF: SH:	73 74 75	10 weeks	65 (55-92)	Patient diaries	BF: 15 to 6, 63% PF: 17 to 6, 69% SH: 15 to 7, 59%, p=.23	ND	
Morkved 2002[25]	Stress + mixed	In clinic and home EMG biofeedback with vaginal probe same clinic schedule as PFMT	PT with vaginal palpation weekly x 2 months, then every 2 weeks x 4 months.	BF: PF:	53 50	6 months	47 (30-70)	Pad test with standardized bladder volume. Also 48 hour pad test.	NR % Cure (< 2 gm) Standard volume BF: 58% PF: 46%, p=.22 48 hour BF: 65% PF: 57%, p=NS	Standard volume BF: 26 to 6, 76% PF: 29 to 11, 63% 48 hour test BF: 41 to 6, 84% PF: 45 to 6, 87%	No significant differences on any outcome.
Aksac 2003[26]	Stress	EMG biofeedback with vaginal probe weekly x 8 weeks, home exercises 3 x/week	Weekly visits x 8 weeks, vaginal palpation for teaching, home exercises "regularly"	BF: PF: Ctl:	20 20 10	8 weeks	52	Pad test (1 hour)	ND	BF: 20 to 1, 94% PF: 20 to 2, 89% Ctl: 29 to 28, 3%	BF group had greater increase in 1 measure of strength (perineometry)
Aukee 2004[27] Aukee 2002[28]	Stress	Home EMG biofeedback with vaginal probe and PT 5 visits over 12 weeks	Verbal and written instructions for home practice 20 min/d 5 d/week x 12 weeks.	BF: PF:	16 19	12 weeks and 1 year	50 (31-69)	Unclear	ND	12 weeks BF: 28 to 19, 37% PF: 47 to 22, 52%, p=.91 after adjustment for baseline difference	No blinding, large differences at baseline in disease severity.
Wang 2004[29]	Urge	EMG biofeedback with vaginal probe and PT	Home training using PERFECT manual, no palpation/clinician training	BF: PF: ES:	40 38 42	12 weeks	53	Unclear Large # missing entries from diaries	BF: 6.4 to 4.9, 24% PF: 6.0 to 5.1, 15% ES: 14.6 to 13.6, 7%	ND	Large baseline differences primarily in ES group. Differences between BF and PF NS on all outcomes.

NR: Not reported   BF: Biofeedback   PF: Pelvic floor muscle training   ES: Electrical stimulation
PT   Physical therapist   EMG   Electromyography   NP   Nurse practitioner   NS: Not statistically significant

TA Criterion 3:   The technology must improve the net health outcomes.

Table 1 describes the methodologic quality of the comparative trials and Table 2 gives the primary outcome data of the comparative trials. Below the review will focus on the newer randomized trials that have been published since the biofeedback was assessed in 2000. However, all of the trials are summarized in the two tables.

<u>Comparative trials of biofeedback plus pelvic floor muscle training vs. pelvic floor muscle training alone</u>

Wang *et al.*[29] report on a single blind randomized trial from Taiwan of pelvic floor muscle training, biofeedback assisted pelvic floor muscle training and electrical stimulation (ES) in the treatment of overactive bladder. For this review, we will focus on the comparisons between the pelvic floor muscle training and biofeedback groups. Overactive bladder refers to a syndrome of urgency, frequency or nocturia in the absence of overt pathology and with or without urge incontinence. The pelvic floor muscle-training subjects were instructed in home pelvic muscle exercises to be performed at least three times daily. The biofeedback arm subjects were trained with an intravaginal electromyogram probe twice weekly at the center, and the ES subjects underwent electrical stimulation for 20 minutes twice weekly at the research unit. Overall, 137 women were recruited and 120 were randomly allocated. Of these, 17 patients dropped out and were not included in the final analysis of the results. There were significant differences between the groups after randomization in the number of prior pregnancies (more in the ES group), number of women in menopause (less in the ES group), and in baseline urinary leakages per day (pelvic floor muscle training, 0.86 +/- 1.80; biofeedback, 0.92 +/- 1.77; ES, 2.09 +/-; P=0.046). The differences were primarily between the ES group and other groups, not between the pelvic floor muscle training and biofeedback groups. Patients in all groups improved on the subjective assessment of urinary incontinence with no statistically significant difference between the groups. They did find a statistically significant difference between the groups in episodes of leakage per day favoring the pelvic floor muscle training and biofeedback groups over the ES group, but did not use this as an outcome measure "because of the large number of incomplete records which could have resulted in a statistical bias." Overall, there were no significant differences between pelvic floor muscle training and biofeedback for the treatment of overactive bladder in this study.

