DE NOVO CLASSIFICATION REQUEST FOR ARC^{EX} SYSTEM

REGULATORY INFORMATION

FDA identifies this generic type of device as:

> **Transcutaneous electrical spine stimulator to improve skeletal muscle strength and sensation**. A transcutaneous electrical spine stimulator to improve skeletal muscle strength and sensation is a device that can be programmed to apply an electrical current via electrodes on a patient's skin over the spine to improve muscle strength and sensation after neurological deficit.
>
> **NEW REGULATION NUMBER:** 21 CFR 890.5851
>
> **CLASSIFICATION:** Class II
>
> **PRODUCT CODE:** SDO

BACKGROUND

> **DEVICE NAME:** ARC^{EX} System
>
> **SUBMISSION NUMBER:** DEN240014
>
> **DATE DE NOVO RECEIVED:** March 28, 2024
>
> **SPONSOR INFORMATION:**
>
> Onward Medical Inc.
> 50 Milk Street
> Boston, Massachusetts 02109

INDICATIONS FOR USE

The ARC^{EX} System is indicated as follows:

> The ARC^{EX} System is intended to deliver programmed, transcutaneous electrical spinal cord stimulation in conjunction with functional task practice in the clinic to improve hand sensation and strength in individuals between 18 and 75 years old that present with a chronic, non-progressive neurological deficit resulting from an incomplete spinal cord injury (C2-C8 inclusive).

LIMITATIONS

The sale, distribution, and use of the ARC^{EX} System are restricted to prescription use in accordance with 21 CFR 801.109.

In FDA's evaluation of the benefits of the ARC^{EX} device, the following observations were noted:

- Probable benefits of the ARC^{EX} therapy were observed only in conjunction with intensive outpatient rehabilitation.
- Due to the nature of the single-arm, within-subject control, open-label study design, it is unclear which improvements in outcome measures were the result of device use or ongoing intensive rehabilitation effects. (Refer to Summary of Clinical Information for more details)
- There are no demonstrated functional benefits associated with the device. This includes no demonstration of neurological recovery as defined by change in neurological level of injury as per America Spinal Injury Association (ASIA) exam, or ASIA Impairment Scale (AIS) grade.
- Durability testing of benefits has not been completed; persistence of benefits beyond adjunctive device use with rehabilitation are currently unknown.

Contraindications

- The ARC^{EX} System is contraindicated for patients with active implantable devices or wearable defibrillators.

Warnings and Precautions

- The long-term effects of chronic electrical stimulation are unknown.
- Operation in close proximity (e.g. 1 m) to shortwave or microwave therapy medical electrical equipment may produce instability in the Stimulator output.
- Safety of use during pregnancy has not been established.
- Caution should be used for patients with suspected or diagnosed heart problems.
- Caution should be used for patients with suspected or diagnosed epilepsy.

Risks:

- Autonomic dysreflexia may be triggered by electrical stimulation. The chances of experiencing autonomic dysreflexia can be reduced by following these precautions:
- Ensure patient has emptied their bladder and bowels before starting a session with the ARC^{EX} System.
- Do not use ARC^{EX} System if there is an ongoing bladder infection or fever.
- Electrical stimulation may lead to musculoskeletal spasms, stiffness, and pain. If this occurs, consider adapting the stimulation parameters (e.g. reduce amplitude) or if symptoms persist, pause the therapy session. For more details on how to adjust stimulation parameters, refer to Labeling (Instructions for Use).
- Electrical stimulation may lead to skin irritation, sweating and redness. If this occurs, move the electrode(s) to a new location.
- Electrical stimulation may lead to a temporary increase in heart rate. If this persists, adapt the stimulation parameters (e.g. reduce amplitude) or if symptoms persist, pause the

therapy session. For more details on how to adjust stimulation parameters, refer to Labeling (Instructions for Use).
- It is normal for electrical stimulation to cause some discomfort, paresthesia, or neuralgia. This sensation may become familiar as the patient uses the ARC^{EX} System.

PLEASE REFER TO THE LABELING FOR A COMPLETE LIST OF WARNINGS, PRECAUTIONS AND CONTRAINDICATIONS.

