Author, Year; Country Score Research Design Sample Size	Methods	Outcomes
Other forms of electrically assisted training		
Menendez et al. 2016 Spain PEDro=7 RCT Level 1 N=10	**Population**: 10 individuals- 8 males and 2 females; all wheelchair users; AIS A or B; mean age =46.3 ± 12.9y; years post injury= 12.4 ± 7.8y **Treatment**: All participants received 10 2-h rehabilitation sessions per month, which consisted of standing (tilted) position, passive movements, low-intensity resistance training or electrotherapy and physiotherapy treatment. Ten participants with SCI were assessed in five different sessions. After a familiarization session, four interventions were applied in random order; Whole body vibration (WBV), Electromyostimulation (ES), simultaneous WBV and ES (WBV+ES), and 30 s of WBV followed by 30 s of ES (WBV30/ES30). Each intervention consisted of 10 sets × 1 min ON+1 min OFF. Participants were seated on their own wheelchairs with their feet on the vibration platform (10 Hz, 5 mm peak-to-peak), and ES was applied on the gastrocnemius muscle of both legs (8 Hz, 400 µs). **Outcome Measures:** Popliteal artery blood velocity (BV) and skin temperature (ST) of the calf	1. The simultaneous application (WBV+ES) produced the greatest increase in mean BV (MBV; 36% and 42%, respectively) and peak BV (PBV; 30% and 36%, respectively) during the intervention. 2. This intervention produced the greatest mean increases in MBV (21%) and PBV (19%) during the recovery period. Last, this intervention produced the highest increase in ST during the intervention (2.1 °C).
Carty et al. 2012; Ireland Prospective cohort Level 2 N=14	**Population:** N = 14 participants with T2-T11 SCI (11M;3F); 11 AIS A, 3 AIS B; mean (SD) age: 45.08 (7.92); mean (SD) yr since injury: 11.22 (11.23). **Treatment:** Four electrodes were placed bilaterally on the quadriceps and hamstrings muscle groups, and subtetanic contractions were elicited using a neuromuscular electrical stimulation device. Training was undertaken for 1 hr, 5d/wk for 8 weeks. Participants increased the stimulation intensity on an incremental wheelchair exercise test of increasing speed and incline as quickly as tolerable to bring them to the desired training intensity as recorded on the Borg scale of rating of perceived exertion (RPE) (between 13 and 15 on RPE). **Outcome Measures:** Incremental treadmill wheelchair propulsion exercise test with simultaneous cardiopulmonary gas exchange analysis to determine VO_{2peak} and HR_{peak}.	1. A significant increase in VO_{2peak} and HR_{peak} between baseline and follow-up was observed. Changes in VO_{2peak} ranged from -1.1% to 57.2%. 2. There was no significant difference in the mean VO_{2peak} change between the 2 groups based on the level of injury (above T6, T6 and below).
Asselin et al. 2015 USA Pre-Post Level 4 N= 8	**Population**: 8 individuals; non-ambulatory persons with paraplegia. **Treatment**: 8 non-ambulatory persons with paraplegia were trained to ambulate with a powered exoskeleton. Once the participant was fitted properly in the device, he or she participated in three training sessions per week. **Outcome Measures:** Measurements of oxygen uptake (VO2) and heart rate (HR) were recorded for 6 min each during each maneuver while sitting, standing, and walking.	1. The average value of VO2 during walking was significantly higher than for sitting and standing. 2. The HR response during walking was significantly greater than that of either sitting or standing. Persons with paraplegia were able to ambulate efficiently using the powered exoskeleton for overground ambulation, providing the potential for functional gain and improved fitness.

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Ryan et al. 2013; USA Pre-post Level 4 N=14	**Population:** N = 14 Participants(11M;3F) with motor complete SCI C4-T7 level; AIS A or B; mean (SD) age: 26.7(4.7) yr; mean (SD) time post injury: 7.7 (6.5) yr. **Treatment:** Participants performed resistance exercise training of the knee extensor muscles twice weekly for 16 weeks. Four sets of 10 knee extensions were performed using neuromuscular electrical stimulation. Legs were alternated after 10 repetitions, and training sets were separated by 2 min. **Outcome Measures:** plasma glucose and insulin; thigh muscle and fat mass; quadriceps and hamstrings muscle size and composition; muscle oxidative metabolism.	1. Mean (SD) muscle mass increased in all participants (39(27)%). The mean change (SD) in intramuscular fat was 3(22)%. 2. Phosphocreatine mean recovery time constants (SD) were 102(24) and 77(18)s before and after electrical stimulation-induced resistance training, respectively. 3. No improvement in fasting blood glucose levels, homeostatic model assessment calculated insulin resistance, 2-hour insulin, or 2-hr glucose was observed.
