ประสิทธิภาพของการเคลื่อนที่ข้อต่อด้านข้างของกระดูกสันหลังส่วนคออย่างเป็นจังหวะเป็นระยะเวลา 4 สัปดาห์ ในการรักษาอาการปวดคอด้านเดียว

นางสาวมลทิชา สกุณา

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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THE EFFECT OF THE 4-WEEK DURATION OF THE UNILATERAL POSTERO-ANTERIOR CERVICAL MOBILIZATION IN THE TREATMENT OF UNILATERAL NECK PAIN

Miss Monticha Sakuna

A Thesis Submitted in Partial Fulfillment of the Requirements
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By	Miss Monticha Sakuna
Field of study	Physical Therapy
Thesis Principal Advisor	Assistant Professor Rotsalai Kanlayanaphotporn, Ph.D.
Thesis Co-advisor	Assistant Professor Adit Chiradejnant, Ph.D.

Accepted by the Faculty of Allied Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

Vanida Nopponpunth.....Dean of the Faculty of Allied Health Sciences
(Assistant Professor Vanida Nopponpunth, Ph.D.)

THESIS COMMITTEE

Prawit Janwantanakul.....Chairman
(Associate Professor Prawit Janwantanakul, Ph.D.)

Rotsalai Kanlayanaphotporn.....Thesis Principal Advisor
(Assistant Professor Rotsalai Kanlayanaphotporn, Ph.D.)

Adit Chiradejnant.....Thesis Co-advisor
(Assistant Professor Adit Chiradejnant, Ph.D.)

Aatit Paungmali.....External Member
(Assistant Professor Aatit Paungmali, Ph.D.)

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งานวิจัยนี้ศึกษา ผลการขยับข้อต่อจากหลังไปหน้า บริเวณด้านข้างของกระดูกสันหลังด้านเดียวกับที่มีอาการปวดคอ (IUPA) ในการรักษาผู้ป่วยที่มีอาการปวดคอทางด้านข้าง เป็นระยะเวลา 4 สัปดาห์ ผู้ป่วย 15 คน (ชาย 1 คน หญิง 14 คน, อายุ 24 – 56 ปี) เข้าร่วมการศึกษาครบโปรแกรม ผู้ป่วยได้รับการรักษาด้วยเทคนิค IUPA 2 ครั้งต่อสัปดาห์ โดยจะถูกทำการวัดระดับความเจ็บปวดและช่วงการเคลื่อนไหว (ROM) ของคอทุกครั้งที่รักษา ระดับความไม่สามารถในการทำกิจกรรม (NDI) จะวัดก่อนการรักษาครั้งแรกและครั้งที่ 8 ส่วนระดับการรับรู้ผลการรักษาโดยรวม (GPE) จะวัดก่อนการรักษาในครั้งที่ 5 และ 8 ผลการวิเคราะห์ทางสถิติด้วย One-way repeated measures analysis of variance และ *post-hoc* analysis พบการลดลงอย่างมีนัยสำคัญของระดับความเจ็บปวด ($p < 0.05$) แต่ไม่พบการเปลี่ยนแปลงอย่างมีนัยสำคัญของ ROM ($p > 0.05$) ผลการวิเคราะห์ด้วย Paired *t*-test พบความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างค่า NDI ที่วัดครั้งแรกและครั้งที่ 8 ($p < 0.001$) ผู้ป่วยประมาณ 73 เปอร์เซ็นต์รายงานค่า GPE ในระดับดีขึ้น ผลการศึกษาชี้ให้เห็นว่าการรักษาด้วยเทคนิค IUPA มีประสิทธิภาพในการลดความเจ็บปวดและระดับ NDI ขณะเดียวกันก็ทำให้ระดับ GPE ดีขึ้น ในผู้ป่วยที่มีอาการปวดคอทางด้านข้าง ผลการรักษาต่อระดับความเจ็บปวดมีผลสะสมเมื่อทำการรักษาครั้งต่อๆไป อย่างไรก็ตามเทคนิคดังกล่าวไม่มีประสิทธิภาพในการเพิ่ม ROM ของคอ

ภาควิชา.....กายภาพบำบัด..... ลายมือชื่อนิสิต.....มลทิชา สกุณา.....

สาขาวิชา.... กายภาพบำบัด..... ลายมือชื่ออาจารย์ที่ปรึกษาวิทยานิพนธ์หลัก รสลัย กัลยาณพจน์พร

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497 72044 37: MAJOR MUSCULOSKELETAL PHYSICAL THERAPY
KEY WORD: CERVICAL MOBILIZATION / MECHANICAL NECK PAIN / UNILATERAL POSTERO-ANTERIOR TECHNIQUE / MANUAL THERAPY

MONTICHA SAKUNA: THE EFFECT OF THE 4-WEEK DURATION OF THE UNILATERAL POSTERO-ANTERIOR CERVICAL MOBILIZATION IN THE TREATMENT OF UNILATERAL NECK PAIN. THESIS PRINCIPAL ADVISOR : ASST. PROF. ROTSALAI KANLAYANAPHOTPORN, Ph.D., THESIS CO-ADVISOR : ASST. PROF. ADIT CHIRADEJNANT, Ph.D., 100 pp.

This study investigated the effect of the ipsilateral unilateral postero-anterior (IUPA) cervical mobilization technique for treating unilateral neck pain over 4-week treatment course. Fifteen patients (1 male and 14 females, aged 24 – 56 years) completed the treatment course. The patients received IUPA cervical mobilization twice a week for 4 weeks. The measurement of pain intensity and cervical range of motion (ROM) took place every visit while the Neck Disability Index (NDI) scores were measured only at baseline and pre-treatment of the 8th visit. The global perceived effect (GPE) was measured at pre-treatment of the 5th and the 8th visits. One-way repeated measures analysis of variance and *post-hoc* analysis demonstrated significant improvement in pain at rest and on worst movement ($p < 0.05$). Paired *t*-test demonstrated significant difference in the NDI scores between baseline and the 8th visit ($p < 0.001$). Approximately 73 percent of patients reported their GPE as improved. No statistical significant differences in cervical ROM of each visit from baseline were found ($p > 0.05$). The results suggest that the IUPA cervical mobilization technique is effective in decreasing pain and disability while improving GPE in the patients with unilateral neck pain. The clinical effect on pain is cumulative with the subsequent applications of the mobilization. However, it is not effective in improving cervical ROM.

Department.....Physical Therapy...Student's signature.....Monticha Sakuna.....
Field of study....Physical Therapy...Principal Advisor's signature.....Rotsalai Kanlayanaphotporn
Academic year.....2008.....Co-advisor's signature...Adit Chiradejnant

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LIST OF ABBREVIATIONS

ANOVA	=	Analysis of variance
CROM	=	Cervical range of motion instrument
dPAG	=	Dorsolateral periaqueductal gray
DPIS	=	Descending pain inhibitory system
EMS	=	Electrical muscle stimulation
GPE	=	Global perceived effect
HVLA	=	High velocity low amplitude
ICC	=	Intraclass correlation coefficient
IUPA	=	Ipsilateral unilateral postero-anterior
MDC	=	Minimal detectable change
mm	=	Millimeter
MNP	=	Mechanical neck pain
NDI	=	Neck disability index
PA	=	Postero-anterior
PAG	=	Periaqueductal gray
RCT	=	Randomized controlled trial
ROM	=	Range of motion
Rx	=	Treatment
SD	=	Standard deviation
SEM	=	Standard error of measurement
SG	=	Substantia gelatinosa
SMT	=	Spinal manipulative therapy
SPSS	=	Statistical package for the social sciences
T	=	Transmission cell
VAS	=	Visual analogue scale
vPAG	=	Ventrolateral periaqueductal gray

CHAPTER I

INTRODUCTION

1.1 Background and rationale

Neck pain is a common musculoskeletal disorder associated with disability in general population (Cote et al., 2004). Approximately 67 percent of population experience neck pain at least once in their lifetime. Additionally 54 percent of population experience neck pain within the last 6 months (Cote et al., 2003).

Mobilization is a technique which is typically used by a manual therapist in the management of patients with neck pain (Bronfort et al., 2004, Gross et al., 2004, Vernon and Humphreys, 2007, Vernon et al., 2007). It can be applied anywhere within a joint range of motion (ROM) as a set of oscillatory movements by which the patients can choose to prevent the movement (Maitland et al., 2005). Previous studies showed that cervical mobilization could provide an immediate reduction of neck pain and an increase in cervical ROM (Cassidy et al., 1992, Martinez-Segura et al., 2006). When following up at longer duration, an improvement in neck disability index (NDI) and global perceived effect (GPE) were also illustrated (Hoving et al., 2006, Hoving et al., 2002, Hurwitz et al., 2002). At 2 weeks after a cervical mobilization, a reduction in both of the most severe neck pain and the pain on average was reported and this reduction continued up to 6 months (Hurwitz et al., 2002). The greatest reduction was found during the first 2 - 4 weeks. However, in that study, the justification for the application of the mobilization was not stated and the patients were heterogeneous in their symptom distribution area. Moreover, any possible other interventions that might be sought by the patients before the follow-up period were not controlled. As a result, the long-term effect of the cervical mobilization on pain is still inconclusive. No study on the long-term effect of the cervical mobilization on cervical ROM has been found.

Despite the diversity of cervical mobilization which a therapist uses for treating neck pain, the Maitland spinal mobilization is one of the most widely used therapies. This

therapy, Maitland suggested the therapist to select the mobilization technique based on the symptom distribution area of the patients. It is believed that the joint(s) underlying the symptomatic area is responsible for neck pain and it should be mobilized. The patients with unilateral neck pain should be therefore treated with the ipsilateral unilateral postero-anterior (IUPA) mobilization technique which is applied directly over the zygapophyseal joints of the affected side of the cervical spine (Maitland et al., 2005). Even though there has been no published research designing to test the effectiveness of this IUPA mobilization technique, its therapeutic merits could be expected. It was demonstrated in patients with unilateral neck pain that the cervical manipulation applied to the same side of neck pain resulted in a greater immediate decrease in resting pain and increase in cervical ROM than that applied to the opposite side of neck pain (Pikula, 1999). The studies on the use of muscle energy technique, sustained stretching, and osteopathic mobilization on the side of neck pain also showed an immediate effect in decreasing pain and increasing cervical ROMs after a single treatment (Cassidy et al., 1992, Martinez-Segura et al., 2006, McNair et al., 2007).

Due to the lack of the detailed study on the effect of the IUPA cervical mobilization technique for treating unilateral neck pain over a certain treatment period, this study was conducted. From previous studies, the suitable follow-up period for the effectiveness of the manual therapy to be demonstrated varied from 2 - 4 weeks (Hoving et al., 2002, Hurwitz et al., 2002, Vernon and Humphreys, 2007). To ensure that the plausible effectiveness of the IUPA mobilization technique would be observed, this study was undertaken over a 4-week period.

1.2 Objective

The objective of this study was to investigate the effect of the IUPA cervical mobilization technique for treating unilateral neck pain over 4-week treatment course.

1.3 Specific objectives

- To investigate the effect of the IUPA cervical mobilization technique on pain at rest, pain on worst movement, and cervical ROM after each visit in comparison with baseline
- To investigate the effect of the IUPA cervical mobilization technique on the NDI values, after the 4-week treatment course
- To investigate the effect of the IUPA cervical mobilization technique on GPE by calculating the proportion of the patients who identified themselves as being improved, unchanged, and worsened at pre-treatment of the 5^{th} and the 8^{th} visits of the treatment course

1.4 Hypotheses

- There would be statistically significant differences in pain at rest, pain on worst movement, and cervical ROM between the post-treatment values of each visit from baseline.
- There would be statistically significant difference in the NDI values taken at the 8^{th} visit from baseline.
- The majority of patients would identified themselves as being improved at the 5^{th} and the 8^{th} visits.

1.5 Scope of the study

This study investigated the effect of the IUPA cervical mobilization technique on pain intensity, cervical ROM, NDI, and GPE. The patients who participated in this study suffered from unilateral neck pain. They received the treatment twice a week for 4 weeks.

1.6 Brief method

Patients who had unilateral mechanical neck pain (MNP) were recruited into the study and all of them signed informed consent. They were interviewed and screened by a physical therapist. After that, baseline data of pain at rest, pain on worst movement,

cervical ROM, and NDI values were measured by an assessor. Then, the therapist performed full assessment and the patients received the IUPA cervical mobilization technique treatment from the therapist. When the treatment session was completed, the same assessor came back to collect the post-treatment data. In this study, the therapist was blind to all outcome measurements. Only one assessor was responsible for collecting all outcomes of measurement.

The patients were asked to come for follow-ups twice a week for 4 weeks. These made up of 8 visits in total. The measurement of pain intensity and cervical ROM took place every visit while the NDI was measured only at baseline and pre-treatment of the 8^{th} visits. The GPE was measured at pre-treatment of the 5^{th} and the 8^{th} visits.

1.7 Expected benefit

This study would provide the advantageous information about the management of unilateral neck pain by using IUPA cervical mobilization technique.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

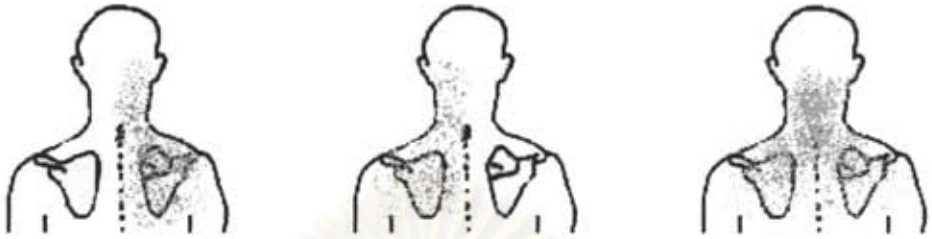
This chapter describes the definition of neck pain, the management of neck pain, the effectiveness of manual techniques especially the cervical mobilization for neck pain, and the application of Maitland cervical mobilization.

2.2 Neck pain

Neck pain is commonly experienced by most people although the prevalence may vary between different nations (Cote et al., 2004, Fejer et al., 2006, Jensen and Harms-Ringdahl, 2007). The 1-year prevalence was 26 and 36 percent in Europe and Scandinavia, respectively (Fejer et al., 2006). Cost of the use of health services for neck pain has been increased dramatically. It was approximately 540 euro a year in 1996 and increased to 447 – 1379 euro a year in 2003 (Korthals-de Bos et al., 2003).

Different classification criteria have been proposed for neck pain. Some researchers classify neck pain with regard to the duration of symptoms as acute (1 - 30 days), sub-acute (30 - 90 days), and chronic (more than 90 days) neck pain (Fejer et al., 2005). Some researchers classify neck pain with regard to the cause of symptoms as non-MNP and MNP (Ferrari and Russell, 2003). The former one is caused by serious pathology such as malignancy, infection of the vertebra, metabolic bone diseases, and fracture of the spine (Ferrari and Russell, 2003). The etiology of the latter more common one is, however, not clearly understood but it usually involves with mechanical dysfunction of various anatomical structures of the cervical spine (Bogduk and Aprill, 1993). The structure that is often affected is the zygapophyseal joint (Cavanaugh et al., 2006). The cervical motion may become stiff in one or all directions (Ahn et al., 2007). The symptoms are provoked by maintained neck postures, by neck movement, or by palpation of the cervical muscles. In respect to symptom distribution area, neck pain can be categorized into right unilateral, left

unilateral, and bilateral neck pain over the posterior aspect of the cervical spine (Figure 2.1).



(A) Right unilateral pain (B) Left unilateral pain (C) Bilateral pain

Figure 2.1 Possible symptom distribution area for neck pain.

2.3 Spinal manipulative therapy for neck pain

The management of neck pain can be divided into 2 major groups that consist of surgical and non-surgical treatments. The non-surgical treatment includes pharmacology, acupuncture, conventional physical therapy, manual therapy, etc. Spinal manipulative therapy (SMT) is one of the manual therapies that have been widely used for treating neck pain (Vernon and Humphreys, 2007). Typically, it is classified into two groups as manipulation and mobilization. Manipulation is a small amplitude thrust being performed at the limit of the available passive range at so high speed that the patients cannot stop the movement (Maitland et al., 2005). Mobilization is a small or large amplitude oscillatory movement being performed anywhere within the available passive range at the speed under the patients' ability to prevent the movement (Maitland et al., 2005). There are a number of studies investigating the effectiveness of cervical manipulation and mobilization in the treatment of neck pain over the last decade. Table 2.1 summarizes the effectiveness of the cervical manipulation and mobilization reported by previous studies. The studies investigated in unilateral neck pain were rarely found.

Table 2.1 Summary of the effectiveness of the cervical manipulation and mobilization in randomized controlled trials studies for managing neck pain

Study	patients	Treatment	Technique	Additional Rx	Results
Immediate studies					
Cassidy et al (1992)	Acute, sub-acute, and chronic neck pain Unilateral symptom	(Group1) **Mobilization** (n = 48) (Group2) Manipulation (n = 52)	Muscle energy technique HVLA thrust	-	Muscle energy and HVLA thrust technique demonstrated immediate **pain** reduction and improvement of cervical **ROM**.
Pikula (1999)	Acute neck pain Unilateral symptom	Group1) Manipulation (n = 12) 1 (Group2) Manipulation (n = 12) (Group3) Detuned ultrasound (n = 12)	HVLA thrust on the side of neck pain HVLA thrust opposite the side of neck pain No specific technique	-	HVLA thrust on the side of neck pain was more effective than HVLA thrust opposite the side of neck pain and detuned ultrasound on **pain** reduction and cervical **ROM**. Detuned ultrasound had - immediate pain reduction but no improvement of cervical ROM
Martinez-Segura et al (2006)	Sub-acute and chronic neck pain Unilateral symptom	(Group1) **Mobilization** (n = 37) Group2) Manipulation (n = 34)	Sustained mobilization in manipulated position HVLA thrust	-	Sustained mobilization and HVLA thrust demonstrated immediate **pain** reduction and improvement of cervical **ROM**.

Table 2.1 Summary of the effectiveness of the cervical manipulation and mobilization in randomized controlled trials studies for managing neck pain (continued)

Study	patients	Treatment	Technique	Additional Rx	Results
Long-term studies					
Brodin (1985)	Chronic neck pain No reported the distribution of symptom	(Group1) **Mobilization** (n = 23), 3 Rx/week over 3 weeks + daily aspirin + neck school	Maitland mobilization, No data of specific technique	Massage Electric stimulation Relaxing traction	Mobilization demonstrated significant **pain** reduction and increased summation of cervical **ROM** at 3 weeks. The effects were greater than aspirin.
		(Group2) Daily aspirin (n = 23), over 3 weeks	No specific technique		
		(Group3) Daily aspirin + neck school + mock therapy (n = 17), 9 Rx over 3 weeks	No specific technique		
David et al (1998)	Chronic neck pain. No reported the distribution of symptom.	(Group1) **Mobilization** (n = 35), 6 Rx over 6 weeks	Maitland mobilization, mixed technique	-	Mobilization was as effective as acupuncture in pain and cervical ROM improvement. **Pain** reduction and improvement of cervical **ROM** were significant at 6 weeks.
		(Group2) Acupuncture (n = 35), 6 Rx over 6 weeks	No specific technique		
Hutwitz et al (2002)	Acute, sub-acute, and chronic neck pain. No reported the distribution of symptom.	(Group1) **Mobilization** with/with out heat and EMS (n = 165), 1Rx over 6 week	Chiropractic mobilization, No data of specific technique	Stretching, strengthening, and flexibility exercise	Both manipulation and mobilization demonstrated significant improvement in pain and disability. Manipulation was as effective as mobilization. **Pain** reduction was significant at 2 weeks. **NDI** showed significant reduction at 6 weeks.
		(Group2) Manipulation with/without heat and EMS (n = 171), 1Rx over 6 week	Chiropractic manipulation, No data of specific technique		

Table 2.1 Summary of the effectiveness of the cervical manipulation and mobilization in randomized controlled trials studies for managing neck pain (continued)

Study	patients	Treatment	Technique	Additional Rx	Results
Hoving et al (2002)	Acute, sub-acute, and chronic neck pain. No reported the distribution of symptom	(Group1) **Mobilization** (n = 60), 1 Rx/week over 6 weeks	Maitland mobilization, No data of specific technique	Massage Coordination technique	Mobilization is better than physical therapy or continued care by a general practitioner on most outcome measures. At 7 weeks, **pain** was significant reduction, cervical **ROM** and **NDI** was significant improvement, **GPE** showed 68.3 percent of patients recovered.
		(Group2) Physical therapy (exercise) (n = 59), 2 Rx/week over 6 weeks	No specific technique		
		(Group3) General practitioner care (n = 64), every 2 weeks	No specific technique		

EMS = Electrical muscle stimulation, GPE = Global perceived effect, HVLA = High velocity low amplitude, NDI = Neck disability index, ROM = Range of motion, Rx = Treatment

Most studies used the changes of pain intensity, cervical ROM, disability, and GPE as the outcomes to represent the effectiveness of the treatment. The pain intensity is a quantitative of severity or magnitude of perceived pain of the patients. The cervical ROM shows the extent of neck movement limitation. The disability represents how much of restriction or lack of ability (resulting from the neck pain) to perform an activity in manner of everyday activities. The GPE reflects the overall perception of the patients' symptom.

In general, it was demonstrated that the application of a single cervical manipulation and mobilization to the side of neck pain resulted in immediate reduction of neck pain and improvement in cervical ROM (Cassidy et al., 1992, Martinez-Segura et al., 2006, Pikula, 1999). However, the greater changes were found in the group that received cervical manipulation than those who received cervical mobilization (Cassidy et al., 1992, Martinez-Segura et al., 2006). Comparisons of the effectiveness among the cervical manipulation techniques, it was found that applying cervical manipulation to the side of neck pain demonstrated greater pain reduction and improvement in cervical ROM than applying to the opposite side (Pikula, 1999). The comparison between application of the cervical mobilization to the same side and to the opposite side of neck pain has never been reported.