Aukee et al.[27, 28] reported 12 week and one year outcomes for 35 women randomized to biofeedback plus pelvic floor muscle training or pelvic floor muscle training alone. They took a consecutive sample of women at a gynecologic outpatient clinic that had urodynamically proved stress incontinence and randomized them in blocks of four to either biofeedback or pelvic floor muscle training. Apparently there was no allocation concealment or any attempt at blinding. Patients randomized to pelvic floor muscle training received verbal and written instructions for home practice and were asked to exercise 20 minutes per day at least five days per week. They apparently did not receive any

specific training with a therapist. Women randomized to the biofeedback group visited a physical therapist five times for education regarding pelvic anatomy and biofeedback training. Thus it appears that they received significantly more hands on training with a therapist. The biofeedback device was an EMB-assisted vaginal probe with both visual and auditory feedback. The patients received specific training assisted by the physical therapist during the five office visits and took a device home for home therapy. Outcomes included 24-hour home pad tests, the subjective leakage index, pelvic floor muscle activity, and at one year, the proportion undergoing surgery. During the 12 weeks of active therapy, the biofeedback group used the device an average of 68 sessions plus an additional 48 days of exercise without the device recorded in a diary. The pelvic floor muscle-training group recorded an average of 56 days of home exercise. At baseline, the groups were similar in terms of their age, body mass index and menopausal status, but the biofeedback group had significantly less leakage by the 24-hour pad test (28 g vs. 47 g, p<0.001) and a significantly higher leakage index (45.5 vs. 38.5, p=0.003). The biofeedback group had significantly greater increase in pelvic floor muscle activity (p=0.02), but no differences in the leakage index or 24-hour pad test results after adjustment for the baseline differences. At one year 31% of the patients in the biofeedback group and 47% of patients in the pelvic floor muscle-training group either had or were planning to have surgery for incontinence (p NS). The data suggest that there may be some benefit to the addition of biofeedback, but the lack of blinding, large and highly significant baseline differences in primary outcome measures of the study, and the apparent differential co-intervention (five office visits with therapist with specific hands on training in biofeedback group alone) make it impossible to have any confidence in the results. Furthermore, the pelvic floor muscle training was clearly inadequate – hands on training sessions with a therapist has been shown in prior studies to be superior to verbal and written instructions about an exercise plan. This apparently only happened in the biofeedback group. Regular contact with a therapist and continued hands-on education about the correct techniques for pelvic floor muscle exercises are needed in order to have significant improvements in incontinence symptoms with pelvic floor muscle training.

Aksac et al[26] randomized 50 women with stress incontinence in a 2:2:1 distribution to biofeedback assisted training, pelvic floor muscle training with vaginal palpation, or a control group without any exercises. Women were seen weekly for a 20 minute session of biofeedback or vaginal palpation-assisted exercises and were asked to perform the exercises regularly at home. Outcomes were measured prior to the intervention and at the end of eight weeks of training sessions. Patient characteristics, including age, body weight and parity, were similar at baseline in the three groups. All women were post-menopausal and taking hormone therapy. Unfortunately, the authors did not report whether any patients dropped out of the study during follow-up. Both the biofeedback, and pelvic floor muscle training groups had significant improvements (p<0.001 for all comparisons) in incontinence measured by the pad test and a Likert scale of incontinence frequency, pelvic floor muscle strength measured by perineometry and by digital palpation; and in quality of life measured by the social activity index scale. The control group had no significant improvement on any of the five measures. Changes in the measurements between the three groups were significant

