EMG ANALYSIS OF MASSETER AND TEMPORAL MUSCLES IN ORTHODONTIC TREATMENT INDIVIDUALS WITH OCCLUSAL ADJUSTMENT

ANÁLISE ELETROMIOGRÁFICA DOS MÚSCULOS MASSETER E TEMPORAL, ANTES E APÓS AJUSTE OCLUSAL, EM PACIENTES TRATADOS ORTODONTICAMENTE

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RESUMO: *Finalidade: O objetivo deste trabalho foi verificar a atividade eletromiográfica em 18 indivíduos de ambos os gêneros submetidos a tratamento ortodôntico corretivo com a Mecânica de Edgewise, comparando um grupo controle constituído por 09 indivíduos, que ao término do tratamento ortodôntico, apresentaram uma máxima intercuspidação habitual (MIH) igual a relação cêntrica (RC), com 09 indivíduos que ao término do tratamento ortodôntico apresentaram a máxima intercuspidação habitual diferente da relação cêntrica e avaliá-los novamente após o ajuste oclusal. Material e Métodos: As análises eletromiográficas foram realizadas por meio de movimentos mastigatórios e manutenção de posições posturais, antes (A) e após (P) a terapia do ajuste oclusal. Foram utilizados cinco canais do Eletromiógrafo K6-I EMG de oito canais. Foi realizada análise estatística (ANOVA) para a avaliação entre as situações antes e após a terapia adotada. Resultados:Notou-se que houve uma tendência para o aumento da atividade eletromiográfica no repouso, na relação cêntrica e na mastigação e uma diminuição da atividade na lateralidade e protrusão nos indivíduos submetidos à terapia de ajuste oclusal para p<0,05. Conclusão: baseado nos resultados obtidos, conclui-se que a terapia de ajuste oclusal por desgaste seletivo promove alterações na ativação da musculatura mastigatória.*

UNITERMOS: *Eletromiografia; ortodontia corretiva; músculo masseter; músculo temporal*

INTRODUCTION

The application of different therapeutic procedures such as occlusal splints[13], occlusal adjustment[1], orthodontic treatment[32], biofeedback procedures,[9] traditional massages,[19] electric transcutaneous stimulation[2,7,18], show the modification on the electromyographic activity of the masticatory muscles. Thus, the aim of this study was to analyze the electromyographic activity of the masseter and temporal muscles, right and left sides, before and after the occlusal adjustment in individuals submitted to orthodontic treatment, in the following clinical conditions, rest, centric relationship (RC), usual maximum intercuspation (MIH), mandible laterality to the right and left sides, protrusion, chewing with soft food (chocolate) and maximum voluntary contraction[31], and compare them with individuals who at the end of orthodontic treatment showed the normal MIH similar to the RC.

MATERIAL AND METHODS

The Ethics in Research Committee of the University of São Paulo/Ribeirão Preto, São Paulo,

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Brazil approved all procedures in this study, complying with international laws.

Volunteers

It was selected in this study, eighteen individuals of both sexes, with an average age of 21.0 ± 5 years, submitted to orthodontic treatment with the Edgewise appliance. Participants were divided into two groups: Group 1 (control), consisting of 09 individuals, who at the end of orthodontic treatment, showed the normal maximum intercuspation (MIH) relationship similar to the centric relationship (RC); Group 2, composed by 09 individuals that in the end of orthodontic treatment had the highest intercuspation different from the usual centric relationship. A third group (Group 3) was composed by the same participants of the Group 2 after being subjected to occlusal adjustment, with the aim to obtain a normal maximum intercuspation (MIH) similar to the centric relationship (RC). The electromyographic analysis was performed in all groups, Group 1 (Control), Group 2 (before the occlusal adjustment), and in Group 3 (after the treatment with occlusal adjustment).

