# Effect of Percutaneous Tibial Neuromodulation with the NURO System on Brain Activity

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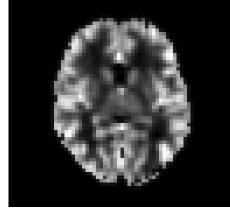
### Introduction

- Overactive bladder (OAB) affects 15% of women, and dramatically impairs quality of life.
- Many fail to improve with first and second line medical therapies.
- Therefore, third line therapies, such as neuromodulation, play a crucial role in the care pathway of women with OAB.
- PTNM is a third line therapy with proven efficacy. However, its mechanism of action is poorly understood. In this study, we use functional neuroimaging to investigate and quantify brain activity changes that may result from PTNM treatment.

### Methods

- The study included 13 women without bladder pathology and 12 women with refractory OAB.
- All participants completed voiding symptom questionnaires.
- All participants underwent an fMRI exam while their bladders were filled via a catheter at a rate of 50ml/minute.
- Images were obtained at predetermined bladder volumes: 0mL, 50mL, 100mL, 200mL, 350mL, and 500mL
- Subjects were instructed to indicate when they experienced the first sensation of bladder filling, first desire to void, and strong desire to void.
- OAB subjects then received a PTNM treatment using the NURO<sup>™</sup> system and a repeat fMRI series with bladder filling.





First desire to void Strong desire to void Baseline Figure 1: fMRI images of a control subject obtained at baseline and during bladder filling

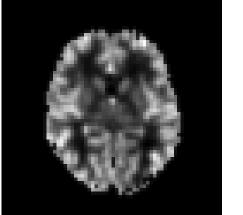
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	De	emographi	cs (r	nean, SD)	
	Control (n=13)		OAB(n=12)		P-value
Age	24.00±7.00		51.	00±35.00	< 0.01
BMI	24.8	7±6.00	30	.25±9.76	0.04
	Voiding	g Questior	nnair	es (mean, S	SD)
		Control (n=13)		OAB (n=12	2) P-value
UDI6 to	tal score	0.00±12.50		45.83±37.50	0.01
Bladder volume at Bladder sensation Controls vs OAB (Median, IQR)					
Bladder Sensation		Controls		OAB	P-value
First Sensation		30.00±63.00		13.50±20.00	0.12
First Desire		100.00±90.00		50.00±16.50	) <0.01
Strong Desire		290.00±210.00		50.00±50.00	) <0.01
Full		300.00±186.00		100.00±97.0	0 <0.01
Bladder volume at Bladder sensation in OAB: Pre vs Post PTNM (Median, IQR)					
	Bladder Pr Sensation		I Post-PTNM		P-value
First Sensation 13.50±2		13.50±20.0	0	7.50±22.50	0.82
First Des	First Desire 50.00±16		0 6	65.00±50.00	0.41
Strong D	esire	50.00±50.0	0 10	02.50±121.00	0.16
Full		100.00±97.0	00 16	68.50±100.00	0.50

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Demographics (mean, SD)					
	Control (n=13)		OA	B(n=12)	P-value
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# Results



					<b>Brain Region</b>	Known Function
Bladder	Pre-PTNS	P-	Post-PTNM	P-	Insula	"seat of visceral
Sensation	vs Controls	value	vs Pre-PTNM	value		sensation"
Baseline	▲Left Insula	P < 0.01			Hippocampus	Consolidation of short term to long term memory,
(Empty)	↓Left MCC	P = 0.03				spatial memory
	<b>↑</b> Right ACC	P = 0.04	Right ACC	P = 0.02	Anterior Cingulate	Emotional response and
First Desire	▲Right Insula	P = 0.02		P = 0.03	Cortex motivational behaviors	motivational behaviors
First Desire		P < 0.01			Mid Cingulate	Nocifensive and awarded
	▲Left Insula	P = 0.03				behaviors, orientation of head and body
Ctropg		P = 0.03	<b>↑</b> Right SMA	P = 0.03	Dorsolateral Pre-	Executive function,
Strong Desire	▲Right DLPFC	P < 0.01		P = 0.01	Frontal Cortex	working memory, abstract reasoning
Full				P = 0.03	Supplemental	Coordination of movement
					Motor Area	

## Results

- Patients in the OAB group were older, had high BMI, and reported worse voiding symptoms.
- OAB patients reported each bladder sensatio lower bladder volume compared to controls.
- After treatment with PTNM, volumes at report bladder sensations trended upward.
- Compared to healthy controls, patients with O demonstrated significant differences in cerebi perfusion during bladder filling in the insula, supplemental motor cortex, anterior cingulate middle cingulate cortex, and the dorsolateral frontal cortex.
- After treatment with PTNS there was a signific reversal in these differences seen in the anter cingulate cortex, insula, and supplemental me area.





Results

	Conclusion
igher	<ul> <li>Our study identified brain regions where activity changes after a single PTNM treatment.</li> </ul>
on at a	<ul> <li>Future research is needed to assess how brain activity changes with longer term PTNM therapy.</li> </ul>
rted	References
OAB	
oral	Milsom I, Abrams P, Cardozo L, Roberts RG, Thuroff J, Wein AJ. How widespread are the symptoms of an overactive bladder and how are they managed? A population-based prevalence study. BJU Int 2001;87:760-6.
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