The effect of a Lucia jig for 30 minutes on neuromuscular re-programming, in normal subjects

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Abstract: The Lucia jig is a technique that promotes neuromuscular re-programming of the masticatory system and allows the stabilization of the mandible without the interference of dental contacts, maintaining the mandible position in harmonic condition with the musculature in normal subjects or in patients with temporomandibular dysfunction (TMD). This study aimed to electromyographically analyze the activity (RMS) of the masseter and temporal muscles in normal subjects (control group) during the use of an anterior programming device, the Lucia jig, in place for 0, 5, 10, 20 and 30 minutes to demonstrate its effect on the stomatognathic system. Forty-two healthy dentate individuals (aged 21 to 40 years) with normal occlusion and without parafunctional habits or temporomandibular dysfunction (RDC/TMD) were evaluated on the basis of the electromyographic activity of the masseter and temporal muscles before placement of a neuromuscular re-programming device, the Lucia jig, on the upper central incisors. There were no statistically significant differences ($p < 0.05$) in the electromyographic activity of the masticatory muscles in the different time periods. The Lucia jig changed the electromyographic activity by promoting a neuromuscular reprogramming. In most of the time periods, it decreased the activation of the masticatory muscles, showing that this device has wide applicability in dentistry. The use of a Lucia jig over 0, 5, 10, 15, 20 and 30 minutes did not promote any statistically significant increase in muscle activity despite differences in the data, thus showing that this intra-oral device can be used in dentistry.

Descriptors: Electromyography; Dental Occlusion; Masticatory Muscles; Stomatognathic System; Control Group.

Introduction

The Lucia jig is used to de-program the masticatory muscles and facilitate the manipulation of the jaw in the centric relation position in normal subjects or in patients with TMD.[1,2] One of its mechanisms of action is to avoid contact between the posterior teeth during mandible elevation and thus prevent the proprioceptive impulses that arise from guiding the mandible to other standard positions. It also provides muscle relaxation and makes jaw manipulation much easier.[3]

Electromyography (EMG) is a very useful tool to monitor masticatory muscle activity during the activation of the stomatognathic system.

It evaluates the muscular record during rest to help determine the adaptive position of the mandible and the condyle by verifying the effectiveness of devices that may increase or decrease the electromyographic activity.[4-8]

The Lucia jig not only eliminates any type of occlusal interference that may cause mandibular deviation of the centric relation (CR) for maximum habitual intercuspation (MHI) but also reduces the effect of muscular hyperactivity.[9] It facilitates the mandibular manipulation of normal subjects, assisting dental surgeons to centralize the condyles along with their respective articular discs in the mandibular fossae.[10,11]

The purpose of this study was to evaluate the effect of a Lucia jig on the neuromuscular reprogramming in normal subjects (control group), emphasizing its action on the stomatognathic system, especially with respect to clinical indications in dentistry. The unpublished results obtained with this study may guide dental surgeons to develop diagnoses, prognoses and oral rehabilitation plans to contribute to patients' quality of life.

Methodology

Sample

Forty-two adult subjects (control group) were selected: 20 men and 22 women, aged 21 to 40 years (30 ± 4 years), from the Occlusion and Orofacial Service DAPE. The exclusion criteria were as follows: the absence of posterior occlusal stability and the use of medication that may interfere with muscular activities. The inclusion criteria were as follows: nasal-breathing individuals and normal occlusion with neither parafunctional habits nor clinical signs and symptoms of temporomandibular dysfunction (RDC/TMD index).[12] The study protocol was approved by the University Ethics Committee, protocol no. 2009.1.1391.58.5.

Preparation of Lucia jig

The Lucia jig was placed by a single dental surgeon, a specialist in oral rehabilitation, directly into the oral cavity of each individual with Duralay chemically activated acrylic resin (CAAR) (Reliance Dental Mfg Co., Worth, USA). After the manipulation of the powder and liquid, the resin was adapted to the upper central incisors during the plastic phase. They were then isolated with the aid of solid Vaseline to protect and prevent the spaces between the posterior teeth from having contact with the acrylic resin. The Lucia jig extended from the vestibular to the palatine aspects of the dental elements, remaining in the palatine face, with two sides converging to a wedge-shaped vertex. The individual was instructed to slowly occlude the lower central incisors on the vertex of the resin until the posterior teeth were approximately 1 mm apart.

The Lucia jig was adjusted with a pear-shaped tungsten drill so that it had only one contact point in the palatine wedge vertex against the lower central incisors, in the midline, when the mouth was closed, providing a 1 millimeter maximum disocclusion between the posterior teeth.

Electromyography

Evaluation of muscular activity was conducted through electromyographic records of the masticatory muscles in the resting position, with the Lucia jig attached to the upper central incisors in contact with the lower central incisors for the following time periods: 0, 5, 10, 15, 20 and 30 minutes (during the same session).

