80 - THE THERMOGRAPHY IN THE EVALUATION OF THE MASSETER MUSCLE OF ROWING ATHLETES DURING THE MAXIMUM EFFORT

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INTRODUCTION

To define rowing in few words, one can say that is about one of the oldest and most traditional sports, which practical conjugates technique, synchrony of movements, force and physical preparation. It is a sport that provides a healthful contact with the water and that it is practiced by athletes of all the ages. Today rowing is beyond a competitive sport, a form of physical activity and recreation (LAUMANN & WHARTON, 1994). According to Redgrave (1997), it is a sport of resistance and force, requiring periods of activities in competitions that vary from few seconds until half an hour, depending on the type of dispute.

In accordance with Elliott & Mester (2000), rowing is a sport with repeated applications of submaxim force, for drawn out periods. In the first part of the exit phase, that lasts from 10 to 15 seconds; the boat is sped up with 8 to 10 strokes, from a stationary position, until the maximum speed of about 6 m/s. Each stroke is effected with maximum force and a rating of approximately 44 stroke /minute. For Diefenthaeler (2003) this is a particularity of this sport, where the requirement is maximum in the jettison to break the inertia of the boat and to leave with advantage on the adversaries.

In the attempt to increase the force in search of one better performance, mainly in the jettison, it is common to observe parafunctional movements in these athletes. Parafunctional movements are muscular contractions not related to the motor gesture that is being developed, but that are carried through jointly to the motor gesture. During this parafunctional activity, that occurs almost entirely in subconscious level, the neuromuscular protection mechanisms are absent (OKESON, 1992), being able to cause damages to the masticatory system and temporomandibular clutters (VANDERAS,1995). Of this form, this parafunctional buccal habit would have to be diagnosised and controlled the earlier as possible (AAPD, 1996). An example of parafunctional movement can be seen in Figure 1, where the athletes appear to be holding their teeth and movements of the face musculature. These parafuncional movements can favor the sprouting of a hyperactivity of the masticatory muscles. Bricot (1999) described that the sailors in galleys bit wooden pieces when the cadence of the strokes increased.



Figure 1 - Parafunctional movements during strokes

The temporomandibular joint (TMJ) is considered by Maciel (1996) the most complex joint of the human body. This joint is supported in the face by muscles and ligaments and, for being bilateral, the chewing muscles must work in perfect synchrony. The staple fibres must contract and relax in a regular standard in the muscle and in a co-ordinated way with the muscles at the contralateral side (IGLARSCH & SNYDER-MACKLER, 1994), once tthere is a direct influence of a joint for the other. According to Okeson (1992), the positional stability of the joint is not determined by the articular disc, but by the muscles that cross and hinder the articular surfaces displacement. It still affirms that the directional forces in these muscles determine the ideal position for the steady functioning of the joint. In parafunctional movements there is existence of muscular spasms and these, according to Quintanilha, Rocha, Miranda, et. al. (2001), are related to areas of more raised temperatures.

The Termography is a new field that is appearing in Biomechanics (ZARO, 1999), where thermal images are gotten through a device called thermographer, and the colors define fields of different temperatures, suggesting bigger activity in certain regions that in others. Veratti (1984) says that it is one technique that allows to a long-distance register and the formation of images (thermograms), from the infrared radiation naturally emitted by the bodies in function of their absolute temperature. The use of Termography in diagnosis quickly grew after the publication of the first medical thermogram in 1956 by Lawson, a Canadian physicist, and then some researchers had immediately started using the new equipment to determine the temperature of the skin surface (CHRISTIANSEN, 1990). Veratti (1984) affirms that, in its development, the Termography found infinity of applications in diverse fields of the human activity, as in military, medical and industrial applications, in astronomy and the remote sensing, each one with its particularitities and proper objectives. For Zaro (1999), the correct interpretation of this "thermal map" can bring important information for the health area professionals, what it is confirmed by Maciel (2003), that describes that the use of Termography to map the surface temperature of selected areas, as plus a diagnostic resource, will be able to offer significant contribution for the advance of the pain studies.

The present study had as objective to evaluate the activity of the muscle masseter of rowing athletes through Termography, and to relate possible evidences of temporomandibular dysfunction with the temperature.

METHOD

For the identification of possible temporomandibular dysfunction, as well as describing the profile of the athletes, a mixing questionnaire was elaborated, consisting on open and closed questions. The questionnaire made possible to acquire data referring the parafuncional activities, signals and symptoms of temporomandibular dysfunction and occurrence of incidents. The parafunctional activity was described for the presence of parafuncional habits as to press the maxillary against the jaw, biting the cheeks, creaking teeth; and for dysfunction symptoms as pain in the TMJ, chronic headache, ontological symptoms, pain in the cervical region and/or snaps when opening or closing the mouth. According to Rizzatti-Barbosa, Monteiro-Pedro, Martinelli et. al. (1998), as a syndrome, the temporomandibular dysfunction characterizes itself when three or more signals and/or symptoms are diagnosised.

