MNK Publication

International Journal of Latest Research in Science and Technology **ISSN (Online):2278-5299**
Volume 3, Issue 5: Page No 67-70 (2014)
https://www.mnkjournals.com/journal/ijlrst/index.php

HOT OR NOT: INDIRECT ANALYSIS OF DEEP TISSUE TEMPERATURE IN PATIENTS WITH PAINFUL TEMPOROMANDIBULAR DISORDER (TMD)

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Received : 30 August 2014; Accepted : 12 September 2014 ; Published : 31 October 2014

Abstract*- Occlusal parafunction, as bruxism, causes additional muscle effort and elevates muscle temperature. The aim of the study was evaluation of the temperature on the skin surface, overlying masticatory muscles and TMJ in patients with painful TMD. Patients attending the TMD Department were enrolled in the study - 40 patients: 28 women and 12 men. The control group consisted of 40 healthy volunteers. Patients were diagnosed according to RDC/TMD questionnaire, physical examination and VAS scale. Skin temperature was measured on seven points in each patient with an electronic thermometer INTEK KI. Temperature of seven skin points was compared(six muscle points and Glabella point). The average skin temperature on selected points in patients with painful TMD in the experimental group was higher (35,76°C) than in the control group (35,49°C). The difference was statistically significant, p=0,026. Temperature of the skin overlying the masticatory muscles and TMJ was correlated with the side where pain was reported (R or L) (D=0,2). The study on the temperature of masticatory muscles and TMJ is a valuable diagnostic criterion, helpful in assessing the stomatognatic system condition. Elevated temperature on the skin surface in this area can provide information about hyperactivity of masticatory muscles or TMJ.*

Keywords: Surface temperature, masticatory muscles, TMD

I. INTRODUCTION

Oral dysfunctions apart from caries or periodontitis are one of most common problems in dental practice. Screening and elimination of harmful factors and parafunction seems to be significant to avoid the destruction in a stomatognatic system.

Examination of the masticatory system should be routine before any prosthetic or orthodontic treatment. If any pathology is diagnosed, a pre-treatment should be implemented to avoid preservation or intensification of bruxism or painful muscles.

Disturbance in the masticatory system is one of the main causes of non-odontogenic pain in the facial skeleton. Symptoms can involve muscle pain, temporomandibular joint disorders, headaches, otalgias, tinnitus or pain of soft tissues [1]. Patients also complained of being fatigued, weary, and pain or force reduction in the masticatory muscles. In painful TMD a physiotherapy is an easy method for self treatment [2]. Temperature and humidity of performed massage plays an important role in this therapy: moist heat was more effective in muscle pain than dry heat [3, 4]. Pathologies of the stomatognatic 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. The muscle, while elevating or lowering the mandible consumes 20% of energy produced by muscle cells. The remaining 80% is released as heat to maintain the body temperature [5]. According to that information we can assume that in case of muscle hyperactivity the temperature rise can be measured on the skin overlying this hyperactive muscle. Muscle temperature increases after splint therapy. This temperature change may suggest different loading of the muscle [6].

In the course of muscle TMD diagnosed according to RDC/TMD (Research Diagnostic Criteria for Temporomandibular Disorders) Ia and Ib (Ia- myofacial pain without mouth limited opening, Ib- myofacial pain with limited mouth opening) [7] we can assume that one of the symptoms of inflammatory process is the warming of tissues. The use of an infrared camera or thermometer to measure the

temperature of the inside tissues proved to be interesting and valuable instruments which could help in the diagnostic procedure. However using them is rather limited due to costs and poor availability. On the other hand, using a simple electronic thermometer while examining the masticatory system appears to be a quick, cheap, objective and non-invasive diagnostic method. Evidence of at least small changes of temperature – in the range of sensitivity of those thermometers will be a motivation to carrying out more specialised research.

The aim of the study was the evaluation of the temperature rise of integument overlying masticatory muscles and temporomandibular joint, which could occur in the course of dysfunctions of the masticatory system.

