

## **The possible mechanisms of massage therapy.**

**Houyong Zhong<sup>1,2,3\*</sup>, Cuimei Wang<sup>1</sup>, Zhen Wan<sup>4</sup>, Jinpei Lei<sup>5</sup>**

<sup>1</sup>Faculty of Physical Education, Gannan Normal University, Ganzhou, P.R. China

<sup>2</sup>Faculty of Associated Medical Sciences, Khon Kaen University, Khon Kaen, Thailand

<sup>3</sup>Research and Training Center for Enhancing Quality of Life of Working-Age People, Khon Kaen University, Khon Kaen, Thailand

<sup>4</sup>Kaiping Maternal and Child Health Care Family Planning Service Center of Guangdong Province, Kaiping, P.R. China

<sup>5</sup>Kaiping Central Hospital of Guangdong Province, Kaiping, P.R. China

### **Abstract**

**Massage therapy is called "green medicine" by the World Health Organization. It has been used as an effective treatment for various conditions, diseases, symptoms, and disorders, which include pain syndromes, hypertension, fatigue, depression, cancer, aging problems, etc. In order to understand the mechanism of massage therapy this article reviews plenty of previous studies investigated the effects of massage, and discusses the different possible mechanisms of massage therapy which include biochemical mechanisms (passive muscle stiffness, range of motion, visual analog scale), physiological mechanisms (skin and muscle temperature, blood pressure, blood flow, heart rate variability, heart rate, pressure pain threshold), neurological mechanisms (Hoffman reflex, anxiety associated with scapulothoracic syndrome, state anxiety inventory), and psychological mechanisms (heart rate variability, profile of mood states, salivary cortisol).**

**Keywords:** Mechanism, Massage therapy, Review.

*Accepted on February 27, 2018*

### **Introduction**

Massage therapy has been shown that have beneficial effects on varying conditions including preterm infants, prenatal depression, full-term infants, skin conditions, autism, pain syndromes [1,2], hypertension, autoimmune conditions, immune conditions including human immunodeficiency virus and breast cancer and aging problems (Parkinson's and dementia) [3,4]. Massage therapy also has been widely used in sports.

Quick recovery from training and competition is recognized as the most important aspects for athletes, which can reduce the accumulation of exercise-induced fatigue (EIF), avoid overtraining, and prevent the risk of sports-related injuries [5]. To achieve this goal, many methods are used, and therapeutic massage is one of the effective treatments. Evidence-based researches show massage can affect muscle fatigue, which include both the body's overall fatigue [6,7] and the local fatigue, such as, thumb fatigue [8], quadriceps fatigue [9], lumbar muscle fatigue [10], enhance body recovery [11], release the delayed onset muscle soreness [12], prevent injury, promote athlete performance [13] etc.

The mechanism of massage therapy is a complex system. For this reason, the effects of massage therapy are most likely produced by more than one mechanism [14]. Nine compute databases (PubMed, Science direct, SPORT Discus, Springer Link, ProQuest, PubMed, Google scholar, Medline and Europe PMC) were used to this literature, in addition to manual journal searches. The key words and phrases for searching include: 'sport massage', 'massage', 'massage therapy', 'mechanism', etc. The following are recognized as the major mechanisms of massage therapy, which include biomechanical, physiological, neurological and psychological mechanism.

### **Biomechanical Mechanism of Massage Therapy**

A summary of the experimental study statistics for the effects of massage therapy on biomechanical aspect as measured by joint arrange of motion, stiffness, is presented in Table 1.

The study of Stanley investigated the effects of massage therapy on passive stiffness. A 10 minute effleurage had no significant effect on the stiffness of the passive gastrocnemius when compared to a 10-minute rest. The reasons may be that the pressure of effleurage may not be sufficient to produce a mechanical effect of massage, or the effleurage could produce

a reflective response, but the changes in muscle properties may be present in the contractile elements [15,16].

Several studies have been evaluated the effects of massage on flexibility of the body by measurement of the range of motion. For example, Crosman et al. found that 9-12 minutes massage for lower extremities can significantly increase the hip flexion and knee extension, Crosman's study confirmed this result [17]. Nordschow and Bierman [18] used finger to floor test to evaluate the flexibility of lumbar, the results showed that massage can increase the lumbar range of motion.

