

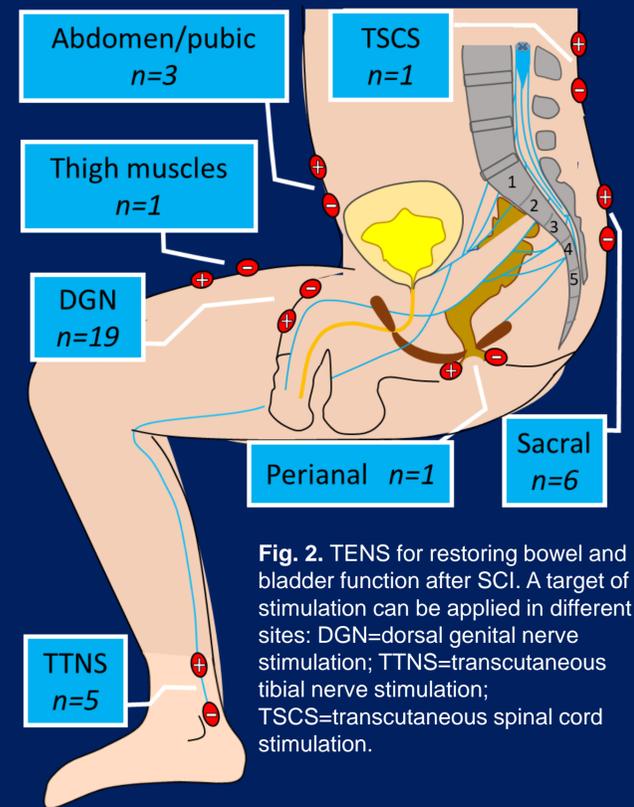
# Transcutaneous electrical nerve stimulation for improving bowel and bladder dysfunction following spinal cord injury: A systematic review and meta-analysis

Sam Paritt<sup>1</sup>, Greg O'Grady<sup>2,3</sup>, Darren Svirskis<sup>4</sup>, Anna Lawrence<sup>5</sup>, Bensy Mathew<sup>5</sup>, Sureshbabu Subramanian<sup>5</sup>, and Simon J. O'Carroll<sup>1</sup>

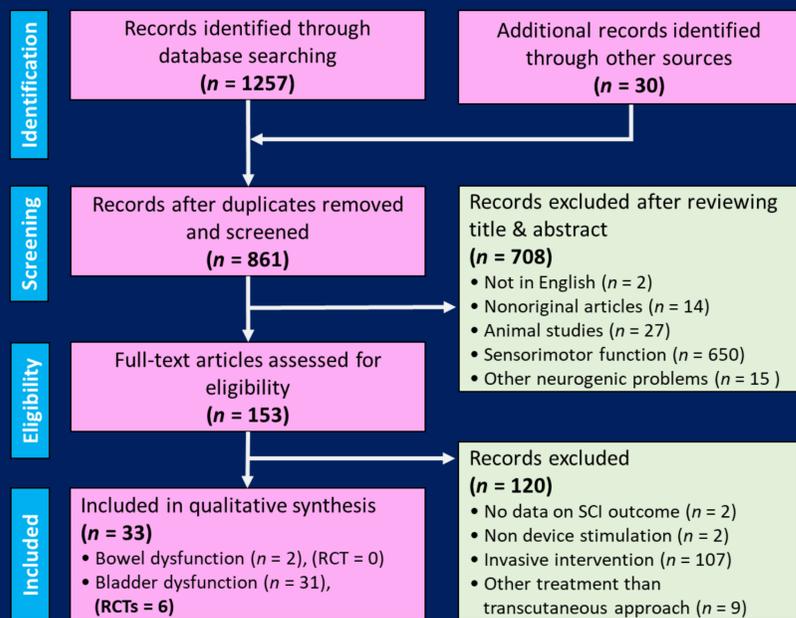
<sup>1</sup>Department of Anatomy and Medical Imaging, the Centre for Brain Research, University of Auckland, New Zealand  
<sup>2</sup>Department of Surgery, Faculty of Medical and Health Sciences, University of Auckland, New Zealand  
<sup>3</sup>Auckland Bioengineering Institute, University of Auckland, New Zealand  
<sup>4</sup>School of Pharmacy, Faculty of Medical and Health Sciences, University of Auckland, New Zealand  
<sup>5</sup>Auckland Spinal Rehabilitation Unit (ASRU), Counties Manukau Health, Auckland, New Zealand

## Background/Aims

Over 1 million people are living with spinal cord injury (SCI) in the world and 3,500 people in New Zealand [1,2]. Due to medical advances, most people living with SCI now have a near-normal life expectancy, and focus has shifted to improving long-term quality of life. Neurogenic bowel and bladder dysfunction after SCI occurs in most cases and has a major impact on quality of life for individuals and their families. Improving urination and defecation function is an outstanding clinical research priority and one of the top priorities that people with SCI wish to achieve [3]. However, the current treatments are often unsatisfactory and new modalities should be explored. Transcutaneous electrical nerve stimulation (TENS) is a practical, inexpensive and non-invasive neuromodulation approach in people with SCI. This study aimed to perform a systematic review and meta-analysis of clinical studies investigating the efficacy and safety of TENS for improving bowel/bladder dysfunction following SCI.



**Fig. 2.** TENS for restoring bowel and bladder function after SCI. A target of stimulation can be applied in different sites: DGN=dorsal genital nerve stimulation; TTNS=transcutaneous tibial nerve stimulation; TSCS=transcutaneous spinal cord stimulation.



