Locomotor Training Within an Inpatient Rehabilitation Program After Pediatric Incomplete Spinal Cord Injury

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Background and Purpose

The outcomes of intense locomotor training after incomplete spinal cord injury (SCI) have been described in adults with acute and chronic injuries and with various levels of ambulatory function. This case report describes a comprehensive inpatient rehabilitation program with a locomotor training component in a child with a severe incomplete SCI.

Case Description

A 5-year-old girl injured at C4 participated in locomotor training for 5 months during inpatient rehabilitation.

Outcomes

The patient's Functional Independence Measure for Children II (WeeFIM II) mobility score increased from 5/35 to 21/35. Her Walking Index for Spinal Cord Injury II (WISCI II) score improved from 0 to 12. The patient returned to walking in the community with assistive devices.

Discussion

It is feasible to include an intense locomotor training program in the clinical rehabilitation setting for a child with a severe SCI, and the outcomes were consistent with results in adults. Further investigation with experimental designs and more participants will determine the extent to which this intervention benefits the pediatric population with SCI.

Over the past decade, spinal cord injury (SCI) rehabilitation research has provided physical therapists with guidelines for locomotor training with patients following incomplete SCI.[1–6] These studies used partial–body-weight suspension and treadmill gait training with adults with acute[1–3,5] and chronic[3,6] injuries, with tetraplegia[1–5] and paraplegia,[2,3,5,6] and with various levels of ambulatory capability. Treadmill training is often followed by overground gait training.[1–3,6] The greatest improvements in function and participation have been reported in individuals with an initial American Spinal Injury Association (ASIA) Impairment Scale[7] classification of C and D,[1–6] and the majority of these participants had chronic injuries. When applied to individuals with acute[5] or chronic[8] ASIA B injuries, training did not result in improvements in overground mobility.

A recent multicenter, randomized clinical trial compared 12 weeks of locomotor training using body-weight–supported treadmill walking with 12 weeks of overground mobility training, including standing or stepping training, or both, during inpatient rehabilitation in individuals with acute incomplete SCI.[9] At the end of the intervention and at follow-up 3 months later, no differences were demonstrated between groups in Functional Independence Measure (FIM) locomotor walking scores for participants with an initial ASIA classification of B or C or in walking speed for participants with an initial ASIA classification of C or D.[9,10] However, overground walking speed was greater in both groups than traditionally achieved after incomplete SCI, with medians of 1.1 m/s (interquartile range=0.8–1.4 m/s) for the treadmill walking group and 1.0 m/s (interquartile range=0.7–1.5 m/s) for the mobility training group. These results may suggest an important effect of the intensity of training in both groups. Time from injury to initiation of either type of training also was important, with those beginning either intervention within 4 weeks of injury demonstrating better outcomes on all measures at both the 12-week and follow-up assessments than those beginning training 4 to 8 weeks after injury.[9,10]

Children under the age of 16 years accounted for 3.7% of traumatic SCIs reported by the Model Spinal Cord Injury Systems (MSCIS) between 1973 and 2003.[11] This percentage, however, likely underestimates the percentage of children in the total population, as young children are frequently treated in pediatric facilities instead of in MSCISs. There is no evidence of the effectiveness of intensive locomotor training in young children following incomplete SCI. Neuromaturation of the central motor pathways is known to continue until adolescence,[12–15] yet little is known of the potential for these processes to interact with the training-induced plasticity of the nervous system that occurs with locomotor training.[16,17]

The primary purpose of this case report is to describe and report outcomes of a comprehensive inpatient rehabilitation program with a locomotor training component in a child with a severe incomplete SCI. A secondary purpose is to demonstrate the feasibility of implementing such a program in the clinical rehabilitation setting, as measured by patient tolerance, use of personnel, and cost.

Case Description

Patient

Information regarding the patient's injury and acute hospitalization were obtained from medical chart review in a manner that complied with the Health Insurance Portability and Accountability Act requirements for disclosure of protected health information. Both parents gave written consent for the case to be reported. The patient also signed an assent of a minor statement.