(p<0.001) on all five measures. There were no significant differences (p>0.05) between the biofeedback group and the pelvic floor muscle-training group except the biofeedback group had a greater increase in pelvic floor muscle strength measured by perineometry (p<0.001). Cure rates, defined as less than 1 gram of urine loss on the 1-hour pad test, were 80% in the biofeedback group, 75% in the pelvic floor muscle-training group, and 0% in the control group. All patients in the two active groups had at least a 50% reduction in urine loss by the pad test. This study clearly demonstrated a large, clinically significant reduction in incontinence for both the biofeedback and pelvic floor muscle training groups compared to the control group. There were no clinically important differences between the two intervention groups, although the biofeedback group did have a greater increase in one measure of pelvic floor muscle strength. The major concerns about the study include the lack of reporting about follow-up, the lack of blinding, and the lack of some standard outcome measures (patient diaries for number of incontinent episodes/week; validated menopause specific quality of life questionnaire). The number of patients was relatively small, but the highly significant findings demonstrate that the study had more than adequate power for the outcomes assessed. One other concern is whether patients would be able to maintain their improvements for months to years after the end of the treatment program.

Morkved et al[25] randomized 103 women with stress or mixed incontinence to biofeedback or pelvic floor muscle training with vaginal palpation. All patients were treated individually by a physical therapist. Both groups received the intervention weekly for two months and then every two weeks for the following six months. Patients were also instructed to three sets of exercises daily at home. Biofeedback was performed using a vaginal probe that measured vaginal pressure. The patients in the biofeedback group used this device in the clinic and at home. The physical therapist updated the biofeedback guidelines for patients during their follow-up visits based on the patients' individual progress. This was the only study that explicitly blinded outcome assessment. Given the length of the intervention, loss to follow-up was reasonable in the study (about 9% in each group) and comparable in both groups, although one woman dropped out of the biofeedback group because she disliked the equipment. The groups were similar in age (47 years), body mass index, parity, duration of symptoms, and baseline measures of the outcomes. After six months of therapy, objective cure rates, defined as less than two grams of leakage on the pad test using a standardized bladder volume, were 58% in the biofeedback group and 46% in the pelvic floor muscle-training group (p=.22). Cure rates using the 48-hour pad test were slightly better in both groups (65% vs. 57%, p NS). Patient reported cure rates were also similar in the two groups (p=.35) with a trend towards better outcomes in the biofeedback group (incontinence not a problem in 40% vs. 30%; minor problem in 35% vs. 39%). Both groups had significant (p≤.001) improvements in outcomes at six months in the standardized pad test, the 48-hour pad test, the leakage index, and the social activity index. There were no significant differences between groups on any of these outcomes or in pelvic muscle floor strength measured by a vaginal balloon catheter (p≥.35 for all comparisons). Similar to Aksac et al, this study demonstrates significant improvements in urinary incontinence in both groups, but no differences between

groups. This study used a longer intervention period and thus had longer follow-up but did not re-evaluate efficacy after the end of the active treatment period. Ideally the outcomes would have been assessed again six months after the end of the treatment period to evaluate the durability of the treatment response.

One of the leading incontinence researchers, Kathryn Burgio published a large randomized trial of pelvic floor muscle training with and without biofeedback in a population of older women with urge incontinence.[24] The investigators randomized 222 women to eight weeks of pelvic floor muscle training with verbal feedback based on vaginal palpation, the same eight weeks of pelvic floor muscle training plus biofeedback, or eight weeks of pelvic floor muscle training using a self-help booklet. The patients were recruited by advertising, community outreach and physician referrals. They were required to be at least 55 years old and have predominant urge incontinence at least twice a week for at least three months. Urodynamic testing was performed to define the incontinence for stratification (urge only versus mixed urge and stress). Patients were randomized to one of the three arms stratified by severity of incontinence and race. The verbal feedback group had four clinic visits over eight weeks during which they received teaching about skills and strategies to prevent incontinence and oral and written instructions for home practice. The group received verbal feedback based on vaginal palpation to help patients identify and contract their pelvic floor muscles. If patients did not have at least a 50% improvement by the third visit, the training with vaginal palpation was repeated. Patients in the biofeedback group received the same program except that a three-balloon anorectal biofeedback device was substituted for vaginal palpation to help patients identify the pelvic floor muscles and contract and relax these muscles selectively while keeping the abdominal muscles relaxed. Similar to the verbal feedback group, the biofeedback group received repeat training at the third visit if they did not report at least a 50% reduction in symptoms. Finally, the control group received the same content taught during the four clinic visits but they were provided in a written eight-week step-by-step self-help program. The materials included instructions for vaginal palpation in order to locate their pelvic floor muscles and instructions for daily pelvic floor muscle exercises. Outcomes were assessed using bladder diaries, three quality of life questionnaires (the Hopkins Symptoms Checklist, the Incontinence Impact Questionnaire and the Short Form 36 Health Survey) and urodynamics prior to the intervention and two weeks after the last clinic visit. At randomization, 73 women were assigned to the biofeedback group, 74 to the verbal feedback group, and 75 to the self-help group. All women were included in the primary analysis, but only 62/73 (85%) women completed the eight weeks of biofeedback, 65/74 (88%) completed the eight weeks of verbal feedback, and 68/75 (91%) completed the eight weeks in the self-help group. The primary reason for dropouts in all three groups was that the treatment required too much time or effort. The three groups were well matched at baseline. Participants ranged in age from 55 to 92 years (mean 65 years) and the majority had graduated from high school (91%). Participants in the biofeedback group had a slightly greater bladder capacity (282 ml vs. 238 ml vs. 266 ml, p=.04), which was adjusted for in the analyses. All three groups had large decreases in the average number of incontinent episodes per week (63% in the biofeedback group, 69% in the verbal feedback group and 59%