**Fig. 1.** Flow diagram of the selection process.

## Methods

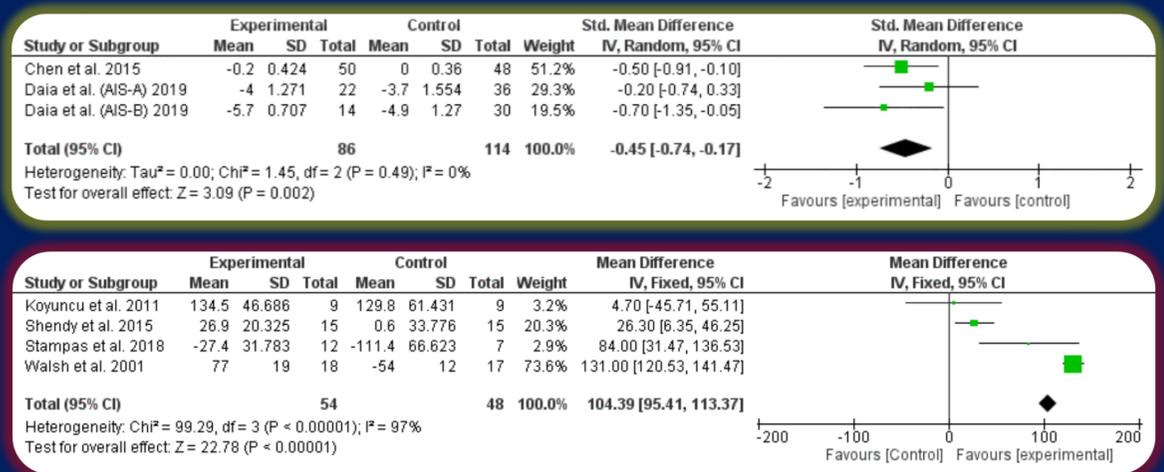
Electronic databases were searched along with the reference lists of retrieved publications. Study selection, data extraction and quality appraisal were performed and meta-analysis was undertaken with RevMan software 5.3.

## Results

A total of 33 studies (Fig. 1) were included in the systematic review, only 6 were randomised controlled trials (RCTs). Most studies (31/33) reported improvements in bowel (2/2) and bladder (29/31) function. Studies applied TENS intervention with different sites of transcutaneous stimulation (Fig. 2) and 19 of them (non-RCTs) reported that dorsal genital nerve (DGN) stimulation was a promising modality in improving bowel/bladder function in SCI patients. Interestingly, 7 of the 19 DGN studies were in agreement on safety and compliance for short-term TENS at home. The meta-analysis (Fig. 3) demonstrated significant effects for reducing the frequency of clean intermittent catheterisation (SMD -0.45, 95%CI -0.74 — -0.17, P=0.002) and increasing maximum cystometric capacity (MD +105mL, 95%CI 95.89 — 114.12, P<0.001). No serious side effects were reported.

## Discussion

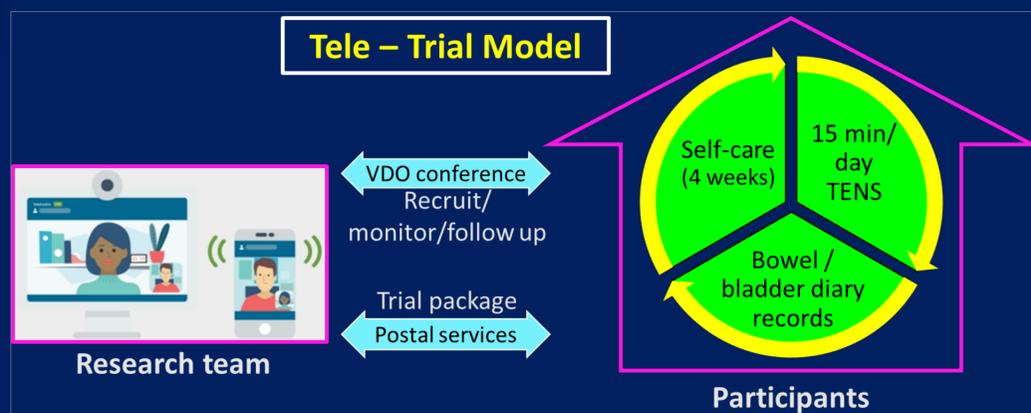
TENS increased anal motor activity, improved rectal emptying at defecation and restored urine storage including voiding function in people with SCI. TENS is advantageous as it may reduce bowel/bladder medication dosage, anticholinergic side effects and the need for invasive surgical treatments to improve bowel/bladder function. Importantly, no significant adverse reactions to TENS were reported by any of the included studies, suggesting that this non-invasive neuromodulation is safe from adverse events.



**Fig. 3.** Meta-analysis and forest plot diagram of the number of clean intermittent catheterisations per 24 h and maximum cystometric capacity in SCI participants with neurogenic bladder in both groups after treatment. Mean values with 95% confidence intervals. Positive values indicate an increase; negative values indicate a decrease.

## Conclusions

TENS is an effective and safe intervention for neurogenic bowel/bladder dysfunction following SCI. Further studies are essential to confirm these results. Thus, a feasibility study and RCT are being designed to establish the clinical trial of this method at the Auckland Spinal Rehabilitation Unit.



## Future study

We have developed a daily home TENS protocol of self-administration (4 weeks) to investigate whether using TENS at home is safe and feasible to be performed in people with chronic SCI. This study could pioneer a non-invasive, cost-effective and convenient solution to treat neurogenic bladder dysfunction, in order to improve health-related quality of life for individuals with SCI and a community benefit for New Zealanders.

## References

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