With regard to the immediate improvement in cervical ROM, the direction that showed the greatest improvement varied with studies. One study reported the direction in flexion followed by ipsilateral rotation and contralateral flexion (Cassidy et al., 1992). Another study reported the direction in ipsilateral rotation followed by ipsilateral flexion and contralateral flexion (Pikula, 1999). Within each study, however, the differences in magnitude of cervical ROM in each direction were small (0.1 – 3.2 degrees). It seems that the application of a single cervical manipulation and mobilization only to the side of neck pain caused an increase in cervical ROM in more than one direction. This may imply that the effectiveness of cervical manipulation and mobilization on the cervical ROM is non-specific and not dependent on the application side.

For the longer term effect, approximately 68 percent of the patients whom received the cervical mobilization once a week repeatedly over 6 weeks reported their GPE as

improved when being measured at the 7th week (Hoving et al., 2002). Two weeks after a single treatment of cervical mobilization, it was demonstrated that the NDI values was also reduced and the clinically significant reduction was found at 6 weeks by which there was continuous reduction afterwards (Hurwitz et al., 2002). These greater pain reduction and improvement in cervical ROM were demonstrated in comparison to those who received medical treatment (Brodin, 1983), acupuncture (David et al., 1998), conventional physical therapy, and general practitioner care (Hoving et al., 2002). To our knowledge, the study on the application of the cervical mobilization to the side of neck pain has never been investigated in the long term.

Although the effectiveness of the cervical mobilization has been investigated before, the results of these studies still have some clinical limitations as the following reasons. Most studies collected data from the heterogeneous group of patients. Besides that, the specific mobilization technique used was not clearly stated. The patients was also received some additional treatments during the treatment course. These additional treatments may provide some confounding effects on these results and lead to the unclear conclusion of the therapeutic effect of individual cervical mobilization technique. As a result, the study designed for the investigating the long-term effectiveness of individual cervical mobilization technique for treating the homogeneous group of patients needs to be conducted.

Although it seems that cervical manipulation is more effective than cervical mobilization in regard to pain, the cervical mobilization is considered to be relatively safer with less incidence of adverse effects (Vernon and Humphreys, 2007, Hurwitz et al., 2002, Gross, 2005). The adverse effects associated with cervical manipulation that have been reported are headache, local pain, transient dizziness, and loss of balance (Di Fabio, 1999). As a result, the cervical mobilization is suggested to be applied first before progressing to the use of the cervical manipulation. The cervical mobilization procedure that has been conducted and learned worldwide is the one that was described by Maitland (Haldeman et al., 2005). Therefore, this study will focus on Maitland's mobilization.

2.4 Maitland's mobilization

Maitland's mobilization can be performed either as a passive oscillatory movement or a sustained stretching (Maitland et al., 2005). For the passive oscillatory movement, the oscillation can be performed either slowly (one in 2 second) or quickly (three per second) as a smooth or a staccato movement (Maitland et al., 2005). The movement of a joint that imitates the one that the patients can perform actively is known as the passive physiological movement. The movement that must be performed by other person is called the passive accessory movement.

To plan for an appropriate treatment, Maitland advocated that several parameters needed to be considered and this becomes the foundation of the Maitland's concept. Pain, resistance, and muscle spasm in response to active and passive movements are taken into account. Together with the severity and irritability of the disorder as well as any pathological contraindications are related to the presenting signs and symptoms of the patients (Maitland et al., 2005). The cervical spine level and the movement that reproduce the patients' symptom are noted for being the level and the movement to be mobilized.

The behaviors of all parameters mentioned above throughout the cervical joint ROM can be depicted in a movement diagram (Maitland et al., 2005) (Figure 2.2). Line AB represents the ROM through which the joint is moved, B is the end of normal range for that movement in a so-called "normal" individual, L is the limit of range available in movement being tested, and line AC represents the intensities of severity, irritability, dizziness, paraesthesia, or "nature" (i.e. the kind of pathology, tissue, integrity, quality, or characteristics of the symptoms) (Magarey, 1985). Pain, joint resistance, and muscle spasm are the most common factors represented on the diagram as "P", "R", and "S", respectively. To represent the beginning of each factor, "1" is added behind each symbol. To represent the factor which causes the limitation of the movement, "2" is added. To represent the factors that reach their maximum intensity within the available range, " ' " is added.

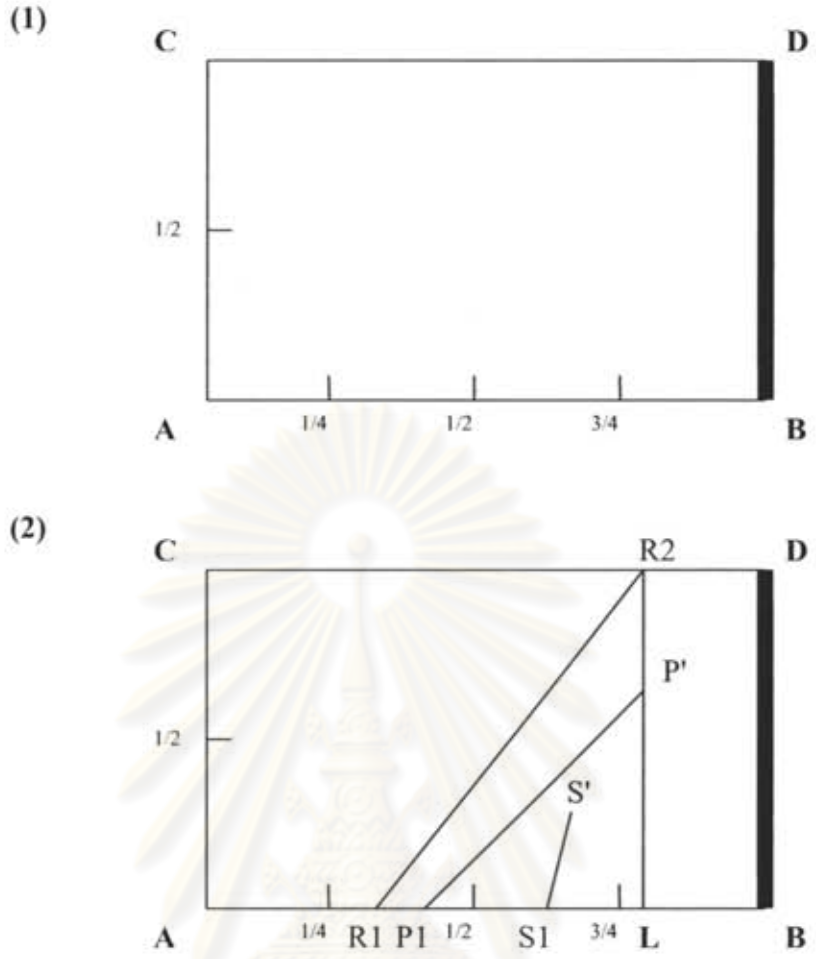


Figure 2.2 Movement diagram (modified from Maitland et al., 2005). (1) Basic outline of a movement diagram; A = beginning of the range, B = end of normal range, AC = the intensities of severity, irritability, nature, BD = a line to complete the movement diagram. (2) Example of all factors that can be presented during the movement test; R1 = the onset of resistance, P1 = the onset of pain, S1 = the onset of muscle spasm, R2 = the maximum resistance which causes the limitation of the movement, P' = the maximum pain within L, S' = the maximum intensity of muscle spasm within L, and L = limit of range available in movement being tested.

The movement diagram enables the therapists to analyze the "feel" of the joint movement so that the selection of passive treatment technique becomes more logical and the technique chosen will have more chance of success. The grade of movement,

the direction or the technique of mobilization, the frequency of mobilization, and the duration of mobilization are then justified.

2.4.1 Grade of movement

Maitland defined grade of movement based on amplitude and joint ROM (Maitland et al., 2005). Traditionally, four grades of treatment were proposed (Figure 2.3). Grade I is a small-amplitude movement performed near the starting range. Grade II is a large-amplitude movement that occupies the range that is free from any resistance. Grade III is also a large-amplitude movement but it occurs with some resistance. Grade IV is also a movement into resistance but it is carried out as a small amplitude movement. In general, the resistance perceived while performing grades III and IV is suggested to be approximately 50 percent of the normal resistance (Magarey, 1985) (Figure 2.4A). Currently, the grade of movement can be further refined to become a stronger or gentler movement in order to accommodate for various clinical problems (Figure 2.4B). An addition of plus (+) or minus (–) sign to the traditional grade is then applied to designate the refinement. The + and – signs represent the technique that perform with an increase or decrease of 25 percent of the resistance, respectively. In general, it is suggested that grades I, II, and III are suitable for treating pain dominant problem and grade IV is suitable for treating stiffness dominant problem.

Figure 2.3 Grades of movement of a normal joint under a hard end-feel. A = starting of the range, B = end of the range (modified from Maitland et al., 2005; page 175)

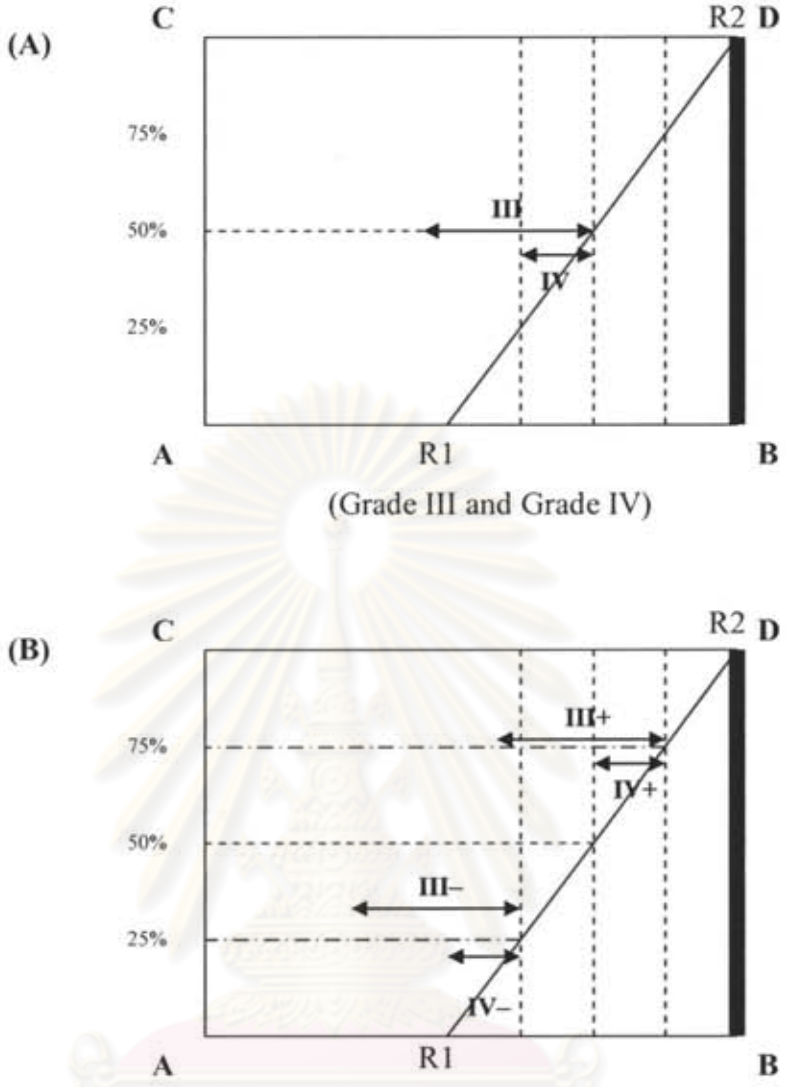


Figure 2.4 Grades of movement of a normal joint under a soft end-feel (A) Traditional grades of movement, (B) Refinement of grade of movement modified by Magarey (1985): A = Starting of the range, B = end of normal range, AC = the intensities of severity, irritability, nature, BD = a line to complete the movement diagram. R1 = Beginning of the resistance from stiffness or muscle spasm, and R2 = the maximum resistance which causes the limitation of the movement (modified from Magarey, 1985)

2.4.2 Direction or technique of mobilization

The four primary directions or techniques in which the mobilization can be performed on the vertebrae are the postero-anterior pressure on the spinous process or central

PA, the postero-anterior pressure on the zygapophyseal joint or unilateral PA, the transverse pressure on the lateral surface of the spinous process, and the antero-posterior pressure on the transverse process. The technique which is the most frequently used are the central PA and the unilateral PA mobilization techniques (Snodgrass et al., 2006). The therapists carry out the central PA technique by standing at the patients' head and place the thumb pads on spinous process of the cervical spine to apply pressure rhythmically in the PA direction (Figure 2.5A). To perform the unilateral PA technique, the therapists place their thumb pads over a zygapophyseal joint to apply pressure rhythmically in the PA direction (Figure 2.5B).

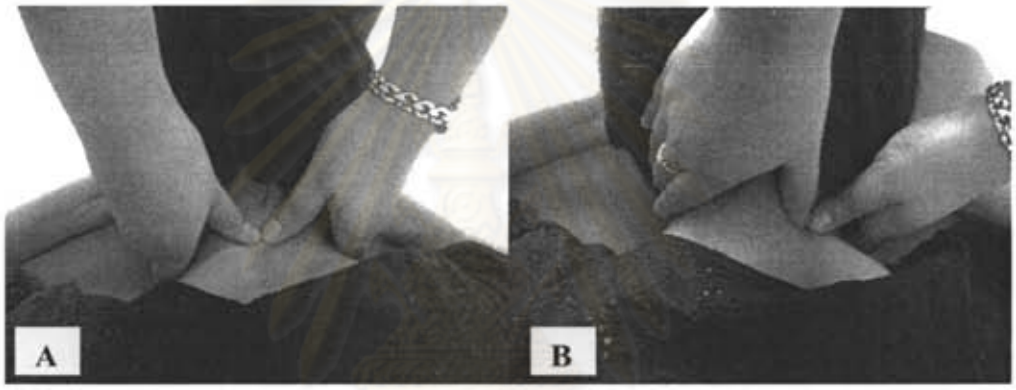


Figure 2.5 Application of the (A) central PA and (B) unilateral PA cervical mobilization techniques.

For the selection of mobilization technique, Maitland proposed the guidelines based on whether the patients' symptoms are distributed unilaterally or centrally or bilaterally (Maitland et al., 2005). The guideline suggests that the patients with central or bilateral symptom should be first treated with the central PA technique while the patients with unilateral symptom should be treated with IUPA or rotation technique (Figure 2.6).

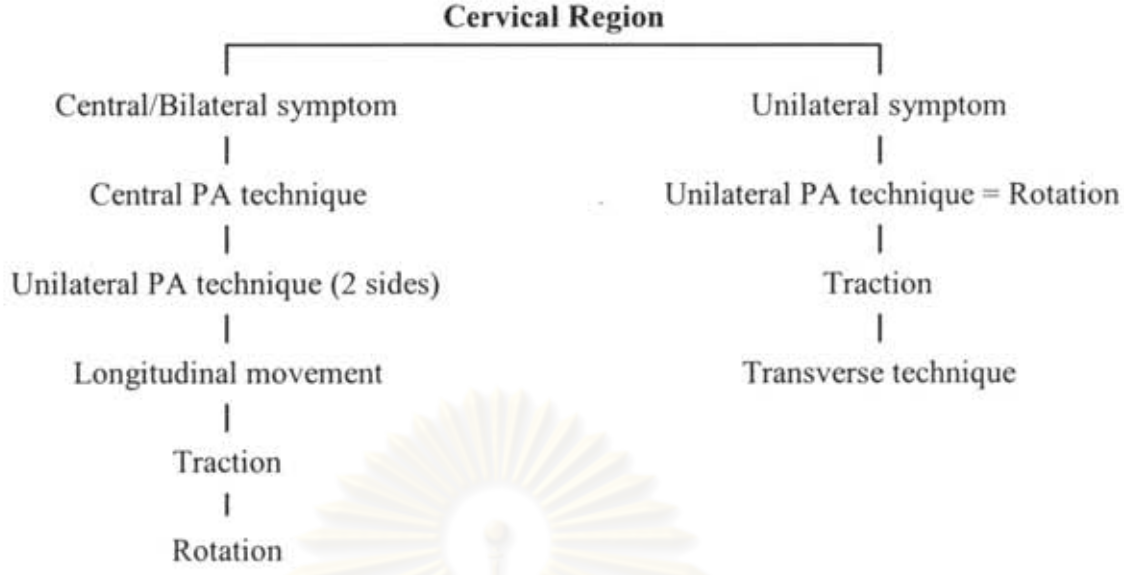


Figure 2.6 Sequence of selection technique (from Maitland et al., 2005; page 184).

2.4.3 Frequency of mobilization

Maitland et al. (2005) recommended applying mobilization at a rate ranging from 0.5 to 2 Hz. This range is similar to 0.54 to 1.75 Hz reported while performing cervical mobilization in asymptomatic subjects (Snodgrass et al., 2007). In general, the low frequency is suggested when the treatment aim is for relieving pain. The high frequency is suggested for improving joint mobility.

2.4.4 Duration of mobilization

It is suggested that the duration of the 1st treatment session should be less than subsequent treatments as the 1st stretching of a joint appears to cause more reaction than subsequent stretches (Maitland et al., 2005). Depending on the response to the previous treatment, the duration of treatment at subsequent sessions can be determined. Although optimal treatment duration can vary with different joint conditions, each joint should be mobilized for 30 seconds to one minute duration for a total of three or four sets (Maitland et al., 2005, Petty and Moore, 2004). However, these numbers are given as a guideline only and they can be adjusted under therapists' consideration.

2.4.5 Contraindications to mobilization

The possibility of serious damage resulted from mobilization, particularly cervical mobilization, may occur if the patients' condition is not suitable for the treatment. So, the contraindications to mobilization must be kept in mind to prevent from any serious effect. The contraindications to mobilization are malignancy (primary or secondary), inflammatory conditions (e.g. osteomyelitis), spinal cord compression, cuada equine compression, recent fractures, and osteoporosis (Maitland et al., 2005).

2.5 Biomechanical and neurophysiological mechanisms of mobilization

Many studies investigated the mechanisms of cervical mobilization in reducing pain intensity and increasing cervical ROM in patients with neck pain. From previous evidence, two mechanisms have been proposed. They are the biomechanical and neurophysiological mechanisms.

2.5.1 Biomechanical mechanisms

Biomechanical mechanism is often used in explaining the effect of mobilization technique on ROM, rather than on pain. However, a number of studies have to be investigated before a clear understanding of this mechanism on ROM can be obtained.

The recent study reported that applying the central PA force at one of the cervical spinous process could increase cervical lordosis (Lee et al., 2005). This shows that the force applied at one spinous process produces movements not only at the target vertebra but also of the entire cervical spine. During mobilization, anterior translation of the target vertebra resulted in extension and flexion movements of the upper and lower segments, respectively (Figure 2.7).

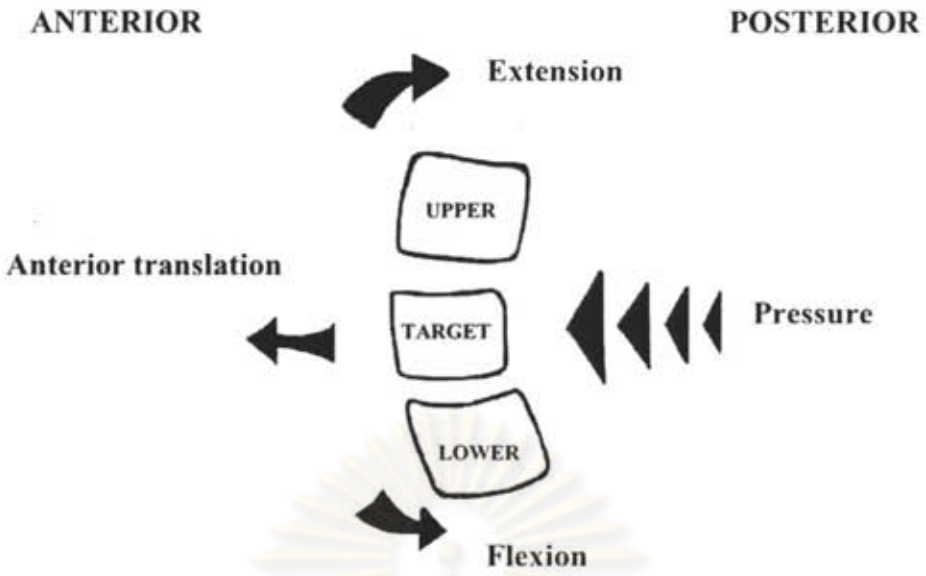


Figure 2.7 The movement of the target vertebra, the upper, and the lower segments during cervical PA mobilization.

However, the increase of cervical lordosis after removing the pressure has not been reported. If the increased cervical lordosis is still observed, it may imply that this mobilization technique can alter the extensibility of the connective tissue around the joint. To produce the permanently elongation of the connective tissue, the forces applied to the joint must be able to provide sufficient magnitude to produce micro-trauma (Threlkeld, 1992). The recommended guideline observed in cadaver ranged from 244 to 1136 newtons (Threlkeld, 1992). But the forces used, during cervical mobilization in asymptomatic subjects were reported to be in the range of 42.2 to 81.1 newtons (Snodgrass et al., 2006). This magnitude is much lower than the recommended guideline. So, this may be unable to produce a permanently change in connective tissue extensibility. However, these findings should be interpreted with care because the characteristics of connective tissue properties in cadaver and in asymptomatic subjects may be different. As a result, an alteration of the connective tissue extensibility after mobilization is still inconclusive. The use of the biomechanical mechanism in explaining the effect of cervical mobilization technique on cervical ROM is also unclear.

