

**Spinal Cord Outcomes Partnership Endeavor (SCOPE, [www.scope-sci.org](http://www.scope-sci.org))**  
**Current SCI Clinical Trials of Rehabilitation and Technological Interventions to Improve Functional Outcomes**

Revised May 30, 2017

<u>Sponsor/NCT</u>	<u>Intervention</u>	<u>Inclusion/Exclusion Criteria</u>	<u>Time Frames Post-SCI Follow-up</u>	<u>Enrollment</u>	<u>Study Phase Study Design</u>	<u>Outcome Measures</u>	<u>Comments</u>
University of Ioannina <a href="#">NCT02031835</a>	Body Weight Supported Treadmill Training (BWSTT) as Physical Therapy Treatment to Spinal Cord Injury Patients	8-88yr age SCI level NS AIS B, C, D	Time post SCI NS F/U 6wks	Began 3/2012 Greece 50 Subjects	Phase IV Single Group Open Label	WISCI ISNCSCI Ashworth Quality of Life DXA	Effect of BWSTT on quality of life, walking capability, spasticity, functional abilities, and bone health
Hugo W. Moser Research Institute, Kennedy Krieger, Inc <a href="#">NCT02774603</a>	Aquatic Locomotor Training Compared to Overground Locomotor Training in Improving Ambulatory Function and Health-Related Quality of Life	18-65yr Age C1-C7 AIS C, D Some ability to walk	Chronic SCI SCI >12m F/U 16wks	Began 6/2015 Baltimore 10 Subjects	Phase N/A RCT Parallel Group Single Blind	6 Minute Walk Berg Balance SF-36 SCI QL-23	Comparing efficacy of Aquatic vs. Over-ground locomotor training
North Norway Rehabilitation Center <a href="#">NCT00854555</a>	Robotic (Lokomat) Locomotor Training vs Manual-Assisted Locomotor Training; 60 sessions over 6 months to improve walking or standing function in persons with SCI	18-70yr Age SCI level NS AIS C, D	Chronic SCI SCI ≥2yr F/U 4wks	Began 8/2008 Oslo&Tromso Norway 60 Subjects	Phase N/A RCT Single Blind	Recovery of ability to walk/stand Improved ADL function Balance, LE strength Sensation, AIS, QoL	The ATLET Study: Robotic (Lokomat) vs Manual Assisted Locomotor Training
Instituto Nacional de Rehabilitacion <a href="#">NCT02749357</a>	Robotic (Lokomat) Locomotor Training 5 sessions/wk for 6 weeks, comparing training session duration of 60 minutes vs. 30 minutes	≥16yr Age SCI level NS AIS C, D	Chronic SCI SCI ≥6m	Not yet recruiting Mexico City 10 subjects	Phase N/A RCT Single Blind	Gait Rite System Measures Lokomat Measures SCIM III	Study comparing effectiveness of two Lokomat training session durations
Clinique Romande de Readaptation <a href="#">NCT02808078</a>	Gait training on a treadmill equipped with an augmented (visual) reality system compared to standard gait training; each group receives 20 sessions of 30 minutes over the 4 week program	Age >18yr SCI level NS Able to walk 2 minutes	Acute/subacute SCI SCI <40days F/U 4m	Began 1/2016 Sion, Valais, Switzerland 70 Subjects	Phase N/A RCT Parallel Group Open Label	2 Minute Walk Test Berg Balance Falls Efficacy Scale SF-36 Treadmill Kinematics	Study of added benefit of augmented reality system in persons receiving treadmill gait training
Indiana University <a href="#">NCT03144388</a>	High intensity stepping training in multiple environments, including overground, on a treadmill and on stairs vs. High intensity non-stepping training, including balance, strength, and cycling tasks. 20 sessions over a 6 week period	Age 18-75yr SCI C1-T10 AIS C, D Can walk without assistance	Chronic SCI SCI ≥1yr F/U 6wks	Not yet recruiting Indiana 20 Subjects	Phase N/A RCT Parallel Group Crossover Option Single Blind	Walking Speed Walking Distance	Study of the effects of rehab activity task-specificity on locomotor recovery in persons with chronic SCI
Ohio State University <a href="#">NCT02498548</a>	Motor Control Training to evaluate the effect of downhill training at moderate speeds on knee function. Comparing uninjured controls vs. locomotor trained iSCI without and with knee joint rehabilitation	18-90yr Age C1-T10 AIS C, D Able to step overground & on treadmill	Chronic SCI D/C from rehab at least 6 months	Began 6/2015 Columbus, OH 32 Subjects	Phase 1/2 RCT Parallel Group Single Blind	6 minute walk test 10 meter walk test Knee power absorption Eccentric knee contraction Neuromuscular Recovery Scale Berg Balance	Eccentric Motor Control Training to Improve Human Spinal Cord Injury: Knee Function During Walking

