

CHAPTER 5

DISCUSSIONS

1. Pain perception

An average pain visual analog scales and pressure pain threshold were the primary outcome measures. Pain perception was assessed by visual analog scales and pressure pain threshold over upper trapezius muscles and over the facet joints of L4-5.

In the sport massage technique, the average pain visual analog scales significantly decreased 26.04% - 35.10% (-0.94 to -1.31 scales) and an average the pressure pain threshold over upper trapezius muscles and L4-5 significantly increased 11.51% - 14.15% and 12.88% - 19.42%, respectively. The clinical significant defined as decreased pressure pain threshold by 10% or more and increase visual analog scales of 0.5 or more from the pre-value (45). Therefore, the changes in pain perception of this study was considerably be both clinical and statistic significances.

Decrease in pain perception as demonstrated by visual analog scales (subjective measure) as well as pressure pain threshold (objective measure) strengthens the effect of sport massage in reducing pain intensity.

Sport massage may reduce pain by providing the mechanical and neurobiological effects on pain receptors that could be explained by pain gate mechanism. Pain gate mechanism is the blockage of pain impulses which is transmitted from sensory neurons (21). Sensory neurons consist of Class A fibers (Group I and II - alpha) Class B fibers, Class C fibers (Group IV), and other sensory neurons (A-delta fiber, I and II). Class A fibers which have a large diameter with thickly myelinated axons

transmitt non-pain impulses such as light touch, pressure, and vibration. Pain impulses (such as sharp pain and dull pain) are transmitted along the Class C fibers and A-delta fibers which have a small diameter with thinly or non-myelinated axon. The diameters of nerve fibers with myelinated and non-myelinated axons are showing the characteristic of nerve fibers to transmit the impulses. Large fibers with myelinated axon can transmit impulses faster than the smaller fiber with thinly or non-myelinated axon. Applying light touch, pressure, and vibration during massage will stimulate the larger fibers to inhibit the pain gate mechanism at the dorsal horn cells of the substantia gelatinosa and inhibit the pain impulses to the higher center (thalamus and cerebral cortex). Therefore, pain is reduced in intensity or not perceived at all.

There are also several potential ways that massage can influence pain perception. One way that is removing the waste products and promotes blood circulation to the area of muscle spasm. The effects of the sport massage technique such as kneading or effleurage techniques can improve blood circulation and enhance the removal of waste products. Furthermore, when the muscle tissue are injured or irritated, they will release the chemical substances such as serotonin, bradykinin, histamine, and prostaglandins to blood circulation (21). These chemical substances will activate the nociceptors which are free-nerve endings that distributing in body tissues. The pressure from massage application can enhance blood flow in superficial blood vessels as well as in the deeper arterioles (21). Mechanical effect of the massage also helps to increase perfusion of plasma into the general systemic circulation, increase

venous return to the heart, drain the interstitial fluid into the lymph vessels and ducts (21).

Massage not only reduces pain by gate control and promoting local blood circulation mechanism. Massage also causes relaxation via the parasympathetic nervous system and also sends the impulse on the afferent fiber to activate the higher center (the cortical and brain stem) to release endorphins hormone which is the pain killer substance that helps to strengthen the effectiveness of pain gate control mechanism.

Studies by Kaada and Torsteinbo (46) has been shown that massage increased plasma endorphin level. This notion was investigated in 12 back pain subjects and evaluated the level of endorphin and level of pain at 5, 30, and 90 minutes after 30-minute of massage. The result of this study demonstrated that the endorphin level increased after receiving massage, and also showed the relation of decreasing in back pain symptom.

Muscle spasms or guarding can activate nociceptive receptors that cause pain.

Massage also helps to relieve pain by decreasing muscle tension and muscle spasm.

Massage techniques promote relaxation effects by providing pressure or tensile force

to muscle fibers and tendons (21). Massage helps to alleviate pain by inhibit reflex

effects on motor neuron via golgi tendon organ. The motor neuron is extrafusal

muscle fiber that consisted of Group Ia and Group II afferent neurons. Group Ia

afferent neurons respond to both velocity and degree of stretch. On the other hands,

group II afferent neurons only detect the degree of stretch. Massage reduces the

extrafusal muscle fibers activity and activates Golgi tendon organs to inhibit or reduce

agonist muscle contraction and activate antagonist muscle contraction. There cause to reduce muscle spasm and muscle tone. Moreover, the effect of massage can reduce H-reflex amplitude of the motor neuron. H-reflex amplitude is measurement of excitability level of the motor neurons. Inhibition or reduction in H-reflex amplitude can decrease the excitability of motor neurons, promote relaxation effects and decrease activation of pain receptors (21).

