Original Article

A Summary of 5 Crossover Trials on Sacral Nerve Stimulation for Fecal Incontinence

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Key Words
Sacral nerve stimulation;
Fecal incontinence;
Randomized controlled trial;
Cleveland Clinic incontinence score;
Fecal Incontinence Quality of Life Scale

Aims. Sacral nerve stimulation is a well-known treatment for fecal incontinence (FI). Standard reprogramming restores FI for some patients, but not all. A review of the literature was carried out to study this question.
Methods. A literature search was performed on Pubmed and Embase databases for all relevant articles till December 2018. Studies were included if they were crossover randomized clinical trial, evaluating the use of SNS on the patient with fecal incontinence and assessing at least one of the following end-points: the frequency of fecal incontinence episodes, Cleveland Clinic incontinence score (CCIS), Fecal Incontinence Quality of Life Scale (FIQLS) and the Wexner incontinence score. No restrictions on language or study size were made.
Results. Five RCT papers were identi?ed and all of those were randomized crossover study. These included 176 patients and 104 participants. The average follow-up duration for these 5 studies was 3 months. Preliminary results suggest good outcome after permanent SNS implant. Results from the first three studies showed significantly reduced frequency of fecal incontinence episodes during the ON period. All three studies reported positive outcomes with the Cleveland Clinic incontinence score (CCIS) that were significantly improved in the ON period than the OFF period. Optimal pacemaker settings were individual, but a trend towards higher patient satisfaction and decreased incontinent episodes was evident for high-frequency stimulation (31 Hz/210 μs) in comparison with the standard setting (14 Hz/210 μs) ($p < 0.05$). Subsensory stimulation as low as 50% of the sensory threshold is as effective as stimulation at or above the sensory threshold. Finally, bilateral stimulation is not superior to standard unilateral stimulation in the short term.
Conclusions. The review suggests that SNS for fecal incontinence has significant improvement in fecal incontinence during the ON period with higher patient satisfaction and decreased incontinent episodes under high-frequency stimulation.
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Fecal incontinence (FI) is commonly defined as an involuntary loss control of the fecal material of liquid or solid stool.[1] FI remains a substantial therapeutic issue in many patients when medical treatment fails and sphincter repair is unsuccessful. While variations exist regarding prevalence due to differences in survey methods, screening questions, definition and population studied. Biologic or artificial neosphincters

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are a therapeutic option in some cases, but these treatments have a significant failure rate and high associated morbidity.[2,3]

Matzel and colleagues introduced Sacral nerve stimulation (SNS) therapy for fecal incontinence in 1995.[4] SNS is a minimally invasive procedure that involves cutaneous electrical stimulation of the sacral nerve plexus via the S3 or S4 foramen, producing a physiological effect on the organs innervated by these nerves.[5] Through neuromodulation, there is the potential to alter pelvic floor and anal sphincter function and afferent sensation eliciting a clinically beneficial effect. The concept of SNS can be traced back to the 19th century when the first clinical application was used by Brindley with high-voltage stimulation to treat patients with spinal cord injury.[6] This was then adapted and applied to treat patients with urological dysfunction and the beneficial effect on fecal incontinence was also observed as well[7] Since then SNS has been demonstrated to have a beneficial effect in several retrospective trials[4,8-15] and four prospective crossover trials.[16-19]

Neurostimulation is one of the fastest growing areas of medicine with application that significantly changed the treatment paradigm for many patients over the past decades. Study has shown that 80% of patients with fecal incontinence undergoing SNS had more than fifty percent improvement in their symptoms.[20] Long-term results have even shown a long-term maintenance rate of 71% in patients after permanent implant, with half of them having full continence.[21] It is now considered the first-line surgical treatment option for the majority of adults with FI in whom medical treatments have failed to do the work.[22]

Although sacral nerve stimulation has become an important tool for the treatment of fecal incontinence, on the other hand, the mechanism remains unclear and inter-individual differences do exist. This systematic review will look at coss-over studies on the use of SNS on patients with fecal incontinence and its effect on their quality of life.