The patient was a 5-year, 10-month-old girl injured in a motor vehicle accident. Her Glasgow Coma Scale[18] score in the emergency department was 13/15. A computed tomography (CT) scan of her cervical spine revealed fractures of C4 and C5 with normal alignment. Magnetic resonance imaging of the cervical spine showed ligamentous injury with edema from C2–C6 and enlargement of the cord with edema consistent with contusion from C3–C5. A CT scan of the head revealed a mild fracture of the left frontal bone, a small left frontal pneumocephalus, and a mild left subdural hematoma. Steroids were administered and a halo brace was placed on her 3 days after injury. The patient was transferred to a pediatric inpatient rehabilitation facility 5 days after the injury with a diagnosis of SCI at C4, an ASIA A classification, and mild traumatic brain injury.

Examination, Evaluation, and Prognosis

The initial physical therapist examination occurred on the day after admission to inpatient rehabilitation. The patient was dependent for all self-care and mobility. She had full passive range of motion in all extremities except that pain limited shoulder elevation bilaterally. She tolerated elevation of the head of her bed to 45 degrees for approximately 30 minutes. She had a neurogenic bowel and bladder. Her cognition was intact. The patient was motivated and had excellent support from her family and community.

The prognosis was that upper-extremity function would improve to allow some self-care skills to be performed with adaptive equipment or assistance. According to research by Crozier and colleagues,[19] the patient's ambulatory prognosis based on sacral sensation was poor. In their review of patients classified as ASIA B 24 hours after injury, those with only light touch sensation in the sacral dermatomes had an 11% chance of becoming functional ambulators compared with 89% of those with light touch and pinprick sensation. Moreover, the patient in this case was classified as ASIA A 24 hours after injury and was not classified as ASIA B until 5 days after injury. The patient was not considered a candidate for gait training at this time due to the severity of her motor and sensory impairment.

Outcome Measures

Initial status and outcomes were assessed at all levels of the *International Classification of Functioning, Disability and Health*, including impairment (ASIA sensory and motor scores), activity (Functional Independence Measure for Children II [WeeFIM II] and Walking Index for Spinal Cord Injury II [WISCI II] scores), and participation (patient and parent report).[20,21]

ASIA sensory and motor scores. The patient's initial ASIA sensory score was 26/224 (initial pinprick score=12/112, initial light touch score=14/112), including impaired light touch in the right S3 and S4–5 dermatomes. The patient also demonstrated trace contraction of the left biceps brachii muscle, scoring 1/50 for the Upper Extremity Motor Score (UEMS) and 0/50 for the Lower Extremity Motor Score (LEMS). The reliability of ASIA scores in children 6 to 11 years of age have been reported.[22] Intraclass correlation coefficients (ICC) with 95% confidence intervals were .711 (.226–.892) for total motor score, .952 (.867–.983) for pinprick score, and .952 (.867–.983) for light touch score.[22]

WeeFIM II. Initial WeeFIM II[23] motor scores were: mobility=5/35, self-care=8/54 (54 is age-appropriate self-care maximum for a 5- to 6-year-old). This scale is highly reliable in children with disabilities (ICC=.98 for combined mobility and self-care subscale scores).[24]

WISCI II. The patient's ambulation ability was 0 (unable to walk) on the WISCI II scale.[25] Reliability of the original version of this instrument was 100% in an international study, and the correlation coefficient (r) for concurrent validity with the FIM was .77.[26] The age range of the participants was not reported. Criterion validity was assessed in a later study that showed relationships with the Spinal Cord Independence Measure (r=.97), the FIM (r=.70), and the LEMS (r=.58).[27] The age of the youngest participant in the study by Morganti et al[27] was 12 years (mean age=50.4±19.3 years).

Mobility in home, school, and community. Participation information was collected by patient and parent report. At the initial evaluation, the patient was not participating in any home, school, or community activities.