Electromyography

For electromyographic record, it was used five channels of electromyography K6-I EMG Light Channel Surface Electromyography device (Myo-tronics Co. Seattle, WA, USA), with eight-channel, and double electrode surface of silver chloride disposable (Duotrodes, Myo-tronics Co., Seattle, WA), containing a conductive gel (Myogel-Myo-tronics Co., Seatlle, WA). The system amplifies (15-430 Hz), filters (60 Hz), reworking, scan and saves the information in the memory of each muscle.

After cleaning the patient skin with alcohol in order to remove waste grease or any pollution present in places of the study, electrodes were positioned on the region of masseter and temporal muscles, right and left sides. A reference electrode was positioned near to the subject nape.

During the electromyographic registration, the environment was kept calm and quiet. The patient remained seated in a comfortable chair, in upright position, feet on the ground, arms and hands supported on the legs. The head was maintained according to the Frankfourt parameter of positioning. The electromyographic records for these clinical conditions were performed using the "Scan" # 9 of the K6-I Myo-tronics System. This "Scan" # 9 performs the average calculations of the electromyographic values, and displays at the same time, the muscle activity register.

The muscle activity evaluation was performed in the following clinical conditions: rest position; centric relationship (RC); normal maximum intercuspation (MIH); right and left mandible laterality; protrusion; mastication with soft food (chocolate) and voluntary maximum contraction (standardization factor for the electromyographic data).

The first record of the muscle activity was carried out with individual in the clinical condition of mandible rest. The subject was instructed to move the tongue lightly on the lips, seal the lips, let the teeth without an occlusion condition and the tip tongue supported on incisive papilla.

In sequence, it was performed the electromyographic records in centric position (RC), maximum normal intercuspation (MIH), mandible laterality to the right and left sides, protrusion, mastication with soft food and voluntary maximum contraction during 4 seconds. These values were used to standardize the data of the electromyographic sample.

The normal maximum intercuspation record was obtained through the maximum teeth contact, but without touch between them. Electromyographic records of the movements into the right and left sides were made informing the patient to start in the normal maximum intercuspation position (MIH), slide the mandible to the right side, until the inferior canine tooth cusp touch the cusp of the upper canine, and after returns to the original position. In sequence, perform the movement to the left side with the same movement amplitude. After this, it was performed the protrusion electromyographic record, informing the patient to start in the maximum intercuspation position and slide their anterior inferior teeth on the palatine surface of the anterior superior teeth, until to get the top-to-top position.

Orthodontic treatment

It was used the Edgewise orthodontic technique, aiming to perform a skeletal correction where indicated and fixes through dental alignment, leveling, and intercuspation retraction. The Hawley lip splint and the tongue bar were used after the orthodontic appliance removal as retainers in the upper and lower arches, respectively.

Occlusal adjustment

The occlusal adjustment was carefully performed by selective gridding obeying the rules that were drawn up by Guichet [12] and recommended by Janson[17], molding the upper and lower arches of individuals and construction of models, assembly these in centric relationship by Lucia Jig[26,33], using a semi-adjustable articulator Gnatus, model 8600, with facial bow, carrying out analysis and mapping of the occlusal wear in selective models mounted on this device. After the selective resurfacing done in the articulator and with the results of this occlusal adjustment in the models, it was initiated this therapy in the mouth. The occlusal adjustment was made with the mandible position in centric relationship (RC), using the Lucia Jig device, developed by Lucia [22] with the aim to identify premature contacts that the mandible deflection promoted from centric relationship to normal maximum

intercuspation. These contacts have been removed through small dental damage, providing the occlusal remodeling, an uniform periodontal stimulation, and setting the occlusal condition closely to the optimum situation, without mandibular sliding (deflection). The occlusal adjustment was made only in the centric maxillomandibular relationship (RC), because the patients that compose this study showed no occlusal interference in laterality movements and protrusion condition.

Statistical analysis

The values of the root mean square (RMS) of signals collected were normalized according to the electromyographic magnitude in maximum voluntary contraction of masseter and temporal muscles, obtained by teeth clenching in usual intercuspation for four seconds. Statistical analysis was performed using the SPSS software version 17.0 (Chicago, IL) and the data were compared by analysis of variance (ANOVA).

