

Voorham J¹, Voorham - van der Zalm P¹, Putter H², Pelger R¹, Vagenee D³, Lycklama à Nijeholt G¹, De Wachter S³
1. Leiden University Medical Center, Dep. of Urology, Leiden, The Netherlands, 2. Leiden University Medical Center, Dep. of Medical Statistics, Leiden The Netherlands, 3. University Hospital Antwerp, Dep. of Urology, Antwerp, Belgium

NEEDLE PLACEMENT AND POSITION OF ELECTRO STIMULATION INSIDE SACRAL FORAMEN DETERMINES PELVIC FLOOR EMG RESPONSE – IMPLICATIONS FOR SACRAL NEUROMODULATION

Hypothesis / aims of study

Sacral neuromodulation is a well-accepted treatment for overactive bladder, non-obstructive urinary retention and faecal incontinence. A lead is placed through the 3rd or 4rd sacral foramen to stimulation the sacral nerve roots, and position is determined based upon clinical observation of an inward movement of the bellows (e.g. pelvic floor contraction). However for urological indications, intention to treat results varies between 50 and 60% (1). One of the reasons may be inadequate lead location, e.g. not close to the target nerve.

The aims of the study are to determine the pelvic floor (PF) EMG responses upon electro-stimulation at different locations within the same foramen (e.g. S3 or S4); hypothesizing that different locations inside the foramen will lead to different EMG responses.

Study design, materials and methods

After ethical approval, 6 patients considered eligible for sacral neuro modulation were tested during the lead placement procedure. Patients under general anaesthesia without muscle relaxants were positioned prone. Standard PNE needles were used. In 4 patients 4 needles were introduced in the same foramen (S3 in 2 patients; S4 in 2 patients, parallel to the midline, with the needles also parallel to each other. In the other 2 patients, 3 parallel needles were placed (S3 in 2 patients; S4 in 1). X-ray was used to ensure that the needle tip was inside the foramen superposing the bone table. This would be the ideal position to finally release the tined lead. Electrostimulation was delivered on the PNE needle (square wave pulses 210 msec , 5 Hz) at increasing amplitudes (1-2-3-5-7-10V). PF-EMG activity was measured using the Multiple Array Probe (MAPLe) placed intravaginally. The MAPLe is a probe with a matrix of 24 electrodes enabling EMG measurement from different sides and layers of the PF (2). For this study the maximal EMG response was taken from the anterior, posterior, ipsilateral (EMG response at same side as where the foramen needle was) and contralateral side, irrespective of the depth layer of the PF.

Results

In total 147 measurements were made. There was a clear amplitude difference in EMG response at the four measuring sites (repeated measures ANOVA $p < 0.001$) (Table I).

EMG (μ V)	Maximum	Mean	SD
Ipsilateral	1227	314	345
Posterior	674	149	193
Contralateral	466	121	136
Anterior	420	98	102

When stimulation caused an inward movement of the bellows, different EMG activity patterns were measured. Cranially placed needles had higher PF EMG activity than the caudally placed needles, although statistical significance was only reached between cranial lateral and caudal lateral position (Table II). The PF EMG activity within an individual also depended on the position of the needle inside foramen (Figure 1).

EMG (μ V)	Stimulation amplitude (V) – data are mean					
	1	2	3	5	7	10
Cranial Medial	81	208	212	346	396	554
Cranial Lateral	109	411	627	597	702	695
Caudal Medial	146	211	347	389	391	493
Caudal Lateral	16	102	187	291	306	315

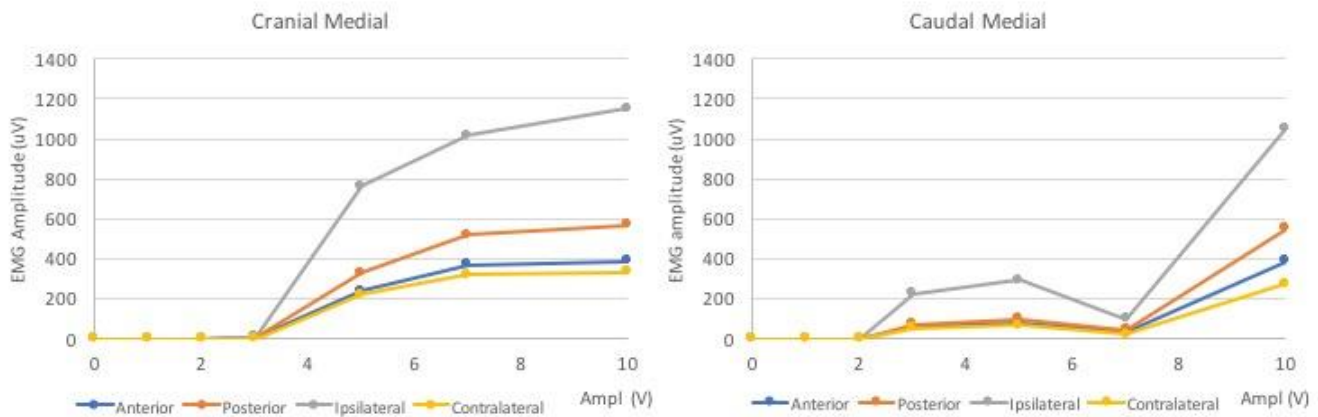


Figure I: PF EMG activity within an individual also depended on the position of the needle inside the foramen.

Remarkably, in 4 stimulations inward contraction posteriorly from the anus was observed without any measurable EMG activity on any of the 24 electrodes. From a clinical point of view, the response at low amplitude (1V and 2V stimulation) is the most important to find the best position for lead placement. With these low voltage stimulation on cranial positioned needles 22% of the stimulations delivered more than 25% of the individual patient's maximal EMG response, compared to 9% in the caudal positions (Chi-square; $P=0.01$).

Interpretation of results

In the majority of cases, clinical observation of bellows contraction coincided with measurable PF EMG. Only in 4 stimulations, the bellows contraction was visible posterior from the anus without any PF EMG. Stimulation on the PNE needle leads to an amplitude dependent PF EMG response. In the majority of positions, highest responses are measured at the ipsilateral side, followed by the posterior, contralateral and anterior side. In some positions this order was different. Highest PF EMG was measured when the needle was in the cranial position compared to the caudal. Furthermore, for clinical practice voltage at or below 2V are advised for lead placement to spare battery life during sacral neuromodulation treatment. Looking at the EMG responses upon low voltage stimulation showed significantly more PF activity when the cranially placed needles were stimulated compared to the caudally placed ones.

Concluding message

Position of the needle inside the foramen determines the pelvic floor muscle activation. A cranial position inside the foramen gives the strongest contraction of the pelvic floor. This should be the position aimed for to release the tined lead for sacral neuromodulation.

References

1. Marcelissen TA, Leong RK, de Bie RA, van Kerrebroeck PE, de Wachter SG. Long-term results of sacral neuromodulation with the tined lead procedure. *J Urol* 2010 Nov;184(5):1997-2000.
2. Voorham-van der Zalm PJ, Voorham JC, van den Bos TW, Ouwkerk TJ, Putter H, Wasser MN, et al. Reliability and differentiation of pelvic floor muscle electromyography measurements in healthy volunteers using a new device: the Multiple Array Probe Leiden (MAPLe). *Neurourol Urodyn* 2013 Apr;32(4):341-8

Disclosures

Funding: NONE **Clinical Trial:** Yes **Registration Number:** Belgium1111 **RCT:** No **Subjects:** HUMAN **Ethics Committee:** Medical Ethical Committee of the University of Antwerp, Belgium **Helsinki:** Yes **Informed Consent:** Yes