Intervention

Inpatient Rehabilitation

The physical therapy plan of care was designed as indicated by the *Guide to Physical Therapist Practice*,[28] evidence in SCI and pediatric rehabilitation, the primary therapist's (LAP) clinical experience, and the patient's and her family's values. The patient received inpatient physical therapy for 60 to 90 minutes per day on weekdays, 30 minutes each Saturday, and 2 to 4 additional 30-minute aquatic physical therapy sessions per week, for an average of 8 to 9 total hours of physical therapy each week. Physical therapy sessions initially included family and patient education, power wheelchair positioning and mobility, sitting tolerance, and passive range of motion. With return of volitional control, activities progressed to bed mobility, therapeutic exercise, trunk control activities, transfer training, and locomotor training. Aquatic physical therapy sessions focused on upright mobility, lower-extremity weight bearing, and stepping.

As part of her comprehensive rehabilitation program, the patient also received intense occupational therapy, as well as recreation and child life therapies, psychology, school, and weekly play and support groups. Occupational therapy was typically two 30-minute sessions every weekday and one session each weekend, and the sessions focused on upper-extremity function, sitting, and self-care activities such as eating, grooming, writing, and dressing. Recreation therapy was typically two or three 30-minute sessions per week and focused on upper-extremity function and fine motor skills, particularly for using a computer and playing board games.

Locomotor Training

Ambulatory prognosis was reassessed 1 month after injury when some volitional lower-extremity movement returned. At that time, the patient demonstrated volitional right knee extension and ankle dorsiflexion (LEMS score=4/50), a UEMS score of 8/50, and volitional anal contraction. Her ASIA classification was C, and the pattern of sensory and motor loss was consistent with Brown-Séquard syndrome.[7] Based on the rehabilitation team's previous experience and the predicted long-term functional status from UEMS and LEMS 1 month after injury,[29] the prognosis at this time was that, with locomotor training, the patient would achieve some ambulation with assistive devices.

The patient did not have any contraindications for locomotor training with body-weight support (eg, lower-extremity contractures, orthostatic hypotension, and pressure wounds at the area of contact with the weight support harness).[3,30] The patient was cleared for locomotor training by her orthopedic surgeon and the attending pediatric physiatrist. Locomotor training was initiated at this point and included within physical therapy sessions. Training was provided as described in other work[2] using a Lite Gait WalkAble* over a *Gait*Keeper 1800T treadmill.* The parameters in Table 1 were established by previous work with adults and were followed as closely as possible. Each was reassessed daily and progressed when appropriate. A physical therapy aide who was trained in providing manual assistance assisted in early training when the patient required stepping assistance for each leg. The importance of achieving knee extension during mid-stance and hip extension during terminal stance was emphasized.

The Lite Gait WalkAble system does not have the capacity to automatically measure weight support. Weight support was measured at the beginning of each session with a scale that was level with the treadmill belt. The patient was instructed to "Push down through your legs as much as you can. Make your knees straight." Weight on the scale was subtracted from her body weight and the weight supported by the harness was calculated as a percentage of body weight. The accuracy of this system may be less than those with automatic measurement, but the same scale was used each time to increase the reliability in indicating the relative decrease in weight support between sessions.

Overground training began 10 weeks after injury, when the patient could independently step with her right leg on the treadmill. Overground training followed treadmill training the majority of sessions thereafter. Initially, overground training included the use of a posterior rolling walker, left articulated ankle-foot orthosis (AFO), and the assistance of the therapist and aide. Progression followed in a similar manner as treadmill training—with daily reassessment; a gradual decrease in assistive devices, orthoses, and manual assistance; and a gradual increase in speed and distance walked. Upright trunk posture, symmetrical weight shifting, and hip and knee extension were emphasized during overground training.

