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Scientific Logic Language as a New Paradigm in Masticatory Rehabilitation. Part 2

Gianni Frisardi* and Flavio Frisardi

Masticatory Rehabilitation Department, Epochè Center, Italy

***Corresponding Author:** Gianni Frisardi, Masticatory Rehabilitation Department, Epochè Center, Italy.

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Abstract

In the previous article we discussed the machine language used by the Central Nervous System (CNS) to send a message to the outside world through a natural verbal language that is sometimes misinterpreted due to the difficulty of signal transduction, from the ionic one, typical of the nervous structures, to the alphabetical one typical of verbal language.

So, in this next article we will go into more specific of the concept expressed previously touching on topics such as the coding of the electrophysiological signal coming out from the Cerebral Cortex.

Keywords: *Masticatory Rehabilitation; New Paradigm; Central Nervous System*

The system also communicates with its own encrypted language machine (action potentials and ionic currents). Therefore, it is not possible to interpret the symptoms reported by the patient through a natural language. This concept deepens the knowledge of the health state of the system because it elicits a response from the inside or at least from a large part of the network by allocating the normal and/or abnormal components of the various nodes of the network. In scientific terms, this concept introduces a new paradigm in the masticatory system called 'Neuro Gnathology Functional' (paradigm NGF).

Currently, the interpretation of 'emergent behaviour' of the masticatory system in dentistry is performed only by analysing voluntary response through electromyographic recordings (EMG Interference Pattern) or radiographic and axiographics records (mandibular movement replicators) that can only be considered as gnathologic descriptive tests.

The gnathologic descriptive paradigm has been in crisis for years. Despite the attempt to rearrange the various axioms, schools of thought, clinical and experimental concepts in the field of temporomandibular disorders through the implementation of a protocol called RDC/TMDs, it is not yet accepted for scientific-clinical incompleteness of the procedures.

Consequently, we can consider the added value of NGF paradigm for this description. The protocol RDC/TMD was designed and initiated to prevent the loss of standardized diagnostic criteria and to evaluate a diagnostic standardization of the empirical data available.

This protocol was supported by the National Institute for Dental Research (NIDR) and conducted at the University of Washington and Group Health Cooperative of Puget Sound, Seattle, Washington. Samuel F Dworkin, M Von Korff, and L Leresche [1] were the principal investigators. To arrive at the formulation of the protocol of the DRC, a literature review of the diagnostic methods in rehabilitative dentistry and TMDs was done. After that, these methods were subjected to validation and reproducibility. The taxonomic systems of D Farrar [2,3], Eversole e Machado [4], Bell [5], Fricton [6], the American Academy of Craniomandibular Disorders (AACD) [7], Talley [8], Bergamini e Prayer-Galletti [9] and Truelove [10] were taken into consideration, and compared with a set of evaluation criteria. The evaluation criteria were divided into two categories involving a) methodological considerations and b) clinical considerations.

At the conclusion of the search, a series of instrumental diagnostic methods, such as the interferential electromyography (EMG Interference Pattern), the pantography, the radiological diagnostics etc., were eliminated from clinical evaluation for lack of scientific and clinical validation. (These topics will be described in more detail in future editions of Mastication pedia).

The first target of RDC was, therefore, the request for a scientific 'objective fact' and not generated by opinions, schools of thought, or subjective assessments of the phenomenon. In the Workshop Meeting of the International Association for Dental Research (IADR), in 2008, the preliminary results of the RDC/TMDs were presented to validate the design of the project. The conclusion was that to come to a review and validation of the same RDC/TMD, it is crucial that the tests can not only make a differential diagnosis between patients with and without TMD pain, but also discriminate between patients with TMD pain and those with orofacial pain without TMDs [11].

This result-reconsidering the pain as an essential symptom for clinical interpretation-calls into play all the phenomenology of trigeminal neurophysiology and beyond.

In this context, the Neuro Gnathological Functions (NGF) fit. Starting from the assumption that every 'complex system' generates dynamic and variable activities of the functional type that is inevitably subjected to a well-defined anatomical structure, the NGF focuses its attention on a kind of functional symmetry normalized to an anatomical symmetry.

To achieve this target, therefore, a different scientific and clinical approach is required, and the horizons of expertise in fields like bioengineering and neurophysiology must be broadened. It is, therefore, essential to focus on how to collect the trigeminal electrophysiological signals evoked as a response to a series of triggers elicited, deal with the data, and determine an organic-functional integrity value of the trigeminal masticatory system.