2.5.2 Neurophysiological mechanisms

Neurophysiological mechanism is often used in explaining the effect of mobilization technique on pain (Melzack and Wall, 1965, Wright, 1995), rather than on ROM. For more understanding about the therapeutic effect of joint mobilization inducing hypoalgesia, Figure 2.8 summarizes the overlapped mechanism of the three control levels; peripheral, spinal and supraspinal levels.

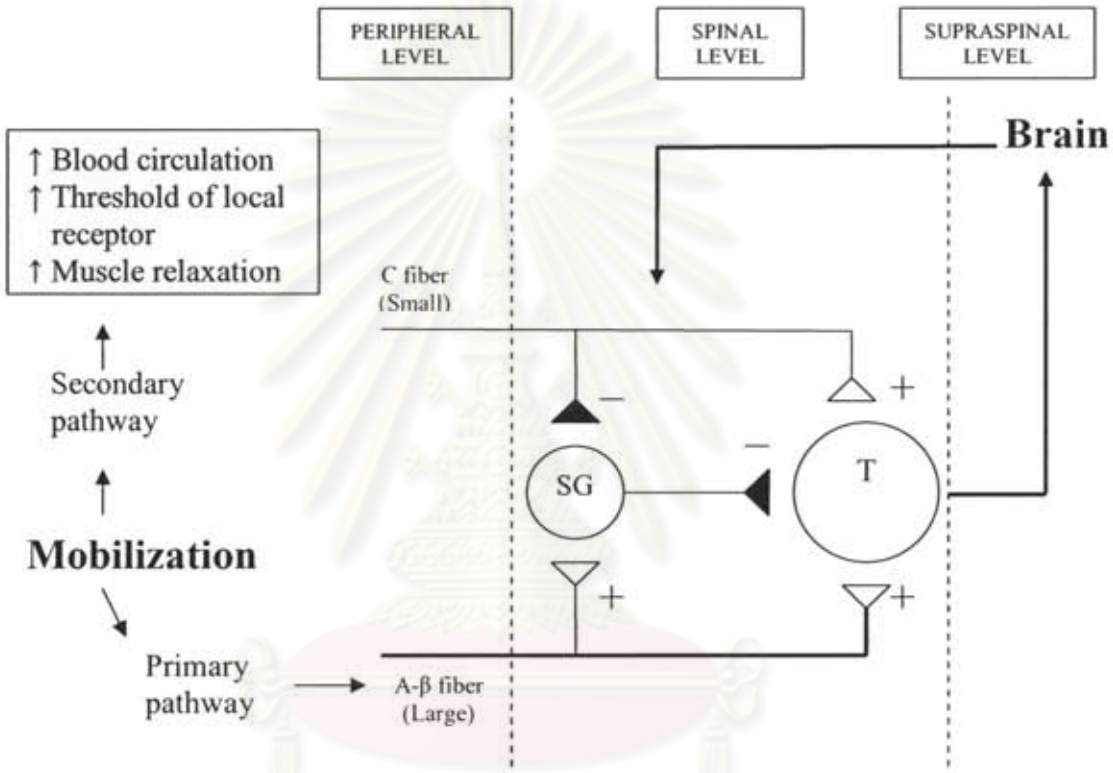


Figure 2.8 Summary of the neurophysiological mechanisms of mobilization. SG = the substantia gelatinosa, T = transmission cell, + and - represent the activation and inhibition of the impulse, respectively.

With regard to the peripheral level, the oscillatory movements of joint mobilization can produce pain reduction via several mechanisms. At the application site, the oscillatory movements may cause an increase in blood circulation around its vicinity and this may promote clearance of toxic substances such as substance P and histamine from the painful site (Maigne and Vautravers, 2003). An increase in the threshold limit of the receptors at the application site has also been proposed as one mechanism. Besides nociceptor, pain can be generated when the other types of receptors are

stimulated beyond their threshold limits. These receptors are mechanoreceptor, thermoreceptor, and chemoreceptor. It has been demonstrated that the repeated stimulation of these receptors would lead to an adaptation of the receptors and increase their threshold (Katavich, 1998). However, this phenomenon does not occur in nociceptor. Because of defensive mechanism of human body, repetitive stimulation of nociceptor will make the nociceptor to be hypersensitive. Moreover, it has been proposed that the oscillatory movement at the end range resulted in reduction in muscle spasm (Zusman, 1986). This stimulates the golgi tendon organ and induces muscle relaxation.

In regard to the spinal level, the gate control theory was proposed (Melzack and Wall, 1965). The gate is located in the spinal cord. The small fiber is responsible for carrying the afferent impulse from nociceptor to the brain (open gate). The large fiber transmits the afferent impulse from mechanoreceptor and proprioceptor resulting in the inhibition of interneuron in the substantia gelatinosa (SG). This will block the pain signal that goes to the transmission cell (T) which will be sent to the brain (Figure 2.9). Subsequently, pain perception is reduced (close gate). The spinal mobilization reduces pain via the stimulation of the large fiber.

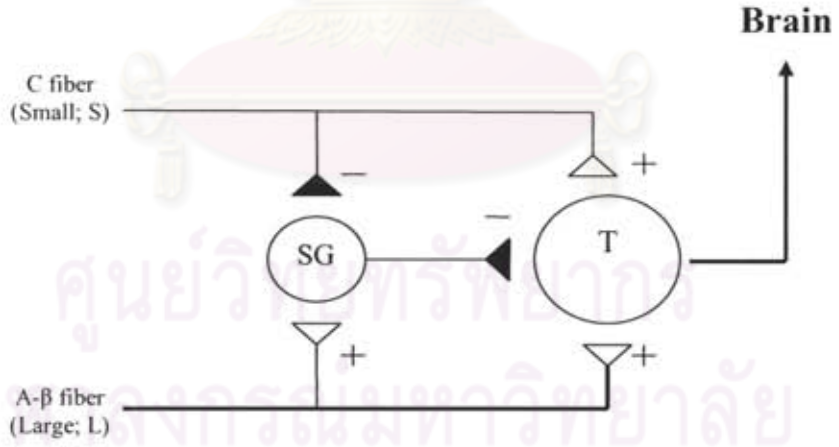


Figure 2.9 Gate control theory (modified from Melzack and Wall, 1965): SG = the substantia gelatinosa, T = transmission cell, + and - represent the activation and inhibition of the impulse, respectively.

In regard to the supraspinal level, the descending pain inhibitory system (DPIS) also causes the reduction in pain perception (Wright, 1995). There are two different

projection systems from periaqueductal gray (PAG) in midbrain to the spinal cord. One is the projection from dorsolateral periaqueductal gray (dPAG) and another one is ventrolateral periaqueductal gray (vPAG). Mobilization will stimulate these two DPIS pathways resulting in an immediate hypoalgesic effect (occurred within 15 seconds) and latent hypoalgesic effect (20 - 45 minutes later) (Figure 2.10).

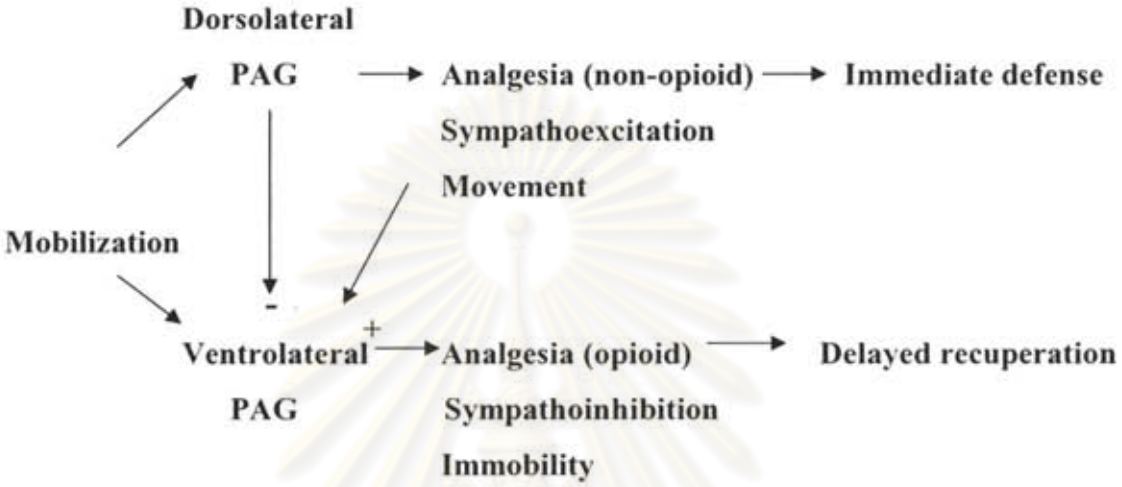


Figure 2.10 Hypoalgesic effect after mobilization therapy (modified from Wright, 1995): PAG = periaqueductal gray, + and - represent the activation and inhibition of the impulse, respectively.

2.6 Summary

Neck pain is one of the most prevalent health problems in population. Among the several kinds of mobilization used for treatment of this condition, the mobilization proposed and described by Maitland has been conducted and learned worldwide. Maitland suggested a guideline for selection of mobilization technique for neck pain depending on the distribution of area of symptoms. The IUPA cervical mobilization technique is recommended for treating patients with unilateral neck pain. However, no research evidence supports this recommendation. Although there are some studies that provide information on the immediate and long-term effects of Maitland's mobilization technique, an investigation on the IUPA cervical mobilization technique has never been conducted. Moreover, the long-term effect over a treatment period of this technique still inconclusive.

CHAPTER III

METHODOLOGY

3.1 Introduction

This chapter describes the study design, characteristic of participants, materials, procedures, and statistical analyses.

3.2 Study design

Prospective, repeated measures study design was used to investigate the effectiveness of the IUPA cervical mobilization technique for treating unilateral neck pain. The protocol was approved by the Ethical Review Committee for Research Involving Human Subjects and/ or Use of Animal in Research, Health Science Group of Faculties, Colleges and Institutes, Chulalongkorn University, Thailand (Appendix A).

3.3 Participants

3.3.1 Patients

Patients who had unilateral MNP were recruited from patients at the Health Sciences Service Center, Chulalongkorn University. The neck symptoms could be perceived as pain, ache, or discomfort over the posterolateral aspect of the cervical spine in the area between the superior nuchal line and the 1st thoracic vertebra that was provoked by maintained neck posture or by neck movement (Mersky and Bogduk, 1994). An extension of the symptoms down the upper extremity of the same side of neck pain was also possible. The patients were eligible for the study if they aged more than 20 years. They had to have unilateral neck pain both at rest and on worst movement greater than 20 out of 100 millimeters (mm) on visual analogue scale (VAS) to allow for any clinically important changes to be demonstrated (Ostelo and de Vet, 2005). Their neck pain had to persist for more than 2 weeks to control for any confounding factors from the possible spontaneous recovery of neck pain within this period. They had not received manual treatment for neck pain in the past month to prevent

confounding effect from previous treatment. Patients were excluded if they had the following features: (1) any contraindications to cervical mobilization, for instance, malignancy, inflammatory or infectious disease affecting the spine, fracture in the cervical spine, positive neurological sign that indicated the problems of the central nervous system (Maitland et al., 2005), (2) history of cervical spine surgery, and (3) communication problem.

3.3.2 Therapist and assessor

One physical therapist with 2-year clinical experience in using manual technique and one assessor involved in this study. The therapist was responsible for performing the physical examinations and defining the appropriate treatment details such as grade of IUPA cervical mobilization technique and spinal level(s). The assessor, who did not involve in the assessment and treatment, was responsible for taking and recording the outcome measures including cervical ROM, pain intensity, NDI, and GPE.

3.4 Materials

3.4.1 Visual analogue scale (VAS)

VAS was used to measure pain intensity (Appendix B). The scale consists of a line that is 100 mm long rating from "no pain" to "worst possible pain" (Figure 3.1). This measure was found to be suitable and sensitive for detecting improvement in pain intensity (Ostelo and de Vet, 2005). The patients were asked to report their pain at rest and pain on worst movement by placing a vertical mark on the line. The distance from the "no pain" end to the mark made by the patients was recorded as pain intensity score. The change score of 20 out of 100 mm is considered clinically relevant (Ostelo and de Vet, 2005).

Figure 3.1 Visual analogue scale (VAS)

3.4.2 Cervical range of motion instrument (CROM)

CROM (Performance Attainment Associates, St Paul, MN) was used for measuring cervical ROM in this study. This instrument is similar to eyeglasses and consists of 3 inclinometers (Figure 3.2). These 3 inclinometers are attached to a frame and each inclinometer is responsible for measuring the cervical ROM in the sagittal (flexion and extension), the frontal (lateral flexion), and the horizontal (rotation) planes. The inclinometers in the sagittal and the frontal planes use a gravity-dependent needle while the one in the horizontal plane uses a magnetic needle with a magnetic yoke worn on the neck to indicate ROM.

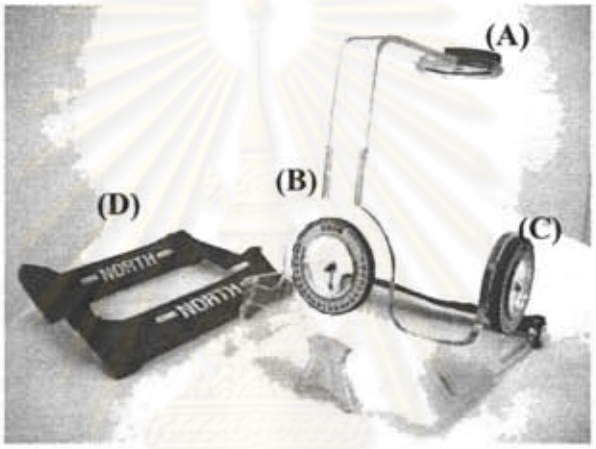


Figure 3.2 The cervical range of motion instrument: (A) inclinometer in the horizontal plane, (B) inclinometer in the frontal plane, (C) inclinometer in the sagittal plane, and (D) a magnetic yoke

The validity of CROM instrument when tested against the radiographic method was reported to be high (Tousignant et al., 2000, Tousignant et al., 2002) with the Pearson's *r* correlations of 0.97, 0.98, 0.82, and 0.84 for flexion, extension, left lateral flexion, and right lateral flexion, respectively. The CROM also showed high validity in the measurements of left and right rotations when being tested against an optoelectronic system with the Pearson's *r* correlations of 0.94 and 0.89, respectively (Tousignant et al., 2006). In addition, the reliability of CROM for all movements was reported to be high with the intraclass correlation coefficient (ICC) values of 0.84 - 0.95 for intra-observer reliability and 0.73 - 0.92 for inter-observer reliability (Youdas et al., 1991). In this study, the result of intra-observer reliability study was excellent

($ICC_{(2,1)}$ = 0.85 - 0.98) and the minimal detectable change (MDC) was less than 10 degrees (Appendix C).

3.4.3 Neck disability index (NDI)

Thai Neck Disability Index (Thai NDI) (Appendix D), which was cross-culturally adapted by Luckumnueporn (2007), was used for measuring the neck-related disability of the patients. It comprises of 10 items that are related to activities of daily life. The first question is about their pain intensity occurring at that moment and the other questions are related to washing, dressing, lifting, reading, headaches, concentration, driving, sleeping, work, and recreation. Each item is scored from 0 to 5 in which the higher score indicates the greater disability (the total score varied from zero to 50). After the patient answered the questionnaire, the NDI scores were transformed to percentage. This questionnaire was reported to be a valid and reliable instrument for measuring neck disability in Thai patients with MNP (Luckumnueporn, 2007). Test-retest reliability was excellent ($ICC_{(2,1)}$ = 0.90). The standard error of measurement was equal to 2.67 percent and the MDC was 7.40 percent.

3.4.4 Global perceived effect (GPE)

The overall perception of the patients' symptom was assessed by a 7-point rating scale (Appendix E). This scale asks about the perceived change after the treatment which can range from 1 to 7: 1 = completely recovered, 2 = much improved, 3 = slightly improved, 4 = no change, 5 = slightly worsened, 6 = much worsened, and 7 = worse than ever. It was found that the changes of GPE scores of at least two points on the scale would represent the clinically detectable change (Ostelo and de Vet, 2005).

3.4.5 The couch

The height-adjustable couch with a hole for allowing the patients to breathe comfortably (Gymna Uniply, Pasweg 6a, Bilzen) was used in this study (Figure 3.3). This allowed the therapist to perform the IUPA cervical mobilization technique with appropriate body mechanics.

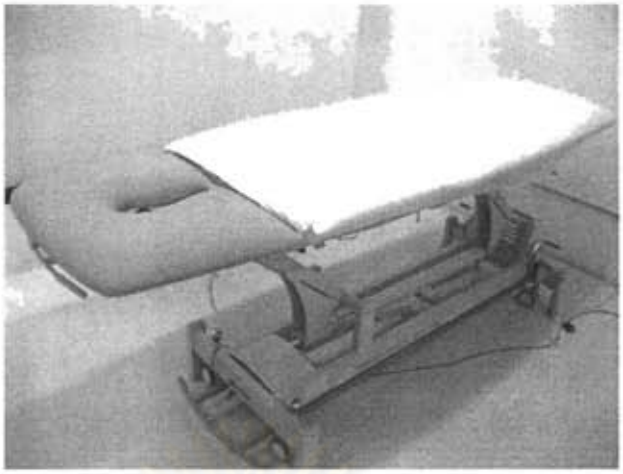


Figure 3.3 The couch

3.4.6 Wooden chair

The wooden chair that had the vertical backrest supporting from thorax to sacrum was used. The height from the floor to the seat was 45 centimeters and from the seat to the top of backrest was also 45 centimeters. The seat dimension was 40 x 45 centimeters. The patients were asked to sit with their back against the backrest. This was to prevent any compensatory movements from the thorax to the cervical movements.

3.4.7 The pillow

The pillow with the dimension of 50 x 40 centimeters was put on the patients' laps. This was to facilitate the relaxation of the patients' shoulders during the measurement of the cervical ROM.

3.4.8 The mirror

In this study, the 150 x 30 centimeters mirror was placed in front of the patients for providing self-feedback for the patients to recognize the neutral head position at the beginning of each movement.

3.5 Procedure

All patients received the participant information sheet (Appendix F), explaining all information of this research such as background and rationale, expected benefit, objectives, and methodology. The patients who agreed to participate were required to

sign the informed consent (Appendix G) before taking part in this study. Initially, they had to fill out a screening questionnaire (Appendix H) asking about demographic data and the characteristic of their symptoms. Next, the therapist performed subjective and objective examinations. The patients were examined in prone position with their forehead resting on their overlapped palms. The patients for whom the cervical mobilization was indicated (found abnormal mobility of the intervertebral movement during passive accessory movement examination), the treatment details such as spinal level and grade of mobilization were selected and recorded (Appendix C). This selection of techniques was at the therapist's discretion and based on the initial and subsequent examinations as commonly used by the Maitland's approach (Maitland et al., 2005). The patients' pain, muscle spasm, and resistance being produced during the objective examination were taken into account. In brief, the cervical level(s) that was deemed to be mobilized was the one that resulted in the reproduction of the patients' symptoms while being examined for its intervertebral mobility. After the therapist left the treatment unit, an assessor began to measure cervical ROM and pain intensity. For the 1st visit, the NDI was also completed by the patients as baseline data.

The assessor gave uniform instructions (Appendix I) to the patients in order to set starting position and to perform all 6 cervical movements which consisted of flexion, extension, left lateral flexion, right lateral flexion, left rotation, and right rotation. The starting position was to sit erect in front of the mirror, lean back against the chair, rest arm on the pillow that placed above their laps, position hips and knees at 90 degrees, and place feet on the floor (Figure 3.4A). Then, the patients worn the CROM and positioned their cervical spine in neutral position. The neutral position was defined as the anatomical position of head (vertically upright without rotation) (McNair et al., 2007). An imaginary line from the corner of the eye to the ear was parallel to the floor and the angles between each shoulder and the cervical spine were symmetry (Figure 3.4B).

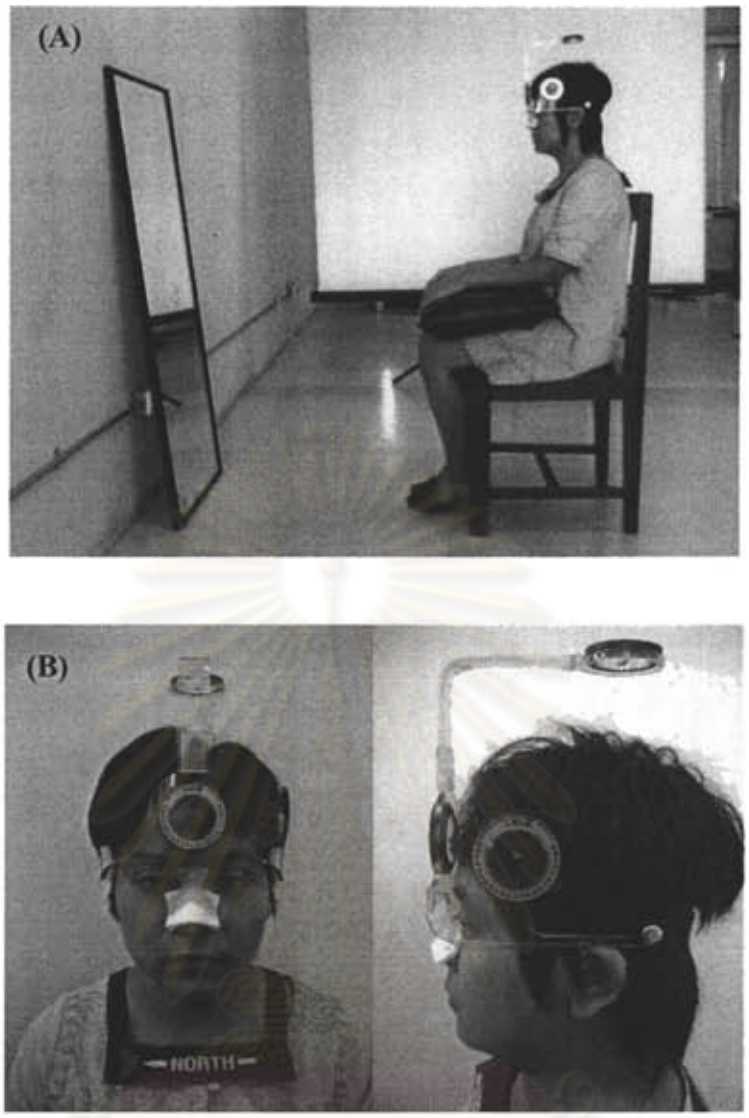


Figure 3.4 (A) Starting position for measuring the cervical ROM and (B) the CROM position

With assistance from the assessor, all 3 inclinometers of the CROM had to indicate 0 degree. The patients were required to perform each movement as far as possible (Figure 3.5) and the assessor used both hands to fix the patients' shoulders for preventing any compensatory movements (Figure 3.6). The cervical movements were performed in order, i.e., flexion, extension, left lateral flexion, right lateral flexion, left rotation, and right rotation. With this sequence, no systematic error was exhibited (Appendix C). The patients were asked to perform each movement twice. The 1st repetition was warm-up and the 2nd repetition was collected and recorded in the data collection sheet (Appendix J).