Chanawong and co-workers found that Thai massage can provide improvements in some physical markers in soccer players, which indicated that Thai massage can increase blood flow and reduce muscle tension [19]. The potential mechanisms of it may include the enhancement of reduced adhesion and muscle spasm and the stimulation of proprioceptors of muscles in the tissues being massaged. Thai Massage can cause an increase in muscle blood supply which allows the muscles to get more oxygen from the blood and provide enough nutrients for the muscles [20].

**Table 1.** The effects of massage therapy on biochemical makers [15,17-21].

Study	Subjects	Intervention	Measurement	Results
Stanley et al.[15]	Healthy	10 minutes massage	Maximum tension; Passive muscle stiffness	Non- significant
Wiktorsson-Moller et al. [20]	Healthy males, n=8	6-15 minutes massage (kneading)	Strength of quadriceps and hamstring muscles; ROM of lower extremities	Stretching can significantly increase the range of hip flexion and extension, hip abduction, knee flexion, and ankle dorsiflexion.
Chanawong et al. [19]	Soccer players, n=34	30 minutes Thai	sit-ups; hand grip strength; VO <sub>2</sub> max sit and reach; 40 yards technical agility; 50-meter sprint; push-ups;	All the outcomes were significantly improved after Thai massage.
Nordschow and Bierman [18]	Normal subjects, n=25	30 minutes Swedish and Hoffa massage	Finger to floor test	Stretching can significantly increase the lumbar range of motion.
Crosman et al. [17]	Normal female subjects, n=34	9-12 minutes massage for lower extremities	Range of motion	Massage can increase the hip flexion and knee extension.
Leivadi et al. [21]	Female university dancer, n=30	30 minutes massage twice a week, five weeks	State Anxiety Inventory; Profile of mood states; Visual analog scale; Neck extension; Shoulder abduction	Massage can increase the neck extension and shoulder abduction.

## Physiological Mechanism of Massage Therapy

A summary of the experimental study statistics for the effects of massage on physiological aspect as measured by temperature, heart rate variability, blood flow, cortisol etc. is presented in Table 2.

Some studies showed that massage can increase temperature of the subjects. Hidetoshi et al. investigated the effects of 5 minutes massage on the lumbar region after 90 seconds back muscle contraction induced fatigue, the results showed that significant differences of skin temperature exist between massage group and control group, skin temperature of massage group 0.45°C higher than control group [7]. Drust et al. reported an increase in intramuscular and skin temperature of the vastus lateralis muscle irrespective of massage duration [22]. Miguel et al. reported that massage can significantly increase preterm infants' temperature during massage and after massage. JoEllen et al. reported that massage treatment can significant increase the temperature in five regions: anterior upper chest, posterior neck, upper back, posterior right arm, and middle back [23]. The reasons of it are not very clear, therefore, the increase of temperature may be due to massage, heat transferring from the hands of therapist, or both.

Many researchers believe that the mechanical pressure of massage can speed up blood flow, thereby increasing the rate of elimination of metabolites and the ability to supply oxygen. [7,23,24] Hidetoshi et al. reported that 5 minutes massage on the lumbar region can increase skin blood flow, muscle blood volume [7]. JoEllen et al. investigated the effects of massage on peripheral blood flow by measurement of skin temperature. The finding was that massage can significantly increase the temperature in five regions: anterior upper chest, posterior neck, upper back, posterior right arm, and middle back, then the study concluded that massage can increase the peripheral blood flow [23]. In another study, light massage on the back can increase regional cerebral blood flow of the subjects with prone position [24]. However, Tessa H et al. reported that there were no significances for blood flow which includes femoral artery blood flow skin blood flow [25].

Massage has shown some experimental evidence for increasing parasympathetic activity through reducing blood pressure and heart rate, increasing heart rate variability, reducing cortisol level [26-30]. Warangkana et al. [26] investigated the patients with depression. The results showed that traditional Thai massage can reduce the heart rate. Surussawadi [27] (benett's acute) reported that when compared with baseline within group, the cortisol level and heart rate were significant

reduction, but no significant differences in cortisol level between the two groups.

