CHAPTER 3

Methods

3.1 Sample size calculation

Sample size calculation in this study was based on our unpublished data of the lower trapezius thickness conducted in patients with unilateral neck pain (n = 30) and healthy controls (n = 30) utilizing the same ultrasound method at resting condition (0° shoulder abduction). The mean thickness of the lower trapezius muscle for the neck pain and control groups was 2.76 ± 0.66 and 3.28 ± 0.75, respectively. To achieve a power of 80% with a significance level of 0.05 and effect size of 0.74, a total of 48 subjects (the neck pain group = 24 and the control group = 24) were recruited for the study.

3.2 Participants

Twenty-four volunteers with chronic neck pain aged between 18 and 59 years were recruited through advertising in physical therapy clinics, hospitals and community. Twenty-four matched controls of age, gender and body mass index were also sought for the study. Inclusion and exclusion criteria for both groups were as follows.

3.2.1 Inclusion criteria for the neck pain group:

1) Had been suffering from chronic neck pain for at least 3 months
2) Had unilateral (right) idiopathic neck pain Grade I or II
3) Had the Neck Disability Index score of > 10/100
4) Had a dominant right hand which was considered according to Yoshizaki et al's study (56)

3.2.2 Inclusion criteria for the control group:

1) Had no history of neck pain for 12-month period (VAS < 2/10)

2) Had a dominant right hand which was considered according to Yoshizaki et al's study (56)

3.2.3 Exclusion criteria for the neck pain and control groups:

1) Had a history of neck surgery
2) Had a training program involving the scapular muscles in the past 12 months
3) Had fibromyalgia or myofascial pain
4) Had systemic diseases
5) Had neurological disorders
6) Had shoulder/back disorders
7) Had a severe scoliosis

The study was approved by Human Experimental Committee of Faculty of Associated Medical Sciences, Chiang Mai University and the informed consent was obtained from each participant prior to commencement of the study.

3.3 Measurements

3.3.1 Questionnaires

1) A General questionnaire

General questionnaire was developed to include demographic data and neck pain characteristics (i.e. duration, sides and associated symptoms of neck pain). Details of the questionnaire are provided in Appendix D1.

2) Visual Analog scale (VAS)

Visual analog scale (VAS) is commonly used to evaluate pain perception in both research and clinical settings (66) and has shown high reliability and validity (67, 68). It consists of a 100-mm horizontal line (69). Participants were asked to rate their level of pain in their neck from the no pain (0 cm) anchored on the left to the worst pain imaginable (10 cm) anchored on the right. The distance from the ''no pain'' anchor to this mark was measured by a ruler in millimeters (mm) and used as the overall pain

intensity score (70, 71). The overall pain score could range from 0 to 100 (71). Details of this questionnaire are provided in Appendix D2.

3) Neck Disability Index-Thai version (NDI-TH)

The Neck Disability Index (NDI) is a self-reporting of neck disability questionnaire (68). It includes 10 items: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. Each item is scored out of 5 with a maximum total score of 50 (72). The interpretation of the NDI score is as follows: 0-4 = none; 5-14 = mild disability; 15-24 = moderate disability; 25-34 = severe disability; over 34 = complete disability. The NDI-TH has been translated from the original English versions of the NDI and shown to be valid and reliable for measure neck disability in Thai patients with neck pain (73). Details of this questionnaire are provided in Appendix D3.

3.3.2 Ultrasound imaging

A real-time ultrasound scanner (Toshiba Famio 8, Tokyo, Japan) with a 12-MHz linear transducer was used to image the lower trapezius muscle, according to the procedure described by O'Sullivan et al (16). The lower trapezius muscle was imaged at the spinous process of T8. The transducer was placed centrally and moved laterally over the inferior edge of the T8 spinous process to image the lower trapezius muscle. The echogenic bone of the T9 spinous process was identified and maintained as a consistent landmark to capture the muscle. The transducer might be angled slightly caudad or cephalad to capture the best images. The images of the lower trapezius muscle were measured twice both sides.

The thickness of the lower trapezius was measured by a blinded investigator using Image J software (available for free download at http://rsb.info.nih.gov/ij/docs/index.html). The cursor was placed on the inside edge of the muscle border and the measurement was made at 3 cm lateral to the lateral edge of the spinous process (Figure 4).