The collection was carried through in the rowing ergometer (figure 2, left) that is a stroke simulator. The equipment

can be monitored by different variables as: speed, rhythm, distance, force, average of each 500 meters past and calories spent per hour. For the thermal register the Termovisor (FSI, model Prism SP) was used (figure 2, right), with sensitivity of 0,1º C.



Figure 2 left: rowing ergometer ; right: Termovisor

For the thermal register the following procedures had been respected: ambient temperature was kept in 20±2ºC; the distance of two meters between the termovisor and rowing ergometer was respected; the emissivity adjustment was of 0,98 compatible with the human skin (FLIR SYSTEMS, 2003); the acquisition time was of five seconds. Eleven mensurations had been carried through for each citizen. The first register was carried through being the citizen in rest (REST). After that, the warm up of fourteen minutes in the rowing ergometer was carried through, with ten minutes of constant speed and four minutes with speed variation. After the warming up, the second register was carried through (W. Up). In the sequence, nine series of 45 seconds had been carried through simulating the real intensity of competition, with intervals of 90 seconds. To the ending of each series, the registers had been become fulfilled (1ºInt; 2ºInt; 3ºInt; 4ºInt; 5ºInt; 6ºInt; 7ºInt; 8ºInt; End).

RESULTS AND DISCUSSION

In figure 3 it is possible to visualize the thermal register of the masseter muscle of a research subject during the data collection.

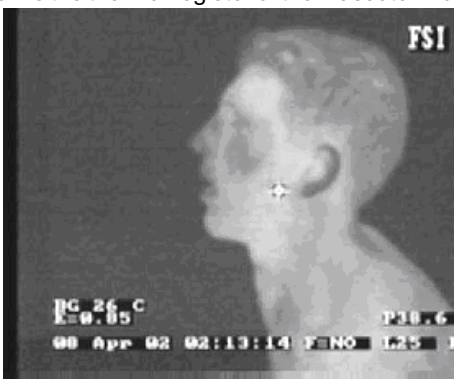

Figure 3 - Thermal register of the region of the muscle masseter

Nine rowers had participated of the research with average age of 21±4 years old, that have carried through competitive training at the very least 2 years and in the maximum 15 years. The daily training lasts about 4±1 hours and they carry through 11±1 sessions of training per week.

The presence of signals and/or symptoms was identified in three subjects, being that only one of them presented a triad of the symptomatology of temporomandibular dysfunction, thus evidencing, the dysfunction in this last one.

The temperature behavior during the carried through simulation is visualized in Figure 4. One verifies temperature increase in the masseter muscle region, evidencing thus, increase of activity in the related region, what is compatible with the affirmation of Duarte et al. (1993), that confirms that with the physical activity the body temperature is raised due to the produced energy waste in form of heat, where local points of the human body can present different behaviors about the temperature.

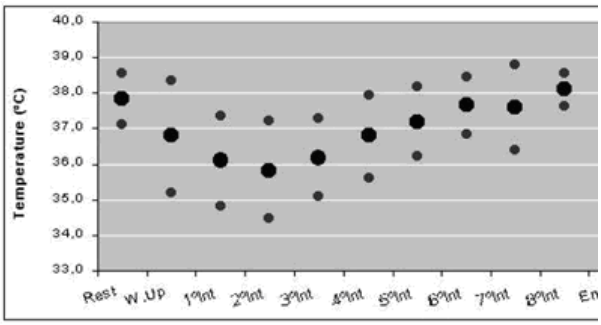

Figure 4 - Graphical representation of the average behavior (+/- standard deviation) of the temperature in each mensuration.

When analyzing Figure 4 it is possible to observe that right after the body warms up occurs a temperature reduction in relation to the measurement in rest. With the training continuity the temperature increases significantly, as illustrated in the thermal register graph. According to Guyton (1988), when the hypothalamic thermostat evidences that the body temperature is excessively hot or cold, it adopts appropriate procedures destined to reduce or to increase the heat. The same author says that, to reduce the body heat, the thermostatic system uses three important mechanisms: intense dilation of the sanguineous vases to increase the transference of heat for the skin in up to eight times; stimulation of the perspiration, that presents an increase in the heat loss for resultant evaporation of sweating; and inhibition of certain chemical mechanisms as chills and

thermogenesis. Considering that the thermal energy in the interior of the human body is transmitted through fabrics by different forms of propagation and that the organism counts on thermoregulatory mechanisms through the exchanges of heat with the environment, one can expect that endogenous alterations are evidenced in the skin surface (QUINTANILHA et al., 2001). The increase of the temperature during the period of training can be related with increase of the activity of the body metabolism, what is confirmed by Maciel (2003), that mentions the hypothesis of changes in the cutaneous sanguineous flow, mainly vasodilatation in the capillaries and small vases with local hyperemia.

