

# A Modified Technique for Implantation of Sacral Neuromodulators: The Tailored Laminectomy of the Os Sacrum

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## Abstract:

**A new surgical technique for implantation of sacral electrodes for neuromodulation is presented. After description of the method in detail the first experience in 7 patients is reported. The results are discussed.**

## I. INTRODUCTION

In untreatable chronic perineal pain<sup>8, 12, 17</sup> and persistent detrusor contractility disorders<sup>1-7, 9-11, 13-17</sup> sacral neuromodulation can be a beneficial treatment option. Electrodes at current are usually implanted unilaterally through the dorsal sacral foramen at one level (S<sub>3</sub> in most cases) via a small skin incision, electrode displacement being a common complication<sup>11, 12, 17</sup>. As a modification Sauerwein (personal communication) and other groups<sup>5, 14</sup> used a sacral laminectomy and placed electrodes bilaterally, achieving improved stimulation and lower displacement rates. However, the large approach can cause extensive postoperative fibrosis which may result in pain and in the need for higher stimulation currents. To minimize surgical trauma and still to have low displacement rates we used a tailored bilateral sacral approach.

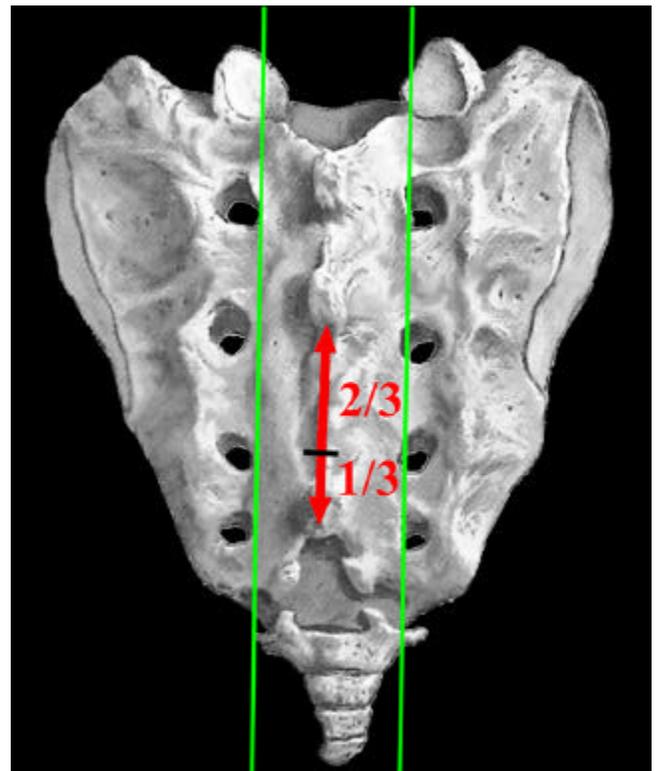
## II. METHODS

### A. Patients:

Our new surgical technique was applied in 7 patients so far, 2 female, and 5 male. Their age ranged from 23 to 68 years. The indication for sacral neuromodulation was urge incontinence in 5 cases, detrusor hypercontractability in one case, and chronic pudendal pain in 1 patient. The possible benefit from neuromodulator implantation was established for each patient through a percutaneous peripheral nerve evaluation test on an outdoor-patient basis<sup>18</sup>.

### B. Sacral approach:

Patients were rested in prone position in a usual manner. After surgical cleansing and draping of the skin the intended level of electrode implantation – mostly S<sub>3</sub> – was established by percutaneous stimulation of the sacral nerves through the dorsal sacral foramina similar to the peripheral nerve evaluation test.

