4 URINARY AND FECAL INCONTINENCE

The Use of Electromyographic Biofeedback for Training Pelvic Floor Musculature

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Introduction

Incontinence is a major healthcare problem costing a conservative estimate of $15 billion, annually, in the USA. This reality is mirrored in countries worldwide. Patients with this problem often lead lives of quiet desperation and social isolation.

Incontinence is among the leading causes of nursing home admission, with approximately 50% of all residents being incontinent. While it is estimated that the number of incontinent geriatric patients can be as high as 80%[11], it is more difficult to estimate the incidence in younger populations, though studies by Nygaard show incontinence to be common in young nulliparous women, particularly during physical activities. One Danish study[5], conducted with a group of 45-year-old women, found that 22% experienced stress incontinence. It was also noted that only three percent of these women sought medical attention for their problem.

The National Association for Continence (NAFC) states "that while only one out of twelve incontinent patients in the United States actually report their symptoms to their doctors, approximately 80% can be cured or improved." Unfortunately, women wait an average of 3 years before admitting their incontinence to a health care provider. A persistent myth is that incontinence is a natural part of aging. The cause of incontinence is often multi-faceted and many combined factors, other than age, are often responsible. These factors may include childbirth, hormonal status, previous surgery, muscle dysfunction or weakness, physical injury or medication, to name a few.

The main types of urinary incontinence are stress, urge, mixed and overflow. Stress incontinence occurs when the pressure within the abdomen is higher than the urethral resistance. This can happen while coughing, sneezing, bending, lifting a heavy object or participating in athletic activities. Urge incontinence, or overactive bladder, is the inability to prevent urine leakage long enough to reach the toilet when one senses the urge to void. Urge incontinence is the primary type of loss of bladder control in persons over the age of 65. When an individual experiences symptoms of both stress and urge incontinence it is called mixed incontinence and usually one type of symptom is more bothersome to the patient. Only 5-10% of incontinent patients experience overflow incontinence. Overflow incontinence occurs when the bladder cannot empty completely because of obstructions or loss of bladder muscle strength, and, thus, becomes over distended. It leads to frequent, and, sometimes, nearly constant, urine loss. It also usually requires medical management.

Urge incontinence is frequently treated and improved by pharmacologic manipulations. Anticholinergic drugs are usually quite effective in inhibiting the involuntary bladder contractions that cause leakage in patients with this type of incontinence. Many patients will benefit from non-invasive behavioral treatments that can be started along with the medication. Often, these patients will be able to reduce or even stop using medication once they have begun to benefit from the behavioral intervention. Certain pharmaceutical blocker agents can help when overflow incontinence is secondary to a bladder neck obstruction, such as prostate hypertrophy.

Very few controlled studies have shown patient improvement of stress incontinence using medication. Behavioral modification, as a treatment modality for stress urinary incontinence, has been the focus of clinical attention for the past couple of decades in North America, although European doctors

have used these techniques for far longer with a very high success rate.

The core behavioral treatment of urinary incontinence is pelvic muscle re-education. The pelvic floor refers to the complex of connective tissues and muscles that close off the pelvic outlet and act as a "floor" to the abdominopelvic cavity. The primary muscular component of the pelvic floor is the Levator Ani group of striated muscle fibers which is comprised of the pubococcygeus, puborectalis and the ileococcygeus muscles. The external sphincter of the urethra and the anal sphincter are in continuity with these muscles. Both receive pudendal innervation. Biofeedback "takes the guesswork out of pelvic muscle training" (reference NIDDK) because it enables the patient to improve pelvic muscle function through muscle awareness, which, when combined with a home exercise program, leads to increased muscle strength and improved coordination.

In a review of several studies using biofeedback to teach pelvic muscle exercises (Kegel's exercises) for the treatment of incontinence[14], Tries states that patients benefit from biofeedback by developing a greater sense of control and mastery of bladder and bowel control , thus significantly reducing their fear, anxiety, isolation and hopelessness. A 1998 article in the Journal of the Americal Medical Association (JAMA) by Burgio reports that "patients treated with biofeedback showed a significantly greater reduction in urinary incontinence than a second group who received pharmaceutical intervention."