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Ohio State University University of Notre Dame <a href="#">NCT02821845</a>	Motor Control Training (3 times a week for 12 wks at slow speeds) to evaluate the effect of downhill training on hip function. Comparing uninjured controls vs. locomotor trained iSCI without and with hip joint rehabilitation	18-90yr Age C1-T10 AIS C, D Can take some steps	Chronic SCI Discharged from outpatient rehab ≥6mos	Began 6/2015 Columbus, OH 32 Subjects	Phase 1/2 RCT Parallel Group Single Blind	6 minute walk test 10 meter walk test Frontal hip loading response Neuromuscular Recovery Scale Berg Balance QoL Score	Eccentric Motor Control Training to Improve Human Spinal Cord Injury: Hip Function During Walking
University of Louisville <a href="#">NCT03036527</a>	Studying the effects of activity-based locomotor, activity-based standing, and activity-based upper extremity ergometry training on recovery of bladder and sexual function. One hour training sessions, 5 days/wk for 80 sessions.	Age≥18yr SCI level NS (suprasacral) AIS NS Spinal Shock resolved	Chronic SCI Inpatient rehab completed	Began 9/2014 Louisville, KY 30 Subjects	Non-random Parallel Group Open Label	Bladder Capacity Voiding Efficiency (% voided) Leak Point Pressure Bladder Compliance IIEF, FSFI	Effects of Activity Dependent Plasticity on Recovery of Bladder and Sexual Function After SCI
University of Miami NINDS <a href="#">NCT02451683</a>	Study of motor task training with real or sham stimulation assessing electrophysiological parameters of time domain and location	18-65yr Age SCI C8 & above Some grasp and reach ability	Chronic SCI SCI≥6months F/U 5months	Began 4/2015 Miami, FL 300 Subjects	Phase N/A RCT Crossover Open Label	Functional tests of arm/hand function Cortical Neurophysiology Upper limb movements scale	Study of Corticospinal Function After Spinal Cord Injury
University of British Columbia Rick Hansen Institute <a href="#">NCT02799966</a>	MyndMove, a non-invasive medical device that uses short, low energy electrical pulses with surface electrodes to cause muscle contractions which result in UE movement. By assisting movement with MyndMove stimulation, patients may gain volitional ability	Age≥18yr C4-C7 AIS B, C, D SCIM Self-Care score ≤10 No existing e-stim device	Acute-Chronic SCI Early SCI 10d-6m Late SCI>6m F/U 7wks	Not yet begun Multicenter Canada/USA 40 subjects	Phase N/A Non-randomized Parallel Assignment Open Label	SCIM GRASSP TRI-HFT ARAT	Study of the effectiveness of MyndMove therapy in improving the ability of individuals to voluntarily move their arms and hands
PXL University <a href="#">NCT02982811</a>	Standard Rehabilitation Therapy together with 3X45 minute training with intelligent Activity-based Client-centered Training (iACT) device vs. Standards Rehabilitation Therapy alone during 6 week program	Age≥18yr SCI level NS Extrem. and/or core stability dysfunction; involvement in clinical rehab; Speaks Dutch	Chronic SCI, MS, CVA SCI≥3m	Not yet begun Overpelt, Belgium 160 Subjects (CVA, MS, and SCI)	Phase 3 Non-random Parallel Group Open Label	Wolf Motor Function Test Manual Ability Measure Modified Fatigue Impact Scale Trunk Impairment Scale SF-36 Canadian Occupational Performance Measure	Study to determine whether use of iACT device adds to benefits of Standard Rehabilitation therapy in persons with CNS impairments
Case Western Reserve University NINDS <a href="#">NCT02329652</a>	Implantation and use of networked neuroprosthesis system (NNS) for arm, hand and trunk function.	Age≥17yr Motor level C4-8 AIS A, B, C, D Elbow flex≥2/5	Chronic SCI≥6m F/U 3m	Began 12/2014 Cleveland 10 Subjects	Phase N/A Single Group Open Label	ADL Abilities Test Grasp-Release Test	implanted device for providing hand function, reach, and trunk function to individuals with cervical SCI

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Case Western Reserve Univ. MetroHealth Medical Center NINDS <a href="#">NCT01659541</a>	Implantation of spinal cord expiratory muscle stimulator wire leads to restore cough	18-75yr Age SCI C8 or above AIS NS Expiratory muscles weak	Chronic SCI AIS A: SCI≥6m AIS B, C, D ≥12m F/U 2yrs	Began 4/2015 Cleveland, OH 16 Subjects	Phase N/A Single Group Open Label	Peak Expiratory Flow Maximum Airway Pressure Caregiver Burden Inventory Secretion Management Index Incidence of Resp. Infections SCI related Quality of Life	determine efficacy of spinal cord stim, with wire leads, to produce effective cough in patients with SCI
Palo Alto Veterans Institute for Research <a href="#">NCT02978638</a>	Implantation of Finetech Vocare Bladder System—a sacral nerve root stimulator. The study tests the use of the system to inhibit bladder contractions by electrically stimulating sensory nerves (as an alternative to cutting sensory nerves).	Age≥18yr SCI below C4 AIS A Dyssynergia Detrussor Hyper-reflexia	Chronic SCI SCI≥2yr F/U 12m	Began 9/2014 Palo Alto, CA 10 Subjects	Phase 1 Single Group Open Label	Bladder Capacity (Cystometry) Frequency of Incontinence	Restoration of Bladder and Bowel function using electrical stimulation and block after SCI
Swiss Paraplegic Centre Nottwill <a href="#">NCT03048331</a>	Surface Functional Electrical Stimulation (FES) in persons who have had Upper Extremity reconstructive surgery (tendon and/or nerve transfers) to determine if the additional of FES vs. standard therapy can improve motor learning and functional outcomes after these surgeries	Age≥18yr SCI C4-T1 AIS A, B, C, D Planned UE reconstructive surgery	Chronic SCI SCI>6m F/U 16wk	Began 3/2017 Switzerland 30 Subjects	Phase N/A RCT Parallel Group Open Label	Force, Power of treated muscle COPM Surface EMG Treatment Effectiveness (Questionnaire) Ultrasound (Muscle Volume)	Pilot Study of FES in in persons with tetraplegia who receive UE reconstructive surgery
University of Louisville UCLA Reeve Foundation Kessler Foundation <a href="#">NCT02339233</a>	Implantation and use of spinal epidural 16 electrode array for spinal cord electrical stimulation to facilitate standing and stepping in persons with SCI	18-75yr Age SCI above T10 Unable to stand or step independently	Chronic SCI SCI ≥1yr F/U 20m	Began 1/2010 Louisville 10 Subjects	Phase N/A Single Group Open Label	Voluntary Movement	Spinal Epidural Electrode Array to Facilitate Standing and Stepping After Spinal Cord Injury
U of Minnesota <a href="#">NCT03026816</a>	Implanted epidural spinal cord stimulator for improving volitional motor activity autonomic function in persons with chronic motor complete SCI	Age≥22yr SCI C6-T10 AIS A, B	Chronic SCI SCI>1yr F/U 15m	Not yet begun Minneapolis 100 Subjects	Phase 2 Single Group Single Blinded Outcome (BMCA)	Brain Motor Control Assessment Volitional Movement Sympathetic Skin Response Blood Pressure Cerebral Blood Flow (tilt table) Arterial Stiffness	Epidural Stimulation for Chronic Motor Complete SCI