The child was able to tolerate the intense locomotor training in addition to all of the other therapies included in inpatient rehabilitation. Several techniques were used to motivate and reward her for cooperating with the program. The therapist, aide, and patient would play a variety of word games, sing songs, or play music during the time on the treadmill. The patient also was given one thing at a time on which to concentrate, such as "step with your left leg like you are marching" or "make your knee all the way straight." She was rewarded for achieving a specific time goal each session and was given feedback on her progress (eg, "only 2 minutes left"). Rewards usually involved playing 5 minutes of her favorite board game at the end of the session and included her choosing where to walk when the treadmill training was followed by overground training (she loved going to visit other people, such as her occupational therapist or psychologist).

The child's active participation was essential to the success of the program. The therapist asked for and valued the patient's feedback and frequently made small adjustments when requested by the patient (eg, harness too tight). She was never forced to continue when she was in pain or scared (and modifications did not resolve the issue), but she was expected to work hard and concentrate when necessary.

Outcomes

Locomotor Training

Once initiated, locomotor training was performed 3 to 4 times per week for the remainder of the patient's inpatient admission (6 months total in duration), except for a 1-week period after removal of the halo brace (15 weeks after injury) due to poor

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Table 1.
Parameters for Locomotor Training Using a Treadmill and Body-Weight Support With Patients With Incomplete Spinal Cord Injury

Parameter	Goal
Frequency	3–5 d/wk[1–5]
Duration	20–30 min[1,2,5]
Speed	Approximate normal walking speed[1,2]
Weight support	The least amount required to achieve knee extension independently, if possible[1–3]
Manual assistance	The least amount required to achieve whole body normal gait kinematics[1,2]
Handlebars	Do not use, encourage reciprocal arm swing[1,2]
Orthoses	Avoid use as they inhibit normal gait kinematics[1]

Table 2.
Progression of Locomotor Training (LT) With Body-Weight Support Over a Treadmill

Month After Injury	Weight Support (Percentage of Body Weight)	Speed (m/s)	Manual Assistance Provided	
			Right	Left
1 (first LT session)	80%	0.27	Total	Total
2	50%–52%	0.35–0.45	25%	Total
3	40%	0.45–0.54	None	50%
4	28%–34%	0.67–0.80	None	50%
5	18%–22%	0.80–0.98	None	50%
6	10%	0.98–1.12	None	25%

head control and cervical pain. Duration of training progressed from 10 minutes during the first 3 sessions to an average of 20 minutes for the remainder of sessions. During the return of bowel and bladder function, the patient frequently expressed an urgent need to void, and several sessions were terminated early. This patient never experienced any autonomic dysreflexic episodes. Table 2 shows the month-to-month progression of locomotor training in the body-weight support and treadmill environment.

Some adaptations to the recommended parameters (Tab. 1) were necessary in the clinical setting and to achieve optimal training despite the severity of the patient's injury. Handlebars were used for the first several weeks of training. The patient was not able to grasp the bars at the time, but would rest her forearms on the bars to prevent bilateral shoulder pain from the combination of shoulder weakness and the weight of gravity on her arms. The handlebars were removed as soon as she could tolerate it. The handlebars also had been helping to stabilize her trunk, however, and after they were removed, her trunk moved excessively during stepping in the harness. This trunk movement is controlled by a trunk trainer in research settings,[1,2] but this clinical setting did not have the advantage of a third person to assist with training. An elastic band was used around the pelvis and tied to the treadmill in front for 2 weeks to stabilize the pelvis and allow isolated hip extension bilaterally.

The patient's left AFO was used initially to help control the knee and allow the therapist to focus on facilitating hip and knee kinematics. The AFO was initially a solid ankle orthosis and in neutral position, as no lower-extremity movement was present at the time of fabrication. Facilitation of gait at this point achieved heel-strike, and the foot moved to foot flat as the tibia moved to a vertical position. In order to not restrict step length on the contralateral side, heel-off was facilitated with greater flexion of the knee than typical. Several weeks into the training, when lower-extremity movements were improving, an articulated ankle orthosis was fabricated to allow for more optimal ankle kinematics, although it still limited plantar-flexion range of motion. The AFO continued to be used frequently for the next few months to prevent ankle pain that typically began after 5 to 10 minutes on the treadmill and restricted the patient's ability to bear weight through the limb.