in the self-help group). Fewer patients in the self-help group (31%) thought that they were doing much better compared to those in the biofeedback (62%) and verbal feedback groups (63%, p<0.001). Patients in the self-help group were also less likely to be completely satisfied with their progress (75% biofeedback, 85% verbal feedback, 56% self-help, p=0.001) and to report that incontinence does not at all restrict their activities (69% biofeedback, 78% verbal feedback, 51% self-help, p=0.007). Most patients in the biofeedback and verbal feedback groups felt that they could continue the treatment indefinitely (98% and 100% respectively). The investigators concluded that biofeedback did not enhance the effectiveness of behavioral training for the treatment of urge incontinence.

The trial was of fair quality. There was apparently no attempt to blind the patients or the staff assessing outcomes. That would likely bias the results in favor of biofeedback and against the self-help group, so would not affect the primary conclusions of the article. There were also differential co-interventions in that the biofeedback and verbal feedback groups had more visits with providers. As there were no significant differences in the management of the biofeedback and verbal feedback groups, this methodologic issue would not affect the comparison between biofeedback and verbal feedback, but may partially explain why the self-help group was less satisfied. Finally, the investigators used a last observation carried forward approach so that all women could be included in the analysis. This would likely bias the results against the group with the largest number of dropouts (biofeedback) in favor of the group with the fewest dropouts (self-help) because the number of incontinent episodes tended to go down with time. The investigators report that the results of analyses did not change when excluding patients lost to follow-up, but it would have been instructive to see the per protocol results. Overall, this was the largest and one of the highest quality studies comparing behavioral therapy with and without biofeedback and suggests that biofeedback has no role in the primary treatment of urge incontinence. The investigators suggest in the discussion that biofeedback may have a role for patients who have poor outcomes with verbal feedback, but the trial does not directly address that question.

Two other randomized trials and one non-randomized trial prospectively evaluated biofeedback compared to pelvic floor muscle training. Both randomized trials reported no difference in outcomes between the biofeedback and pelvic floor muscle training groups. The non-randomized trial noted differences, but only after adjustment for significant differences in baseline incontinence frequency, thus highlighting the importance of randomization. This study also combined biofeedback with pelvic floor electrical stimulation, making it impossible to separate out the independent contribution of biofeedback from electrical stimulation.

<u>Systematic Reviews</u>

Seven systematic reviews were found that evaluated whether biofeedback as a component of pelvic floor muscle training was more effective than pelvic floor muscle training alone. [4, 10, 19, 30-34] Two early reviews[31, 34] suggested that there was a trend towards more cures in patients treated with behavioral therapy that includes biofeedback. More

recent reviews[4, 10, 30, 32, 33], including the Cochrane reviews[10, 33], concluded that biofeedback was not significantly better for the treatment of urinary incontinence than pelvic floor muscle training alone.

Pending Trials

There is at least one ongoing trial comparing PFMT plus biofeedback to pelvic floor muscle training alone: a three arm study with one year follow-up.[35] Results should be available within the next year.

Patient Risks

Adverse events associated with biofeedback are generally mild. Some patients reported discomfort with the various probes used for biofeedback, but no serious incidences were reported. Other women appreciated the objective feedback received while exercising. There are no known long-term adverse consequences associated with biofeedback.

