CLINICAL EXPERIENCE REPORT:

Enhancing Hand Function Recovery with ARC^{EX}: Carry-over into daily activities



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Summary:

The patient is a 35-year-old male with a chronic, incomplete cervical spinal cord injury (SCI), AIS C, sustained in a construction work accident approximately 3 years and 9 months before starting ARC^{EX} Therapy.

Despite extensive rehabilitation and multiple tendon transfer surgeries, he presented with bilateral upper extremity weakness and impaired hand dexterity, with greater involvement of the right hand, limiting daily activities such as dressing, handwriting, and tying shoelaces.

Over 7 months, he completed 43 one-hour occupational therapy sessions combining ARC^{EX} stimulation with task-specific functional practice to address these impairments and to promote improved upper extremity function. As a result, he now demonstrates increased grip strength, gross motor dexterity, sensation, and fine motor coordination, and reports greater independence in cooking, dressing, tying his shoelaces, and texting.

The patient lives in an independent living facility in Florida. He enjoys cooking, bowling, spending time at the beach, working in his workshop, attending church, and talking with his family.

Initial Presentation:

Demographics & Injury Profile

- *35-year-old male*
- *Level of injury: C4-C6*
- *AIS classification: AIS C*
- *Time since injury: 3 years and 9 months*

Overall Clinical Impression

The patient sustained an incomplete cervical spinal cord injury in June 2022 when an object fell from a crane and struck his head, resulting in C4-C6 fractures, hemorrhagic cord contusion, and incomplete tetraplegia. Following a complicated acute hospitalization, which included multiple tendon transfer surgeries, the patient participated in intensive rehabilitation before transitioning to a transitional living facility.

At baseline, he demonstrated bilateral upper extremity weakness and impaired hand dexterity, with greater deficits in right upper extremity gross motor dexterity and fine motor coordination. Cognitive screening was within normal limits, with a Brief Interview for Mental Status (BIMS) score of 15/15.

Initial Functional Status & Assistance Needs

- ***Home environment:*** *Resides in an independent living apartment.*
- ***Mobility:*** *Modified independent with functional mobility, using a rollator within his apartment and a power wheelchair in the community.*

- ***Functional limitations:*** *Persistent upper extremity impairments affected dressing, toileting, meal preparation, handwriting, driving, and tying shoelaces.*
- ***Handwriting:*** *Baseline sample (see Image 2 below) showed decreased penmanship control, inconsistent letter formation, and reduced overall legibility.*

Motor Performance Initial Evaluation

- ***Manual Muscle Testing (MMT):*** *approximately 3+/5 bilaterally, with full active range of motion against gravity and minimal resistance*
- ***Grip strength:*** *2 lb (right), 5 lb (left)*
- ***Box and Blocks Test:*** *18 blocks (right), 39 blocks (left), indicating reduced gross manual dexterity bilaterally*
- ***Nine-Hole Peg Test:*** *3 pegs placed in 139 seconds (right); test completed in 63 seconds (left), indicating impaired fine motor dexterity bilaterally*
- ***Compensatory pinch patterns:*** *lateral pinch (right) and tip-to-tip pinch (left), consistent with reduced intrinsic hand strength*

Sensation Initial evaluation

- ***Light touch:*** *impaired in digits 4-5 of the right hand (assessed by lightly brushing the skin with a cotton ball while vision was occluded)*
- ***Deep pressure:*** *impaired in digits 4-5 of the right hand (assessed by applying pressure with a pen sufficient to slightly indent the skin without eliciting pain while vision was occluded)*
- ***Other sensation:*** *within functional limits*

Goals:

The patient and Occupational Therapist collaboratively established the following goals:

Overall Goal: Improve Independence in Daily Activities

1	*Dressing and tying shoelaces*
2	*Writing*
3	*Grasping and manipulating objects*

Supporting Goals: Improve the skills needed for these activities

1	*Bilateral upper extremity strength*
2	*Gross and fine motor dexterity*
3	*Hand function, including grasp and release*

Treatment:

ARC^{EX} Therapy was integrated into a skilled occupational therapy (OT) plan of care. Over 7 months, the patient completed 43 one-hour skilled OT sessions, scheduled three times per week and each incorporating approximately 50 minutes of continuous ARC^{EX} stimulation.

Treatment was delivered in two blocks (see Image 1 below): a first block of 11 weeks and 6 days (29 visits), followed by a second one of 5 weeks (14 visits) that is still ongoing. The two were separated by an 11-week break while additional visits awaited insurance authorization.

43 one-hour OT sessions, ARC^{EX} + task-specific training

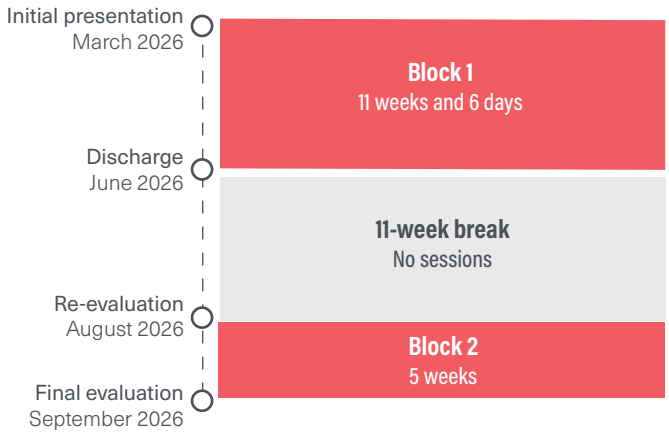


Image 1: Treatment timeline, showing the two ARC-EX treatment blocks, the 11-week break, and the four evaluation points.

