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### Neuromodulation for constipation: Sacral and transcutaneous stimulation

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Constipation is a frequently occurring digestive ailment that is usually treated conservatively. Neuromodulation is altering function of an organ by altering neural activity. This paper reviews methods of neuromodulation used to treat constipation. This includes direct stimulation of sacral nerves and stimulation across the skin. Direct stimulation of sacral nerves is the most well developed method and is presented in detail. It is generally accepted that the mechanism of action is modulation rather than stimulation so it is called sacral neuromodulation (SNM). SNM involves percutaneous placement of an electrode in the third sacral foramen and implanting a stimulating device under the skin in the buttocks. SNM is founded on the physiological principle that activity in one neural pathway modulates pre-existing activity in another through synaptic interaction. The mechanism of action in constipation may be neuromodulation of the extrinsic neural control of the large bowel or modulation of reflexes inhibiting large bowel function. Limited evidence is available to assess the outcome of SNM in constipation. Results in the medium term seem promising for selected patients with idiopathic slow and normal transit constipation not responding to optimal conservative treatment. Adverse events include electrode migration and infection. The availability of a testing phase provides a predictor of treatment outcome.

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In addition, transcutaneous stimulation using sticky pad electrodes over the lumbosacral region or acupuncture points has been reported to improve constipation symptoms. In general, the level of evidence is low and further studies are needed.

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## Introduction

Constipation is a frequently occurring digestive ailment with a prevalence ranging from 1.9% to 27.2%, with most estimates between 12% and 19%. In adults, females are affected more than males (2.2:1) while in children the ratios are equal. Incidence increases with age [1,2]. Common symptoms of constipation include a reduction in bowel movements, difficult evacuation and abdominal bloating and pain resulting in a diminished quality of life. Many patients have idiopathic functional constipation, while some originate from organic and drug-related causes. Functional constipation includes 4 groups: normal transit and anorectal function, pelvic floor dysfunction/functional defecatory disorders, slow transit constipation with delayed transit in the proximal colon, combined slow transit constipation and pelvic floor dysfunction [3].

Chronic constipation is treated with patient education and dietary changes followed by laxatives or enemas and biofeedback therapy [4,5]. In more severe cases retrograde or antegrade colonic irrigation may be used [6–8]. Invasive surgical therapy includes subtotal colectomy and ileorectal anastomosis but this is reserved for selected patients as complications occur frequently [9]. More recently, neuromodulatory techniques have been applied.

Neuromodulation is a term applied to altering the function of an organ by modulating neuronal activity. It is generally achieved by electrical stimulation. Nerves and muscle cells are electrically excitable cells with ion channels that open allowing current flow between the extracellular fluid and the cytoplasm. Other cells such as Purkinje cells in the heart and interstitial cells of Cajal in the intestine are able to generate current and propagate the current rapidly from cell to cell. Electrical stimulation can affect all of these cell types, and the effects are determined by the site of application of the current and the frequency and intensity of current applied.

Most of the electrical stimulation methods applied for constipation have previously been used to treat bladder dysfunction. In patients with severe detrusor instability refractory to conservative treatments, the use of transcutaneous electrical stimulation (TES) and sacral neuromodulation (SNM) produced significant changes in urodynamic parameters and presenting symptoms [10]. The literature on the bladder reflects a longer period of use [11,12]. As the topic of this review is neuromodulation and constipation, only the studies reporting effects on the large bowel will be discussed in detail. Although the level of evidence is low in many cases, all neuromodulation methods available for use in constipated patients are presented.

## Sacral neuromodulation

SNM is founded on the physiologic principle that activity in one neural pathway modulates the pre-existing activity in another through synaptic interaction [13]. The first use of electrical stimulation for pelvic floor disorders was in the field of urology. In the late 1980s, Tanagho and Schmidt were the first to implant neurostimulators in an attempt to treat retention in neurogenic bladder disease [14]. The technique was developed further and used successfully to treat various urological disorders such as urge incontinence, urgency-frequency and urinary retention [15–17]. Some patients treated with SNM also reported an improvement in faecal incontinence (FI). The possibility to treat double incontinence alerted surgeons to the potential of SNM. Matzel et al adapted the technique to treat patients with faecal incontinence [18]. Since then a large number of studies have shown positive results of SNM treatment for FI [18–23].

First suggestions that SNM might be beneficial for patients with idiopathic constipation arose from a combination of early studies of over 250 patients with urinary voiding disorders treated with SNM.

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