

Thermal Condition of Muscle Area Around the Temporomandibular Joint in Patient with Systemic Lupus Erythematosus Using Infrared Thermography Application: A Case Report

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ABSTRACT

Recently, the use of infrared thermography in medical has been increasingly developed and widely used in medical devices to detect diseases, including one used in the field of dentistry, which can be used to detect joint conditions in case of temporomandibular disorder (TMD). Some literature has shown this method of infrared thermography was used to determine the surface temperature of the skin based on the emission of infrared radiation from the body. Thermal measurement is also a noninvasive method that does not provide patient inconvenience, but its application until now has not been so wide. The case study reported on the description of thermal condition of muscle area around temporomandibular joint (TMJ) in a 42-year-old woman with systemic lupus erythematosus (SLE) disease. She had experienced TMD. Infrared thermography is applied to observe the thermal condition of the muscle area around the right and left joints by thermal detection. Thermal measurement was obtained on infrared image capture, and the temperature difference was found to be greater than 0.3°C. Several studies have shown that temperature in the area around TMJ was higher, and thermal asymmetry was greater in individuals with joint disorder/TMD when compared with normal groups.

KEYWORDS: *Infrared thermography imaging, systemic lupus erythematosus, temperature measurement, temporomandibular disorder*

INTRODUCTION

Infrared rays are very popular in the field of health, where infrared rays emitted in certain waves are believed to help the healing process of some diseases such as diabetes, anemia, aches, rheumatism, low back pain, and high blood. In addition to its use for disease therapy, infrared rays are widely used in medical devices to detect disease as well.^[1] Because the infrared rays are able to detect a person's health condition, recently infrared rays are regularly used to diagnose patient illnesses, which helps to take appropriate actions or decisions as per the patient's condition.^[2]

Infrared rays in the field of dentistry are commonly used for the treatment of temporomandibular disorder

(TMD). This disease attacks the temporomandibular joint (TMJ), in which the TMJ is one of the components of the masticatory system. The position of the TMJ in this case plays an important role in the movement of opening and closing the jaw, chewing, and speech. Mouli *et al.*,^[2] in their study, discussed the clinical application of the infrared rays in the patients with symptoms of TMD and patients without symptoms of TMD. However, it stated that there was a difference

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in the results of the average examination with infrared between the two groups of patients.^[2,3]

The TMD is a complex and multifactorial problem, involving aspects of muscles and joints. Muscles and joints interact simultaneously, but if the function of one or both of them are impaired, it can lead to problems.^[4] TMD generally causes signs and symptoms that can be felt by the patient. Signs and symptoms that are felt tend to be chronic. Common symptoms are complaints of specific pain, head and neck pain, buzzing ears, jaw muscle pain, limited jaw movement and feel locked, and occlusion changes.^[5] Similarly, area around TMJ in patients with systemic lupus erythematosus (SLE) disease, often has signs and symptoms that are complained of in the joints along with rheumatoid arthritis that accompanies the disease. According to research, Aliko *et al.* reported that significantly^[6] SLE patients with a rheumatoid higher percentage of complaints and symptoms perceived (67%), showed the highest frequency, especially to joints and pain in TMJ when compared with controls.

Some literature shows that normally the average human body temperature on the right and left sides is not significantly different, with the difference in temperature of only 0.1°C or no more than 0.2°C, that's mean temperature on the left and the right side of normal TMJ almost the same (balanced), although there are variations in some individuals. However, if there is a disorder or abnormality in the joints, there will be an increase in temperature difference up to 0.4°C.^[7,8]

This study focused on measuring the thermal conditions, which are seen in the area around the TMJ, including the area around the back of the ear, head, joints, forehead, temporal muscles, and masseter muscles. Generally, this study wants to know how is the thermal conditions in the area around the patient's TMJs, this case is unique because the patient had a disorder in the TMJ and also suffered from SLE. The SLE patients often experience inflammatory conditions, therefore that body temperature increases including temperature in the area around the temporomandibular joint, also supported by a study conducted by Valentim Adelino Ricardo Baraˆo *et al.* (2011) that after TMJ treatment with occlusal splint there will an increase in temperature due to hyperactivity in the muscles around the joints. Therefore, this paper reports infrared thermography application on the area around patients of TMJ with SLE, which was aimed to be used as an alternative in supporting diagnostics with thermal identification.

