Title: Kurtosis, a new variable with possible diagnostic value in analysis of jaw muscle surface EMG.

Short title: Kurtosis & Jaw Muscle SEMG.

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Contribution made by each author:

Boxiu Li and Yan Dong was a guarantor of integrity of entire study. Boxiu Li, Sven E Widmalm and Yan Dong conceptualized and designed the study. Boxiu Li, Jianlai Hu, and Min Lin involved in literature research, clinical studies, experimental studies and data acquisition. Jianlai Hu, Sven E Widmalm, Tongsheng Zhang and Dong Zhou analysed/interpreted the data and involved in statistical analysis. Boxiu Li, Sven E Widmalm, Anders Buvarp and Yan Dong prepared, edited and revised/reviewed the manuscript. Sven E Widmalm, Anders Buvarp and Yan Dong involved in the final version approval of the manuscript.

Conflict of interest:

All authors (both the corresponding author and co-authors) confirmed that we do not have a conflict of interest to declare.

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Research data are not shared.

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Abstract The aim was to record and analysis voltage and kurtosis levels of SEMG recorded bilaterally in the masseter and anterior temporalis areas during rest and clenching and to compare the kurtosis levels between 23 healthy controls and 21 patients with TMJ disc dysfunction. The hypothesis was that kurtosis values are higher in patients with disc dysfunction

than in healthy subjects. Recordings were made with the BioPAK EMG system. Gain was adjusted to record the data within the range of ±2000μV. The kurtosis levels of clenches were significantly higher in patients in all four areas with sensitivity, 38.1% to 61.9%, and specificity, 82.6% to 100.0%. No differences were found in kurtosis levels during mandibular rest. The results support, that kurtosis values of SEMG recorded during clenching have a potential diagnostic interest. A limitation is that kurtosis values cannot be correctly calculated if EMG-amplitudes are clipped, which often happens if the maximal range is only at ±1000μV.

Keywords: Excessive kurtosis, TMD, masseter muscle area, surface EMG, sensitivity, specificity, amplifier gain.

Background

Surface electromyographic (SEMG) recording of muscle activity is a commonly used tool in the study of skeletal muscle function, and in diagnosis and treatment of muscle dysfunction (1, 2, 3). Healthy muscles are expected to be able to contract within a functional force range, and to keep an even activity level, during contractions (4).

Comparing voltage levels of the recorded activity, is a conventional choice in analysis of SEMG recordings from dental patients (1, 2). So far, studies have mostly been focused on changes in mean voltage levels. However, keeping the activity steady and at a desired level, is also important, given the mean voltage values do not reflect differences regarding variations in amplitude height, within one and the same recording. That is, the amplitudes can in one recording have the same height and vary in heights in another, while the mean voltages still are the same in both recordings. There is a need for methods to compare differences due, not only to mean voltage levels, but also to distribution anomalies. Increased variation in amplitude heights is reflected in higher kurtosis values and can therefore be used as a measure of the ability to keep an even force level. Calculating the kurtosis values has been found to be of value in non-dental medical studies (5-10). If the recorded activity of a patient shows more extreme values than expected, then this would be observed in the kurtosis value, which summarizes the extent of values in the tails of a distribution. Kurtosis has been described in jaw muscle research (11) but has not been tested in TMD patients as a possible diagnostic aid. It is of interest to know if kurtosis can be a useful measure with the potential for improving diagnostic accuracy. The measurement of excess kurtosis is against a Gaussian distribution which is a commonly used assumption for SEMG values.

The aims were to compare kurtosis levels of SEMG, at clenching with maximal force, and mandibular rest, between a group of healthy volunteers and a group of TMD patients with the primary diagnosis TMJ disc dysfunction. SEMG was recorded in four facial areas, the right masseter, left masseter, right anterior temporalis, and left anterior temporalis areas.

The hypotheses were, that kurtosis values of SEMG recorded during rest and contractions are higher in patients with TMJ disc dysfunction than in healthy subjects.

In this paper, the words "clenching with maximal force" and "clenching", and mandibular rest" and "rest" are used interchangeably.

Methods

Subjects

All subjects gave informed consent. The experimental protocols were approved by the Zhejiang University Ethical Committee. There were a total of 44 subjects, 14 male age 25.7 ± 7.23 and 30 female age 26.5 ± 12.00 years. They were divided into 2 groups.