II. MATERIAL AND METHODS:

40 patients enrolled in the Department of TMD of Silesian Medical University in Zabrze were selected to the study: 28 women and 12 men (70% and 30% respectively) aged from 17 to 71(average mean of 33 years). The subjects with chronic inflammatory processes in the area of facial skeleton were excluded as well as the patients with general conditions that might raise the body temperature (hyperthyroidism, bacterial/viral infections). Subjects taking medications such as steroids or NSAID were also not enrolled in the study. The control group consisted of 40 healthy people – 27 women and 13 men (67% and 33% respectively) aged from 22 to 57 (27 years old on average). Patient selection was performed by means of anamnesis and clinical examination. The presence of TMD was confirmed by the Dworkin and LeResche research diagnostic criteria (RDC) questionnaire [RDC/TMD]. The clinical examination was performed, according to Dworkin and LeResche, by two examiners. One examiner, calibrated according to the RDC/TMD standard, and another, who received calibration training, performed the clinical examination. In accordance with the RDC/TMD, the clinical diagnoses are Ia and Ib: a – myofascial pain without limited opening; b – myofascial pain with limited opening.

Only patients allotted in the RDC axis 1 (myofascial pain) and with myofascial pain in one or more targeted muscles (masseter, anterior temporal, digastric) were selected. The selected subjects were informed about the examination to be performed and signed a consent form, in accordance with the recommendations of the Human Research Ethics Committee.

Each subject was comfortably kept in a room with an ambient temperature of 20ºC for at least 30 mins. prior to the test. All selected patients underwent a clinical examination and were supposed to evaluate their pain according to VAS (Visual Analogue Scale). Average VAS value was 4,28. The side of pain was noted. Afterwards the skin temperature was measured using an electronic Thermometer INTEK KI8210 in following points:

- TMJ in front of tragus,
- The masseter on its insertion (the angle and lower half of the lateral surface of the mandible ramus),
- Insertion of temporal muscle to coronoid process above the zygomatic arch
- Glabella point as a point has no temperature rise as it was expected(Fig.1)

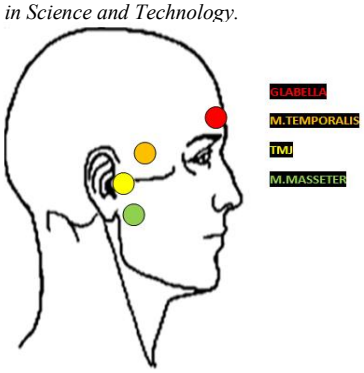

Fig. 1. Points of temperature measurement (both left and right side)

In all muscles, measurement was evaluated on both the right and left sides. Each temperature analysis was performed three times. A mean value of the three measurements was calculated. In all temperature measurements, the thermometer was positioned 10 mm from each muscle surface. Results were noted in the table:

Results from both the study and control group were evaluated by statistical analysis using Statistica 7.0 and t-Student test.

III. RESULTS

The conducted research showed that the temperature differs between the chosen points, which is shown on the Fig.2.

- Glabella 35,90c
- Temporal muscle 35,70c
- Temporomandibular joint 35,40c
- Masseter muscle 35,20c

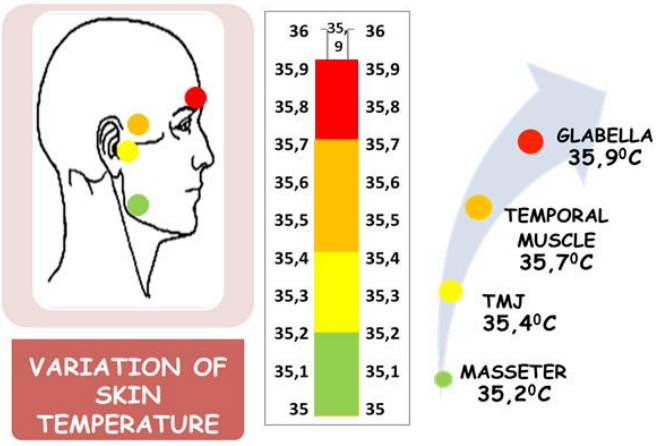

Fig.2. Variation of skin temperature- median values.

The warmest area turned out to be the forehead area, then the area of insertion at the temporal muscle, then at TMJ and the coldest was the area of the angle and lower half of the lateral surface of the mandible ramus. The results showed that the mean temperature on the skin overlying the masticatory muscles and TMJ in the study group was Tm=35,76°C and the mean temperature at the Glabella point Tg=35,91°C. In the control group those results were respectively Tm= 35,49°C and Tg=36,01°C.