CASE REPORT

A 42-year-old female presented with the general medical history of SLE for approximately 16 years, who was on steroid-type drugs for her illness. Commonly, the differential diagnosis of SLE is systemic rheumatic diseases or the other rheumatologic disorders such as polymyalgia rheumatica. As a result of long-term use of steroid drugs, the patient who also had rheumatoid arthritis, experienced bone loss and had implanted the hip area [Figure 1]. In the first implant installation operation, the patient was paralyzed by 55cm on the right foot because of inadequate surgery, therefore

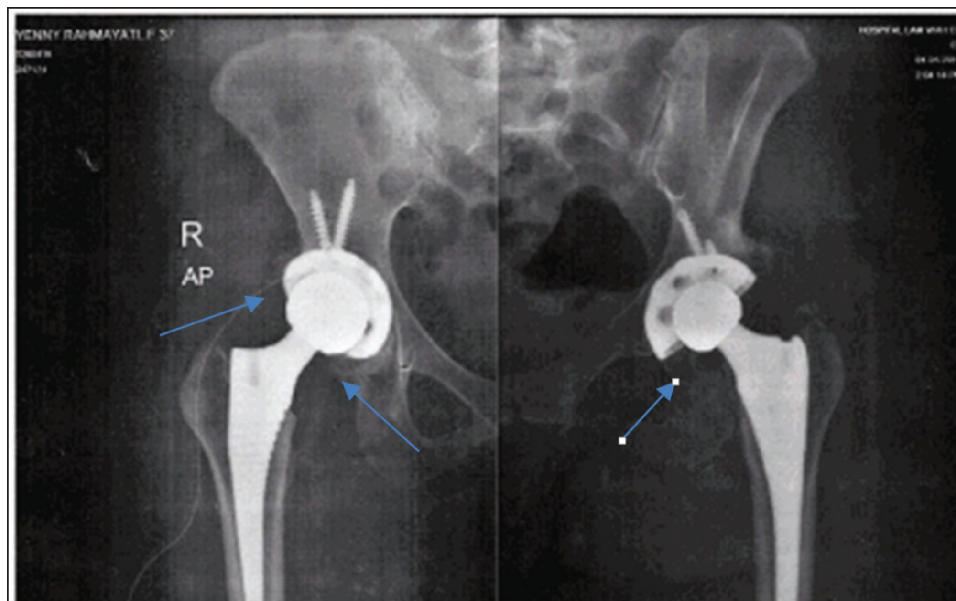


Figure 1: The X-ray of implanted hip area (right and left side) in a 42-year-old woman who presented with systemic lupus erythematosus (SLE); the right hip shows an X-ray image of metal implant (arrows) and in the left side shows the ceramic implant (arrow)

the patient is routinely on physiotherapy with infrared light lamp. A family history of the same disease was observed, which means there are genetic factors that play a role. The patient was a workaholic woman, and always active in social activities and nongovernmental organizations.

The patient also had experienced discomfort in the area around the TMJ, the feeling of stiffness in the joints, and occasionally there was pain, but still did not let it interfere with her daily activities. An occlusal splint was made for this patient. The patient used an occlusal splint to overcome the disorder in the joint. The occlusal splint used was the one for stabilization, which was used for approximately 6 months.

