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# Infra Red Therapy Monitoring Tools and Short Wave Diathermy in Body Network Phantom

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**Abstract:** Pain is the most common symptom most visible in the general population and the medical world. The World Health Organization (WHO) survey showed that of 26,000 primary care patients on five continents, 22% reported persistent pain more than a year which could lead to a significant increase in the number of surgeries and other invasive or invasive procedures, and also the main reason for users complementary and alternative medicine. The therapeutic methods used to treat the pain are several techniques including using Short Wave Diathermy (SWD) and therapy using Infrared lights. The use of phantom is used to measure and monitor the heat output provided by the source of therapy. In this study a measurement system was developed to monitor the rate of heat change in the invitro treatment process using phantom. Time of exposure for 10 minutes, 20 minutes, 30 minutes. Distance of Infrared Exposure 30 cm, 40 cm and 50 cm. In the process of heat exposure, Philips Infraphil Infrared Type PAR38E/150 Watt lamps and Short Wave Diathermy (SWD) devices are used. From the results of the study, the measurement results using SWD on Sensor T1 with a depth of 1 cm has a variable temperature value of 37.063°C, Sensor T2 at a depth of 1.5 cm has a variable temperature value 37.074°C, Sensor T3 at a depth of 2 cm has a temperature variable 37.090°C and T4 sensor at 2.5 cm depth has a temperature variable of 37.107°C

**Keywords:** Short Wave Diatherm, Infra Red.



## INTRODUCTION

Pain is the most common symptom most visible in the general population and the medical world. The World Health Organization (WHO) survey showed that of 26,000 primary care patients on five continents, 22% reported persistent pain more than a year which could lead to a significant increase in the number of surgeries and other invasive or invasive procedures, and also the main reason for users complementary and alternative medicine. Of the various types of pain, acute pain is the most important reason for patients to seek medical treatment. Physiotherapy is part of health science. The concept of heat therapy or commonly called thermotherapy is applied to reduce pain, especially pain in the body's muscle tissue. Nowadays, with the development of science in the field of medicine and heat therapy technology, there have been many developments. Physiotherapy by removing heat effects on the tissue commonly used to reduce pain is infrared light and SWD (Short wave dhiatermy).

Infrared therapy is a therapeutic apparatus for heating body tissues by converting light energy to heat energy. Infra red light has a wavelength of 800-900 nm. The therapy process uses countinuous mode or continuous irradiation during the set time. Infrared rays with a wavelength of 800 nm-900 nm have more energy penetrating the surface of the network. It is estimated that 50% of the penetrating power will occur at a depth of 8 Cm and penetrating power is reduced by 1% at a distance of 20cm. Infrared energy is used to heat tissue and provide effects that can be used to reduce pain. In the application of beauty infrared ray stimulated by NaK + will increase the permeability of cell membranes and give effect to pH balance on skin cells. Skin cells can increase absorption of nutrients and limit the parts that are not needed by the skin.

The use of infrared light that uses a heating system in the body's muscle tissue can heat the body's tissues at a depth of 3 cm to 5 cm without the effect of excessive heat (over heating) on the structure of the skin tissue. The price of infrared is much cheaper compared to SWD and the pattern of infrared distribution is more distributed in puskesmas. The ability of infrared rays to increase the effect of heat on panthom body tissues with different exposure distances will be carried out in this study. SWD (Short Wave Diathermy) is a therapeutic tool to warm up the body's tissue by converting electromagnetic energy into heat energy. SWD waves are Shortwave at 27.12 MHz. The therapy process uses countinuous mode or continuous irradiation during the set time.

SWD (Short Wave Diathermy) is usually called short wave diathermy. Serves to heat tissue and blood vessels with short waves, so that blood circulation becomes smooth. Previous research by Lamidi, entitled Measurement of Temperature Changes in Phantom Body Tissue Due to Short Wave Diathermy [1]. In taking phantom temperature, the LM35 type temperature sensor is used with a resolution of 10 mv / ° C. The sensor is installed on 4 vertical points with a distance between sensors of 2 cm [2]. Temperature sensor calibration is carried out on four sensors with a temperature range between 20 °C to 50 °C. The results showed that four sensors at different depths gave a mean value of 37.87°C. The results of the analysis show that if the distance of the sensor is shifted 2 cm with a fixed depth, the middle value of the temperature does not change, this indicates the sensor data is valid. When choosing a heating system for the therapy process using both infrared and SWD (Short Wave Dhiathermy), the researcher must consider the depth of body tissue, location of therapy and area of therapy. Effectiveness The use of SWD (Short Wave Dhiathermy) and infrared will be developed at exposure distances different and has never been done before. At different exposure conditions, patients with low temperatures with the help of SWD (Short Wave Dhiathermy) and infrared therapy get warmed up which can normalize the patient's body temperature. To find out the pattern of the increase in the effects of heat SWD (Short Wave Dhiathermy) and infrared on the panthom of body tissues with different exposure distances and how long it takes to increase the phantom temperature of body tissues. Based on the background that has been delivered, and taking therapy using infrared and SWD (Short Wave Dhiathermy)

