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Standardization of the electromyographic signal through the maximum isometric voluntary contraction.

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The objective of this study was to analyze the electromyographic (EMG) data, before and after normalization. One hundred (100) normal subjects (with no signs and symptoms of temporomandibular disorders) participated in this study. A surface EMG of the masticatory muscles was performed. Two
different tests were performed: maximum voluntary clench (MVC) on cotton rolls and MVC in intercuspal position. The normalization was done using the mean value of the EMG signal of the first examination. The coefficient of variation CV showed lower values for the standardized data. The standardization was effective in reducing the differences between records from the same subject and in different subjects.

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Activity and asymmetry index of masticatory muscles in women with and without dysfunction temporomandibular.
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PROPOSE: Compare the symmetry of the activity and masticatory muscles in individuals with TMD and asymptomatic.

METHODS: The study included 50 women, while 31 had temporomandibular disorders (TMD) and 19 were asymptomatic (control group), aged between 19 and 40 years. The volunteers were subjected to clinical examination of the diagnostic criteria in research with TMD (RDC/TMD) with the aim of diagnosing volunteers with or without TMD, and evaluate the electromyographic activity of the right temporalis muscle (TR) and left (TL), right masseter (MR) and left (ML), in situations of rest, isometric contraction of the muscles of the jaw elevators. We obtained the rates of activity and asymmetry in each situation and for the collection and TMD control groups. RESULTS: For the index of activity for the rest there was significant difference (p = 0.0008) between the control group and the TMD group, with predominance of temporal muscle, was not observed difference between groups for the index of activity during the isometric contraction (p = 0.1069). For the index of asymmetry no difference between groups during rest, for the masseter muscles (p =0.4182) and the temporal (p = 0.7614), and also during the isometry for both masseter muscles (p = 0.8691) and for time (p = 0.6643). CONCLUSIONS: The control group showed prevalence of TMD and temporal muscle during rest, which did not occur in the isometry, and no difference for the index of asymmetry between the groups for the masseter and temporal muscles.

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[Electromyographic evaluation of functional status of temporal muscles and mastication muscles in patients with close position of frontal teeth in cases of different occlusion]. [Article in Russian]

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Functional status of mastication muscles in 44 patients of the age 19-35 years with close position of frontal teeth and different occlusion variants was studied. General electric activity of mastication and temporal muscles (IMPACT, mKV/s), index of proportional activity of symmetric muscles (capital ER, Cyrilliccapital O, Cyrilliccapital ES, Cyrillic, %), activation index (ATTIV, %) and torque coefficient (TORS, %) were determined. According to the received results in patients with close position of frontal teeth and different occlusion variants some disbalance was disclosed in the work of mastication muscles that testified to functionally unstable occlusion and the necessity of its correction.
Electromyographic standardized indices in healthy Brazilian young adults and data reproducibility.
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The determination of normal parameters is an important procedure in the evaluation of the stomatognathic system. We used the surface electromyography standardization protocol described by Ferrario et al. (J Oral Rehabil. 2000;27:33-40, 2006;33:341) to determine reference values of the electromyographic standardized indices for the assessment of muscular symmetry (left and right side, percentage overlapping coefficient, POC), potential lateral displacing components (unbalanced contractile activities of contralateral masseter and temporalis muscles, TC), relative activity (most prevalent pair of masticatory muscles, ATTIV) and total activity (integrated areas of the electromyographic potentials over time, IMPACT) in healthy Brazilian young adults, and the relevant data reproducibility. Electromyography of the right and left masseter and temporalis muscles was performed during maximum teeth clenching in 20 healthy subjects (10 women and 10 men, mean age 23 years, s.d. 3), free from periodontal problems, temporomandibular disorders, orofacial myofunctional disorder, and with full permanent dentition (28 teeth at least). Data reproducibility was computed for 75% of the sample. The values obtained were POC Temporal (88.11 +/- 1.45%), POC masseter (87.11 +/- 1.60%), TC (8.79 +/- 1.20%), ATTIV (-0.33 +/- 9.65%) and IMPACT (110.40 +/- 23.69 microV/microV.s %). There were no statistical differences between test and retest values (P > 0.05). The Technical Errors of Measurement (TEM) for 50% of subjects assessed during the same session were 1.5, 1.39, 1.06, 3.83 and 10.04. For 25% of the subjects assessed after a 6-month interval, the TEM were 0.80, 1.03, 0.73, 12.70 and 19.10. For all indices, there was good reproducibility. These electromyographic indices could be used in the assessment of patients with stomatognathic dysfunction.
and masseter muscles was recorded in all patients and the activity (ratio between the activities of the temporal and masseter muscles) index was computed over a maximum voluntary clench test of 3 seconds. Muscular waveforms were also analysed by computing a percentage overlapping coefficient (POC, an index of the symmetric distribution of the muscular activity determined by the occlusion) and a Torque Coefficient (TORS, to estimate the possible presence of a mandibular torquing). The electrical activity was performed just before and immediately after the insertion of the splint and data were compared by paired Student’s t-test. Results: overall, the splint made the electrical activity more equilibrated both between the left and right side (larger symmetry in the masseter muscle POC, \(p< 0.05\) and in the global POC, \(p< 0.05\)) and the temporal and masseter muscles (activity index, \(p<0.05\)) and between TR and ML and TL and MR muscles couples (larger symmetry in TORS, \(p<0.05\)). Conclusions: this study shows the utility of sEMG analysis for the management of TMD patients and in particular for the control of the correct construction and balance of occlusal splints.