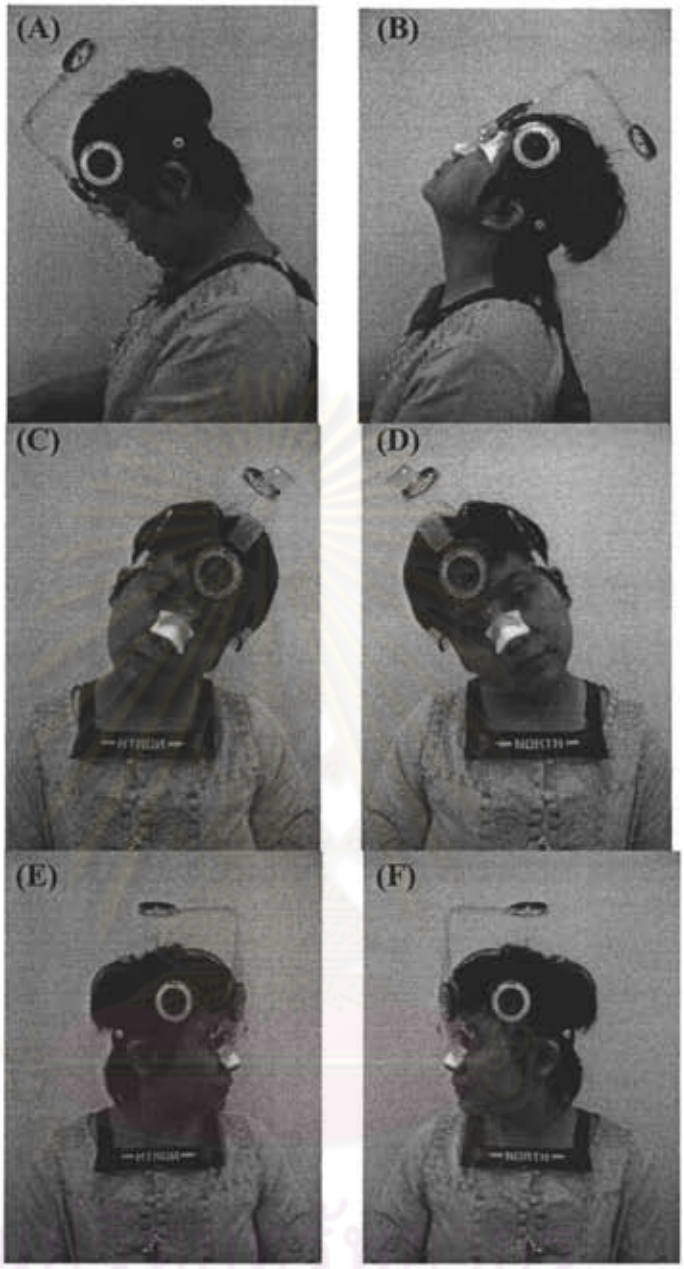


Figure 3.5 The cervical movements in six directions: (A) flexion, (B) extension, (C) left lateral flexion, (D) right lateral flexion, (E) left rotation, and (F) right rotation

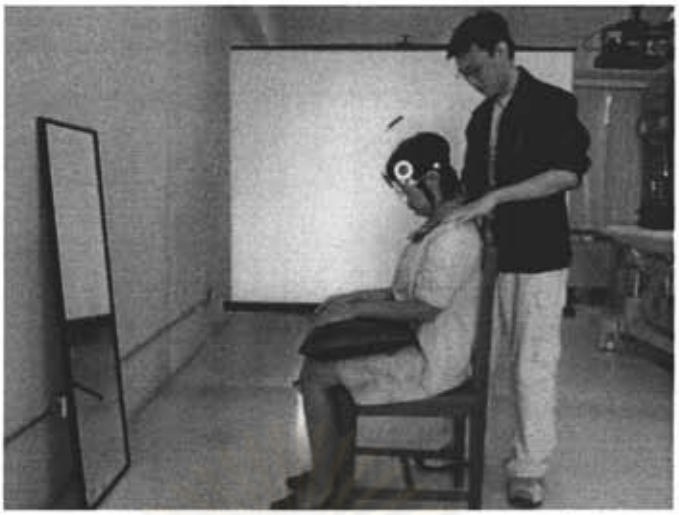


Figure 3.6 This picture demonstrate how to prevent the compensatory movements during cervical ROM measurement

After obtaining data from all movements, the assessor measured the patients' pain intensity, i.e. pain at rest and pain on worst movement. When the measurements were completed, the therapist re-entered the treatment area and performed the IUPA cervical mobilization technique (Figure 3.7). The detailed feature of the mobilization technique that had already been established during the examinations was followed. The treatment was standardized by which the therapist performed 3 sets with approximately 1 minute over the zygapophysial joint of each treated cervical spine level (Petty and Moore, 2004). However, the number of sets could slightly be adjusted for each patients based on their symptoms.

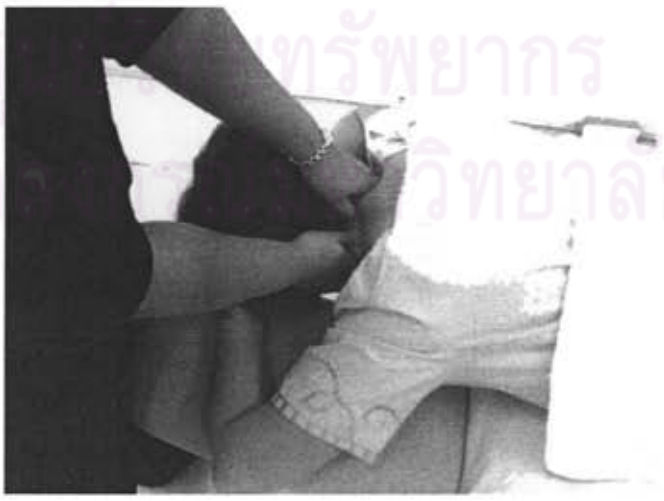


Figure 3.7 This picture demonstrates the application of the IUPA cervical mobilization technique

After the therapist left the treatment unit, the assessor returned to collect the post-treatment data by instructing the patients to perform cervical movements in the same manner as those for the pretreatment data. The whole intervention period took approximately 45 minutes. Patients were instructed to return twice a week for 4 weeks. An appointment card was given for reminding the date of the next visit.

Throughout the 4-week treatment course, the patients were asked to refrain from other treatments which could affect their symptom to prevent any confounding effects on the results. But the patients were allowed to continue general exercise that they had received prior entering into this trial. The measurements of pain intensity and cervical ROM took place every visit both pretreatment and post-treatment while the NDI was measured only at baseline and pretreatment of the 8^{th} visits. The GPE was measured at pretreatment of the 5^{th} and the 8^{th} visits.

The treatment might be discontinued before completing all 8 visits if the patients developed a serious adverse effect and the therapist considered that mobilization technique was no longer an appropriate treatment. However, the patients would be considered to have recovered if they rated pain intensity of pretreatment measurement less than 10 out of 100 mm on VAS for more than seven consecutive days. These patients would stop receiving any treatment but they were asked to continue all planned measurements until the 8^{th} visit.

3.6 Statistical analyses

Data were analyzed with the Statistical Package for the Social Sciences (SPSS) version 11.5 for Windows. Descriptive statistics were used to summarize all outcome measures taken at each visit. The significant difference level of all outcomes was set at 0.05. Normal distribution of the quantitative data was assessed by means of the Kolmogorov-Smirnov test.

To investigate the effect of the IUPA cervical mobilization technique on pain and ROM after each visit in comparison with baseline, one-way repeated measures analysis of variance (ANOVA) was used. If any significant differences were found, *post-hoc* analysis was carried out using Tukey's honestly significant difference test to

detect significant differences between the data taken from the 2nd to the 8th visits and the baseline.

To investigate the effect of the IUPA cervical mobilization technique on the NDI values after the 4-week treatment course, the paired *t*-test was used. The NDI values taken from the baseline and the 8th visits were compared.

To investigate the effect of the IUPA cervical mobilization technique on GPE, the patients were classified into three categories. The patients who identified themselves as completely recovered and much improved categories were classified as "improved" group. Those who identified themselves as slightly improved, no change, and slightly worsened categories were classified as "unchanged" group. Those who identified themselves as much worsened and worse than ever were classified as "worsened" group. The percentages of patients in the "improved", "unchanged", and "worsened" groups were calculated.

CHAPTER IV

RESULTS

4.1 Introduction

The results of this experiment are presented sequentially. The patients' demographic data and sample size calculation were demonstrated. The effects of the IUPA cervical mobilization technique were presented in order of the tested hypotheses.

4.2 The patients' demographic data

Recruitment of patients who suffered from unilateral MNP was conducted over a 5-month period from September 2007 – January 2008. Forty-two unilateral MNP patients volunteered to participate in this study. Twenty-two patients were excluded because they had pain less than 20 mm of 100 mm on VAS. Twenty patients met the study protocol. Two patients dropped out from the study after the 2nd visit and three patients dropped out from the study after the 3rd visit due to time constraint. A total of 15 patients completed 8th visits (Figure 4.1). No patients reported any adverse effect. The demographic data of 15 patients are presented in Table 4.1.

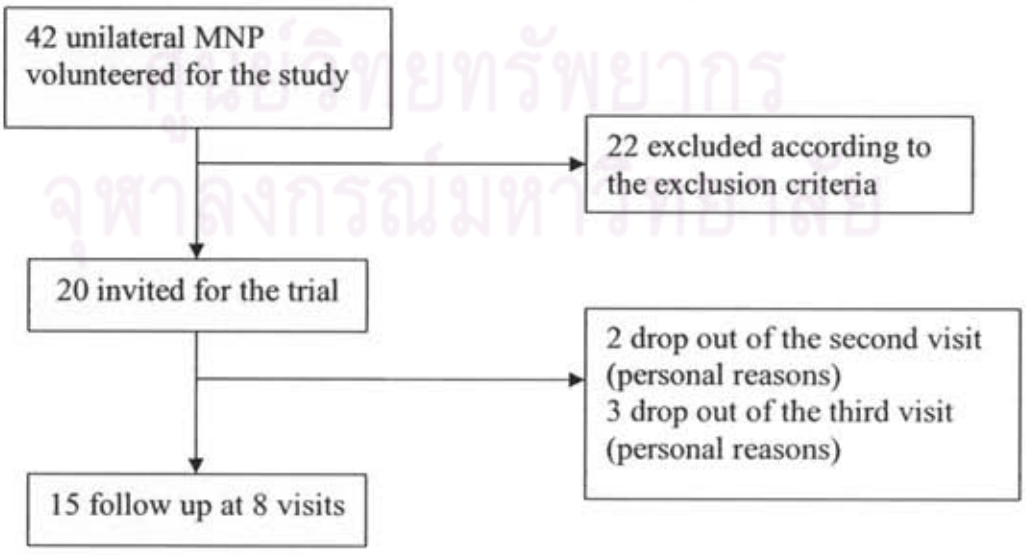


Figure 4.1 Flow chart describes the participation of patients through the trial

Table 4.1 Means and standard deviations of the demographic data of the patients at baseline (n = 15).

	mechanical neck pain patients (n=15)
Gender	
Male	1
Female	14
Age (years)	41.07 (10.51)
Duration of symptoms (days)	365 - 1460
Pain VAS (0-100 millimeters)	
At rest	41.20 (16.21)
On worst movement	56.53 (15.36)
Cervical ROM (degrees)	
Flexion	49.93 (10.44)
Extension	54.27 (12.37)
Ipsilateral flexion	37.07 (9.62)
Contralateral flexion	38.40 (8.29)
Ipsilateral rotation	61.13 (8.63)
Contralateral rotation	62.00 (9.75)
On worst movement	44.60 (10.36)
Neck Disability Index (percent)	29.30 (12.20)
Number of level treated	
1 level	3
2 levels	5
3 levels	7

4.3 Sample size calculation

Retrospective sample size calculation was carried out to warrant for the clinical study pertaining to risks of enrolling either an inadequate number of subjects or more subjects than the minimum necessary to reject the null hypothesis (Lerman, 1996). The estimation of the sample size requires four statistical elements: the significance criterion (α), sample variance (σ^2), magnitude of the minimum clinically significant difference between the level of treatment means (δ), and power ($1-\beta$) (Portney and Watkins, 2000). The significance criterion is usually set at 0.05 ($p<0.05$) by which the null hypothesis is falsely rejected. For β of 0.2, the power is 0.8, which is the minimum power required to accept the null hypothesis. The formula for sample size calculation (Kamolrattanakul et al., 2002) is shown in Figure 4.2.

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \sigma^2}{\delta^2}$$

Figure 4.2 Formula for power and sample size calculation. (n = sample size need in the trial, z = area under normal curve, σ^2 = sample variances, δ = magnitude of the minimum clinically significant difference between means of the treatment result in each visit, α = level of significance, β = probability of failing to reject a false null hypothesis) (Kamolrattanakul et al., 2002).

The magnitudes of the minimum clinically significant difference of each variable were set at 20 mm for pain intensity (Ostelo and de Vet, 2005) and 10 degrees for active cervical ROM (Appendix C). For the number of 15 subjects tested, the power of greater than 80 percent was achieved for all comparisons (Table 4.2). This suggested that the result of this study could be accepted with sufficient confidence.

Table 4.2 Summary of the sample size needed to achieve the 80 percent statistical power to test for significant difference in observed pain intensity and cervical ROM in this study (number of subjects tested = 15)

Outcome measure	δ	σ^2	n
Pain intensity			
At rest	20.0	20.8	8.5
On worst movement	20.0	18.2	6.5
Cervical ROM			
Flexion	10.0	11.3	10.0
Extension	10.0	10.7	9.0
Ipsilateral flexion	10.0	5.7	2.5
Contralateral flexion	10.0	5.3	2.2
Ipsilateral rotation	10.0	10.1	8.0
Contralateral rotation	10.0	10.2	8.2
On worst movement	10.0	20.8	4.8

δ = magnitude of the minimum clinically significant difference between means of the treatment results in each visit, σ^2 = maximum difference of each sample variances, n = the number of patients required in this study

4.4 Pain intensity and cervical ROM

Raw data of pain intensity and cervical ROM of 15 patients are presented in Appendix K. Baseline and post-treatment data of pain intensity and cervical ROM of each visit are shown in Table 4.3. Both pain at rest and on worst movement decreased continuously until the 8th visit. Pain at rest was reduced from 41.2 to 2.2 millimeters and pain on worst movement was reduced from 56.5 to 5.0 millimeters (Figure 4.3).

Table 4.3 Means (standard deviations) of pain intensity and cervical range of motion (ROM) of baseline data and post-treatment data of each visit (n = 15).

Outcome measures	Baseline	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8
Pain intensity (millimeters)									
At rest	41.2 (16.2)	31.8 (17.6)	25.2 (16.9)	17.2 (17.6)	7.9 (11.3)	5.4 (8.3)	7.8 (10.8)	2.4 (5.1)	2.2 (4.9)
On worst movement	56.5 (15.4)	44.1 (17.4)	35.2 (20.4)	29.1 (17.6)	23.0 (19.4)	12.2 (12.1)	12.6 (13.2)	6.3 (9.7)	5.0 (7.9)
Cervical ROM (degrees)									
Flexion	49.9 (10.4)	51.4 (6.3)	51.1 (6.2)	51.7 (5.2)	50.1 (5.8)	52.0 (6.6)	51.6 (6.7)	51.9 (7.5)	50.0 (6.6)
Extension	54.3 (12.4)	56.5 (12.4)	53.0 (8.9)	58.5 (8.6)	55.7 (7.9)	56.6 (9.5)	56.8 (8.7)	56.9 (8.8)	57.3 (7.7)
Ipsilateral flexion	37.1 (9.6)	38.6 (7.3)	37.6 (8.2)	38.1 (8.4)	37.4 (6.9)	37.2 (6.8)	37.1 (7.5)	37.1 (7.6)	36.9 (6.6)
Contralateral flexion	38.4 (8.3)	40.1 (6.6)	40.7 (9.4)	40.7 (9.7)	40.4 (7.7)	40.0 (5.2)	39.1 (7.9)	39.4 (8.4)	39.6 (7.9)
Ipsilateral rotation	61.1 (8.6)	63.7 (7.3)	62.2 (7.6)	64.1 (6.4)	64.5 (5.2)	64.0 (6.4)	64.3 (5.5)	64.7 (5.2)	65.3 (5.1)
Contralateral rotation	62.0 (9.8)	64.8 (6.4)	64.4 (7.5)	65.5 (7.3)	65.1 (5.8)	67.5 (6.1)	65.1 (6.5)	64.1 (5.7)	66.5 (6.4)
On worst movement	44.6 (10.4)	46.8 (9.6)	47.7 (9.9)	48.4 (10.2)	47.8 (9.5)	47.5 (12.1)	47.3 (11.6)	47.7 (11.2)	48.1 (11.2)

Post X = the post-treatment values of visit X

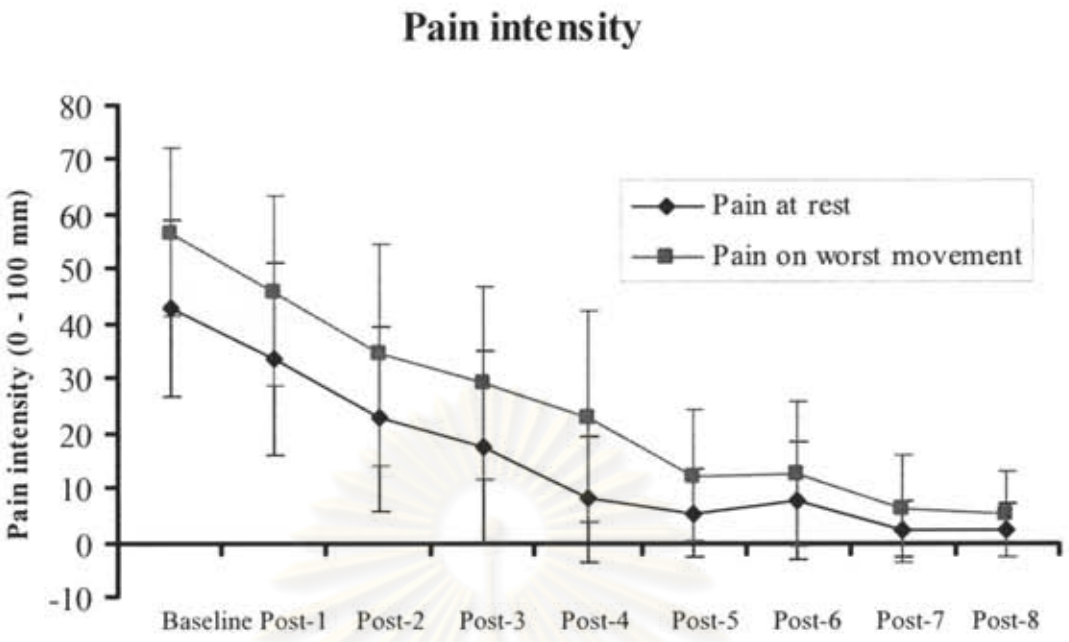


Figure 4.3 Means of pain at rest and pain on worst movement at baseline and post-treatment for each appointment, Post-*a* = post-treatment data recorded at *a* appointment (n = 15)

Kolmogorov-Smirnov test (Appendix L) showed the normal distribution of the quantitative data of this study. One-way repeated measures ANOVA found statistically significant differences in pain at rest and pain on worst movement ($p < 0.001$) (Table 4.4). No statistically significant differences in active cervical ROM in all directions were found ($p > 0.05$).

Table 4.4 Results of one-way repeated measures ANOVA testing for the difference between the data taken from the 2nd to the 8th visits and baseline.

	$F_{(8,112)}$	*p*-value
Pain intensity (millimeters)		
At rest	24.431	< 0.001*
On worst movement	39.381	< 0.001*
Cervical ROM (degrees)		
Flexion	0.581	0.791
Extension	1.454	0.224
Ipsilateral flexion	0.493	0.859
Contralateral flexion	1.015	0.413
Ipsilateral rotation	1.765	0.174
Contralateral rotation	2.038	0.123
On worst movement	1.274	0.296

* $p < 0.05$

To determine which visit was significantly different from the baseline, *post hoc* tests were performed and the results are shown in Table 4.5. The results from the Tukey's honestly significant difference tests demonstrated the significant reduction from baseline in pain at rest after the 3rd visits onwards ($p < 0.005$) and the significant reduction in pain on worst movement after the 2nd visit onwards ($p < 0.005$)

Table 4.5 Pairwise mean differences of pain at rest and pain on worst movement between the data taken from the 2nd to the 8th visits and baseline. (n = 15).