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Rehab Institute of Chicago <a href="#">NCT02991248</a>	Three arm study comparing robotic/pelvic force-perturbation treadmill training with 1) active vs. 2) sham transcutaneous spinal direct current stimulation (tsDCS), and 3) standard treadmill training only. Three treatment sessions per week for 6 weeks.	18-65yr Age SCI C4-T10 AIS C, D Able to walk 10 meter with no more than AFO	Time after SCI NS F/U 14wk	Not yet begun Chicago 54 subjects	Phase N/A RCT Parallel Group Single Blind Assessments	Gait Speed (overground) 6 minute walk test Dynamic Gait Index Berg Balance Scale	whether pelvis perturbation training with tsDCS will be effective in improving dynamic balance and locomotor function
University of Zurich <a href="#">NCT03137108</a>	Transcutaneous electrical spinal cord stimulation (tSCS) using RehaMove 3 stimulator applied during standing and overground walking in FLOAT body-weight support system. 2 sessions within 2 weeks.	Age≥18yr SCI above T12 AIS C, D Can walk 10 m independently	Subacute SCI 3-12m Chronic SCI≥12m F/U 2 wks	Not yet begun Zurich, Switzerland 15 subjects	Phase N/A Single Group Open Label	Kinematic Movement Motion Capture Force Plate	effects of tSCS with different stimulation modalities on voluntary motor in persons with iSCI
UCLA <a href="#">NCT02331979</a>	Transcutaneous electrical and/or magnetic stimulation for spinal cord neuromodulation to improve urinary bladder function in persons with SCI	18-45yr Age C2-T8 SCI AIS A, B	Chronic SCI SCI≥1yr F/U 48m	Began 9/2015 Los Angeles 24 subjects	Phase 0 Single Group Open Label	Urine Flow Voided Volume	Study of spinal cord neuromodulation to improve bladder function in subjects with SCI
UCLA <a href="#">NCT02313194</a>	Study of implanted epidural electrode array for spinal cord stimulation to improved arm and hand function in subjects with non-progressive SCI above C5	Age≥18yr SCI above C5	Chronic SCI SCI≥1yr F/U 24m	Began 7/2013 Los Angeles 12 Subjects	Phase 1/2 Single Group Open Label	Assessment of Arm and Hand Function Formal Motor Testing	spinal cord stimulation to improve the ability to move in spinal cord injured humans
Vanderbilt University <a href="#">NCT02899858</a>	IntraSpinal Micro-Stimulation (ISMS) with up to 16 electrodes implanted during clinically indicated spinal surgery along each side of the spinal cord at levels that correlate with hip, knee, and ankle segmental innervation.	18-50yr Age T2-T8 Undergoing surgery allowing T9-12 laminectomy AIS A	Chronic SCI SCI>1yr F/U 3yr	Began 1/2015 Nashville, TN 2 Subjects	Phase N/A Single Group Open Label	Intraoperative Movement Post-Operative Kinesiology	Microstimulation of the spinal cord for restoration of standing and walking in persons with chronic complete SCI
C. Hospitalier Univ. Vaudois Ecole Polytechnique Federale de Lausanne <a href="#">NCT02936453</a>	Implanted closed-loop Epidural Electrical Stimulation (EES) combined with over-ground robot assisted rehabilitation training (STIMO) for improving ambulation in persons with chronic incomplete SCI	18-65yr Age T10 and above AIS C, D Can stand with walker/crutches	Chronic SCI SCI≥12m F/U 9-11m	Began 7/2016 Lausanne, Switzerland 8 Subjects	Phase N/A Single Group Open Label	WISCI 10 Meter Walk, 6 Minute Walk Weight Bearing Capacity AIS, SCIM III Berg Balance, SF-36 Urodynamics, Kinematics, EMG	Single group study of the combination of closed-loop EES with robotic assisted rehabilitation in chronic iSCI

