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CASE REPORT

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Bilateral sacral spinal nerve stimulation for fecal incontinence after low anterior rectum resection

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Abstract *Background and aims:* The somatomotor innervation pattern has been shown to differ in patients undergoing percutaneous nerve evaluation for sacral nerve stimulation. In some patients bilateral stimulation might improve clinical outcome; however, only single-channel pulse generators have until now been available. We report a patient with fecal incontinence after surgery for rectal carcinoma in whom a dual-channel, individually programmable, pulse generator permitted implantation of neurostimulation electrodes bilaterally. *Patients and methods:* Intractable fecal incontinence developed in a 48-year-old man who underwent low anterior rectum resection, owing mainly to reduced internal anal sphincter function. The morphology of the anal sphincter was without defect. Based on the findings of unilateral and bilateral temporary sacral nerve stimulation the patient underwent placement of foramen electrodes on S4 bilaterally. Both electrodes were connected to a dual-channel impulse generator for permanent low-frequency stimulation. *Results:* The percentage of incontinent bowel movements decreased during unilateral test stimulation from 37% to 11%, during bilateral test stimulation to 4%, and with chronic bilateral stimulation to 0%. The Wexner continence score improved from 17 preoperatively to 2, and quality of life (ASCRS score) was notably enhanced. Anorectal manometry revealed improved striated anal sphincter function; the internal anal sphincter remained unaffected. *Conclusion:* Sacral nerve stimulation can effectively treat incontinence after rectal resection, and bilateral stimulation can improve the therapeutic effect.

Keywords Sacral nerves stimulation · Fecal incontinence · Rectal neoplasms · rectal surgery

Introduction

Since its first therapeutic application for fecal incontinence [1] sacral nerve stimulation has gained increasing interest. The indication for permanent implantation of a neurostimulation device is based on the results of acute and subchronic testing phases. During the first phase the somatomotor innervation pattern of the striated pelvic floor muscles is evaluated; during the second phase the sacral spinal nerve most relevant to sphincteric function is stimulated with a temporary electrode and an external pulse generator. A permanent electrode connected to an implantable impulse generator is then implanted on the site demonstrated to be most efficient therapeutically.

It became apparent after many percutaneous nerve evaluations (PNEs) that the somatomotor innervation pattern of the striated external anal sphincter varies between individuals with regard to the level of the spinal nerve most relevant functionally and to the distribution of innervation; both symmetrical and asymmetrical patterns have been found [2, 3]. Despite the latter finding, however, permanent foramen electrodes were placed on-

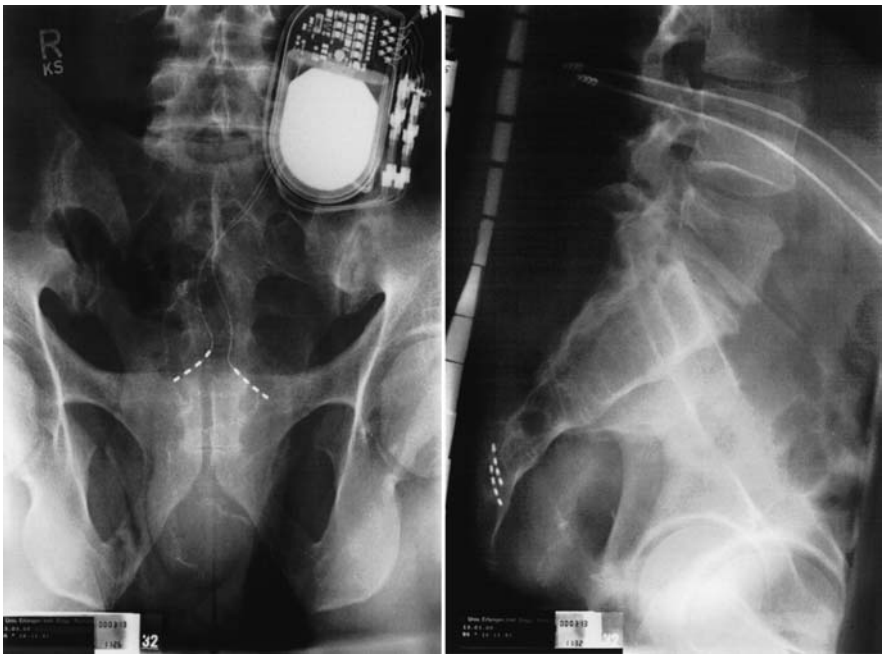

Fig. 1 Radiographic image of implanted pulse generator and bilateral S4 foramen electrodes; anterior view, lateral view

ly unilaterally because only single-channel pulse generators were available. With the recent development of a two-channel pulse generator in which each channel can be programmed separately we have been able for the first time to deliver appropriate treatment to a patient in whom PNE demonstrated that bilateral stimulation could prove more beneficial. This patient was noteworthy additionally because he was the first to receive sacral nerve stimulation for fecal incontinence secondary to rectal resection for carcinoma.