## Methods

The research design used was to use pre experimental method with the type of after-study design because the final result of measurement tool compared with the control group. Research tools is infra red and short wave diathermy measure which changes body network phantom.

## Results and Discussion

**Infra Red Ray**

The greatest ability of infrared light is its ability to penetrate the surface of the skin. Infra red rays can reach depths of 2-3 inches below the surface of the skin without causing damage to the tissues, blood flow, and muscles. While SWD (Short Wave Dhiathermy) is used in heat therapy because the effect of heat can last longer. How the performance of the two therapeutic tools will be discussed in a comparative study conducted. The process of reducing pain occurs at the cellular level when infrared energy rays convert light energy into heat in contact with tissues in the body. Heat energy in molecules, causes molecules to have micro vibrations. This process causes blood vessels to dilate, which in turn increases blood flow in the irradiated area. Increased blood flow causes blood vessels to quickly carry and supply the essential nutrients and oxygen needed to restore the affected area.

The use of phantom which has the same permittivity and conductivity can be used to simulate the body's tissue system [3]. The development of phantom materials provides a simulation of the approximate electromagnetic properties of the human body through the specified frequency and temperature range used. The selection of phantom materials is important to understand the interactions between implant medical devices and the effects of infrared light. In taking phantom temperature, the LM35 type sensor is used with a resolution of 10mv / ° C. The sensor is installed on 4 vertical points with a distance between sensors of 2 cm. Temperature sensor calibration is carried out on four sensors with a temperature range between 20 °C to 50 °C. The results showed that four sensors at different depths gave a mean value of 37.87°C.

The concept of heat therapy or commonly called thermo therapy is applied to reduce pain, especially pain in the body's muscle tissue. Now with the development of science in the field of medicine and heat therapy technology has undergone many developments. Heat therapy using infra red proved to be the most effective way to calm muscle spasms and has been recommended by medical professionals. Further research has shown that infre red heat therapy is more beneficial in reducing muscle pain than other methods. Heat emitted by carbon fiber, produces Far Infrared rays that are more effective than shallow heat produced by the use of heated fabric methods, or the use of hot water bottles and other instant heating systems.

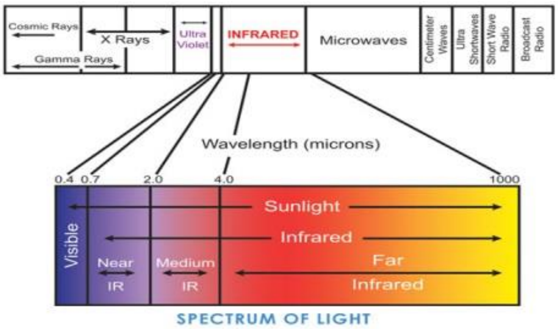


**Fig-1: Infrared ray spectrum**

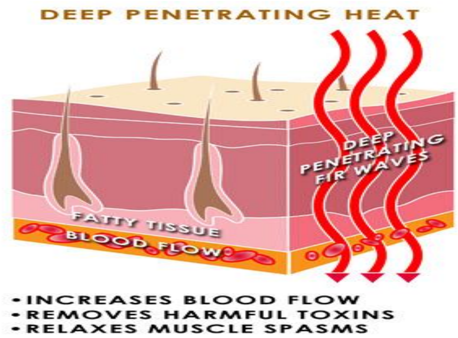


**Fig-2: Infrared penetrating power**

**The physiological effects on the implementation of infrared therapy cause a rise in temperature. A number of physiological responses found during the infrared radiation process include**

At the cellular level, increasing temperature increases the rate of biochemical reactions. Increased cell metabolism leads to an increase in demand for oxygen and nutrients. Blood supply increases. The increased output of waste cell products triggers widening capillaries and arteries. The increase in temperature itself causes some dilation, especially in the shallow tissue where the greatest warming occurs. In addition, stimulation of sensory nerve endings (on superficial tissue) can cause widening of the reflex.

