

Introduction:

The use of **electrical stimulation** (ES) for the treatment of fecal and **urinary incontinence** and other related problems such as **interstitial cystitis** spans a 30-year period.

Electrical stimulation for urinary incontinence is a very popular treatment modality outside the US but only over the past few years has this treatment become part of US medical practice for these conditions.

Important Terms and Concepts of Electricity Used in Treatment for Urinary Incontinence

To understand the use of **electrical stimulation** as a treatment for **urinary incontinence**, it is important to understand principles for using electricity. Current is defined as the flow of electrical charge from one point to another. In the body, current is a flow of ions, mainly chloride (CL⁻), sodium (Na⁺), and potassium (K⁺). During **electrical stimulation**, charge (ions) moves from one point to another. This transfer of charge (ions) causes physiologic changes to occur and in this case the physiologic changes occur in the pelvic floor and bladder muscles.

Types of Current

There are 3 types of current:

1. Direct
2. Alternating
3. Pulsed - (this is the type most commonly used in **electrical stimulation** of the pelvic floor muscle or bladder). Pulsed current is the flow of charged particles either in one direction or in two directions that stops at regular intervals before flowing again. The two types of pulsed current are:
 - a. Current passes in same direction, which can result in skin/tissue irritation.
 - b. Bi-directional – biphasic is when particles move in one direction, according to their charge, fall briefly to zero, and then reverse direction.

Most electrical stimulation of the pelvic floor muscle or bladder is biphasic in nature to reduce the chance of skin irritation because the ions are flowing more evenly.

Electrical stimulation is often referred to as *pelvic floor muscle electrical stimulation* (PFES) or *functional electrical stimulation*. PFES is the application of electrical current to the pelvic floor muscle. PFES combined with biofeedback may prove useful in that the **electrical stimulation** provides a passive contraction that increases awareness of pelvic floor muscle contractions in general. Applying a low grade electrical current to pelvic floor muscles stimulates the pelvic muscle to contract. Muscle contraction from PFES is a useful addition to pelvic floor exercises in the rehabilitation of weakened pelvic muscles, It can be very beneficial for both men and women who are unable to contract these muscles on command as it may teach the correct action. These electrical currents stimulate and contract the same muscles as Kegel exercises.

PFES of the pudendal nerve (the nerve that innervates the pelvic floor muscle) at a relatively high frequency can cause a pelvic floor muscle contraction through a pudendal nerve reflex loop. The majority of the nerve fibers that supply the muscle of the bladder and pelvic operate at relatively high frequencies of 50 – 100 HZ. PFES causes:

1. A direct motor response to the muscle (limited)
2. A reflex widespread contraction of pelvic floor musculature.

PFES improves the function of the bladder and levator ani (pelvic floor) muscle groups. These include the smooth muscle and striated muscle types.

PFES is used as an adjunct to pelvic muscle exercises and with biofeedback therapy to:

- Assist with identification and isolation of pelvic muscle
- Increase pelvic muscle contraction strength
- Decrease unwanted or uninhibited detrusor (bladder) muscle contraction
- Assist with normalizing pelvic muscle relaxation

Key Components of Pelvic Floor Electrical Stimulation

The key components of Pelvic Floor Electrical Stimulation are as follows:

1. Amplitude.
Amplitude is the intensity of the electrical current. The amplitude must be sufficient to cause the anus to contract reflexively, or create an "anal wink." **The electrical current reaching the muscle is non-therapeutic if it does not produce an anal wink.**
2. Ramping.
Ramping is the ability of the electrical current to reach the muscle either quickly or slowly. The more gradual the current rises to the pre-set amplitude or threshold level, the more comfortable the stimulation may feel to the person. Likewise, the more aggressive the ramp, or the more vertical the ramping up signal, the more likely a person may experience discomfort.
3. Frequency Rate.
The rate or frequency refers to the number of pulses that are generated per unit of time (seconds). This is reported as HZ (hertz). The optimal frequency of electrical stimulation is determined by how quickly the impulses pass through the nerve being targeting (conduction velocity). The frequency rate is contingent on the diagnosis:
 - Stress urinary incontinence = 50 HZ
 - Urge urinary incontinence = 13 HZ.

High frequency (50HZ) builds strength (bulks up muscle, increases urethral closure.) Low frequency (13 HZ) has a calming effect on the detrusor muscle thus decreasing unwanted bladder contractions. Even when a person has urge **urinary incontinence** it may be best to start with the stress mode to increase strength, which enhances urge inhibition and bladder retraining.