DEVICE DESCRIPTION

The ARC^{EX} System is a medical device that delivers transcutaneous programmed, Carrier Frequency-enabled electrical spinal cord stimulation (ARC^{EX} Therapy). The System is intended to be used in conjunction with functional task practice in the clinic to improve hand sensation and strength in individuals with cervical spinal cord injury (SCI).

The stimulation is intended to be delivered transcutaneously and the active electrodes are intended to be placed in direct contact with intact skin, in appropriate locations along or near the spine to elicit desired outcomes. The ARC^{EX} System is intended to be used in a medical center setting by patients and their rehabilitation professionals.

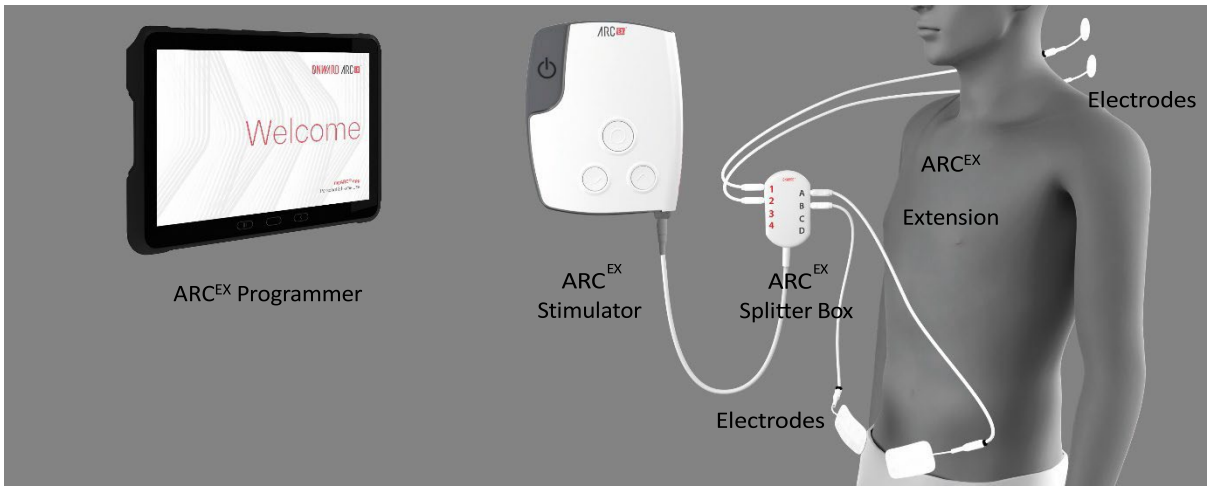


Figure 1: Schematic representation of ARC^{EX} System

The primary components of the ARC^{EX} System are:

- ARC^{EX} Stimulator
  The Stimulator is an internally powered device equipped with a rechargeable battery. It generates and delivers electrical stimulation to the Electrodes based on commands received from the ARC^{EX} Programmer.

- ARC^{EX} Stimulator Charger
  The Stimulator Charger is a wired charger used to recharge the Stimulator battery.

- ARC^{EX} Splitter Box
  The Splitter Box is used to connect and transmit current from the Stimulator to the Electrodes (via the Extension Cables).

- ARC^{EX} Extension Cables
  The Extension Cables are used to connect the Splitter Box to the Electrodes. Two different Extension cable lengths are provided:
  short Extension Cables (50 cm/19.7 inches long)
  long Extension Cables (100 cm/39.4 inches long)

- ARC^{EX} Programmer
  The Programmer is an off-the-shelf tablet with the ARC^{EX} PRO app pre-installed and can be used by the Rehabilitation Professional, to exchange data with the Stimulator.

- Programmer Charger
  The Programmer Charger (Tablet Charger) is used to recharge the Tablet battery.

- ARC^{EX} Case
  The Case is intended for transportation and storage, in between use, of the ARC^{EX} System.

The ARC^{EX} System is intended to be used with the FDA-cleared Axelgaard PALS electrodes (K132422).