RESULTS

1. Rest clinical condition

During this condition, there was no statistical difference between the analyzed groups, and it was observed a great electromyographic activity in individuals submitted to occlusal adjustment when compared with the electromyographic activity in individuals before the occlusal adjustment and the control group (Table 1).

2. Centric relationship

During this clinical condition, there was not observed statistical difference between the groups, and it was found a great electromyographic activity in subjects before and after the therapy with occlusal adjustment when compared to the control group, in except on the left temporal muscle (Table 1).

3. Protrusion

In the clinical condition of protrusion, there was not identified statistical difference between the analyzed groups, and it was observed a similar electromyographic activity in the examined muscles before and after the occlusal adjustment and between the control group, in except for the left masseter muscle, where the electromyographic activity was lower after the occlusal adjustment. Control group showed an electromyographic activity similar to other groups, in exception for the left masseter muscle before the occlusal adjustment, where the electromyographic activity was more expressive (Table 1).

4. Right side

During the laterality to the right side, it was not observed statistical difference between the groups. For this situation, after occlusal adjustment, there was a minor electromyographic activity on the left temporal and masseter muscles compared to the group before the occlusal adjustment, however for the right masseter and temporal muscles, this activity was higher. In relation to the control group, it was observed a minor electromyographic activity before and after occlusal adjustment for the right and left temporal muscles, a larger electromyographic activity for the right masseter muscle was observed before the occlusal adjustment and for the left masseter muscle after the occlusal adjustment (Table 1).

5. Left side

During this clinical condition, comparing the conditions of pre and post occlusal adjustment, it was observed a greater electromyographic activity for the right and left temporal muscles, and for the right masseter muscle, in exception for the left masseter, where this activity was lower. When the control group was compared to the group that was performed the occlusal adjustment, it was observed a minor electromyographic activity for the right temporal, right masseter and left masseter muscles, while for the left temporal muscle this activity was increased. It was not observed statistical difference between the groups (Table 1).

6. Chewing with soft food - chocolate

During this clinical condition, it was not observed statistical difference between the groups. For this clinical situation, it was observed a higher electromyographic activity after the occlusal adjustment in the studied muscles, in except for the left masseter muscle, which was observed a minor electromyographic activity. In relation to the control group, it was verified an increased electromyographic activity on the left temporal and masseter muscles when compared to the group that was performed the occlusal adjustment and a decreased electromyographic activity on the right temporal and masseter muscles (Table 1).

DISCUSSION

Nowadays, many orthodontic treatments are not satisfactorily finished due to skeletal discrepancies, discrepancies in size of teeth and / or patient collaboration, which can generate a maxillo-mandibular slippery, an example, the centric relationship (CR) different to the usual maximum intercuspation (MIH), which can cause destabilization of the condyle / articulate disc structures, myofunctional changes and temporomandibular disorders[24]. The occlusal adjustment used in this study is a very effective therapeutic procedure with enormous value in the treatment of occlusal dysfunction, acting as an artificial system in the replacing when the natural mechanism failed in its mission to preserve the morphofunctional harmony[20]. In most cases, the

occlusal adjustment is necessary in cases that it is not possible to correct by orthodontic treatment, such as discrepancy in size and shape of teeth, facial discrepancies, impacted teeth and lack of cooperation from the patient. These conditions result in occlusal interference provoking the mandible slide, i.e., the CR different to MIH. The occlusal adjustment procedure after the orthodontic device removal and retainers placement should be minimal, because there is a physiological movement in the first month, after this period, the occlusal analysis is done selectively to plan and identify the items to be adjusted, removing the minimum quantity of enamel, because this is an irreversible procedure[15, 23, 25].