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Dept. of Veterans Affairs NIH <a href="#">NCT01923662</a>	Device: IST-16 (16-Channel implanted stimulator-telemeter) for standing in persons with paralysis resulting from neurological disorder such as low cervical/thoracic spinal cord injuries (C6-T12)	Age ≥21yrs C6-T12 AIS NS	Chronic SCI SCI ≥6m F/U 12m	Began 4/2013 Cleveland, OH 10 Subjects	Phase N/A Single Group Open Label	Elapsed Standing Time for different stimulation paradigms Subject Impression of Stability Body Weight Distribution Standing Stability Measures	multiple-contact peripheral nerve cuff electrodes to selectively activate portions of a muscle to improve fatigue characteristics
Case Western Reserve University NIH VA Office of Research and Development <a href="#">NCT00623389</a>	Device: IST-16 (16-channel implanted stimulator-telemeter) with pre- and post-surgical training to facilitate exercise, standing, stepping and/or balance in people with various degrees of paralysis	Age ≥18yr C6-T12 or other paralysis AIS A, B, C Normal ROM	Chronic SCI SCI ≥6m F/U 12m	Began 5/2005 Cleveland, OH 10 Subjects	Phase N/A Single Group Open Label	Standing, walking and balance performance Standing duration, reachable workspace, and ability to perform other functional activities of daily living	Evaluation of an Advanced Lower Extremity Neuroprostheses
Case Western Reserve University VA Office of R&D <a href="#">NCT01474148</a>	Device: IRS-8 (8-Channel implanted stimulator-telemeter) to facilitate stability of the trunk and hips; Study the effect of stabilizing and stiffening the trunk with FES to change the way persons with SCI sit, breathe, reach, push a wheelchair, roll in bed	Age ≥21yr C4-T12 AIS A, B, C	Chronic SCI SCI ≥6m F/U up to 36m	Began 7/2011 Cleveland, OH 10 Subjects	Phase 1 Single Group Open Label	Effect of Trunk stimulation on control seated posture, respiration, seated interface pressures, reach ability, seated stability & personal mobility	Surgical implantation of an 8 channel FES system to facilitate stability of the trunk and hips
University of Zurich <a href="#">NCT02165774</a>	Implanted Sacral Neuromodulation for improvement in Lower Urinary Tract Dysfunction (LUTD) such as urgency, frequency, incontinence, retention. Comparison of outcomes with neuromodulation turned ON vs. OFF	Age ≥18yr Neurogenic LUTD not responsive to drug therapy Level/AIS NS	Chronic/stable neurologic injury >12m	Began 4/2012 Multicenter in Switzerland 60 Subjects	Phase N/A RCT Double Blind Placebo Controlled	“Successful” Neuromodulation Neuro-urological Assessments Neurophysiological Assessments Bladder/Urethra Stim Perception Thresholds Sensory Evoked Potentials	Study of bladder function/physiology outcomes with neuromodulation stimulator ON vs. OFF
University of Miami NINDS <a href="#">NCT02446210</a>	Magstim 200 stimulator for Transcranial Magnetic Stimulation and electrical Peripheral Nerve Stimulation	18-65yr Age Injury above L5 Can grip bilat Can ambulate a few steps	Sub acute/Chronic SCI ≥1 month F/U 5months	Began 3/2015 Miami, FL 514 Subjects	Phase N/A RCT Crossover Open Label	Motor Cortical Excitability EEG/EMG Enhanced motor UE Enhanced motor LE	Neural Control of Bilateral Hand, Arm, and Leg Movements After Spinal Cord Injury
Cleveland Clinic <a href="#">NCT01539109</a>	Transcranial Direct Current Stimulation (tDCS) vs. sham tDCS in incomplete cervical SCI patients undergoing rehabilitation training	18-75yr age SCI >6m Cervical Level AIS B, C, D	Chronic SCI SCI >6m F/U 3m	Began 11/2011 Cleveland 10 Subjects	Phase N/A RCT Parallel Group Double Blind	UEMS MRI of Brain TMS	Study of tDCS combined with training of UE in incomplete tetraplegia



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Shepherd Center <a href="https://clinicaltrials.gov/ct2/show/study/NCT02611375">NCT02611375</a>	Transcranial Direct Current Stimulation (tDCS); Peripheral Nerve Somatosensory Stimulation PNSS; Sham (tDCS); each combined with functional task practice (FTP) to assess improvement in upper extremity function	18-65yr Age C1-C8 AIS A, B, C, D	Acute/Subacute, Chronic SCI SCI<6m SCI>1yr F/U 4-6wks	Began 1/2017 Atlanta, GA 70 Subjects	Phase N/A RCT Parallel Group Sham Control Double Blind	GRASSP UE Sensation (Semmes-Weinstein) Perceived UE Performance & Satisfaction (COPM)	Comparison of tDCS+FTP vs. PNSS+FTP vs. Sham tDCS+FTP to assess effect on UE function
University of Sao Paulo General Hospital <a href="https://clinicaltrials.gov/ct2/show/study/NCT02562001">NCT02562001</a>	Active vs. placebo High definition transcranial electrical direct-current stimulation (tDCS) followed by robotic Lokomat BWSTT training and ARMEO Spring	18-65yr Age SCI Level NS AIS C, D	Subacute/Chronic 1m≤SCI≤36m F/U 18wks	Not begun Sao Paulo, Brazil 20 Subjects	Phase N/A RCT Placebo Control Double Blind	WISCI AIS Ashworth Berg Balance 10Meter, 6 Minute walk SCIM	Study of tDCS on patients receiving Gait Training (Lokomat) and ARMEO Spring
University of Sao Paulo <a href="https://clinicaltrials.gov/ct2/show/study/NCT02899637">NCT02899637</a>	Repetitive, high frequency 5Hz Transcranial Magnetic Stimulation (rTMS) over the lower limb area of the motor cortex vs. sham rTMS over 5 consecutive days of treatment	18-60yr Age SCI Level N.S. Stable iSCI; In inpatient rehab in Paraiba, Brazil	Time after SCI NS Must be in inpatient rehab program at study center F/U 3wks	Not begun Paraiba, Brazil 30 Subjects	Phase N/A RCT Crossover Sham Control Double Blind	AIS ASIA Motor Score ASIA Sensory Score Fugl-Meyer Electromyography	Sham controlled RCT of repetitive high frequency TMS to improve sensorimotor function in incomplete non-progressive SCI
Bronx VA Medical Center <a href="https://clinicaltrials.gov/ct2/show/study/NCT02469675">NCT02469675</a>	Transcranial Magnetic Stimulation; median nerve stimulation; cervical transcutaneous stimulation. Combinations of magnetic and electrical stim will be compared to determine optimal effect on nerve circuits	21-65yr Age C2-C8 iSCI with ≥ 3/5 strength of finger muscles	Chronic SCI SCI≥12months F/U 90 minutes	Began 6/2015 Bronx, NY 30 Subjects	Phase N/A RCT Crossover Single Blind	MEP Hand Dexterity Grip Strength Neurophysiology	Paired Stimulation to Increase Cortical Transmission to Hand Muscles: Pilot Study
University of Zurich <a href="https://clinicaltrials.gov/ct2/show/study/NCT03053791">NCT03053791</a>	Unilateral implantation of a Medtronic Activa SC deep brain stimulation system in the mesencephalic locomotor region	18-75yr Age SCI T10 & above AIS C, D walk 10 meters	Chronic SCI SCI≥6m F/U 6m	Began 2/2017 Zurich, Switzerland 5 Subjects	Phase 1/2 Single Group Open Label	6 Minute Walk TUG, Ashworth SCIM III WISCI II SF-36 Bladder, Bowel, Sexual Function	Mesencephalic locomotor region deep brain stimulation for improvement of locomotion and gait
Shepherd Center NIH <a href="https://clinicaltrials.gov/ct2/show/study/NCT02340910">NCT02340910</a>	Various frequencies and durations of Whole Body Vibration compared to Transcutaneous Electrical Spinal Cord Stimulation for improvement in spasticity and walking in persons with motor incomplete chronic SCI	16-70 Yr Age T12 or higher AIS C, D	Chronic SCI SCI≥6m F/U 45m	Began 1/2015 Atlanta 34 Subjects	Phase N/A Single Group Open Label	Spasticity (Pendulum Test, SCI-SET, Electrophysiology) Walking Speed, Endurance, Pattern Strength, Pain	Dose-Response Effects of Whole Body Vibration on Spasticity and Walking in SCI