Additionally, the patient had a halo brace for the first 10 weeks of training. After the halo brace was removed, the patient was cleared for any activity that she could tolerate, while wearing an Aspen collar. She was not comfortable walking for 1 week after removal of the halo brace due to neck pain and cervical muscle weakness that made it difficult for her to hold her head upright. During that week, physical therapy focused on gentle therapeutic exercise and manual therapy to the neck, and head and upper trunk control in static positions. After a 1-week hiatus of locomotor training, the Aspen collar was worn for 2 additional weeks and a custom-made soft spinal orthosis (SSO) was worn for the following 4 weeks to aid in upright posture. The patient was gradually weaned off both devices as she was able to maintain an upright trunk on her own.

Overground Walking

During the initial overground training session, the patient used a posterior rolling walker, and 2 people provided manual assistance. One person provided weight support at the pelvis and assisted with weight shifting. The second person assisted in left lower-extremity stepping, advancing the walker, and maintaining the patient's grip on the walker. By discharge from inpatient rehabilitation, the patient was walking all day between her room and all therapy sessions (30–100 m each trip) independently with a forward rolling walker and left articulated AFO. She could walk up to 30 m with supervision using bilateral Loftstrand crutches and the AFO. Physical therapy sessions included ambulating without assistive devices, with approximately 25% assistance at the pelvis for up to 30 m. She ambulated in the community with a rolling walker and the articulated AFO.

ASIA Impairment Scores

At discharge from inpatient rehabilitation, the patient's sensory scores were 98/112 for pin prick and 112/112 for light touch. Her UEMS increased from 8/50 at the initiation of training to 31/50 and her LEMS increased from 4/50 to 29/50 (Figure, graph A). All key muscles on the right side were 4/5 except fifth finger abduction, which was 3/5. On the left side, greater impairment was present distally compared with proximally and in the lower extremity compared with the upper extremity.

WeeFIM II

WeeFIM II scores were reassessed monthly and are shown in the Figure (graph B). The patient's scores improved from 5/35 to 21/35 in mobility and from 8/54 to 34/54 in self-care.

WISCI II

The patient's ambulation ability improved from 0 to 12 (2 crutches, braces, no assistance, 10 m) on the WISCI II scale. The Figure (graph C) shows WISCI II scores at 1-month intervals.

Participation

Two weeks prior to inpatient discharge, the patient achieved a long-term goal of walking down the aisle in her family's church. She returned to school the week after discharge and walked 100% of the time. She participated in all activities during the school's annual field day, including jumping and running short distances over grass, with the moderate assistance of a school aide. At home, she walked the majority of the time and walked up the stairs to her bedroom with a handrail and minimal assistance. She joined a community health club with her family where she went swimming daily with her father. She also began practicing riding a bicycle with training wheels outside with her parents and brother. Outpatient physical therapy