Electromyographic standardized indices in healthy Brazilian young adults and data reproducibility.

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The determination of normal parameters is an important procedure in the evaluation of the stomatognathic system. We used the surface electromyography standardization protocol described by Ferrario et al. (J Oral Rehabil. 2000;27:33-40, 2006;33:341) to determine reference values of the electromyographic standardized indices for the assessment of muscular symmetry (left and right side, percentage overlapping coefficient, POC), potential lateral displacing components (unbalanced contractile activities of contralateral masseter and temporalis muscles, TC), relative activity (most prevalent pair of masticatory muscles, ATTIV) and total activity (integrated areas of the electromyographic potentials over time, IMPACT) in healthy Brazilian young adults, and the relevant data reproducibility. Electromyography of the right and left masseter and temporalis muscles was performed during maximum teeth clenching in 20 healthy subjects (10 women and 10 men, mean age 23 years, s.d. 3), free from periodontal problems, temporomandibular disorders, orofacial myofunctional disorder, and with full permanent dentition (28 teeth at least). Data reproducibility was computed for 75% of the sample. The values obtained were POC Temporal (88.11 +/- 1.45%), POC masseter (87.11 +/- 1.60%), TC (8.79 +/- 1.20%), ATTIV (-0.33 +/- 9.65%) and IMPACT (110.40 +/- 23.69 microV/microV.s %). There were no statistical differences between test and retest values (\(P > 0.05\)). The Technical Errors of Measurement (TEM) for 50% of subjects assessed during the same session were 1.5, 1.39, 1.06, 3.83 and 10.04. For 25% of the subjects assessed after a 6-month interval, the TEM were 0.80, 1.03, 0.73, 12.70 and 19.10. For all indices, there was good reproducibility. These electromyographic indices could be used in the assessment of patients with stomatognathic dysfunction.

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Asymmetric activation of temporalis, masseter, and sternocleidomastoid muscles in temporomandibular disorder patients.

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The aim of this study was to analyze the symmetry of the electromyographic (EMG) activity of the temporalis, masseter, and sternocleidomastoid (SCM) muscles in volunteers divided into a control group and a temporomandibular disorder (TMD) group. The surface EMG recordings were made during mandibular rest position, maximal intercuspal position, and during the chewing cycle. Normalized EMG waves of paired muscles were compared by computing a percentage overlapping coefficient (POC). The difference between the groups and between the static and dynamic clenching tests was analyzed through repeated measures, ANOVA. Symmetry of the temporalis, masseter, and SCM muscles activity was smaller in the TMD group compared to the control group. The mandibular postures were also significantly different among themselves. The asymmetric activation of jaw and neck muscles was interpreted as a compensatory strategy to achieve stability for the mandibular and cervical systems during masticatory function.

