CHAPTER V

DISCUSSION

The purpose of this study was to evaluate the effect of backward gait training on a treadmill with partial body weight support (PBWS) in children with cerebral palsy (CP), age ranged between 8 and 18 years. Participants were randomly divided into 2 groups by drawing with matched pair between groups. Group A performed forward gait training alone and Group B performed a combination of forward and backward gait training. All variables including the physiology cost index (PCI), maximum walking speed (MWS), gross motor function during standing (%GMFM), and hip angle during standing (Hip angle) were compared between pre- and post-training for both groups. For compared between groups, percent changes after training of PCI, MWS, %GMFM, and Hip angle were used. Although the sample sizes might be small, the results supported the hypotheses that after training for 8 weeks, children with CP significantly improved PCI, MWS, and %GMFM and Group B significantly improved their PCI and MWS more than Group A.

Physiological cost index (PCI) and maximum walking speed (MWS) on treadmill training with PBWS in children with CP

The means PCI in both groups were decreased because the treadmill was controlled in constant rate which provided forward translation movement and rhythmic input that reinforces a coordinated reciprocal pattern of movement.

Therefore, children with CP could be repetitively proactive more rhythmical and efficient walking pattern (28). Moreover, the gait training on treadmill may cause cardiovascular adaptation which can be seen after training 6-12 weeks (39). The program in this study was 8 weeks and found a decreased in mean HR after training in both groups (Group A from 90.43 beats/min to 89 beats/min or 1.58% decreasing and Group B from 90.10 beats/min to 87 beats/min or 3.44% decreasing). From the PCI formula, heart rate (HR) is directly related to the PCI. If the HR increases, the PCI will increase. Therefore, the training in this study might cause the body receiving enough responses from the cardiovascular system leading to change in this system by increasing mean HR. Besides, mean HR decrement might occur from autonomic nervous system because gait training might facilitate the parasympathetic nervous system and inhibit the sympathetic nervous system leading to respiratory control by vagus nerve such as slowing heart beat which causes decreasing in HR (39-41).

In addition, normal PCI for children equals to 0.11 – 0.51 beats/meter (42, 43). After training, children with CP have improved their PCI and reached normal PCI (Group A = 0.32 ± 0.41 beats/meter and Group B = 0.13 ± 0.14 beats/meter). This improvement resulted increasing the distance during assessment. Therefore, the MWS of post training was increased when compared to pre- training. The result was similar to previous studies (5, 10, 44).

After training 8 weeks, Group B showed significantly improvement in PCI and MWS as compared to Group A. These results suggested that the combination of forward and backward gait training on treadmill with PBWS was superiorly than the forward gait training alone. The less improvement in PCI for Group A might be because in daily activity, the forward walking was not a difficult skill when compared

with backward walking and forward walking. Novel task such as the backward gait training may require a larger number of motor units to be recruited, which results in increased energy utilization (45, 46). Although backward walking is often used for short periods during daily activities; it may be considered as a novel task when performed continuously on a treadmill. In addition, alteration of stride length frequency may be a reason for increased cardiovascular and metabolic cost, as stride length is shorter during backward walking as compared to forward walking (47, 48). From the optimal length tension relationships of muscle, when stride length is shortened (49), the maximal force production of the muscle is decreased, leading to a less energy-efficient activity during backward walking. Furthermore, adenosine triphosphate (ATP) requirements for muscles are higher during concentric contraction than those during eccentric contraction. In backward walking, the quadriceps are acting in more concentric work pattern than those forward walking (50).

Gross motor function measure on treadmill training with PBWS in children with CP

The results of the percent gross motor function during standing (%GMFM) showed that the mean %GMFM for both groups in post-training was increased as compared to pre-training. The improvement of the gross motor function during standing may be result from the PBWS because the PBWS can adjust weight bearing during gait training. At the beginning of the training, the body weight should be adjusted about 60%, when children improve their balance; it was adjusted to 80% and 100% of the body weight, respectively. Since reduction in the weight bearing using

the body weight support provides an increase in postural control, children with CP easily practice the skill of dynamic balance by shifting their weight the left, right, forward and backward. Furthermore, during gait training the constant rate of the treadmill speed provides rhythmic input that reinforces a coordinated reciprocal pattern of movement. Therefore, during training, children with CP were more confident and were not fearful of falling during gait training, leading to significantly increase the %GMFM as compared to the pre-training.

When compared Group A to Group B, there was no significant difference. This result was opposite to Schndl et al (6) and Cherng et al (51) studies which found that the sum score of the gross motor function during standing increased by 47% after training for 3 months. This might be because the training time was not enough. In addition, there might be a limitation of the GMFM itself. For example, on item 6 and 7 a child would be given 3 scores if they could perform standing on one leg hold 10 seconds. Therefore, if before training a child was given 2 scores when he/she performed 6 seconds and then after training he/she was given 2 scores (same score) even though he could stand on one leg hold 9 seconds. In this study, it was found that on these items, Group B was able to increase the holding time (increasing by 1-6 seconds) as compared to Group A (increasing by 1-2 seconds).