Stimulation Parameters:
Electrical stimulation parameters generated by the ARC^{EX} System are summarized in the table below:

Table 1: Stimulation Parameters

Parameter	Values
Waveform	Monophasic or Biphasic
Monophasic Stimulation Pulse Amplitude range	0 mA – 100 mA For load impedance range from 150 Ohms to 500 Ohms
Monophasic Balance Pulse Amplitude range	0 mA – 12.5 mA Note: the amplitude is configured automatically for charge balancing.
Biphasic Stimulation Pulse Amplitude range	0 mA – 250 mA For load impedance range from 150 Ohms to 500 Ohms

Intra-burst Pulse Repetition Frequency	10000 Hz or 20000 Hz
Intra-burst Pulse Width	50 us or 100 us
Carrier Frequency	5000 Hz or 10000 Hz
Frequency	0.2 Hz – 100 Hz
Pulse (Burst) Width	0.1 ms – 5 ms
Ramp-up Duration	2 s – 60 s
Program Duration	1 min – 180 min

SUMMARY OF NONCLINICAL/BENCH STUDIES

BIOCOMPATIBILITY/MATERIALS

The patient contacting materials are:

Table 15: Patient contacting part - description and duration

Part	Description of contact	Cumulative duration
Electrodes	Direct contact with **intact skin** for the duration of therapy (1 hour per session)	Long term contact
Extension Cable	Direct contact with **intact skin** for the duration of therapy (1 hour per session)	Long term contact
Splitter Box clip	Clipped to patients' clothes (clothes, pocket, collar, etc.), can be in direct contact with **intact skin** if clipped on collar	Prolonged contact

Overall biocompatibility evaluation:

Parts are in direct contact with intact skin only.
All the materials in Table 15: Patient contacting part - description and duration and mentioned in section 17.2.2 are listed in Section B in the Attachment G of the FDA Guidance on the use of ISO 10993, and are known to have a documented history of safe use.

- None of the exclusion criteria listed in Section C of Annex G apply.

In the framework of a least burdensome approach, no further testing was deemed necessary per ISO 10993-1, and the ARC^{EX} System was determined to not raise a significant biological risk.

Electrodes:

Description: In normal use of the ARC^{EX} System, the primary patient contacting components are the Electrodes, affixed to the patient's intact skin. The ARC^{EX} System is labeled for use only with compatible Electrodes:

- Round active Electrodes

- Rectangular return Electrodes

Both Electrode types are manufactured by Axelgaard and have been previously cleared by FDA (K132422) for the same nature of body contact and contact duration.
Biocompatibility evaluation: These Electrodes have demonstrated biocompatibility based on evaluations per ISO 10993-1 "Biological evaluation of medical devices – Part 1: Evaluation and testing within a risk management process." Their use with the ARC^{EX} System does not impact biocompatibility and no new assessment of these cleared devices are required.

Extension cable:

- Description: Extension Cables are connected to the Electrodes (active and return), and the Splitter Box. Up to 8 Extensions Cables can be used in a therapy session, depending on the number of Electrodes set by the Rehabilitation professional. Sections of the cable and the cable plugs connected to the Electrodes are in direct contact with patient skin, for the duration of the therapy. The Extension Cable body is silicone based, and extension cable plugs are made of polyamide.
- Biocompatibility evaluation:

  Biocompatibility testing of the Extension Cables, including cytotoxicity, sensitization, and irritation was provided. The testing followed the appropriate standards, and the results support the Extension Cables are non-cytotoxic, non-sensitizing, and non-irritating.
  This testing was viewed as supplementary information since adequate information per Attachment G for the Extension Cables was provided.

(1) Toxicology risk assessment of color additives: Color additive information was provided. The color additives in the extension cable and plug were titanium dioxide and carbon black. The color additive information for the Extension Cable (body and white housing of plugs) and the toxicological risk assessment of the color additives was provided and found to be acceptable.

Splitter Box:

- Description: Splitter Box is connected directly to the Stimulator and to the Extension Cables. It is intended to be clipped to the patient's clothes by means of the Splitter Box Clip (indicated by an arrow on Figure 5), including a clipping to the collar. Splitter Box Clip is coated with Polyurethane (Cardinal Polyurethane Coating 6700-BK21129) on a Polycarbonate enclosure.
- Biocompatibility evaluation:

  Additionally, the sponsor submitted biocompatibility testing of the Splitter Box Clip, including cytotoxicity, and irritation, followed the appropriate standards, and the results support the Splitter Box Clip is non-cytotoxic and non-irritating. We note that it is unclear if the test article is representative of the final device, and there was no sensitization testing;

however, this testing was viewed as supplementary information since there was adequate information per Attachment G for the Splitter Box Clip.