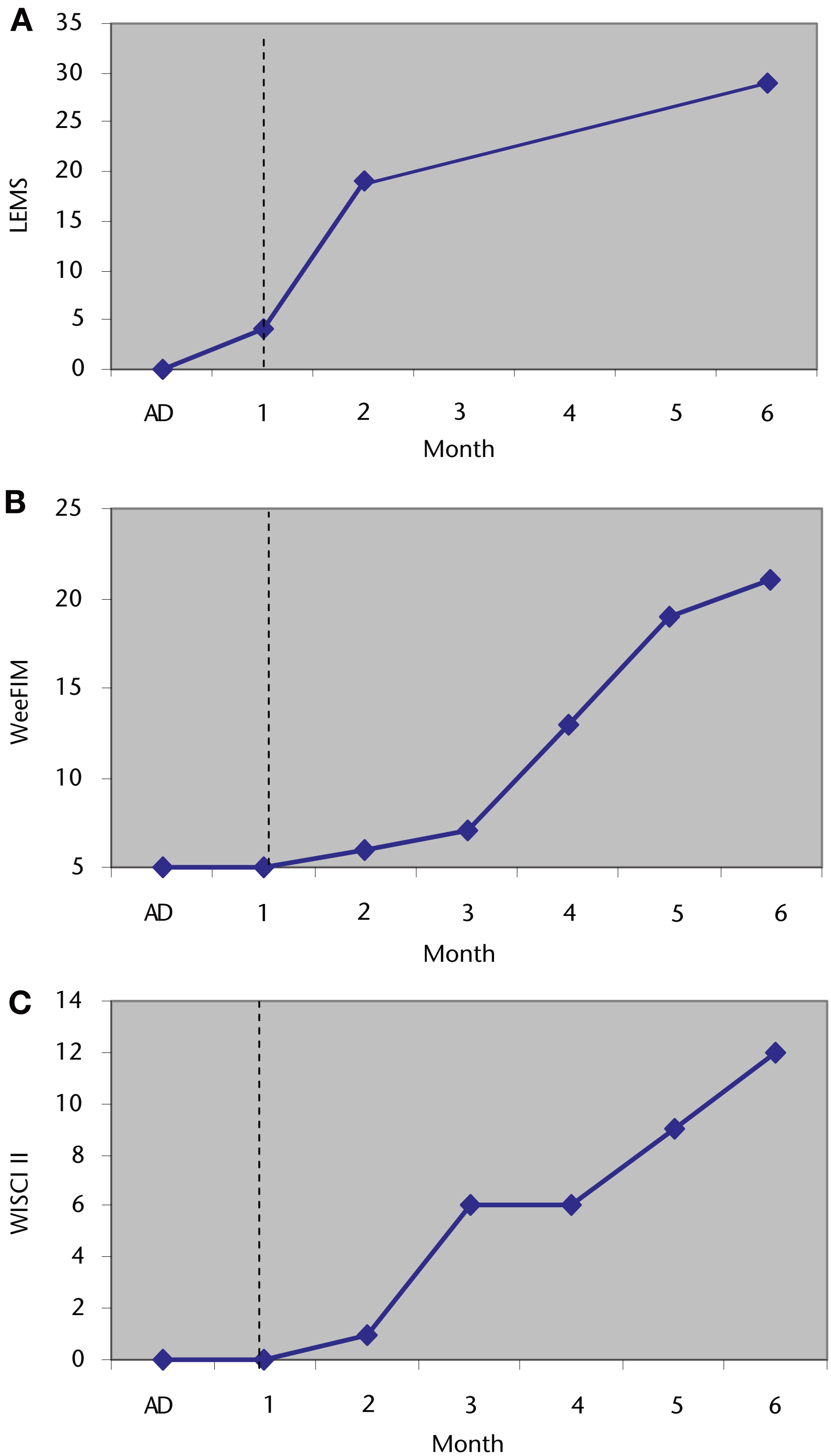

Figure.
(A) Changes in American Spinal Injury Association (ASIA) Lower Extremity Motor Scores (LEMS), (B) Functional Independence Measure for Children (WeeFIM) mobility domain scores, and (C) Walking Index for Spinal Cord Injury II (WISCI II) scores at 1-month intervals between admission and discharge from inpatient rehabilitation. AD=admission to inpatient rehabilitation hospital. Dotted vertical lines represent initiation of locomotor training 1 month after admission.

continued 2 to 3 times per week after inpatient discharge.

Discussion

This case report describes the outcomes of a comprehensive inpatient rehabilitation program with an intense locomotor component in a child with an acute incomplete SCI. Locomotor training involved a combination of weight-supported treadmill training and overground training. Progression occurred using the same guidelines as reported with adults, with some minor modifications. Some adaptations were necessary in a clinical setting with limited personnel and to achieve the most optimal training despite the patient's severity of injury. The patient made improvements in strength (force-generating capacity), ambulatory function, and participation over the course of the intervention.