Group 1 (control group) consisted of 23 subjects, healthy volunteers, without signs or symptoms indicating any of the diagnoses listed in the groups of diagnoses presented under the heading TMD, with mean age 24.5 ± 5.88 years, of which 9 males were with mean age 27.7 ± 8.05 and 14 females with mean age 22.5 ± 2.74 years. Health is defined as a state of optimal, physical, mental, and social well-being, but it does not mean that the subjects could not have any asymptomatic disease or infirmity (12). Such absence can never be guaranteed with any method. Here healthy means that the control subjects reported that they felt healthy and that no unhealthy signs were detected at the examination.

Group 2 (experimental group) had 21 patients where the primary diagnosis was TMJ disc displacement, mean age 28.1 ± 14.06. The group consisted of 5 males with mean age 22.2 ± 4.03 and 16 females with mean age 29.9 ± 15.62 years. 10 patients had disc displacement without reduction (DD) in one or both joints, 10 had disc displacement with reduction (DDR) in one or both joints, one had DD on one side and DDR on the other. The only significant age difference was between male and female control subjects, where males were about 5 years older ($p = .037$).

All patients had one of the RDC diagnoses (13) in group II. Some patients had also diagnoses in the groups I and III. Regarding the individual RDC diagnoses, the numbers of patients within each diagnosis subgroup were Ia 0, Ib 1, IIa 8, IIb 10, IIc 4, IIIa 4, IIIb 3, and IIIc 1.

The patients were recruited from those coming for treatment with acute signs or symptoms of TMJ/muscle pain or dysfunction and having a diagnosis belonging to the RDC subgroup II. All diagnoses of disc position were based on examination according to RDC standards (13), and all, except one, who did not want MRI examination, also on bilateral MR imaging of the TMJs to confirm disk position and morphological characteristic (14). It is the policy of the Clinic to not treat pain free subjects without jaw movement dysfunction, even if they had clicking of DDR type observed at auscultation.

The subjects underwent bilateral MRI examinations of their TMJs with the jaw in closed and open positions. MRI was performed with a 1.5T magnetic resonance unit (Signa, General Electric Co, Milwaukee, WI). Images were obtained at closed- and open-mouth positions in the sagittal plane and at the closed-mouth position in the coronal plane. Disc position evaluations, both uni- and bilateral, were based on the criteria described by JE Drace, & DR Enzmann (14). The method was devised to quantify disc displacement in terms of the number of degrees from a 12 o'clock or vertical position relative to the condyle.

Test movements

We collected our SEMG data from left and side recordings from the four areas, left and right masseter areas and the left and right anterior temporalis areas. The SEMG recordings were made with the subjects sitting in a chair with their back and head upright. They were instructed to clench with maximal force for about 3 seconds at least 6 times with the mandible back in resting position for about 3 seconds between each clench, followed by a 3-second rest after the last clench. They were instructed to stop clenching if they felt pain. Patients, with acute pain, induced when attempting to clench, were not included. Persuading them to clench hard, despite pain, might increase the damage to already injured TMJ tissues.

Recording of jaw muscle area surface EMG

Recordings were made using the BioPAK system Version 7.2 (Bio Research Associates Inc. Milwaukee, WI, USA) (15). Bilateral SEMG were collected in both masseter and anterior temporalis areas during the tests.

The BioPAK EMG system is embedded with optically isolated differential amplifiers. The input impedance of the amplifiers was 10^{11} Ohms in the BioPAK III model. The common mode rejection ratio (CMRR) of the amplifiers was guaranteed at > 130 dB at 50/60 Hz and remaining at 120 dB at the LP cutoff frequency. The input common mode voltage range of the system is +/- 3.0

volts that is large enough to reject the powerline interference in our experiments in the clinic. The analog EMG signals from the last 32 subjects were recorded with a gain of 2500, reduced from the default amplification of 5000 by increasing the amplitude range from ± 1000 µV to ± 2000 µV in the system. No amplitude clipping was observed in the first 11 subjects. Clipping still occurred in a few subjects and those recordings were excluded in our post-analysis.

In the BioPak system, the amplifiers included both a 12 dB/octave high-pass proprietary linear filter with a high-pass (HP) cutoff frequency of 10 Hz and a 6 dB/octave low-pass proprietary linear filter, with a low pass (LP) cutoff frequency of 1000 Hz in the amplifier.

The signal to noise ratio is 54 decibel (dB). All recordings were digitized with a 16 bits A/D card. The theoretical 16-bit resolution is 0.03 µV, but the BioPAK program rounds off to the nearest 0.1 microvolt. Due to the very high common mode rejection ratio the maximum signal to noise ratio is 106:1.

