Locomotor Training in the Pediatric Spinal Cord Injury Population: A Systematic Review of the Literature

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Background

Currently there is very little evidence to support the natural progression of recovery in children with spinal cord injury (SCI) leaving the restoration of walking ability an increasingly important goal in physical therapy. Locomotor training (LT) is a rehabilitation strategy that aims to restore both walking and postural control after an SCI. This strategy uses functional training with the goal of facilitating activity-dependent neuroplasticity by providing sensory input to the damaged nervous system. Through neuroplasticity, neurons in the central nervous system change their structure and function in response to development, learning, or injury. Several different types of LT exist, including body weight supported treadmill training and robotic, which aim to provide appropriate affirmer information for the desired motor pattern.

Purpose

The aim of this review was to investigate the effects of LT on pediatric SCI and develop recommendations for pediatric LT guidelines.

Methods

Preliminary Search

- Databases searched: PubMed, Scopus, Ovid, and CINAHL
- Search terms: children, pediatric, locomotor training, gait, treadmill, spinal cord injury
- Search conducted: individually by the five primary authors

Article Selection

- Inclusion criteria: abstracts, full-length articles, pediatric populations, adult studies, spinal cord injury, availability to distinguish specific pediatric data
- Exclusion criteria: inclusion criteria, abstracts, full-length articles, pediatric populations, adult studies, spinal cord injury, availability to distinguish specific pediatric data

Inclusion Criteria

- Human studies
- Abstracts
- Published in last 10 years
- Book chapters
- Pediatric populations
- Adult studies
- Spinal Cord Injury
- Availability to distinguish specific pediatric data

Exclusion Criteria

- Inclusion criteria
- Abstracts
- Full-length articles
- Pediatric populations
- Adult studies
- Spinal Cord Injury
- Availability to distinguish specific pediatric data

Evaluation of Quality and Risk of Bias

A risk of bias assessment was performed using the Downs and Black checklist, which was developed to assess methodological quality of both randomized and non-randomized research studies. The final six studies were graded by three students and the faculty research advisor. Discrepancies between article scores were determined through discussion and resolved via research group consensus.

Participant Characteristics

- Authors
- Study design/subjects
- Age/gender
- Injury level
- Time from injury to intervention

Intervention Descriptions

- Intervention
  - Behavioral Training (BWSTT)
  - Occupational Therapy (OG)
- Time spent training
  - 30-90 minutes
- Participant characteristics
  - 20 sessions
- Participants: 208 sessions
- Participants: 45 sessions
- Parameters used to ensure LT and maintain performance include:
  - Variability in stepping
  - Parameters used to ensure LT and maintain performance include:
  - Variability in stepping

Results

Outcomes Measures and Results by Study

- Participants: Behrman (2008)
- Time of measurements
  - Baseline and 10 weeks later
- Distance measured
  - Baseline, 10 weeks later
- Walking Independence
  - WSCG-II
  - Walking Adaptable
- Sub-activities
  - Walking Adaptable
- Gait ability
  - WSCG-II
- Balance
  - WSCG-II
- Function
  - WSCG-II
- Activities
  - WSCG-II
- Comprehension
  - WSCG-II
- Participation
  - WSCG-II

Discussion

- The results of the discussed studies indicate that the pediatric SCI population can benefit from LT.
- Several measured parameters indicate that participants made gains in the ability to ambulate, regardless of the change in the International Standards for Neurological Classification of Spinal Cord Injury level.
- No clinically best guideline for the pediatric population can be determined from this review, however, it’s worth noting the similarities and the differences among the studies that may have impacted patient progression.
- Five of the six studies focused on segmental control and the ability of the participant to maintain proper trunk, pelvis, and lower extremity alignment.
- As a patient’s independence in trunk alignment and limb position increased, BWS decreased.
- As BWS decreased and segmental independence increased, gait speed also increased, allowing for a more normalized walking speed and functional gait pattern.
- Every patient also progressed to a change in environmental practice at some point in his or her treatment (e.g. over-ground training).
- In the pediatric population, the nervous system is continuously developing, therefore, the adult guidelines for LT in the SCI population must be altered to fit the needs of the pediatric population.
- It can be noted from this review that improvements in ambulation can be seen even when initiated in the chronic phase of injury-disabling the “sooner the better” philosophy.
- Principles of neuroplasticity can help explain the comparable gains seen across various treatment implementations, as it appears most important to simply participate in task-specific training regimens.

Limitations

- No randomized control trials
- Small, specific participant population with bimodal age distribution (5-45 years and 13-17 years)
- Lack of a standardized protocol for the pediatric population
- Questionable reliability when using the ISNCSCI classification system in the pediatric SCI population
- Varying time between injury and intervention
- No consistency among outcome measures with many not being tested for reliability in the pediatric population

Conclusions

Currently, studies investigating the benefits of LT in pediatrics with SCI are based on results found within the adult SCI population. Presently, there are no established guidelines specifically for the pediatric population. While this review showed positive results for gait speed, distance, and participation, further research is needed to determine whether or not prior level of ambulation and time since injury plays a role in the ability to regain function following a SCI. Future research designs should utilize controlled research trials to determine a causal relationship between LT and the return to ambulatory function.

References