Toxicology risk assessment of color additives: Color additive information was provided. The color additives in the splitter box were titanium dioxide, carbon black, yellow iron oxide and red iron oxide. The color additive information for the Splitter Box Clip and the toxicological risk assessment of the color additives was provided and found to be acceptable.

SHELF LIFE/STERILITY

Sterility:

The ARC^{EX} system is non-sterile. It is meant for multiple uses with different patients when used in the hospital environment. The Off-The-Shelf (OTS) electrodes are non-sterile and are intended for multiple uses for a single patient. They are intended to be replaced when their adhesive no longer fully adheres to the skin.

Shelf-Life:

The ARC^{EX} system does not have a shelf-life. The device is non-invasive, externally used, and comprised entirely of electronic components and medical grade plastics. The composition of the device, including the rechargeable battery, does not predispose it towards deterioration and diminution of its safety and effectiveness when stored under conditions specified in device labeling. As such the device is not adversely affected by aging and has no shelf-life specifications. The expiry date of the Electrodes (previously cleared under K132422) is 3 years and is specified on the Electrode's packaging. The Electrodes are replaceable and information on how to obtain new electrodes is included in the user manual.

ELECTROMAGNETIC CAPABILITY & ELECTROMAGNETIC SAFETY

Testing was performed to conform to the following FDA recognized standards:

Electromagnetic compatibility (EMC):

- IEC 60601-1-2:2014/A1:2020 Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance – Collateral Standard: Electromagnetic disturbances - Requirements and tests
- IEC/TR 60601-4-2 Edition 1.0 2016-05 Medical electrical equipment - Part 4- 2: Guidance and interpretation - Electromagnetic immunity: performance of medical electrical equipment and medical electrical systems
- ANSI AAMI HA60601-1-11:2015+AMD1:2021 Medical Electrical Equipment -- Part 1-11: General requirements for basic safety and essential performance -- Collateral Standard: Requirements for medical electrical equipment and medical electrical equipment and medical electrical systems used in the home healthcare environment

Electrical, thermal, and mechanical safety:

- ANSI/AAMI ES60601-1:2005/A2:2021Medical electrical equipment — General requirements for basic safety and essential performance
- ANSI AAMI HA60601-1-11:2015+AMD1:2021 Medical Electrical Equipment -- Part 1-11: General requirements for basic safety and essential performance -- Collateral Standard: Requirements for medical electrical equipment and medical electrical equipment and medical electrical systems used in the home healthcare environment
- IEC 60601-2-10 2016 - Ed. 2.1 Medical electrical equipment - Part 2-10: Particular requirements for the basic safety and essential performance of nerve and muscle stimulator

Battery safety:

- IEC 62133-2:2017 - Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary lithium cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems
- UN38.3.5 - United Nations Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria PARTIII, section 38.3 (ST/SG/AC.10/11/Rev.6/Amend.1).
- EN IEC 55035:2017/A111:2020 - Electromagnetic compatibility of multimedia equipment - Immunity requirements

MAGNETIC RESONANCE (MR) COMPATIBILITY

The ARC^{EX} device is not an implant and is not intended to be used with the MR environment (Computed Tomography (CT) system, operating room table, etc.) and therefore MR compatibility was not evaluated and not needed.

SOFTWARE & CYBERSECURITY

The device software and cybersecurity documentation was provided according to FDA Guidance document, "Content of Premarket Submissions for Device Software Functions," issued June, 2023. The software level of documentation was determined to be Enhanced. Complete verification and validation of all components of the device, including software, hardware, firmware, cybersecurity, wireless compatibility and coexistence were provided.