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Electromyographic analysis of masticatory and neck muscles in subjects with natural dentition, teeth-supported and implant-supported prostheses

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Objectives: To compare the electromyographic (EMG) characteristics of masticatory and neck muscles in patients with natural dentition, teeth-supported prostheses and implantsupported prostheses. Materials and methods: Twenty-five subjects aged 40–80 years were examined. Five patients had maxillary and mandibular implant-supported fixed prostheses; five patients had mandibular implant-supported fixed prosthesis and maxillary removable complete denture; seven patients had implant-supported fixed prosthesis (one arch) and natural dentition or full-arch tooth-fixed prosthesis (one arch); and eight control subjects had natural dentition or single tooth-fixed prostheses. Surface EMG of masseter, temporal and sternocleidomastoid muscles was performed during maximum teeth clenching and unilateral gum chewing. Interarch dental contacts were assessed with shims. Results: All groups had similar interarch dental contacts (P=0.05). During clenching, patients with maxillary and mandibular implant-supported fixed prostheses had unbalanced standardized masseter and temporalis anterior activities (74%), with significantly larger values found in the other patients and control subjects (all mean values larger than 86%, P=0.017). All patients chewed with significantly larger muscular potentials than control subjects (on average, 1434–2100 mVs vs. 980 mVs, P=0.04), and had altered muscular patterns (left side, P=0.021). The patients with one arch with natural dentition/tooth fixed prostheses had chewing muscular patterns similar to the control subjects. Conclusions: Clenching with the analyzed prostheses was performed with a relative...
increment of temporalis activity. Neuromuscular coordination during chewing was larger in patients who maintained their teeth or dental roots, independently from the number of dental contacts.


Evidence of an influence of asymmetrical occlusal interferences on the activity of the sternocleidomastoid muscle.
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To investigate the hypothesis of a functional coupling between occlusion and neck muscles, the immediate effect of asymmetrical occlusal interferences on the pattern of contraction of the sternocleidomastoid muscles (SCM) during maximum voluntary clench (MVC) was analysed in 30 healthy subjects. All subjects had a complete and sound permanent dentition, without temporomandibular joint (TMJ) and craniocervical disorders. A 5-s surface electromyogram (EMG) examination of the SCM was performed during (1) MVC in intercuspal position and (2) MVC with a single 200-microm occlusal interference alternatively positioned on teeth 16, 13, 23, 26. All subjects had a symmetrical EMG activity during MVC in intercuspal position. For each subject, SCM potentials were standardized as percentage of the mean potentials recorded during MVC on natural dentition and the EMG waves of left- and right-side muscles were compared by computing the relevant percentage overlapping coefficient (POC). For each subject, the best and the worst POCs computed during the four MVC tests with occlusal interferences were found and the percentage difference between them was calculated. In the four MVC tests with occlusal interferences, SCM symmetry was very different from that recorded during MVC on natural dentition. The difference between the best and worst POCs computed within each subject was very variable, ranging from 1.52 to 41.57%. In conclusion, when young healthy subjects with a normal occlusion clenched on an asymmetrical occlusal interference, they had an altered left-right side pattern of contraction of their SCM. In almost all subjects, a previously symmetrical pattern became asymmetrical.

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Immediate effect of a stabilization splint on masticatory muscle activity in temporomandibular disorder patients.
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Surface electromyography (EMG) allows the quantification of the occlusal equilibrium in dysfunctional patients, for instance in those with temporomandibular disorders (TMD). Fourteen patients (ten women, four men) with internal derangement type I were selected among the TMD patients referred to a private practice in Milan. A stabilization splint with posterior contacts was made for each patient. To verify the static neuromuscular equilibrium of occlusion, EMG activity of left and right temporal and masseter muscles was recorded in all patients and the activity (ratio between the activities of the temporal and masseter
muscles) index was computed over a maximum voluntary clench test of 3 s. Muscular waveforms were also analysed by computing a percentage overlapping coefficient (POC, an index of the symmetric distribution of the muscular activity determined by the occlusion). The total electrical activity was measured by calculating the area under the entire muscular waveforms. In all patients EMG was performed just before and immediately after the insertion of the splint and data were compared by paired Student’s t-tests. Overall, the splint reduced the electrical activity of the analysed muscles (P < 0.005) and made it more equilibrated both between the left and right side (larger symmetry in the masseter muscle POC, P < 0.05) and between the temporal and masseter muscles (activity index, P < 0.01).