Average increases in WeeFIM score for 91 children admitted to comprehensive inpatient rehabilitation for SCI have been reported.[31] Average gain for patients injured at C1–C4 was 18.3. Average gain in patients with incomplete injuries was 29.3. Measures of variability about the mean were not reported. This patient's WeeFIM score increased 42 points, indicating greater than average functional improvement; however, this patient's length of admission was longer than the average as well, making a precise comparison difficult.

Waters and colleagues[29] reported strength and functional status of 50 adults with incomplete tetraplegia 1 month and 1 year after injury in order to predict functional outcomes. Of the patients with a 1-month score of 1 to 9, the average increase in the ASIA UEMS score was 9.3 ± 6.2 and in the ASIA LEMS was 15.6 ± 8.0 and 3 of 14 individuals achieved community ambulation. This patient made UEMS gains greater than 2 standard deviations above the mean, LEMS gains greater than 1 standard deviation above the mean, and was a community ambulator in only 6 months.

These authors[29] also reported recovery of individual muscles on the ASIA scale. Of upper extremity muscles that were 0/5 at 1 month after injury, 54% recovered some volitional control (score $\geq$1/5) and 20% recovered to scores $\geq$3/5 by 1 year. In the lower extremities, 64% recovered some volitional control and 24% recovered to $\geq$3/5.[29] In the current case, 100% (7/7) of the upper-extremity muscles that were 0/5 at 1 month recovered some volitional control by only 6 months and 71% (5/7) recovered to scores of $\geq$3/5. In the lower extremities, 100% of muscles that were 0/5 at 1 month (8/8) recovered some volitional control and 50% (4/8) recovered to scores of $\geq$3/5 by 6 months.

As mentioned previously,[19] only 11% of adult patients classified as ASIA B with only light touch sensation in the sacral dermatomes 24 hours after SCI are predicted to become functional ambulators. This patient was not classified as ASIA B until 5 days after injury, and only demonstrated light touch sensation at that time, but became a functional ambulator.

Comparison of the present case with the 3 previous studies indicates that this patient made greater functional gains than predicted based on similar groups of patients who did not receive intense locomotor training. Clinical practice guidelines describe the rate of motor recovery after incomplete injuries.[32] Typically, one half to two thirds of 1-year recovery occurs within the first 2 months, with continued, but slowed, recovery from 3 to 6 months. This appears to be consistent with the present case, although her motor score at 1 year is not known. Half of the recovery up to 6 months occurred in the second month postinjury, with slower, but continued recovery thereafter (Figure, graph A).

Behrman and Harkema[2] and Hornby et al[30] each reported one patient with a similar severity of injury who received locomotor training for a similar duration as the current case. The former group[2] presented an adult (subject 2) who began training 1 month postinjury, concurrent with inpatient rehabilitation, and had a LEMS score of 2/50. At the end of training, he walked independently with a cane and had a LEMS score of 38/50. The functional outcome was slightly less, therefore, for the present case, but my patient was tetraplegic, whereas Behrman and Harkema's subject was injured at T5. Hornby et al[30] reported outcomes in a 13-year-old female (patient 1) injured at C6. In addition to conventional rehabilitation, training was initiated 6 weeks after injury. Before training, the patient had a LEMS score of 6/50 and a WISCI II score of 0. After training, her LEMS was 48/50 and her WISCI II score was 16. She ambulated in the community with 2 crutches and no braces. My patient made similar functional gains, ambulating in the community with a walker rather than crutches.

From comparison with the previous 2 cases and a multicenter clinical trial,[9,10] the results of my case appear to be consistent with outcomes in adults and adolescents who have participated in locomotor training. Intense locomotor training within inpatient rehabilitation may be effective in facilitating functional gains in children.