Surface electromyography was performed using five channels of the Myosystem-Br1 (DataHominis Ltda., Uberlândia, Brazil) with simultaneous acquisition and common grounding to all channels. Surface electromyographic data were collected using surface differential electrodes (two Ag-AgCl bars, 10 · 2 · 1 mm, with a 10-mm inter-electrode distance, a gain of 20, an input impedance of 10 GΩ and a common mode rejection ratio of 130 dB). The electromyographic signals were sampled with a 12-bit A/D converter board at a frequency of 2 kHz and band-pass filtered at 0.01–1.5 kHz. The raw sEMG data were digitally bandwidth-filtered at 10–500 Hz, and the root mean squares (RMS) were calculated. The skin was shaved at the electrode sites, gently abraded and cleaned with alcohol to reduce skin impedance prior to the attachment of the electrodes, which were positioned in accordance with SENIAN recommendations.[13] Surface electromyo-

graphic signals were recorded simultaneously from the masseter and temporalis muscles on both sides. Using palpation, the muscles were located, and the electrodes were positioned bilaterally on the medial portion of the masseter muscles and on the anterior portion of the temporalis muscles with the long axes remaining parallel to the muscle fibers. During the EMG recordings, individuals were placed in a calm, quiet environment with low luminosity, sitting in an upright position with their feet on the floor, arms resting on their thighs, looking forward, and with the Frankfort plane parallel to the floor.

Results

The EMG data were tabulated and analyzed statistically using SPSS version 19.0 for Windows (SPSS Inc., Chicago, USA). We performed a descriptive analysis (i.e., the mean, standard deviation, and maximum and minimum values) for each variable at a 95% confidence level ($p < 0.05$). The values obtained were compared using repeated measures over the entire duration of the experiment (0 to 30 minutes) with the Lucia jig.

Table 1 shows the electromyographic data obtained with the use of the Lucia jig during the time period (0 to 30 minutes) in normal subjects. No statistically significant difference was found for the masseter and temporal muscles ($p < 0.05$).

Table 1 - Electromyographic means and standard errors of the right masseter (RM), left masseter (LM), right temporalis (RT) and left temporalis (LT) muscles for five different time periods (minutes), zero (0), five (5), ten (10), fifteen (15), twenty (20) and thirty (30) minutes, with the Lucia jig in normal subjects.

Time and muscles	N	Mean ± standard error	Significance
RM			
0	42	7.640 ± 0.510	
5	42	8.309 ± 0.904	
10	42	7.791 ± 0.542	
15	42	8.341 ± 0.903	ns
20	42	8.317 ± 0.811	
30	42	9.398 ± 1.240	
LM			
0	42	7.016 ± 0.580	
5	42	6.329 ± 0.263	
10	42	6.465 ± 0.322	
15	42	6.475 ± 0.381	ns
20	42	6.262 ± 0.369	
30	42	6.579 ± 0.437	
RT			
0	42	8.550 ± 1.139	
5	42	8.959 ± 0.979	
10	42	8.420 ± 0.775	
15	42	8.440 ± 0.842	ns
20	42	8.474 ± 0.972	
30	42	9.042 ± 1.067	
LT			
0	42	7.489 ± 0.856	
5	42	7.471 ± 0.748	
10	42	7.630 ± 0.807	ns
15	42	7.741 ± 0.902	
20	42	7.319 ± 0.630	
30	42	7.439 ± 0.774	

ns: not significant for $p < 0.05$.

Discussion

In movement records, all proprioceptive impulses that control them during mandibular closure should be blocked to prevent deviations and thus enable the correct record of the centric relation (CR). These impulses are responsible for awareness of the jaw position in space and guide them to habitual contacts. The reflexes that occur are reinforced by the proprioceptive stimuli. A relationship between the actions of mandible elevation should be obtained without any lateral deviation. A practical way to block the normal proprioception is to avoid dental contact.

The Lucia jig is a device made with a chemically activated acrylic resin (self-polymerized) placed between the upper anterior incisors to de-program the proprioceptive patterns of habitual contact between teeth, thus changing the mandibular closure pattern. The individual is instructed to keep his/her teeth out of contact while the jig is being adjusted to avoid hindering the deprogramming.[13]

The Lucia jig is a technique applied by dental surgeons to promote neuromuscular re-programming in normal subjects or in patients with TMD of the

masticatory system. Its purpose is the stabilization of the mandible without the interference of dental contacts, thereby maintaining a harmonic condition of the reflex arc of the mouth opening and closing.[14]

After using the Lucia jig, Galo *et al.*[15] observed that it was easier for professionals to clinically manipulate the mandible of normal subjects while centrally positioning the condyles along with their respective articular discs in the mandibular fossae, thereby facilitating the determination of the mandibular rotation axis. The Lucia jig can also help and guide the professional to perform occlusal adjustment using the regressive method in CR so that the wax is not pierced by the occlusal contacts. Consequently, an accurate record is obtained, i.e., without causing dimensional changes in the wax and allowing, if necessary, the same procedure to be repeated with the same CR record.

