Novel Sensory Intervention to Promote Late Motor Recovery in an Individual with Incomplete Spinal Cord Injury: A Case Report

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Figure 1. streognosis activity

IRB Approval
This study was granted approval for participation by human volunteers from the Institutional Review Board of the University of Puget Sound on May 4, 2015; Protocol #1415-097

BACKGROUND

Incomplete cervical spinal cord injury (SCI) is now the most common category of new traumatic SCI in the United States[1]. Most of these individuals are sensory incomplete.[2] If interventions capitalizing on the sensory preservation can be used to facilitate motor recovery, the population of individuals with SCI will benefit.

PURPOSE

Describe the use of progressive stereognosis activities followed by motor level electrical stimulation that promoted meaningful motor recovery in one patient with incomplete SCI.

CASE DESCRIPTION

19 year old female with incomplete Brown Sequard syndrome ASIA D SCI since age 12 with L sensory and R motor impairment.

Presenting function: ambulatory and independent in all ADL and IADL and a full time student at our institution. Since injury she had not had active triceps or wrist extension function on her R. Referral to PT initiated upon noting trace triceps. Residual motor deficits were more involved in her UE than LE. R UE had dystrophic signs and was held in a protective posture of shoulder IR and adduction and forearm pronation. This arm was used for writing with a gross grip but otherwise intentionally neglected. Tactile sensation was intact in the R hand.

INTERVENTION

Participant attended 6 one-hour appointments over 11 weeks at the University of Puget Sound Onsite Student Physical Therapy Clinic. Each session included progressive stereognosis training followed by electrical stimulation to wrist extensor and finger extrinsic muscles. Table 1 details specific stereognosis activities, TENS parameters and motor ability noted in each session.

	2/20/15	2/27/15	3/6/15	4/3/15	4/17/15	4/23/15
Sensory Re-training	Eyes Closed: Large wooden letter identification Wooden ring placement	Eyes Closed: Large wooden letter identification Coin palpation	Eyes Closed: Plastic letter identification Coin palpation and calculation	Eyes Closed: Dominoes palpation Coin palpation and calculation	Eyes Closed: Scrabble tile palpation and ID (single letter and multi-letter)	Eyes Closed: Scrabble tile palpation and ID (single letter)
						
TENS	75 MHz -225 microseconds -5 minutes proximal and distal volar wrist flexors -10 minutes dorsal wrist extensors	75MHz -225 microseconds -15 minutes dorsal wrist extensors -11 cm proximal-medial from ulnar styloid process -17 cm proximal-medial from ulnar styloid process	Same parameters	Same Parameters	Same Parameters	Same Parameters
Motor Ability	-Picks up, palpates and verbally identifies wooden letters -Immediate, strong, visible contraction of wrist extensors	-Palpates wooden letters and spell out 3-letter words -Palpates and identifies whether a coin is a penny, nickel, dime or quarter. Correctly identifies 8/12 coins -Visible contraction of wrist extensors	-Palpates and identifies smaller letters of a different texture than previous sessions -Palpates and calculates amount of currency placed in front of her; correctly calculates 8 different combinations of 3,4 and 5 coins -Visible contraction of R wrist extensors	-Palpates and identifies number of dots on domino using; correctly identifies 12/14 dominoes -Palpates and calculates 5 different combinations of 4 and 5 coins -Visible and palpable contraction of wrist and finger extensors	-Palpates and identifies 5/10 Scrabble letters -Palpates letters and identifies word that is spelled; correctly identifies 1 3-letter word and first 3 letters of a 4-letter word -PT notes apparent activation of R hand intrinsics during fine motor task -PT and participant note significant R thumb opposition with first 5 minutes of TENS	-Palpates and identifies 9/15 letters -Visible R wrist extension; visible and palpable R finger extensor activation with TENS

OUTCOME

At discharge, participant was more comfortable and willing to utilize her R UE. There was visible definition in her R triceps and forearm musculature, as well as a noticeable decrease in the erythema in her R hand. She was able to perform 11 repetitions from full R elbow flexion to extension, holding a ¼ pound weight, with her shoulder flexed to 90 degrees. She achieved anti-gravity R wrist extension and she was able utilize R wrist and finger extensors during therapeutic exercises and sensory-motor activities, and exhibited progressively refined stereognosis ability.

DISCUSSION

Studies have shown that improved function is possible in chronic SCI.[2-4] The participant in this study made significant gains in strength, motor activation and stereognosis ability in a very short time. The speed at which these gains occurred are likely a result of reversing learned non-use and re-activating volitional pathways that had been latent.

CLINICAL RELEVANCE

This case adds to the literature supporting the use of afferent input to facilitate motor recovery after SCI.

Figure 2. Voluntary wrist extension at discharge