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NCMRR NICHD NIDCD VA Office of R & D NINDS <a href="#">NCT00912041</a>	Implantation of the one or two BrainGate2 sensor electrode arrays into the motor cortex; training implanted subjects to control a computer cursor and other assistive devices with their thoughts	18-75yr age Cervical SCI AIS A, B, C, D Live≤3hr drive	Time post SCI NS F/U 1yr	Began 5/2009 4 Centers, USA 15 Subjects	Phase N/A Single Group Open Label	Safety Feasibility of BrainGate2 to establish the parameters for a larger clinical study (appropriate neural decoding algorithms, endpoints, success criteria, etc.)	4x4 mm BrainGate2 sensor is placed into the motor cortex, connected to a percutaneous pedestal.
California Institute of Technology UCLA Casa Colina <a href="#">NCT01958086</a>	Implantation of two Neuroport electrode arrays in posterior parietal cortex allowing direct brain-control of a computer interface. Ultimate objective is to allow the patient autonomous control over the Google Android tablet operating system.	Age 22-65yr high cervical SCI Lives<60 miles from study center; not on ventilator	Time post SCI NS F/U 1yr	Began 10/2013 Pomona, CA 2 subjects	Phase N/A Single Group Open Label	Subject control of tablet computer Absence of infection or irritation Adverse Events	Feasibility Study for Use of a Brain Implant for Neural Control of a Tablet Computer
University of Pittsburgh DARPA Dept. of Defense Johns Hopkins University <a href="#">NCT01894802</a>	Implantation of microelectrode Cortical Recording and Stimulating (CRS) arrays in the motor cortex and sensory cortex of the brain for neural activity recording and use in control of external devices	22-70yr age Limited or no ability to use hands due to cervical SCI or other condition	Chronic Condition SCI≥1yr F/U 12m	Began 12/2013 Pittsburgh 5 Subjects	Phase N/A Single Group Open Label	Safety: array not removed for safety during 12 month F/U Efficacy: long-term recording of neural activity and successful control of external devices	Two Blackrock Microsystems CRS Arrays will be implanted in the motor cortex and sensory cortex
University of Pittsburgh Dept. of Defense Johns Hopkins University <a href="#">NCT01364480</a>	Implantation of two NeuroPort electrode arrays in the motor cortex of the brain to demonstrate the safety and efficacy for long-term recording of brain activity	18-70yr age Limited or no ability to use hands due to cervical SCI or other condition	Chronic Condition SCI≥1yr F/U 12m	Began 5/2011 Pittsburgh 5 Subjects	Phase N/A Single Group Open Label	Safety: array not removed for safety during 12 month F/U Efficacy: long-term recording of neural activity and successful control of external devices	Two Blackrock Microsystems NeuroPort Arrays will be implanted in the motor cortex
Cleveland Clinic NASA MetroHealth Medical Center <a href="#">NCT03098927</a>	Mirror neuron network-based motor imagery training in an immersive virtual reality environment	Age 18 to 45yrs C5-C7 Level AIS B, C, D	Subacute-Chronic 3m≤SCI≤6m F/U 2yr	Began 9/2014 Cleveland 8 Subjects	Phase N/A RCT Crossover Open Label	Change in motor imagery performance Cortical EEG signal generation	assesses the effect of training paradigm on cortical signals (EEG) generated during motor imagery
University of Southern California Rancho Los Amigos <a href="#">NCT01964261</a>	Implantation of 3 Neuroport electrode arrays to enable learned control of an end effector (for reach and grasp tasks) by thought augmented with sensory feedback via intracortical brain stimulation	22-65yr Age High cervical SCI AIS NS	Time after SCI NS F/U 1yr	Began 11/2013 California 2 Subjects	Phase N/A Single Group Open Label	Patient control of end effector (virtual or physical) Absence of Infection or Irritation	Providing Closed Loop Cortical Control of Extracorporeal Devices to Patients With Tetraplegia