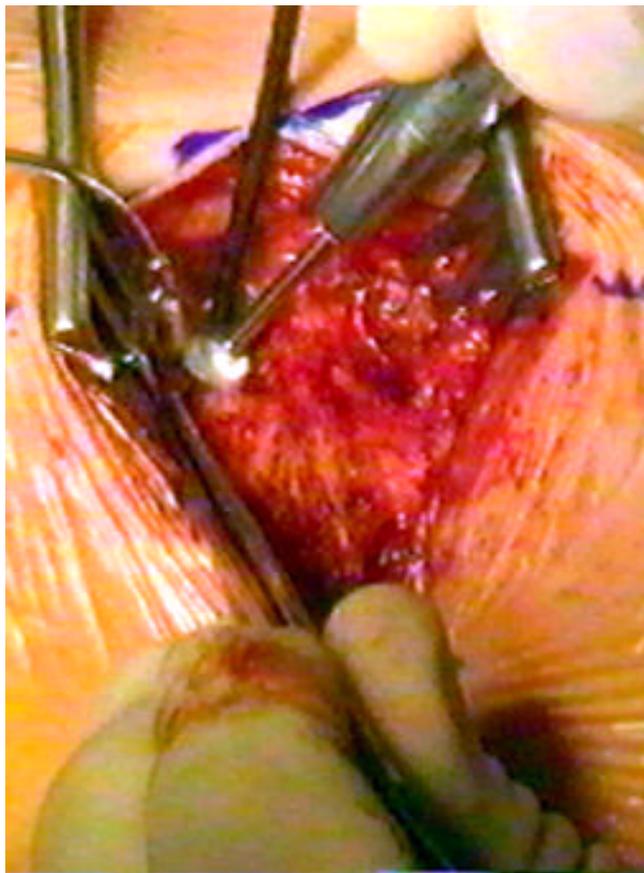


*fig. 1:* Approach to the sacral roof. Red double arrow: skin incision. Green lines: medial borderlines of the dorsal sacral foramina.

This level was marked on the skin. Thereafter, a 6 to 10 cm

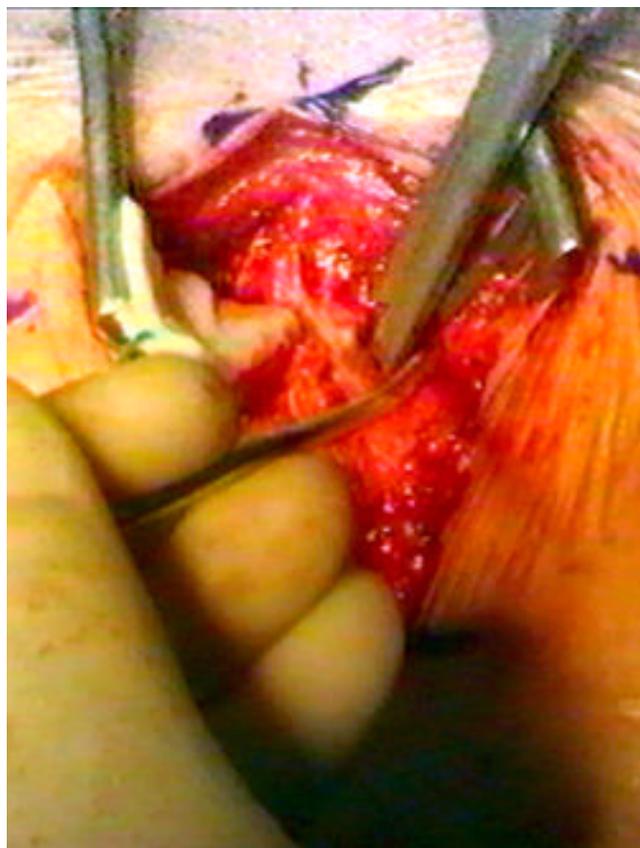
long midline skin incision was performed, 2/3 of which were cranial to the skin mark. Subcutaneous tissue and sacral fascia were opened along the midline in a longitudinal way parallel to the skin incision. The sacral roof was exposed by scraping off the muscles with a raspatorium not exceeding the medial rim of the dorsal sacral foramina (*fig. 1*).

The dorsal face of the os sacrum was perforated on both sides using a Rosen burr (*fig. 2*).



*fig. 2:* Approach to the sacral canal. For details see text.