The individuals had presented different variations in the simulation, however the variation coefficient (VC) was low in average (2,8%), being the biggest variation presented after the period of warming up (VC = 4.3%), being able to be explained by the differences and speed in the physiological responses of each subject.

In average the temperatures had varied 0,3±0,2ºC, comparing the rest temperature to the biggest temperature presented, occurred in the eighth interval for seven subjects and at the end for two of them. In five subjects there wasn't alteration in the measured temperature in rest and the biggest evidenced value practically did not occur (variation of ±0,2ºC).

Four subjects that had presented a bigger increase of the temperature, and among them three had presented signals and/or symptoms of temporomandibular dysfunction. The rower that did not present positive answers in the questionnaire had a variation of 0,6ºC. In the subjects with positive answers, a variation of 0,5ºC occurred for the subject with a positive reply and 0,8ºC for the subject with two positive answers.

For the only athlete that presented the triad, that characterizes a temporomandibular dysfunction, the temperature varied 1,5ºC, being much bigger and expressive in relation to the other subjects.

CONCLUSION

As a method, the Termography revealed to be efficient in the evaluation of the activity of the muscle masseter. For not involving physical contact, it allows to the thermal register and the formation of images (thermograms). Thus, it becomes possible an evaluation through a non invasive method, being able to be a tool for the diagnosis of musculoskeletals dysfunctions.

The biggest temperature variation presented by the only rower with temporomandibular dysfunction triad, seems to show evidences that this method can be used as an alternative of evaluation and/or diagnosis of temporomandibular dysfunctions.

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THE THERMOGRAPHY IN THE EVALUATION OF THE MASSETER MUSCLE OF ROWING ATHLETES DURING THE MAXIMUM EFFORT

ABSTRACT

Trying to increase the force in search of the best rowing performance it is common to observe in the athletes parafunctional movements, defined as not related muscular contractions to the motor gesture. This habit, generally buccal, would have to be diagnosed/controlled the earlier as possible therefore it can cause damages to the masticatory system and temporomandibular disorders. In these muscular movements occur spasms and, thus, areas of more raised temperatures. The present study had as objective to evaluate the activity of the muscle masseter through Termography, and to relate possible evidences of temporomandibular dysfunction with temperature. Nine rowers had participated. For temporomandibular dysfunction identification was used a questionnaire. The collection was carried through in a rowing simulator and for the thermal register a Termovisor with sensitivity of 0,1ºC. was used. One had carried through 11 measurements for each citizen. There was presence of signals and/or symptoms of temporomandibular dysfunction in three citizens, being that only one of them presented the triad of the symptomatology. For the only citizen that presented the triad the temperature varied 1,5ºC,

greater and more expressive in relation to the other citizens. As method, the Termography revealed to be efficient in the evaluation of the activity of the muscle masseter becoming possible an evaluation for a not invasive method for the diagnosis of musculoskeletals dysfunctions. The biggest variation of temperature presented for the only citizen with temporomandibular dysfunction triad seems to show evidences that this method can be used as an alternative of evaluation and/or diagnosis.
Word-key: Biomechanics; Termography; Temporomandibular dysfunctions.

LE THERMOGRAPHIE DANS L'ÉVALUATION DU MUSCLE DE MASSÉTER DE RAMER DES ATHLÈTES PENDANT L'EFFORT MAXIMUM

RÉSUMÉ

Essayer d'augmenter la force à la recherche de la meilleure performance de la conduite à l'aviron, il est commun d´observer les mouvements de parafunctional des athlètes, défini comme contractions musculaires qui ne sont pas relativés au geste du moteur. Cette habitude, généralement buccal, devrait être diagnostiqué le plus tôt comme possible donc il peut endommager le système de masticatoire et les désordres temporo-mandibulaires. Dans ces mouvements musculaires les spasmes se produisent et, ainsi, secteurs températures de plus sont augmentés. La présente étude a eu en tant qu'objectif pour évaluer l'activité du masseter de muscle par Termographie, et pour relier des évidences possibles de dysfonctionnement temporo-mandibulaire avec la température. Neuf rameurs avaient participé. Pour le dysfonctionnement temporo-mandibulaire l'identification a été employée un questionnaire. La collection a été exécutée dans un simulateur ramant et pour le registre thermique on a utilisé un Termovisor avec la sensibilité de 0,1ºC. On avait exécuté 11 mesures pour chaque citoyen.Il y avait de présence des signaux et/ou symptômes de dysfonctionnement temporo-mandibulaire dans trois citoyens, être celui seulement un d'entre eux a présenté la triade du symptomatologie. Pour le seul citoyen qui a présenté la triade la température ont changé 1,5ºC, plus grand et plus expressif par rapport aux autres citoyens. Comme méthode, le Termographie a indiqué pour être effecace dans l'évaluation de l'activité du masséter du muscle qui devient possible une évaluation pour une méthode non invahissante pour le diagnostic des disfunctions de musculoskeletals. La plus grande variation de température a présentée pour le seul citoyen avec la triade du disfunction temporo-mandibulaire prouver à des évidences que cette méthode peut être employée comme alternative d'évaluation et/ou diagnostic.
Mot-clef : Biomécanique ; Termography ; Dysfonctionnements temporo-mandibulaires.

