Development of Active Gait Trainer : System Verification

C.h Yu, C.W Yu and M.J Huang
Institute of Rehabilitation Science and Technology, National Yang-Ming University
email: chyu@ym.edu.tw, web: www.ym.edu.tw/%7Echyu/

INTRODUCTION

Motor development is the process of change in motor behavior that is related to the age of the individual.[1] The walking ability affect the subsequence development of children.[2] It frees the hands and promotes the development of hands and increased the ability of exploring the world. There are invasive and noninvasive. The invasive therapy is surgical operation. The noninvasive therapies are oral medication which can improve the spastic level and rehabilitation therapy. Treadmill and gait trainer are commonly used assistive devices in training gait in rehabilitation therapy. The advantages of using treadmill are that adjust the walking speed is easy and training is in a fixed point. But, the disadvantages are that treadmill gait pattern is from overground and requires two therapists to assist the patient's gait.[3-6] The advantages of using gait trainer includes that supporting the body weight and holding user upright posture of trunk. But, the disadvantages are that children must have the some ability of walking and there aren't gait training device and external power assistive and require therapy to assist the patient's gait. In clinical, therapist hold the ankles of children by their hands to offer a fit gait on the gait trainer. The purpose of this study was to design an active gait trainer which can imitate the hands of therapist holding the ankle joints of children to train gait.

METHODS

Our system contains five parts by function and these relationship are shown in Figgure 1.

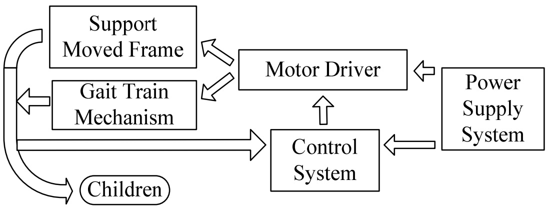

Figure 1 The structure of gait trainer.

The major function of gait train mechanism would imitate the hands of therapist holding the ankle joints of children to train gait. Therefore, we had to design a trajectory of mechanism which would match with the trajectory of ankle joint in walking. The range of motion (ROM) of hip and knee joint which were got from twenty-three children with mean age 5.5 years of by motion analysis system by Huang collocated the length of thigh and shank to calculate the trajectory of ankle joint relative to the hip joint by Matlab.[7]. NI PCI-7344 motion control card and LabVIEW were used to be control interface and PD (Proportional-Derivative) and position control in motor. One normal 5 years old girl seated on the suspension and her feet were fixed on the six-bar linkage. Recording the position variation of encoders which were set on the both sides motor of the gait train mechanism.

RESULTS AND DISCUSSION

The prototype of gait trainer was showed in Figure 2. The position variation of motor was similar to the target in first three steps (Figure 3), but it was almost stop at the fourth step. We conjecture that the muscle firing on left leg of child caused the motor couldn't driven the left of child. We didn't consider muscle firing producing the extra force when we calculated the specification of motor at initial. The way of solving was added the condition of muscle firing producing the extra force and recalculated the specification of motor. But on the other hand, the motor couldn't driven the left become a safe mechanism. There was no stop state in right foot and the position variation of motor was similar to target (Figure 4).

Figure 2. Experiment.

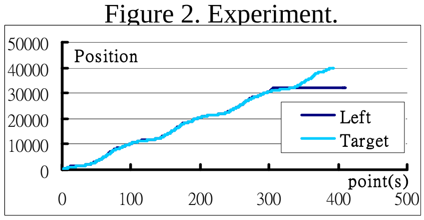

Figure 3. Position variation of left motor and target.

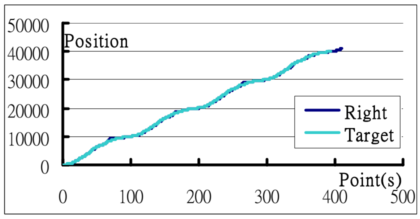

Figure 4. Position variation of right motor and target.

CONCLUSIONS

We had verified the feasibility of the gait trainer on normal child. We will verified the feasibility of the gait trainer on cerebral palsy (CP) children.

REFERENCES

1.Tecjlin JS: Pediatric physical therapy Philadelphia, Lippincott, 1994.
2.Ulrich DA, et al.: Treadmill training of infants with Down syndrome: evidence-based developmental outcomes. Pediatrics 108: E84, 2001.
3.Alton F, et al.: A kinematic comparison of overground and treadmill walking. Clin Biomech (Bristol, Avon) 13: 434-440, 1998.
4.Jeng S-F, Liao H-F, Hu M-H: Comparison of Treadmill Walking with Overground Walking in Children and Adults. FJPT 26: 18-27, 2001.
5.Schindl MR, et al.: Treadmill training with partial body weight support in nonambulatory patients with cerebral palsy. Arch Phys Med Rehabil 81: 301-306, 2000.
6.Werner C, et al.: Treadmill training with partial body weight support and an electromechanical gait trainer for restoration of gait in subacute stroke patients: a randomized crossover study. Stroke 33: 2895-2901, 2002.
7.Huang WG: Normal Children Gait, in National Cheng Kung University, 1995.

ACKNOWLEDGEMENTS

This study was supported by funding from the National Science Council (NSC 92-2218-E-010-011)