Taylor et al. 2011; USA Pre-post Level 4 N = 6	**Population:** Six male patients with SCI (T4-T9, ASIA A, within 18 years of injury, and younger than 40 years) **Treatment:** Arms-only rowing and FES rowing. A sub-group (n = 3) completed at least 6 months of a progressive FES row training exercise program with graded exercise tests every 6 months. **Outcome measures:** VO_2peak, peak ventilation, peak respiratory exchange ratio, peak heart rate, and peak oxygen pulse.	1. VO_2peak was greater for FES rowing (20.0 ± 1.9 $mL·kg^{-1}·min^{-1}$, P=.01) than for arms-only rowing (15.7 ± 1.5 $mL·kg^{-1}·min^{-1}$) 2. For 5 participants, the increase in aerobic capacity ranged from 12 to more than 50%. 3. Peak respiratory exchange ratio was higher for arms-only rowing than FES rowing (1.28 ± 0.16 vs. 1.17 ± 0.03, P = 0.14) 4. Peak heart rate was higher for FES rowing than arms-only rowing (179 vs. 170, P = 0.19). 5. Peak oxygen pulse was 35% greater during FES rowing than arms-only rowing (6.90 vs. 9.08, P = 0.0007).
Jeon et al. 2010; Canada Pre-post Level 4 N = 6	**Population:** 6 healthy male participants with paraplegia participated in the study (mean age, 48.6±6y; mean weight, 70.1 ± 3.3 kg; injury levels between T4-5 and T10). **Treatment:** Twelve weeks of FES-rowing exercise training 3 to 4 times a week (600–800 kcal). **Outcome measures:** VO_2peak, plasma leptin, insulin, and glucose levels, insulin sensitivity, body composition.	1. VO_2peak increased from 21.4 ± 1.2 to 23.1 ± 0.8 $mL·kg^{-1}·min^{-1}$ (P = 0.048). 2. Plasma glucose levels were reduced in all 6 patients after the training (pre: 103 ± 7.4 vs. post: 92.5±3.7 $mg·dL^{-1}$); however, this did not reach statistical significance. 3. Plasma leptin levels were significantly decreased after the training (pre: 6.91 ± 1.82 $ng·dL^{-1}$ vs. post: 4.72 ± 1.04 $ng·dL^{-1}$; P = 0.046). 4. Plasma glucose and leptin levels were significantly decreased after exercise training by 10% and 28% (P = 0.028), respectively. 5. Whole-body percent body fat decreased

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		by 5% (pre: 25.5 ±1.8 vs. post: 24.4 ± 1.6%); however, this did not reach statistical significance (P = 0.074) 6. A trend toward fat mass reduction was seen in 4 of the 6 participants; this change did not reach statistical significance (P = 0.08).
Berry et al. 2008 UK Pre-Post Level 4 N = 11	**Population:** 12 SCI participants(10 male, 2 female), with motor and sensory complete T3 to T12 lesion (AIS - A) **Treatment:** Electrically stimulated (ES) cycling training, 236 sessions over 52 weeks **Outcome Measures:** heart rate; O_2 pulse; power output	1. Peak heart rate increased by 13% after 6 months 2. Peak O_2 pulse increased significantly after 6 months 3. Peak power output increased significantly after 3 months and 6 months
Stoner et al. 2007; USA Pre-post Level 4 N = 5	**Population:** 5 males; Age: mean 35.6±4.9 yrs; Level of injury: range C5-T10; Time since injury: mean 13.4±6.5 yrs; Type of injury: AIS A. **Treatment:** Neuromuscular electric stimulation-induced resistance training; the quadriceps femoris muscle group of both legs were trained 2x/week with 4x10 repetitions of unilateral, dynamic knee extensions for 18 weeks. **Outcomes measures:** FMD and resting diameter and arterial range of the posterior tibial artery.	1. FMD improved from 0.08 ± 0.11 (2.7%) to 0.18 ± 0.15 (6.6%) and arterial range improved from 0.36 ± 0.28 mm to 0.94 ± 0.40 mm. Resting diameter did not change.