PERFORMANCE TESTING - BENCH

Testing was performed to conform to the following FDA recognized standards:

- IEC 60601-2-10 2016 – Ed. 2.1 Medical electrical equipment – Part 2-10: Particular requirements for the basic safety and essential performance of nerve and muscle stimulator

SUMMARY OF CLINICAL INFORMATION

One clinical investigation was performed to evaluate the safety and effectiveness of the ARC^{EX} system. The results are published in Moritz et al. 2024 (Moritz, C., Field-Fote, E.C., Tefertiller, C. et al. Non-invasive spinal cord electrical stimulation for arm and hand function in chronic tetraplegia: a safety and efficacy trial. Nat Med 30, 1276–1283 (2024). https://doi.org/10.1038/s41591-024-02940-9).

The study was a prospective, non-randomized, within-subject controlled trial performed at fourteen (14) investigational sites, five (5) of which were located outside of the United States, in Canada, the Netherlands, and Scotland. The study enrolled adults (at least 22 years of age) who had experienced a C2-C8 incomplete spinal cord injury (SCI) at least 12 months prior and had upper limb weakness and not paralysis as evidenced by screening assessments.

The goal of the study was to assess whether adjunctive use of the transcutaneous spinal cord stimulator (ARC^{EX} system) would improve upper limb strength and sensation when used adjunctively with intensive outpatient rehabilitation in individuals with chronic incomplete cervical SCI. Sixty-five participants were enrolled and ultimately 60 completed the study. The study was carried out in two phases. In Phase 1, each participant completed 2 months of intensive outpatient rehabilitation, consisting of 60-minute sessions with 12-20 sessions a month. They completed functional assessments at baseline, after the first month, and after the second month. They also completed the standard Box and Blocks test at each rehabilitation session. Those who completed the study completed at least 24 sessions over the rehabilitation-only phase, with a mean of 25 sessions. Participants then went onto Phase 2, during which they completed another 2 months of the same intensive outpatient rehabilitation schedule with the addition of transcutaneous spinal cord stimulation via the ARC^{EX} system. Monthly assessments during Phase 2 were completed with stimulation turned off. Those who completed the study completed at least 24 sessions over the rehabilitation-only phase, with a mean of 25 sessions.

All study participants underwent the same monthly assessments. These consisted of:

The International Standards for Neurological Classification of Spinal Cord Injury - Upper Extremity Motor Score (ISNCSCI-UEMS) to assess change in upper limb strength

- The Graded Redefined Assessment of Strength, Sensibility, and Prehension (GRASSP)-Strength, Prehension Performance, and Sensibility subscales to assess change in upper limb strength, function, and sensation
- Pinch and grasp forces to assess change in pinch and grasp strength
- Capabilities of Upper Extremity Test (CUE-T) to assess change in upper limb function
- The International Standards for Neurological Classification of Spinal Cord Injury - Upper Extremity Sensory Score (ISNCSCI-UESS) to assess change in upper limb sensation

