

Efficacy of Transcutaneous Spinal Cord Stimulation as an Adjunctive Treatment to Activity Based Therapy: A Case Series

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INTRODUCTION:

Technical developments in non-invasive tSCS have led to a new generation of stimulators that offer multi-level, high frequency burst spinal stimulation paradigms that, in restricted case studies, have provided evidence of enhanced voluntary locomotor effort during robotic gait and over ground stepping in individuals with complete paraplegia⁹.

The concurrent delivery of tSCS with activity-based physical therapy, such as manually assisted locomotor therapy, demonstrate improvements in voluntary lower limb motor and autonomic function in motor complete SCI². The success of this combined approach appears to be dependent on spinal networks engaging and maintaining the appropriate state of excitability for the desired task, in the presence of voluntary drive or will power³. In individuals with chronic spinal cord injury, the spinal pathways and circuitry used to volitionally coordinate muscle activity and provide the synergies of purposeful limb movement are isolated. By providing coordinated limb motion through activity-based therapy interventions, anchored in motor control theory, movement related sensory feedback to the spinal cord may re-engage this circuitry.

OBJECTIVE:

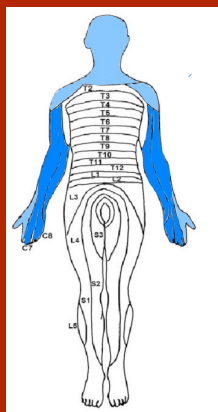
To report the efficacy of transcutaneous spinal cord stimulation used as an adjunctive modality to activity based therapeutic training for three patients with spinal cord injuries

METHODS:

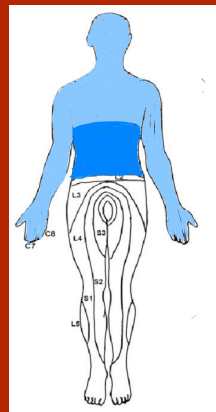
Case Series: Pre and Post test.



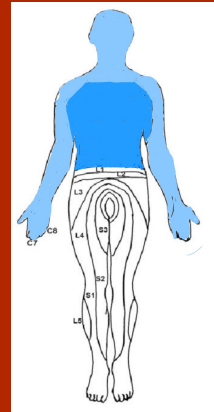
Transcutaneous spinal cord stimulation combined with activity based therapy elicits **POSITIVE** motor, sensory, and autonomic changes, however, Quality of Life remains **static**.



Subject 1
24 yo Male
C6 AIS A > T1 ASIA B
5 Years Post Injury



Subject 2
17 yo Male
T6 AIS A > L1 ASIA C
1.6 Years Post Injury



Subject 3
55 yo Female
T1 AIS A > T12 ASIA B
17 Years Post Injury

Pre Treatment AIS Level

Post Treatment AIS Level

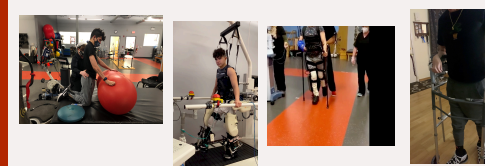
INTERVENTIONS:

Patient specific activity based therapeutic interventions were provided, focusing on proximal stability with progression following developmental sequencing and augmented with transcutaneous spinal cord stimulation two times per week for 26 weeks (52 sessions) for 90 minutes each session.

Activity based training included:

- Trunk control/Core Strengthening
- Scapular and pelvic girdle strengthening
- Upper and LE strengthening
- Developmental sequence transitional movements
- Standing tolerance
- Locomotor Training:
 - Lokomat training
 - TheraStride locomotor training
 - Overground training

Transcutaneous spinal cord stimulation was provided using the Chattanooga Vectra Neo – with a symmetrical biphasic waveform with following parameters :
Pulse width : 400 μ s, frequency of 40Hz, and an amplitude intensity sufficient to elicit a motor response below the level of lesion and within patient tolerance., ranges were consistently between 50 to 80 mA for all subjects.



RESULTS:

Assessment	Pre-Intervention			Post-Intervention		
	Sub. 1	Sub. 2	Sub. 3	Sub. 1	Sub. 2	Sub. 3
a. Motor Level	10	50	50	14	50	50
b. Sensory Level	18	52	32	24	80	76
c. Autonomic Function	5	7	7	6	9	7
MAP during exercise	67 mmHg	79 mmHg	73 mmHg	85 mmHg	93 mmHg	83 mmHg
WISCI	0	0	0	1	6	1
Neuro Recovery Scale						
a. Sit Up	1c	2a	2c	2a	3b	3a
b. Reverse Sit Up	1c	1c	2a	2b	3a	2c
c. Stand Adaptability	1a	1a	1a	1a	2c	1c
Function In Sitting	32/56	37/56	33/56	35/56	40/56	36/56
Quality of Life – SCI Ver. 3	26.5	20.5	24.5	26.5	22.5	24.0

DISCUSSION:

Although measurable sensory, motor and autonomic improvements were obtained, patient specific meaningful changes in the patient's quality of life were not realized. This finding suggests that further investigation is needed to best determine approaches that best address functional recovery with quality of life improvement.

References:

1. Behrman, A.L., E.M. Ardolino, and S.J. Hankema. Activity-Based Therapy From Basic Science to Clinical Application for Recovery After Spinal Cord Injury. *J Neuro Phys Ther*. 2017. 41 Suppl 3 Supplement, IV STEP Special Issue. p. 539-445.
2. Van den Brink, B., et al. Restoring voluntary control of locomotion after paralytic spinal cord injury. *Science*. 2012. 336(6083): p. 1182-5.