The patient was asked for prior approval as a subject in this case report, and she had stated her approval. Then a written informed consent was taken from her and ethical approval for this study was obtained from the institute. She was photographed on the area around the right and left TMJ with infrared thermography camera, with the specification resolution of visible image 0.3 megapixels. Temperature measurement was carried out on the area around the joint, TMJ in front of tragus, the masseter on its insertion (the angle and the lateral lower surface of the mandible ramus), insertion of temporal muscle to the coronoid process above the zygomatic arch, glabella point as a point that has no temperature rise as it was expected [Figure 2].^[8]

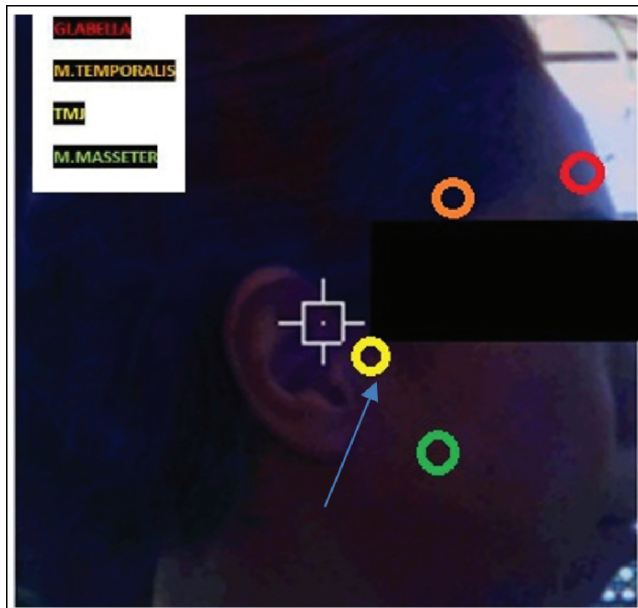


Figure 2: A 42-year-old woman with SLE who presented with temporomandibular disorder (TMD), the arrow shows area temporomandibular joint (TMJ) to assess the temperature measurement, and also the area around TMJ (forehead, temporalis muscle, and masseter muscle)

Photo capture was done at picture capture 30%. Seen the area temperature around the right joint was 34.6°C and left joint temperature at 34.1°C [Figure 3]. An identifiable image of the infrared that was visible appears at the right side TMJ. The temperature was more diffuse than in the left joint, also reaches the cheek area (masseter and temporalis muscle), when compared infrared image between the right and the left joint.

In another photo capture, from some captures taken, it was also found that the right TMJ was higher in average temperature than the left joint. When viewed in the visible infrared light, there was also a slight difference, seen in the left joint of heat that looks more spread in the area of the side head toward the back, whereas for the right TMJs, infrared image was more diffuse in the area of the side head and the front [Figure 4].

DISCUSSION

Several literatures show that normally the average human body temperature on the right and left sides is not significantly different, with the difference in the temperature of only 0.1°C or no more than 0.2°C. The same as on TMJ, the normal TMJ the left and right side the temperature almost the same (balanced), although there are variations in some individuals. However, if there is a disorder or abnormality in the joints, there will be an increase in temperature difference up to 0.4°C.^[7,8]

In this patient, the right joint temperature was 34.6°C, and the left joint had a temperature of 34.1°C [Figure 3]. This means there was a difference of 0.5°C between the right and left joints. As described in a study by Nitecka-Buchta et al. 2014 in interrupted joints there will be

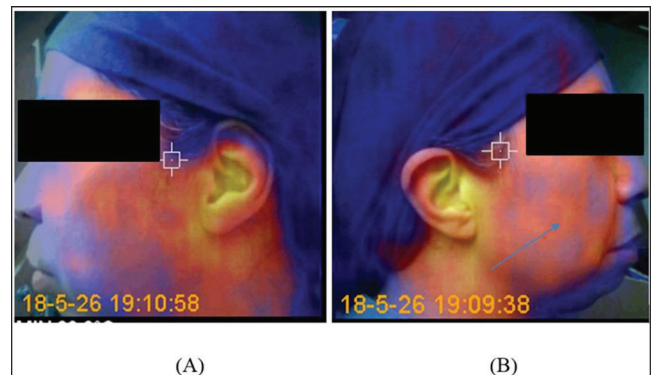


Figure 3: A 42-year-old woman with SLE who presented with TMD. (A) Infrared imaging shows the left joint view at 30% capture with detected temperature as 34.1°C. (B) Infrared image from the right joint view at 30% capture shows the detected temperature as 34.6°C, and the infrared image shows the illustrate red area more diffuse in the right than the left side (arrow). It means that there was a different temperature between the right and the left side (0.5°C)

a difference in temperature between left and right of joints of more than 0.2°C (still within normal limits if the difference is 0.1°C to no more than 0.2°C), although there are variations in some individuals. In accordance with the results of photographs in this patient, it was found that there was a difference of up to 0.5°C , which may be used to identify the disturbance in the TMJ.^[8-10]