Outcome measures	B-Post 1	B-Post 2	B-Post 3	B-Post 4	B-Post 5	B-Post 6	B-Post 7	B-Post 8
Pain intensity (millimeters)								
At rest	9.40	16.00	24.00*	33.27*	35.80*	33.40*	38.80*	39.00*
On worst movement	12.40	21.33*	27.47*	33.53*	44.33*	43.93*	50.20*	51.53*

B-Post X = the difference scores of baseline scores and the post-treatment scores of visit X

4.5 Neck Disability Index

Raw data of the percentage of the NDI values which obtained from 15 patients are shown in Appendix J. A mean decrease of 16.3 percent was found (from 29.3 percent at baseline to 13 percent at the 8th visit). Paired *t*-test demonstrated significant difference in the NDI scores between baseline and the 8th visit ($p < 0.001$).

4.6 Global Perceived Effect

The results of GPE measurement are shown in Table 4.6 and the raw data are shown in Appendix J. GPE scores recorded from pretreatment of the 5th visit showed that there were 66.7 percent of patients reported their GPE as improved, 33.3 percent reported their GPE as unchanged, and no patients reported their GPE as worsened. At the 8th visit, 73.3 percent reported their GPE as improved.

Table 4.6 The number of patients who rated their global perceived effect in each of the 7-point scale categories obtained from pretreatment of the 5th and the 8th visits (n = 15).

Global perceived effect	Pretreatment of the 5th visit	Group	Pretreatment of the 8th visit	Group
1 = completely recovered	1	10 improved	6	11 improved
2 = much improved	9		5	
3 = slightly improved	5	5 unchanged	4	4 unchanged
4 = no change	0		0	
5 = slightly worse	0	0 worsened	0	0 worsened
7 = worse than ever	0		0	

CHAPTER V

DISSCUSSION

5.1 Introduction

This current study demonstrated the effect of the IUPA cervical mobilization technique in treatment of patients presenting with unilateral neck pain over four weeks. The results showed that the IUPA cervical mobilization technique could reduce pain intensity both at rest and on worst movement, improve NDI, and GPE while it had no effect on active cervical ROM in all directions. These findings partially support the effectiveness of the IUPA mobilization technique in this group of patients.

5.2 Effect of IUPA mobilization technique on pain

The similar pattern of pain reduction was shown for both pain at rest and pain on worst movement (Figure 4.3). Throughout the 4-week treatment course, both pain parameters reduced at similar magnitude of approximately 90 percent from baseline. The reduction was relatively greater in the early phase until the 4th visit at which the reduction became smaller. This finding might be related to the floor effect of the treatment technique. After the 4th visit, both pain parameters were lower than 10 mm on the VAS so the further reduction of pain was then limited. From the previous studies, it was demonstrated that at six weeks after receiving the cervical mobilization could reduce mean of pain on average and most severe pain (Hoving et al., 2002, Hurwitz et al., 2002). The reduction was more than 20 mm on VAS. Due to the differences in the kind of pain parameter from this current study, comparison between studies is difficult. The pattern of the continued decrease of both pain intensities since the 1st visit also suggests the cumulative effect of the IUPA cervical mobilization technique.

Immediately after the 1st visit, the mean reduction in pain at rest was 9.4 mm and this magnitude was similar to the reduction of 10.5 mm found immediately after the

muscle energy technique in the similar group of patients (Cassidy et al., 1992). However, the magnitude of reduction was much smaller after the mobilization by sustaining of the patients' neck in the cervical manipulated position (4 mm) (Martinez-Segura et al., 2006).

The reason for the discrepancy among studies might relate to the differences in the extent of the treated structures. The IUPA cervical mobilization and muscle energy technique effected a greater numbers of cervical spine levels than the sustaining of the patients' neck in the cervical manipulated position. In this study, all cervical spine levels that were deemed to be responsible for the patients' symptom were mobilized with the IUPA cervical mobilization. Subsequently, more than one zygapophyseal joint were treated. For the muscle energy technique, the hypertonic muscles responsible for restricting the cervical movement and producing pain were dealt with. As these hypertonic muscles usually traverse more than one level of the cervical spine, more than one intervertebral joint underneath the muscles would be moved and treated. In contrast, the sustaining of the patients' neck in the cervical manipulated position was applied directly at only one cervical spine level. The relatively lower therapeutic effects of this latter technique than the former two techniques would therefore be expected. However, the treatment dose and experimental setting differ among studies. It may be difficult to make a direct comparison. With regard to pain on worst movement, no published studies could be compared.

After 4 weeks, it is interesting that the pain on worst movement showed a faster positive outcome than the pain at rest (Table 4.5). The statistically and clinically differences in pain on worst movement were firstly observed after the 2nd visit while they were noted after the 3rd visit for pain at rest. These results suggest that it would take at least 3 visits for IUPA cervical mobilization technique to demonstrate its effectiveness on pain reduction.

If both pain intensities were considered together, the findings of this study might suggest that the IUPA cervical mobilization technique could not cure the patients within 4 weeks treatment course. No patients rated both of their pain intensities of pre-treatment measurement less than 10 out of 100 mm on VAS for more than seven consecutive days, within the 4-week treatment course (Figure 4.3). In respect of pain

at rest alone, however, the patients were deemed to have recovered since they received the 4th treatment. The mean magnitude of pain at rest started to fall below 10 mm after the 4th visit and it tended to continue falling thereafter. In respect of pain on worst movement alone, it would take at least 7th visits for the patients to be considered as recovered. If the treatment course would have been extended to 4.5 weeks, the pain intensity less than 10 out of 100 mm on VAS for more than seven consecutive days might be observed. The pain intensity obtained from the 9th visit would help verifying this hypothesis.

5.3 Effect of IUPA mobilization technique on cervical ROM

No statistically significant changes in cervical ROM from baseline were found after the patients received the IUPA cervical mobilization technique (both immediately and after each visit). The changes were found to fluctuate within the range of 4 degrees which were considered not being clinical significance (not greater than 10 degrees). These results were consistent with previous studies in unilateral neck pain patients which reported the maximal improvement of less than 5 degrees (Cassidy et al., 1992, Martinez-Segura et al., 2006).

The minimal increase in active cervical ROM might be related to the amount of the mobilization forces being applied by the physical therapist. As it was reported that the force required for lengthening of the connective tissue is much higher than the force applied during mobilization (see Section 2.5.1 for details). Besides that, all patients in this current study were in chronic stage. The extensibility of their connective tissue might have decreased or changed. In addition, all patients recruited in this study showed minimal restriction in cervical ROM in comparison with normal (Table 5.1). As a result, any obvious improvement in cervical ROM in this study is unlikely.

It was surprising to find similar changes in cervical ROM in all directions. The differences in magnitude of cervical ROM between each direction were 0.3 – 1.0 degrees. It is expected that the effect of the IUPA mobilization technique on cervical ROM should be asymmetrical. A greater effect on one side than the other should be

noted either in the cervical rotation or lateral flexion. This may be implied that the IUPA cervical mobilization produces non-specific effect on cervical ROM.

Table 5.1 Comparison of the cervical ROM of patients in this study with the normative data investigated by Youdas et al. (1992)

Cervical ROM	Age (years)			
(degrees)	20 - 29	30 - 39	40 - 49	50 -59
Flexion	48 - 64	51 - 59	47 - 56	43 - 47
	(42 - 68)	*(30 - 68)*	*(28 - 72)*	*(30 - 70)*
Extension	52 - 76	58 - 65	46 - 60	30 - 68
	(65 - 111)	*(52 - 102)*	*(45 - 102)*	*(30 - 98)*
Lateral flexion	36 - 54	37 - 51	24 - 44	27 - 38
	(30 - 56)	*(30 - 62)*	*(20 - 65)*	*(20 - 50)*
Rotation	62 - 78	62 - 72	50 - 73	55 - 64
	(62 - 85)	*(52 - 84)*	*(42 - 80)*	*(35 - 80)*

Normative data of cervical ROM from Youdas et al. are shown in italic

5.4 Effect of IUPA mobilization technique on NDI

At the end of 4-week treatment with the IUPA cervical mobilization technique, a significant improvement from baseline in level of disability was found. The 16.3 percent decrease of NDI scores which more than 7.4 percent of MDC (Luckumnueporn, 2007) demonstrates that this change is clinically relevant. This suggests that the IUPA mobilization is a suitable treatment for patients with unilateral neck pain.

Comparing the result with other studies, the reduction of the NDI scores in the current study was similar to the 15.6 percent reduction obtained at 6 weeks of the study using Maitland mobilization combined with other techniques (Hoving et al., 2002). However, it may be difficult to conclude that the effects of these two techniques are equal because there are many factors that could influence on the results. For example, the number of visits of the previous study was less than that employed in the current study (once a week and twice a week, respectively). With more than one technique used in the previous study, this may result in the comparable effect to only one technique used in the current study.

Comparison with the single Chiropractic mobilization technique (Hurwitz et al., 2002), it seems that the reduction of the NDI scores in the current study were greater than 11 percent reduction of previous study (Hurwitz et al., 2002). However, there are many factors that may contribute to the different effects between these studies such as the differences in symptom distribution of the patients, the follow-up period, the number of visits, and the additional treatment. Therefore, the comparison of these two techniques may still be inconclusive.

5.5 Effect of IUPA mobilization technique on GPE

Most patients had improved from neck pain when being measured at the 5th and the 8th visits. This suggests that the IUPA mobilization technique is effective in treating patients with unilateral neck pain. However, the small percentage difference between the 5th visit (66.7 percent) and the 8th visit (73.3 percent) suggests a slightly change in the patients' symptoms towards the end of the 4-week treatment. This finding might be related to the ceiling effect of the treatment technique. After the 5th visit, the majority of the patients reported their pain at rest and on worst movement lower than 6 mm and 13 mm out of 100 mm, respectively. Further improvement is therefore limited.

After 4-week treatment, the percentage of patients who had improved from neck pain in the current study was similar to that reported by previous study (68 percent) (Hoving et al., 2002). However, this finding must be interpreted with care. There are several factors as discussed earlier in Section 5.4 as well as patients' expectation and motivation that may have an influence on this result.

5.6 Overall effect of IUPA mobilization technique for treating patients with unilateral neck pain

In general, the IUPA mobilization technique produces positive effects on all outcome measures except the cervical ROM. The technique tends to have a greater therapeutic impact on the subjective outcome measures in comparison with the objective outcome measure. Pain, NDI, and GPE showed consistent positive response after treatment. This suggests the close relationship among these outcome measures. These findings

support the widely known concept that pain is a crucial parameter that influences on patients' affection and functional activities. It might be possible that the perception of pain reduction would induce the patients to be satisfied with the treatment and allow them to participate more on their daily activities.

Although there are two mechanisms used to explain the effectiveness of mobilization, these current results are inconsistent with previous literature. The reduction in pain but no change in cervical ROM might suggest the dominance of the neurophysiological mechanism over the biomechanical mechanism of the IUPA mobilization technique. The slightly change in overall cervical ROM implies an even smaller or no change in the connective tissue extensibility of each cervical segment. The only mechanism that can explain the effectiveness of the IUPA technique would be the neurophysiological mechanism.

5.7 Limitations of this study

The results of this study should be considered with some limitations. First, the patients participated in this study were in the chronic stage. These results may not be applied to the patients with acute or sub-acute condition. Second, the effectiveness of the IUPA technique would be clearer if it was compared with a control to be confident that these therapeutic outcomes are not due to natural recovery. Third, the patients recruited in this study had moderate pain intensity. The different finding may be found in patients who have high level of pain intensity. Fourth, this group of patients had small limitation on cervical ROM. If the patients had obvious limitation, it may provide different results. Finally, the measurement of pain on worst movement was not referred to baseline of cervical ROM on the worst direction. Moreover, the direction of the worst movement was inconsistent throughout the treatment course. So, it is difficult to track the change in pain on worst movement. For further study, the pain on worst movement should be assessed by referring to the same reference point.

5.8 The suggestion for further study

These results partially support Maitland's recommendation that the patients with unilateral neck pain should be treated with IUPA technique. The recommendation that the patients with bilateral neck pain should be treated with bilateral technique has not been proven. The results of this study suggest that the IUPA technique is effective in reducing pain intensity of unilateral neck pain patients. If applying unilateral PA mobilization to the side of neck pain is effective in reducing pain intensity, application of this mobilization to both side of the neck may provide the good therapeutic effects in bilateral neck pain. This suspicion may be the new hypothesis for further study.

CHAPTER VI

CONCLUSION

This study has implication for the treatment of the unilateral neck pain. The results indicate that the IUPA cervical mobilization technique is effective in reducing pain (both at rest and on worst movement), reducing disability, and improving GPE. But the IUPA cervical mobilization technique is not effective in improving cervical ROM. These results partially support Maitland's recommendation for the use of the IUPA cervical mobilization in treatment of patients with unilateral symptom.

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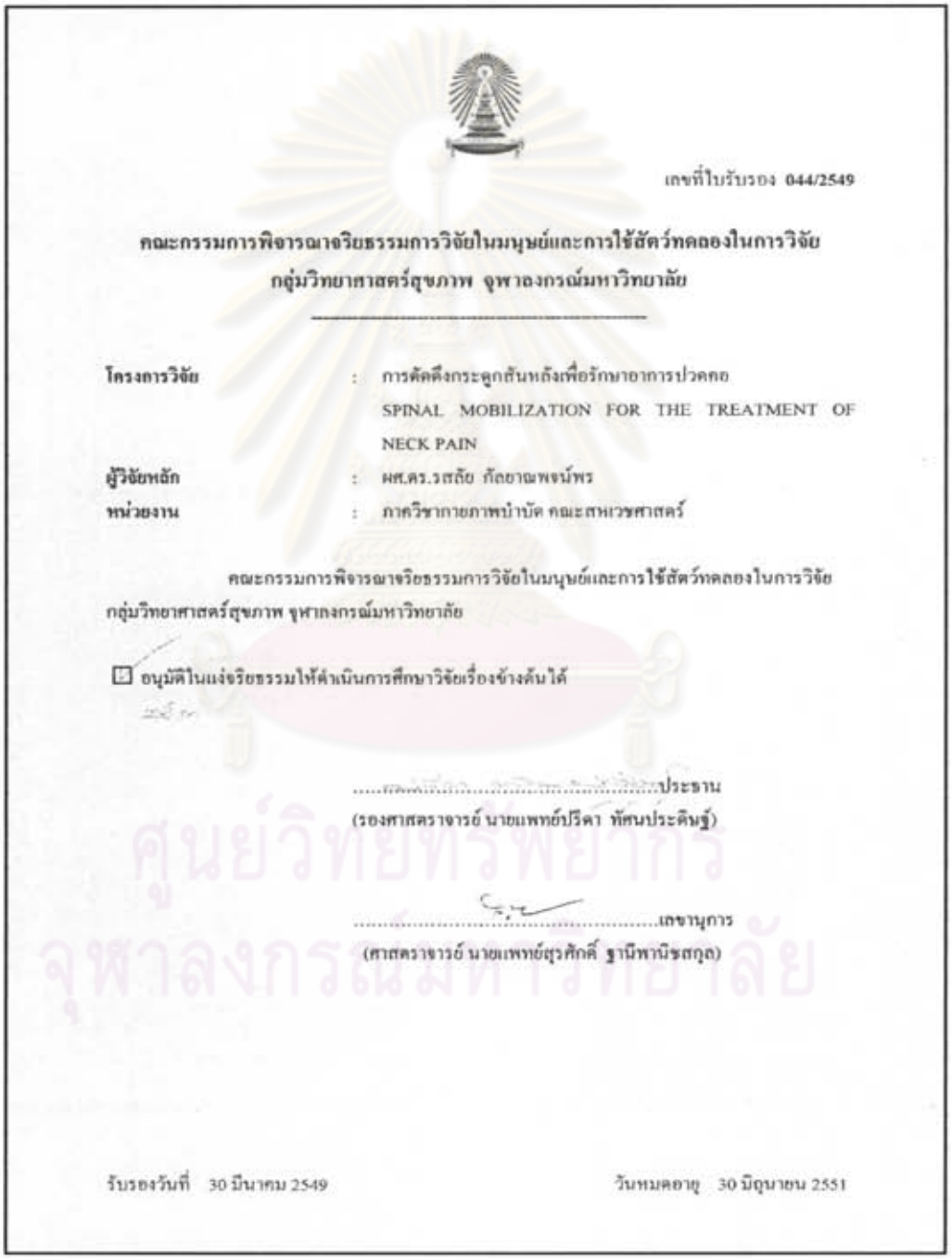
APPENDICES

APPENDIX A

Ethical approval granted by the Ethical Review Committee for Research Involving Human Subjects and/or Use of Animal in Research, Health Science Group of Faculties and Institutes, Chulalongkorn University, Thailand



เลขที่ใบรับรอง 044/2549

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์และการใช้สัตว์ทดลองในการวิจัย
กลุ่มวิทยาศาสตร์สุขภาพ จุฬาลงกรณ์มหาวิทยาลัย

โครงการวิจัย : การดัดดึงกระดูกสันหลังเพื่อรักษาอาการปวดคอ
SPINAL MOBILIZATION FOR THE TREATMENT OF NECK PAIN

ผู้วิจัยหลัก : ผศ.ดร.วสัย กัลยาณพจน์พร

หน่วยงาน : ภาควิชากายภาพบำบัด คณะสหเวชศาสตร์

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์และการใช้สัตว์ทดลองในการวิจัย กลุ่มวิทยาศาสตร์สุขภาพ จุฬาลงกรณ์มหาวิทยาลัย

☑ อนุมัติในแง่จริยธรรมให้ดำเนินการศึกษาวิจัยเรื่องข้างต้นได้

.....ประธาน
(รองศาสตราจารย์ นายแพทย์ปรีดา ทัศนประดิษฐ์)

.....เลขานุการ
(ศาสตราจารย์ นายแพทย์สุรศักดิ์ ฐานีพานิชสกุล)

รับรองวันที่ 30 มีนาคม 2549 วันหมดอายุ 30 มิถุนายน 2551

APPENDIX B

VISUAL ANALOGUE SCALE

กรุณาทำเครื่องหมาย | ลงบนเส้นด้านล่าง เพื่อแสดงระดับความเจ็บปวดของคุณ

- ระดับความเจ็บปวดในขณะพัก

ไม่มีอาการเจ็บปวดเลย ——————————— เจ็บปวดมากที่สุดเท่าที่จะจินตนาการได้

- ระดับความเจ็บปวดเมื่อทำการเคลื่อนไหวคอไปในทิศทางที่ก่อให้เกิดความเจ็บปวดมากที่สุด

ไม่มีอาการเจ็บปวดเลย ——————————— เจ็บปวดมากที่สุดเท่าที่จะจินตนาการได้

หมายเหตุ

การวัดระดับความเจ็บปวดในขณะพัก จะให้ผู้ป่วยสังเกตอาการปวดขณะที่ไม่มีการเคลื่อนไหวคอ แล้วรายงานระดับความเจ็บปวดนั้นโดยขีดเส้น | ตัดลงบนเส้นตรงในแผนภาพ

การวัดระดับความเจ็บปวดเมื่อทำการเคลื่อนไหวคอไปในทิศทางที่ก่อให้เกิดความเจ็บปวดมากที่สุดนั้น จะให้ผู้ป่วยลองทำการเคลื่อนไหวคอไปในทิศทางต่างๆ โดยในแต่ละทิศทางให้เคลื่อนไหวไปให้มากที่สุดเท่าที่จะไปได้ จากนั้นให้สังเกตว่าทิศทางใดก่อให้เกิดความเจ็บปวดมากที่สุด จึงรายงานระดับความเจ็บปวดในทิศทางนั้นโดยขีดเส้น | ตัดลงบนเส้นในแผนภาพ

APPENDIX C

PILOT STUDY

C I Introduction

Of all the instruments used for measuring cervical ROM, CROM is one of the advantageous devices which are used by the researchers. Its validity and reliability have been established as presented in Section 3.4.2. Nevertheless, the investigation on intra-observer reliability in measuring cervical ROM using the CROM in a specific population is recommended. This study, therefore, aimed to examine this intra-observer reliability in patients with unilateral neck pain.

C II Objective

To examine the intra-observer reliability in measuring cervical ROM using the CROM in patients with unilateral neck pain

C III Hypothesis

The cervical ROM could be measured reliably with CROM in patients with unilateral neck pain.

C IV Study design

A test-retest research design was used to examine the intra-observer reliability in measuring cervical ROM using the CROM in patients with unilateral neck pain. The protocol was approved by the Ethical Review Committee for Research Involving Human Subjects and/ or Use of Animal in Research, Health Science Group of Faculties, Colleges and Institutes, Chulalongkorn University, Thailand (Appendix A).

C V Participants

A separate group of 15 unilateral neck pain patients from those who were recruited in the main study participated in this study. The inclusion and the exclusion criteria were the same as those described in Section 3.3.1. All patients signed informed consent before taking part in this study (Appendix G).

C VI Materials and methods

The materials described in Section 3.4 were used for this study. The same assessor who performed the cervical ROM measurement in this study was tested. The measurements of cervical ROM occurred in two sessions with 5-min break between the sessions. In brief, all patients were instructed to performed cervical movements in six directions in order from flexion, extension, left lateral flexion, right lateral flexion, left rotation, to right rotation. Each movement was performed repeatedly three repetitions. The 1st repetition was warm-up without collecting data and the other two were collected for further analysis. The measurement procedure using the CROM was described in Section 3.5. Between the sessions, the assessor removed the CROM from the patients' head and allowed the patients to move around the assessment unit. The cervical ROM data taken from both sessions were recorded on separate sheets (Appendix M).

