

Neuromodulation of Sacral Nerves in the treatment of voiding dysfunction.
A comparison to other therapies

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Introduction

Voiding dysfunction affects more than 20 millions Americans. The major problem facing those patients is urinary incontinence. Eighty percent of the incontinent population is females. It is estimated that half of nursing home admissions patients are suffering from urinary incontinence. The economic and the social impact of the bladder dysfunction is estimated to reach a billion dollar pad and appliances industry¹. This represents a major source of financial restraint not including the social reclusion affecting incontinent patients.

The functions of the bladder are two folds: **reservoir** to hold urine at low pressure and **voiding** function to evacuate the urine. Disturbances in one or both of these functions will result into voiding dysfunction. The urinary bladder and its outlet are under neural control from the sacral nerves. The latter are under influence from higher centers particularly the pontine micturition center (PMC). The PMC receives neural input from the frontal lobe cortex, the cerebellum and the basal nuclei to mention a few. Any neurological disturbances inflicted on one or more of these nerve structures result into voiding dysfunction^{2,3} to neurogenic bladder.

Voiding dysfunction can occur also in the absence of an overt neurologic lesion. It is estimated that urinary incontinence represents 80% of non neurologic bladder dysfunction. Those patients suffer from different forms of incontinence namely urge in conjunction with stress incontinence. Those patients are known to have pelvic floor dysfunction that results in lower urinary tract malfunction. The association between urinary bladder and the musculature of the pelvic floor has been proven in repeated studies^{2,3}. The treatment of those patients with conventional pharmacological treatment usually do not achieve satisfactory results. Repeated surgical intervention aimed at denervating or augmenting the bladder is usually inefficient to control the urge incontinence.

Sacral Root Stimulation

This modality of treatment has been advocated for patients with **spinal cord injury** in order to drive the bladder to evacuate. The treatment involves the exposure of the sacral nerve roots in the sacral neural canal. This involves a laminectomy that extends to the upper 2/3 of the sacrum. The sacral nerve roots are separated into dorsal and ventral. The dorsal roots of 2nd, 3rd and 4th sacral nerves are cut in order to facilitate the bladder evacuation with the least sphincteric contraction during the stimulation. Electrodes connected to an implantable device wrap the ventral roots. The latter is activated by a radiofrequency signals to stimulate the bladder to evacuate.

This treatment is limited to patients with complete suprasacral spinal cord lesion i.e. para and quadriplegic. It is not recommended for:

- a. Patients with incomplete spinal cord injury since they show poor tolerance to the stimulation.
- b. Male patients who desire to keep their erectile function intact. The dorsal rhizotomy of S2, 3 and 4 risks denervating the penis and hence causes erectile dysfunction.
- c.

¹ Blaivas JG. A modest proposal for the diagnosis and treatment of urinary incontinence in women. J Urol 138:597-598, 1987.

² Fall M, Erlandson BE, Nilson AE and Sundin T. Long-term intravaginal electric stimulation in urge and stress incontinence. Scan J Urol Nephrol 44:(

³ Jonasson A, Larsson B, Pschera H and Nylund L. Short-term maximal electric stimulation-a conservative treatment of urinary incontinence. Gyne Obst Invest. 30:120-124, 1990.

Biofeedback and Pelvic floor rehabilitation

Pelvic floor rehabilitation with or without biofeedback (BFB) has been used with 20-60% success in treating patients with urge frequency^{4, 5}. The principle of treatment relies on the educating the patients to contract the pelvic muscles in order to achieve a better control on the bladder contractility. By recruiting the pelvic musculature into contraction, the patient may be able to inhibit unwanted bladder contractions and suppress the sense of urgency and hence the incontinence.

The treatment involves the use of recording probes that are inserted inside the vagina or the anal canal.

These probes convert the pelvic floor contractility into signals perceived by the patients either visually or auditory. The patient is requested to contract and relax the pelvic muscles according to those signals.

The treatment involves repeated office visits to train the patients. Once the patient becomes familiar with the devices, he/she requested to perform those exercises at home repeatedly. The latter involves long term commitment and dedication of the patient towards the therapy.

The results available in the literature vary in the degree of cure from 17 to 60%.

The disadvantage of the therapy:

- a. Early good result fades with time.
- b. Commitment and motivation of the patient are crucial to the success of the therapy.
- c. Patients need continuous reminder of the therapy in order to maintain the success.

Conclusion

In comparing the sacral neuromodulation to the other modalities of therapy it is imperative to delineate the following:

- a. Sacral neuromodulation is less invasive therapy than neurostimulation of the sacral nerve roots. It offers treatment to patients that are neurologically intact yet are suffering from voiding dysfunction. The latter is present in population far more numerous than patients with spinal cord injury are.
- b. Sacral neuromodulation offers continuous low-grade stimulation to the sacral nerve innervating the pelvic floor. The patient is then able to recruit the pelvic muscles in order to control the sense of urgency and incontinence.
- c. Patient is not continuously wearing intravaginal or anal devices to achieve efficacy in the therapy.
- d. Sacral neuromodulation improves significantly (up to 73% of patients) the bladder control in patients with urge incontinence.

Comparison between different therapy

For bladder dysfunction

	Neuromodulation	BFB*	Sacral nerve Stimulation
Indications	Urge Incontinence	Urge incontinence	Neurogenic bladder
Nerve integrity	present	present	absent
Localization of stimulation	precise	diffuse	precise
Efficacy	>70%	20-60%	70%
Safety	safe	safe	Risk of denervation
Stimulation	Low frequency & amplitude	Low frequency & amplitude	High amplitude

⁴ Payne CK, Kunkle JC and Whitmore KE. Combined biofeedback and electrical stimulation for the treatment of female urinary incontinence. J Urol 145:222A: Abstract 40, 1991.

⁵ Hirakawa S, Hassouna M, Deleon R and Elhilali M. The role of combined pelvic floor stimulation and biofeedback in female urinary incontinence. Can J Urol 1:72-77, 1994.

* BFB= Biofeedback