ARC^{EX} Parameters Used:

- ***Electrode placement:***
  - *Active electrodes: C4 and C7*
  - *Return electrodes: Right and left ASIS*
- ***Waveform:*** *Biphasic*
- ***Frequency:*** *30 Hz*
- ***Carrier frequency:*** *10 kHz*
- ***Pulse width:*** *1 ms*
- ***Amplitude range:*** *20-85 mA*

Therapeutic Interventions:

ARC^{EX} stimulation was paired with repetitive, task-specific activities to promote neuromuscular activation and improve bilateral upper extremity strength, dexterity, and coordination. Practice emphasized right-hand use in writing, handling objects, dressing, and tying shoelaces, with progression based on performance and goals.

Sessions typically began with fine motor coordination activities, followed by gross motor dexterity and strengthening exercises. This sequence was selected to prioritize hand dexterity and task-specific practice early in the session, when the patient was likely to have greater capacity for activities requiring sustained precision and motor control, followed by activities emphasizing larger amplitude movement and strengthening.

Activities incorporated varied grasp patterns, including cylindrical, lateral pinch, 3-jaw chuck, and tip-to-tip pinch, and were progressed through changes in resistance, object size, task complexity, and assistance to promote functional carryover to Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).

Fine Motor Coordination and Dexterity Exercises:

- *Card sorting and dealing*
- *Pegboard and bead manipulation*
- *Handwriting*
- *Fasteners*
- *Personal projects ("Sticker by Number and diamond art") using both upper extremities, incorporating bilateral upper extremity use, dexterity, and fine motor control*

Strengthening Exercises:

- *TheraPutty and resistive clothespin exercises*

Functional Task Practice:

- *Simulated self-feeding and cooking*
- *Functional reaching and object manipulation*

Outcomes:

Across 43 one-hour skilled OT sessions incorporating ARC^{EX} and task-specific training, delivered in two blocks separated by an 11-week break, the patient showed improvements in bilateral upper extremity strength and gross manual dexterity compared with initial presentation. Outcomes at four evaluation points are shown below *(Table 1)*:

OUTCOME MEASURE	INITIAL PRESENTATION (March 2026)	DISCHARGE (June 2026)	RE-EVALUATION (August 2026)	FINAL EVALUATION (Sept 2026)
Grip Strength (Right)	*2 lb*	*7 lb*	*4 lb*	*6 lb*
Grip Strength (Left)	*5 lb*	*17 lb*	*10 lb*	*24 lb*
MMT (Right UE)	*3+/5*	*3+/5*	*4-/5 (grossly)*	*4-/5*
MMT (Left UE)	*3+/5*	*3+/5*	*4+/5 (grossly)*	*4+/5*
Box and Blocks (Left)	*39 blocks*	*49 blocks*	*41 blocks*	*45 blocks*
Box and Blocks (Right)	*18 blocks*	*32 blocks*	*29 blocks*	*32 blocks*

OUTCOME MEASURE	INITIAL PRESENTATION (March 2026)	DISCHARGE (June 2026)	RE-EVALUATION (August 2026)	FINAL EVALUATION (Sept 2026)
9-Hole Peg Test (Right)	*3 pegs in 139 sec*	*9 pegs in 142 sec*	*9 pegs in 244 sec*	*9 pegs in 240 sec*
9-Hole Peg Test (Left)	*9 pegs in 63 sec*	*9 pegs in 40.60 sec*	*9 pegs in 53 sec*	*9 pegs in 41 sec*
Sensation (light touch / deep pressure)	*Impaired in right digits 4-5; remaining digits within functional limits*	*Intact*	*Intact*	*Intact bilaterally*

Table 1: Change in outcome measures across four evaluation points.

By discharge from the first treatment block, the patient had improved in most measures. During the 11-week pause, some tests decreased (grip strength, Box and Blocks and 9-Hole Peg Test performance), while others were maintained or improved (Manual Muscle Testing, sensation). Importantly, even at re-evaluation, no measure had fallen back to its level at initial presentation. After the 11-week treatment break, most measures had improved again by the final evaluation, with left grip strength surpassing its discharge level. Some measures, such as right-hand 9-Hole Peg Test time, had not yet returned to end-of-first-block levels, as the second treatment block lasted only 5 weeks after the 11-week pause. All measures nevertheless remained better than at initial presentation, and the patient is continuing therapy.

Additionally, at functional observation during skilled OT an increased functional use of bilateral upper extremities and decreased need for assistance during daily activities was noticed.