Increase in temperature can cause muscle relaxation. If there is abnormal muscle activity caused by pain, Infrared treatment can be beneficial. Sensory nerve response during heat is useful for relieving pain in general. Mild heating appears to inhibit the transmission of sensory impulses through nerve fibers. In addition, when pain results from tissue inflammation, an increase in temperature can result in secondary pain relief.

**Short Wave Diathermy**

Short wave diathermy refers to heating the inner tissue using alternating electric fields and magnetic fields at high frequencies. Shortwave radiation is a determining factor in implementing therapy. SWD (Short Wave Dhiathermy) produces alternating electric and magnetic fields with a frequency of 27.12 MHz. Because radio waves with frequencies in the range of 10 MHz to 100 MHz are called short waves. SWD (Short Wave Dhiathermy) equipment consists of a series of sine wave generators that produce alternating current with a frequency of 27.12 MHz. The sine wave generator supplies energy for resonant circuits with transformer actions. The sine wave generator consists of a power supply, an oscillator with good frequency stability and a power amplifier. The power supply converts the AC voltage from the power grid (frequency 50 Hz) to the DC needed for powering the equipment. DC voltage is used to power a sine wave generator, a resonance circuit that oscillates at 27.12 MHz

**Fig-3: Short Wave Dhiathermy device**

In SWD (Short Wave Dhiathermy) the material between plates is a dielectric material that is capable of carrying out polarization in electric fields and depolarization in dielectric absorption. Use SWD (Short Wave Dhiathermy) without any conversion of electrical energy to heat energy. SWD (Short Wave Dhiathermy) plate material, which has high ion content and water content, is a material that is not ideal when placed in an electric field. The body's biological network systems are exposed to alternating electric or magnetic fields at the frequency of 27.12 MHz, SWD (Short Wave Dhiathermy) can be applied using a capacitor plate (which produces an electric field) or an inductive coil (which produces a magnetic field).

**Heating in the Body's Network System**

Heating in the body's tissue system and changes in temperature rise can be explained in the determination of power dissipation. Power is affected by resistance, the rate at which electrical energy is converted into heat energy.

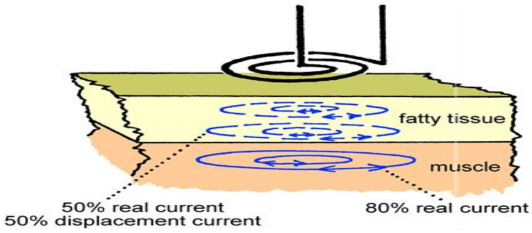


**Fig-4: Current induction with spiral plate on skin tissue**

In the picture above shows that the muscle has a higher conductivity than the dielectric constant of the fat tissue. At the value of conductivity and a high dielectric constant it produces low impedance. Thus fat tissue has electrical impedance (Ω) 10 times greater than muscle. If the electromagnetic field's distribution or convergence is minimal, the rate of heat production in fat tissue will be seven times higher than in muscle. In the picture above shows that the muscle has a higher conductivity than the dielectric constant of the fat tissue.

**Increased Temperature and Heat of Body Tissues**

In the body's tissue system in addition to the rate of tissue heating, it also analyzes the relationship between the level of heating and the rate of increase in temperature. The rate of heating per unit volume is given according to the intensity of the electric field and current density.

When considering the effects of SWD (Short Wave Diathermy) therapy, not only is the heat produced. In the physiological response of the body tissues it also takes into account the resulting temperature rise. Temperature is a key factor in determining the rate of chemical reactions and physiological processes.

When SWD (Short Wave Diathermy) provides constant heat to be given to different substances, the changes in the temperature of each substance will be very different. The factor that determines the increase in temperature produced is heat capacity. Heat capacity is defined as the amount of heat needed to raise 1 kg of substance through one kelvin. The heat capacity unit is joules per kilogram per kelvin. In the heating system of the body tissue by SWD (Short Wave Diathermy), heat transfer between tissue and blood flow has a large impact on temperature distribution during the therapy process. Before starting the therapy process, body tissue is in a state of dynamic balance. Cell activity, metabolism and muscle contraction produce stable heat. Circulation of blood and fluids in the body's tissues efficiently transfers heat. The heat production system is offset by the transfer of heat from the body tissue to make the temperature stable numerical phantom, which is used for computer simulations, and experimental phantom, which is used for experiments [4]. Phantom is a simulation model of body tissue with various electrical constants from biological networks, used to evaluate changes in temperature characteristics in the use of Infrared. Phantoms are designed to be used in the range of 3 to 10 GHz. Phantoms can be classified into three types, namely liquid, solid phantom and gel.