Under the condition of sport massage in combination with lumbopelvic stability training, the average pain visual analog scales significantly decreased 44.92% - 51.04% and the pressure pain threshold over upper trapezius muscles and L4-5 significantly increased 18.11% - 25.66% and 15.68% - 19.95%, respectively. These combination techniques significantly provided the therapeutic effects as demonstrated in visual analog scales than the sport massage technique. The combined techniques may provide more stimulation to induce both mechanical and neurobiological effects as previously mentioned for each individual treatment technique. The biomechanical effects of lumbopelvic stability training may help to relieve pain by reducing tension of muscles or structures around the spinal area (15). The lumbopelvic stability training enhances core stability and pelvic control that helps to reduce loads and shearing forces to the spinal segments. The postural stability, therefore helps to decrease stress and tension which reduce further damage, pain and enhance recovery (15). So that, the mean reduction on pain perception in the sport massage with lumbopelvic stability training significantly greater effect than sport massages technique.

Regarding to improvement in pain VAS scores was demonstrated under the sport massage and the combined conditions (sport massage plus core stability training). This may suggest some points: firstly, the average pain VAS scales, which are quite subjective, may not be sensitive to detect minimal changes. Secondly, it gives direction that the combined treatment techniques are more effective in this studied population than the sport massage technique. Finally, it may be better to include the objective outcome measure to evaluate pain perception as well. This current study also included pressure pain threshold over two standard fixed point to evaluate change of the pre-values. The pressure pain threshold over both regions of upper trapezius and L4-5 demonstrated significant cumulative effects over three days of repeated applications. It supports that the studied treatment applications provide cumulative and carry-over effect for reducing pain perception.

2. Blood flow

Blood flow was the secondary outcome measure in this study using the laser Doppler blood flow meter (Moor UK) to detect the tissue blood flow. In the sport massage technique, blood flow significantly increased after receiving sport massage approximately 112.36% - 122.94%. Sport massage may increase blood flow by reflex effect on the autonomic nervous system and the mechanism of hemodilution. Reflex mechanism on the autonomic nervous system can reduce sympathetic activity and stimulate parasympathetic. The parasympathetic achieved the relaxation in the smooth muscles of blood vessels as the result of vasodilation, promote blood circulation and enhance venous return (21). The effects of the sport massage

technique such as effleurage and the compression technique are not only affecting on the superficial but also on the deep lymphatic vessels (21). One of mechanisms for lymph flow is the pressure differences within the capillary end and the interstitial tissues that call hydrostatic pressure. Massage enhances hydrostatic pressure of lymph flow and pushes the circulation from high pressure area (i.e. capillary end) to a lower pressure area (i.e. the interstitial space of the tissues) and lymphatic duct. Improving blood and lymphatic circulation helps tissues to remove irritating and waste products away from the affected area and bring the fresh blood which is rich in nutritions and oxygen into the affected tissues for promoting healing process (47).

In the sport massage in combination with lumbopelvic stability training, blood flow significantly increased after receiving combine technique 131.17% - 152.21%. The sport massage in combination with lumbopelvic stability training had significantly greater effect than sport massage technique. The combination effects especially for sport massage technique, it can stimulate the reflex mechanisms on the autonomic nervous system that enhance the relaxation in the smooth muscles of the blood vessels and also cause vasodilation. Exercise and contraction of muscles may enhance blood circulation. Exercise can stimulus autonomic nervous system that emphasis sympathetic nervous activity and decrease parasympathetic nervous activity (48). The previous study showed that the sympathetic nervous system can control vascular conductance and blood flow in active muscle and maintain arterial blood pressure during exercise (49). In essence, there is the direct relationship between the contraction of skeletal muscle fibers and increase in muscle blood flow. During the skeletal muscle contraction, biological substances (such as norepinephrine, lactic acid,

nitric oxide, hydrogen ion or potassium ion) are released from the contracting muscle and these increase capillary perfusion and vascular conductance (47, 48). Furthermore, it also causes vascular smooth muscle relaxation and consequent vasodilation (47). In addition, during muscle contraction, there are some waste products (such as lactic acid and nitric oxide) that may release in the circulation. These substances also increase muscle blood flow and enhance removal of the waste product and promote the recovery (50).

During exercise, the contraction frequency and intensity of exercise can increase in the temperature of the working muscle. The temperature-related mechanism is response for change in energy turnover during exercise. Those include change in cross-bridge activity (51). When muscles increase the temperature, it has been demonstrated that ATP turnover of the greater rate of cross-bridge activity during intense especially for isometric contraction and dynamic exercise (51). This is supported by the observation of an elevated myofibrillar ATPase activity in single human muscle fibers that are increasing temperature (51). As a result of increasing tissues temperature, our body will keep homeostasis by promoting blood circulation and vasodilation.