Summary

Biofeedback appears safe and well tolerated. Pelvic floor muscle training has been demonstrated to be effective in treating urinary incontinence. Trials directly comparing PFMT with biofeedback to traditional PFMT using vaginal palpation demonstrated no significant advantages to the addition of biofeedback, but the two approaches appear equivalent with trends generally favoring the biofeedback group. In the few studies that also included a control group receiving no therapy or sham therapy, the improvements with PFMT plus biofeedback over control were large enough to be clinically significant.[16, 26] Thus, the evidence demonstrates that biofeedback, as part of a comprehensive program of PFMT and behavioral therapy, is an effective treatment for urinary incontinence in women.

TA criterion 3 is met

TA Criterion 4:   The technology must be as beneficial as any established alternatives.

Many strategies have been used to treat urinary incontinence in women including behavioral interventions such as PFMT, vaginal weights, bladder training, pharmacological interventions and surgery. PFMT was first introduced in 1948 by Arnold Kegel to treat women with urinary incontinence. In the management of stress urinary incontinence, it is based on the rationale that pelvic floor contraction will clamp the urethra and thereby increase intraurethral pressure, thus preventing leakage of urine during abrupt increases in intra-abdominal pressure. The rationale for PFMT is less clear in urge incontinence, though one theory holds that PFMT may lead to reflex inhibition of detrusor contractions.[9] Results from several randomized trials strongly support the use of PFMT as a safe and effective

treatment in the management of stress, urge and mixed incontinence in women. A recent Cochrane review concluded that PFMT is superior to placebo treatment for women with stress and/or mixed incontinence.[10, 33] The frequency and intensity of PFMT needed for sustained response is less clear.

For PFMT to be effective the patient must learn to contract the appropriate muscles without straining, which can lead to increases in intra-abdominal pressure. Biofeedback assisted PFMT has been used as an adjunct to teach patients proper pelvic muscle contraction. Results from randomized trials, however, do not confirm that biofeedback improves outcomes over PFMT alone.[6, 10] Vaginal cones have also been used to promote strengthening of the pelvic floor musculature, particularly in the treatment of stress incontinence. Results from randomized trials do not support their use over PFMT.[3, 4]

A variety of pharmacological therapies have been used in the treatment of urinary incontinence in women. For urge incontinence, anti-cholinergic/antimucarinic medications have been found to be superior to placebo in subjective improvement or cure. Tricyclic antidepressants have also been shown to be of benefit.[3, 4] For stress incontinence, the role of pharmacotherapy has been more limited. Research has focused recently on alpha-1-A-selective adrenoreceptor agonists with the theory that these agents might effectively increase the bladder outlet resistance and therefore limit symptoms in women with stress urinary incontinence. Clinical trials are still ongoing.[36] Other treatments, such as botulinum toxin for urge incontinence, are far on the horizon.

Surgery is an option for women with stress urinary incontinence who have failed more conservative treatment approaches. A variety of surgical techniques have been evaluated. The goals of surgical treatment are to stabilize the bladder neck to prevent descent with increased intra-abdominal pressure and to create a stable fascial layer for urethral compression. A recent Cochrane review concluded that open retropubic colposuspension (Burch procedure) was the most effective treatment modality for SUI, with 85 to 90 percent of patients continent after one year and 70 percent after five years.[37] Comparing the different surgical procedures is difficult due to variations in patient selection, experience of the surgeon, diagnostic methods, techniques, outcome criteria and length of follow-up. Potential complications of surgery include urinary retention (generally short term), detrusor overactivity, injury to the bladder or ureter, infection, hemorrhage and enterocele.

The primary question for this review is whether biofeedback enhances the response to therapy seen with behavior therapy programs that include PFMT as a component of therapy. Of the 17 trials comparing biofeedback plus PFMT to PFMT alone, only three found statistically significant results in favor of biofeedback. However, each of these trials suffered from the methodological flaws outlined above, and there was no consistency between the trials in type of biofeedback provided and the control PFMT regimen that was followed. All of the recent, higher quality studies found no difference in outcomes between biofeedback plus PFMT compared to PFMT alone. On the basis of the current

evidence, it is not possible to conclude that biofeedback as an adjunct to PFMT improves the net health outcomes more than PFMT alone in women with urinary incontinence.