Hip angles measure on treadmill training with PBWS in children with CP

Hip angles between pre- and post training in both groups were also compared. However, there were no statistically significant differences for all conditions. Crouch gait is a characteristic of children with CP persisted hip and knee flexion during standing and walking because gluteus maximus and abductor muscles are weak (52,

53). This study was thought that backward gait training would improve the hip angle by increasing muscle strength around the hip joint. However, it seems that gait training on treadmill with PBWS promotes coordination of leg muscles but may not increase specific gluteus maximus and abductor muscle strength, which, this study did not assess the muscle strength. Ciprini et al (54) evaluated the adaptations in the gait cycle produced by backward walking on treadmill at 0, 5, and 10 % inclination. The results showed that significant change occurred in the joint positions of the knee and ankle joints (not hip joint) at the initial contact as the treadmill was raised from 0 to 10%. In conclusion, the backward gait training on treadmill with PBWS may not increase all joint positions such as the hip joint. Therefore, the backward gait training with not adjust inclination of the treadmill during training may reason that no change in hip joint, leading to when compared percent change between Group A and Group B, hip angle was led to not differ.

In conclusion, this study found that children with CP could be trained on treadmill with PBWS both with forward and backward walking. However, the combination of forward and backward gait training can improve the PCI, MWS, and %GMFM more than the forward gait training alone.

CONCLUSION

The purpose in this study was to evaluate the effect of backward gait training with partial body weight support (PBWS) on a treadmill in children with cerebral palsy (CP), age ranged 8-18 years. They were randomize divided into 2 groups by draw with mach pair between group, Group A (forward gait training performing alone) and Group B (combination of forward and backward gait training performing). Both groups were scheduled for 30 minutes per trial (a trial had 2 sessions with a 5 minute rest between sessions), 3 trials per week for 8 weeks. The physiological cost index (PCI), the maximum walking speed (MWS), the percent gross motor function measure during stand (%GMFM) and the hip angle were compared between pre-and post training in Group A and Group B and compared percent change after training of all variables between Group A and Group B. The results showed the improvement of all variables except hip angle during standing position in both groups as compared to the pre-training. When compared percent change after training of PCI, MWS, GMFM, and Hip angle between Group A and Group B. The results showed the improvement of all variables except %GMFM and Hip angle during standing position and Group B seemed to have more improvement of %GMFM than Group A. In conclusion, the backward gait training with PBWS on a treadmill has benefits for children with CP. We concluded that the backward gait training with PBWS on a treadmill could improve the PCI, MWS, and GMFM in children with CP.

CLINICAL APPLICATION

Both the forward gait training with the PBWS alone and the combination of the forward and backward gait training with the PBWS on a treadmill have advantages for children with CP. In this study, the combination of forward and backward gait training with the PBWS on a treadmill had significant differences percent change of PCI and MWS and seemed to show better results than the forward gait training with PBWS alone although there were no significant differences percent change of %GMFM and Hip angle during standing position between groups. Therefore, if the children with CP had more training time using the combination of the forward and backward gait training on treadmill with the PBWS on a treadmill , it was believed that there would be some results in positive effects for the children with CP. The recommendation for the gait training with the PBWS in children with CP is that 1) training time should be more than 8 weeks such as 12 weeks 2) walking speed should begin adjust at 0.5 mph and 60% of weight bearing (step 2) for spastic hemiplegia with high ability gross motor function. However, the backward gait training is a novel task for training in children with CP. The combination of forward and backward gait training on treadmill with the PBWS program needed for more information.

FUTURE STUDY

The future study should consider;

1. Muscle strength of LE, assessment of muscle strength (especially of gluteus maximus and hip abductor muscle) should be done at pre- and post-training to compare the effect of gait training.
2. Knee and ankle joint position, this study showed no significant difference of the hip angle between groups but it seemed two participants showed an improvement of upright posture and decrease of knee angle flexion with increase ankle dorsiflexion during backward gait training
3. Training time, the duration of gait training in this study was 8 weeks and backward gait training was 15 min/session. It may not enough to change between groups. Therefore, future study should allow more time for training (such as 12 weeks).
4. Training speed and weight bearing, in children with CP had less severity the walking speed should be adjusted to begin at 0.5 mph and 60% of weight bearing because the walking speed of 0.25 mph was too slow for him/her.
5. Research design
   5.1. The future study may evaluate the effects of backward gait training alone compare with forward gait training alone.
   5.2. Besides sex, age, type of CP, the types of walking and body weight should be considered.

5.3. Besides compare between groups design, within subjects design should be considered.