Methods

In May 1996 a 48-year-old man underwent low anterior rectum resection with straight colorectal anastomosis for rectal cancer (pT2pN0MX, G2, R0). Immediately thereafter fecal incontinence ensued. This was unresponsive to conservative treatment, including medical treatment, biofeedback, dietary manipulation, and anal irrigation; 41 months after rectal resection 37% of the patient's bowel movements were involuntary.

At the initiation of sacral nerve stimulation the patient was free of cancer recurrence. Clinical examination and transanal ultrasound detected no morphological defects in the internal and external anal sphincter. The function of the internal sphincter was reduced (Table 1); voluntary and reflex functions of the external sphincter were within normal limits. Rigid sigmoidoscopy visualized the anastomosis and showed it to be without evidence of pathology at 6 cm from the anal verge.

Acute PNE was performed under general anesthesia without muscle relaxants with the patient in prone position [4, 5]. Needle electrodes (Medtronic Model 041828 or 041829 Foramen Needles, Medtronic 3065U PNE Kit, Medtronic, Kerkrade, The Netherlands) were inserted into the dorsal sacral foramina of S2–S4 via a dorsal approach. The effect on activity of the external anal sphincter was checked visually and assessed by electromyography with concentric needle recording at 3 and 9 o'clock lithotomy positions.

When acute PNE proved successful, the needle electrodes were replaced by wire electrodes (Medtronic 041830, Temporary Screening Lead) connected to an external impulse generator (Medtronic Screener 3625, Medtronic, Minnesota). In this manner subchronic (18-day) PNE of left S3 was performed (frequency 15 Hz; pulse width 210 μs; voltage adaptable by the patient within a limited range (1–10 V) according to his perception of sphincteric muscle contraction or perianal sensation), interrupted during defecation and voiding.

The therapeutic benefit of this unilateral test stimulation fell short of the patient's expectations. Because acute PNE had shown bilateral stimulation of S3 and S4 to result in a similar muscular reaction of the pelvic floor and anal sphincter, this subchronic PNE phase was repeated; S4 was stimulated bilaterally for 16 days. The improved result prompted implantation of a permanent stimulation device bilaterally. The implant was performed at 43 months after rectal resection.

Foramen electrodes (Medtronic Model 3886), each consisting of four individually addressable contact points, were inserted inferiolaterally into the dorsal sacral foramen of S4 and fixed (Fig. 1) [6]. With a subcutaneously placed extension lead (Medtronic Itrel II/X-Trel, 7495, Extension Kit), the electrodes were connected to a two-channel pulse generator (Medtronic 7424 Synergy) implanted in a subcutaneous pocket in the lower abdominal wall (Fig. 1).

Therapeutic stimulation began the day after surgery. The pulse generator was activated by telemetry (Medtronic Model 7432 Console Programmer) and deactivated by a hand-held programmer for defecation and voiding. By testing the single-contact electrodes of each electrode with monopolar stimulation we could choose the most effective contact with regard to required voltage and patient's perception of muscular contraction of the perineum and anal sphincter (pulse width 210 μs; frequency 15 Hz; intermittent stimulation: on/off ratio 5/1 s; current amplitude adapted to the patient's perception of muscular contraction of the perineum and anal sphincter). Threshold voltages for perception were 2.25 and 3.05 V.

Before and during subchronic PNE and over the course of follow-up, bowel habits were documented with a standardized bowel habit diary [7]. Quality of life was assessed by the American Society of Colon and Rectal Surgery (ASCRS) Quality of Life Ques-