Method

A literature search was performed on PubMed and Embase for all relevant articles. The following keywords were used in various combinations to conduct the search: 'sacral nerve stimulation', 'SNS', 'sacral nerve modulation', 'fecal incontinence', 'faecal incontinence', and 'crossover'. This comprehensive search used Boolean operator "OR" for expanding sensitivity and applied Boolean operator "AND" for specifying the result on this study topic. The search did not restrict the language or date, and the search strategy was completed on September 2018. All studies which were identified in this search were screened by investigators according to PRISMA guideline. The investigators screened title and abstract to include potential references and reviewed full-text to exclude the not eligible references. Our exclude criteria were Different type of device, Non-adult, Non-RCT, Different disease entity and Different target. After study selection, the investigators evaluated the quality of the eligible studies using Cochrane Risk of Bias Tool.

Patients with fecal incontinence on SNS were assessed at least one of the following end-points: the frequency of fecal incontinence episodes, Cleveland Clinic incontinence score (CCIS), Fecal Incontinence Quality of Life Scale (FIQLS) and the Wexner incontinence score.

Results

1726 studies were identified in the initial search and reviewed. 1698 studies were excluded due to non-randomized control trial. Nine repeated studies were excluded. Fourteen studies were on use of SNS on fecal continence and therefore were deemed irrelevant to this review by both authors. The remaining five trials included a total of 176 patients (Fig. 1). Among these patients, however, only 104 patient agreed to be enrolled for analysis. The characteristics of these studies are shown in Table 1.

In 2005,[16] the first double-blind multicenter prospective randomized study reported by Leroi et al. examined the effectiveness of cross-over sacral nerve stimulation in patients with fecal incontinence. A total of 27 patients was enrolled. Twenty-four patients (89%) were self-reported to have improvement during

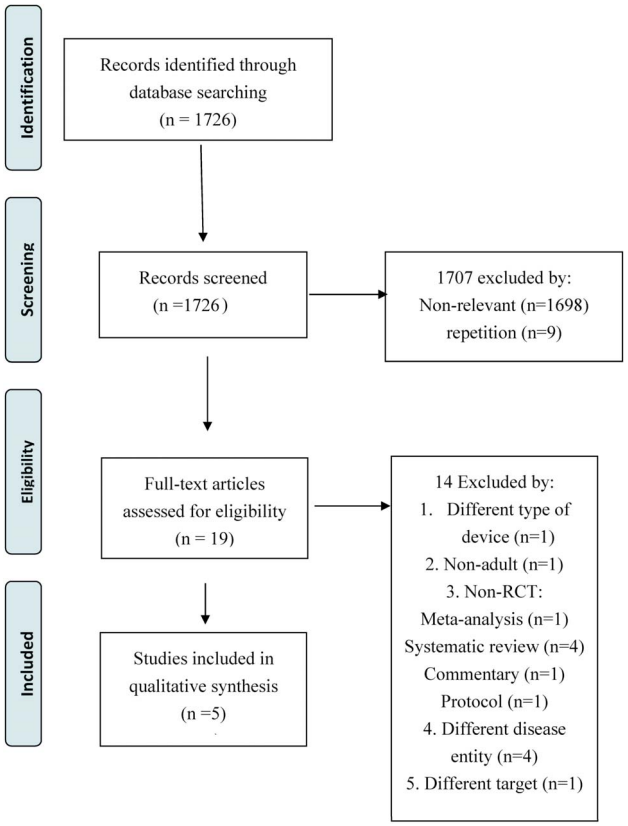

Fig. 1. PRISMA flow diagram.

the ON crossover period in comparison with 17 (63%) during the OFF period. Patients also felt that there was a significant improvement of their FIQOL. Cleveland Clinic incontinence score (CCIS) improved during postimplantation ($p < 0.002$) and final visits ($p < 0.0004$). Treatment details of permanent SNS implant are shown in Table 2. Four patients (0.1%) could not decide if they had improved or not ($p < 0.02$). Results of patients choice of stimulation (stimulation ON or OFF at the end of crossover), are shown in Table 3. Patients' choice for stimulation ON could be justified by a more marked symptomatic improvement during the ON than the OFF crossover period. That was not the case for those who had chosen the OFF stimulation.