C VII Data analysis

SPSS software package for Windows was used to analyze all data. For all comparisons, the p – value less than 0.05 was considered significant. To evaluate for the intra-observer reliability in measuring cervical ROM using the CROM, the cervical ROM data taken from each cervical movement was examined separately. Two pairs of the cervical ROM data were tested. One was between the data taken from the 2nd repetition of each session and the other was between the data taken from the 3rd repetition. Initially, the paired t-test was used to assess whether there was any systemic difference in the cervical ROM data obtained from both sessions – i.e. within each pair comparison. Two reliability coefficients were calculated: the intra-class correlation coefficients (ICC) and MDC.

The $ICC_{(2,1)}$ was used to test for the level of agreement between the cervical ROM data obtained from both sessions. The ICC values were interpreted as follows: the values less than 0.25 indicated no reliability, 0.25 - 0.50 indicated fair reliability, 0.51 - 0.75 indicated good reliability, and more than 0.75 indicated high reliability (Portney and Watkins, 2000). Between the two pairs, the pair that produced a relatively higher ICC value in most cervical movements was selected for further analysis. This pair of data was then recorded in the main study.

The MDC were used for contemplating on the amount of error that associated with repeated measurements. They show the error in the unit of the measurements. In this study, these reliability coefficients were calculated separately for each cervical movement. The MDC was calculated using the formula: $1.96 \times SEM \times \sqrt{2}$. In this formula 1.96 is the standard normal score associated with a two-tailed 95 percent confidence interval and the $\sqrt{2}$ is included to reflect the fact that the measurement error is from the first and the second measurements (Beckerman et al., 2001). SEM was calculated as $SD_{diff}/\sqrt{2}$, where SD_{diff} was the variance of the difference scores (Hopkins, 2000).

C VIII Results

Fifteen unilateral neck pain patients (11 female, 4 male), aged between 19 to 71 years, completed the study. Their mean age was 39.73 years with a standard deviation of 15.54 years. Mean values for cervical ROM in all directions are given in Table C I. Raw data of this pilot study are presented in Appendix N.

Table C I Means (standard deviations) of the cervical range of motion in each direction (n = 15)

Motion	Means (SD)			
	A1	A2	B1	B2
Flexion	52.13 (4.50)	52.33 (4.56)	52.73 (5.69)	52.13 (6.00)
Extension	60.80 (11.59)	60.87 (11.35)	61.07 (10.55)	61.00 (10.43)
Left lateral flexion	40.67 (6.62)	40.20 (6.56)	40.67 (6.60)	40.13 (6.82)
Right lateral flexion	40.80 (7.02)	40.67 (7.27)	41.60 (6.12)	41.53 (5.91)
Left rotation	68.67 (5.03)	67.60 (5.23)	68.13 (5.16)	68.20 (4.92)
Right rotation	65.53 (6.51)	64.87 (6.71)	66.07 (5.71)	65.47 (6.04)

A1 = the data of the 2nd repetition from the 1st session, A2 = the data of the 3rd repetition from the 1st session, B1= the data of the 2nd repetition from the 2nd session, B2= the data of the 3rd repetition from the 2nd session

Comparisons of the cervical ROM data of the same repetition but taken from different sessions, paired *t*-tests demonstrated no systemic differences ($p > 0.05$) (Table C II). The $ICC_{(2,1)}$ values calculated from the 2nd repetition data ranged from 0.85 – 0.98 while the values calculated from the 3rd repetition data ranged from 0.85 – 0.97. As, both repetitions demonstrated almost the same range, the $ICC_{(2,1)}$ values obtained from the 2nd repetition data were chosen for further calculation of the SEM and MDC values. In this study the SEM and MDC values calculated from the 2nd repetition were in the range from 1.25 to 2.66 degrees and from 3.46 to 7.37 degrees, respectively (Table C III).

Table C II The intraclass correlation coefficient (ICC) values and *p*-value of cervical range of motion of the 2nd and the 3rd repetitions data obtained from both sessions (n = 15).

Motion	Data from the 2nd repetition (A1 and B1)		Data from the 3rd repetition (A2 and B2)	
	$ICC_{(2,1)}$	*p*-value	$ICC_{(2,1)}$	*p*-value
Flexion	0.86	0.80	0.91	0.32
Extension	0.98	0.84	0.97	0.70
Left lateral flexion	0.85	0.95	0.85	1.00
Right lateral flexion	0.86	0.37	0.89	0.35
Left rotation	0.94	0.21	0.85	0.48
Right rotation	0.86	0.52	0.88	0.52

ICC = intra-class correlation coefficient, A1 = the data of the 2nd repetition from the 1st session, A2 = the data of the 3rd repetition from the 1st session, B1= the data of the 2nd repetition from the 2nd session, B2= the data of the 3rd repetition from the 2nd session

Table C III Standard error of measurement (SEM) and minimal detectable change (MDC) (n = 15).

Motion	Data from the 2nd repetition (A1 and B1)	
	SEM (degrees)	MDC (degrees)
Flexion	2.09	5.79
Extension	1.77	4.91
Left lateral flexion	2.66	7.37
Right lateral flexion	2.59	7.18
Left rotation	1.25	3.46
Right rotation	2.49	6.90

C IX Discussion

This study demonstrated the intra-observer reliability in measuring cervical ROM using the CROM in patients with unilateral neck pain to be high. The ICC values in all directions were over 0.85. These results are consistent with previous studies that reported high intra-observer reliability in patients with cervical dysfunction with the ICC values ranged from 0.84 - 0.95 (Youdas et al., 1991) and 0.76 – 0.98 degrees

(Rheault et al., 1992). As a result, the method that uses CROM for measuring the cervical ROM is highly reliable.

The ICC values calculated from the 2nd and the 3rd repetitions were almost the same so the patients could be asked to perform each cervical movement only two instead of three repetitions. Any adverse effects from too many repetitive movements could then be minimized. The testing duration could also be reduced.

In this study, the MDC values were less than 8 degrees in all six directions. This suggests that the changes in patients' cervical ROM more than 8 degrees would be from an intervention. In our knowledge, the clinically detectable change has not been reported. As a result, this study used 10 degrees as a minimum value for justifying the clinical effect of IUPA mobilization on the changes of cervical ROM.

Furthermore, this study found no significant differences among the cervical ROM values collected from both sessions. This suggests that the order of the cervical movement testing has no effects on the reliability of the measurement. Consequently, there is no need to random the order of cervical movements during measurement.

C X Conclusion

The CROM was the reliable instrument for measuring the cervical ROM in the patients with unilateral neck pain. The intra-observer reliability of the cervical ROM measurement in this study was high. The data of cervical ROM collected from the 2nd repetition could be used for analysis. In this study, the changes in cervical ROM over 10 degrees would be considered as clinical change.

C XI References

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APPENDIX D

THAI NECK DISABILITY INDEX

ดัชนีชี้วัดการจำกัดการทำกิจกรรมจากอาการปวดคอ (Luckumnueporn, 2007)

คำชี้แจง: แบบสอบถามนี้ถูกออกแบบขึ้นเพื่อให้ข้อมูลกับผู้รักษาว่าอาการปวดคอมีผลต่อการทำกิจวัตรประจำวันของคุณอย่างไร กรุณาตอบแบบสอบถามทุกข้อ หากมีตัวเลือกที่ตรงกับคุณมากกว่าหนึ่งข้อ **โปรดทำเครื่องหมายหน้าตัวเลือกที่บรรยายลักษณะใกล้เคียงกับคุณมากที่สุดเพียงข้อเดียว**

1. **ระดับความเจ็บปวด**
   - ☐ ในขณะนี้ ฉันไม่มีอาการปวดเลย
   - ☐ ในขณะนี้ ฉันมีอาการปวดเล็กน้อย
   - ☐ ในขณะนี้ ฉันมีอาการปวดปานกลาง
   - ☐ ในขณะนี้ ฉันมีอาการปวดค่อนข้างรุนแรง
   - ☐ ในขณะนี้ ฉันมีอาการปวดรุนแรงมาก
   - ☐ ในขณะนี้ ฉันมีอาการปวดมากที่สุดเท่าที่จะจินตนาการได้
2. **การดูแลตัวเอง (เช่น การอาบน้ำ การแต่งตัว เป็นต้น)**
   - ☐ ฉันสามารถดูแลตัวเองได้ตามปกติ โดยไม่มีอาการปวดเพิ่มขึ้น
   - ☐ ฉันสามารถดูแลตัวเองได้ตามปกติ แต่มีอาการปวดเพิ่มขึ้น
   - ☐ ในขณะที่ดูแลตัวเองฉันมีอาการปวด ฉันต้องทำช้าๆ ด้วยความระมัดระวัง
   - ☐ ฉันสามารถดูแลตัวเองได้เป็นส่วนใหญ่ แต่ต้องการความช่วยเหลือบ้าง
   - ☐ ฉันต้องการความช่วยเหลือในทุกๆวันในการดูแลตัวเองเกือบทุกอย่าง
   - ☐ ฉันไม่สามารถแต่งตัวเองได้ ฉันอาบน้ำด้วยความลำบากและนอนอยู่บนเตียงเป็นส่วนใหญ่
3. **การยกของ**
   - ☐ ฉันสามารถยกของหนักได้ โดยไม่มีอาการปวดเพิ่มขึ้น
   - ☐ ฉันสามารถยกของหนักได้ แต่จะทำให้อาการปวดเพิ่มขึ้น
   - ☐ ฉันไม่สามารถยกของหนักขึ้นจากพื้นได้เนื่องจากมีอาการปวด แต่ฉันสามารถยกของนั้นได้ ถ้ามันอยู่ในตำแหน่งที่สามารถยกได้สะดวก เช่น บนโต๊ะ
   - ☐ ฉันไม่สามารถยกของหนักขึ้นจากพื้นได้เนื่องจากอาการปวด แต่ฉันสามารถยกของที่มีน้ำหนักเบาถึงปานกลางได้ ถ้ามันอยู่ในตำแหน่งที่สามารถยกได้สะดวก

☐ ฉันสามารถยกของที่เบาๆได้

☐ ฉันไม่สามารถยกหรือถือของได้เลย

4. **การอ่านหนังสือ**

☐ ฉันสามารถอ่านได้มากเท่าที่ต้องการ โดยไม่มีอาการปวดคอ

☐ ฉันสามารถอ่านได้มากเท่าที่ต้องการ แต่มีอาการปวดคอเล็กน้อย

☐ ฉันสามารถอ่านได้มากเท่าที่ต้องการ แต่มีอาการปวดคอปานกลาง

☐ ฉันไม่สามารถอ่านได้มากเท่าที่ต้องการ เนื่องจากมีอาการปวดคอปานกลาง

☐ ฉันไม่สามารถอ่านได้มากเท่าที่ต้องการ เนื่องจากมีอาการปวดคอรุนแรง

☐ ฉันไม่สามารถอ่านได้เลย

5. **ปวดศีรษะ**

☐ ฉันไม่มีอาการปวดศีรษะใดๆ

☐ ฉันมีอาการปวดศีรษะเล็กน้อย แต่ไม่บ่อย

☐ ฉันมีอาการปวดศีรษะปานกลาง แต่ไม่บ่อย

☐ ฉันมีอาการปวดศีรษะปานกลาง บ่อยๆ

☐ ฉันมีอาการปวดศีรษะรุนแรง บ่อยๆ

☐ ฉันมีอาการปวดศีรษะเกือบตลอดเวลา

6. **การมีสมาธิ หรือความจดจ่อในการทำงาน**

☐ ฉันมีสมาธิเต็มที่ตามที่ต้องการ โดยไม่ลำบาก

☐ ฉันมีสมาธิเต็มที่ตามที่ต้องการ โดยมีความลำบากเล็กน้อย

☐ ฉันมีความลำบากปานกลาง เมื่อฉันต้องการมีสมาธิ

☐ ฉันมีความลำบากมาก เมื่อฉันต้องการมีสมาธิ

☐ ฉันมีความลำบากอย่างยิ่งยวด เมื่อฉันต้องการมีสมาธิ

☐ ฉันไม่มีสมาธิเลย

7. **การทำงาน หรือการประกอบอาชีพ**

☐ ฉันสามารถทำงานได้มากเท่าที่ต้องการ

☐ ฉันสามารถทำงานประจำได้ตามปกติ แต่ไม่สามารถทำเพิ่มได้

☐ ฉันสามารถทำงานประจำได้เป็นส่วนมาก แต่ไม่สามารถทำเพิ่มได้อีก

☐ ฉันไม่สามารถทำงานประจำตามปกติได้

☐ ฉันแทบจะไม่สามารถทำงานใดๆได้

☐ ฉันไม่สามารถทำงานใดๆได้เลย

8. การขับรถ (ตอบเฉพาะผู้ที่ขับรถอยู่เป็นประจำ)

☐ ฉันสามารถขับรถได้โดยไม่มีอาการปวดคอ

☐ ฉันสามารถขับรถได้นานเท่าที่ต้องการ แต่มีอาการปวดคอเล็กน้อย

☐ ฉันสามารถขับรถได้นานเท่าที่ต้องการ แต่มีอาการปวดคอปานกลาง

☐ ฉันไม่สามารถขับรถได้นานเท่าที่ต้องการ เนื่องจากมีอาการปวดคอปานกลาง

☐ ฉันเกือบจะขับรถไม่ได้ เนื่องจากมีอาการปวดคอรุนแรง

☐ ฉันไม่สามารถขับรถได้เลย

9. การนอนหลับ

☐ ฉันไม่มีปัญหาในการนอนหลับ

☐ การนอนหลับของฉันถูกรบกวน จากอาการปวดคอ เล็กน้อย (นอนไม่หลับ น้อยกว่า 1 ชั่วโมง)

☐ การนอนหลับของฉันถูกรบกวน จากอาการปวดคอ ไม่มาก (นอนไม่หลับ 1-2 ชั่วโมง)

☐ การนอนหลับของฉันถูกรบกวน จากอาการปวดคอ ปานกลาง (นอนไม่หลับ 2-3 ชั่วโมง)

☐ การนอนหลับของฉันถูกรบกวน จากอาการปวดคอ อย่างมาก (นอนไม่หลับ 3-5 ชั่วโมง)

☐ การนอนหลับของฉันถูกรบกวน จากอาการปวดคอ ตลอดคืน (นอนไม่หลับ 5-7 ชั่วโมง)

10. กิจกรรมยามว่าง

☐ ฉันสามารถทำกิจกรรมยามว่างได้ โดยไม่มีอาการปวดคอ

☐ ฉันสามารถทำกิจกรรมยามว่างได้ โดยมีอาการปวดคอเล็กน้อย

☐ ฉันสามารถทำกิจกรรมยามว่างได้เป็นส่วนมากแต่ไม่ทั้งหมด เนื่องจากมีอาการปวดคอ

☐ ฉันสามารถทำกิจกรรมยามว่างได้เล็กน้อย เนื่องจากมีอาการปวดคอ

☐ ฉันเกือบจะไม่สามารถทำกิจกรรมยามว่างใดๆได้ เนื่องจากมีอาการปวดคอ

☐ ฉันไม่สามารถทำกิจกรรมยามว่างใดๆได้เลย

APPENDIX E

GLOBAL PERCEIVE EFFECT

การวัดอาการโดยรวมภายหลังการรักษา

(Global perceived effect; Modified from Ostelo and de Vet, 2005)

กรุณาเลือกตัวเลขที่ระบุระดับอาการโดยรวมของคุณภายหลังการรักษา

1	อาการโดยรวมดีขึ้นจนหายเป็นปกติ (Completely recovered)
2	อาการโดยรวมดีขึ้นมาก (much improved)
3	อาการโดยรวมดีขึ้นเล็กน้อย (slightly improved)
4	อาการโดยรวมไม่เปลี่ยนแปลง (no change)
5	อาการโดยรวมแย่ลงเล็กน้อย (slightly worsened)
6	อาการโดยรวมแย่ลงมาก (much worsened)
7	อาการโดยรวมแย่ลงมากที่สุดอย่างไม่เคยเป็นมาก่อน (worst than ever)

APPENDIX F

PARTICIPANT INFORMATION SHEET

ข้อมูลสำหรับผู้เข้าร่วมการวิจัย

1.ชื่อโครงการวิจัย

(ภาษาไทย) ประสิทธิภาพของการเคลื่อนที่ข้อต่อด้านข้างของกระดูกสันหลังส่วนคออย่างเป็นจังหวะเป็นระยะเวลา 4 สัปดาห์ในการรักษาอาการปวดคอด้านเดียว

(ภาษาอังกฤษ) The effect of the 4-week duration of the unilateral postero-anterior cervical mobilization in the treatment of unilateral neck pain

2.ชื่อผู้วิจัย นางสาว มลทิชา สกุณา ตำแหน่ง นิสิตปริญญาโท

3.สถานที่ปฏิบัติงาน ภาควิชากายภาพบำบัด คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

โทรศัพท์ที่บ้าน 0-28664812 โทรศัพท์เคลื่อนที่ 08-96790491

E-mail: nukibka@hotmail.com

4.รายละเอียดโครงการ

4.1 วัตถุประสงค์ของโครงการ – โครงการวิจัยนี้เพื่อศึกษาผลของการรักษาผู้ป่วยที่มีอาการปวดคอบริเวณแนวด้านข้างของคอ ซ้ายหรือขวา โดยโปรแกรมการรักษาสี่สัปดาห์ด้วยวิธีการขยับข้อต่อด้านข้างจากด้านหลังไปด้านหน้า

4.2 การทำวิจัย – จะประกอบไปด้วยการวัดระดับความเจ็บปวด, องศาการเคลื่อนไหวของคอ, ระดับการจำกัดการทำกิจกรรมจากการปวดคอ, และระดับการรับรู้การดีขึ้นหรือแย่ลงโดยรวม โดยจะวัดเทียบผลก่อนและหลังการรักษา การรักษาจะเป็นโปรแกรมต่อเนื่องนาน 4 สัปดาห์ สัปดาห์ละ 2 ครั้ง ในแต่ละครั้งจะใช้เวลาประมาณ 45 นาที ถึง 1 ชั่วโมง

4.3 ขั้นตอนในการทำวิจัย – เริ่มจากนักกายภาพบำบัดซักประวัติของผู้มีความประสงค์จะเข้าร่วมงานวิจัย จากนั้นผู้เข้าร่วมงานวิจัยลงนามในใบยินยอมเข้าร่วมการวิจัย กรอกข้อมูลประวัติและรายละเอียดต่างๆ จากนั้นผู้ทำการวัดจะทำการเก็บข้อมูลก่อนการรักษา คือ ระดับความเจ็บปวด, ระดับการจำกัดการทำกิจกรรมจากการปวดคอโดยตอบลงในแบบสอบถาม, และองศาการเคลื่อนไหวของคอโดยทำการวัด ผู้เข้าร่วมการวิจัยจะนั่งสวมเครื่องมือวัดหน้ากระจกและเคลื่อนไหวคอในทิศทางต่างๆรวม 6 ท่า ประกอบไปด้วย ก้มคอ, เงยคอ, เอียงคอไปด้านซ้ายและขวา, และหมุนคอไปด้านซ้ายและขวา ผู้ทำการวัดจะสาธิตท่าทั้ง 6 ให้ดูก่อน จากนั้นจะทำการวัดจริง หลังจากการวัดนักกายภาพจะทำการตรวจร่างกาย และทำการรักษา โดยจะให้การรักษาด้วยการดัดดึงข้อต่อเป็นจำนวน 3 เซตลงบนข้อต่อที่เป็นสาเหตุให้เกิดอาการของผู้เข้าร่วมงานวิจัย เมื่อทำการรักษาเสร็จแล้ว ผู้ทำการวัดจะทำการวัดระดับความเจ็บปวดและองศาการเคลื่อนไหวของคออีกครั้งหนึ่ง การรักษาในครั้งแรกสิ้นสุด นักกายภาพบำบัดจะทำการนัดหมายผู้เข้าร่วมงานวิจัยเพื่อเข้ารับการรักษาต่อไปจนกว่าจะสิ้นสุดโปรแกรมการรักษา 8 ครั้ง

4.4 ผู้เข้าร่วมงานวิจัยไม่มีความรับผิดชอบใดๆกับงานวิจัยนี้

4.5 ผู้เข้าร่วมงานวิจัยอาจจะมีอาการปวดระบมที่บริเวณที่ได้รับการรักษาได้เล็กน้อย ซึ่งถือว่าเป็นเรื่องปกติสำหรับผู้ที่ไม่เคยได้รับการรักษาด้วยวิธีการดังกล่าว โดยอาการดังกล่าวอาจจะเกิดขึ้นทันทีหลังจากเสร็จสิ้นขั้นตอนในการวิจัย หรือหลังจากนั้นประมาณ 1-2 วัน โดยอาการจะค่อยๆหายไปในระยะเวลาไม่เกิน 1 สัปดาห์

4.6 ผู้เข้าร่วมงานวิจัยอาจไม่ได้รับประโยชน์จากการวิจัยครั้งนี้โดยตรง แต่ผลจากการวิจัยนี้ทำให้เกิดความก้าวหน้าทางวิชาการ ในการรักษาอาการปวดคอต่อไปในอนาคต

4.7 การเข้าร่วมโครงการวิจัยทำโดยสมัครใจ และผู้เข้าร่วมงานวิจัยอาจปฏิเสธที่จะเข้าร่วม หรือถอนตัวออกจากการวิจัยได้ทุกขณะ โดยไม่ต้องได้รับโทษหรือสูญเสียประโยชน์ซึ่งพึงได้รับ