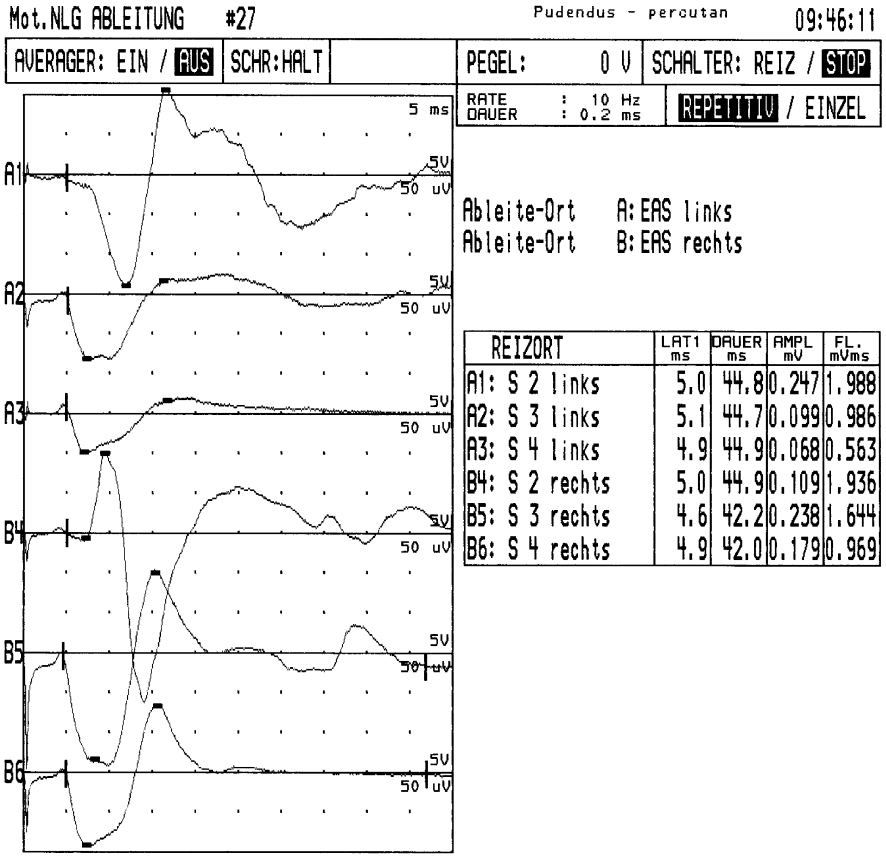

Fig. 2 Innervation patterns of the external anal sphincter during percutaneous nerve evaluation and concentric needle recording. Note comparable pattern at S4 left and right. Ipsilateral muscular responses to stimulation: *tracks A 1–3* left S2–S4 stimulation; *tracks B1–3* right S2–S4 stimulation

tionnaire for fecal incontinence [8], which addresses 29 issues in four categories: life-style, coping behavior, depression/self-perception, and embarrassment.

Anorectal manometry with a stationary pull-through technique (Synectics Medical, Frankfurt/Main, Germany) was used for anal pressure recording. The following parameters were evaluated: mean resting pressure, maximal squeeze pressure (highest pressure during voluntary contraction of the anal sphincter), and mean squeeze pressure (maximal squeeze pressure over 30 s), thresholds for first perception, urge and maximal tolerable volume, and compliance. Squeeze pressure values represented increments over mean resting pressure. All evaluations were done before treatment and 3, 12, and 18 months postoperatively.

Informed consent regarding the experimental nature of this therapy was obtained. The procedure was approved by the medical ethics committee of the University of Erlangen.

Results

During acute PNE the clearest muscular response was obtained by stimulation of S3 and S4 on both sides (Fig. 2). During subchronic PNE unilateral stimulation of left S3 reduced the frequency of incontinent episodes (to 11% of movements) but not to the patient's satisfaction. When subchronic PNE was repeated, symptomatic improvement was greater with bilateral stimulation of S4 (Fig. 3). With permanent bilateral stimulation of S4 the clinical findings of the screening stimulation were repro-

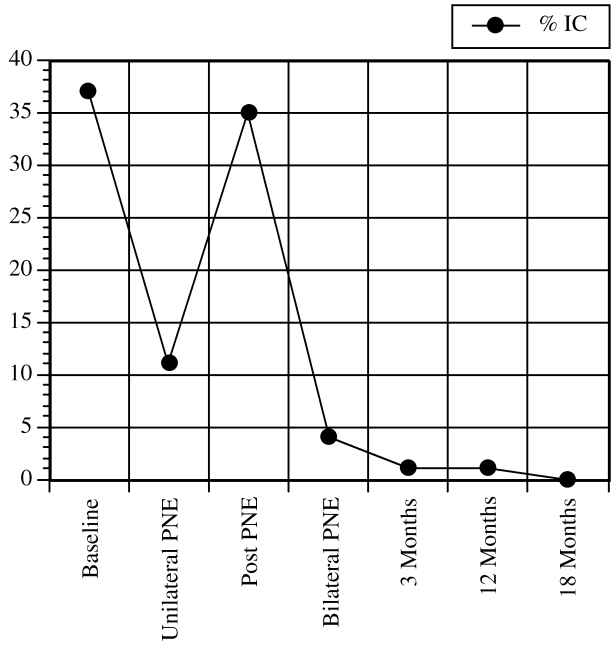

Fig. 3 Percentage of incontinent episodes during unilateral stimulation (*S3*), bilateral temporary stimulation (*S4*), and bilateral chronic stimulation (*S4*)

