Infrared Imaging of the Crânio-Cervico-Mandibular Complex in Bruxism Patients

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SUMMARY

Many authors have suggested the existence of a functional dependence between the cervical muscle and mastication muscles. In the sequence of this functional dependence postural, changes, specially in the head and neck, can influence certain neuronal-muscular patterns leading to the development temporomandibular disorders. The existing of hyperactivity of the mastication muscle in bruxism patients can originate areas of neuro muscular sensibility, that can be detected by thermography with asymmetric thermogram patterns. It is therefore important to evaluate the existing differences of head and neck posture in bruxism patients and asymptomatic individuals and the respective correlation of the thermographic patterns.
The sample of the present study consisted on 32 individuals (16 bruxism patient and 16 asymptomatic individuals) students of the Dental Faculty of Porto University with ages between 22-26 years old. A clinical examination was made in order to diagnose the presence of signs and symptoms of bruxism. The thermographic evaluation was made using the thermographic camera Flir® A325.
The ΔT of thermography showed assymetric patterns in the temporomandibular joint and within most of the muscles of the cranio-cervic-mandibular complex.
Infrared imaging technique can be a complement method of diagnostic in temporomandibular disorders, when evaluating the possible association of specific muscles of the cranio-cervico-mandibular complex with an increased muscular activity seen in bruxism patients.

1. INTRODUCTION

Human body posture control is maintained by the somatosensory, vestibular and visual systems, integrated within the locomotor and central nervous systems (1).
Besides all these mechanisms of feed-back and feed-forward, the stomatognatic system (SS) plays also an important role in posture control. Stomatognatic system is a functional unit characterized by several structures such as: skeletal components (maxilla and mandible), dental arches, soft tissues (salivary glands, nervous and vascular supplies), the temporomandibular joint (TMJ) and masticatory muscles (1, 2). TMJ works as muscular and ligamentary connector between the cranium and all the cervical region, forming the cranio-cervico-mandibular complex (CCMC) (1).
In the sequence of this functional dependence between cervical region and SS, postural changes, specially in the head and neck, can influence certain cranio-cervical neuronal-muscular patterns leading to the development temporomandibular disorders (TMD)(3-6). The presence of TMD may also contribute to postural changes (3-6) The most common posture disorder observed in TMD patients is a forward head position, usually associated with shortening of the posterior cervical muscles and length of the anterior cervical muscles (7-9).
According to the American Academy of Orofacial Pain, bruxism is a "psychophysiological disorder that can be defined as diurnal or nocturnal tooth contact parafunctional activity, such as clenching and grinding" (10). This parafunctional activity take to a situation of hyperactivity of the mastication muscle that can originate areas of neuro-muscular sensibility that can be detected by thermography with asymmetric thermogram patterns (6, 8, 9, 11-14).
Thermography involves the detection of infrared radiation that can be directly correlated with the temperature distribution of a defined body region and appears as a non-radiating, non-contact and non-invasive analysis tool which provides informations on the basis of temperature patterns and evaluation of temperature asymmetry (12, 14-18).

2. MATERIALS AND METHODS

The sample of the present study consisted on 32 individuals (16 bruxism patient and 16 asymptomatic individuals) students of the Dental Faculty of Porto University with ages between 22-26 years old. The study protocol was approved by the Ethics Committee of the Dental Faculty of Porto University and informed consent was given to all participants.
A clinical examination was made in order to diagnose the presence of signs and symptoms of bruxism. The thermographic evaluation was performed using the thermographic camera FLIR® A325 with a resolution of 320x240 pixels, a measurement accuracy of ±0,2C and thermal sensitivity 0,07 C. Thermograms were recorded at 30Hz and informatical analyzed with ThermaCAM Researcher Professional® 2.10.software.
Data were submitted to statistical analysis by Wilcoxon-Mann-Whitney test at a 5% significance level.

