



Neurotechnology Fundamentals and Emerging Devices
for the Treatment of Paralysis

Restoring Lower Urinary Tract Function by Electrically Evoked Bladder Reflexes

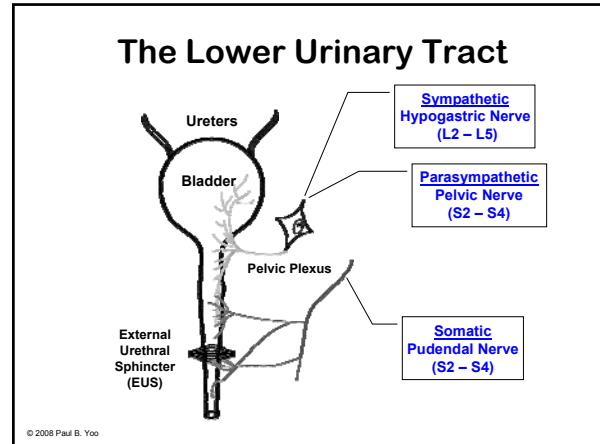


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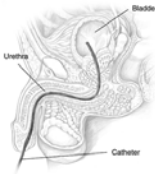
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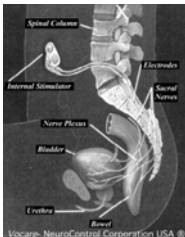
Neurogenic Bladder

- ➔ Factors
 - Stroke, Diabetes, Multiple Sclerosis, Spinal Cord Injury, Parkinson's disease and benign prostatic hyperplasia
- ➔ Symptoms
 - Detrusor overactivity
 - Detrusor-sphincter dyssynergia
 - Urge Incontinence
 - Urinary retention
- ➔ Pharmacological
 - Anti-cholinergics
 - α -blockers
- ➔ Mechanical (urinary catheter)
 - Recurrent urinary tract infection
 - Bladder & kidney stones
 - Urethral erosion



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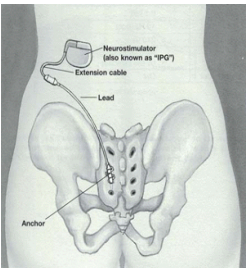
Functional Electrical Stimulation Finetech-Brindley (Vocare) System



- ➔ The first commercially available device for restoring bladder function.
- ➔ Direct activation of detrusor muscle = effective voiding.
- ➔ Limiting factors
 - Highly invasive surgery
 - Dorsal root transection
 - Irreversible
 - Loss in residual sexual function
 - Fecal incontinence

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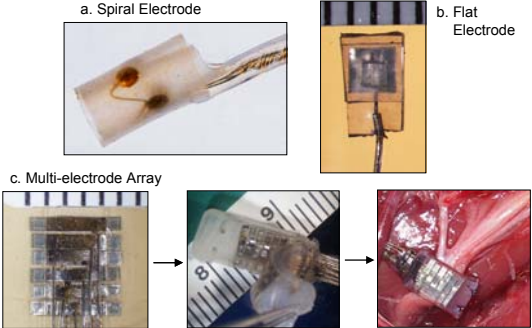
Sacral Neuromodulation Interstim® Therapy

- ➔ Less invasive approach.
- ➔ Urge incontinence, frequency and urinary retention.
- ➔ Replace dorsal rhizotomy.
- ➔ Leg movement, pain and neural plasticity

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Nerve Cuff Electrodes

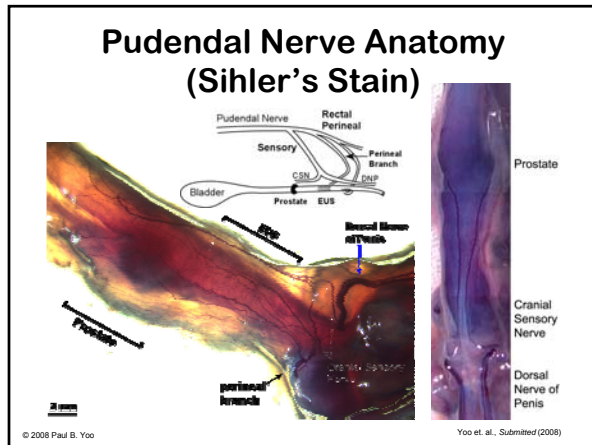
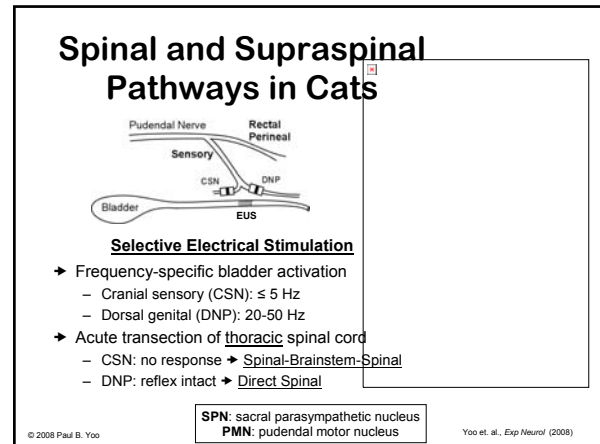
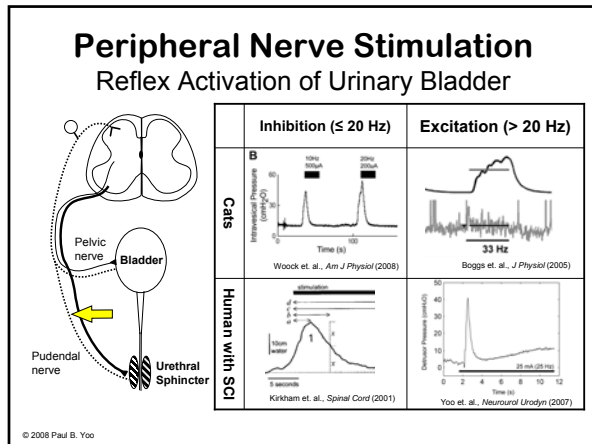


a. Spiral Electrode

b. Flat Electrode

c. Multi-electrode Array

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Summary and Clinical Outlook

- Multiple approaches to restoring urinary function
 - Functional electrical stimulation (Finetech-Brindley)
 - Neuromodulation (Interstim®)
 - Peripheral nerve stimulation ("Bladder Pacemaker")
- Challenges to clinical translation
 - Novel Stimulation techniques
 - Neural Plasticity
 - Neuro-anatomical and physiological understanding

"design of an optimal neural interface"

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