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Neuromuscular evaluation of post-orthodontic stability: an experimental protocol.
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To prevent relapse after orthodontic treatment, retention is often considered indispensable. Soft tissues are thought to have a significant influence on dental movements. To quantify the influence of masticatory muscles on post-treatment relapse, and in an attempt to avoid unnecessary procedures, 2 male orthodontic patients (13 and 30 years old at debonding) were followed up. The patients completed 2 years of fixed orthodontic treatment and received no post-orthodontic retention. After 1 week and again after 6 months, alginate impressions of dental arches and a surface electromyographic (EMG) assessment of the masseter and temporalis muscles during maximum voluntary clenching were performed. The younger patient received surface EMG monitoring once a month for the first 6 months and at the 1-year follow-up appointment. Arch dimensions and the 3-dimensional inclination of the facial axis of the clinical crown (FACC) were measured using a computerized digitizer. Symmetry in muscular contraction was measured by the percentage overlapping coefficient (POC), and potential lateral displacing components were assessed by the torque coefficient (TC). At the 6-month follow-up, no clinical modifications were observed. Quantitative evaluation assessed that arch dimensions had changed slightly (up to 1 mm). While the adolescent patient had no modifications in FACC inclinations, the 30-year-old patient showed significant alterations (up to 18 degrees). In all examinations of the adolescent patient, POC was higher than 86% and TC was lower than 10%. In the adult, POC was inside the normal range, while all TCs were higher than 10.5%. The larger TC measured in the adult may explain the larger modifications in the 3-dimensional position of his dental crowns. In conclusion, a surface EMG assessment may help in the detection of patients who might need post-orthodontic retention.

PMID: 12596694  [PubMed - indexed for MEDLINE]


The effects of a single intercuspal interference on electromyographic characteristics of human masticatory muscles during maximal voluntary teeth clenching.
Ferrario VF, Sforza C, Serrao G, Colombo A, Schmitz JH.
In 13 healthy subjects (eight men and five women, mean age, 22 years), an aluminum intercuspal interference (height, 0.25 mm) was placed on the maxillary right first premolar to study its effect on the contractile symmetry of the right and left masseter and anterior temporalis muscles when measured through a Percentage Overlapping Coefficient (POC), derived from surface electromyographic recordings of maximum voluntary teeth clenching. Additionally, and to estimate the potential of the experimental intercuspal interference to induce lateral displacement of the mandible, a Torque Coefficient (TC) was derived from surface electromyographic recordings. The conclusion was that the experimental occlusal interference gave rise to asymmetric contractile activity in the studied mandibular elevator muscles as well as a potential to displace the mandible in a lateral direction.

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Coordinated electromyographic activity of the human masseter and temporalis anterior muscles during mastication
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The present report aimed at evaluating the within- and between-subject electromyographic coordination between the masseter (M) and temporalis anterior (T) muscles during the performance of a standardized chewing task. Electromyographic activity of M and T muscles was recorded in 60 young healthy adults (30 men, 30 women) during two 15-s unilateral mastications of gum. Left-right differential potentials (8M = MR-ML, 8T=TR-TL) were computed and the J(5M- + 8T-) moduli were calculated. The maximum modulus relative to each masticatory cycle was located, and each modulus and differential potential were expressed as a % of the maximum modulus for each subject and chewing trial. For each subject and chewing side, the masticatory frequency was computed, and statistics of the moduli as %s of the maximum were determined by means of bivariate analysis. Within-subject repeatability of the unilateral chewing patterns was good. Mean population values for the modulus position (bivariate analysis), chewing frequency, and maximum modulus of the differential potentials (univariate statistics) were computed. A significant gender difference was found for the masticatory frequency, with larger values in men than in women. Conversely, no gender or side differences were found for the mean values of the maximum modulus or for the mean position of the percentage moduh. The chewing test applied allowed the evaluation of the neuromuscular coordination during the performance of a standardized physiologic activity. In particular, it quantified the within-subject and chewing side repeatability of the muscular pattern.