4.8 ผู้กำกับและดูแลการวิจัย ผู้ตรวจสอบ และคณะกรรมการพิจารณาจริยธรรม สามารถเข้าไปตรวจสอบบันทึกข้อมูลทางการแพทย์ของผู้เข้าร่วมงานวิจัย เพื่อเป็นการยืนยันถึงขั้นตอนในการวิจัยทางคลินิก และข้อมูลอื่นๆ โดยไม่ล่วงละเมิดเอกสิทธิ์ในการปิดบังข้อมูลของผู้เข้าร่วมการวิจัย ตามกรอบที่กฎหมาย และกฎระเบียบได้อนุญาต นอกจากนี้โดยการเซ็นให้ความยินยอม ผู้เข้าร่วมการวิจัยมีสิทธิ์ตรวจสอบและมีสิทธิที่จะได้รับข้อมูลเช่นกัน

4.9 ข้อมูลที่อาจนำไปสู่การเปิดเผยตัวของผู้เข้าร่วมการวิจัยจะได้รับการปกปิด ยกเว้นว่าได้รับความยินยอมโดยกฎระเบียบและกฎหมายที่เกี่ยวข้องเท่านั้น จึงจะเปิดเผยข้อมูลแก่สาธารณชนได้ ในกรณีที่ผลการวิจัยได้รับการตีพิมพ์ ชื่อและที่อยู่ของผู้เข้าร่วมการวิจัยจะต้องได้รับการปกปิดอยู่เสมอ

4.10 ผู้เข้าร่วมการวิจัยสามารถติดต่อแจ้งข้อมูลเพิ่มเติมที่เกี่ยวข้องกับการวิจัย สิทธิของผู้เข้าร่วมการวิจัย และในกรณีที่เกิดอันตรายที่เกี่ยวข้องกับการวิจัย ได้ตามชื่อ ที่อยู่ และเบอร์โทรศัพท์ ดังกล่าวไว้ข้างต้น

4.11 จำนวนของผู้เข้าร่วมการวิจัย 30 คน (การทดลองนำร่อง 15 คน และการทดลองหลัก 15) คน โดยเป็นผู้ที่มีอาการปวดคอเชิงกล

APPENDIX G

INFORMED CONSENT FORM

ใบยินยอมของผู้มีส่วนร่วมในการวิจัย

ชื่อโครงการวิจัย ประสิทธิภาพของการเคลื่อนที่ข้อต่อด้านข้างของกระดูกสันหลังส่วนคออย่างเป็นจังหวะเป็นระยะเวลาสี่สัปดาห์ในการรักษาอาการปวดคอด้านเดียว

ข้าพเจ้าได้ทราบจากผู้วิจัย ชื่อ ผศ. ดร. รสลัย กัลยาณพจน์พร, นางสาว มลทิชา สกุณา,
นาย ประพัฒน์ สิริประภาพร
ที่อยู่ ภาควิชากายภาพบำบัด คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ซึ่งได้ลงนามด้านท้ายของหนังสือนี้ถึงวัตถุประสงค์ ลักษณะ และแนวทางการศึกษาวิจัย รวมทั้งทราบถึงผลดี ผลข้างเคียง และความเสี่ยงที่อาจเกิดขึ้น ข้าพเจ้าได้ซักถาม ทำความเข้าใจเกี่ยวกับการศึกษาดังกล่าวนี้ เป็นที่เรียบร้อยแล้ว

- ข้าพเจ้ายินดีเข้าร่วมการศึกษาวิจัยครั้งนี้โดยสมัครใจ และอาจถอนตัวจากการเข้าร่วมศึกษาดังกล่าวนี้เมื่อใดก็ได้โดยไม่จำเป็นต้องแจ้งเหตุผล
- ข้าพเจ้าได้รับทราบจากผู้ทำการวิจัยว่า หากข้าพเจ้าได้รับความผิดปกติเนื่องจากการศึกษาทดลอง ข้าพเจ้าจะได้รับความคุ้มครองตามกฎหมาย และจะแจ้งผู้ทำการวิจัยทัน ในกรณีที่มิได้แจ้งให้ผู้ทำการวิจัยทราบในทันทีถึงความผิดปกติที่เกิดขึ้นได้ จะถือว่าข้าพเจ้าทำให้การคุ้มครองความปลอดภัยเป็นโมฆะ (ตามที่กฎหมายกำหนด)
- ข้าพเจ้ายินดีให้ข้อมูลของข้าพเจ้าแก่คณะผู้วิจัย เพื่อเป็นประโยชน์ในการศึกษาวิจัยครั้งนี้
- ข้าพเจ้าเข้าใจและตระหนักว่า ผู้วิจัยจะเก็บข้อมูลเฉพาะเกี่ยวกับข้าพเจ้าเป็นความลับ และจะเปิดเผยได้เฉพาะในรูปที่เป็นผลสรุปการวิจัย (หรือข้าพเจ้าอนุญาตให้ผู้วิจัยเปิดเผยข้อมูลเกี่ยวกับตัวข้าพเจ้าต่อหน่วยงานต่างๆที่เกี่ยวข้องตามที่ผู้วิจัยเห็นสมควร)
- ข้าพเจ้ายืนยันว่า ข้าพเจ้ามีอายุ 20 ปีบริบูรณ์ หรือมากกว่า
- ข้าพเจ้ายินดีเข้าร่วมการศึกษาครั้งนี้ ภายใต้เงื่อนไขที่ได้ระบุไว้แล้วในข้างต้น

ลงนามประชากรตัวอย่าง .....
หรือผู้มีส่วนร่วมในการวิจัย ( ) สถานที่ / วันที่
ลงนามผู้วิจัยหลัก .....
( ) สถานที่ / วันที่
ลงนามพยาน .....
( ) สถานที่ / วันที่

เบอร์โทรศัพท์สำหรับติดต่อ.....

APPENDIX H

SCREENING QUESTIONNAIRE

แบบคัดกรองผู้เข้าร่วมการวิจัย

1. ชื่อ (นาย, นาง, นางสาว) ..... นามสกุล .....
2. อายุ ..... ปี น้ำหนัก ..... กิโลกรัม ส่วนสูง ..... เซนติเมตร
3. อาชีพ .....
4. ระยะเวลาที่มีอาการปวด ..... ปี ..... เดือน ..... วัน
5. คุณมีสภาวะต่อไปนี้หรือไม่

ก.	ตั้งครรภ์	☐ ไม่มี	☐ มี .....
ข.	มีไข้	☐ ไม่มี	☐ มี .....
ค.	กระดูกพรุน	☐ ไม่มี	☐ มี .....
ง.	อุบัติเหตุบริเวณคอ	☐ ไม่มี	☐ มี .....
จ.	กระดูกหักบริเวณคอ	☐ ไม่มี	☐ มี .....
ฉ.	ประวัติการผ่าตัดบริเวณคอ	☐ ไม่มี	☐ มี .....
ช.	Cervical instability	☐ ไม่มี	☐ มี .....
ซ.	Rheumatoid arthritis	☐ ไม่มี	☐ มี .....
ฌ.	Ankylosing spondylitis	☐ ไม่มี	☐ มี .....
ญ.	Migraine	☐ ไม่มี	☐ มี .....
ฎ.	มีประวัติเนื้องอก	☐ ไม่มี	☐ มี .....
ฏ.	VBI	☐ ไม่มี	☐ มี .....

☐ Dizziness ☐ Diplopia ☐ Dysarthria ☐ Dysphagia

☐ Drop attack ☐ Tinnitus

6. คุณเคยได้รับการวินิจฉัยจากบุคลากรทางการแพทย์ด้วยโรคใดหรือไม่

☐ ไม่เคย

☐ เคย ระบุ .....

7. คุณเคยได้รับการถ่ายรังสี หรือการตรวจ MRI หรือ CT scan หรือไม่

☐ ไม่เคย

☐ เคย เมื่อวันที่ ..... ผล .....

8. คุณกำลังรับประทาน หรือใช้ยาใดหรือไม่

☐ ไม่ใช้

☐ ใช้ ระบุ .....

9. ภายใน 6 เดือนนี้ คุณเคยมีอาการปวดคอที่ต้องการการรักษา และต้องลาหยุดงานหรือไม่

☐ ไม่เคย

☐ เคย ระบุ .....

10. ในขณะนี้คุณมีอาการปวดคอหรือไม่

☐ ไม่มี

☐ มี โดยมีอาการปวดคอครั้งนี้ติดต่อกันเป็นเวลานาน.....ปี.....เดือน.....วัน.....

11. กิจกรรมใดทำให้อาการปวดคอเพิ่มขึ้น

.....

12. กิจกรรมใดทำให้อาการปวดคอลดลง

.....

13. คุณได้ทำการรักษาอย่างไรมาก่อนบ้าง

☐ ไม่ได้ทำการรักษา

☐ พบแพทย์และได้ทำการรักษาด้วย.....

.....

☐ พบนักกายภาพบำบัด และได้ทำการรักษาด้วย.....

.....

14. คุณคิดว่า อาการปวดคอนี้มีสาเหตุจากอะไร

.....

APPENDIX I

INSTRUCTION FOR PARTICIPANTS

Instruction for cervical range of motion measurement

ผู้ทำการวัดเริ่มกระบวนการวัดองศาการเคลื่อนไหวของกระดูกสันหลังส่วนคอ โดยอธิบายให้ผู้เข้าร่วมงานวิจัยทราบขั้นตอนพร้อมทั้งแสดงภาพตัวอย่างการเคลื่อนไหวในท่าต่างๆไปพร้อมๆกัน ดังนี้

"ในการวัดองศาการเคลื่อนไหว ดิฉันจะสวมเครื่องมือที่เห็นอยู่เข้ากับศีรษะและคอ โดยจะให้คุณนั่งตัวตรงตามองตรงไปที่กระจกด้านหน้าไม่หันซ้ายหันขวา ไม่ก้มตาหรือเอียงศีรษะไปข้างใดข้างหนึ่ง แล้วทำท่าต่างๆที่เห็นอยู่นี้ในแต่ละท่าจะให้ซ้อมทำการเคลื่อนไหวก่อนหนึ่งครั้ง และจะวัดจริงอีกหนึ่งครั้ง เวลาเคลื่อนไหวเคลื่อนไหวไปให้สุดช่วงการเคลื่อนไหวเท่าที่ทำได้แล้วให้หยุด รอจนกว่าดิฉันจะบอกให้กลับมายังจุดเริ่มต้นนะคะ"

จากนั้นผู้ทำการวัดสาธิตท่าทางที่จะทำการวัดทั้งหกท่า พร้อมสิ่งที่ควรระวังดังนี้

"เริ่มแรกดิฉันจะให้ก้มคอลงตามองพื้น ก้มลงไปให้มากที่สุดเท่าที่จะทำได้ปล่อยคอสบายๆไม่ต้องเกร็ง ก้มลงเฉพาะส่วนคอ หลังพิงพนักเก้าอี้ไว้ไม่ก้มตาม ท่าที่สองจะให้เงยคอขึ้นตามองเพดาน เงยขึ้นไปให้ได้มากที่สุดเท่าที่จะทำได้ไม่แอ่นหน้าอก ท่าที่สามคือเอียงคอไปด้านซ้าย ให้เอียงคอไปด้านซ้ายให้ได้มากที่สุดเท่าที่จะทำได้ ไหล่ขวาไม่ต้องยกตาม ท่าที่สี่คือเอียงคอไปด้านขวา ให้เอียงคอไปด้านขวาให้ได้มากที่สุดเท่าที่จะทำได้ ไหล่ซ้ายไม่ต้องยกตาม ท่าต่อไปคือหันคอไปด้านซ้าย ให้หันคอไปด้านซ้ายให้ได้มากที่สุดเท่าที่จะทำได้ หันไปเฉพาะส่วนคอไหล่ขวาพิงพนักไว้ไม่เคลื่อนไหวลำตัว และท่าสุดท้ายคือหันคอไปด้านขวา ให้หันคอไปด้านขวาให้ได้มากที่สุดเท่าที่จะทำได้ หันไปเฉพาะส่วนคอไหล่ซ้ายพิงพนักไว้ไม่เคลื่อนไหวลำตัวนะคะ"

จากนั้นให้ผู้เข้าร่วมงานวิจัยนั่งตัวตรงบนเก้าอี้ไม้ หลังส่วนล่างชิดพนักพิง สวมเครื่องมือและจัดท่าเริ่มต้นให้

1. Flexion จากท่าเริ่มต้นให้ผู้วัดออกคำสั่งดังนี้ "ก้มคอลงตามองพื้นนะคะ ก้มลงไปให้ได้มากที่สุดเท่าที่จะทำได้ปล่อยคอสบายๆไม่ต้องเกร็งค่ะ หลังพิงพนักเก้าอี้ไว้ไม่ก้มตาม นิ่งๆนะคะ เงยหน้ากลับค่ะ" เมื่อผู้เข้าร่วมงานวิจัยทำได้ถูกต้องแล้วจึงทำการวัดเพื่อเก็บข้อมูลจริงอีกสองครั้ง โดยใช้คำสั่งเดิมซ้ำ

2. Extension จากท่าเริ่มต้นให้ผู้วัดออกคำสั่งดังนี้ "เงยคอขึ้นตามองเพดานนะคะ เงยขึ้นไปให้ได้มากที่สุดเท่าที่จะทำได้ไม่แอ่นหน้าอก นิ่งๆนะคะ ก้มคอกลับค่ะ" เมื่อผู้เข้าร่วมงานวิจัยทำได้ถูกต้องแล้วจึงทำการวัดเพื่อเก็บข้อมูลจริงอีกสองครั้ง โดยใช้คำสั่งเดิมซ้ำ

3. Left lateral flexion จากท่าเริ่มต้นให้ผู้วัดออกคำสั่งดังนี้ "เอียงคอไปด้านซ้ายนะคะ เอียงไปให้ได้มากที่สุดเท่าที่จะทำได้ไหล่ขวาไม่ต้องยก นิ่งๆนะคะ เอียงคอกลับค่ะ"

4. Right lateral flexion จากท่าเริ่มต้นให้ผู้ทำการวัดออกคำสั่งดังนี้ "เอียงคอไปด้านขวานะคะ เอียงไปให้ได้มากที่สุดเท่าที่จะทำได้ไหล่ซ้ายไม่ต้องยก นิ่งๆนะคะ เอียงคอกลับค่ะ"

5. Left rotation จากท่าเริ่มต้นให้ผู้ทำการวัดออกคำสั่งดังนี้ "หันคอไปด้านซ้ายนะคะ หันไปให้ได้มากที่สุดเท่าที่จะทำได้ไหล่ขวาพิงพนักไว้ไม่เคลื่อนไหวลำตัวนะคะ นิ่งๆนะคะ หันคอกลับค่ะ"

6. Right rotation จากท่าเริ่มต้นให้ผู้ทำการวัดออกคำสั่งดังนี้ "หันคอไปด้านขวานะคะ หันไปให้ได้มากที่สุดเท่าที่จะทำได้ไหล่ซ้ายพิงพนักไว้ไม่เคลื่อนไหวลำตัวนะคะ นิ่งๆนะคะ หันคอกลับค่ะ"

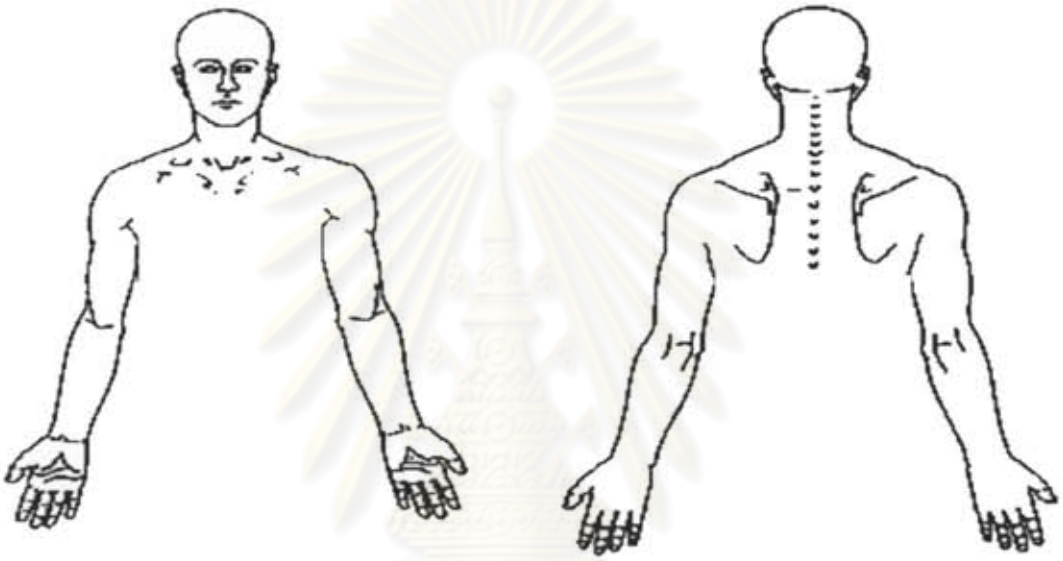
ในแต่ละท่าจะให้ผู้เข้าร่วมงานวิจัยทำหนึ่งครั้งเพื่อเป็นการซ้อมก่อน เมื่อผู้เข้าร่วมงานวิจัยสามารถทำท่าได้ถูกต้องแล้ว จะทำการออกคำสั่งให้ทำซ้ำอีกครั้งเพื่อเก็บข้อมูลจริง

APPENDIX J

DATA COLLECTION SHEET FOR MAIN STUDY

Before treatment

กรุณาระบุบริเวณ และลักษณะอาการในขณะนี้บนแผนภูมิ



กรุณาทำเครื่องหมาย | ลงบนเส้นด้านล่าง เพื่อแสดงระดับความเจ็บปวดของคุณ

- ระดับความเจ็บปวดในขณะนี้

ไม่มีอาการเจ็บปวดเลย ——— เจ็บปวดมากที่สุดเท่าที่จะจินตนาการได้

- ระดับความเจ็บปวดเมื่อทำการเคลื่อนไหวคอในทิศทางที่ก่อให้เกิดความเจ็บปวดมากที่สุด

ไม่มีอาการเจ็บปวดเลย ——— เจ็บปวดมากที่สุดเท่าที่จะจินตนาการได้

ช่วงการเคลื่อนไหวของคอก่อนการรักษา

Motion	ROM (degrees)	* for worst movement
Flexion		
Extension		
Left lateral flexion		
Right lateral flexion		
Left rotation		
Right rotation		

After treatment (5 minutes later)

□ Stiffness □ Pain

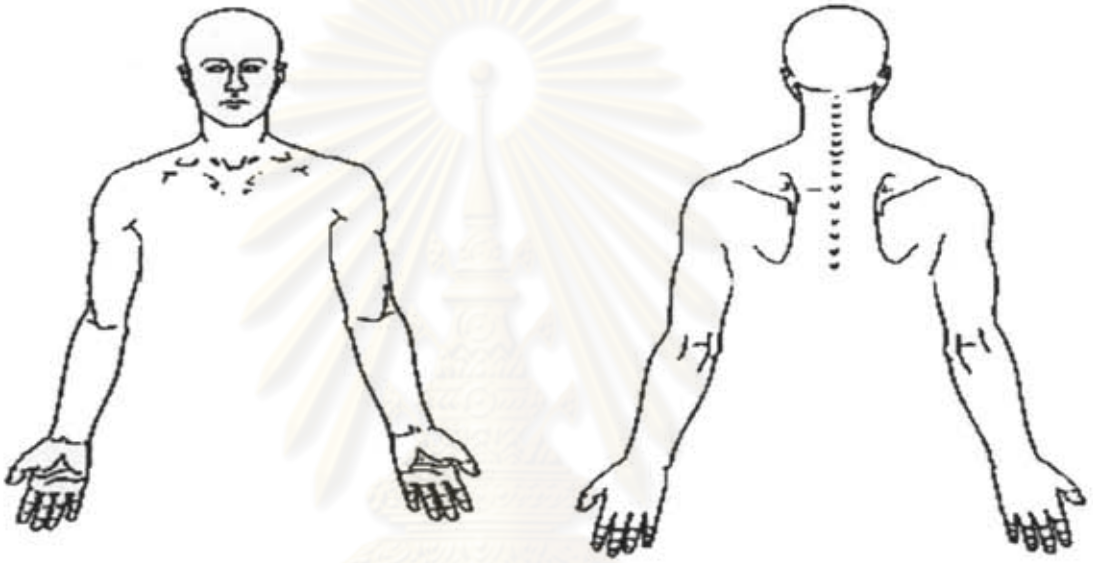
□ Left unilateral PA □ Right unilateral PA

Cervical level ..... Grade ..... Set.....

Cervical level ..... Grade ..... Set.....

Cervical level ..... Grade ..... Set.....

กรุณาระบุบริเวณ และลักษณะอาการในขณะนี้บนแผนภูมิ



ระดับความเจ็บปวด (อ้างอิงแผนภูมิใน Before treatment form)

- ระดับความเจ็บปวดในขณะนี้.....
- ระดับความเจ็บปวดเมื่อทำการเคลื่อนไหวคอในทิศทางที่ก่อให้เกิดความเจ็บปวดมากที่สุด.....

