CHAPTER I
INTRODUCTION

1. Rationale and background of the study

Spinal cord injury (SCI) infers to either a non-traumatic or traumatic injury that results in a partial or total disruption of the neural pathways in the spinal cord (Haisma, 2008; Maynard et al., 1997). The injury affects motor, sensory and autonomic nervous systems that impairs ability to perform functional activities (Haisma, 2008). The magnitude of these impairments depends largely on the levels and severity of the lesion (Maynard et al., 1997).

One of the most common concerns found in patients with SCI is whether they will be able to walk again (Lapointe at al., 2001). Although the number of patients with incomplete SCI (iSCI) has steadily increased (from 45.9% in the 1970s to 55.3% in 2005) and more than 80% of these patients can regain ability of walking, only approximately one-third of these patients can become functional ambulators (Tang et al., 1994; National Spinal Cord Injury Statistical Center, 2006). In addition, the quality and method of mobility adopted vary from one patient to another. Thus, most patients are able to walk non-functionally and required assistive/walking devices (Lapointe at al., 2001; Melis et al., 1999; Scivoletto et al., 2008).

Walking devices are commonly prescribed for the patients in order to compensate for lower extremity muscle weakness and impaired balance control, and promote the patients to increase levels of independence (Bateni and Maki, 2005; Melis et al., 1999). However, long lasting use of a walking device contributes negative impacts onto the patients (Melis et al., 1999). Walking with an assistive device requires considerable attentional demand, jeopardizes stability in a certain situation, and increases risk of fall by causing a trip or disrupting balance control due to limited forward and lateral movements of the legs (Bateni and Maki, 2005; Melis et al., 1999). Furthermore, using walking devices induce abnormal posture, and put a considerable demand onto upper extremities and energy expenditure (Bateni and Maki, 2005; Melis et al., 1999). Thus, the patients likely walk at a slow speed and abnormal manner, and have upper limb pain (Koh et al., 2002). Later, continuing use

of a walking device facilitates the development of muscle shortening, and retards ability to withdrawn from the walking device (Bateni and Maki, 2005). Thus from the incorporation of objective data helping the process of decision-making to withdraw a walking device are crucial to promote the advancement of walking ability and prevent negative impacts due to long-lasting use of a walking device.

In general methods of clinical evaluation can be done using either qualitative or quantitative assessments (van Iersel et al., 2008). Qualitative assessments through observation methods are widely applied as a screening tool. However, the result is subjective and highly dependent on experience the evaluators (Mancini and Horak, 2010). In addition, the decisions about clinical relevant changes can be difficult when time intervals between visits are long or with changes in the assessors (van Iersel et al., 2008). Quantitative measures are more objective and easier to be standardized, thus results from the tests can be compared among the testers and the test intervals (van Iersel et al., 2008; Mancini and Horak, 2010). Both qualitative and quantitative assessments can be executed in the forms of system assessments or functional assessments. The neurological system assessments encompass the standardized assessments established by the American Spinal Injury Association (ASIA) (Maynard et al., 1997). The findings indicate system disorders and provide insight into treatment plan. However, thorough assessment of every system involve with the task of walking is time-consuming and the results may not relate to walking ability (van Wieringen, 1996; Wirz et al, 2006). As a result, quantitative functional assessments are more preferable to use as a screen tool in general clinical and community settings (Lusardi et al., 2003; van Iersel et al., 2008).

Ditunno et al (2000) suggested that ambulatory function could be assessed based purely on the requirement of assistive devices. However, several authors suggest the use of quantitative temporal-distance measures (Holden et al., 1984; 1986; Richard et al., 1993). Among these tools, the impairments relating to the requirements of walking devices can be quantified using 10-meter walk test (10MWT), timed up and go test (TUGT), and five times sit-to-stand test (FTSST) (Jackson et al., 2008; van Hedel et al., 2005; Mong et al., 2010). The 10MWT and TUGT have been successfully utilized in SCI population (van Hedel et al., 2005). The 10MWT measures walking speed that indicates functional capacity rather than physical

disability. Results of the test are considered as a surrogate for the overall quality of gait (and motor function) (Jackson et al., 2008). The findings associate with functional capacity as measure by using the 6-minute walk test (6MWT) and ambulation categories as evaluated using the walking index spinal cord injury (WISCI) II (van Hedel, 2006). The TUGT requires patients to perform sequential locomotor tasks that incorporate sitting-to-standing, walking and turning (Shumway-Cook et al., 2000). Results of the test correlated with level of functional mobility, balance and postural control, gait speed, and risk of falls (Podsiadlo and Richardson, 1991). The 10MWT and TUGT have been verified their validity and reliability (inter and intra-rater reliability of 10MWT were $r = 0.974$ and $r = 0.983$, $p < 0.001$(van Hedel, 2005) and reliability of TUGT was $r > 0.97$ (van Hedel, 2008). The task of FTSST is mechanically demand and requires adequate torques to be developed at each joint during spatial and temporal motion of the body segments are coordinated (Bahrami et al., 2000). Thus, results of the test are mostly consistent to lower-extremity muscle force production (Eriksrud and Bohannon, 2003). In addition, ability to complete the task is highly correlated to sensation, balance, speed, and psychological status of individuals (Whitney et al., 2005). The test has been successfully applied in many groups of subjects such as stroke (Brunt et al., 2002; Cheng et al., 1998), older adults (Alexander et al., 1991; Bohannon, 1998; Hughes, 1994, 1996,1998; Schenkman et al., 1996), people with arthritis (Newcomer et al., 1993) and renal disease (Bohannon et al., 1995), and as an outcome of interventions (Chandler et al., 1998; Dean, 1997; Drabsch et al., 1998; Headley et al., 2002).

Body system impairments following SCI attribute negative effects on muscle strength, balance control, and walking ability (Bateni and Maki, 2005; Melis et al., 1999). These impairments limit ability of the patients to walk independently at an optimal speed and distance, and compel the patients to use a walking device (Behrman and Harkema, 2000). The 10MWT, TUGT and FTSST are objective/ practical tests for these impairments. An investigation on predictive ability of these tests to indicate the requirement of walking device would provide important data to promote rehabilitation outcomes.

2. Objectives of the study

Primary objective: To investigate predictive ability of the 10MWT, TUGT and FTSST to indicate the requirement of walking devices using data from cut-off scores, sensitivity, specificity, and area under curve (AUC).

Secondary objective: To investigate the inter-tester reliability of the 10MWT, TUGT and FTSST to assess ability in patients with SCI.

3. Research questions

3.1 Were the 10MWT, TUGT and FTSST able to predict the requirement of walking devices in patients with SCI?

3.2 Were these tests reliable to assess ability in patients with SCI?

4. Hypothesis of the study

The three functional tests were reliable and had good capability to predict the requirement of walking devices in patients SCI.

5. Scope of the study

The study recruited patients with iSCI who were able to walk independently at least 50 meters with and without walking devices (Functional Independent Measures locomotor score: FIM_L score = 6 – 7). Majority of them were recruited from patients who were admitted in the Srinagarind hospital, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand. Predictive ability of the test was investigated using data from cut-off scores, sensitivity, specificity, and area under curve.

6. Benefits of study

Findings of the study would provide objective data to predict the requirement of walking devices in patients with SCI. The data would aid the decision-making process for walking advancement using a practical measure, thus can be used to monitor levels of ability by either rehabilitation professionals or patient themselves.