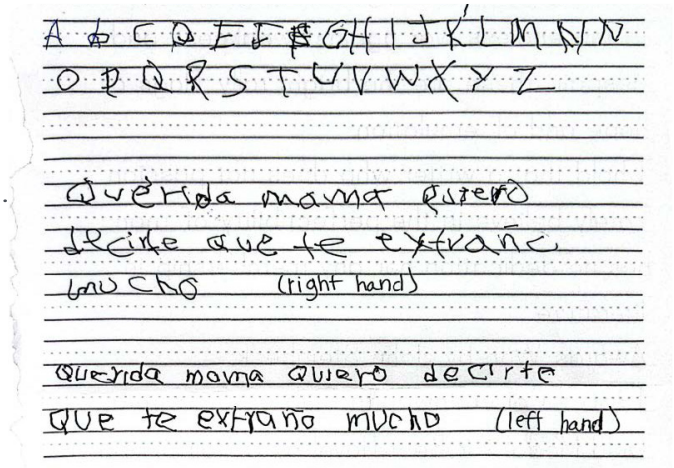
The patient himself also reported increased independence and ability in the following activities:

- Cutting food and cooking
- Tying his shoelaces
- Putting on his socks
- Dressing
- Texting on his phone
- Grasping and manipulating objects with his right hand
- Writing with his right hand (see *Image 2* below)

These gains reflect carryover of improved upper extremity function from skilled occupational therapy activities into meaningful ADLs and IADLs and increased independence in his daily routine.

Handwriting description: compared with the initial sample (March 2026), the follow-up sample (October 2026) showed improved motor control, more consistent letter formation, and increased overall legibility.

INITIAL (March 2026):



FINAL (October 2026):

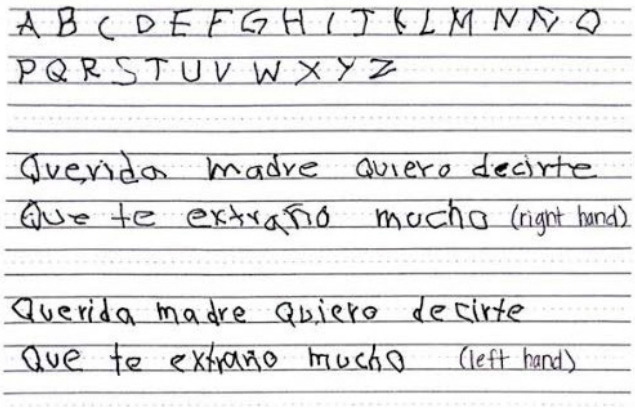


Image 2: Original handwriting samples obtained during occupational therapy sessions and reproduced with the patient's written consent.

Conclusion:

This case demonstrated that integrating ARC^{EX} stimulation with skilled, task-specific occupational therapy was feasible in an individual with chronic incomplete cervical SCI and was associated with improvements in bilateral upper extremity strength, gross manual dexterity, and functional hand use. The patient also reported meaningful carryover into daily activities, including cooking, dressing, tying shoelaces, texting, and handwriting.

Gains made during therapy were partly lost during the 11-week break, though never down to the initial level, and were regained once therapy resumed. This pattern highlights the importance of continuing therapy.

Pairing ARC^{EX} stimulation with repetitive practice of functional hand and upper extremity activities allowed treatment to target skills directly related to the patient's daily needs. Similar patients may benefit from incorporating stimulation while practicing meaningful tasks such as grasping and manipulating objects, handwriting, dressing, self-feeding, and cooking, with grasp patterns, resistance, object size, task complexity, and level of assistance progressed according to individual performance and goals.

A key clinical consideration was the importance of adapting activities to the patient's changing motor performance and functional goals. The case also highlights the value of combining ARC^{EX} stimulation with skilled occupational therapy rather than using stimulation in isolation, allowing stimulation to be paired with purposeful, repetitive motor practice.

Testimonial:

> *I have noticed big improvements in my hand function over time. I can now put on my socks and tie my shoes independently. I'm very happy I decided to use this technology*

About us:

Neubility Rehabilitation & Wellness is a neuro-specialized outpatient rehabilitation clinic located in Pinellas Park, Florida, dedicated to helping individuals with neurological conditions maximize independence, function, and quality of life. The clinic provides individualized, one-on-one rehabilitation with a focus on evidence-based, patient-centered care and innovative treatment approaches.

Neubility offers specialized Physical Therapy, Occupational Therapy, and Speech Therapy services for individuals with conditions including spinal cord injury, stroke, traumatic brain injury, Parkinson's disease, multiple sclerosis, peripheral neuropathy, vestibular disorders, and other neurological conditions. Services address mobility, balance, strength, upper extremity and hand function, activities of daily living, cognition, communication, swallowing, and participation in meaningful daily activities.

The clinic incorporates advanced rehabilitation technologies and specialized programs, including ONWARD ARC^{EX}, functional electrical stimulation, vestibular rehabilitation, and Parkinson-specific programming. Treatment is individualized to each patient's goals and emphasizes intensive, task-specific practice to promote functional carryover into everyday activities.

Clinic website: https://neubilityrehab.com/

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