

# The effect of Hegu acupoint stimulation in dental acupuncture analgesia

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## ABSTRACT

*In daily life, dental treatments are often related with oral pain sensation which needs anesthesia procedures. Sometimes local anesthetics can not be used because patients have hypersensitive reaction or systemic diseases which may lead to complications. Stimulating acupoint, such as Hegu activates hypothalamus and pituitary gland to release endogenous opioid peptide substances that reduce pain sensitivity. The aim of the study was to determine Hegu acupoint stimulation effect on the pain sensitivity reduction in maxillary central incisor gingiva. The laboratory experimental research was conducted on 12 healthy male Wistar rats (3 months old, weights 150–200 grams). All rat samples received the same treatments and adapted within 1 month. The research was done in pre and post test control group design. 40-Volt electro-stimulation was done once on the maxillary central incisor gingiva prior to the bilateral Hegu acupoint stimulation, then followed by 3 times electro-stimulation with 3 minutes intervals. The pain scores were obtained based on the samples' contraction in each electro-stimulation. The responses were categorized into 5 pain scores and statistically analyzed using Wilcoxon Test. The results showed that Hegu acupoint stimulation lowered the pain scores significantly ( $p < 0.05$ ). Hegu acupoint stimulation could reduce the pain sensitivity in maxillary central incisor gingiva. Therefore, the use of acupuncture analgesia in dental pain management can be considered in the future.*

**Key words:** Hegu acupoint, Dental, Acupuncture analgesia

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## INTRODUCTION

In daily life, dental treatments are often related to oral pain sensation. Pain is a protective mechanism that occurs whenever any tissues are being damaged. Oral surgery treatments, such as tooth extraction needs anesthesia procedures to relieve the pain. In certain conditions, local anesthetics can not be used because patients suffered systemic diseases or hypersensitive reaction.<sup>1,2</sup>

Pain impulses are transmitted to the central nervous system (CNS) by two fibers system. One nociceptor system is made up of myelinated A fiber that secrete glutamate and transmit fast sharp pain. The other consists of unmyelinated C fibers that release substance P and glutamate. These latter fiobers transmit slow-chronic pain. Dental pulpal nociceptor system is made up of A fibers that secrete glutamate and transmit fast-sharp pain. Both fiber group end at the dorsal horn of the spinal pain. Both fibers groups end at the dorsal horn of the spinal cord.<sup>2-4</sup> Pain impulses from oral cavity are transmitted to trigeminal nerves by mandible and maxillary nerves.<sup>5,6</sup> Furthermore, these impulses are transmitted to CNS through somatic sensory pathway from spinothalamic tract at medula pons, and thalamus midbrain. Pain perception is processed at cerebral cortex to perceive pain location, intensity, and quality.<sup>7</sup>

Acupuncture is a traditional chinese medicine (TCM) that uses specific needles insertion in various certain acupuncture points (acupoints). Insertion of the needles in skin surface and muscle causes therapeutical effect and disease prevention.<sup>8</sup> This technique can be used as an alternative in anesthesia procedure.<sup>9,10</sup> Hegu acupoint is often used in pain management because analgesia occurs by stimulating it.<sup>11</sup>

Hegu acupoint is a major point in large intestine meridian that has a pathway to orofacial area.<sup>12</sup> Meridian is a specific pathway which interconnects acupoints to form a network with organs. Because of this specific relationship, meridian can be defined as specific cellular pathway.<sup>13</sup> Stimulating acupoints results in *Yin-Yang* equilibrium by accelerating *qi* (bio-energy) flow. TCM's *Yin-Yang* equilibrium phenomena is in accordance with Western medicine's homeostasis.<sup>11,14,15</sup> Acupuncture theory is based on cellular and molecular systems. Stimulus of bio-energy from acupoint is transmitted through both systems to target organ.<sup>13</sup>

Hegu acupoint is located between the first and the second metacarpal bones, approximately in the middle of the second metacarpal bone. Anatomically, this point passes through skin and subcutaneous tissues, penetrates musculus interosseous dorsalis I, and then reaches musculus

adductor pollicis.<sup>16</sup> Stimulating this acupoint with various levels of stimulation activates hypothalamus and pituitary gland to release endogenous opioid peptide substances ( $\beta$ -endorphin, enkephalin, and dynorphin) that reduce pain sensitivity.<sup>11</sup>

Based on the above background, the research was conducted to determine *Hegu* acupoint stimulation effect on the pain sensitivity reduction in maxillary central incisor gingiva. The research was conducted on male Wistar rats with medical bioenergy approach. By carrying out this research, anesthesia method using acupuncture is expected to be developed in dental science.