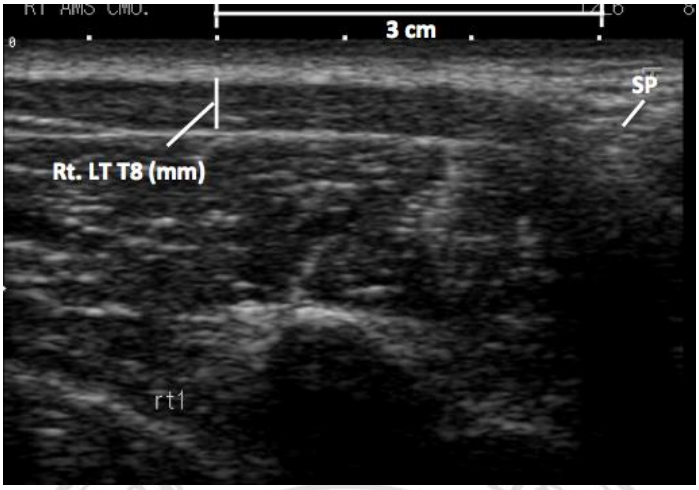

Figure 4 Measurement of the thickness of the lower trapezius muscle

The reliability of the measurement of the lower trapezius thickness in this study had been shown to be good to excellent ($ICC_{3,1}$ for intra-reliability = 0.86 and $ICC_{2,1}$ for inter-reliability = 0.92). Details of the inter- and intra-reliability are provided in Appendix E1 and E2.

3.4 Procedures

On the testing day, all participants completed a consent form and general questionnaire. Participants with neck pain also completed the neck disability index-TH version (NDI-TH) (68) and visual analogue scale (VAS). Participants were then positioned prone on a treatment plinth with the head in midline, the arms close to the side and the palms facing the ceiling (14-16). An investigator who was blinded to the participant's condition palpated the spinous process of T8 and marked with a non-permanent marker as a reference line for imaging the lower trapezius muscle. The ultrasound imaging measurement of the lower trapezius muscle was performed both sides under a standard set of conditions: (1) at rest at 0° shoulder abduction; (2) at rest at 120° shoulder abduction and; (3) during contraction at 120° shoulder abduction. For the first condition, participants were instructed to completely relax with their arms remaining at their side. For the second condition, participant's arm was positioned at 120° abduction measured by a goniometer (16). This position was relevant to the line of the lower trapezius muscle fibers and recommended as a standard position for manual

muscle testing (17). Participants were then asked to maintain the position and relax as much as possible. For the last condition, participants were asked to lift their arm straight up without any compensation. The height that participants could lift without compensation was set as a reference point, using an adjustable bar. To prevent compensation during the test, the other investigator stood at the side test and stabilized the contralateral scapula (8, 17, 48) (Figure 5). The side measured for all conditions was performed in a random order. Each condition was captured two times with a 30-60 second rest between images and each image captured was measured twice using Image J software. The mean values of each side for each condition were used for further analysis. A flow chart of the study is shown in Figure 6.

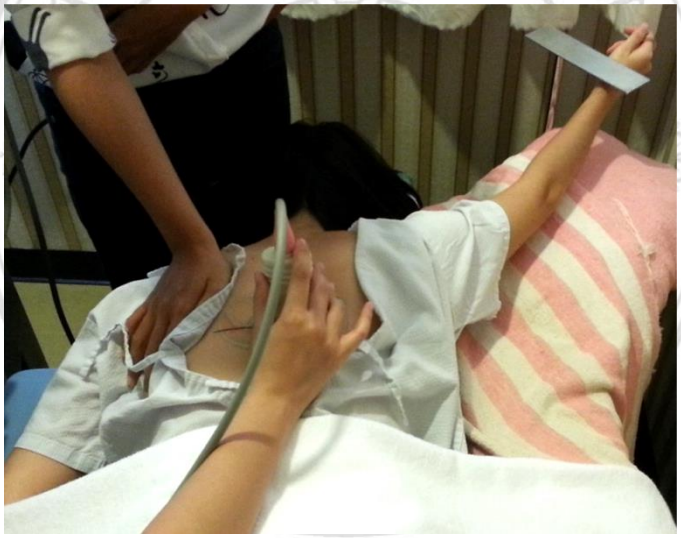

Figure 5 The ultrasound imaging measurement of the lower trapezius muscle during contraction at 120° shoulder abduction

