CHAPTER 1

INTRODUCTION

1. Rationale

The incidence of patients with hemiplegia is high worldwide (1-3), especially patients who had a cerebrovascular accident (CVA). Hemiplegia is a major cause of death and disability in Thailand. Approximately two thirds of patients survive with some levels of musculoskeletal deficits. Patients with hemiplegia encounter difficulties while performing tasks such as standing and walking (2, 4, 5). Approximately 75% of survivors have a reduced quality of life (3). The disability that resulted from hemiplegia is very critical, due to the tremendous expenditures arising from the cost of intensive treatment, the large demand for continued health care, and the loss of productivity.

People with hemiplegia can have a greatly disrupted gait. More than half of people who experience a stroke in the acute phase are unable to walk. Walking impairments are still present 3 months after the onset. Approximately 60% of patients with stroke have limited walking capabilities (6). Patients with hemiplegia usually have a decreased walking velocity with a shorter duration of stance phase, decreased weight bearing, and increased swing time of the affected leg. The unaffected leg has an increased stance time and decreased step length (7). These changes in gait parameters usually results from the impairments of the hip, the knee, or the ankle joint. Since control of the knee during stance and swing phase of gait cycle are one of the critical components (7, 8). The present study will focus on the management of the knee joint control and its effect on gait parameters.

There are various forms of gait rehabilitation techniques available such as traditional physiotherapy, treadmill training, functional electrical stimulation (FES), and orthosis (9). No one procedure of traditional physiotherapy has been shown to have any greater benefit over another in terms of mobility. Conventional gait training requires manual support and guidance from physical therapists (10). This approach requires both time and effort from patients and therapists (11). Thus, only a limited training time is available during the physical therapy treatment. Treadmill training with body weight support (BWS) is a task-specific approach, which provides a longer time of training. However, one of the major disadvantages of treadmill training is the requirement of one or more physical therapists to advance the affected limb and control trunk movements (10-12). Since the therapists are tired, along with the patient, gait may become asymmetrical and the benefit of the sustained treatment is lost (11). This technique also carries the disadvantages of requiring high cost machinery, and lack of portability. FES system can assist with propulsion during the gait cycle which contributes to a reduction of energy costs and increases walking velocity compared to non FES-assisted orthosis gait system (13). FES system is advantageous because it is easy to put on and take off and has a good cosmetic appearance (14, 15). However, the pure FES system must supply electrical stimulation continuously to the paralyzed nerves and/or muscles, which causes rapid muscle fatigue, limits standing time and walking distance, provides poor control of joint torques, and has a high energy requirement (16, 17). The orthosis system is designed to provide stability to the joint, control motion, and improve general safety during gait (18). The knee-ankle-foot orthosis (KAFO) system also helps to save energy during walking, and to improve balance, endurance, and overall body

awareness (18, 19). This system is used for training but is not practical because of difficulty in donning and doffing, and patients feeling cumbersome (15, 20, 21). KEO, which combine the benefit of FES and orthosis, has been developed to provide propulsion of walking, reduce energy consumption, and enable better stability in the lower extremities (15).

Although a number of the electro-orthosis have been used worldwide, there is no evidence of this treatment technique in Thailand. Availability and cost of device and knowledge of therapists are critical reasons for introducing this therapeutic approach to Thai patients. We believe that by developing an affordable simple KEO system for patients with hemiplegia will facilitate the use of this system in the future. Through this usage, a better and a higher technology to develop electro-orthosis will be available in Thailand. Patients with other neurological conditions will also get a benefit of this development as another choice of treatment.

2. Operational definition

2.1 Gait Cycle (GC) is the elapsed time between the first contact of two consecutive footfalls or the same foot.

2.2 Velocity (cm/sec) is obtained after dividing the distance by the time elapsed between the first contacts of the first and the last footfalls.

2.3 Cadence (steps/min) is the number of steps taken in a minute.

2.4 Step Length (cm) is measured from the heel point of the current footfall to the heel point of the previous footfall on the opposite foot.

2.5 Swing Time (sec) is the time elapsed between the last contacts of the current footfall to the first contact of the next footfall on the same foot.

2.6 Stance Time (sec) is the time elapsed between the first contact and the last contact of two consecutive footfalls on the same foot.

2.7 Knee angle (degree) is defined as the angle subtended by a line drawn through the mid-shaft of the femur with respect to one drawn through the mid-shaft of the tibia.

3. Purposes of the study

3.1 Main purposes of the study

To develop a simple knee electro-orthosis for patients with hemiplegia

3.2 Specific purposes of the study

3.2.1 To develop a simple knee electro-orthosis with quadriceps stimulation for patients with hemiplegia.

3.2.2 To compare gait parameters with and without a knee electro-orthosis, and with only knee orthosis in patients with hemiplegia.

4. Hypothesis

A knee electro-orthosis can improve gait parameters in patients with hemiplegia.

5. Advantages of the study

A simple knee electro-orthosis will be useful for gait rehabilitation in patients with hemiplegia and facilitate the development of electro-orthosis in Thailand.