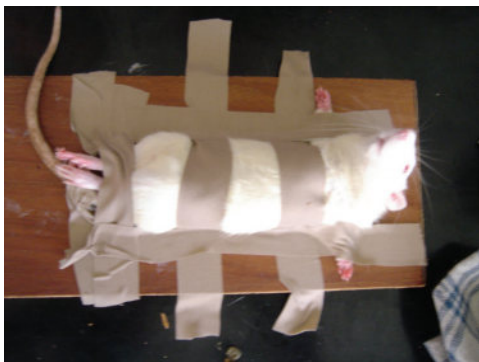
## MATERIALS AND METHODS

The laboratory experimental research was done in pre and post test control group design. A total of 12 male Wistar rats were used in this research. All rats were healthy, 2-3 months old, weighed 150 to 200 grams, adapted within 1 month, and raised with same treatments.

All rats were fixated with band aid on the wooden fixation board at their chest, stomach, upper legs, and lower legs (Figure 2). *Hegu* acupoint (Figure 3) was located with acupuncture point detector Ying Di KWD-808-I, 6 channel output and 9 Volt DC Voltage (Figure 1), then marked with board marker. The marked points were smeared with cotton bud soaked in 75% alcohol.



**Figure 1.** Electro stimulator, acupuncture point detector, wooden fixation board, beaker glass with 75% alcohol, band aid, stopwatch, board marker, cotton bud, scissors, acupuncture needles.



**Figure 2.** Rat fixated on wooden fixation board.



**Figure 3.** *Hegu* acupoint located with acupuncture point detector.



**Figure 4.** Needle insertion in *Hegu* acupoint.



**Figure 5.** Rat with acupuncture needles inserted.



**Figure 6.** Electro-stimulation on maxillary central incisor gingiva with electro stimulator.

All rats were once stimulated on maxillary central incisor gingiva with 40-Volt electro stimulator (Figure 6), then followed by bilateral needle insertion in *Hegu* acupoints with disposable stainless steel acupuncture needles 0.2 mm diameter and 13 mm long (Figure 5). The needles were manipulated by twirling approximately 90° counter-clockwise twice. Electro-stimulations were done three times with 3 minutes intervals after *Hegu* acupoints stimulation. Pain scores obtained in each electro-stimulation were categorized into 5 scores based on contraction and extremities movement caused by spinal nerve stimulation. The pain scores were:<sup>17</sup> 0 = No surrounding tissues contraction and no extremities movement, 1 = Local mucosa contraction, 2 = Mucosa and lip contractions, 3 = Mucosa and lip contractions, superior extremities movements, 4 = Mucosa and lip contractions, superior and inferior extremities movements.

**RESULTS**

Pain scores at all rats were obtained by observation. The pain scores at the 3<sup>rd</sup> minute, 6<sup>th</sup> minute, and 9<sup>th</sup> minute were obtained after *Hegu* acupoint stimulation (Table 1).

**Table 1.** Pain scores based on time intervals

No.	Scores			
	Initial	3 <sup>rd</sup> minute	6 <sup>th</sup> minute	9 <sup>th</sup> minute
1	4	3	0	0
2	4	4	3	2
3	4	3	3	0
4	3	3	3	2
5	3	3	2	2
6	3	3	2	0
7	4	2	0	0
8	4	2	2	2
9	3	3	3	3
10	3	3	3	2
11	4	3	3	0
12	4	3	3	3

Based on above data, calculations were done to get Mean and Standard Deviation (Table 2). These calculation showed that pain scores decreased from the initial (initial = 3.58), then the 3<sup>rd</sup> minute ( $\bar{X}$  3<sup>rd</sup>\_minute = 2.92), the 6<sup>th</sup> minute ( $\bar{X}$  6<sup>th</sup>\_minute = 2.25), and the 9<sup>th</sup> minute ( $\bar{X}$  9<sup>th</sup>\_minute = 1.33).