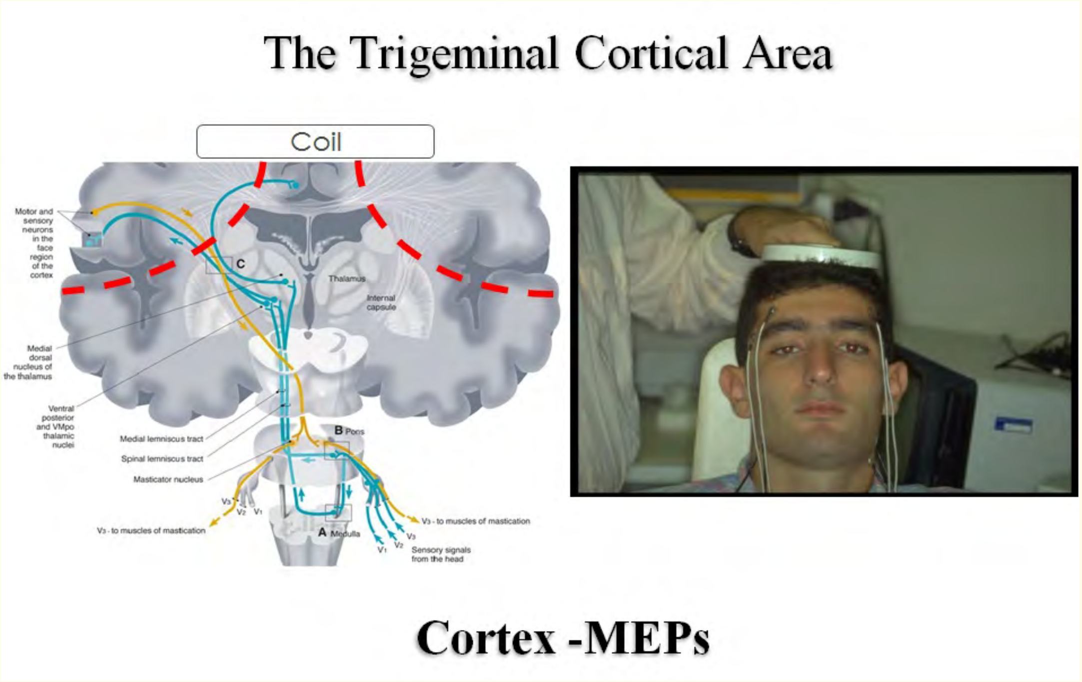
Therefore, a system that unifies the masticatory system and the neurophysiological one must be thought about by introducing a new term, the NGF. Topics that have not been considered before, like some fundamental issues of bioengineering and neurophysiology, will contribute to a deeper understanding of the NGF paradigm.

Virtual Segmentation of the Masticatory Nervous System

We begin, first of all, with the thinking that the interpretation of the encrypted signals coming from the neuronal activity is a task that is, if not impossible, complex and courageous. But by implementing a simplification strategy, we can deduce interesting data to understand the 'EB' of the system.

It has been previously mentioned that to be interpreted, the indeterministic-type systems should be stimulated by an external trigger, and, then, the response of the system from the trigger stimulus should be studied. This implies that the kind of stimulus should be known and well calibrated because a sub-maximal stimulus would generate a kind of response from the CNS while a more supra-maximal one would generate a saturated response.

Segmenting the CNS, which, at least in a first approach, is involved in masticatory functions, means dividing it into three main areas: a) the cortical area, which analyses the response of the Motor Trigeminal Cortex, b) the peripheral area, in which we analyses the response from the trigeminal root, called the 'peripheral area', and c) the midbrain-bulb-pontine, which is involved in a wide genesis of trigeminal reflexes (named, for simplification, 'brainstem area'), as can be seen in figure 1.



The Trigeminal Cortical Area

Cortex -MEPs

Trigeminal Cortical Area

If we wanted to quantify the integrity and/or the symmetry of the Trigeminal Motor Cortex (TMC), we certainly cannot consider the MR imaging techniques because of a lack of functional data, in the sense that the image symmetry of the TMC areas does not indicate func-

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tional symmetry. So, we are forced to employ electrophysiological stimulation that can evoke a response from the pyramidal tract neurons coming from the first order of the TMC (Figure 1).

Currently, the electrical transcranial cortical stimulation is not used. The magnetic transcranial stimulation (mTCS) is used.

Magnetic Transcranial Stimulation (Mtcs)

In our laboratories, a similar electrophysiological analysis provides a unique or acute experiment in which the same position of electrodes is used on the patient for all series of tests, including mTCS, trigeminal reflexes, and transcranial electric stimulation of trigeminal roots (eTS), as described below.

Figure 1 shows the genesis of the mTCS and the neuromotor responses called the Cortex-Motor-Evoked Potentials (C-MEPs), elicited by an induced current in the brain tissue determined by the passage of the magnetic field provided by a coil placed on the subject's vertex. More specifically, a magnetic stimulator, Magstim BiStim2 (Magstim Ltd, UK) is employed. It is connected to a circular coil (external diameter 10 cm) for the generation of magnetic fields up to 2 Tesla (100% output). The stimulation intensity is expressed as a percentage of the maximum power. The magnetic coil is placed flat on the scalp, stimulating the optimum position on the centre line with the centre of the coil slightly anterior to the top. This position can evoke motor potentials of both masseter muscles, without a noticeable depolarization of the trigeminal root.