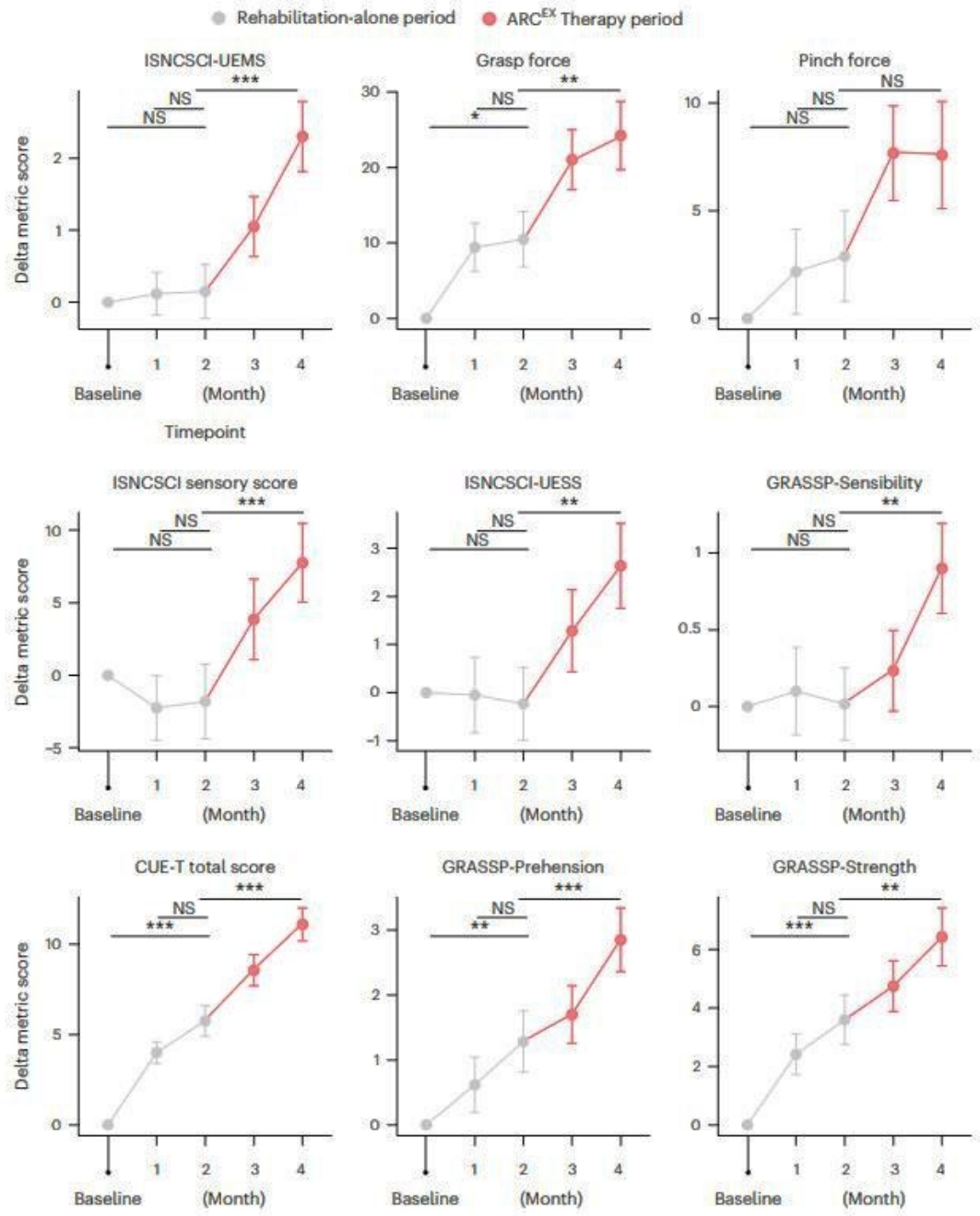
From baseline to 2 months (end of rehabilitation-only phase), participants (N=60) demonstrated a mean improvement in the measures as follows:

Measure	Mean	Standard Deviation	90% Confidence Interval	P-value
ISNCSCI-UEMS	0.2	2.9	-0.5, 0.8	0.292
GRASSP—Strength	3.6	6.6	2.2, 5.1	<0.001
GRASSP—Prehension Performance	1.3	3.7	0.5, 2.1	0.004
Pinch force	2.6	16.7	-1.16, 6.32	0.35
Grasp force	10.5	28.3	4.4, 16.6	0.003
CUE-T	5.8	6.5	4.3, 7.2	<0.001
ISNCSCI-UESS	-0.2	5.9	-1.5, 1.0	0.620
GRASSP—Sensibility	0.0	1.8	-0.4, 0.4	0.313

During the device use phase, in conjunction with ongoing rehabilitation (from Month 2 to Month 4), participants (N=60) demonstrated a mean improvement in the measures as follows:

Measure	Mean	Standard Deviation	90% Confidence Interval	P-value
ISNCSCI-UEMS	2.2	3.2	1.5, 2.8	<0.001
GRASSP—Strength	2.8	5.4	1.6, 3.9	<0.001
GRASSP—Prehension Performance	1.6	2.9	0.9, 2.2	<0.001
Pinch force	4.8	16.1	1.3, 8.4	0.002
Grasp force	13.7	27.4	7.8, 19.6	<0.001
CUE-T	5.3	5.3	4.2, 6.5	<0.001
ISNCSCI-UESS	2.9	4.8	1.8, 3.9	<0.001
GRASSP—Sensibility	0.9	2.4	0.4, 1.4	0.003

The following graph was published in Moritz, C., Field-Fote, E.C., Tefertiller, C. et al. Non-invasive spinal cord electrical stimulation for arm and hand function in chronic tetraplegia: a safety and efficacy trial. Nat Med 30, 1276–1283 (2024). https://doi.org/10.1038/s41591-024-02940-9.