A total of 16 patients was enrolled in the Kahlke et al. study.[19] At the time of stimulator implantation, the mean age ± SD was 55.5 ± 11.8 years. SNS led to a marked reduction in the mean frequency of FI episodes and the number of bowel movements per week during the ON period in comparison to the OFF period ($p = 0.004$). FI episodes decreased significantly from 18 ± 19.6 (mean ± SD) at baseline to 1.1 ± 1.6 after implantation ($p = 0.003$) and remained at the low

Table 1. Characteristics of the studies

Study	Design	Data	No. of patients (enrolled)	Age	Gender M/F
Anne-Marie Leroi et al.	Multicenter Double-blind Crossover study	February 2000 to February 2003	34 (27)	57[a]	3/31
Volker Kahlke et al.	Single-center Prospective randomized Crossover study	February 2012 to December 2012	45 (16)	55.5[b]	12/33
J.Duelund-Jakobsen et al. (2012)	Single-center Double-blind Randomized Crossover study	July to September 2010	35 (15)	54.2[b]	0/15
J.Duelund-Jakobsen et al. (2013)	Single-center Blinded Randomized Crossover study	January to April 2010	27 (19)	59.5[b]	1/18
J.Duelund-Jakobsen et al. (2015)	Single-center Single-blinded Randomized Crossover study	May 2009 to June 2012.	35 (27)	63[a]	2/25

[a] Median; [b] Mean.

Table 2. Treatment details of permanent SNS implant

Study	No. of patients	No. patients (enrolled)	SNS lead	Test period	Follow-up duration
Anne-Marie Leroi et al.	34	27	quadripolar	1 month	3 months
Volker Kahlke et al.	45	16	quadripolar	3 weeks	3 months
J. Duelund-Jakobsen et al. (2012)	35	15	ND	3 weeks	3 months
J. Duelund-Jakobsen et al. (2013)	27	19	ND	3 weeks	3 months
J. Duelund-Jakobsen et al. (2015)	35	27	quadripolar	4 weeks	3 months

Table 3. Results of the Cleveland Clinic incontinence score and changes in the number of fecal incontinence episodes per week

Study	No. of patients	No. patients (enrolled)	Frequency of FI/week			Frequency of defecation/week			Cleveland clinic incontinent score (CCIS)		
			OFF	ON		OFF	ON		OFF	ON	
			0	14 Hz/ 210 μs	31 Hz/ 210 μs	0	14 Hz/ 210 μs	31 Hz/ 210 μs	0	14 Hz/ 210 μs	31 Hz/ 210 μs
Anne-Marie Leroi et al.	34	27	3.5 (0-10)[b]	0.5 (0-11)[b]	ND	11.7 (7-32)[b]	10.6 (7-37)[b]	ND	13 (11-18)[b]	10 (3-17)[b]	ND
Volker Kahlke et al.	45	16	8.4 ± 8.7	1 ± 1.7	ND	18.2 (8.7)[a]	10.9 (4.1)[a]	ND	14.6 (4.6)[a]	8.7 (3.6)[a]	ND
J. Duelund-Jakobsen et al. (2012)	35	15	ND	8.7 (6.2)[a,c]	6.4 (7.2)[a,c]	ND	44.1 (32.1)[a,c]	38.3 (29.6)[a,c]	ND	11.6 (2.9)[a]	11.1 (3.8)[a]

[a] Mean ± standard deviation; [b] Median (range); [c] Three weeks.

level of 1 ± 1.7 throughout the ON period, but increased significantly in the OFF period to 8.4 ± 8.7. During the final period, FI episodes remained at a low 0.3 ± 0.5. CCIS fell from 16 ± 4.6 at baseline to 5.1 ± 1.3 after implantation ($p < 0.0001$).

Fifteen patients were enrolled in J. Duelund-Jakobsen et al. (2012) study.[18] Their mean age was 54.2 ± 9.2 (mean ± SD) years and the duration of fecal incontinence before SNS therapy was 14.2 ± 10.2 (mean ± SD) years. Significant improvement was seen in three of four subdomains in the FIQLS. Decreased number of incontinence episodes dropped from 11.7 (10.8) to 4.8 (4.5) per 3 weeks ($p = 0.011$) and improvements were maintained after 3 months of follow-up. The mean CCIS dropped from a baseline of 16.2 ± 3.3 (mean ± SD) to final score of 13.5 ± 2.5 (mean ± SD). After an initial period of successful treatment all patients had gradual loss of efficacy and reported dissatisfaction during later follow-up (mean 57.1 ± 27 [mean ± SD] months after implantation of SNS). There was a trend towards higher patient satisfaction and improved outcome was observed for high-frequency stimulation (31 Hz/210 μs) in 8 out 15 patients (Table 3).