Blood flow is the one of the most important factors regulating oxygen supply in skeletal muscle, especially during exercise (52). The previous study showed a good correlation between blood flow and oxygen consumption (VO_2). Oxygen is the most important substance that muscles need during exercise and the supply of oxygen is dependent on blood flow (52).

Interestingly, the pre-values of many measurement outcomes, except blood flow, demonstrated cumulative effect over three consecutive days of follow up. No change in the pre-values of tissue blood flux between days reflects the homeostasis of autonomic nervous system to keep balance of our body regulation system.

3. Lumbopelvic stability levels

Lumbopelvic stability training levels were the outcome measures that evaluate the stability of core system by evaluating changes between pre- and post- applications on day1, day2, and day3 between sport massage technique and sport massage in combination with lumbopelvic stability training. Under the condition of sport massage, lumbopelvic stability levels changed minimally after receiving sport massage 5.20% - 13.54%. Effects of sport massage technique may improve muscle extensibility, improve joint range of motion, and promote muscle resting length. Furthermore, there is published evidence that sport massage can increase skin and muscle temperature. This temperature-related mechanism is response for the passive warm-up effect before activity. Moreover, one expected benefit of massage is an increase in blood circulation that may relevant following after increase body temperature (21). Increasing body temperature also activates vasodilation in blood vessel. Increasing blood circulation enhance the delivery of oxygen, protein and prepare other nutrients and substance for muscle contraction (21).

In the sport massage in combination with lumbopelvic stability training, lumbopelvic stability levels increased roughly 3.64% - 14.58% which a little bit slightly greater than sport massage technique. For the effects of both sport massage

and core stability training in the combination techniques, it relates to many mechanisms including increase muscle blood flow, tissue blood circulation, decrease muscle tension or spasm decrease stress hormones and promoting relaxation and providing resting muscle length. Training may help to improve the lumbopelvic stability levels by enhance muscle activation, motor control and motor relearning. The lumbopelvic stability training work together between musculoskeletal system and central nervous system (15). Training effect may activate the local muscles by stimulating contraction of the deep muscle synergy (i.e. transverses abdominis, deep multifidus, and pelvic floor). Using feedback techniques and guide also help to develop the skill of the contraction of the local muscles synergy that improve the motor control and motor relearning. The lumbopelvic stability training also can be explained by the neural adaptation concept of Magill (16). A new motor skill consists three stages of motor learning. First is the cognitive stage, second is the associative of learning stage, and finally is the autonomous of stage of learning. The lumbopelvic stability training in this thesis study can be categorized mainly as in the cognitive or associative learning stages. Because of these stages must take place first with internal and external feedback. Internal feedback is feedback from peripheral sensitization for control of the intervertebral motion and the position sense in the lumbopelvic region to maintain a neutral spinal position (15). External feedback is command from trainer or visual feedback techniques and participants need more attention to practice follow command of trainer step by step for control the lumbopelvic stability. There are pre-conditioning factors for effectiveness co-activation of muscles and re-education of motor control during performance of lumbopelvic stability control (15).

Interestingly, our study has shown some points, subjects who participated in this thesis study were the elite weightlifter. They were trained in high performance and required more core stability than the normal individuals. However, our study found that they have median of the pre-value for lumbopelvic stability only in levels 3, which was relatively similar to normal population who were not an athletes. The study by Thongjunjua et al (53) found that the normal Thai populations have the median of lumbopelvic stability in level 2. When comparing the lumbopelvic stability levels between these two studies, we determined that the elite weightlifters in this thesis study have minimal core stability superior than normal populations. To prevent injury of the musculoskeletal system during high performance task such as weightlifting, the athletes should gain more core stability than they were.

4. Conclusions

The sport massage in combination with the lumbopelvic stability training provides significantly greater effect in reduction of an average pain and improved blood circulation than sport massage technique. Although, changes in lumbopelvic stability training levels were not obvious but it suggests the greater effects when the combine conditions (sport massage plus lumbopelvic stability training) are applied. Therefore, the combination of sport massage and lumbopelvic stability training should be considered as part of management program for excellency of Thai women national weightlifters.

5. Advantages and limitations of the study

Weightlifting is a tough performance that requires hard and repetitive training in everyday. Repetitive microtrauma, soreness and pain are quite common in this special population. This is the first study that evaluated the effect of sport massage maneuver and lumbopelvic stability training program on pain perception, core stability levels and blood circulation in Thai national weightlifters population.