The HP and LP filters embedded in the BioPak limited the noise and other artifacts. All recordings were checked for remaining noise by power spectral analysis. Some had remaining noise, such as dc (0 Hz) with levels of up to about 0.11 µV, and high frequency noise above 1000 Hz. Such remaining noise was further removed by a proprietary filter written by one of the authors (ZT) (16). Data on the validity of the filters were not available, so all decisions were made on a visual inspection of the power spectra.

Surface electrodes (BioFLEX; Bioresearch Associates, Inc., Milwaukee, WI, USA, 2 conductive polyester adhesive rectangular contacts of 144 square millimeters with 20 mm center to center spacing) were placed after cleaning the skin with 95% alcohol, according to generally accepted standards (1) in the middle of each muscle area. Lines through the centers of electrodes on each masseter side were parallel to the muscles' anterior borders. The ground reference electrode was placed on the wrist.

Signal analysis was made using scripts written in Matlab (MATLAB, Version R2017a, MathWorks, Inc., Natick, Massachusetts). BioPAK files stored in TRC format were converted to txt (ASCII) format inside BioPAK and imported into Matlab for analysis. Means and standard deviation (SD) values of absolute voltage levels were calculated. The original amplitude values after preprocessing, as mentioned above, to remove all artifacts in the data were used to compute kurtosis values (17). Hereafter all the original data indicates the preprocessed one, in comparison to the amplitudes after Fourier Transformation.

Statistical methods

Statistical analysis was performed using SPSS (Version 24, SPSS Inc. Chicago, Ill, USA). For each subject, SEMG recordings were made in the left and right masseter areas and the left and right anterior temporalis areas. The subject was asked to consecutively clench, then rest, six times. For each pre-processed SEMG recording, two quantities were computed: the mean of the absolute values and the kurtosis value. For each subject, for each area, we then computed the means of the 6 values, resulting in one mean of 6 absolute mean values and one mean of 6 excess kurtosis values in each area and for clenching/resting. The variability in these values across subjects are presented in Tables 1, 3, 5 and 7. Two measures of the recorded voltage activity, the arithmetic mean of the absolute values and excess kurtosis in the original data, were used to compare recorded activity between healthy subjects and patients. The mean of absolute values was preferred to the mean of the original values because the latter is often very close to 0. The kurtosis value indicates whether the distribution is relatively peaked (more values in the center0 or more flat-topped (more values in the tails). Kurtosis can be defined as the ratio of the fourth moment about the mean to the square of the second moment about the mean (the variation), The presence of large positive or negative values in the SEMG values is indicated by excessive kurtosis over the value of 3, where 3 is the kurtosis value for the normal distribution (18).

Comparisons of means (of the absolute means and of the kurtosis values) between the two groups (healthy controls and patients) were based on the independent samples t-test. For validity of this test, we rely on the assumption that SEMG values are normally distributed. The significance level for a hypothesis test was 0.05 and the confidence level for confidence intervals was 95 %.

Predictive ability was assessed using sensitivity and specificity. Sensitivity is the percentage of patients correctly identified as having TMJ disc dysfunction. Specificity is the percentage of healthy patients correctly identified as not having TMJ disc dysfunction (17). To determine the presence of TMJ disc dysfunction, values, halfway between the groups' mean voltage values, were chosen as predictive levels for activity during clenching and mandibular rest. If there was really no difference between healthy subjects and patients, the overall mean would be an appropriate summary for all subjects.

Results

Voltage levels during clenching (Table 1). The mean voltage levels at clenching (Table 1) were significantly lower in patients in the right masseter (RM) ($p = 0.015$), the left anterior temporalis (LAT) ($p = 0.003$), and the right anterior temporalis (RAT) ($p = 0.007$) areas, than in the control subjects, but not in the left masseter (LM) area ($p = 0.059$).

Sensitivity and specificity of clenching activity (Table 2). The sensitivity values for the left and right masseter areas were the same (76.2 %), while for the left and right anterior temporalis areas they were different (76.2 % and 81.0 %). The specificity values for the left and right masseter areas were 47.8 % and 56.5 %, respectively, but 60.9 % for both the left and for the right temporalis areas.

Excessive kurtosis levels of clenching. In the control subjects, the means and ranges of the excessive kurtosis levels in the left and right masseter and anterior temporalis areas (Table 3) were1.13 ± 0.541 (SD), that is significantly lower than in the patients ($p < 0.001$), where it was 2.84 ± 2.955 (SD). Overload (clipping) was found to cause a recording error by lowering the values of excessive kurtosis.