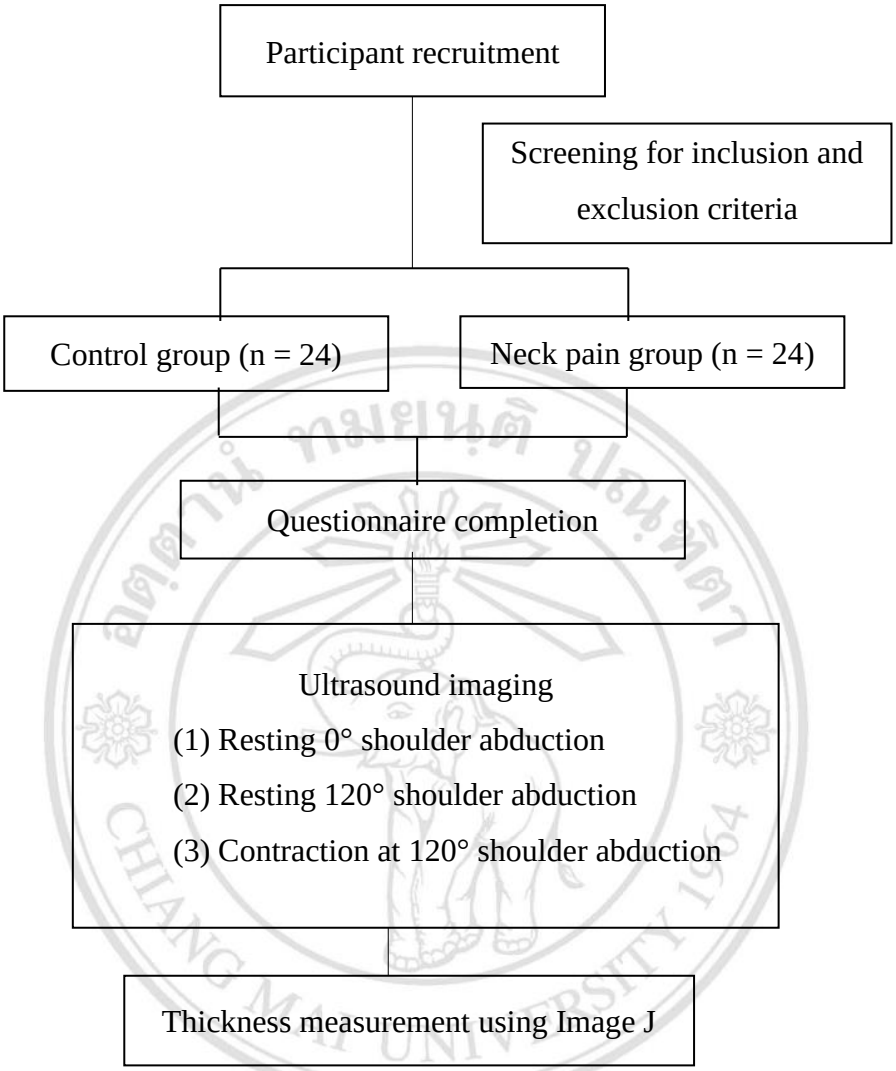

Figure 6 Flow chart of the study procedure

3.5 Independent and dependent variables

3.5.1 Independent variable

Subject group (patients with neck pain and controls)

3.5.2 Dependent variable

The average thickness of the lower trapezius muscle

3.6 Statistical analysis

Kolmogorov-Smirnov test was used to test normality of the variables. Independent *t*-test was then used to determine differences in demographic data and the thickness of the lower trapezius in each condition between the neck pain and control groups. Dependent t-test was further used to determine differences in the muscle thickness between sides for each group. A significance level was set at 0.05. All statistical analyses were analyzed by SPSS (version 16.0).

3.7 Location

The study was conducted at the Radiologic Technology Clinic and Department of Physical Therapy, Faculty of Associated Medical Sciences, Chiang Mai University.