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Aristotle University of Thessaloniki <a href="#">NCT02443558</a>	Emotiv EPOC wireless EEG headset use for control of MERCURY v2.0 robotic arms, a non-commercial 6-degree-of-freedom bimanual robotic arms device	Age≥14yrs SCI at cervical, thoracic, or lumbar levels AIS A,B,C,D,E Uninjured controls	Time after SCI NS F/U 1yr	Not begun Greece 30 Subjects	Phase N/A Non-randomized Parallel Group Open Label	Brain Computer Interface Control SCIM III	Brainwave Control of a Wearable Robotic Arm for Rehabilitation and Neurophysiological Study in Cervical Spine Injury
University of Miami <a href="#">NCT02564419</a>	Implantation of a unilateral subdural strip electrode (Resume II, Model 3587A) over the motor cortex of the brain processed in an implanted Medtronic Activa PC+S connected with Bioness H200 external UE stimulator to produce hand grasp. 24 training sessions over 3-6 months	22-50yr Age C5-6 level AIS A, B	Chronic SCI Time post-SCI NS F/U 24m	Began 11/2015 Miami, FL 3 subjects	Phase N/A Single Group Open Label	Neurological Exams Questionnaires Functional Hand Testing AIS, motor/sensory scores SF-36	Early Feasibility Study of a Medtronic Activa PC+S System for Persons Living With Spinal Cord Injury
The Ohio State University Ali Rezai, MD <a href="#">NCT01997125</a>	Neurobridge System utilizing NeuroPort electrode array implant into motor cortex coupled with external neuromuscular stimulator to produce volitional UE movement controlled by EEG activity	21-89yr age C4-C6 AIS A	Chronic SCI≥1yr F/U 9m	Began 11/2013 Ohio, USA 5 Subjects	Phase N/A Single Group Open Label	achievement of voluntary movement of the upper extremity	Neural bridge system implant and external stimulator for reanimation of UE function in tetraplegia
Rehabilitation Inst of Chicago NIH <a href="#">NCT01608438</a>	Comparison of two ways of customizing the body-machine interface over 40 sessions (spread over 8 months). 1) SCI static—the body-machine interface is static; 2) SCI Machine Learning—there is a machine learning algorithm that adapts to the movements made by the subject	18-65yr age C3-C6 AIS A, B, C	Time post SCI NS F/U 8m	Began 2/2013 Chicago, IL 46 Subjects	Phase N/A Non-random Parallel Group Single Blind	Time to task completion (data entry and navigation of virtual or real obstacle course) Movement Smoothness UE Strength State-Trait Anxiety Inventory	Subjects drive power wheelchairs, interact with computers through interface that maximizes effectiveness of residual motor function
New York University School of Medicine <a href="#">NCT02793635</a>	15 sessions of Indego powered exoskeleton use as a gait training device for subjects with complete or incomplete paraplegia due to SCI	Age≥18yr Paraplegia AIS A, B, C, D Some LE function Height 5'1"-6'3" Weight≤250lbs	Chronic SCI SCI≥1yr F/U 3wks	Began 6/2016 New York 25 subjects	Phase N/A Open Label Single Group	Functional Ambulation Category 10 Meter Walk Test 6 Minute Walk Test	Study to measure the impact of gait training with the Indego device on walking function after SCI



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Vanderbilt University <a href="#">NCT03082898</a>	Indego Exoskeleton walking: three 90minute walking sessions per week for 8 weeks (24 sessions).	Age≥18yr SCI C5 or lower AIS A, B, C, D Non- or Poorly ambulatory FIM gait 1-6	Chronic SCI SCI≥6mos F/U 18wks	Began 11/2016 Tennessee, Florida, Minnesota 24 Subjects	Phase N/A Open Label Parallel Group AIS A, B AIS C, D	10 Meter Walk Test 6 Minute Walk Test WISCI-II FIM Gait Score TUG ISNCSCI Self-Report Score	Study of exoskeletal walking effects on functional, neurological, and health outcomes
Kessler Institute Kessler Foundation <a href="#">NCT03096197</a>	Transcutaneous lumbosacral stimulation (TLS) with Exoskeleton Assisted Walking (EAW) compared to EAW alone for recovery of walking. Each group receives 80 sessions of treatment (60 minutes of EAW+TLS or EAW alone, with EAW+TLS group also receiving 15 minutes of overground training without EAW.	Age 21-58yrs SCI C6-T10 AIS C, D LEMS≥16 Non-walking Wheelchair user	Chronic SCI SCI>6yrs F/U 28wks	Began 03/2017 New Jersey 24 Subjects	Phase N/A RCT Open Label	6 minute walk test (6MW) 10 meter walk test (10MW) Berg Balance Scale LEMS	Study of the effect of adding TLS to EAW on walking recovery in persons with chronic non-ambulatory incomplete SCI
University of Alberta <a href="#">NCT02322125</a>	Use of ReWalk Exoskeleton to train walking in individuals with chronic SCI. Intensive exoskeleton training 1.5hr/day, 4 days/wk for 14 weeks.	18-70yr Age 5'3"- 6'4" height weight≤180 lbs Does not walk or Walks ≤0.4m/s SCI Level NS AIS NS	Chronic SCI SCI≥1yr F/U 20weeks	Began 6/2014 Alberta 15 Subjects	Phase 1 Single Group Open Label	6 minute walk test (6MW) 10 meter walk test (10MW) Manual Muscle Strength Testing Functional Ambulation Profile Balance Somatosensory Percep Threshold McGill Pain Questionnaire	characteristics of persons with SCI who most benefit from ReWalk training; feasibility of ReWalk for home/community ambulation
James J. Peters VAMC <a href="#">NCT02314221</a>	Use of ReWalk and Ekso Exoskeletons vs. Usual Activity Control Group	18-70yr Age Paraplegia T3 and below (New York) Above T2 (Maryland and New Jersey)	Chronic SCI SCI≥6m F/U 3m	Began 2/2015 New York New Jersey Maryland 64 Subjects	Phase 3 RCT Crossover Open Label	10 Meter Walk Test 6 Minute Walk Test Timed Up and Go Advanced Walking Skills Bowel Function Total Body Fat Mass (DXA)	Study of exoskeletal-assisted Walking to Improve Mobility, Bowel Function and Cardio-Metabolic Profiles in Persons With SCI
Ekso Bionics <a href="#">NCT02943915</a>	Exoskeleton Gait Training 3X/wk for 12wks vs. standard BWSTT gait training 3X/wk for 12wks or no gait training/usual activity for 12wks to determine effectiveness for improving walking outcomes in participants with chronic incomplete SCI	18-75yr Age C5-T10 AIS C, D Can use Front-Wheeled Walker Amb<0.44m/sec	Chronic SCI Community-dwelling F/U 24 wks	Began 8/2016 White Plains, NY 164 Subjects	Phase N/A RCT Parallel Group Single Blind	10 Meter Walk 6 Minute Walk TUG WISCI ISNCSCI, AIS SCIM III, QoL	Ekso exoskeleton gait training vs. standard gait training vs. no gait training/usual activities for improving walking