These primary perforations were enlarged with Kerrison's rongeurs (*fig. 3*) tailored to the electrode fixation shoes (*fig. 4*). The nerve channels were pre-tunneled with a blunt probe the diameter of which was equal to that of the electrodes to be implanted. No removal, coagulation or even dissection of epidural fat was performed ever. After such pre-tunneling, the electrodes could easily be slid into the nerve channels on both sides. The correct position and level of the electrodes was reconfirmed by electrical stimulation through the leads themselves. Similar to tack-up sutures in craniotomies, a small hole was drilled with a spiral burr at the lateral edge of the bone window on each side (*fig. 5*), through which the electrodes were fixed using non-absorbable suture material (*fig. 6*). *Fig. 7* shows the final position of the fixed electrodes.



*fig. 3:* Approach to the sacral canal. For details see text.



*fig. 4:* Approach to the sacral canal. For details see text.



*fig. 5:* Approach to the sacral canal. For details see text.



*fig.6:* Approach to the sacral canal. For details see text.



*fig. 7:* Approach to the sacral canal. For details see text.

Via a subcutaneous tunneling the cables were brought to the patients flank on one side, where a second small incision was made. The wounds then were closed in layers. The generator itself was placed in a subcutaneous pouch on one side of the lower abdominal wall (right for right-handed, left for left-handed patients) in a standard way. For this procedure, the patient had to be turned over onto hers / his back and a new surgical cleansing and draping of the skin had to be performed. *Fig. 8* depicts a lateral, and a anterior-posterior x-ray view of an implanted system.



*fig.8:* antero-posterior and lateral x-ray view of an implanted system.

### C. Implanted system:

For implantation, we used a Medtronic system with Interstim generator model 3023, Interstim quadrupolar electrode model 3886, and extension cords model 7495.

### III. RESULTS

No wound healing problems, and no electrode dislocations occurred so far. One system failed due to disrupted connection cords. It was brought back to function by exchanging these cables, the electrodes, however, could be left in place.

Our average over-all implantation time, i.e. first skin incision until last suture, including turn-over and redraping procedure, was 2 hours 15 minutes (range: 2 to 3 hours). The average stimulation current necessary for therapeutic effect was 1.7 Volts (range: 0.5 to 2.5 Volts).

### IV. DISCUSSION

According to Sauerwein's modification we preferred a bilateral electrode implantation through the sacral canal. Leads and sacral nerves, therefore, could be brought in close contact. Additionally, a summation effect of bilateral sacral root stimulation has been reported<sup>5, 14</sup>, both factors increasing stimulation efficacy. Hohenfellner et al.<sup>5, 14</sup> described a reduced sacral approach as compared to the original complete unroofing of the sacral canal introduced by Sauerwein. They performed a 2 level laminectomy of the os sacrum. But, with our technique, bone removal was tailored according to the shape and dimensions of the electrodes, and, consequently, could be reduced to a minimum. Such less "bone work" and straight forward single-level approach costs less preparation time, resulting in a shorter duration of the implantation procedure. Of course it minimizes also the surgical trauma, the extension of which directly corresponds with postoperative sequelae like infection, pain, and scarification.

Leaving epidural fat untouched also saves preparation time and means lesser operative traumatization. Furthermore, this probably reduces the peridural fibrosis, and, therefore, helps to keep the stimulation currents low for a longer period. This should have a positive effect on the batteries' lifetime.

Limiting the soft-tissue approach to the area between the medial borders of the dorsal sacral foramina on both sides, i.e., not to open the foramina themselves, leaves the dorsal branches of the sacral nerves undisturbed, and further contributes to minimal invasiveness.

Similar to tack-up sutures in large trepanations, the electrodes are fixed towards the bone with non-absorbable threads, resulting in a tight and stable fixation. With this method electrode dislocation rates may be brought to a minimum close to 0 %.

Although, due to the low number of patients, statistical evaluation is not possible yet, there were no negative effects related to the surgical technique we applied. The operation time was at least comparable to conventional procedures if not even shorter. Also, the stimulation currents which were needed for a remedy of the patients symptoms were lower than those other groups reported.

### V. CONCLUSION

Therefore, we finally state that our technique of the tailored sacral approach is a fast, safe, and easy to learn modification of the currently used implantation method for neuromodulators, ensuring excellent electrode fixation combined with a minimal surgical trauma.

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