Supraspinal changes in response to locomotor training support the belief that plasticity within existing neural circuits plays a role in recovery of function after locomotor training for SCI.[16,17] Activity-dependent plasticity within spinal circuitry also may play a role in behavioral response to training.[33,34] Neurophysiological function of the motor pathways does not fully mature until adolescence, and it involves increases in synaptic strength, conduction time, and effectiveness of temporal facilitation, as well as decreases in motor stimulation thresholds.[12–15] Little is known about the interaction between neuromaturational processes and training-induced plasticity in the nervous system. The effectiveness of locomotor training may depend on the maturity of existing locomotor networks. Although the child in this case was well below the age of maturity, outcomes did not significantly differ from those reported in adults. She was, however, an independent ambulator prior to injury. The question remains whether locomotor training would be effective in infants or young toddlers who were not yet walking prior to injury.

We are not able to draw conclusions regarding the causal relationship of the intervention and the outcomes in this case for several reasons. First, any individual case lacks grouped data from which statistical methods of probability can be calculated. The lack of a control group prohibits our understanding of the outcomes from the locomotor training in isolation. The patient was receiving concurrent inpatient rehabilitation, which included a high frequency of other physical therapy interventions and occupational therapy, and the functional recovery may be a result of those interventions. Additionally, because the patient was in the acute phase of recovery, we can not determine whether the same results would have occurred with spontaneous neural recovery or reorganization, or to what degree these contributed to the outcomes.

The parameters for locomotor training reported in previous studies with adults were followed closely, although with some minor modifications to accommodate for the patient's severity of injury and limited personnel in the clinical setting. Frequency, duration, percentage weight support, and amount of manual assistance were followed exactly as recommended. Speed began slow at 0.27 m/s, but gradually progressed to 0.98 to 1.12 m/s, approximating the average self-selected walking speed for a child of the patient's age (1.07–1.10 m/s).[35] The patient was in a halo brace for the first 2 months of training and was uncomfortable training at faster speeds. The early use of handlebars and frequent use of the left AFO as mentioned previously also were modifications.

Although these modifications were minor, they may have reduced the afferent information to the patient's spinal cord[36] and reduced the effectiveness of the intervention. For example, the early use of handlebars may have inhibited the retraining of interlimb coordination through reciprocal arm swing.[2,37] This raises a question about how strictly the therapist should adhere to the recommended parameters when the patient is uncomfortable or when a third person is not available to help facilitate exact gait kinematics. Decisions such as these rely on the clinical judgment of the physical therapist to produce the most optimal, yet safe, training conditions and to adapt the program to an individual patient's needs when necessary.

Behrman et al[1] discussed questions regarding the feasibility of providing this type of training in the clinic rather than a research laboratory. This case report verifies the feasibility of implementing an intensive locomotor program in the clinical rehabilitation setting with a patient with severe motor impairment. The rehabilitation stay was reimbursed on a flat per diem rate, regardless of billed therapy units, so there was no additional cost for the training.

The program was included in regular inpatient physical therapy sessions with the short-term assistance of a physical therapy aide. The therapist's treatment time was not greater than any other patient with significant physical therapy needs. The aide was present for treadmill training for approximately 30 minutes, 3 to 4 times per week, for 5 weeks and assisted with overground training several times per week for an additional 3 weeks. The size of the patient may have contributed to the ease of implementing this program. She weighed only 22.5 kg (50 lb), so she could easily be lifted and positioned by the therapist alone. She also had a halo brace for the first 10 weeks of training, which supported her trunk posture while she lacked dynamic trunk control. It is possible that intervention could have been more controlled with an additional aide at the trunk, but the luxury of additional resources was not available in this setting. We did have the luxury of providing a 6-month inpatient rehabilitation program, which is extremely rare after SCI. However, this training can be initiated at the inpatient stage and continued on an outpatient basis, like many adult programs.

Summary

This case verifies the feasibility of implementing a locomotor training program within inpatient rehabilitation for a child with an acute SCI. The guidelines used with adults can be applied to children with SCI with initial severe motor impairment. Further investigation with experimental research designs will determine the extent to which this training may benefit a larger pediatric population with SCI, particularly for even younger children, and will continue to refine decision-making guidelines for children and those with severe motor impairments. As evidence supporting the effectiveness and feasibility of locomotor training continues to grow, implementation in clinical settings will increase, and more patients will benefit.

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