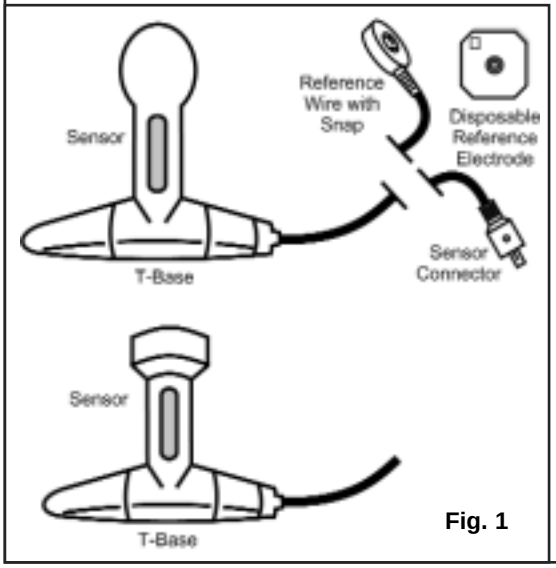

Fig. 1

In 1996, U.S. Department of Health and Human Services, Agency for Health Care Policy and Research (AHCPR), released an updated Clinical Practice Guideline on urinary incontinence, recommending that "behavioral procedures, such as biofeedback, be attempted before consideration of surgical or other invasive techniques."

Assessment of Incontinent Patients

Prior to being admitted to the biofeedback program, patients must be evaluated by a Urologist, Urogynecologist or other physician with expertise in this field. Some forms of incontinence, even genuine stress incontinence, could be secondary to a general disease (multiple sclerosis, diabetes, etc.) or to a local specific disease (carcinoma insitu, interstitial cystitis, tuberculosis, etc.), for which biofeedback treatment may not be appropriate. However, in those cases, although biofeedback does not ameliorate the underlying condition, it may improve the incontinence.

A daily bladder or bowel diary should be kept for one week prior to beginning a behavioral program. This should include the number of incontinent accidents, activity associated with the accidents, times of regular voiding and fluid intake. The evaluation will include a review of the patient's medical history, a vaginal and/or rectal examination, an assessment of bladder and urethral prolapse, rectal prolapse, muscle strength and of the patient's ability to control his or her pelvic muscles. Usually, only urine analysis and culture and post void residuals are necessary. Depending on history and physical examination findings, urodynamic testing, cystometrogram, abdominal leak point pressure, and/or bladder leak point pressure, x-rays and cystoscopy could be useful.

During the pre-treatment visit, the healthcare professional will provide educational information and explain the use of the equipment, including the sensor and its placement. Because of past concerns about sterilization of sensors, "Single-User" sensors, such as shown in Figure 1, have become the standard.

If "T" shaped sensors are used, the patient need not undress, and, if able, they should be allowed to insert the sensor themselves, taking care that the large end remains outside of the vagina or rectum. The "T" allows the patient to sit without any sense of discomfort and has the advantage of having the patient start training in a functional position making it easy to progress from sit to stand.

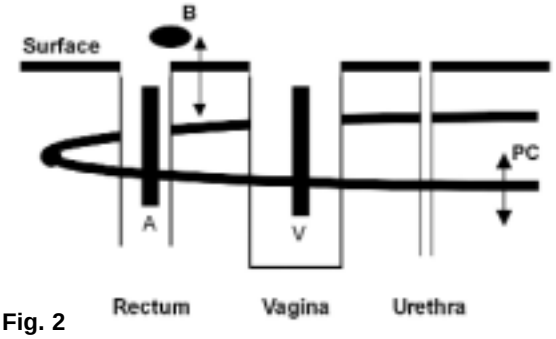

Fig. 2

Figure 2: Longitudinal electrodes (A or V) of inserted sensors in close proximity to the pubococcygeus (PC) portion of the Levator Ani muscle.

Further, the seated position may enhance the patient's awareness of the pelvic floor if seated on a firm, surface. Rectal sensors are appropriate for male patients and some elderly women with small or atrophic vaginal openings. Some clinicians recommend a digital exam be performed by an appropriately trained and licensed clinician to rule out obstruction or impaction, prior to placement of a rectal sensor. The sensor, with a dab of KY Jelly™ on the tip, should be gently inserted into the vaginal or anal canal, until all but the transversal end is inserted.

Before insertable EMG vaginal and anal sensors became widely available surface patch electrodes were placed near the anus to record muscle activity . However, as shown in Figure 2, the insertable sensor's electrodes lie much closer to both superficial ("A") and deeper ("B") segments of the pelvic floor muscles allowing for more sensitivity to the muscle activity.