4. On/off time.
On time is the amount of time that the electrical current is exposed to the muscle. Off time is the amount of time when there is no electrical current to the muscle, allowing it to recover. The ability to allow the muscle to recover is determined by the professional administering the PFES using the following guidelines:
 - At no time should the exposure to the electrical current be more than a one-to-one ratio – **which is time-off should never be less than time on.**
 - In many cases, a one-to-two ratio, one being on and two being off, will be the most appropriate. **Example: 5 seconds on, 10 seconds off.** This is especially true in the beginning stages of therapy when a person has very weak muscle strength.
 - An adjustment to a one-to-two ratio (i.e. 5 seconds on/ 10 seconds off) or a one to one and one/half ratio (i.e. 1:1.5) to allow the patient a greater recovery time and to increase their resistance to fatigue.

PFES is applied to the body by using skin electrodes around the anus or by vaginal or rectal sensors (probes) and may be used in conjunction with biofeedback. The **electrical**

stimulation heightens perception of the pelvic muscle activity and biofeedback reinforces a person's efforts to control the bladder.

It is postulated that Pelvic Floor **Electrical Stimulation**:

1. Increases the proportion of fast twitch fibers of the pelvic floor muscle
2. Increases the number and strength of slow twitch fibers of the pelvic floor muscle thus improving resting urethral closure.
3. Improves recruitment of pelvic muscle fibers when doing voluntary pelvic muscle contractions.
4. Can relax and inhibit bladder activity or bladder contractions that cause urinary urgency, frequency and urge incontinence

Persons with the following medical conditions may benefit from the use of PFES:

- Stress and urge urinary incontinence
- Urinary retention
- Sensory urgency syndrome of the bladder
- Dysuria
- Dyspareunia (painful sexual intercourse)
- [Interstitial cystitis](#)
- Dysmenorrhea

A physician, nurse, nurse practitioner, or physical therapist who is experienced in the treatment of individuals with these medical conditions can perform **electrical stimulation**. **Electrical stimulation** is usually combined with a pelvic muscle exercise program.

Contraindications for Pelvic Floor Electrical Stimulation

There are contraindications for PFES and persons with the following conditions should not use **electrical stimulation**:

1. Complete denervation of the pelvic floor (will not respond)
2. Dementia
3. Demand cardiac (heart) pacemaker
4. Unstable or serious cardiac arrhythmia
5. Pregnancy or planning/attempting pregnancy
6. Broken/irritated peri-anal skin
7. Rectal bleeding
8. Active infection (UTI/vaginal)
9. Unstable seizure disorder
10. Swollen, painful hemorrhoids

The 1996 Agency for Health Care Policy and Research (AHCPR) treatment guidelines for urinary incontinence indicated that functional electrical stimulation (PFES) acts by contracting levator ani, external urethral and anal sphincters, and causes a reflex inhibition of the detrusor. It may be helpful in women with mixed urge and stress incontinence.

New Treatments for Urinary Incontinence

There are two new treatments that are in the same category as **electrical stimulation**.

- A **surgical treatment** ([InterStim® Therapy](#) by Medtronic) for persons with severe urge incontinence is an implanted sacral nerve stimulator. During surgery, the stimulator is placed in the pelvis and a wire is attached to the lower part (sacral area) of the spinal cord. Electrical stimulation is continuously applied to the sacral nerves to

inhibit or prevent unwanted bladder contractions. This is a permanent procedure and there can be side effects such as pain and infection. This treatment is not for every person with urge incontinence but may be useful for persons who have failed other treatment options.

- The second treatment, a **pulsed magnetic technology**, has been developed for the induction of nerve impulses to cause pelvic floor muscle contraction. This technology was approved by the FDA for use in women. The therapy is called Extracorporeal Magnetic Innervation (ExMI) (Neotonus) and has been found to be effective for stress, urge or mixed UI. EMI is completely non-invasive and does not require the insertion of a probe or attachment of leads. Women receive therapy by sitting in a chair, which contains the device that produces the pulsing magnetic fields. The magnetic pulses penetrate the pelvic floor depolarizing the motor neuron membranes, inducing nerve impulses. These impulses cause the muscles of the pelvic floor to contract, building strength, endurance and improving circulation. As bone, tissue or fluids do not weaken the magnetic fields, all nerves in the path of the field are activated. This is in contrast to pelvic floor **electrical stimulation**, which uses direct transcutaneous injection for current to stimulate muscles.

EMI treatments are performed fully clothed. While the woman sits on the chair, she feels a tapping or vibration sensation on her bottom. Most women report that pelvic muscle contraction is not felt during treatment but that following treatment the ability to contract the muscle increases. The treatment session consists of two phases, 10 minutes at 5 Hz and 10 minutes at 50 Hz with a rest period in between, for a total treatment time of about 30 minutes. Most patients receive treatments twice a week for 8 weeks.

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