**Table 2.** Mean and Standard Deviation of pain scores

Time Group	Mean	Std. Deviation	N
Initial_score	3.58	.515	12
3_minute_score	2.92	.515	12
6_minute_score	2.25	1.138	12
9_minute_score	1.33	1.231	12

The data calculated in Table 2 was statistically analyzed using Wilcoxon test to get the significance on differences of all time groups (Table 3).

**Table 3.** Wilcoxon test

	3_minute - Initial	6_minute - 3_minute	9_minute - 6_minute
Z	-2.271 <sup>a</sup>	-2.060 <sup>a</sup>	-2.232 <sup>a</sup>
Asymp. Sig. (2-tailed)	.023	.039	.026

Wilcoxon test showed that there was a significant difference between 3<sup>rd</sup> minute group and initial group (p = 0.023, p < 0.05). There was a significant difference between 6<sup>th</sup> minute group and 3<sup>rd</sup> minute group (p = 0.039, p < 0.05). Significant difference also occurred between 9<sup>th</sup> minute group and 6<sup>th</sup> minutes group (p = 0.026, p < 0.05). These results mean that the pain scores decreased significantly from initial to the 9<sup>th</sup> minute after *Hegu* acupoint stimulation.

**DISCUSSION**

Pain occurs whenever any tissues are being damaged, and it causes individual reacts to remove the pain stimulus. Pain can be elicited by multiple types of stimuli. They are classified as mechanical, thermal, chemical, and electrical pain stimuli.<sup>2-4</sup> The pain receptors in the skin and other tissues are all free nerve endings. Pain stimuli on receptors cause sensitization and release of neurotransmitters. Some of the neurotransmitters that were excited are histamine, serotonin, bradykinin, prostaglandins, and leucotrien. Besides these chemicals, pain stimuli also cause the release of neuropeptide substance P that induce the release of histamine.<sup>2-4,7</sup>

Pain is associated with behavioral response, motor reflexes, and alterations in autonomic output.<sup>18</sup> The lateral and anterior corticospinal tracts are descending tracts that convey voluntary motor impulses from the brain (cerebrum) to spinal nerves at various levels in the cord.<sup>19</sup> Rats' extremities movements in this research are based on the level of spinal nerves stimulation.<sup>17</sup>

Acupuncture technique used in this research was hand manipulated by twirling approximately 90° counter-clockwise twice. This technique is in accordance with TCM theory which is *Xie*, known as sedation and reduction method. Based on TCM theory, toothache is caused by heat accumulation from the intestine accompanied with pathogenic factor. *Hegu* acupoint is located in large intestine meridian so that sedation method reduced pathogenic *qi* and heat accumulation. It is showed that the pain in rat's maxillary central incisor gingiva was relieved.<sup>20-22</sup>

In TCM, the natural world develops and constantly varies under the interaction of *Yin* and *Yang*. The philosophers and doctors in ancient China explained all the

phenomena and the nature of the universe and life with the theory *Yin-Yang*. *Ying* and *Yang* are opposite to each other in nature, they constantly repel and restrain each other. If one side is weak and the other side is strong, the general equilibrium is not maintained. Thus, this abnormality will result in disorders, such as pain. Results in table 2 showed Mean of pain scores decrement from initial to 9<sup>th</sup> minute after *Hegu* acupoint stimulation. The decrement occurred because there was an equilibrium between *Yin* and *Yang* by stimulating *Hegu* acupoint which is defined as homeostasis in western medicine.<sup>11,14,15,23</sup>

Acupoint stimulation induced bio-energy circulation through meridian to pain site. This stimulation also controlled the circulation physiologically. Bio-energy disruption in the form of excess energy is the cause of acute pain.<sup>24</sup> *Hegu* acupoint is located in large intestine meridian which has a pathway to orofacial. *Hegu* acupoint stimulation can reduce the pain by releasing the bio-energy obstruction at the area passed through meridian. The stimulation also relieved the pain by reducing pathogenic heat from large intestine pathway.<sup>22</sup>