This graph summarizes changes in the various outcome measures in the rehabilitation-only and ARC^{EX} therapy phases of the clinical trial. Due to the nature of the single-arm, open-label study design, in several outcome measures it is difficult to differentiate the effects of ongoing rehabilitation from that of the ARC^{EX} System. This uncertainty is highlighted in the two functional measures (CUE-T total score and GRASSP-Prehension) in the middle and left panels of the bottom row. Despite the statistical significance between month-4 and month-2, the linearity of the plots raises the question if improvement in CUE-T and GRASSP-Prehension are due to continuation of intense rehabilitation alone or are attributable to adjunctive device use. This is reinforced when considering the mean change during rehabilitation only versus device

use in conjunction with rehabilitation for these two measures (5.8 and 5.3 for the CUE-T and 1.3 and 1.6 for GRASSP-Prehension as shown in the tables above). When considering the potential for ongoing rehabilitation effect during Phase II for strength measures, the ISNCSCI-UEMS, ISCNSCI-UESS, and Grasp force demonstrate a statistically and clinically significant change with adjunctive device use beyond that which might be expected with rehabilitation alone. The change during this second phase also meets the pre-specified threshold for success for the measures.

When analyzing the change in ISCNSCI-UESS based on dermatome, there is a trend of greater change in C6-T1 dermatomes, with C6-C8 dermatomes covering the hand. When analyzing the ISCNSCI-UEMS results, there was a trend of greater improvement in C8 and T1 myotomes, corresponding with finger flexors and hand intrinsics.

Over the course of the study, three participants experienced non-device related serious adverse events (constipation, urinary tract infection, and cystoliths). There were a total of 238 non-serious adverse events, the two most common being urinary tract infections or urinary/renal disorders and musculoskeletal and connective tissue disorders, such as spasms, stiffness, pain, sweating, skin redness, or irritation. The majority of these adverse events were mild or moderate in severity and the incidence of these events did not exceed beyond what is expected for these patients to experience in daily life.

Forty-four adverse events were thought to be possibly related to the device and thirty-seven were thought to be related to study procedure. The most common device-related adverse events were musculoskeletal, such as spasms, stiffness, and pain. The second most common adverse events were skin conditions, including sweating and redness, irritation, or reactions at the active electrode site. Other adverse events included burning sensation and paresthesias in the extremities. These events resolved with turning off the device or reducing stimulation. The most common procedure-related adverse event was musculoskeletal in nature, such spasms, stiffness, and pain.

Pediatric Extrapolation

The ARC^{EX} System is indicated for patients aged 18 years and older. For medical devices, the FD&C Act defines patients before their 22nd birthday as pediatric patients. In this De Novo request, complete data from patients between 22-74 (mean age 46.5) years were used to support the use of the device in adult patients. It was appropriate to indicate the device for individuals 18 and older because patients aged 18 to 21 years do not carry additional differences or risks relative to the patient population studied, incidence of spinal cord injury and upper limb weakness is present in the transitional adolescent population (pediatric sub-population) of 18-21 years of age, and this device has a likely benefit for this group.

LABELING

The labeling (User Manual) meets the requirements of 21 CFR Part 801.109 for prescription devices.

The labeling includes instructions explaining how users can navigate the software application to set-up different stimulation programs. Instructions for use includes information on applying the

device to the patient, how the device operates, and the typical sensations experienced during treatment.

The labeling also includes a summary of the ARC^{EX} System electrical stimulation parameters and outlines the cleaning for clinical use.

RISKS TO HEALTH

The table below identifies the risks to health that may be associated with use of the transcutaneous electrical spine stimulator to improve skeletal muscle strength and sensation and the measures necessary to mitigate these risks.

