

A Case Study on the Effect of Pelvic Control Training on Walking Function of Children with Cerebral Palsy

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Abstract: In order to explore the feasibility of rehabilitation training for children with cerebral palsy in special schools, a case study was used to evaluate the motor abilities of a child with cerebral palsy. A series of rehabilitation training schemes were designed around the pelvic area ability of the child with cerebral palsy. The results showed that pelvic control training could improve the walking function of the children with cerebral palsy. The concept of combining education with rehabilitation can promote the physical and mental development of children with cerebral palsy.

1. Problem posing

Cerebral palsy is a group of persistent entocinesia disorder and postural dysplasia, restricted movement syndromes, accompanied by sensory, perceptual, cognitive, communication and behavioral disorders, as well as secondary skeletal problems, caused by non-progressive brain damage in developing fetuses or infants. Therefore, this kind of children are mainly manifested as abnormal motor development. At the early stage of the development of gross movement, they have lagged behind ordinary children, and then their walking movement or the control of walking posture are affected.

Walking is the most basic movement for people in their daily life, which involves unilateral support and shifting of weight. The basis for walking is the well improvement of basic ability of head, neck, trunk and pelvis, otherwise the occurrence of movement, the regulation of muscle tension and the control of posture will be negatively affected. According to the developmental sequence of children's normal movements, walking ability is the remote control ability. Before the walking movement is fully developed, The ability of the upper body and pelvic area needs to be consolidated. Bobath therapeutic techniques suggest that the core area involves the lumbar - pelvis - hip area(Liquan Cao, Aihua Chen, Sijie Tan, 2011), which is closely related to the maintenance of the body's center of gravity, the occurrence and maintenance of body's chain movements, and the stability control and coordination of pelvis. Studies have found that pelvic control training has a significant impact on the mobility and support capacity of the lower limbs of patients with hemiplegia (Jianxin Chen, Richun Zhang, Xiuyan Cheng, 2015). The kneeling posture training involves the coordination and control of abdominal and pelvic core areas, such as abdominal muscles, dorsal muscles, gluteus muscles, and iliopsoas, etc. Kneeling posture training can inhibit pelvic deflection, promote the stability control of body center of gravity in the core area(Guoliang Lin, 2014), and improve the balance function of the body(Yue Liu, Haibo Wang, Li Li, 2014).

Currently, parents of children with cerebral palsy pay more attention to children's walking ability in terms of movement. However, teachers in special schools pay more attention to their higher cognitive learning ability. Raising head, turning over, sitting, climbing, kneeling, standing, walking, running and jumping are the basic rules of normal movement development of children. Therefore, the improvement of basic ability before walking will affect the performance of gait of children with cerebral palsy and even the development of muscle tension of the whole body. Khyber's perceptual motor theory holds that human development begins with the big muscle movement, and then the movement drives perception, and perception drives the learning of concepts. Before walking and

advanced cognitive development of children with cerebral palsy, the basic ability training is also worthy of attention. The pelvic area is the starting point for most movements, which connects the torso and lower limbs. Active movements in the kneeling position have significant effect on promoting the development of muscle strength and balance of muscle tension in the pelvic area. Therefore, this study believes that pelvic ability training can positively promote the adjustment of gait and the improvement of walking ability in children with cerebral palsy.

With the concept of "combination of education and health" being put forward, special children can both receive school education and get effective rehabilitation, which reflects the equity of education and is beneficial to the positive development of special children's body and mind. In this regard, various provinces and cities are exploring the "interdisciplinary", "multi-sector" and "multi-level" integration model of education and rehabilitation(HuiWang, 2010; LianLu, Fujian Zhang, 2007). However, problems exist in the implementation process. For instance, how to find a suitable education rehabilitation method for children with cerebral palsy based on special schools still needs to be explored. In this study, a case study on pelvic control training of a child with walking cerebral palsy in a special school was carried out, in order to explore a set of motor rehabilitation methods that could be operated in the special school, so as to promote the integration of education and rehabilitation for special children.

2. Research object and method

2.1 Research Object

A female child, named Little N, born in September 2007 with dystocia, was diagnosed as spastic cerebral palsy in hospital. Now she is a freshman in a special school, and able to walk with the help of others on weekdays. Considering that the improvement of lower limb ability is related to pelvic ability, she was identified as the object of this study. She has certain language ability and likes the downy toy, but still is a introverted, timid and less talkative girl. The economic foundation of her family is poor, she has never received systematic rehabilitation training and mainly been taken care of by grandpa, because her parents go out to work.