Nineteen patients were enrolled in J. Duelund-Jakobsen et al (2013) randomized crossover study[23] with a mean follow-up of 51.7 ± 29.9 months, aimed to investigate if stimulation at 75% or 50% of the sensory threshold would be as effective as stimulation at the sensory threshold for fecal incontinence.

The results showed that the mean FI episodes per 3 weeks decreased from pre-SNS therapy significantly ($p < 0.001$). Decreasing the stimulation amplitude to as low as 50% of the subsensory threshold (ST) did not affect the overall number of incontinent episodes ($p = 0.078$). Decreasing the stimulation amplitude to 50% of the sensory threshold did not change the Wexner score when compared with the study baseline ($p = 0.581$).

Twenty-seven bilaterally implanted patients were enrolled in J. Duelund-Jakobsen et al. (2015) randomized crossover study,[24] aiming to investigate efficiency of bilateral sacral nerve stimulation over unilateral stimulation for fecal incontinence.

The results showed that bilateral SNS therapy for fecal incontinence is not superior to standard unilateral stimulation in the short term. The median number

of episodes of FI per 3 weeks significantly decreased and the Wexner score incontinence improved dramatically. Overall, the differences between unilateral right or unilateral left and bilateral stimulation were non-significant, for FI episodes ($p = 0.3$) and for Wexner incontinence score ($p = 0.9$) (Table 4).

Discussion

Fecal incontinence significantly impairs quality of life, affecting nearly all aspects of life. There were few randomized trials (ON vs. OFF stimulation) reported on the effect of SNS for the treatment. This systematic review demonstrates the outcome of 58 patients who had undergone SNS. All three studies reported positive outcomes, with CCIS and incontinence episodes improving significantly. These results are encouraging, as they demonstrate the effect of SNS when all other therapies had failed and therefore improving the quality of life of patients.

Since early implementation of sacral nerve stimulation by Matzel et al. and to the best of our knowledge, it has become an effective treatment.[20] Overall, the findings of this crossover study confirm the positive outcomes of SNS in FI: it significantly reduced the frequency of FI episodes and CCIS, and there was a preference for ON stimulation. These results are largely consistent with the randomized multicenter crossover study published earlier by Leroi et al.[16] and Volker Kahlke et al.[19]

However, these results should be looked at with cautious interpretation. There are many confounding factors which can affect the incontinence score and patient satisfication which include patient age, gender, pre-existing sphincter function. As a result, it is still not easy to correlate subjective and objective parameters to predict outcome for each patient and thus determine who will benefit most from current treatment modalities. From Nicholas J Kenefick early cross-over study that the beneficial clinical effect of SNS is unlikely to be due to placebo but the loss of control on fecal incontinence was seen a year later once the stimulation was removed, suggesting that repeated stimulation is required and that stimulation is a reversible neurological mechanism. However, the cases were few and further larger studies would be needed.[25] Furthermore J. Duelund-Jakobsen et al. (2012). study, it is known that nearly half of all patients experienced gradual loss of therapeutic effect and reported dissatisfaction would likely to occur with standard setting (14 Hz/210 μs) during the later follow-up. The evidence for a treatment for patients experiencing loss of efficacy is limited. Altering the SNS stimulation frequency and pulse width previously to treat urinary disorders has then re-applied for treatment of fecal incontinence. Recently, it is shown that better treatment efficacy with alternative stimulation method (31 Hz/210 μs) could then be obtained lasts at 3-month follow-up.[18] Conclusions: Subsensory stimulation as low as 50% of the ST is as effective as stimulation at or above the ST.