Risks to Health	Mitigation Measures
Ineffective treatment from insufficient stimulation due to device failure, interference with other devices, or user error, leading to worsening condition	Non-clinical performance testing Software verification, validation, and hazard analysis Labeling
Adverse tissue reaction	Biocompatibility evaluation Labeling
Overstimulation due to device failure, interference with other devices, or user error, leading to skin discomfort, burns, electrical shock, pain at stimulation site, muscle spasms and stiffness	Non-clinical performance testing Electromagnetic compatibility (EMC) testing Electrical, thermal, and mechanical safety testing Software verification, validation, and hazard analysis Labeling

SPECIAL CONTROLS

In combination with the general controls of the FD&C Act, the transcutaneous electrical spine stimulator to improve skeletal muscle strength and sensation is subject to the following special controls:

(1) Non-clinical performance testing must demonstrate that the device performs as intended under anticipated conditions of use. The following performance characteristics must be evaluated:
   (i) Characterization of the electrical stimulation parameters, including the following: waveforms; output modes; maximum output voltage and maximum output current; pulse duration; frequency; net charge per pulse; maximum phase charge, maximum current density, maximum average current, and maximum average power density;
   (ii) Characterization of the impedance monitoring system; and
   (iii) Characterization of electrode performance, including the electrical performance, adhesive integrity, shelf life, reusability, and current distribution of the electrode surface area.

(2) Performance data must demonstrate the electromagnetic compatibility, electrical safety and performance, battery safety, and wireless compatibility of the device.

(3) Software verification, validation and hazard analysis must be performed.

(4) The patient-contacting components of the device must be demonstrated to be biocompatible.
(5) Labeling must include:
    (i) Summaries of electrical stimulation parameters;
    (ii) Instructions for user management of the device in the event of adverse effects;
    (iii) A contraindication for patients with active implantable devices or wearable defibrillators;
    (iv) Information on the typical sensations experienced during treatment;
    (v) Instructions for accurate placement of the device on the patient; and
    (vi) Cleaning instructions.

BENEFIT-RISK DETERMINATION

The risks of the device are based on data collected in a clinical study described above. Adverse events such as pain, spasms, muscle stiffness, skin irritation, reaction at the electrode site, dysesthesias, and paresthesias occurred during the study. Known risks for skin contacting devices include issues of biocompatibility and issues due to electrodes peeling off and/or stimulation being concentrated in an unintended way due to lack of proper adherence of the electrodes, leading to injuries such as burns, especially in patients with impaired sensation. With devices of this type, malfunction due to electromagnetic interference or software faults can also pose risks such as thermal injury or inability to treat due to device failure. None of the above are serious and all can be resolved quickly and easily by discontinuing use or adjusting the device.

The probable benefits of the device are also based on data collected in the clinical study as described above. Improvements include improved ISNCSCI-UEMS, ISCNCSCI-UESS, and grasp force which were demonstrated to be both statistically significant and clinically meaningful in the hand.

Sources of uncertainty in the benefits included the potential ongoing rehabilitation effect when device use was added, a single arm open label study design that does not account for potential bias, and a lack of follow up time after rehabilitation and device use to establish durability of treatment effect. In addition, there is insufficient literature to support the threshold for clinically significant change in the reported outcome measures in patients with chronic incomplete SCI, however a justification for the pre-selected thresholds was provided for this study.

Patient Perspectives

A statistically significant change in the Patient Global Impression of Change (PGIC) measure was observed only during the combined device use and rehabilitation phase of the study. The PGIC measure is a patient reported measure of perceived change on a Likert scale from 1 (very much improved) to 7 (very much worse) (https://eprovide.mapi-trust.org/instruments/patient-global-impressions-scale-change-improvement-severity). However the mean change was -0.6, the clinical significance of which is unclear.

Benefit/Risk Conclusion

In conclusion, given the available information above, for the following indication statement:

> The ARC^{EX} System is intended to deliver programmed, transcutaneous electrical spinal cord stimulation in conjunction with functional task practice in the clinic to improve hand sensation and strength in individuals between 18 and 75 years old that present with a chronic, non-progressive neurological deficit resulting from an incomplete spinal cord injury (C2-C8 inclusive),

the probable benefits outweigh the probable risks for the ARC^{EX} System. The device provides benefits and the risks can be mitigated by the use of general controls and the identified special controls.

CONCLUSION

The De Novo request for the ARC^{EX} System is granted and the device is classified as follows:

Product Code: SDO
Device Type: Transcutaneous electrical spine stimulator to improve skeletal muscle strength and sensation
Regulation Number: 21 CFR 890.5851
Class: II