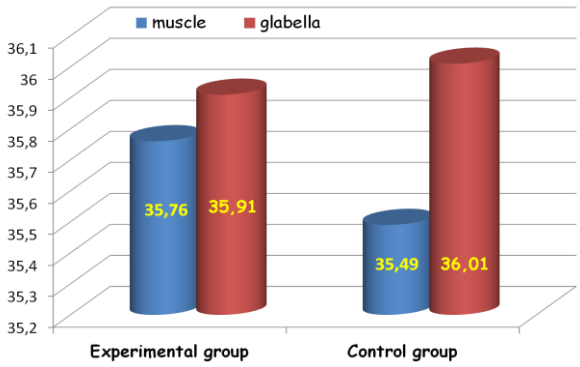

Fig.3. Average temperature in both groups (^{0}C)

In the experimental group (patients with painful TMD) the mean temperature on the skin overlying the masticatory muscles and TMJ are higher than in control group as seen in the Fig. 3.

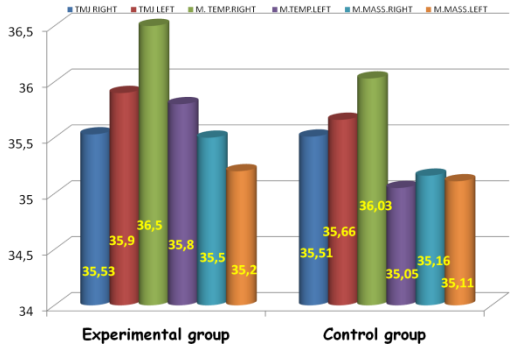

Fig.4. Average temperature in referent points (^{0}C)

Results from both the experimental and control group were evaluated by statistical analysis using Statistica 7.0 and t-Student test. Mean values of temperature at the Glabella point and reference points were lower in the control group (p=0,026) (Fig.4). In order to obtain values that would be independent of ambient temperature, absolute values of the difference between reference points and the Glabella point were analysed. In the study group the difference between the Glabella point and each reference point was lower than in the control group, which means that the temperature on the skin overlying the muscles was closer to the forehead temperature (the integument were hotter)(Fig.5.).

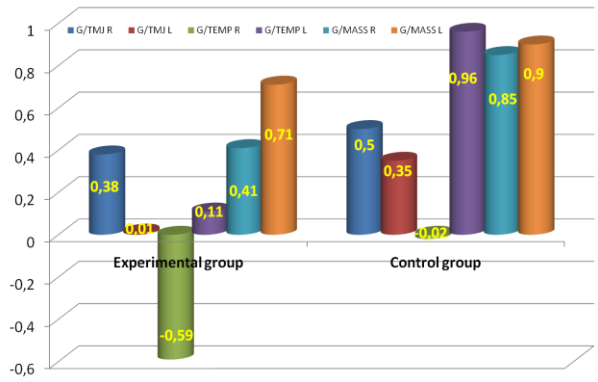

Fig.5. Differences in Glabella and RP temperature

IV. DISCUSSION

The common occurrence of TMD appears to be a significant problem in contemporary dentistry. Hence examination of all elements of the stomatognatic system is highly justified and necessary in an everyday dental practice [8]. Usage of a simple instrument such as a thermometer could be a helpful method in the diagnostic process and observation of the results of an implemented treatment. Careful differential diagnostics is necessary to descope other diseases [9]. Not many authors as far have dealt with the topic of thermometry or thermography usage. Progress and modernity now allow for diagnosis changes using infrared cameras. Some authors have not revealed any efficacy of those methods while other recommend it as additional diagnostic tool: Bartuzi was investigating the possibility of using infrared (IR) thermography for assessing muscle fatigue during low effort. Constant load during the tests resulted in an increase in the temperature of muscle. Similar situation takes places in oral parafunctions like bruxism, the reason for myofascial pain RDC/TMD Ia and Ib The conclusion was that IR thermography is an alternative method for assessing muscle fatigue [10]. The result is similar to our study conclusion.