**Table 2.** The effects of massage therapy on physiological makers [2,7,23,25,27-29].

Study	Subjects	Intervention	Measurement	Results
Miguel et al. [2]	preterm infants, n=72	15 minutes massage	During temperature; Post temperature	Massage can significantly increase temperature of the subjects.
Hidetoshi et al. [7]	healthy male, n=29	5 minutes massage on the lumbar region	Visual Analogue Scale; Skin Temperature; Muscle-Blood volume; Skin Blood flow	Massage can increase skin temperature, muscle blood volume and skin blood flow, and can decrease the score of Visual Analogue scale.
Tessa et al. [25]	healthy male volunteers, n=13	12 minutes massage (effleurage and petrissage)	Muscle temperature; skin temperature; femoral skin blood flow; artery blood flow	Massage can significantly increase the muscle temperature and skin temperature, however, no significance for blood flow.
JoEllen et al. [23]	healthy volunteers, n=17 (9 male and 8 female)	20 minutes neck and shoulder massage	Skin temperature	The massage therapy can significantly increase the skin temperature.
Surussawa di et al. [27]	physiotherapy students, n=36	90 minutes Thai massage	Stress perception rating; heart rate; blood pressure; Saliva cortisol level	When compared with baseline within group, the cortisol level and heart rate were significant reduction, but no significant increase in cortisol level.
Lindgren et al. [28]	healthy volunteers, n=22 (11 male and 11 female)	80 minutes Thai massage on hand and feet	Blood glucose; saliva cortisol; heart rate variability; heart rate; serum insulin	Total heart rate variability and all heart rate variability components decreased during intervention. Insulin level and saliva cortisol decreased significantly after massage.
Buttagat et al. [29]	Patients with back pain, n=36	30 minutes traditional Thai massage on back muscle	Body flexibility; State anxiety inventory; Pressure pain threshold; muscle tension; Pain intensity; Heart rate variability	Traditional Thai massage can significantly increase total LF, HF, PPT and body flexibility, significantly decrease muscle tension, anxiety, and self-reported pain intensity.

### Neurological Mechanism of Massage Therapy

Massage therapy is believed to decrease muscle tension and stimulate sensory receptors by reducing neuromuscular excitability which can be measured by the changes in the Hoffman reflex (H-reflex) amplitude [31-34]. One study reported Hoffman reflex (H-reflex) amplitude of each massage condition were reduced compare to the control group, the reason maybe not due to the mechanical stimulation of cutaneous receptors, but for the deeper mechanoreceptors (Table 3).

Numerous studies investigated the effects of massage on pain, and the results of several studies have shown that massage can relieve pain [35-42]. There are several mechanisms about it. Traditional Thai massage that can relieve patients with headaches can be used to explain their physiological effects. Traditional Thai massage may stimulate blood and lymph circulation and autonomic nervous system by pressing skin and muscles. As a result, the discretion of toxins and residual substances inside the body improves, and the flow of nutrients to tissues is enhanced, thereby reducing swelling and pain. Another famous possible mechanism is the gate control theory. The pressure of Traditional Thai massage acts on the skin and muscles, which can stimulate the pressure receptors and inhibit the transmission of pain perception at the spinal cord or the

“gate”. Traditional Thai massage may modulate pain transmission at spinal cord level by closing the gate, which can be explained by inhibiting transmission cell (T cell) activity *via* substantia gelatinosa (SG cells). The techniques of Traditional Thai massage can influence SG cells through stimulating the mechanosensitive afferent fibers in spinal joints and muscles. In addition, Traditional Thai massage also can decrease the level of pain in biochemical transmission temporarily, substance P, thereby the nerve conductivity to a higher center was limited [29,35,40]. Uraiwon et al. found that Traditional Thai massage can be used as an effective treatment for patients with headache and other pain related with neuromuscular disorders [42]. The mechanism of it maybe include: firstly, myofascial trigger points (MTrPs), which constitute an important source of chemical mediators (bradykinin, calcitonin gene-related peptide, serotonin, and substance P may be present in active MTrPs); Traditional Thai massage may break down any MTrPs adhesions. Secondly, massage reduces muscle tension and improves blood flow may wash out pain metabolites (such as lactic acid and substance P) and lead to reduced muscle tension and pain. Thirdly, Traditional Thai massage provides deep pressure, which may stimulate proprioceptors, such as the Golgi tendon organ and spindle cells, in the target muscles. Reducing muscle adhesion and spasm in tissues will reduce the intensity of pain. [42]

**Table 3.** The effects of massage therapy on neurological makers [32-34,40,42].

Study	Subjects	Intervention	Measurement
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Morelli et al. [32]	Neurologically healthy adult, n=12	3 minutes massage (one-hand petrissage)	Hoffman reflex (H- reflex) amplitude
Sullivan et al. [33]	Undergraduate students and university staff, n=16 (8 men, 8 women)	5 minutes massage	Hoffman reflex amplitude
Buttagat et al. [34]	Patients with scapulocostal syndrome, n=20	30 minutes tradition Thai massage	Anxiety; muscle tension; pressure pain threshold
Funda et al. [40]	Patients with undergone total hip or knee arthroplasty, n=60 (42 women, 18 men)	One hour massage	Blood pressure; State Anxiety Inventory; McGill Pain Questionnaire Short Form
Chatchawan et al. [42]	participants who had headache, n=72	25 minutes massage and 5 minutes stretching	Suboccipital and neck range of motion; pressure pain threshold; Visual analog scale