To evoke C-MEPs, the subjects must exert a slight EMG activity, closing the mandibular in maximum intercuspation to facilitate the interneuron. The onset latency and peak-to-peak amplitude of at least six tests are measured [12].

Excitability of the Motor Cortex and Corticobulbar Connections

Transcranial magnetic stimulation activates the primary motor cortex, mainly interneuronal, exciting the fibres that project on pyramidal cells, leading to a short train of action potentials called indirect waves (I-wave). High-intensity magnetic shocks can also depolarize the axon portion of pyramidal cells, giving rise to a mixed burst comprising a direct action potential (D-wave) and some I-waves [13]. The stimulation of the facial motor cortex gives rise to a downward volley that travels along the corticobulbar tract and reaches the trigeminal and facial motor neurons. Considering the estimated synaptic delay for facial motor neurons, a multi-synaptic connection can be confirmed while the connection of the masseteric motor neurons is very likely a monosynaptic one and almost completely contra-lateral. And so, it is similar to the projection of the corticospinal motor neurons of the hand muscles. Peculiar to the corticotrigeminal system is the need to pre-innervation: even with high-intensity magnetic stimulation, no motor potential can be evoked for the contraction of the target muscles. During contraction, the masseteric evoked potentials appear to be of shorter latency, shorter duration, and of synchronous responses, which reach an amplitude equal to about 30% of the motor response by direct stimulation of the masseter nerve called M-wave. The motor neuron activation with the mTCS follows the principle of the size, namely, the smaller motor neurons are activated first [13]. When it is activated by the stimulation of the motor cortex, the masseteric motor neurons show normal excitability. Schwartz and Lund [1995] have recently studied the effect of the nociceptive pressure on the mandibular movement and the EMG activity of the masseter in rabbits' decerebration. Motor neurons are activated by stimulating the corticobulbar masticatory tracts through the same path, but the two inputs differed. In our experiments, the short-duration, high-frequency discharge of action potentials is of the phasic type. In the work of Schwartz and Lund [14], the action potential is tonic. In their experiments on tonic pain, it decreases the amplitude of mandibular movements and the recruitment of masseteric motor neurons. However, we can rule out increased excitability along the entire pathway from the motor cortex to the lower motor neurons.

Bibliography

1. Dworkin SF., *et al*. "A randomized clinical trial using research diagnostic criteria for temporomandibular disorders-axis II to target clinic cases for a tailored self-care TMD treatment program". *Journal of Orofacial Pain* 16.1 (2002): 48-63.

2. Farrar WB. “Differentiation of temporomandibular joint dysfunction to simplify treatment”. *Journal of Prosthetic Dentistry* 28.6 (1972): 629-36.
3. Farrar WB. “Controversial syndrome”. *Journal of the American Dental Association* 85.1 (1972): 30.
4. Eversole LR and L Machado. “Temporomandibular joint internal derangements and associated neuromuscular disorders”. *Journal of the American Dental Association* 110.1 (1985): 69-79.
5. Ciardo F., *et al*. “Eyes keep watch over you! Competition enhances joint attention in females”. *Acta Psychologica* 160 (2015): 170-177.
6. Leider AS., *et al*. “Cystic ameloblastoma. A clinicopathologic analysis”. *Oral Surgery, Oral Medicine, Oral Pathology* 60.6 (1985): 624-630.
7. Barlattani A., *et al*. “[Polymerization exothermal reaction of dental prosthetic resin for temporary crowns”. A comparative evaluation]”. *Minerva Stomatologica* 51.1-2 (2002): 11-20.
8. Stroffolini T., *et al*. “Successful treatment with lamivudine for reactivated hepatitis B infection following chemotherapy for non-Hodgkin’s lymphoma”. *Annals of Hematology* 81.1 (2002): 48-49.
9. Bergamini M., *et al*. “[Autoimmune pathogenesis of recurrent oral ulcers. 1]”. *Stomatol Mediterr* 10.2 1990: 147-52.
10. Truelove EL., *et al*. “Clinical diagnostic criteria for TMD”. New classification permits multiple diagnoses”. *The Journal of the American Dental Association* 123.4 (1992): 47-54.
11. Lobbezoo F., *et al*. “Some remarks on the RDC/TMD Validation Project: report of an IADR/Toronto-2008 workshop discussion”. *journal of oral rehabilitation* 37.10 (2010): 779-83.
12. Cruccu G., *et al*. “Functional organization of the trigeminal motor system in man”. *A neurophysiological study. Brain* 112 (Pt 5) (1989): 1333-50.
13. Rothwell JC., *et al*. “Stimulation of the human motor cortex through the scalp”. *experimental physiology* 76.2 (1991): 159-200.
14. Schwartz G and P Lund. “Modification of rhythmical jaw movements by noxious pressure applied to the periosteum of the zygoma in decerebrate rabbits”. *Pain* 63.2 (1995): 153-61.

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