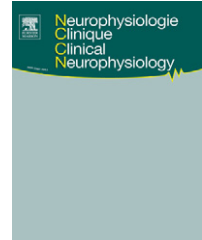




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ORIGINAL ARTICLE/ARTICLE ORIGINAL

# Effect of sacral-root stimulation on the motor cortex in patients with idiopathic overactive bladder syndrome

## Effet de la stimulation de la racine sacrée sur le cortex moteur chez les patients présentant une hyperactivité vésicale idiopathique

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### KEYWORDS

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stimulation;  
Transcranial magnetic  
stimulation

### Summary

*Aims of the study.* – It is presumed that idiopathic overactive bladder syndrome (OBS) is due to visceral hypersensitivity. Sacral-root stimulation can restore the bladder function, but its mechanism remains uncertain. It is well-known that long-term peripheral stimulation can induce brain plasticity. Hence, we investigated whether brain reorganization occurred along with clinical improvement after sacral-root stimulation.

*Material and methods.* – Because toe flexion is the index for monitoring wire placement, we used the flexor hallucis brevis (FHB) as the target muscle. Transcranial magnetic stimulation (TMS) was applied to study motor cortex excitability and the brain mapping of the muscle.

*Results.* – Six patients with idiopathic OBS were included in the study. All demonstrated clinical improvement after sacral-root stimulation. Motor cortex excitability and the area of representation for the flexor hallucis brevis muscle increased for at least 30 min after sacral-root stimulation had terminated.

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**MOTS CLÉS**

Réorganisation  
cérébrale ;  
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L'hyperactivité  
vésicale ;  
Stimulation de la  
racine sacrée ;  
Stimulation  
magnétique  
transcrânienne

*Conclusion.* — Our results showed that cerebral activities changed after sacral-root stimulation. The improvement in urinary urgency and urgency perception was probably due in part to brain reorganization.

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**Résumé**

*Objectif de la recherche.* — On suppose que le syndrome d'hyperactivité vésicale idiopathique (*idiopathic overactive bladder syndrome* IOBS) est dû à une hypersensibilité viscérale. La stimulation de la racine sacrée peut restaurer la fonction vésicale, mais son mécanisme demeure incertain. Il est bien connu que la stimulation périphérique à long terme peut induire une plasticité cérébrale. Nous avons dès lors examiné, si l'amélioration clinique consécutive à une stimulation de la racine sacrée était ou non associée à une réorganisation cérébrale.

*Matériel et méthodes.* — La flexion de l'orteil étant utilisée comme indice de l'emplacement de l'électrode, nous avons choisi de réaliser les enregistrements au niveau du fléchisseur du gros orteil. Nous avons utilisé la stimulation magnétique transcrânienne pour étudier l'excitabilité du cortex moteur et la cartographie cérébrale du muscle.

*Résultats.* — Six patients présentant une OBS idiopathique ont été inclus dans l'étude. Tous les sujets présentaient une amélioration clinique après stimulation de la racine sacrée. L'excitabilité du cortex moteur et la zone de représentation du muscle fléchisseur de l'hallux a augmenté durant au moins 30 minutes après la fin de la stimulation de la racine sacrée.

*Conclusions.* — Nos résultats montrent que les activités cérébrales se modifient après stimulation de la racine sacrée. Les améliorations de l'impériosité et de la perception de l'impériosité sont probablement dues en partie à une réorganisation cérébrale.

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**Introduction**

Sacral neuromodulation is a therapeutic procedure consisting of sacral-root stimulation of S2–4. This has been applied for the treatment of pelvic floor disorders, such as overactive bladder syndrome (OBS). Though the mechanism of sacral neuromodulation is uncertain, it has been hypothesized that sacral neuromodulation stimulates the somatic afferent axons in the spinal roots, which in turn modulate the voiding and continence reflex pathways [6]. The action is postulated to involve not only the arc of sacral reflex, but also supraspinal influences [3].

It is presumed that idiopathic OBS is due to visceral hypersensitivity. Sacral-root stimulation may have a deafferentation effect and reverse urinary perception. Removal of sensory input can induce changes in cortical motor representation [2,4,13]. If sacral neuromodulation can drive a dynamic change of the brain and produce functionally relevant changes in bladder control, the technique of transcranial magnetic stimulation (TMS) might help assess cortical plasticity after sacral neuromodulation. Hence, we applied TMS to study the effect of sacral neuromodulation on the brain.

**Materials and methods****Subjects**

We included six female patients (age: 33–68 y/o; mean:  $45.3 \pm 12.7$  y/o). All had urinary frequency (more than 20 times a day), urgency perception, and nocturia, as evidenced in the voiding diary. Besides, the normal urine routine, a neurological investigation showed intact sacral-root functions (S2–S4), such as normal anal sphincter tone

and normal sensory function of the sacral area. Based upon the standardization of the International Continence Society [1], idiopathic OBS was diagnosed after local pathology or metabolic factors had been excluded. None of the subjects had any surgical intervention in the pelvis and all patients were right-footed. The protocol was approved by the Human Ethics Committee and the subjects gave their informed consents before entering the study. The following assessments were done before and after sacral neuromodulation.

**Sacral-root stimulation**

A test stimulating wire (305715C; Medtronic, Minneapolis, Minnesota, USA) was inserted into the left or right S2–4 foramen for a week. To be sure the stimulating wire was in the correct position, we observed the muscle contraction of the toe flexor. Otherwise, the patient was questioned about typical pulling sensations in the rectum and vagina. If acceptable, the stimulating wire was then connected to an external stimulating control box (3625; Medtronic). The patient was given instructions regarding adjustment of the stimulator amplitude during the stimulation period. A visual analogue scale (VAS 0–10; 0: absolute perfect results; 10: no improvement) and an urgency scale (0–3; 0: normal, 1: mild, 2: moderate, 3: severe) were recorded by the patients to compare the effect of sacral neuromodulation after test stimulation. Moreover, all patients completed a seven-day bladder diary that included the number of voiding events per day, the number of nocturia events and the number of pads used.

**Surface recordings**

Because the motor evoked potentials (MEP) of the sphincter muscles were more variable than those of the flexor hallucis

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