It is also important to consider the tool for evaluation of clinical effect of SNS. Manometry is commonly used in clinical setting for patient with anal disorders. For measurement of efficacy and clinical satisfaction of SNS therapy, the role of manometry seem to be controversial. Current evidence has shown some association with changes in anorectal physiological parameters, but the results are inconsistent.[26,27] From

Table 4. Results of changes in the number of fecal incontinence episodes per 3 weeks

Study	No. of patients	No. patients (enrolled)	Frequency of FI every 3 weeks			
			Baseline[a]	ST (100%)[a]	ST (75%)[a]	ST (50%)[a]
J. Duelund-Jakobsen et al. (2013)	27	19	33.6 ± 31.6[a]	0.5 ± 1.0[a]	1.47 ± 2.71[a]	2.89 ± 6.1[a]
	No. of patients	No. patients (enrolled)	Baseline[b]	ST (right)[b]	ST (left)[b]	ST (bilateral)[b]
J. Duelund-Jakobsen et al. (2015)	35	27	17 (3-59)[b]	2 (0-20)[b]	2 (0-42)[b]	1 (0-25)[b]

[a] Mean ± standard deviation; [b] Median (range); ST, subsensory threshold.

Nicholas J Kenefick study, anorectal physiological parameters did not change much as the stimulation parameters were altered. They suggest the possible mechanism linked to the therapeutic effect of SNS is indirect effect on the anal sphincters or pelvic floor secondary to a central neuromodulatory effect.[25]

Although the mechanism undoubtedly involves both somatic pathways as well as the autonomic and enteric nervous systems but what has been known so far shows that SNS reduces the somatosensory evoked potential latency (SEPL) and increases the cortical peak amplitude after anal stimulation.[28,29] In J. Duelund-Jakobsen et al. (2012) study,[18] High-frequency stimulation (31 Hz/210 μs) significantly improved the CCIS in comparison with stimulation at 14 Hz/210 μs ($p = 0.014$).[28] However, frequencies of 50 Hz and above seems to be the limits to the stimulation of nerve fibres, otherwise neural damage and progressive sphincter fatigue could likely to occur.[30,31]

The clinical individual outcomes of SNS therapy can be best assessed through scoring system. Current scoring systems including the most commonly used Cleveland clinic incontinence score (CCIS) and Fecal Incontinence Quality of Life Scale (FIQLS). For all three RCT studies, CCIS was significantly improved during the ON period but Altomare reported that when stimulation was terminated a median 28 months after implantation that only 10 of 19 (53%) patients went back to stimulation due to recurrent FI within 1 year.[32] Even Maeda et al. recommended a "stimulation holiday" to restore the therpeutic effect in cases where there was a loss of efficacy, may potentially leading to an improved CCIS in the study.[33] Like Leroi et al., Volker Kahlke et al. also found the FI frequency to be significantly reduced by SNS therapy, as demonstrated by comparing the ON periods with the OFF periods.[16,21]

J. Duelund-Jakobsen et al. (2012). revealed good agreement and improvement among the patient bowel habit diary, the CCIS and two of four subdomains of the FIQLS.[18] Overall, based on current evidence in the literature that it is suggested that the significant improvement in FI should be with alternative pacemaker setting under ON mode in order to achieve clinical benefit of better FI control and CCIS.

The detailed mechanisms of SNS therapy are still unclear. However, electrophysiological studies have previously shown improvement using measurements such as s anal resting and squeezing pressures are markedly.[4,9]

Nevertheless, these results of all these studies raise the same problem of the choice of criteria needed to comprehensively evaluate treatment outcome both subjectively and objectively. To better assess the real impact of any treatment of FI, we recommend that future placebo-controlled protocols should include an evaluation of CCIS in combination with physiologic finding such as anal squeeze pressure.

Conclusion

The clinical benefit and improvement on quality of life can be obtained through SNS therapy during ON periods. Based on current evidence the long lasting effect of SNS therapy with high patient satisfaction comes with alternative pacemaker setting at high-frequency stimulation. Further larger studies are needed to clarify this issue.

References

1. Macmillan AK, Merrie AEH, Marshall RJ, Parry BR. The prevalence of fecal incontinence in community-dwelling adults: a systematic review of the literature. *Dis Colon Rectum* 2004;47(8):1341-9.
2. Wong WD, Congliosi SM, Spencer MP, et al. The safety and efficacy from a multicenter cohort study. *Dis Colon Rectum* 2002;45:1139-53.
3. Michot F, Costaglioli B, Leroi AM, et al. Artificial anal sphincter in severe fecal incontinence: outcome of prospective experience with 37 patients in one institution. *Ann Surg* 2003;237:52-6. of the artificial bowel sphincter for fecal incontinence: results.
4. Matzel KE, Stadelmaier U, Hohenfellner M, Gall FP. Electrical stimulation of sacral spinal nerves for treatment of faecal incontinence. *Lancet* 1995;346:1124-7.
5. Mege D, Meurette G, Vitton V, Leroi AM, Bridoux V, Zerbib P, Sielezneff I, Club N. Sacral nerve stimulation can alleviate symptoms of bowel dysfunction after colorectal resections. *Colorectal Dis* 2017;19(8):756-63.
6. Brindley GS. Treatment of urinary and faecal incontinence by surgically implanted devices. *Ciba Found Symp* 1990; 151:267-74.