ช่วงการเคลื่อนไหวของคอหลังการรักษา

Motion	ROM (degrees)	* for worst movement
Flexion		
Extension		
Left lateral flexion		
Right lateral flexion		
Left rotation		
Right rotation		

APPENDIX K

DATA OF MAIN STUDY

Table K I Demographic data of patients (n=15)

Participants	Sex	Age (year)	Weight (kilogram)	Height (centimeter)
1	female	51	50	148
2	female	26	46	160
3	female	41	43	154
4	female	49	61	158
5	female	37	75	163
6	female	24	57	154
7	female	40	50	151
8	female	35	62	163
9	female	54	49	150
10	female	46	57	156
11	male	56	72	165
12	female	25	54	165
13	female	45	51	160
14	female	36	58	158
15	female	51	62	160

Table K II Pain at rest (millimeters) (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	27	27	22	22	19	19	19	16	14	13	17	19	0	4	1	1
2	53	69	54	49	63	36	0	0	0	0	29	23	0	0	0	12
3	70	47	39	18	12	4	32	15	6	9	5	3	9	2	3	1
4	31	28	20	20	0	0	0	0	4	1	0	0	0	0	0	0
5	29	19	8	7	0	0	0	0	0	0	0	0	0	0	0	0
6	23	14	16	3	3	7	1	4	1	0	0	0	0	0	0	0
7	57	24	51	37	0	17	14	0	11	0	0	3	6	1	0	0
8	39	17	14	17	13	10	6	23	12	7	4	5	6	3	2	1
9	44	44	33	26	36	36	38	38	28	28	30	30	20	20	17	16
10	70	56	67	55	70	59	0	0	0	0	0	0	20	0	11	0
11	24	15	0	0	0	0	0	0	0	0	1	0	0	0	0	0
12	46	39	15	15	32	31	5	6	5	5	5	4	2	2	2	2
13	20	20	38	36	14	11	3	2	1	1	5	4	6	4	1	0
14	48	48	28	24	24	28	17	15	21	17	29	26	0	0	0	0
15	37	10	77	49	0	0	19	0	0	0	0	0	0	0	0	0

Pre = Pre-treatment, Post = Post-treatment

Table K III Pain on worst movement (millimeters) (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	36	34	28	28	26	25	25	21	19	18	17	18	16	12	9	7
2	60	59	68	52	64	41	37	25	18	11	40	30	5	0	12	18
3	70	30	62	16	16	14	46	29	21	22	13	11	10	5	5	4
4	40	40	33	30	8	8	4	3	4	3	1	1	1	1	0	0
5	61	36	15	13	13	12	9	3	3	0	2	1	0	0	0	0
6	46	33	65	18	57	48	53	26	35	9	25	17	46	24	32	13
7	53	20	49	39	31	22	19	6	13	4	6	2	4	1	3	0
8	82	66	39	41	44	44	21	42	34	20	9	10	10	5	5	2
9	70	70	66	61	52	51	67	67	46	46	55	43	37	33	27	26
10	71	51	67	61	72	55	59	49	40	18	37	13	27	4	18	0
11	31	12	14	6	3	1	0	0	5	2	1	0	1	0	0	0
12	52	45	19	21	36	35	11	13	9	10	11	9	2	2	4	4
13	45	45	44	36	11	10	4	3	3	3	4	3	11	6	1	1
14	54	51	32	28	30	26	33	24	26	17	33	31	7	2	0	0
15	77	70	91	78	44	44	55	34	0	0	0	0	0	0	0	0

Pre = Pre-treatment, Post = Post-treatment

Table K IV Cervical flexion ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	43	45	52	52	54	51	57	49	65	55	52	46	44	44	37	39
2	64	66	58	54	69	58	63	63	64	55	58	59	62	58	59	57
3	56	54	55	55	51	52	50	51	53	55	53	49	49	53	53	49
4	53	53	48	47	51	44	44	44	55	44	47	47	50	45	47	44
5	51	50	64	61	63	57	58	52	64	57	62	55	56	67	63	63
6	48	55	55	58	51	48	51	51	48	47	49	52	51	50	51	44
7	51	49	42	56	56	53	50	48	42	43	40	48	55	47	54	52
8	59	51	56	47	54	56	56	53	56	58	58	58	64	64	56	55
9	46	43	45	53	52	51	59	50	60	64	58	60	53	58	54	56
10	47	45	40	40	44	44	47	43	44	43	44	39	44	44	42	44
11	45	45	45	42	47	50	44	47	46	44	44	44	45	44	44	45
12	64	62	60	58	55	62	56	62	54	60	54	64	56	58	59	57
13	50	49	50	50	51	54	49	45	51	51	50	48	51	49	52	47
14	52	54	59	50	53	46	47	46	49	51	51	53	45	49	40	46
15	20	50	37	44	47	49	44	47	53	53	54	52	54	48	54	52

Pre = Pre-treatment, Post = Post-treatment

Table K V Cervical extension ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	68	62	58	52	58	56	54	57	55	49	52	52	55	54	64	58
2	76	92	58	60	68	68	71	70	55	80	70	73	80	84	72	77
3	46	52	49	50	46	46	50	48	55	47	43	51	48	51	50	53
4	58	53	44	49	49	55	57	56	44	51	56	56	50	50	50	50
5	58	55	55	65	60	62	60	52	57	50	49	50	53	51	57	55
6	57	59	59	55	61	58	51	53	47	60	60	58	53	60	56	54
7	60	67	70	67	72	74	63	60	43	65	58	58	60	62	66	63
8	65	58	62	60	62	62	60	55	58	62	56	68	55	60	55	59
9	31	33	36	35	49	49	46	46	64	47	38	40	42	50	42	46
10	57	58	66	62	67	69	70	62	43	68	62	61	59	59	60	54
11	46	50	45	46	46	58	46	50	44	49	50	56	52	57	54	55
12	52	54	54	56	59	65	62	58	60	57	64	63	72	58	64	64
13	52	54	46	50	52	58	62	68	51	62	62	64	57	58	63	60
14	58	54	54	46	50	54	62	60	51	50	58	58	60	54	64	63
15	30	46	40	42	43	43	38	41	53	52	48	44	48	46	46	48

Pre = Pre-treatment, Post = Post-treatment

Table K VI Cervical ipsilateral flexion ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	38	43	37	33	41	36	34	38	36	34	28	31	32	36	34	34
2	48	46	37	45	42	42	45	39	42	44	41	44	47	44	45	42
3	24	32	29	30	22	23	27	31	24	27	23	26	28	29	30	30
4	37	32	26	34	33	33	33	30	33	35	32	30	33	32	32	31
5	43	42	43	46	46	46	44	38	42	43	42	38	43	47	42	42
6	43	44	44	40	42	40	47	43	46	43	44	48	42	46	52	44
7	44	52	45	47	50	53	47	45	40	40	39	46	44	42	45	46
8	51	44	47	52	54	47	48	46	44	48	48	48	48	50	42	42
9	27	29	26	26	33	31	33	32	30	31	27	32	30	32	29	31
10	38	36	36	40	40	38	41	37	34	35	32	37	38	36	37	41
11	28	28	28	26	27	30	26	30	26	32	36	33	28	25	29	27
12	37	42	40	40	38	38	40	40	38	34	38	34	39	35	34	36
13	32	38	36	38	33	42	37	37	36	36	37	36	32	32	33	35
14	48	42	43	41	44	46	44	50	49	48	43	46	42	42	43	45
15	18	29	20	26	25	26	25	25	26	28	32	28	28	28	30	28

Pre = Pre-treatment, Post = Post-treatment

Table K VII Cervical contralateral flexion ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	36	37	32	33	35	31	36	38	37	34	32	32	34	32	37	31
2	54	52	52	55	52	56	49	53	54	52	55	50	56	57	56	56
3	24	32	34	33	30	32	32	34	33	38	32	30	32	35	33	33
4	42	40	34	39	32	36	33	34	35	37	37	40	39	34	34	39
5	49	49	50	51	50	51	45	50	43	45	44	46	48	46	46	47
6	46	44	44	50	41	43	43	49	43	42	45	44	46	46	44	46
7	44	45	47	50	44	53	40	41	40	42	38	45	46	45	44	46
8	45	45	41	46	55	54	39	49	50	46	54	54	46	50	45	46
9	31	34	36	30	33	33	34	36	32	36	31	30	30	35	32	35
10	36	39	43	48	40	39	39	39	34	34	34	36	35	37	36	40
11	28	30	27	26	28	26	28	28	32	36	24	27	24	24	23	26
12	36	40	38	40	42	42	38	42	36	39	36	40	40	36	34	34
13	38	44	48	44	37	43	42	45	44	44	36	40	37	42	42	41
14	37	40	37	39	38	44	38	40	39	40	38	40	40	40	40	42
15	30	30	27	26	28	28	26	28	36	35	35	32	30	32	36	32

Pre = Pre-treatment, Post = Post-treatment

Table K VIII Cervical ipsilateral rotation ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	64	62	62	64	61	62	62	62	61	63	60	59	61	62	64	64
2	76	72	68	73	70	64	78	68	73	68	73	70	72	72	74	73
3	64	64	65	60	65	65	65	68	68	68	64	64	70	67	68	67
4	56	60	56	58	66	63	62	66	64	64	64	68	67	65	66	70
5	66	68	70	68	66	66	64	65	66	65	68	67	63	64	68	68
6	67	60	60	59	63	58	61	63	60	58	58	66	66	67	60	64
7	50	72	75	76	77	80	74	75	70	73	68	74	70	76	76	72
8	62	64	66	66	67	69	64	68	68	70	68	68	68	68	66	63
9	55	52	56	58	61	64	60	60	60	57	56	58	58	61	59	63
10	56	60	56	57	56	55	57	54	52	52	55	56	56	60	57	57
11	57	58	53	54	54	58	63	60	62	62	60	61	58	57	57	58
12	64	74	70	64	62	70	65	70	64	72	68	70	67	66	68	72
13	66	72	70	68	66	66	62	64	67	68	65	64	59	66	66	66
14	72	68	54	62	61	66	63	66	72	66	68	64	64	64	67	64
15	42	50	48	46	45	55	49	58	54	54	62	55	60	56	59	59

Pre = Pre-treatment, Post = Post-treatment

Table K IX Cervical contralateral rotation ROM (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	57	59	66	63	68	67	59	62	62	65	59	63	57	60	68	65
2	74	70	64	69	59	59	66	64	64	66	61	63	62	60	63	64
3	62	64	67	67	66	65	66	64	65	68	63	64	62	62	62	64
4	73	72	66	72	63	63	76	70	71	68	72	70	62	60	60	68
5	66	65	64	62	62	63	65	61	65	66	67	67	66	67	66	70
6	62	69	69	65	63	66	66	67	66	66	66	66	66	68	65	70
7	53	72	67	76	72	76	70	71	73	76	68	75	64	76	68	76
8	63	62	68	67	70	72	69	66	65	64	68	64	60	60	69	70
9	60	70	66	66	67	65	66	69	67	68	65	60	63	66	66	68
10	61	61	62	60	63	61	63	64	58	62	59	60	64	62	62	63
11	58	60	60	56	55	55	54	56	60	64	54	61	60	63	56	57
12	78	73	70	74	70	73	72	73	70	76	70	76	73	72	74	70
13	52	56	48	55	62	63	60	62	57	58	58	52	58	54	54	54
14	71	67	67	66	70	80	70	74	70	82	73	74	68	70	78	78
15	40	52	40	48	58	54	50	54	66	64	64	62	63	62	61	61

Pre = Pre-treatment, Post = Post-treatment

Table K X Cervical ROM on worst movement (n=15)

	Appointment 1		Appointment 2		Appointment 3		Appointment 4		Appointment 5		Appointment 6		Appointment 7		Appointment 8	
Participants	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	36	37	32	33	35	31	36	38	37	34	32	32	34	32	37	31
2	54	52	58	60	52	56	49	53	54	52	55	50	56	57	56	56
3	62	64	67	67	66	65	66	64	65	68	63	64	62	62	62	64
4	42	40	34	39	32	36	33	34	35	37	37	40	39	34	34	39
5	66	65	64	62	62	63	65	61	65	66	67	67	66	67	66	70
6	42	46	44	50	41	43	43	49	43	42	45	44	46	46	44	46
7	44	45	47	50	44	53	40	41	40	42	38	45	46	45	44	46
8	45	45	41	46	55	54	39	49	50	46	54	54	46	50	45	46
9	31	33	36	35	49	49	46	46	47	47	38	40	42	50	42	46
10	36	39	43	48	40	39	39	39	34	34	34	36	35	37	35	40
11	57	58	53	54	54	58	63	60	62	62	60	61	58	57	57	58
12	37	42	40	40	38	38	40	40	38	34	38	34	39	35	34	36
13	38	44	48	44	37	43	42	45	44	44	36	40	37	42	42	41
14	39	40	37	39	38	44	38	40	39	40	40	40	40	40	40	42
15	40	52	40	48	58	54	50	58	66	64	64	62	63	62	61	61

Pre = Pre-treatment, Post = Post-treatment

Table K XI Neck Disability Index (percentage) (n=15)

Participants	NDI I	NDI II
1	48.9	20.0
2	31.1	15.6
3	52.0	10.0
4	15.6	8.9
5	14.0	8.0
6	17.8	6.7
7	28.9	6.7
8	30.0	10.0
9	31.1	28.9
10	36.0	32.0
11	28.0	6.0
12	20.0	17.8
13	13.3	8.9
14	28.0	4.0
15	44.4	11.1

Table K XII Global Perceived Effect (n=15)

Participants	GPE I	GPE II
1	3	3
2	2	2
3	2	2
4	3	2
5	3	1
6	2	2
7	2	1
8	2	1
9	2	3
10	3	3
11	2	2
12	3	3
13	2	2
14	2	1
15	1	1

APPENDIX L

KOLMOGOROV - SMIRNOV TEST OF MAIN STUDY

Table L I Pain at rest

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.135	15	0.200
Post1	0.185	15	0.176
Post2	0.148	15	0.200
Post3	0.184	15	0.185
Post4	0.242	15	0.019*
Post5	0.302	15	0.001*
Post6	0.336	15	0.000*
Post7	0.319	15	0.000*
Post8	0.397	15	0.000*

* $p < 0.05$

Table L II Pain on worst movement

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.143	15	0.200
Post1	0.095	15	0.200
Post2	0.134	15	0.200
Post3	0.148	15	0.200
Post4	0.143	15	0.200
Post5	0.156	15	0.200
Post6	0.169	15	0.200
Post7	0.314	15	0.000*
Post8	0.284	15	0.002*

* $p < 0.05$

Table L III Flexion

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.187	15	0.168
Post1	0.152	15	0.200
Post2	0.128	15	0.200
Post3	0.085	15	0.200
Post4	0.157	15	0.200
Post5	0.153	15	0.200
Post6	0.117	15	0.200
Post7	0.199	15	0.115
Post8	0.141	15	0.200

* $p < 0.05$

Table L IV Extension

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.187	15	0.164
Post1	0.219	15	0.050
Post2	0.117	15	0.200
Post3	0.122	15	0.200
Post4	0.093	15	0.200
Post5	0.220	15	0.050
Post6	0.130	15	0.200
Post7	0.231	15	0.031*
Post8	0.149	15	0.200

* $p < 0.05$

Table L V Ipsilateral flexion

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.164	15	0.200
Post1	0.214	15	0.064
Post2	0.148	15	0.200
Post3	0.097	15	0.200
Post4	0.144	15	0.200
Post5	0.170	15	0.200
Post6	0.153	15	0.200
Post7	0.155	15	0.200
Post8	0.199	15	0.112

* $p < 0.05$

Table L IV Contralateral flexion

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.119	15	0.200
Post1	0.123	15	0.200
Post2	0.125	15	0.200
Post3	0.121	15	0.200
Post4	0.133	15	0.200
Post5	0.122	15	0.200
Post6	0.148	15	0.200
Post7	0.146	15	0.200
Post8	0.125	15	0.200

* $p < 0.05$

Table L VII Ipsilateral rotation

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.163	15	0.200
Post1	0.137	15	0.200
Post2	0.113	15	0.200
Post3	0.181	15	0.200
Post4	0.117	15	0.200
Post5	0.135	15	0.200
Post6	0.147	15	0.200
Post7	0.133	15	0.200
Post8	0.137	15	0.200

* $p < 0.05$

Table L VIII Contralateral rotation

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.126	15	0.200
Post1	0.145	15	0.200
Post2	1.320	15	0.200
Post3	0.150	15	0.200
Post4	0.111	15	0.200
Post5	0.270	15	0.004*
Post6	0.170	15	0.200
Post7	0.180	15	0.200
Post8	0.162	15	0.200

* $p < 0.05$

Table L IX Worst movement

	Kolmogorov-Smirnov test		
	Statistic	**df**	**Sig.**
Baseline	0.218	15	0.054
Post1	0.200	15	0.109
Post2	0.141	15	0.200
Post3	0.141	15	0.200
Post4	0.163	15	0.200
Post5	0.182	15	0.194
Post6	0.201	15	0.106
Post7	0.128	15	0.200
Post8	0.242	15	0.018*

* $p < 0.05$

APPENDIX M

DATA COLLECTION SHEET
FOR INTRA-OBSERVER RELIABILITY STUDY

การทดลองวัดความน่าเชื่อถือในการวัดช่วงการเคลื่อนไหวของกระดูกสันหลังระดับคอด้วย

Cervical Range of Motion Instrument

ID ..... Date ..... / ..... / 2007

ชื่อ (นาย, นาง, นางสาว) ..... นามสกุล .....

อายุ ..... ปี น้ำหนัก ..... กิโลกรัม ส่วนสูง ..... เซนติเมตร

Motion	ROM (degrees) First repetition	ROM (degrees) Second repetition
Flexion		
Extension		
Left lateral flexion		
Right lateral flexion		
Left rotation		
Right rotation		

APPENDIX N

DATA OF PILOT STUDY

Table N I Demographic data of participants (n=15)

Participants	Sex	Age (year)	Weight (kilogram)	Height (meter)
1	female	56	58	157
2	male	26	63	170
3	female	42	60	156
4	female	26	49	162
5	male	22	54	164
6	female	60	62	160
7	female	46	59	163
8	female	19	77	156
9	male	42	66	167
10	male	19	72	170
11	female	42	61	154
12	female	71	63	162
13	female	46	46	159
14	female	33	48	154
15	female	46	58	164

Table N II Cervical flexion ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	53	53	48	51
2	56	55	58	56
3	50	49	48	50
4	50	51	49	50
5	49	48	45	49
6	50	49	50	48
7	47	49	46	47
8	54	55	60	60
9	46	46	50	50
10	60	58	61	61
11	57	56	56	56
12	45	45	42	42
13	60	62	62	64
14	54	52	52	52
15	54	54	55	55

Table N III Cervical extension ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	72	72	71	71
2	71	71	70	70
3	49	47	50	49
4	70	70	70	71
5	77	78	72	72
6	67	67	68	68
7	64	65	68	68
8	38	38	36	36
9	56	56	55	55
10	62	62	63	64
11	60	60	60	61
12	46	46	50	50
13	44	44	48	48
14	70	70	68	68
15	67	66	66	65

Table N IV Cervical left lateral flexion ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	34	36	29	31
2	46	46	36	37
3	36	33	37	38
4	48	48	47	47
5	49	49	47	48
6	37	39	38	40
7	43	47	44	46
8	38	38	38	38
9	36	36	36	36
10	46	46	48	48
11	36	36	40	40
12	28	28	28	28
13	32	34	35	35
14	44	44	50	50
15	50	50	49	48

Table N V Cervical right lateral flexion ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	28	28	37	36
2	39	39	40	42
3	36	34	38	36
4	46	46	44	44
5	40	42	40	40
6	45	45	38	40
7	46	46	46	47
8	40	40	38	38
9	35	35	35	35
10	49	48	49	50
11	44	44	46	46
12	36	38	36	37
13	28	30	34	32
14	42	41	46	46
15	56	56	56	55

Table N VI Cervical left rotation ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	69	71	66	64
2	72	74	72	73
3	68	70	66	66
4	66	66	67	68
5	71	73	71	69
6	64	63	64	65
7	80	80	81	81
8	65	65	64	62
9	70	70	70	70
10	58	61	62	62
11	66	68	68	68
12	58	60	60	60
13	70	71	72	72
14	68	68	70	72
15	69	70	70	70

Table N VII Cervical right rotation ROM (n=15)

	Range of motion (degree)			
	First Session		Second Session	
Participants	1	2	1	2
1	63	63	64	64
2	64	66	68	68
3	68	68	68	68
4	70	70	66	67
5	72	72	66	68
6	67	69	64	66
7	74	74	77	76
8	54	54	52	52
9	64	64	63	62
10	64	64	63	64
11	73	74	74	74
12	52	53	58	60
13	54	56	60	62
14	64	66	67	68
15	70	70	72	72

APPENDIX O

LETTER OF ACCEPTANCE FOR PUBLICATION

วารสารสหเวชศาสตร์ คณะสหเวชศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย ถนนพระราม 1
เขตปทุมวัน กรุงเทพฯ 10330

9 กันยายน 2551

เรื่อง ตอบรับการตีพิมพ์บทความวิจัย
เรียน คุณมลทิชา สกุณา

ตามที่ท่านได้ส่งบทความเรื่อง **"The effect of the ipsilateral unilateral posteroanterior mobilization technique on pain and cervical range of motion in patients with mechanical neck pain: 72 hours follow-up"** เพื่อลงในวารสารสหเวชศาสตร์ และได้ปรับปรุงแก้ไขตามที่ผู้ทรงคุณวุฒิแนะนำแล้วนั้น บัดนี้ กองบรรณาธิการมีความยินดีจะแจ้งให้ทราบว่า บทความวิจัยของท่าน จะตีพิมพ์ในวารสารสหเวชศาสตร์ ปีที่ 7 ฉบับที่ 2 กรกฎาคม-ธันวาคม 2550 ซึ่งคาดว่าจะเผยแพร่ได้ประมาณเดือนพฤศจิกายน 2551

ขอแสดงความนับถือ

(ผู้ช่วยศาสตราจารย์ ดร.จิตอนงค์ ก้าวกสิกรรม)
บรรณาธิการ

BIOGRAPHY

Miss Monticha Sakuna was born on February 21, 1984 in Ratchaburi, Thailand. She graduated her high school from Satriwatrakhang School, Bangkok, in 2001. She enrolled in the Department of Physical therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Thailand and graduated with a Bachelor degree, second class honors, in 2005. She continued her study in graduate program for Master degree of Musculoskeletal Physical Therapy at Chulalongkorn University in 2006 and worked at Charan 13 Physical Therapy Clinic concurrently.