2.2 Research Method

This study mainly presents assessment on the pelvic, walking and related performance of little N. The assessment includes existing abilities, abnormal muscle tone, and other related abilities. Observation evaluation was used for existing capability assessment, and the evaluation tools include FAC evaluation table, etc. Abnormal muscle tone was assessed by hand manipulation. The muscle tone of major muscles in the pelvis and lower limbs was evaluated as well. Other relevant abilities were evaluated by observation, including sensory abilities such as visual, auditory, olfactory, tactile, vestibular abilities, as well as cognitive, emotional and linguistic abilities. The assessment was carried out by two evaluators. When the two evaluators reached the same assessment conclusion on the core assessment degree of little N, then the student's behavioral ability was believed to pass or manifest in this stage.

3. Assesment and training objective formulation

3.1 Assessment of Actions and Related Issues

According to Functional ambulation categorn scale (FAC), the evaluation result of little N was grade 2, this is she is able to walk under the continuous support of one person.

The present motor ability of the student was evaluated according to the developmental sequence of gross movements. Results showed that the ability of the pelvic area of such object was represented by the ability to complete a high kneeling position and to move forward independently while keeping kneeling posture. However, the movement performance was relatively slow, hand support of others was needed after moving with kneeling posture more than 3 steps.

According to the assessment of the student's current motor ability, it can be concluded that the

lack of gluteal muscle strength in the pelvis area is one of the main factors affecting the kneeling posture. Moreover, according to the abnormal muscle tension test, the adductor muscle tension was high, which is another one of the important factors affecting semi-kneeling posture. In addition, some tension was found in the soleus muscle and gastrocnemius muscle, which affected the walking ability and posture.

Other related abilities of such student were mainly characterized by tactile dependence, vestibular sensitivity, strong pelvic reflexes, emotional sensitivity, general cognitive response and poor language expression.

According to the comprehensive evaluation results, the improvement of pelvic control ability is the core of the current training for such student, which should be supplemented by the training of other regional abilities. During training, the student's psychology needs to be taken into account, and appropriate assistance may help children to relieve psychological insecurity and reduce abnormal sensory and cognitive reactions.

3.2 Training Goal Formulation

According to the assessment results, it is difficult to ensure that little N can complete the action training in the training room every day, considering that she has to study in a special school and the her caregiver is old. Therefore, the training goal of this semester is to move steadily forward with kneeling posture for 10 meters.

3.3 Training Arrangement

Using combined method of education and exercise rehabilitation, the training starts from March 2015 to June 2015. In the 14-week rehabilitation training course, individual rehabilitation training is arranged two times a week, one hour each time, and the rest time will be spent guiding parents to carry out training for their children at home. During training, the cognitive development characteristics of children should be fully considered, and methods such as induction, visual cues and assistance and support should be adopted to reduce the tension of students in action training, so it is more practical to implement the teaching plan of action rehabilitation through game activities.

4. Intervention process

4.1 Before Training

This stage refers to the first week of training. In this stage, the trainer will not do any rehabilitation training for little N, but only plays the game of delivering things with kneeling posture. The researchers records how many times the student touched something to support herself during 10 meters of kneeling walk. To ensure the accuracy of the records, the student's performance in each class is recorded by video, and then the kneeling behavior in video is analyzed. Performance in each class is recorded three times, and the average value is taken as the final value of the class. The overall performance of this student is characterized by slow speed of kneeling walking. At the initial stage of kneeling walk, the student can basically complete about 5 steps independently. At the later stage, the student needs more than one time of support and rest to complete the final task.

4.2 Training Period 1

The pelvic control training stage starts from the second week and lasts for four weeks, i.e. The from the second to the fifth week. Considering that little N has a poor ability to straighten her pelvis and a weak gluteal muscle strength, the training program is mainly focused on gluteal muscle training. The students' cognitive ability is low, so the game of inductivity is introduced in the training plane. The training content mainly includes the flexion and extension of the hip joint in kneeling position, forward flexion and backward extension of hip joint in kneeling position, training of left and right lateral tilt of the pelvis on a stable plane with one knee in front and back, and pelvis forward tilt training in standing position, etc. During the implementation of each activity project, it is emphasized to train the interesting interaction between teachers and students, so that students can complete the training requirements through game activities, such as kneeling up, holding the ball

high and then throwing the ball, pushing the big cage ball forward and backward in kneeling position, grabbing the fuzzy toys with body leaning left, right, forward, and backward. This reflects the combination of "happy" learning and rehabilitation training as well as the integration of "education" and "rehabilitation". At the end of the training, the student is asked to kneeling walk for 10 meters and frequency of touching something for support is recorded.

