

# Neuromuscular evaluation by means of electromyographic parameters

Rodrigues da Silva, M.A., Felício, C.M.; Vieira e Silva, C.A.; Melchior, M.O.; Rodrigues da Silva, A.M.B.

Faculty of Medicine and Dentistry of Ribeirão Preto, University of São Paulo, Brazil



**INTRODUCTION:** Experimental studies, conducted using electromyography (EMG) on masticatory muscles have produced favorable results. This has endorsed the use of EMG in clinical settings, as well as the use of routine as an instrument for the preliminary diagnosis of craniomandibular pathologies<sup>9</sup>, and in managing patient therapy and follow-up<sup>2;6;7</sup>.

Ferrario and colleagues<sup>6</sup> proposed and developed the POC (*percentage overlapping coefficient*; %), a parameter indicative of the symmetric distribution of muscle activity<sup>6</sup>.

Calculating the torsion index (TORS, %) makes it possible to identify the presence of a force with a potential lateral displacement component.<sup>3</sup>

Similarly to the POC, the asymmetry index (ASIM, %) evaluates muscle contraction symmetry or asymmetry.

**AIM:** The aims of the present study were: to compare, through EMG analysis, the POC, TORS, and ASIM indexes between a population with temporomandibular dysfunction (TMD) and a control group (C).

**METHODS:** The group consisted of 16 subjects (13 women and 3 men) of which complaints were consistent with temporomandibular dysfunction characteristics. Thirteen volunteers participated as control subjects (12 women and 1 man) with no TMD signs or symptoms. An eight-channel EMG system (De Götzen srl; Legano, Milano, Italy) was used, with double silver chloride bipolar surface electrodes.

EMG activity was recorded using computerized equipment, and the electrodes were placed on both sides of the masseter and anterior temporalis muscles, according to muscle fiber direction. A reference electrode (ground) was placed on the forehead.

**RESULTS and DISCUSSION:** In the assessment of POC values of temporalis (T) and masseter (M) muscles, as well as of TORS and ASIM, a statistical difference was found between the TMD group and control ( $p < 0.05$ ), in terms of the masseter POC, TORS and ASIM as observed in Table 1.

	Mean	Mean		
	TMD	C	t-value	p
POCT	85.57688	87.70385	-1.69028	NS
POCM	82.13688	86.52	-2.28308	0.030519
TORS	10.92375	8.553846	2.073562	0.047785
ASIM	7.46375	4.020769	2.201586	0.036422

Table 1. **Table 1:** POCT, PCOM: percentage overlapping coefficients for the temporalis anterior and masseter muscles.

P: Probability of paired Student's t-test  
NS: non Significant ( $P > 0.05$ ).

EMG allows for verifying and quantifying neuromuscular balance between muscles on both sides of the body (POC) as well as between muscle pairs with a possible effect of lateral mandible displacement (TORS)<sup>5;7</sup>. Moreover, the quantitative analysis of muscle contraction standards during standardized dynamic activities permits to evaluate muscle coordination<sup>4;5</sup>.

To be considered within normality standards, POC values must be above 83%. In the present study, there was no statistical difference between the TMD group and the control group, and the POC value of temporalis muscles in both groups is within the expected values. Regarding the POC of masseter muscles, there was a difference between the TMD group and control, with the latter presenting values below normality standards.

Mandible displacement is considered insignificant in mandible pairs when TORS is below 10%. Both groups present values within the expected range. However, there was a difference between groups TMD and C.

Perfect symmetry equals 0%. It is expected that the asymmetry index (ASIM) presents a value tending to 0%. Regarding the ASIM, there was also a difference between the TMD and C groups.

Based on group or individual results, it is verified that occlusion has an effect over neuromuscular coordination, as well as the compensations that take place. These compensations permit to establish which dental procedures are more appropriate. Moreover, they permit to determine which pairs of homologous (POC) and ipsilateral (TORS) muscles are balanced or not, with the aim to select the most appropriate goals and conducts of the therapy.

In the present TMD group, conducts should be directed toward providing balance between the coordination of masseter and temporalis muscles, in terms of contraction over time (POC) as well as activity (ASIM).

**CONCLUSIONS:** EMG parameters permit to identify the neuromuscular imbalance in the TMD group. This is important to determine a clinical instrumental analysis protocol, which allows for the individualization of the method used for measuring the function and dysfunction of the stomatognathic system. This is especially true because it is a non-invasive method, merely alternative and cost-effective, thus favoring treatment planning.

## REFERENCES:

1. Falda, V.; Guimarães, A.; Bérzin, F. Eletromiografia dos músculos masseteres e temporais durante deglutição e mastigação. *Revista da APCD*, 52; 2: 151-156, 1998.
2. Ferrario V.F., Sforza C., D'Addona A., Miani A.Jr. Reproducibility of electromyographic measures: a statistical analysis. *J Oral Rehabil*; 18: 513-521, 1991.
3. Ferrario, V.F., Sforza, C., Miani, A. Jr., D'Addona, A., Barbini, E. Electromyographic activity of human masticatory muscles in normal young people. Statistical evaluation of reference values for clinical applications. *J Oral Rehabil*; 20; 271-280, 1993
4. Ferrario V.F., Sforza C. Coordinated electromyographic activity of the human masseter and temporalis anterior muscles during mastication. *Eur J Oral Sci*, 104: 511-517, 1996
5. Ferrario V.F., Sforza C., Serrao G., Colombo A., Schmitz J.H. The effects of a single intercuspal interference on EMG characteristics of human masticatory muscles during maximal voluntary teeth clenching. *J Craniomand Pract*, 17: 184-188, 1999.
6. Ferrario V.F., Sforza C., Colombo A., Ciusa V. An electromyographic investigation of masticatory muscles symmetry in normo-occlusion subjects. *J Oral Rehabil*, 27: 33-40, 2000.
7. Ferrario VF, Sforza C, Tartaglia GM, Dellavia C. Immediate effect of a stabilization splint on masticatory muscle activity in temporomandibular disorder patients. *J Oral Rehabil*, 29; 9:810-815, Sep 2002.
8. Ferrario VF, Sforza C, Zanotti G, Tartaglia GM. Maximal bite forces in healthy young adults as predicted by surface electromyography. *J Dent*, 32; 6:451-457, Aug 2004.
9. Naeije, M., McCarrol, R.S., Weijis, W.A. Eletromyographic activity of human masticatory muscles during submaximal clenching in the inter-cuspal position. *Journal of Oral Rehabil*, 16: 63, 1989.
10. Stohler, C.S., Ash, JR. M.M. Demonstration of chewing motor disorder by recording peripheral correlates of mastication. *J Oral Rehabil*, 12; 1: 49-57, Jan, 1985.

The electromyographic waves of the muscle pairs were compared and the overlapping percentage coefficient was calculated (POC, %)<sup>5,6</sup>, an index of neuromuscular coordination symmetry. The POC for the masseter and temporalis, as well as its mean, was obtained for each patient.

Torque coefficient (TORS, %) was also calculated, because an unbalanced contraction of the masseter and contralateral temporalis, such as the right temporalis and left masseter, for instance, produces a potential component of lateral displacement<sup>6,8</sup>.

The asymmetry index (ASIM) in which the negative sign indicates the dominance of the left side of the body, and the positive sign indicates dominance of the right side<sup>9</sup>.

## Data Analysis

The obtained data were analyzed by parametric statistics t test for non-paired data, such as EMG data. The level of significance was 5%.