Research with using infrared thermography in the diagnosis of temporomandibular joint arthralgia was carried out by Fikackov and Ekberg. The question examined was whether the infrared thermography could be reliably used as a tool to diagnose arthralgia by objectively assessing the site of origin and the degree of irritation. The study revealed that thermography fails to meet the criteria for a high level of evidence. Further studies are required to confirm these results in order to specifically analyse facial thermal patterns and to better understand the relationship between TMJ arthralgia and regional temperature changes. Until then infrared thermography cannot be recommended for routine use as a diagnostics technique to identify TMJ disorders[8]. On the other hand D.C Betty and R. Yem indicated that using an infrared camera could be useful. It has been shown that the skin immediately overlying the tender area is commonly hotter than the corresponding area on the other side of the face. It is suggested that the higher surface temperature is due to the presence of a state of inflammation with hyperaemia in the tender area of the masseter muscle [1].

Haddad also concluded that infrared imaging measurements (thermography) can provide a useful, non-invasive and non-ionizing examination for diagnosis of myofascial trigger points in masticatory muscles[11]. Rodriques-Bigaton was trying to assess the accuracy of infrared image analysis in patients with TMD divided into two groups, according to RDC/TMD. There was no significant difference between skin temperature between TMD and control group. Infrared red thermography was not consistent with RDC/TMD for diagnosing myogenus TMD [12]. Dibai-Filho in the study reported that no association was found between skin surface temperature and pain intensity in 40 patients with TMD [13,14].

Barao in the study was evaluating temperature changes before and after occlusal splint therapy with a digital thermometer, Conclusion was a significant muscle temperature increase after splint therapy on both sides: right and left [6]. Edefonti suggested the existence of responses to

weather changes in patients with TMD. Temperature is one of the main variables, but according to Edefonti et al further studies are necessary [15]. Petrofsky was analyzing interrelationships between the amplitude and frequency of the electromyogram (EMG), muscle tension, muscle fatigue, and muscle temperature. The frequency components of the EMG were inversely related to muscle temperature. The amplitude of the EMG with muscle fatigue was reduced for the coldest muscle temperatures. With a 10 degrees C reduction in temperature resulting in a 32 Hz reduction in the center frequency. In our study we did not use EMG, but that should be a reason for further studies to check the relationship between EMG amplitude and muscle temperature [16].

Koop et al measured the masseter and temporomandibular joint temperature with thermistor and concluded their research that it seems possible to use this thermometric method to assess inflammatory processes and/or changed metabolic activity in the TMJ and masticatory muscles [17]. Kawano also measured masticatory muscle temperature with the transcutaneous probe (deep thermometry) All of the normal subjects showed differences between the right and left TMJ region of less than 0.3 degrees C. Patients with TMD showed differences of more than 0.3 degrees C between the asymptomatic and asymptomatic TMJ region. The deep thermometry measurements can provide useful medical information about muscle fatigue [18].

The limitation of using thermometry or thermography is that a small number of scientific studies have been carried out on a narrow group of disorders of the temporomandibular joint. Therefore, additional studies are required to evaluate the muscular temperature changes in in healthy patients [19,20] and subjects with different types of TMD as affected by different therapies.

V. CONCLUSIONS

According to the data analysis we can state that the mean differences between the temperature of muscles and the temperature of the forehead in the study group are lower than in the control group, which reveals the rise of muscle temperature in the study group. It is worth noting that the temperature rise is a sign of the hyperfunction of muscles in the course of painful TMD. Examination of patients using an electronic thermometer can be an easy, quick, non-invasive additional method in diagnosis and treatment of patients with painful temporomandibular disorder. Obtained results are a motivation for carrying out further studies concerning the temperature rise in the course of TMD. In the study group a temperature rise in the area of muscles and the temporomandibular joint was observed. The presence of those temperature changes speaks to the possibility of using temperature measurements in the diagnostic and treatment plan. Thanks to those methods early detection of diseases and the implementation of appropriate preventive and therapeutic procedures would be possible.

VI. ACKNOWLEDGMENTS

This paper has been supported by the Program Project UMO-2012/07/B/ST6/01238 and authors would like to express their appreciation for that. The authors declare that there is no conflict of interests regarding the publication of this paper.

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