## Psychological Mechanism of Massage Therapy

Massage has been presented that can affect the psychological factors of receivers, such as, reduce psychological stress, increase body relaxation, decrease the anxiety [13,26,36,43-48] (Table 4).

Firstly, massage therapy can decrease the anxiety. Warangkana et al. found that traditional Thai massage can significantly decrease the anxiety level of all depression patients. They think that although mechanisms of traditional Thai massage on depression are not very clear, but traditional Thai massage can provide care and love to the depression patients [26]. Field et al. found that moderate pressure of massage contributed to increased dopamine which leads to decreased norepinephrine levels; therefore anxiety levels are decreased [43]. Since massage is a kind of pressure massage, the same mechanism may at least lead to a reduction in anxiety partially. When a

relaxation reaction occurs due to massage, the stress response is suppressed and the level of anxiety is lowered. Decreased stress is accompanied by increased diminished activity of the sympathetic nervous system and vagal outflow [30].

Secondly, increase body relaxation and reduce stress. The decreased feeling of muscle tension after receiving massage therapy may be explained by the theory of relaxation response. Delaney et al. suggested that the decreased muscle tension is probably the result of an overall reduction in the defence-arousal response and an increased relaxation response [44]. The result of Thanarat et al. showed that the decreased heart rate, and increased time domain indices and high frequency of heart rate variability, and automatic nerve system activity. Which indicated that massage therapy can decrease sympathetic activity and increase parasympathetic activity [45].

**Table 4.** The effects of massage therapy on psychological makers [13,21,37,39,45].

Study	Subjects	Intervention	Measurement	Results
Buttagat et al.	patients with back pain, n=36	pressure pain	Body flexibility; pressure pain threshold; muscle tension; heart rate variability; anxiety	Results showed that significant increase in HRV which include increased high frequency and total frequency.
Leivadi et al.	30 dance students	30 minutes whole body massage (petrissage, effleurage, and friction)	Visual analog scale; Profile of mood states; State Anxiety Inventory; Salivary cortisol	Massage can significantly decrease the salivary cortisol, Profile of mood states, and State Anxiety Inventory.
Hemmings et al.	Amateur boxers, n=8	20 minutes whole body massage (petrissage and effleurage)	Heart rate; Blood lactate; Perceived recovery scale; Boxing performance	Results showed a significant increase in perceived recovery.
Cristina et al.	patients with headache, n=11	40 minutes head-neck massage	Pressure pain thresholds; mood states; heart rate variability;	Massage can produce a decrease in tension and an immediate increase of index HRV.
Sripongngam et al.	healthy participants, n=29	60 minutes traditional Thai massage	Heart rate variability; salivary alpha-amylase levels; plasma renin activity	Massage can cause stress reduction as indicated by a reduced salivary alpha-amylase levels and an increased high frequency of HRV.

## Conclusion

Massage is called "green medicine" by the World Health Organization because of its remarkable effect, low price and no toxic side effects. Its mechanism of action involves many disciplines such as physiology, biochemistry, electrophysiology, and biomechanics. The previous studies show that massage therapy can affect the biochemical makers

(passive muscle stiffness, range of motion, visual analog scale), physiological makers (blood flow, skin and muscle temperature, blood pressure, heart rate, heart rate variability, pressure pain threshold), neurological makers (Hoffman reflex, anxiety associated with scapulocostal syndrome, state anxiety inventory), and psychological makers (heart rate variability, profile of mood states, salivary cortisol). Understanding the mechanisms of massage therapy will help to guide clinical

practice. Although many research results have been achieved in the mechanisms of massage therapy, however there are still many problems need to be examined, solved, and explained in the future. Such as the effects of different types of massage therapy (Traditional Thai Massage, Swedish Massage, Traditional Chinese Massage, and so on), the effects of different kinds of the massage techniques (Petrissage, Stroking, Kneading, Effleurage).

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**\*Correspondence to**

**Houyong Zhong**

Faculty of Associated Medical Sciences

Khon Kaen University

Khon Kaen, Thailand