**Temperature Monitoring Of Phantom Networks**

Phantom body arm is inserted into the water; the function of water is used as a signal conditioner so that the phantom matches the normal human body temperature of 37$^{o}$C. One sensor is placed in the water to always keep the water temperature at 37$^{o}$C. After the water temperature reaches 37$^{o}$C, the phantom arm tissue is inserted into the water as shown in the picture.

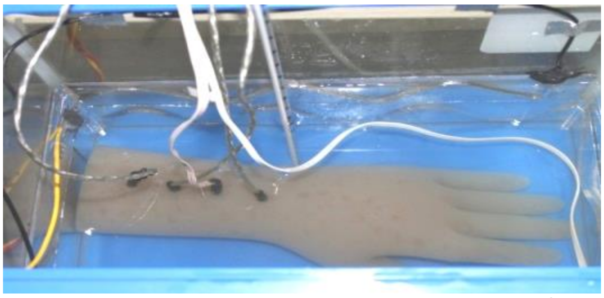

**Fig-5: Phantom arms are put into water at 37°C**

Four sensors were placed with a distance of 2 cm each with a different depth. Sensor T1 at a depth of 1 cm, Sensor T2 is placed at a depth of 1.5 cm. The T3 sensor is planted at a depth of 2 cm and the T4 sensor is placed at a depth of 2.5 cm. with four sensors available, then irradiation with diathermi is done for 60 minutes. Graphs of four sensors can be seen in Figure 4.3. Short wave diathermy is set to 80% maximum power with irradiation on four sensors for one hour. T1 sensor planted at a depth of 1 cm at minute 1 shows a temperature of 36.85°C. The T2 sensor at a depth of 1.5 cm shows a temperature of 36.45°C. T3 sensor with a depth of 2 cm shows a temperature of 36.17°C. The T4 sensor is the deepest sensor, 2.5 cm showing a temperature of 35.87°C. from the first minute data collection shows that the sensor depth affects the temperature of each sensor. The biggest difference in temperature is the T1 sensor and T4 sensor with a value of 0.98°C. The distance of the sensor which is 1.5 cm adrift at the first minute shows a difference of 0.98°C.

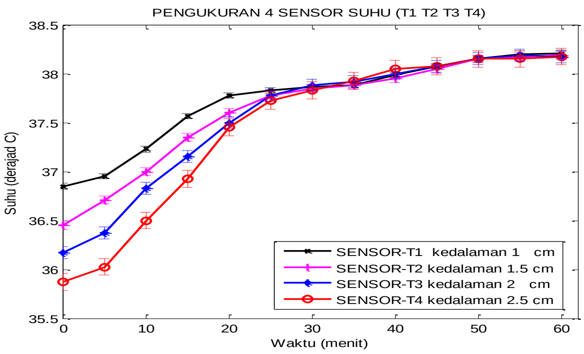


**Fig-6: Temperature changes at 4 sensors at different depths**

The temperature movement then cones after irradiation entered in the 30th minute. The experimental data shows a Tcm sensor distance of 1cm with a value of 37.86 °C. The T2 sensor distance of 1.5 cm shows a temperature of 37.85°C. T3 sensor with a distance of 2 cm shows a temperature of 37.88°C and Sensor T4 with a distance of 2.5 cm showing a temperature of 37.83°C. The difference in temperature at the farthest distance between the T1 sensor and the T4 sensor is 0.03°C. A very small difference in temperature indicates that the phantom arm that is made can distribute the heat obtained from being cured well in a 30 minute period. The depth of the sensor used is only different in the early minutes. But after entering at 30 minutes the temperature tends to be stable and close to the same. In the 30th minute, the phantom temperature rises by 0.8°C compared to the normal body temperature which was initially 37°C to 37.8°C. At the last minute, the 60th minute, the temperature of each sensor is not much different compared to the 30th minute. The temperature in the 60th minute for the T1 sensor with a depth of 1 cm is 38.21 °C. The T2 sensor with a depth of 1.5 cm is 38.185°C T3 sensor with a depth of 2 cm is worth 38,175°C. Sensor T4 with a depth of 2.5 cm is worth 38,175°C. The temperature difference in the 60th minute for the four sensors is only 0.035°C. The initial conclusion that the 30th minute to the 60th minute phantom temperature conditions tended to be stable at the largest value of 38.21°C, so the biggest difference in normal temperature was 1.2°C and the smallest difference was 1.1°C.