In this study, eighteen individuals were submitted to corrective orthodontic treatment. The basic principles for an ideal orthodontic treatment were followed, according to the criteria and six keys concepts of occlusion from Andrews[3], as a tool for diagnosis and treatment planning, until to get a harmonious and balanced occlusion. The mechanics used in orthodontic treatment of this study was the Edgewise technique, which offers at the end of orthodontic treatment an aligned teeth condition, and with interocclusal contact[10,21]. This study focuses on the electromyographic activity of the temporal and masseter muscles, after the mandibular slide in a rest and in different clinical conditions, using the occlusal adjustment with the aim to contribute to the knowledge of these muscles performance, before and after this kind of treatment. In addition, the electromyographic analysis represents not only an evaluation method of the patient, but a kind of method in watching this subject[28, 29, 30].

Electromyography science has been contributed to understand the performance of facial muscles in various physiological processes such as mastication, swallowing, speech and occlusion[6,11,34,35]. In this study, the standard electromyographic analysis was crucial and allowed to evaluate the performance of the mastication muscle activity in different clinical conditions, and after occlusal adjustment. It was performed in this study the data standardization, because in accordance with previous studies involving groups of subjects, there is a need for electromyographic data standardization due to the great variability of the electromyographic registers, in relation to different individuals and muscles[16].

During the rest clinical condition, it seems that all the muscles showed electromyographic activity, these data are in accordance with Regalo et al., [27] and Castrofolio et al.[5] found electrical activity in the minimum rest of the muscles involved with the mastication process. Individuals submitted to orthodontic treatment and with RC coinciding with MIH, Group 1, i.e. without mandible sliding and without the adjustments need, used as control group, showed lower electromyographic activity than individuals belong to the Group 2, orthodontic treated, and finished with RC different from MIH, who were submitted to occlusal adjustment, with the aim to reach the ideal situation, CR position similar to MIH position, which the electromyographic activity has been increased.

With the implementation of occlusal adjustment by selective grinding, it was removed the occlusal interference on surfaces, distributing the chewing forces, reducing the trauma, improving the function and thus obtaining a balanced occlusion, aiming to stabilize the orthodontic treatment. Possibly, the increased electromyographic activity in this group occurred due to the muscles adaptation in relation to the occlusal interference removal, allowing more tooth contact and a muscular stimulus which possibilited a greater muscular activity after occlusal adjustment, which it is in according to Harper et al. [14].

During the centric relationship condition, it was found more electromyographic activity in subjects before and after the occlusal adjustment therapy, in exception for the left temporal muscle. This finding can be supported by the enormous teeth intercuspation, which would proportionated a great muscle activation. These study, in subjects with complete denture, the maximum electromyographic activity of the masseter and temporal muscles were observed during the dental clenching, thus showing a sign of good adaptation of the neuromuscular system to the occlusal condition[5,6].

In respect to the protrusion clinical condition, after occlusal adjustment, there was an acquisition of electromyographic pattern contraction already expected to maintain this attitude, characterized by a great activation of masseter muscle when compared to the temporal muscular activity. Results also found in searches of Da Silva et al.[8] to the protrusion clinical condition. The occlusal adjustment in the clinical conditions adopted in this study provided a suitability muscle activity equivalent to the levels of electromyographic activity to the control group.

Based on the concepts related to the neuroanatomical muscular activity in the lateral movement of the mandible, it is widely know that during this kind of movement, it occurs an increase of the electromyographic activity of the temporal muscle into the side that it is occurring the mandible movement, however, for the masseter muscle, the most active side is the contralateral side of this movement. Similar results are found in the search for Cecilio et tal.[6], where in the laterality conditions, greater activation of the right temporalis and left masseter was found during the condition of right laterality; greater activation of the left temporalis and right masseter muscles was recorded during the condition of left laterality. These findings were also observed in this study in all the analyzed groups. After this occlusal adjustment, it occurs a tendency to standard the electromyographic signals of the groups.

Table 1 - Normalized median (RMS) and st andard error before and after the treatme in each condition.