Scientific literature does not show enough evidence to establish the influence of the Lucia jig in neuromuscular reprogramming in normal subjects. This study sought to describe the dominant morpho-functional patterns of the masticatory system from 0 to 30 minutes with the Lucia jig in normal subjects using the analysis of the electromyographic activity of the masseter and temporalis muscles.

The low levels of tonic activity of the masticatory muscles are controlled by the sensory receptors from the central nervous system, with low or no electromyographic activity.[16]

Even with the use of a Lucia jig for 30 minutes, no statistically significant changes were observed in the muscle activation patterns over time. The activation pattern eventually increased or decreased, but the numerical pattern changes were small. It should be emphasized that, in agreement with the findings of Cecilio *et al.*,[5] the temporalis muscles were found to be the most active of the muscles studied throughout the experiment. This outcome was not expected in our study. We posited that, with the use of a Lucia jig, a decrease would be observed in activation of the entire musculature under analysis; however, that was not verified. A hypothesis for such results can be explained by the selected sample. In this study, normal subjects (control group) were chosen as long as they did not present any sign of muscular dysfunction (*e.g.*, painful symptoms and temporomandibular disorder) that could influence the results.

It was also observed that when the mandible remained at rest for longer periods of time, an alteration occurred in the electromyographic activity of the masseter and temporalis muscles, indicating that the re-programming device changed the electromyographic activity during its use.[17]

Lund *et al.*[17] reported that when the mandible remained in the resting position for longer periods of time, a change occurred in the electromyographic activity of the masseter and temporalis muscles. Such results are in agreement with the ones obtained in this study, in which the re-programming device changed the electromyographic activity during the specified time period; however, the data were not statistically significant.

Donegan *et al.*[18] observed that neuromuscular reprogramming devices did not alter the electromyographic patterns of the temporalis and masseter muscles in a period of 15 minutes. The results of this study are not in agreement with those of Donegan *et al.*[18] because in our study, over time (and also in a comparison between the initial time and after 15 minutes), changes occurred in the activity of the masseter and temporalis muscles, increasing the myoelectric activity of the right masseter and left temporal muscles and decreasing the myoelectric activity of the left masseter and the right temporalis muscles.

In this study, with the use of a neuromuscular reprogramming device producing a programmed contact of the anterior teeth for the specific time periods proposed by the study, we observed the highest electromyographic values in relation to the resting position at 0, 5, 10, 15, 20 and 30 minutes for the left temporalis and right masseter muscles; at 0 min for the left masseter muscle; and at 5 and 30 minutes for the right temporalis muscle in normal subjects.

Santosa *et al.*[19] demonstrated that a neuromuscular device eliminates the posterior occlusal contacts, causing a de-programming of the proprioceptive memory of the periodontal ligament and promoting the relaxation of the masticatory muscles.

Landulpho *et al.*[20] analyzed the EMG activity of

the masseter and temporalis muscles before, during and after treatment with the device on the occlusal plane surface and concluded that there was a decrease in the electromyographic activity of the temporalis muscle during the evaluation periods proposed in this study. Those data are not in agreement with the results of this study, wherein the electromyographic activity of the temporalis muscle increased in most of the clinical situations analyzed.

The right masseter and the left temporalis muscles showed a change in the electromyographic activity patterns with the use of a Lucia jig for the aforementioned time periods, suggesting that the proprioceptive response may change both the articular stability and the muscular activity in returning to the proper position.

The Lucia jig technique is efficient in muscular reprogramming for up to 5 minutes as a result of previous muscle stops, which allow the condyles to sit in a more central position in the fossae, thus decreasing the activation of the entire musculature. However, this effect was not observed in the present study, wherein the presence of a neuromuscular reprogramming device programmed to be in contact with the anterior teeth, for certain time periods, showed higher electromyographic values after 5 min in relation to the starting position for the right masseter and left and right temporalis muscles.

Over the course of 15 minutes, there were no significant changes in the electromyographic patterns of the masseter and temporalis muscles;[15] however, the results of this study showed that some changes occurred in the activity of the right masseter and left temporalis muscles over time. These changes consisted of increased myoelectric activity of the right masseter and left temporal muscles and decreased myoelectric activity of the left masseter and right temporalis muscles.

An explanation for such results can be the selected sample, which included control individuals who did not present any sign of muscular dysfunction (*e.g.*, painful symptoms and temporomandibular dysfunction) that could influence the results.

The comparative analysis between the initial position and the use of a device between the teeth did not show any significant increase in muscular activity. The study sought to respect the free, functional space and the preparation of the Lucia jig was kept within the 3-mm limit. Therefore, the changes in muscular activity could not be related to the use of a device between the teeth, which could promote changes in the functional equilibrium of the stomatognathic system in normal subjects.

Conclusion

The authors concluded that the Lucia jig changes the electromyographic activity in normal subjects and thus may lead to a neuromuscular reprogramming of the jaw. This is important to allow the dentist to diagnose the patient's occlusal position correctly.

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