**Monitoring Of Temperature Measurements Against Phantoms (Location Of Sensors Behind)**

The results of temperature measurements will be discussed at the time of diathermy exposure. To be able to determine the performance of exposure to phantom temperature of arm tissue in diathermy use, the researchers turned the four sensors with details of the T1 sensor placed at a distance of 2.5 cm after the T1 sensor was placed at the shallow distance on the surface, only 1 cm. Next is the T2 sensor at a distance of 2 cm, the T3 sensor at a distance of 1.5 cm and the last is the T4 temperature sensor placed at a distance of 1 cm. Putting 4 sensors can be seen in figure 4.16. Exposure to diathermy is also placed in the right place according to the location of four sensors on the phantom of the body tissue.

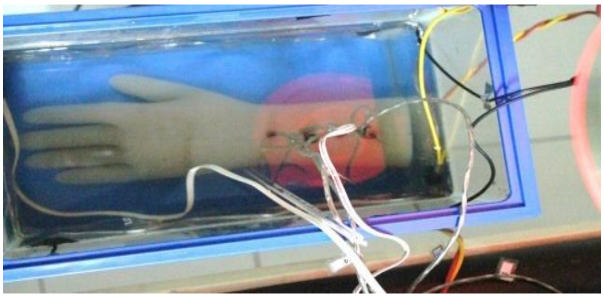

**Fig-7: The location of the phantom temperature sensor is changed on diathermy exposure**

The T4 sensor planted at a depth of 1 cm in the 1st minute shows a temperature of 36.85 $^{o}$C. T3 sensor at a depth of 1.5 cm shows a temperature of 36.4 $^{o}$C. T2 sensor with a depth of 2 cm shows a temperature of 36.3 $^{o}$C. The T1 sensor is the deepest sensor, 2.5 cm showing a temperature of 35.85 $^{o}$C. From the first minute data collection shows that the sensor depth affects the temperature of each sensor. The biggest difference in temperature is the T4 sensor and T1 sensor with a value of 1 $^{o}$C. This temperature difference compared to the previous sensor placement is at the value of 0.98 $^{o}$C, so that there is no influence there is a sensor that is reversed. The distance of the sensor which is 1.5 cm adrift at the first minute shows a difference of 1 $^{o}$C.

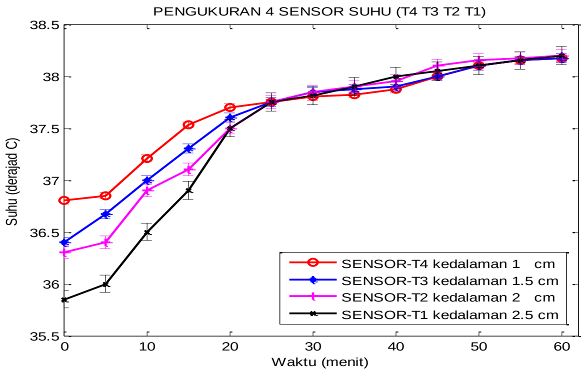


**Fig-8: Temperature change of 4 sensors**

## CONCLUSIONS

The initial conclusion that the 30th minute to the 60th minute phantom temperature conditions tended to be stable at the largest value of 38.21$^{o}$C. There is no influence location of the phantom temperature sensor on diathermy exposure.

## REFERENCES

1. Lamidi, Sekartedjo Koentjoro, and Aulia Nasution, Suitability of Self-Fabricated Solid Tissue Phantom for Quality Insurance Examination of Shortwave Diathermy (SWD) Unit, Applied Mechanics and Materials. Trans Tech Publications.2015; 771: 80-83
2. Kobayashi, Nojima T, Yamada K, Uebayashi S. Dry phantom composed of ceramics and its application to SAR estimation, IEEE Trans. Microwave theory and techniques. 1999; 41(1):136–140
3. Repasky E., Issels R. Physiological consequences of hyperthermia: heat, heatshock proteins and the immune response. International Journal of Hyperthermia. 2002; 18 (6): 486-489
4. Ito K, Furuya, Okano Y, Hamada L. Development and the Characteristics of a Biological Tissue-equivalent Phantom for Microwaves, IEICE Trans. 1998 J81-B-II(12): 1126–1135