Sensitivity and specificity of excessive kurtosis of clenching activity (Table 4). Excessive kurtosis (≥ 2), as a predictor of disc displacement, had the sensitivity of 42.9 % and 47.6 %, and specificity of 82.6 % and 87.0 % in the right and left masseter areas, respectively. In the temporalis areas, the sensitivity vs. specificity was 38.1 % vs. 95.7 % on the right side and 61.9 % vs. 100.0 % on the left side.

Voltage levels during mandibular rest (Table 5). There were no significant differences found between controls and patients regarding resting levels in the anterior temporalis and masseter areas.

Sensitivity and specificity of voltage levels during mandibular rest (Table 6). There were no significant differences found between controls and patients regarding excessive kurtosis of resting activity in the anterior temporalis and masseter areas. The predictive levels for disc dysfunction had in the masseter areas sensitivity of 33.3 % and 42.9 % and specificity 69.6 % and 78.3 %. In the anterior temporalis areas, the sensitivity values were 33.1 % and 38.1 % and the specificity values were 60.9 %.

SEMG activity during mandibular rest. Excessive kurtosis (Table 7).

There were no significant differences between muscles or groups.

Sensitivity and specificity of excessive kurtosis of activity during mandibular rest (Table 8). The sensitivity vs. specificity levels were in the masseter areas 38.2 % and 42.9 % vs. 52.2 %. In the temporalis areas they were 47.6 % vs. 69.6 % and 78.3 %.

Discussion

The main result was that the variable, kurtosis, known for a long time, but not tested before for possible use in diagnose of TMJ disc displacement, or other TMD disorders, was found to be of possible interest in basic jaw muscle physiology and clinical TMD research. The kurtosis levels of clench recordings were significantly higher in disc displacement patients than in healthy controls (Table3), indicating less ability by the patients to keep a steady contraction level. The sensitivity levels (Table 2) were low, but it is important, and of clinical value, if confirmed in prospective larger studies, that the specificity was high (Table 2).

The use of kurtosis is new in analysis of jaw muscle SEMG recordings. The values at clenching were found to differ significantly between patients with TMJ disc displacement and control volunteers in the masseter and anterior temporalis areas, and are of interest, because they indicate, that this variable has the potential of being of value when screening patients for signs of TMJ disc/muscle dysfunction.

The mean voltage values at clenching had a large range in both groups. The lowest values in the control group's range need consideration of the symmetry of SEMG activity in deeper synergists, such as the medial pterygoid muscles, where the SEMG activity of some cannot be accurately measured.

A possible explanation, for low contraction values, could be that the subjects did not follow or understand the instructions. This was considered, and efforts were made to make sure that the subjects understood.

Regarding voltage levels, as predictors of TMJ disc dysfunction, the results indicate that sensitivity values are high enough (76 % to 81 %), but specificity, being between 48 and 61 %, may be too low to be of interest. Values above 50 %, even if low, do have some weight. For clenching, sensitivity values were greater for levels, and specificity for excessive kurtosis. This suggests that the mean levels are better at predicting dysfunction whereas the excessive kurtosis values are better at predicting lack of dysfunction.

The finding that overload (clipping) (Fig. 1) makes it impossible to accurately calculate kurtosis in strong contractions, wherein the amplitudes were out of the range of ± 1000 μV. The future of EMG kurtosis in clinical research depends therefore, to at least some degree, on what technical details, manufacturers of the needed equipment will consider to be of commercial interest.

No differences were found between groups regarding kurtosis levels of SEMG during mandibular rest (Table 7). Theoretically, that does not mean that significance and specificity values could not have been of interest. They were, however, also found to be too low, both for voltage levels (Table 6) and for kurtosis levels (Table 8) to be of clinical interest. The current results are consistent with our previous study (19).

The levels of voluntary strong, close to maximal, contractions, did not differ significantly between males and females. Our results did not support that gender had any significant effect on any of the SEMG distribution parameters in this study, and therefore male and female data were pooled in the statistical analysis (18). However, this might have been because the group sizes were too small. As expected, means of voltage levels in contraction recordings were much lower for patients, significantly so in 3 of the 4 areas where recordings were made.

The limits for being of clinical value, and motivating treatment, depend on many factors, such as effects on pain and function, costs for treatment, possible side effects etc. and are not discussed here. It should, however, always be of interest to know the figures, whatever the levels are for being of clinical interest, and how high those levels should be, is therefore not discussed in this report. That topic is for separate future studies.