Many clinicians find it valuable to assess and record initial resting baselines and voluntary contractions. A suggested assessment protocol follows:

The patient, fully clothed, is seated on a firm chair. This position allows for easy progression to a more functional standing position and further increases the patient's proprioception of the target muscles due to contact with the firm surface. The sensor is then connected to the EMG instrumentation.

Electrodes, monitoring accessory muscles, usually the abdominals, are attached by the clinician. These surface patch electrodes can be placed above the pubic symphysis and to the right of the umbilicus, 3-4 centimeters apart, to monitor muscle activity. After connecting to the EMG instrument, the assessment can begin. First, baseline information is gathered for the resting EMG levels of the pelvic floor muscles. The resting EMG levels should be acquired over a 1-3 minute interval.

Typically, a resting EMG reading under 2 microvolts rms is considered to be within normal limits, however, many patients will exhibit higher resting tones during the initial biofeedback visit and, occasionally, during the first few minutes of subsequent sessions. The patient is then asked to tighten the pelvic muscles and to hold the contraction for 10 seconds). The amplitude of the contraction will vary from patient to patient and is dependent on a variety of factors, including prior nerve or muscle damage to the pelvic floor as a result of childbirth or surgical trauma, genetic makeup of the individual, as well as placement of the electrodes and instrumental bandwidth. There is no "magic" number for signal amplitude during contraction and no evidence has been found to support any specific amplitude necessary to attain continence. Patients must be monitored on an individual basis. After the pelvic muscle contraction, a period of relaxation should follow, typically ten seconds. It is important that the pelvic muscles are isolated and that the accessory muscles of the legs, abdomen and buttocks are not contracted. The clinician may be able to observe this, but a second channel of EMG is necessary to rule out undesirable and often subtle activity from the accessory muscle groups. The clinician should instruct the patient to contract and relax the pelvic muscles four to six times, allowing for ten second rest periods between each contraction. These voluntary contractions should be observed for maximal amplitude, the average amplitude of the ten seconds, recruitment and fatigue. The resting levels should be observed for any evidence of muscle spasm, such as abnormally high resting tone, or even excessive activity at lower amplitudes.

Thought Technology sensors (Figure 1) have been shown to be virtually identical to the gold standard, inserted wire needle electrodes. Scottish researchers found that longitudinal electrodes correlated r=0.99, 0.99, and 0.91 respectively for rest, contract, and push-out strain, with traditional needle electrodes. They also found longitudinal electrodes to be considerably more sensitive to EMG signals than circular (i.e., electric stimulation) electrodes."

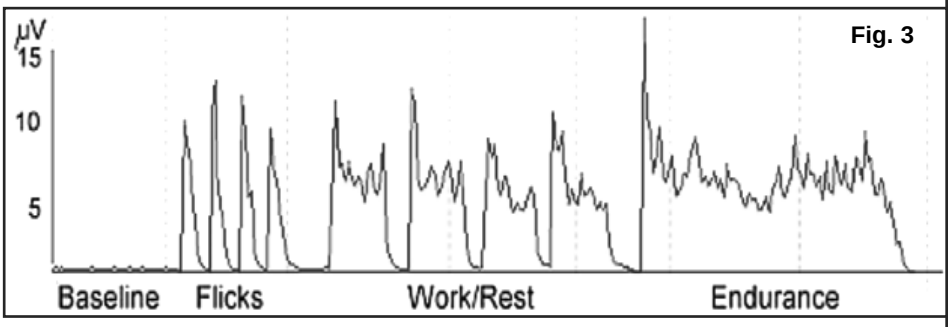

Fig. 3

A response time, or measure of "latency", can be determined by recording the length of time it takes for the EMG signal to make the transition from rest to work and work to rest. These measures are typically 0.5 seconds for contraction and 1.0 seconds for relaxation.[7] A series of five rapid, forceful contractions, sometimes called "quick flicks", are a good measure of the fast twitch fibers of the pelvic floor. The ability to perform 5 such rapid contractions in a ten second period is a goal in training patients to be able to use their muscles in a functional manner such as "squeezing" while coughing or sneezing. If using a computerized program, the display time on the polygraph screen can be set to show 2 minutes of activity, which will display all of the assessment information. The data can be saved, viewed on the screen or printed.