7. Tanagho E, Schmidt R. Electrical stimulation in the clinical management of neurogenic bladder. *J Urol* 1988;140:1331-9.
8. Malouf AJ, Vaizey CJ, Nicholls RJ, Kamm MA. Permanent sacral nerve stimulation for fecal incontinence. *Ann Surg* 2000;232:143-8.
9. Matzel KE, Stadelmaier U, Hohenfellner M, Hohenberger W. Chronic sacral spinal nerve stimulation for fecal incontinence: long-term results with foramen and cuff electrodes. *Dis Colon Rectum* 2001;44:59-66.
10. Matzel KE, Kamm MA, Stösser M, et al. Sacral spinal nerve stimulation for faecal incontinence: multicentre study. *Lancet* 2004;363:1270-6.
11. Mellgren A, Wexner SD, Coller JA, et al.; SNS Study Group. Long-term efficacy and safety of sacral nerve stimulation for fecal incontinence. *Dis Colon Rectum* 2011;54:1065-75.
12. Gallas S, Michot F, Faucheron JL, et al.; Club NEMO. Predictive factors for successful sacral nerve stimulation in the treatment of faecal incontinence: results of trial stimulation in 200 patients. *Colorectal Dis* 2011;13:689-96.
13. Brouwer R, Duthie G. Sacral nerve neuromodulation is effective treatment for fecal incontinence in the presence of a sphincter defect, pudendal neuropathy, or previous sphincter repair. *Dis Colon Rectum* 2010;53:273-8.
14. Wexner SD, Coller JA, Devroede G, et al. Sacral nerve stimulation for fecal incontinence: results of a 120-patient prospective multicenter study. *Ann Surg* 2010;251:441-9.
15. Hull T, Giese C, Wexner SD, et al.; SNS Study Group. Long-term durability of sacral nerve stimulation therapy for chronic fecal incontinence. *Dis Colon Rectum* 2013;56:234-45.
16. Leroi AM, Parc Y, Lehur PA, et al.; Study Group. Efficacy of sacral nerve stimulation for fecal incontinence: results of a multicenter double-blind crossover study. *Ann Surg* 2005; 242:662-9.
17. Vaizey CJ, Kamm MA, Roy AJ, Nicholls RJ. Double-blind crossover study of sacral nerve stimulation for fecal incontinence. *Dis Colon Rectum* 2000;43:298-302.
18. Duelund-Jakobsen J, Dudding T, Bradshaw E, Buntzen S, Lundby L, Laurberg S, Vaizey C. Randomized double-blind crossover study of alternative stimulator settings in sacral nerve stimulation for faecal incontinence. *British Journal of Surgery* 2012;99(10):1445-52.
19. Kahlke V, Topic H, Peleikis HG, Jongen J. Sacral nerve modulation for fecal incontinence. *Dis Colon Rectum* 2015; 58(2):235-40.
20. Thin NN, Horrocks EJ, Hotouras A, Palit S, Thaha MA, Chan CL, Matzel KE, Knowles CH. Systematic review of the clinical effectiveness of neuromodulation in the treatment of faecal incontinence. *Br J Surg* 2013;100(11):1430-47.
21. Altomare DF, Giuratrabocchetta S, Knowles CH, Munoz Duyos A, Robert-Yap J, Matzel KE, European SNSOSG. Long-term outcomes of sacral nerve stimulation for faecal incontinence. *Br J Surg* 2015;102(4):407-15.
22. Norton C, Thomas L, Hill J. NICE guidelines: management of faecal incontinence in adults: summary of NICE guidance. *BMJ* 2007;334:1370.
23. Duelund-Jakobsen J, Buntzen S, Lundby L, Laurberg S. Sacral nerve stimulation at subsensory threshold does not compromise treatment efficacy. *Annals of Surgery* 2013;257(2): 219-23.
24. Duelund-Jakobsen J, Buntzen S, Lundby L, Sørensen M, Laurberg S. Bilateral compared with unilateral sacral nerve stimulation for faecal incontinence: results of a randomized, single-blinded crossover study. *Colorectal Disease* 2015; 17(12):1085-93.
25. Kenefick NJ. Sacral nerve neuromodulation for the treatment of lower bowel motility disorders. *The Annals of the Royal College of Surgeons of England* 2006:88(7):617-23.
26. Moya P, Arroyo A, Lacueva J, Candela F, et al. Sacral nerve stimulation in the treatment of severe faecal incontinence: long-term clinical, manometric and quality of life results. *Tech Coloproctol* 2014;18(2):179-85.
27. Ratto C, Litta F, Parello A, Donisi L, De Simone V, Zaccone G. Sacral nerve stimulation in faecal incontinence associated with an anal sphincter lesion: a systematic review. *Colorectal Disease* 2012;14(6):e297-304.
28. Malaguti S, Spinelli M, Giardiello G, Lazzeri M, Van Den Hombergh U. Neurophysiological evidence may predict the outcome of sacral neuromodulation. *J Urol* 2003;170:2323-6.
29. Giani I, Novelli E, Martina S, Clerico G, Luc AR, Trompetto M, et al. The effect of sacral nerve modulation on cerebral evoked potential latency in fecal incontinence and constipation. *Ann Surg* 2011;254:90-6.
30. Agnew WF, McCreery DB, Yuen TG, Bullara LA. Evolution and resolution of stimulation-induced axonal injury in peripheral nerve. *Muscle Nerve* 1999;22:1393-402.
31. McCreery DB, Agnew WF, Yuen TG, Bullara LA. Relationship between stimulus amplitude, stimulus frequency and neural damage during electrical stimulation of sciatic nerve of cat. *Med Biol Eng Comput* 1995;33:426-9.
32. Altomare DF, Giannini I, Giuratrabocchetta S, Digennaro R. The effects of sacral nerve stimulation on continence are temporarily maintained after turning the stimulator off. *Colorectal Dis* 2013;15:e741-8.
33. Maeda Y, Lundby L, Buntzen S, Laurberg S. Suboptimal outcome following sacral nerve stimulation for faecal incontinence. *Br J Surg* 2011;98:140-7.