Limitations

Regarding contractions it has been reported that, after correcting for skinfold thickness, mean voltage levels did not differ between males and females (20). This is a possible source of error, when comparing means of voltage levels. Future studies are needed to show if it also affects the kurtosis values. Occlusion was not included as a factor, because it was beyond the resources to do such an evaluation. It should, however, be mentioned that none of the controls, and only one patient, had malocclusion motivating referral for orthodontic treatment.

The gain was still too high for a few recordings. One of the coauthors (TZ) has been working on the construction of an amplifier with a larger range of gain settings.

It is desirable to increase the number of subjects and to also include patients with diagnoses in RDC groups I and III but that was not possible in the present study that had no funding support.

The variability of electromyographic (EMG) recordings between and within participants is a complex problem. The importance of signal normalization has long been recognized, but the method used might influence variability (21).

In addition to reporting the mean amplitude and standard deviation, future EMG studies of clenching should also report the intra-individual variability, preferably using variance ratio VR as it is independent of peak amplitude, provides a good measure of repeatability and is insensitive to mean EMG amplitude and the degree of smoothing applied.

It is of interest to know if differences between SEMG recordings may depend on uni- versus bilateral DD and left vs. right side DD. The number of patients was too small in this study for such comparisons.

Conclusion

A new variable, excessive kurtosis, not tested before in TMD research, was found to be a criterion of possible clinical interest. Sensitivity was found to be high enough to be of interest, but the specificity was too low to support that the variable is of significant clinical value. The sensitivity and specificity levels were found to be high enough to motivate further studies. Voluntary jaw muscle clenching levels are lower in patients with TMJ disk displacement dysfunction than in healthy subjects. To avoid overload and clipping, which can make it impossible to calculate kurtosis in strong contractions, the amplitude range has, however, to be higher, even than the ± 2000 µV we used, while it now usually is maximally ± 1000 µV in the SEMG equipment usually used by dentists.

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Figure legend

Fig. 1. SEMG recording from the right masseter area in a female patient with disc displacement without reduction.

The two windows show the same recording. The upper is the original EMG. In the lower window the same recording has all parts between - 1000 µV and - 2000 µV removed by a computer program. The figures illustrate that an amplitude range of ± 1000 µV, which is the maximum in many common EMG equipment used in dental clinics, cannot be used for truthful representation of contraction amplitudes. This may play little role for mean voltage, but not for kurtosis, values. In the upper window the mean value is 190 µV with SD ±256 µV and excessive kurtosis = 4.09. In the lower window the mean value is 188 µV with SD ±249 µV and excessive kurtosis = 1.86. The level 1.86 in the clipped recording, is according to the results in the normal range, but 4.09 in the original recording is well above the border between healthy and patients. In the original, but not in the clipped recording, the excessive kurtosis value placed the subject in one group, and the mean voltage value placed the subject in another. This is an example of the

finding that contraction recordings should not be evaluated only by calculating the mean voltage values.

Table 1. SEMG Activity during clenching. Means & SDs of mean absolute SEMG µV values from 6 clench recordings per subject.

	Control group. N=23		Patient group. N=21		
Muscle areas	Mean & SD	Range	Mean & SD	Range	p
RM	111.9±85.71	16.3 – 371.4	59.1 ± 39.44	7.4 – 138.0	.013
LM	105.9±81.20	20.6 – 331.8	66.2 ± 49.01	12.4 – 208.7	.059
RAT	85.6±47.42	7.0 – 185.6	48.4 ± 29.16	16.4 – 115.0	.003
LAT	87.3±57.24	20.8 – 238.9	49.3 ± 29.25	7.8 – 121.1	.009

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 2. Clenching Voltage Levels: Sensitivity and Specificity.

Levels	Sensitivity	Specificity
RM µV ≥ 86	76.2 %	56.5 %
LM µV ≥ 86	76.2 %	47.8 %
RAT µV ≥ 67	81.0 %	60.9 %
LAT µV ≥ 67	76.2 %	60.9 %

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 3. SEMG activity during clenching. Means & SDs of excess kurtosis values of SEMG µV values from 6 clench recordings per subject.

