CHAPTER 5

DISCUSSION

This study examined the validity of using a repeated one-leg STS test for evaluation of strength and endurance of the knee extensor muscles by exploring the relationship between variables obtained from the 5 and 10 repeated one-leg STS tests (time to complete the 5 and 10 repeated one-leg STS tests and power of the test) and variables representing strength and endurance of the knee extensor muscles.

In previous studies, researchers were interested in relationship between knee extensor muscle strength and two-leg STS test. Performance of a two-leg STS test was contributed by the sum of both legs strength. In fact it is often that knee extensor muscle strength are unequal in both legs, especially in elderly or persons who had pathology that affect muscles strength. Therefore this study performance one-leg STS test was introduced to isolate strength measurement for each leg.

In present study, the mean time to complete 5 and 10 repeated one-leg STS tests were 6.81 and 13.32 sec, respectively. Therefore, the mean time per 1 repetition were 1.36 and 1.33 sec, respectively. In the study by Takai et al (6) the mean time to complete 10 repeated two-leg STS tests was 10.3 sec (The mean time per 1 repetition was 1.03 sec). Although, only one leg was used to perform the STS movement the time spent to complete 1 repetition in this present study was slightly greater than using two-leg for control the movement. In young people, leg muscle were relatively stronger than the elderly people, thus control of the whole body movement using one-leg is possible

Power is the rate of doing work or the capacity of muscle to generate force for movement in a unit of time. In the present study, mean power of 5 and 10 repeated one-leg STS test (P5-STS and P10-STS) were 162.32 and 166.19 W. Takai et al (6) reported slightly greater mean P10-STS of 184 W. In this present study, participants had relatively larger body structure (body weight and height) compared to participants in Takai's study (6) and the using of one-leg STS test made STS movement more difficult compared to two-leg STS movement. However the difference between two studies was quite small because in young population of this present study was able to use muscle from one-leg to control the movement effectively than elderly population.

This study aimed to validate the use of a one-leg STS test for evaluation of strength and endurance of the knee extensor muscles by exploring the relationship between variables obtained from the 5 and 10 repeated one-leg STS tests (time and power of the test) and variables representing strength and endurance of the knee extensor muscles (maximum voluntary contraction; MVC and time to fatigue, respectively). There was no correlation between MVC, T5-STS and T10-STS in this present study. Ferrucci et al (35) reported that the relationship between time to complete 5 repeated two-leg STS test and knee extensor muscle force was not linear. The reason for non-linear relationship between time and MVC is that the movement time will not change much if the participant had MVC greater than 98 N. All of participants in present study had knee extensor muscle MVC above 98 N (mean = 209.95 N, range = 103.64 – 491.12). Therefore, it can be assumed that the relationship between time variable and MVC in the present study was in the plateau part of the relationship between time and MVC. This suggested that the measures of time to complete one-leg STS test was not consistently related with knee extensor muscle strength. Individual differences in physical characteristics such as body weight and leg length also lead to differences in the distance of the center of gravity during movement, and in turns affect the mechanical work and power during the sit-to-stand task. Participants with greater body structure tended to use more force to overcome the gravity force and they would take time to stand up and sit down more than the participant with smaller body structure. Therefore, if the participants with greater body build took more time, it did not mean that they had less leg muscle strength compared to these with small body structure.

In present study, a positive relationship between power of a one-leg STS (P5-STS and P10-STS) and MVC was found which confirmed our research hypothesis. This finding was in agreement with the study of Takai et al (6). Although in this present study one-leg STS test was performed, the relationship between power STS and MVC still high ($r = 0.83$ and 0.76, respectively). This suggested that participants with high knee extensor muscle strength will have high value of STS power. From results as shown in Figure 11, participants with low MVC also had low power output and participants with high MVC values also had high power output.

There were no correlation between time to fatigue and power of the one-leg STS test. The relationship between time to fatigue and time to complete one-leg STS (T5-STS and T10-STS) were fair ($r = -0.32$ and -0.39, respectively). Similar to Netz et al study (10), the relationship between 10 repeated two-leg STS test, leg strength, leg endurance and general endurance in elder participants were assessed. They reported no relationship between time to complete two-leg STS test and leg endurance. This present study used the isometric endurance test performed the study of Allaire et al (26). The mean time to fatigue of this present study was 86.09 sec but time to complete one-leg STS (T5-STS and T10-STS) were 6.81 sec and 13.32 sec, respectively. It is possible that, the one-leg STS tests used in this study were not strenuous enough to induce knee extensor muscle fatigue therefore, clearly relationship between time to fatigue and variables of the one-leg STS can not be found. In the study by Kawabata et al (30), knee extensor and flexor muscles endurance were assessed using isokinetic dynamometer. The participants performed 50 repetitive maximal concentric contractions to determine the fatigue rate but in this present study the one-leg STS tests performed only 5 and 10 repetition. The insufficient in repetitive work in the one-leg STS tests might not sufficiently induced knee extensor muscle to its endurance state. This suggested that these functional tests (5 and 10 repeated one-leg STS tests) were not be able to be used as index to evaluate knee extensor endurance.

In this study, several determinants of the one-leg STS test such as chair height and foot position were controlled in order to minimize confounding factors of the STS performance. The chair height was adjusted for individual participant to avoid the advantage and disadvantage due to differences of participant's leg length. The appropriate chair height was 120% of participant lower leg length (15). Foot position was set by controlled the starting position of the knee angle at 100° flexion and controlled the distance between posterior aspect of the knee to the chair's edge at 15 cm.

5.1 Conclusion

This study revealed that mean MVC, time to fatigue, T5-STS, T10-STS, P5-STS and P10-STS were 209.95 ± 81.00 N, 86.09 ± 51.08 sec, 6.81 ± 0.85 sec, 13.32 ± 1.79 sec, 162.32 ± 40.98 W and 166.19 ± 40.76 W, respectively. Knee extensor MVC was positively correlated with P5-STS and P10-STS (r = 0.828, $p = 0.00$ and r =0.759, $p = 0.00$, respectively). The knee extensor muscle time to fatigue was negatively correlated with time to complete the 5 repeated and 10 repeated one-leg STS tests (r = -0.317, $p = 0.025$ and r = -0.394, $p = 0.005$, respectively).

This study showed that the power of one-leg STS test was only one variable which had high correlation to the knee extensor muscle strength. In the other hand, both of time and power of one-leg STS test were inappropriate to assess knee extensor muscle endurance.

These functional tests; 5 and 10 repeated one-leg STS tests may be used as indicator for measuring the knee extensor muscle strength in young adults.