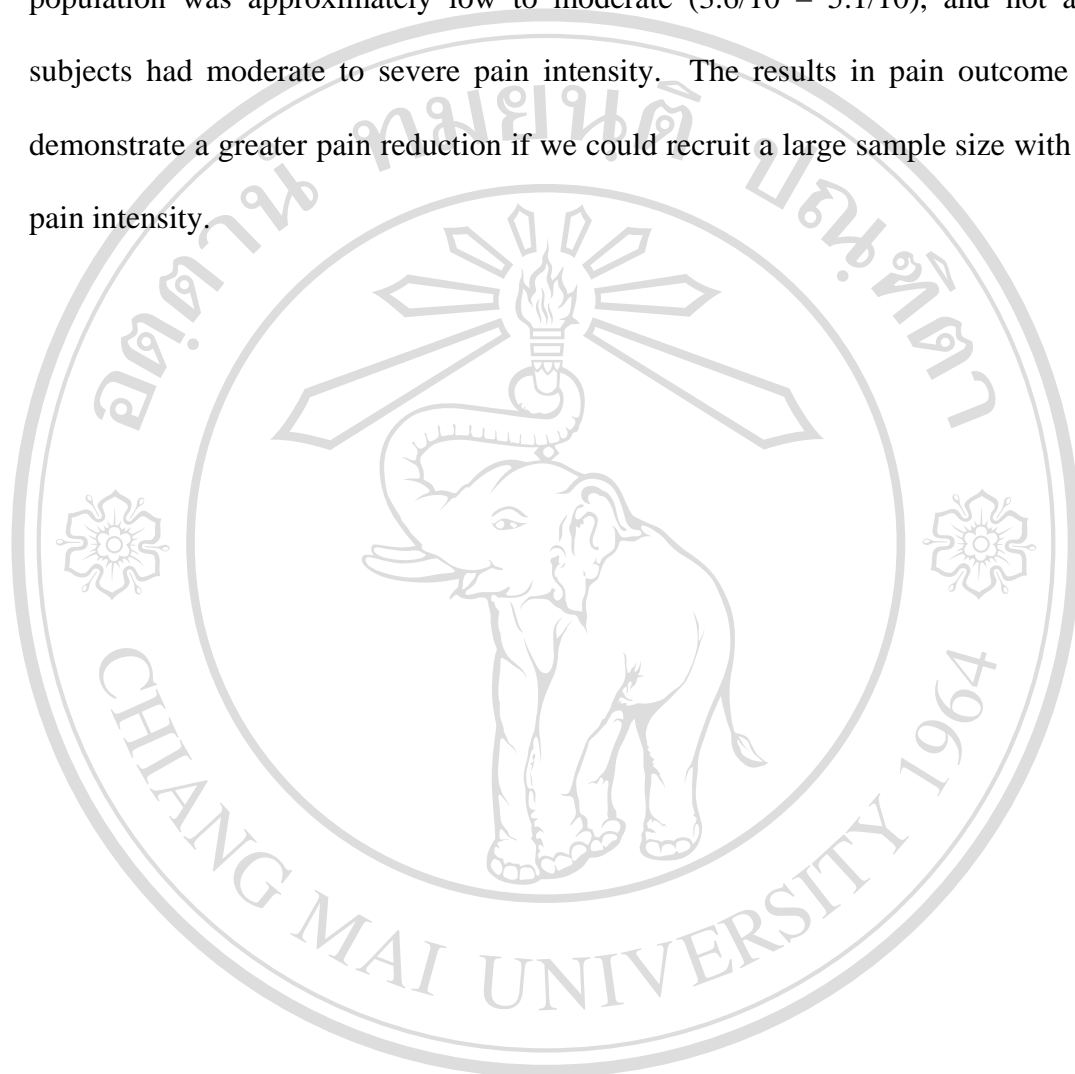
Although, this study might have some limitations as following:

1. This current thesis study mainly evaluated an immediate physiological outcomes in pre-, post- comparison design. It may have limitation to answer “ How long does the effect last? ”. However, this type of research design can help the investigator to prove that the changes in dependent variables (outcomes) are the consequence effect mainly from the independent variable (intervention). Last but not least, this thesis study also evaluated changes on day 2 and day 3. Interestingly, the data showed the trend that the intervention have some carry-over effects and also provide the cumulative effects over the days of evaluation. Further randomised-controlled clinical study is needed to clarify this notion.

2. This thesis study recruited all team member (n=16) of Thai women national weightlifters. However, sixteen subjects may be considered as a small sample size to detect changes in some outcome variables (especially difference between compared conditions). If we have chance to evaluate changes in larger sample size, we may have opportunity to observe some changes more clearly.

3. An evaluation of pain in this thesis was considered as “changes in pain perception” rather than “treatment of pain” because the average pain in this

population was approximately low to moderate (3.6/10 – 5.1/10), and not all of subjects had moderate to severe pain intensity. The results in pain outcome may demonstrate a greater pain reduction if we could recruit a large sample size with high pain intensity.



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