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University of Texas Houston <a href="https://clinicaltrials.gov/ct2/show/study/NCT03057652">NCT03057652</a>	algorithmic-based evaluation and treatment approach for wearable robotic exoskeleton (WRE) gait training using ReWalk, Ekso, and REX systems; randomly assigned order of device use. Up to 15 training sessions per device.	Age ≥18yr SCI level NS AIS NS Ashworth <3	Chronic SCI SCI >6m F/U 14-20wks	Began 3/2016 Houston, TX 75 Subjects	Phase N/A RCT Parallel Group Crossover Open Label	10 Meter Walk 6 Minute Walk Surface EMG Oxygen Consumption Gait Kinematics Bone Mineral Density	Development of an algorithmic-based evaluation and treatment approach for exoskeleton gait training
Rehabilitation Inst of Chicago Otto Bock Healthcare Products <a href="https://clinicaltrials.gov/ct2/show/study/NCT02089880">NCT02089880</a>	Comparison of Micro-processor Controlled Knee-Ankle-Foot Orthosis (C-Brace) vs. Stance-control Knee-Ankle-Foot Orthosis (SCO) to improve functional outcomes in individuals with lower extremity impairment	18-80yr Age LE functional impairment due to neurologic condition Prior active use of SCO or KAFO	Time post SCI NS F/U 16wks	Began 2/2014 Chicago, IL 24 Subjects	Phase 2 RCT Crossover Open Label	6 Minute Walk 10 Meter Walk LE Muscle Strength Berg Balance Functional Gait Assessment Stair/Hill Assessment Indices	Comparing Functional Outcomes in Individuals Using Micro-processor Controlled Orthosis Versus Stance Control Orthosis
Hugo W. Moser Research Institute at Kennedy Krieger, Inc. <a href="https://clinicaltrials.gov/ct2/show/study/NCT01491789">NCT01491789</a>	Single group study of the benefits of the VSail-Access simulator (virtual sailing simulator)	18-55y age SCI >6m SCI C1-S1 AIS A, B, C, D	Chronic SCI >6m F/U 12wks	Began 5/2011 Baltimore, MD 20 Subjects	Phase I/II Single Group Open Label	ISNCSCI SCI-QL-23 Functional Reach Grasp/Pinch Sailing Ability Questionnaire	Studying the benefits of a recreational and therapeutic program for people with SCI using the VSail-Access sailing simulator
University of Zurich <a href="https://clinicaltrials.gov/ct2/show/study/NCT02149186">NCT02149186</a>	Interactive Computer-based Therapy System for Legs (iCTuS-L) a virtual reality (VR)-based observation, motor imagery and execution to treat lower-limb neuropathic pain and motor dysfunction	16-80yr age SCI Level NS AIS C, D Has neuropathic pain and/or motor deficits	Acute or Chronic Acute <3m Chronic >1yr F/U 16weeks	Began 10/2009 Zurich, Switzerland 72 Subjects	Phase N/A Single Group Open Label	Questionnaires: Neuropathic Pain, Depression, ADL, Walking Aids, Personal Assistance, Gait  Transcranial Magnetic Stim Transcutaneous PN Stim	Interactive Motor Imagery in Virtual Reality

This table is abstracted from the clinical trial registration website [www.clinicaltrials.gov](http://www.clinicaltrials.gov) using the search term “Spinal Cord Injury” and is updated periodically. This table was derived from a [www.clinicaltrials.gov](http://www.clinicaltrials.gov) search on May 30, 2017 which found a total of 898 SCI trials. Of these, 292 trials were listed having known status and as currently recruiting or not yet recruiting. The table includes 56 SCI trials from the search that: 1) are currently actively recruiting or soon-to-be recruiting subjects; 2) are interventional (testing an intervention/treatment) using rehabilitation, neural stimulation and/or assistive technology strategies and 3) targeted improvement in neurological impairment or related activities outcomes.

Interventional clinical trials are routinely registered on [www.clinicaltrials.gov](http://www.clinicaltrials.gov) based on legal requirements\* and because scientific journals may require registration for publication of the trial results. The [clinicaltrials.gov](http://www.clinicaltrials.gov) website is the largest repository of current and past clinical trials for all diseases and disorders—as of May 30, 2017, the registry contained information

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on 245,634 trials including research conducted in all 50 states in the USA and 200 countries. Investigators may choose not to register some early phase trials and those testing behavioral interventions, even though they may be important and scientifically rigorous studies.

\*U.S. Public Law 110-85 requires the registration and reporting of results of “certain applicable clinical trials,” i.e., controlled interventional clinical trials that are subject to FDA regulation and that involve a Drug or Biologic (other than Phase I investigations), or Device (other than small feasibility studies); <http://prsinfo.clinicaltrials.gov/fdaaa.html>.

More detailed information on individual trials may be accessed by using the NCT number found in the first column of the table. All trials registered with [www.clinicaltrials.gov](http://www.clinicaltrials.gov) are assigned a registration number that begins with NCT (e.g. NCT01321333). Entering the NCT number into the search field of [www.clinicaltrials.gov](http://www.clinicaltrials.gov) or [www.google.com](http://www.google.com) will access the webpage describing the trial, the study centers, and contact information in more detail. When an electronic version of the tables is used (e.g. when downloaded as a pdf file from [www.scope-sci.org](http://www.scope-sci.org)), the webpages describing a specific trial can be directly accessed by using the hyperlink of the NCT number in the table.

### Terms/Abbreviations

**AIS:** the ASIA (American Spinal Injury Association) Impairment Scale is a component of the ISNCSCI that classifies the degree of motor/sensory sparing below the level of injury. The AIS scale ranges from A (most severe, complete injury with no sparing of sensory/motor function in the sacral segments S4-S5 that innervate the anus/rectum) to E (normal). AIS B describes sensory only sparing; AIS C describes sensory and very weak motor sparing; AIS D describes sensory and stronger but not normal motor sparing.