An image representation on the right joint showed more infrared rays that extend to masseter and temporalis muscle areas compared to the left joint, this was likely due to the temperature identified by the higher thermal infrared on the right side compared to the left joint, therefore the image of the light was also stronger and it spread on the right side [Figure 3]. This case report is in accordance with a study by Rodrigues-Bigaton *et al.* that showed the temperature of the mastication muscle in the measurement of the muscle and surrounding areas. In that study the significant value was found in the measurement of the left temporalis muscle area and found asymmetric temperature of the masseter muscle and anterior temporalis muscle.^[3,11] However, according to the literature, the thermal pattern of the human body will normally show a symmetrical condition when compared to the right and left sides.

Central skin temperature control affects both sides of the body uniformly and simultaneously. Therefore, when an imbalance occurs on both sides of the body there will be an increased body temperature difference, which indicates that there is a disorder on one side of the body.^[7,9,12] Another photo capture was found, which showed that temperature rises to 37°C . The time of photo capture in Figure 4 was different, it was taken during the day and the air temperature was high while at the time [Figure 4]. This can happen because according to the reference, the human body temperature can increase to adjust to the surrounding ambient temperature and normally can vary within a day and can vary between people. Therefore, there could be differences in taking photos on different days; even on the same day, there will be variations. Although as the literature that has been explained before, normally central skin temperature control affects both sides of the body uniformly and simultaneously.^[7]

The patient had SLE and routinely consumed steroid drugs that caused bone loss, and for which ceramic implant had to be implanted in the right hip area. However, due to inadequate surgical procedures, the patient was paralyzed due to a nerve injury

