CHAPTER I

INTRODUCTION

1. Rationale

Cerebral palsy (CP) is a chronic neurological disorder caused by a static lesion occurring in the immature brain, particularly the motor system area. Therefore, the motor disorder causes an impaired ability to isolate and control movement (1). The overall incidence of CP has even increased in recent decades. In Thailand, the first official incidence was done in 2001 but CP has not been classified yet until 2007. Therefore, the incidence of CP for the whole Thailand kingdom in 2007 was 29,814. However, the report of Rajanukul Institute revealed that the number of children with CP increased from 1,742 children in 2005 to 2,550 in 2008 (2) (46% increased). Spastic diplegia is found the most, about 30% (4).

Spastic diplegia refers to a weakness and movement incoordination involving the lower limb more than the upper limb. Children with spastic diplegia eventually walk (5). However, the acquisition of this skill is delayed and differs qualitatively from typical pediatric gait. Individual with spastic diplegia typically characterize a crouch gait and genu recurvatum (6). The crouch gait is characterized by excessive knee and hip flexion throughout the stance phase, resulting from hamstrings tightness or/and spasticity or/and weakness and other ankle-plantarflexor weakness or/and excessive length (6). Thus, the crouch gait is often treated by reducing hamstrings muscle contracture and restoring quadriceps femoris muscle strength (7). The genu

recurvatum defined as hyperextension of knee during the stance phase, resulting from quadriceps weakness or/and ankle plantar flexor spasticity or/and quadriceps spasticity or/and gastrocsoleus weakness (8). The quadriceps femoris muscle is one of the muscle groups to maintain an erect posture that acts during the one third of stance phase (6). Although the basic function of the quadriceps femoris muscle is to powerful extend and straighten the leg, the quadriceps femoris muscle weakness due to the muscle is too long while the child walks in crouch or hyperextension positions (7, 9). Therefore, this muscle plays a crucial role for controlling walking, especially the inner range (10-11).

There have been several interventions to improve muscle strength, specifically quadriceps strength, such as a volitional exercise including the free weight (12-13) and weight machine which have been reported without increasing spasticity (12, 14). However, this volitional exercise regime may be more difficult to target isolate muscle and compliance in children with CP (15-17). Although the use of isokinetic training may assist in selective control of movement by active assistance, it is not potable, expensive, and requires special training. At present, another intervention, electrical stimulation (ES) is widely used in America and Europe because it has potential as passive, potable equipment, non-invasive, home-based therapy (18). The most common form of ES is neuromuscular electrical stimulation (NMES). The NMES has been believed that it assists in selective motor control by providing an alternative to resistive exercise or specific strengthening programs (18-19). However, its clinical utility remains a topic for debate because several recently published studies (16, 18) did not detect any statistically significant improvement in strengthening with NMES (16). Although, the ES can improve muscle strength in adult (20), athletic

(21), and stroke patients (21), the strength improvement by ES in children with CP are unclear (15-16, 19).

Several studies have determined a combination of isometric knee extensors strengthening and NMES in health adult and athletics. They found that the combination of voluntary exercise and NMES is more effective in improving muscle strength than exercise alone or NMES alone (21-22, 24). There was only one study done in children with CP, and it was a single subject design (23). Thereby, the limitation of their study is that it can't be generalized for population and they did not explain in detail of the training protocol and it can isolate muscle. Therefore, it would be benefit for therapists in designing a strengthening program in which program (isometric exercise alone or a combination of isometric exercise and NMES) will be suitable for the individuals with spastic diplegia who walk with gait disorders.

2. Purposes of the study

The purposes of this study were to evaluate the effects of the isometric exercise with and without the NMES on the quadriceps muscle in individuals with spastic diplegia**.**

3. Hypothesis of this study

3.1 Primary hypothesis:

There would be significant differences between the isometric exercise alone and the combination of the isometric exercise and the NMES on the quadriceps maximum voluntary isometric contraction (QMVIC), quadriceps lag (QL), muscle tone of

quadriceps and hamstrings, and angles of hip, knee and ankle joints during standing in individuals with spastic diplegia.

3.2 Secondary hypotheses:

3.2.1 For the isometric exercise alone, there would be significant differences among the times of assessments on the QMVIC, QL, muscle tone of quadriceps and hamstrings, and angles of hip, knee and ankle joints during standing in individuals with spastic diplegia.

3.2.2 For the combination of the isometric exercise and the NMES, there would be significant differences among the times of assessment on the QMVIC, QL, muscle tone of quadriceps and hamstrings, and angles of hip, knee and ankle joints during standing in individuals with spastic diplegia.

4. Advantages of the study

The results of this study suggest that the isometric exercise combined with neuromuscular electrical stimulation technique may be useful for applying in clinical application for strength training and helpful information a further study in voluntary exercise combined with neuromuscular electrical stimulation in individuals with spastic diplegia.