Clinical Conditions and muscles	Before	After	Sig.
Rest			
RT	0.585 ± 0.094	0.717 ± 0.068	0.182
LT	0.652 ± 0.132	0.708 ± 0.130	0.950
RM	0.955 ± 0.124	0.984 ± 0.069	0.316
LM	0.750 ± 0.067	0.862 ± 0.075	0.692
Protrusion			
RT	0.706 ± 0.131	0.687 ± 0.137	0.571
LT	0.741 ± 0.125	0.709 ± 0.104	0.952
RM	2.719 ± 0.717	2.665 ± 0.596	0.741
LM	5.415 ± 3.313	2.920 ± 0.973	0.508
Left laterality			
RT	0.689 ± 0.147	0.673 ± 0.121	0.907
LT	1.274 ± 2.624	1.725 ± 0.459	0.561
RM	1.773 ± 0.493	2.345 ± 0.473	0.667
LM	1.701 ± 0.831	1.412 ± 0.415	0.878
Right laterality			
RT	1.248 ± 0.124	1.739 ± 0.448	0.182
LT	0.836 ± 0.223	0.775 ± 0.111	0.950
RM	1.079 ± 0.102	1.505 ± 0.176	0.316
LM	2.968 ± 1.839	1.791 ± 0.460	0.692
Chewing			
RT	6.193 ± 1.200	7.417 ± 1.699	0.728
LT	6.289 ± 1.789	8.083 ± 1.574	0.489
RM	18.36 ± 5.466	27.18 ± 7.232	0.329
LM	18.48 ± 5.691	15.72 ± 3.864	0.904
Centric relationship			
RT	2.336 ± 0.661	1.743 ± 0.331	0.352
LT	1.440 ± 0.216	2.420 ± 0.562	0.130
RM	1.388 ± 0.262	1.234 ± 0.099	0.758
LM	1.154 ± 0.158	1.177 ± 0.101	0.786

RT- right temporal, LT- left temporal, RM- right masseter, LM- left masseter

In this study, the muscle activity during the mastication maintained a normal pattern, where the masseter muscles were more active than the temporal muscles in the three analyzed groups. This finding is due to the morphological and functional characteristics of these muscles. In the clinical condition of mastication, after occlusal adjustment, there was a balance of electromyographic activity of all tested muscles, except for the right masseter muscle where the electromyographic activity was higher after the adjustment. The occlusal adjustment promoted an approximation of the electromyographic activity patterns to the patterns regulated by the control group. The masseter muscle is a potent muscle, with strength function, acting a lot in the masticatory process, while the temporal muscle is faster, being the first to contract in the mandible close process, coordinating the movement and positioning of the mandible and act less during the mastication[4,14].

Based on the methodology used in this study, it was concluded that in all clinical conditions considered in this research, there was no significant difference between the evaluated groups. The occlusal adjustment treatment by selective wear promotes changes in the activation of the mastication muscles and after the application of this therapy, there was a tendency to increase the electromyographic activity in a rest condition, in centric relationship and, in mastication. It was also observed a decrease in the electromyographic activity during the laterality and protrusion movements.

ABSTRACT

Background. This study aimed to assess the electromyographic activity in 18 individuals, both gender, submitted to an Edgewise orthodontic treatment, comparing 9 individuals who ended their orthodontic treatment. They presented mandibular glides/slide and a maximum intercuspation(MHI) different from the centric relationship(CR), and were submitted to occlusal adjustment due to selective wear with 9 control individuals. Material and Methods. The electromyographic analyses were performed during chewing movements and while maintaining postural positions, before and after the occlusal adjustment therapy. An eight-channel electromyographer was used: K6-I EMG Light Channel Surface Electromyography (Myo-tronics Co. Seattle, WA, EUA). ANOVA was performed for the comparison between the situations before and after therapy. Results. It was observed that, after occlusal adjustment, there was a tendency for an increase electromyographic activity in the rest, centric relation and mastication and a reduction of electromyographic activity during laterality and protrusion for $p<0.05$. Conclusion. Therefore, we conclude that the occlusal adjustment therapy, promotes modifications in the activity of the masticatory muscles.

UNITERMS: *Electromyography; Orthodontics, Corrective; Masseter Muscle, Temporal Muscle.*

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