**ARAT:** Action Research Arm Test is a clinical measurement of upper limb function

**Ashworth:** an ordinal measurement scale used to rate the severity of spasticity

**Barthel Index:** is an ordinal scale used to measure performance in activities of daily living (ADL).

**Berg Balance Scale:** A 14-item objective measure designed to assess static balance and fall risk

**BMCA (Brain Motor Control Assessment):** a surface electromyography-based measure of motor output from central nervous system during a variety of reflex and voluntary motor tasks performed under strictly controlled conditions.

**BWSTT:** Body Weight Supported Treadmill Training

**COPM (Canadian Occupational Performance Measure):** Interview assessment of an individual’s perceived occupational performance in the areas of self-care, productivity, and leisure.

**CUE:** Capabilities of Upper Extremity is a clinical measurement of upper limb function for use in person with tetraplegia (quadriplegia)

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**DASH:** Disability of Arm, Shoulder, Hand scale is a measure of the upper limb function

**DXA:** Dual-energy X-ray absorptiometry is a test which measures bone mineral density

**EMG:** the electromyogram refers to a physiological test of muscle and nerve function.

**FMA-UL:** Fugl-Meyer Assessment - Upper Limb, an assessment of upper extremity functional capacity

**Frankel Scale:** an older scale for classifying severity of injury that was modified in 1992 to create the AIS.

**F/U:** follow-up

**GRASSP:** Graded Redefined Assessment of Strength, Sensibility, and Prehension is a clinical measurement of upper limb function for use in person with tetraplegia (quadriplegia)

**H-Reflex:** an electrophysiological measure that assesses the monosynaptic reflex; used as a measure of reflex pathway continuity and excitability

**ICSH:** International Classification for Surgery of the Hand in Tetraplegia is a clinical measure of hand function used by surgeons performing reconstructive surgery to improve function in persons with tetraplegia

**ISNCSCI:** International Standards for Neurological Classification of Spinal Cord Injury—sometimes referred to as the ASIA (American Spinal Injury Association) standards. This refers to the accepted international standards for performing motor/sensory physical examination of persons with spinal cord injury and the classification scheme for documenting the neurological level and the severity (completeness) of injury.

**MEP:** Motor Evoked Potentials, a physiological assessment of motor pathways performed by stimulating the motor cortex of the brain and recording muscle activation responses

**N/A:** not applicable

**NS:** not specified

**Open Label:** a trial in which there is no attempt to conceal the identity of the intervention from the subjects; i.e. there is no “blinding” or “masking” of the intervention—the subjects know that they are receiving the “active ingredient” rather than a placebo.

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**PGI:** Patient Global Impression is a patient reported outcome measurement that rates symptom severity, treatment response, or other specified outcomes on a multipoint scale

**Phase of Study:** Clinical trials usually progress in phases from 1 to 4; Note: trials of rehabilitation and technology interventions are commonly not classified by Phase of Study; i.e. not applicable (N/A) or not specified (N/S)—sometimes documented by investigators as Phase 0

1. Phase 1 trials are usually first-in-human or first-in-disease/condition experiments that are intended to demonstrate feasibility (can it be done), safety (is it reasonably safe), and tolerability (are the side effects tolerable). Phase 1 trials usually do not include a comparison control group and as such, do not provide direct evidence of the interventions efficacy. Phase 1 trials usually enroll a small number of subjects and are commonly done at a single study center but may use a small number of collaborating centers.
2. Phase 2 trials follow successful completion of Phase 1. Phase 2 trials are used to develop information on intervention administration (how to give), dose (how much to give), timing (when and how long to give), effect of the intervention on the body (what does it do, beneficial or harmful). Phase 2 trials commonly utilize multiple study centers, many subjects, and include a randomized control group to provide direct information about efficacy and safety of the intervention. Phase 2 trials enable refinement of how to administer the intervention and how to measure its beneficial effects (what Outcome Measurement to use).
3. Phase 3 trials are conducted using the refined protocols developed from Phase 2 trials. Phase 3 trials are often termed “pivotal” studies because they are sufficiently well-designed and rigorously conducted that their results, if positive, can be used to make the case for regulatory approval (e.g. trials that lead to FDA approval for clinical use). Phase 3 trials almost always enroll large numbers of subjects (in the hundreds or more), use multiple study centers, and randomized control group design (with placebo control and double blinding if feasible). The FDA generally requires two successful confirmatory Phase 3 trials of an intervention for approval.
4. Phase 4 trials are conducted after regulatory (e.g. FDA) approval to gather additional safety and efficacy data.

**PIADS:** the Psychosocial Impact of Assistive Device Scale (PIADS) is a 26-item, self-report questionnaire designed to assess the effects of an assistive device on functional independence, well-being, and quality of life.

**RCT:** Randomized Controlled Trial—a clinical trial in which subjects are randomly (like flipping a coin) assigned to either receive the active treatment or an alternative (control). Well-designed RCT’s minimize the influence of variables other than the intervention that might have an effect on the desired outcome. For this reason, they provide the best evidence of efficacy and safety. The most rigorous RCT’s utilize a placebo (inactive) control group and blinding (concealing active vs. control assignment) to minimize bias in the interpretation of study results.

**SCIM:** the Spinal Cord Independence Measure is a measure of a person’s ability to perform certain activities independently; i.e. an outcome measure of a research subject’s independence in the performance of a variety of specific activities.

**SCI-SET:** 7-day recall self-report questionnaire that takes into account both the problematic and useful effects of spasticity on daily life in people with SCI.

**6 Minute Walk Test:** the distance that can be walked in 6 minutes



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**10 Meter Walk Test:** the time required to walk 10 meters

**tDCS:** Transcranial Direct Current Stimulation

**TRI-HFT:** Toronto Rehabilitation Institute Hand Function Test, a clinical measure of hand function

**Wernig Scale:** a 6-item (0–5) classification scheme that describes the degree of walking independence with or without ambulatory aids.

**WISCI:** Walking Index for Spinal Cord Injury is an ordinal scale measure for walking capabilities in persons with spinal cord injury

**WMFT:** Wolf Motor Function Test