LA TERMOGRAFIA EN LA EVALUACIÓN DEL MÚSCULO MASETERO DE ATLETAS DE REMO DURANTE EL ESFUERZO MÁXIMO

RESUMEN

Tratando de incrementar la fuerza en busca del mejor desempeño es común observar en los atletas movimientos parafuncionales, definidos como contracciones musculares no relacionados al gesto motor. Este hábito, en general bucal, tendría que ser diagnosticado / controlado lo más temprano posible, porque puede causar daños al sistema masticatorio y desordenes temporomandibulares. En estos movimientos musculares ocurrem los espasmos y así en áreas de temperaturas más elevas. El presente estudio tubo como objetivo evaluar la actividad del músculo masetero de atletas remadores a través de la termografia, y relacionar posibles evidencias de disfunción temporomandibular con la temperatura. Nueve remeros habían participado. Para identificación de la disfunción temporomandibular fue utilizado un cuestionario. La colecta de datos fue llevada completamente en un simulador de remo y para el registro térmico fue utilizado un Termovisor con la sensibilidad de 0,1ºC. Fueron realizadas 11 mediciones por cada individuo. Fue observado la presencia de señales y/o síntomas de disfunción temporomandibular en tres individuos, siendo que solamente uno de ellos presentó la tríada de la sintomatologia. Para el único ciudadano que presentó la tríada, la temperatura varió 1,5 C , siendo más expresivo en relación a los otros individuos . Como método, la Termografia se mostró eficiente en la evaluación de la actividad del músculo masetero tornando posible una evaluación como método no invasivo para el diagnóstico de las disfunciones musculoesqueléticas . La mayor variación de temperatura verificado en un único individuo com la triada de disfunción temporomandibular parece mostrar evidencias que este método puede ser utilizado como una alternativa de evaluación y/o diagnóstico de disfunciones temporomandibulares..
Palabras-clave: Biomecánica, termografia, disfunciones temporomandibulares

A TERMOGRAFIA NA AVALIAÇÃO DO MÚSCULO MASSETER DE ATLETAS REMADORES DURANTE O ESFORÇO MÁXIMO.

RESUMO

Tentando aumentar a força em busca do melhor desempenho é comum observar nestes atletas movimentos parafuncionais, definidos como contrações musculares não relacionadas ao gesto motor. Esse hábito, geralmente bucal, deveria ser diagnosticado/controlado o mais cedo possível, pois pode acarretar danos ao sistema mastigatório e desordens temporomandibulares. Nestes movimentos ocorrem espasmos musculares e, assim, áreas de temperaturas mais elevadas. O presente estudo teve como objetivo avaliar a atividade do músculo masseter de atletas remadores através da Termografia, e relacionar possíveis evidências de disfunção temporomandibular com a temperatura. Participaram 9 remadores. Para identificação de disfunção temporomandibular e foi utilizado um questionário. A coleta foi realizada num Remoergômetro e para o registro térmico foi utilizado um Termovisor com sensibilidade de 0,1º C. Foram realizadas 11 mensurações para cada sujeito. Houve presença de sinais e/ou sintomas de disfunção temporomandibular em três sujeitos, sendo que apenas um deles apresentou a tríade da sintomatologia. Para o único sujeito que apresentou a tríade a temperatura variou 1,5ºC, maior e mais expressiva em relação ao demais sujeitos. Como método, a Termografia mostrou-se eficiente na avaliação da atividade do músculo masseter tornando possível uma avaliação por um método não invasivo para o diagnóstico de disfunções músculo-esqueléticas. A maior variação de temperatura apresentada pelo único sujeito com tríade de disfunção temporomandibulares parece mostrar evidências que este método possa ser utilizado como uma alternativa de avaliação e/ou diagnóstico de disfunções temporomandibulares.
Palavras-chave: Biomecânica; Termografia; Disfunções temporomandibulares.