	Control group. N=23		Patient group. N=21		
Areas	Mean & SD	Range	Mean & SD	Range	p
RM	1.36±0.918	0.28 – 4.15	2.43 ±2.158	0.22 – 8.27	0.046
LM	1.34±0.846	0.44 – 4.11	2.34 ± 2.003	0.28 – 8.03	0.044
RAT	0.88±0.486	0.15 – 2.19	3.29±4.346	0.35 – 16.90	0.020
LAT	0.92±0.471	0.15 – 1.94	3.22 ± 3.889	0.33 – 14.40	0.014

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 4. SEMG activity during clenching Excessive kurtosis. Sensitivity and specificity.

Levels	Sensitivity	Specificity
RM ≥ 2.0	42.9 %	82.6 %
LM ≥ 2.0	47.6 %	87.0 %
RAT ≥ 2.0	38.1 %	95.7 %
LAT ≥ 2.0	61.9 %	100.0 %

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 5. SEMG activity during Mandibular Rest. Voltage Levels in µV. None of the differences between patients and controls was significant.

	Control group. N=23		Patient group. N=21		
Area	Mean and SD	Range	Mean and SD	Range	p
RM	2.161 ± 1.874	0.8– 8.2	2.208 ± 1.849	0.7 – 7.6	0.935
LM	2.395 ± 2.173	0.9 – 8.6	1.960 ± 1.249	0.6 – 4.4	0.426
RAT	3.345 ± 2.347	0.8 – 11.0	2.697 ± 2.165	0.8 – 8.6	0.348
LAT	3.125 ± 1.887	0.7 – 9.0	2.914 ± 2.149	0.8 – 8.0	0.730

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 6. SEMG activity during Mandibular Rest. Voltage levels. Sensitivity and specificity.

Levels	Sensitivity	Specificity
RM ≥ 2.18 µV	33.3 %	78.3 %
LM ≥ 2.18 µV	42.9 %	69.6 %
RAT ≥ 3.02 µV	33.3 %	60.9 %
LAT ≥ 3.02 µV	38.1 %	60.9 %

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table7. SEMG activity during Mandibular Voltage Levels (µV). Excessive Kurtosis.

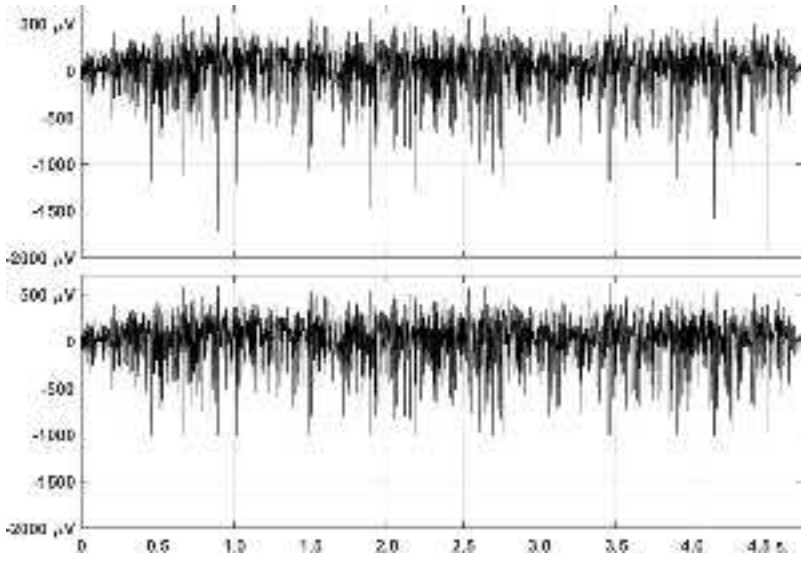
	Control group. N=23		Patients group. N=21		
Areas	Mean & SD	Range	Mean & SD	Range	p
RM	1.96 ±1.764	0.01 – 6.90	1.48 ± 1.077	0.07 – 3.39	0.282
LM	1.85 ± 1.077	0.06 – 6.73	1.40 ± 0.943	0.00 – 3.08	0.267
RAT	1.48 ± 1.077	0.28 – 5.07	2.02 ± 1.216	0.25 – 5.15	0.149
LAT	1.57 ± 1.267	0.32 – 5.30	1.94 ± 1.110	0.25 – 5.15	0.306

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis.

Table 8. SEMG activity during Mandibular Rest. Excessive kurtosis. Sensitivity and specificity.

Levels	Sensitivity	Specificity
RM ≥ 1.67	42.9 %	52.2 %
LM ≥ 1.67	38.2 %	52.2 %
RAT ≥ 1.75	47.6 %	78.3 %
LAT ≥ 1.75	47.6 %	69.6 %

RM = right masseter. LM = left masseter. RAT = right anterior temporalis. LAT = left anterior temporalis. .



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