Biofeedback Technique for Pelvic Muscle Exercises

The biofeedback approach for treating urinary incontinence was pioneered by Arnold Kegel in the 1940's. His work was the basis for the pelvic muscle work being performed today. Currently, simple to use yet highly sophisticated EMG instruments monitor not only the pelvic muscles but the nearby accessory muscles, that patients frequently substitute in an effort to contract the seldom used, weak or damaged, muscles of the pelvic floor. The accuracy of sensors with longitudinal sensing electrodes, such as the

Just as in Dr. Kegel's day, patients continue to benefit from home training with biofeedback by using patient friendly EMG devices. There is some evidence that symptom reduction and elimination of urinary incontinence can be significantly enhanced through the use of such home training devices[16].

There are several methods for training the pelvic floor musculature:

Through trial and error learning using a dual channel instrument, such as the MyoTrac 2™ or MyoTrac 3™ EMG system, EMG biofeedback permits one to isolate only the pelvic muscles. This is mandatory for further muscle training to continue. If a dual channel device is unavailable two single channel MyoTrac™ or U-Control™ units could be used. One of the instruments would monitor the abdominal muscles and the other, the pelvic muscles.

Muscle strengthening is done with maximal contractions, that are held for 5-10 seconds at a time, depending on the patient's ability, with 10-second rest periods in between. These work/rest cycles are repeated several times, until the contraction begins to show fatigue, or when the patient begins to compensate with accessory musculature. Endurance training is done with submaximal contractions held for increasingly longer periods of time.

Speed of recruitment is practiced with several rapid forceful contractions (flicks) in a short time frame, for example, 5 successive contractions, performed within ten seconds. A progressive contraction can also be done, asking the patient to contract and relax gradually. The total time committed to actual biofeedback in a 45 minute appointment is approximately 15 minutes. The time spent on each type of training depends on the patient's problem and response. The remainder of the time is spent on patient education, review of voiding diary, and instruction in voiding schedules and dietary and fluid modification, as appropriate to each patient. A typical EMG signal for a similar protocol is displayed in Figure 3.

A review of the record keeping data, combined with a biofeedback session in the office or clinic, is usually suggested every 7-10 days with the healthcare professional. Initially, the patient is asked to practice at home, every day, with an exercise prescription based on her/his assessment in the initial session. For example, if the patient was only able to sustain a 4 second contraction during the first visit, it would be appropriate to prescribe home exercises in the following manner: contract for a count of 4, relax for a count of 10 for 5 repetitions. Repeat the preceding 5 times a day. The duration of the contractions should be increased until the patient is able to sustain for a full 10 seconds. As the patient progresses, or, initially, if appropriate, two or three EMG feedback sessions can be prescribed using a home unit. It is imperative that the patient be able to isolate the pelvic muscles consistently before using a single channel device for home practice. Additional non-instrumented muscle contraction exercises are also given, based on the patient's performace within the clinical setting. These can be tailored to suit the patient's individual lifestyle, taking into consideration that busy schedules may hamper compliance. The literature shows that 30 to 80 contractions, daily, are sufficient to improve pelvic muscle function thus reducing incontinent episodes. There are a variety of other suggestions available in the literature. A workable schedule, for many patients, has been 5 or more sets of 5 repetitions throughout the day. A commitment of $1^1/_2$-2 minutes for exercise, several times a day, is agreeable to most patients without disturbing their routine to the point of non-compliance. During subsequent weeks, these exercises should be practiced with increasing duration and effort, with changes in position during exercise.

If working with a child or an infirmed elderly patient, the assistance of a parent or attendant may be helpful. Clear instructions as to the frequency of practice and maintenance of any instrument, sensor or equipment should be given.

A continuation of the daily records should be kept throughout the training period. These should include episodes of incontinence, degree of activity during episode as well as occasions of toileting without accident. Once the biofeedback training sessions are complete and symptoms have resolved, it is imperative that the patient continue muscle contraction exercises to maintain the effective muscle function and symptom resolution.

Several choices of monitoring instruments are available. Single or dual portable EMG systems, which provide audio and/or visual feedback, are ideal for home training. A more sophisticated computerized data acquisition system is recommended for clinical assessment.

Conclusion

Incontinence is an extremely prevalent disorder. Biofeedback has had a great impact upon incontinence, due to its ease of use, low cost and very high success rate. Most patients can use EMG biofeedback successfully at home. Although treatment time varies, in most people, continence can generally be restored in 4-8 weeks for both fecal and urinary incontinence by using the techniques described in this protocol, which combine clinical assessment and training with EMG biofeedback.

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