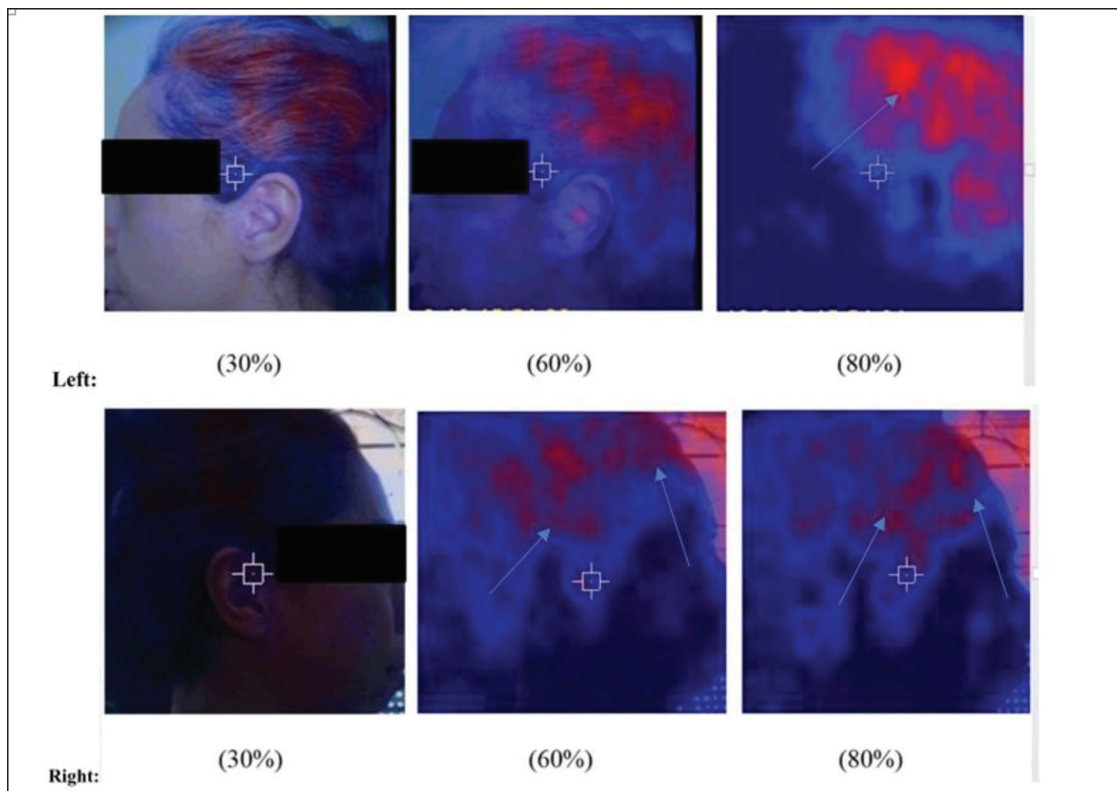


Figure 4: The 42-year-old woman with SLE who presented with TMD. In the left side, image infrared camera of the left temporomandibular joint on picture capture 30%, 60%, and 80% shows the average temperature at 37.6°C , infrared image from infrared camera seen the red area diffuse to head side area extends to the back area (arrow). In the right side, the image of the right temporomandibular joint on picture capture 30%, 60%, and 80% seen average temperature at 37.9°C . The infrared image showed the red area diffuse from forehead to temporalis muscle area (arrows)

along her right leg. She recovered from paralysis, and the condition became normal again because of routine physiotherapy with infrared rays; the infrared rays are effective on abnormal function in the sensory and sympathetic nervous system, system vascular dysfunction, myofascial trauma, and local inflammatory process. In addition, the patient also had rheumatoid arthritis, therefore often experienced pain in the joints that existed throughout the body, including the TMJ.^[13,14] As in the study of Aliko *et al.*^[6] showed the highest frequency of pain and joint sound found in patients with rheumatoid arthritis as much as 65% compared with the control group.^[15]

Many therapies have been advocated for treating TMD like the patient's condition in this case. Therapy that is commonly provided is an occlusal splint, it may be used for occlusal stabilization, for treatment of TMD. Therefore, the use of occlusal splint in this patient was very helpful in dealing with the complaints in the TMJ area.^[1,16-18] However, according to a study by Adelino *et al.*, they assumed that in case of muscle hyperactivity, the temperature rise can be measured on the skin overlying this hyperactive muscle, and they found that muscle temperature increases after splint therapy. This temperature change may suggest different loading of the muscle. Pathologies of the stomatognathic system are often connected to circulatory problems and/or inflammatory processes. When those processes happen, we could try to evaluate fluctuations in skin temperature overlying muscles and soft tissues. The temperature produced by muscle is dependent on its work, blood flow in a particular area, and the ambient temperature.^[19] However, an investigation by Dibai Filho *et al.*^[1] found that there was no significant results in skin surface temperature of chewing muscles among subjects with TMD compared with the control group. As there is still controversy stating that infrared thermography can not be recommended, therefore it needs further study taking into consideration the factors that may be less of the analyzed.^[1] This study had limitation because the cases of SLE disease were still limited in TMD treatment. Therefore, this study did not get a larger sample size, because commonly the patient was looking for medical treatment only. It is recommended to carry out further studies with collaboration between TMD treatment and medical treatment.

CONCLUSION

The application of infrared thermography can be an alternative to the temperature measurement of the area around the TMJ, and in case of a temperature difference between the left and right area around the TMJs greater

than 0.2°C in the TMJ of patients with SLE, it is advisable to perform infrared ray therapy in the muscle area around the TMJ, which aims to smooth the blood circulation and relax the muscles around the TMJ.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

Not applicable

DATA AVAILABILITY STATEMENT

Not applicable

AUTHORS CONTRIBUTIONS

Not applicable

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

CONFLICTS OF INTEREST

There is no conflicts of interest.

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