*Hegu* acupoint stimulation activated hypothalamus and pituitary gland to release endogenous opioid peptide substances to periaqueductal gray matter (PAG) and nucleus raphe magnus (NRM). Thus, analgesia occurred because all pain impulses were inhibited at dorsal horn of the spinal cord. These endogenous opioid peptide substances inhibited the pain by opioid mechanism.<sup>25–29</sup> Based on TCM, opiate receptor is categorized in *Yin* because of its opioid-receive characteristic, while endorphin and enkephalin are categorized in *Yang* because of their analgesic and therapeutic characteristic. *Hegu* acupoint stimulation resulted in equilibrium between *Yin* (opiate receptor) and *Yang* (endorphin and enkephalin) which reduced the pain sensitivity.<sup>30</sup>

Based on table 1, the most pain scores observed in initial group were 3 and 4. This data showed that pain occurred in initial group was in high intensity before *Hegu* acupoint stimulation. Score 3 happened because pain impulses inhibition was inadequate so that impulses were transmitted to the brain and spinal nerves at the brachial plexus area (C5 to T1). The electro-stimulation resulted in motor muscles movement and the response was superior extremities movements. Score 4 was made based on superior extremities, inferior extremities, and tail flexion movements. These responses occurred because there was no inhibitory mechanism resulted in pain impulses transmission to brain and inferior spinal nerves at the sacral plexus (L5 to S1) and coccygeal plexus (S4 to Co1) area.<sup>19</sup>

Results showed that adequate analgesia occurred at 9<sup>th</sup> minute. The pain scores in this group were mostly 2 and 0. Score 0 occurred because pain impulses were inhibited by  $\beta$ -endorphin at peripheral afferent terminal with the result that the impulses could not be transmitted to nerve ending. Pain impulses transmitted to nerve ending were inadequate to induce stimulus at the area surrounding the nerve ending. Score 2 was the result of pain impulses transmitted to

peripheral afferent terminal. The pain impulses transmission reached nerve VII through dorsal horn of the spinal cord. There was a lip contraction caused by nerve VII which innervates lip's motor muscles. Score 1 occurred because of inadequate pain impulses inhibition at peripheral afferent terminal. Thus, the impulses were transmitted to nerve VII without involving higher innervation system that caused local mucosa contraction.<sup>17,19</sup>

Some of the pain scores at the 9<sup>th</sup> minute slightly decreased or did not decrease. The pain scores were both score 3 and 4. These high scores might be caused by bio-energy flow deficiency or disorder in some rats which were anxious, stress, angry, and fearful.<sup>31</sup> Bio-energy flow disorder caused imbalance between *Yin* and *Yang*, meridian function disorder, and disruption of bio-energy circulation. When acupuncture was done at *Hegu* acupoint, bio-energy flow did not circulate well. Thus, pain mechanism remained because obstruction or stagnation of bio-energy caused pain.<sup>14,24</sup> High pain scores at the 9<sup>th</sup> minute happened because endorphin secretion was not enough. Lack of endorphin resulted in pain because of inadequate analgesia.

Acupuncture analgesia needs a considerable amount of time to secrete enough endorphin. Some rats have opiate receptor deficiency and different ability to secrete endorphin. Inadequate analgesia could be happened to these rats. Electro-stimulation on stress rats showed high pain score because neurotransmitters were released at peripheral nerve end resulted in sensitization. Acupuncture analgesia also did not occur at rats which have pituitary suppression or ablation.<sup>25</sup>

Table 2 showed that Standard Deviation at both 6<sup>th</sup> minute and 9<sup>th</sup> minute were above 1 (SD6\_minute = 1.138 and SD9\_minute = 1.231). This condition might be caused by individual characteristic of rats which some of them showed excessive responses. Stress rats have higher pain sensitivity so that electro-stimulation could induce highest pain scores, while pain scores decrement in other rats occurred at these time groups. Therefore, this difference resulted in higher Standard Deviation compared to the other time groups.

The results concluded that *Hegu* acupoint stimulation could effectively reduce the pain sensitivity in maxillary central incisor gingiva. Clinical research can be conducted so that this research becomes applicable in dental science.

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