4.3 Training Period 2

In the second stage of training from week 6 to week 9, the training content is adjusted according to the training situation of the student. For example, from the two hands support to the one hand support, from being supported by stable objects to being supported by unstable objects, the student is required to have higher ability in the control the shifting of weight. The training follows the organic integration of education and rehabilitation. At the end of each training session, students are allowed to kneeling walk 10 meters independently, and frequency of hand supporting is recorded by video.

4.4 Training Period 3

The third stage of training starts from week 10 to week 13, the training concept and main activities in this stage are similar to that in second stage. The difficulty of training gradually change from being supported to being less supported or unsupported, the site for postural control training gradually changes from stable plane to unstable plane, so as to improve overall body control. The difficulty degree of training content is from the easier to the more advanced, so as to gradually approach the target activity. At the end of each training session, the frequency of hand supporting during independent kneeling walk is recorded by video.

4.5 After Training

The 14th week is the last week of the training course. In this week, the training effect of this semester is mainly evaluated to observe the ability of N to kneeling walk 10 meters independently. By 3 times of observation in each class, if the student can kneeling walk 10 meters independently with hand touching the ground for 1 time or less, it is believed that the student's training has reached the target. By observing the walking ability of student, FAC scale was adopted to evaluate the improvement effect of her walking function.

5. Results analysis

According to statistical results of hand support behavior during kneeling walk (Fig.1), the T test results before and after training are significantly different, indicating that pelvic control training has certain effect on the performance of the pelvic area movement ability.

According walking function assessment results by FAC, the student's walking ability is close to level 3, that is, without the direct physical support from others, the student can kneeling walk independently more than 5 steps under supervision. According to the observation results of behavior, little N could complete 10 steps of kneeling walk independently. Her ankle joints were more active than before the training and the body shakes were less than before training, indicating that pelvic control training has a positive effect on improving walking ability.

Table 1: Statistical results of frequency of hand touching support behavior during kneeling walking.

	M	SD	T
Before training	14.0	0.89	
After training	0.67	0.52	3.98***

Note: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

6. Discussion

6.1 Effect of Pelvic Control Training on Walking Ability of Children with Cerebral Palsy

After 3 months of training, the research object showed significant improvement in joint mobility, body sway, independently kneeling and walking ability. This indicates that pelvic control training plays an important role in improving children's walking ability, which is consistent with current research results (Kalin Zhu, 2008). The pelvis is the core area that connects the torso and the lower limbs. During exercise, if stability of pelvis and spine can be maintained, the force to be smoothly transferred from the core area to the muscle groups of the limbs and surrounding areas, which is conducive to maintaining a more stable balance of the body (Yajun Guan, Zhongquan Ma, 2010) and keeping the center of gravity in the neutral position, and thus better control the gait when walking.

6.2 The Effect of Training Program on the Physical and Mental Health of Children with Cerebral Palsy under the Concept of "Combining Education with Rehabilitation"

For special children entering school age, they need to go to school to receive education and do some rehabilitation training. Therefore, the concept of "combination of education and health" has become an important thought to promote the physical and mental development of special children. However, the current development situation in most areas is that medical rehabilitation stops at the pre-school period. After entering in school, school-based education and rehabilitation varies from region to region, and most special school teachers do not have the professional knowledge and skills of rehabilitation (Hui Wang, 2010). Relying on the cultivation of professional talents in colleges and universities, we have developed a set of rehabilitation techniques that are easy to master and easy to implement. More teachers in special schools are requested to master integrated education method as soon as possible, which is a better choice for special children. From the training period, the training mainly focuses on the core muscle groups of the pelvis and surrounding areas, such as the dorsal muscle, gluteus muscle, iliopsoas muscle and adductor muscle. The training program is adjusted according to the changes of students' abilities. Through evaluation, the current and target movement ability of the student is found, which means the nearest development area of training was determined. Follow the principle from easy to difficult, from the cooperative action of bilateral support and bilateral support to the alternating action of unilateral support and single hand support, and finally target action can be completed. In line with the principle of respecting children and teaching happily, through the positive induction of teaching tools and social reinforcement, children can complete rehabilitation training in game activities, which not only achieves the goal of rehabilitation, but also pays attention to the positive development of children's psychology.

7. Conclusions

Pelvic control training can improve the walking ability of this child with cerebral palsy.

Integrated training strategy which combines education with rehabilitation is conducive to promoting physical and mental rehabilitation, intelligent development and social function improvement of special children.

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