TA criterion 4 is not met.

TA Criterion 5:   The improvement must be attainable outside the investigational settings.

Biofeedback added to PFMT has not been shown to consistently improve patient outcomes in the investigational setting.

TA criterion 5 is not met.

CONCLUSION

Urinary incontinence, defined as involuntary leakage of urine, affects over 13 million Americans, and disproportionately impacts women and the elderly. It imposes a significant psychological impact on patients, their families and caregivers; and it is a major cause of institutionalization of the elderly.[1] Urinary incontinence is underreported by patients and families, and often goes undiagnosed and under-treated. Current treatment options for urinary incontinence include non-pharmacologic approaches such as PFMT, behavioral training including bladder training, vaginal cones and electrical stimulation and pharmacologic options; and surgery. Of these, only PFMT and behavioral training including bladder training have been shown in randomized trials to be an effective first line therapy for women suffering from urinary incontinence.

Of the seventeen trials comparing biofeedback to PFMT, only three found statistically significant results in favor of biofeedback. Because of the poor quality of most of the trials, the variation in the type of biofeedback used, variation in the PFMT program, and other methodological considerations discussed above, it is not possible to conclude that biofeedback plus PFMT is superior to PFMT alone for stress, urge or mixed incontinence. In fact, the more recent, higher quality studies suggest that there is no clinically important difference in outcomes between patients initially treated with PFMT and those with biofeedback. Almost all of these studies focused on stress or mixed stress and urge incontinence, but two recent trials in patients with primarily urge incontinence reported no advantages to the addition of biofeedback.

Recent systematic reviews of this subject have reached similar conclusions. The Cochrane group recently reviewed the literature on PFMT for urinary incontinence in women.[10] In this review, they concluded that PFMT is better than no treatment or placebo treatment for women with stress and/or mixed incontinence. Because of inconsistencies in the technique and other limitations in the literature, they found it difficult to reach firm conclusions regarding the benefit of biofeedback as an alternative or adjunct to PFMT. They concluded that there is no good evidence to suggest that there is benefit of adding biofeedback to PFMT for women with urinary incontinence.

Thus biofeedback appears to be effective when used as part of a comprehensive behavioral treatment program for urinary incontinence, but the addition of biofeedback to such programs does not significantly influence the short-term outcomes. There are no long-term outcome studies and no studies evaluating the utility of biofeedback in subgroups of women who fail primary behavioral therapy. At this time, there is no clear role for biofeedback in the treatment of urinary incontinence in women.

DRAFT RECOMMENDATION

It is recommended that biofeedback, as an adjunct to pelvic floor muscle training, does not meet CTAF criteria 4 or 5 for the treatment of urinary incontinence in women.

The California Technology Assessment Forum panel voted unanimously in favor of this recommendation.

June 21, 2006

RECOMMENDATIONS OF OTHERS

Blue Cross Blue Shield Association (BCBSA)

The BCBSA TEC Medical Advisory Panel reviewed the use of biofeedback in the treatment of urinary incontinence in adults in June 2000 and determined that this technology did not meet TEC criteria.

Centers for Medicare and Medicaid Services (CMS)

In October 2000, the CMS released a statement noting expanded coverage of urinary incontinence therapies. The release indicated that Medicare would cover biofeedback for Medicare patients with stress and/or urge incontinence for which pelvic muscle exercise has not worked.

California Urological Association (CUA)

The CUA representative provided testimony in support of the use of this technology.

American College of Obstetricians and Gynecologists, District IX (California) (ACOG)

The California chapter of ACOG was not able to provide representation at the meeting and does not have a formal opinion regarding the use of this technology.

California Society of Physical Medicine and Rehabilitation (CSPMR)

The CSPMR did not respond to a request to provide an opinion on the use of this technology and to have representation at the meeting.

Abbreviations used in this assessment:

PFM – pelvic floor muscle

PFMT – pelvic floor muscle training

PFES – pelvic floor electrical stimulation

BFAPMT – biofeedback assisted pelvic floor muscle training

KHQ – Kings Health Questionnaire

PFME – pelvic floor muscle exercises

KE – Kegel exercise

BF - Biofeedback

PME – pelvic muscle exercise

SUI – stress urinary incontinence

UUI – urge urinary incontinence

ES – electrical stimulation

BT- bladder training

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