

# First UK Experience of Epidural Spinal Cord Stimulation in a Patient with Motor Complete Spinal Cord Injury

Symone Kendall<sup>1</sup>, David Baxter<sup>1,2</sup>, Lynsey Duffell<sup>2,3</sup>, Sarah Knight<sup>2,3</sup>, Erlick Pereira<sup>4</sup>, Manish Desai<sup>2</sup>, Sean Doherty<sup>2,3</sup> and Rhodri Philip<sup>1</sup>  
<sup>1</sup> Defence Medical Rehabilitation Centre, <sup>2</sup>Royal National Orthopaedic Hospital, <sup>3</sup>Medical Physics and Biomedical Engineering UCL, <sup>4</sup> St George's Hospital

## Introduction

Epidural spinal cord stimulation (SCS) after SCI has gained considerable momentum in recent years, due to consistent reports of functional restoration, even after chronic motor-complete and incomplete SCI<sup>1</sup>.

Whilst these studies focused on lower limbs, some participants reported improved autonomic functions, including cardiovascular, bladder, bowel and sexual function<sup>1,2</sup>; functions that are often rated as higher priority for restoration by people living with a SCI<sup>3</sup>.

At present in the UK, epidural stimulation is only approved for the treatment of intractable pain in non-SCI patients.

We present the findings of epidural SCS in a motor complete SCI patient on multiple body systems including volitional control, spasticity and autonomic functions including bladder and bowel.

## Patient details

40-year-old male who acquired a T6 ASIA B SCI in 2016. He is a wheelchair user, uses Peristeen to manage bowels and self catheterizes.

## Method

### Operative details:

A Medtronic Prime Advanced Sure Spinal Cord Stimulator (Medtronic Corp) with a 16 Channel paddle electrode was implanted via a T12-conus laminotomy in October 2020.

### Rehabilitation sessions:

18 weeks of intensive training, spread over a period of 8 months, comprised of:

- Daily independent standing sessions completed using an Oswestry standing frame.
- 3-4 times a week muscle activation work in lying, sitting and standing.
- Locomotor training 3-5 times per week either in the REWALK exoskeleton or the Computer Animated Research Environment (CAREN).

### Outcome measures:

Completed pre-implantation, 3 and 6 months post-implantation:

- Oxford Muscle Grading Scale
- Modified Ashworth Scale (MAS)
- Penn Spasm Score.
- Neurogenic Bowel Dysfunction Score (NBDS)
- The International Index of Erectile Dysfunction (IIED)

## References

1. Harkema, S. *et al.* (2011) Effect of epidural stimulation of the lumbosacral spinal cord on voluntary movement, standing and assisted stepping after motor complete paraplegia: a case study. *Lancet* 377(9781):1938-47
2. Darrow, D. *et al.* (2019) Epidural spinal cord stimulation facilitates immediate restoration of dormant motor and autonomic supraspinal pathways after chronic neurologically complete SCI. *Jnl of Neurotrauma* 36(15):2325-2336
3. Anderson, K. (2004) Targeting recovery: priorities of the spinal cord-injured population. *Journal of neurotrauma* 21(10):1371-83

## Results

**Lower limb function:** Table 1 shows the change in Oxford Muscle scores. The greatest improvements were made in quadriceps and gastrocnemius. By 6 months post op the patient was able to perform knee extension in sitting with SCS switched off.

**Lower limb spasticity:** MAS and Penn Spasm Scores remained unchanged, however, a 50% reduction in Baclofen and 30% reduction of Dantrolene usage occurred.

**Bladder function:** Patient reported a reduction in number of UTI's.

**Bowel function:** NBDS improved from the minor category to the very minor category. Patient reported that the time required for bowel management had decreased by half to only 30 minutes a day.

**Sexual function:** IIED showed an improvement in erectile function, increased intercourse satisfaction, increased orgasmic function and increased overall satisfaction.

	Pre-implantation		Post- implantation	
Muscle group	Right	Left	Right	Left
Gluteals	0	0	1	1
Quads	0	0	3	3
Gastrocnemius	0	0	2	3
Hamstrings	0	0	1	1
Ext hallucis longus	2	0	3	2

Table 1.Oxford Muscle Grading Scores pre and post implantation

**Spasticity:** The reduction in medication has made me more alert in the day

**Bowel:** Instead of it taking an hour to clear my bowel every morning, it has been reduced to around 30 mins

**Sexual function:** To gain an erection before stimulation I would use either an oral tablet or injection into the penis. Since stimulation I can sometimes get and maintain an erection without tablet or injection, however, the tablets are more potent now

## Conclusion

We have observed restoration of lower limb motor control to the extent that the patient was able to perform knee extensions while sitting, even with SCS switched off. We also noted improvements in spasticity, bladder, bowel and sexual function. We believe that SCS may provide gains in function at a multisystem level and be a useful therapy for the complete management of SCI.