原　著

對於骶神經刺激治療大便失禁的五項交叉試驗的總結

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目的　骶神經刺激是大便失禁眾所周知的治療方法。 有一些但不是全部標準流程患者治療大便失禁。 以文獻系統性回顧的方式研究這個問題。

方法　在 Pubmed 和 Embase 數據庫中對 2018 年 12 月之前的所有相關文章進行了文獻檢索。如果是交叉隨機對照試驗，評估骶神經刺激治療對大便失禁患者的使用並評估以下至少一個端點，包括研究： 大便失禁發作頻率，克利夫蘭臨床失禁評分 (CCIS) 和糞便失禁生活質量量表 (FIQLS)。對語言或學習規模沒有限制。

結果　確定了五篇隨機對照試驗論文，均為隨機交叉研究。 其中包括 176 名患者和 104 名參與者。這 5 項研究的平均追蹤時間為 3 個月。 初步結果表明永久性骶神經刺激治療植入後的良好結果。前三項研究的結果顯示在開啟期間大便失禁發作的頻率顯著降低。 所有三項研究都報告了克利夫蘭診所尿失禁評分 (CCIS) 的陽性結果，其在開啟期間顯著改善，而非關閉時期。 最佳刺激器設置是獨立個體的，但與標准設置 (14 Hz/210 μs) 相比，高頻刺激 (31 Hz/210 μs) 的患者滿意度增加和失禁發作減少的趨勢明顯 ($p < 0.05$)。而在低至感覺閾值的 50% 的亞感覺刺激與在感覺閾值或高於感覺閾值的刺激一樣有效。最後，雙側刺激在短期內不優於標準的單側刺激。

結論　該綜述表明，在開啟期間，骶神經刺激治療在大便失禁方面有顯著改善，患者滿意度較高，高頻刺激下失禁發作減少。。

關鍵詞　骶神經刺激、大便失禁、隨機對照試驗論文、克利夫蘭臨床失禁評分、糞便失禁生活質量量表。