2.1 Infrared Imaging Capture Protocol

The thermograms capture was made before the clinical examination and it was performed indoor and the temperature was stabilized to 21ºC. Infrared camera was placed on a tripod and positioned approximately 1.5m and looking perpendicular to the patient. Thermal images were obtained in right and left view and in dorsal view and while this procedure all electronic equipment was kept clear of the volunteers. Before image capture the volunteers were requested to follow certain instructions such as: avoiding cosmetics, avoiding exercise and non-smoking 4 hours before the procedure. Besides, all volunteers remained quiet and rest for 15 minutes for thermal equilibrium, male participants were asked to record thermograms without their t-shirts while female participants were asked to use a sleeveless, avoiding this way skin marks from clothes.

3. RESULTS

The group of bruxism patients reported an average temperature variation of: 0.681; 0.613; 0.500; 0.344 and 0.625ºC in muscles temporal, masseter, trapezius, sternocleidomastoid and TMJ, respectively (Table 1). Control group showed for the same group of muscles, an average temperature variation between right and left side of: 0.263; 0.394; 0.294; 0.231 and 0.369 ºC (Table 2).

Table 1 - Descriptive statistics of ΔT between right and left side: control group.

	Control Group				
ºC	Temporal	Masseter	Trapezius	Sternocleidomastoideu	TMJ
Min	0.40	0.40	0.20	0.00	0.40
Max	1.40	1.20	0.80	0.70	1.10
Mean	0.681	0.613	0.500	0.344	0.625
Std. Deviation	0.2889	0.2247	0.1826	0.1861	0.1693

The temperature variation differences registed between the two groups in study was statiscally significant in all muscles and TMJ. Temporal, masseter, trapezius, sternocleidomastoid muscles and TMJ registed values of p= 0.001, p=0.005, p=0.029, p=0.021 and p=0.014, respectively.

Table 2 - Descriptive statistics of ΔT between right and left side: bruxers group.

	Bruxers Group				
ºC	Temporal	Masseter	Trapezius	Sternocleidomastoideu	TMJ
Min	0.00	0.10	0.00	0.00	0.10
Max	0.70	1.30	1.10	0.4	2.00
Mean	0.263	0.394	0.294	0.231	0.369
Std. Deviation	0.1893	0.3396	0.3214	0.1360	0.4729

4. DISCUSSION

Some authors had study the relationship between the activity of mastication muscles and head posture using the electromiography (EMG) and came to the conclusion that variations in head position could lead to a highest muscular activity, specially of the temporal and masseter muscles (19, 20). The consequences of a permanent muscle hyperactivity can have effects not only in mastication muscles but also in cranio-cervico-mandibular complex (CCCM) due to the common innervation of trigeminal complex (21).
Body temperature control is regulated by the central nervous system and in healthy individuals is available in symmetric patherns (13, 14, 22). The hyperactivity of the mastication muscle in bruxism patients can originate areas of neuro muscular sensibility, which can be detected by thermography with asymmetric thermogram patterns (6, 8, 9, 11-14).
In this investigation we considered that a ΔT ≥0.36 between right and left sides could be an evidence of a strong level of an unusual thermic pathern (22).

The results achieved allowed to verify that there are clear differences of ΔT average values between the same muscles in the two different groups in study. These differences were statistically significant. Temporal and masseter muscle showed a statistical difference more relevant. Trapezius and sternocleidomastoid muscle present the lowest statistically significant differences of ΔT between bruxism and asymptomatic groups. Trapezius muscle showed up as the postural muscle with the lowest value of significance ΔT (p=0.029).
No references in literature of investigations involving bruxism patients and the study of thermal patherns could be found. However, there are some studies that establish the deep relation between the presence of TMD and asymmetric patterns of the CCCM (15, 23, 24).
There are various auxiliary tools for diagnosis of TMD such as: computerized tomography, arthrotomography, arthroscopy and magnetic resonance (25). However, these methods are radiating, expensive and some of them invasive.
In contrast to the abovementioned auxiliary diagnosis methods, thermography analysis is a non-radiating, non-contact and non-invasive analysis tool (13-15, 18, 19, 22).

5. CONCLUSION

The thermography can be a complement method of diagnostic in temporomandibular disorders and prevention of pathologies when evaluating the possible association of specific muscles of the cranio-cervico-mandibular complex with an increased muscular activity seen in bruxism patients. Never the less more studies are needed whit higher samples in order to clarify this situation.

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