Sabatier et al. 2006; USA Pre-post Level 4 N = 5	**Population:** All male, complete AIS A, C5-T10, age 35.6 yrs, 13.4 yrs post-injury. **Treatment:** Home-based electrical stimulation 2 d/wk, 18 wks. **Outcome Measures:** Femoral artery diameter and blood flow, weight lifted, muscle mass, and muscle fatigue.	1. Training resulted in significant increases in weight lifted and muscle mass and a decrease in muscle fatigue. 2. There was no change in femoral artery diameter with training. 3. Resting, reactive hyperaemia, and exercise blood flow did not change significantly with training.
de Groot et al. 2005; The Netherlands Pre-post Level 4 N = 6	**Population:** SCI: 3 male, 3 female, T4-L2, all complete AIS A/B, age 43 yrs, 14.5 yrs post-injury; Controls: 8 able-bodied individuals (4 male, 4 female), age 41 yrs. **Treatment:** Unilateral surface stimulation of the quadricep, tibial anterior, and gastrocnemius muscles, 30 min/d, daily, 4 wks. **Outcome Measures:** Leg circumference, total limb volume, resting mean red blood cell velocity and vessel diameter and blood pressure.	1. An increase in arterial compliance and a decrease in the flow-mediated dilation in the femoral artery of the trained leg, with no changes in these vascular parameters in the femoral artery of the untrained leg, the carotid artery, and the brachial artery. 2. There were no significant training-related changes in resting vessel diameter, blood flow, or shear rate in the femoral, carotid, and brachial arteries.
Wheeler et al. 2002; Canada Pre-post Level 4 N = 6	**Population:** C7-T12, 5 AIS A, 1 AIS C, age 42.5 yrs, 13.8 yrs post-injury. **Treatment:** FES (quadriceps) with arm rowing (70%–75%VO_2peak) 30 min/d, 3 d/wk, 12 wks. **Outcome Measures:** Total rowing distance, VO_2peak, and peak oxygen pulse.	1. Training resulted in significant increases in rowing distance (25%), VO_2peak (11.2%), and peak oxygen pulse (11.4%).
Jacobs et al. 1997; USA	**Population:** 12 males and 3 females; Age: mean 28.2 ± 6.8 yrs, range 21.1-45.2 yrs; Time since	1. Heart rate was lower throughout sub-peak levels of arm ergometry after the ambulation

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Pre-post Level 4 N = 15	injury: mean 3.7 ± 3.0 yrs, range 7-8.8 yrs; Type of injury: all AIS A paraplegia; Level of injury: T4-T11 **Treatment:** 32 sessions of functional neuromuscular stimulation ambulation training using a 6-channel system (Parastep ® 1). Participants trained 3 days/week. Typically, three walking trials were completed during each training session. Participants chose ambulation pace and duration. **Outcome measures:** HR, peak VO_2	training. 2. Peak VO_2 increased from 20.0 ± 3.3 $mL \cdot kg^{-1} \cdot min^{-1}$ to 23.0 ±3.6 $mL \cdot kg^{-1} \cdot min^{-1}$ post-training.
Nash et al. 1997; USA Pre–post Level 4 N = 12	**Population**: SCI: T4–T11 **Intervention**: Parastep training (FES with aid of walker), 3 times per week for 12 weeks. Duration based on comfort of the participant. **Outcome measures**: Femoral artery end-diastolic diameter and flow velocity profiles at rest and after 5 min thigh occlusion.	1. Increased resting common femoral cross-sectional area, computed pulse volume, and arterial inflow volume. 2. Peak systolic velocity was not significantly different. 3. After 5-min thigh occlusion, femoral pulse volume, flow velocity integral and arterial inflow volume increased after training.
Solomonow et al. 1997; USA Pre-post Level 4 N = 70	**Population:** All paraplegia, no other details given. **Treatment:** Reciprocating gait orthosis (RGO) 3 hr/wk, 14 wks. **Outcome Measures:** Cardiac output, stroke volume, vital capacity, knee extensor torque, and heart rate at the end of a 30 m walk.	1. There was a non-significant increase in cardiac output (7.1%) and stroke volume (5.0%) after training. 2. There was a significant increase in knee extensor torque (78.2%).

Note: AIS = ASIA Impairment Scale; BP = blood pressure; d = day; FES = functional electrical stimulation; HR = heart rate; min = minute; wk = week; yrs = year; VO_2peak = peak aerobic power.