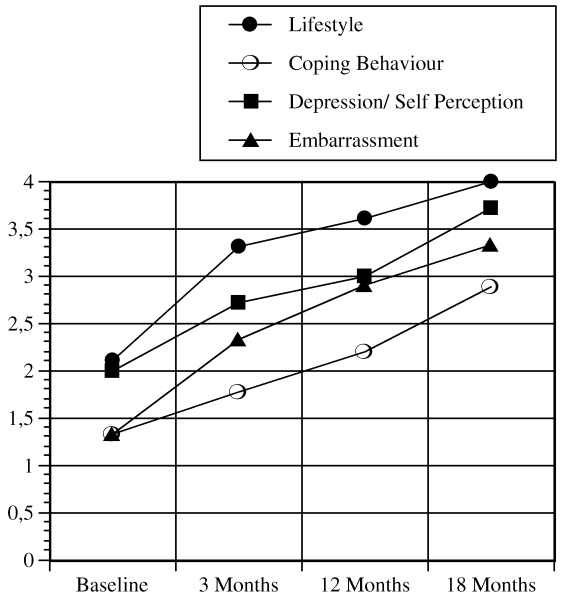

Fig. 4 Quality of life assessment, preoperatively and during follow-up

Table 1 Sacral spinal nerve stimulation for fecal incontinence: anorectal manometry results

	Before stimulation	Permanent stimulation (months)		
		3	12	18
Resting pressure, mean (mmHg)	43	36	47	50
Squeeze pressure (mmHg)				
Maximal	75	104	122	115
Mean	58	93	72	76
Perception (ml)	50	–	40	50
Urge (ml)	60	–	40	50
Maximal tolerable volume (ml)	150	–	100	200
Compliance (ml/mmHg)	8.7	–	7.7	6.9

duced and maintained over the course of follow-up. The frequency of episodes of incontinence to solid or liquid stool over a 7-day period declined from 37% before stimulation to 1% after 3 months of permanent stimulation, remained 1% after 12 months, and was 0% after 18 months. The Cleveland Clinic Continence Score [7] declined from 17 before stimulation to 10 after 3 months of permanent stimulation, 4 after 12 months, and 2 after 18 months. The thresholds for stimulation remained constant (last follow-up, 18 months), and no complications or side effects of sacral nerve stimulation occurred. A noteworthy improvement was achieved in all four categories of the quality of life score (Fig. 4). During permanent stimulation the function of the striated anal sphincter (squeeze pressure) was improved, although the function of the internal anal sphincter (resting pressure) remained unaffected, as were the thresholds for first perception, urge and maximal tolerable volume, and compliance (Table 1).

Discussion

Because the precise mechanism of action of sacral nerve stimulation in the treatment of fecal incontinence remains controversial, and because reliable physiological predictors for its clinical effect are still lacking, the indications for a permanent neurostimulation device and its placement are based solely on the results of acute and subchronic test stimulations [9]. In the present patient results of subchronic percutaneous nerve stimulation had indicated a greater therapeutic effect from bilateral placement. The recent commercial availability of a dual-channel pulse generator made it possible to program each electrode separately to deliver appropriate stimulation to each nerve for the first time with a single pulse generator in the treatment of fecal incontinence. The technique proved both feasible and effective. Incontinent episodes, which had constituted 37% of bowel movements over a 7-day period before stimulation, and had been reduced to 11% with unilateral test stimulation, were abolished by the time of last follow-up evaluation (18 months). Clinical improvement appeared to be based on the increased function of the striated external anal sphincter, as function of the internal anal sphincter, perception, and compliance remained unchanged. The improved external sphincter likely augmented the deficient internal sphincter. This patient had undergone a low anterior rectal resection with straight colorectal anastomosis, a condition in which denervation of the neorectum, at least with regard to the sacral spinal nerves, must be presumed. Thus an effect of sacral nerve stimulation on rectal motility, mediated by sacral reflex arcs [10], is not probable.

Conclusion

Sacral nerve stimulation can effectively treat fecal incontinence after rectal resection, and bilateral stimulation can improve the therapeutic benefit. Because the somatomotor innervation pattern differs between individuals, temporary test stimulation can identify the patients in whom chronic bilateral stimulation can improve the clinical outcome.

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