The Reflex meter, a tool for the masticator muscle exploration

Angels Alfaro Romero Osorno[1]

Mexico

Abstract

Objectives. **Specialty literature review on the issue of the chronologically delayed eruption. Examples of the approached subject by the presentation of two clinical cases of different aetiologies.**

Introduction. **The process of teeth eruption lasts for approximately 13-15 years, during which period primary and permanent teeth erupt successively, at moments placed around the medium eruption time.**

Physiological chronological variations of teeth eruption are situated in the interval of +/- twice the standard deviation from the medium eruption age (calculated on large population groups). Delayed/accelerated eruptions are considered pathological teeth eruptions that take place far beyond the limits of this interval.

Material and method. **The cases of two patients, of age 9 and 10, are presented. Both suffer of delayed dental eruption, of different aetiology, mixed in the firs case and local in the second one. Diagnosis was established by the thorough evaluation of the familial and personal history, the general, facial and oral clinical examination; which led to the elaboration of the individualised treatment scheme. Diagnosis sequence and treatment methods adapted on the specific situation were established.**

Results and conclusions. **Large deviations from the medium teeth eruption standards alert the paedodontist, which must thoroughly investigate the patient's oral and general development and thus track down as soon as possible the local dental anomalies as well as the systemic diseases that may disturb the craniofacial complex's functionality.**

Keywords: medium eruption age, chronological delayed eruption.

Introduction

The masticator system consists of different physiological processes, from the stimulation of the periodontal mechanoreceptors, the control of the masticator reflexes, the activation of motoneurons of mandible muscles to the arrival of afferent sensorial information at the mesencephalics nuclei in the reticular formation. The modulation in the central nervous system and the necessary feedback that shoots to the mechanisms of control and protection in different conditions is not thoroughly clear; therefore it is necessary to study each one of the processes involved. There are different circumstances that put the masticator balance at risk; it is the case of hard foods that need to be broken down to be swallowed, reason why the teeth exert an important force which, without the mechanisms of compensation and control would injure the teeth, the arch dentures, the tongue, the temporomandibular joint (TMJ), etc. Although the control mechanisms are not entirely known, the exploration of the masticator reflexes has been very helpful in understanding many of the processes mentioned. The present work reviews the mesenteric inhibitor reflex, the technical elements and design of the Reflex meter and the results of its clinical application in different investigation reports starting with 1981.

Inhibitor reflex

In 1972 Bickford [20] proposed the name of "micro-reflexes" to the auto answers

1 Div. Studies of Postgraduate and Investigation, Laboratory of Physiology, Faculty of Odontolgy UNAM1, Department of Attention to the Health, Independent University Metropolitana-Xochimilco 2.

that occur during a motor activity in starting position which exhibit a strong dependency on such activity. This is the case of the inhibitor reflex in abductor muscles of the hand described by Angel and Col (1965). [7,9] During mastication there is an inhibitor reflex which occurs when we bite and we break down a hard piece of food; an important muscular force acts against the weight of the jaw (approximately 500gr), so that the jaw acquires a great speed and the inferior teeth hit the superior ones with sufficient violence to fracture them. Given to the short distance and the high speed involved, the time available for a voluntary breaking would be insufficient; this does not happen thanks to the intervention of the inhibitor reflex that acts blocking the motor activity of elevator muscles of the jaw before the sudden arrival of afferent information. This implies that if the reflex exists to prevent situations which do not require any muscular effort, bruxism or the dysfunction of the temporomandibular articulation could appear. The reflex which occurs during mastication, can be provoked by asking the patient to make an occlusal effort while the mesenter muscle is palpated. (starting condition); it is an answer that modulates a pre-existing motor activity; its characteristics depend on the muscle condition. Bessete and col. (1973), [18] observed that the silent period evoked within electromiography when applying a blow to the chin during the accomplishment of an occlusive effort, appears altered in the patients withTMJ dysfunction. Since then, different works have been made that use the measurement of the reflected silent period like a quantitative criterion that supports the diagnosis and allows evaluating the answer to the treatment (Bats, 1984). [16] Godaux and Desmendt (1975), [29] introduce for the study of this type of reflexes the technique of promediation proposed by Bickford (1964)[19], emphasizing the fact that the reflex does not consist solely of an inhibition, but also lead to later disorders of DMS such as involution. Van der Glas and goes Steenberghe (1985) [36 performed the studies again and managed to obtain new results, but they restricted the evocative stimulation of the reflex to a very smooth blow on a single tooth.

Reflexometry

Traditionally, the reflexes have been explored in the clinic subjective way; the exploration aims to detect injuries of the involved nervous routes in the regulation of the motor functions which these reflexes contribute to. The exploration helps predict the answers of the system under different circumstances. As a result of the clinical exploration the existence of the emphasize or absence of the reflexes is appraised. Nevertheless, if a precise discrimination is desired, it is necessary to measure both the stimulus and the answer simultaneously. Since the reflex happens in surroundings of sensorial and motor activity, its evocation must appear as near as possible to a same clinical starting condition; for example to seat the patients in the same position, to make them watch and listen to identical patterns, to carry out the same routines of relaxation, etc. (Kandel, 2000; Zulqarnain, 1989). [30,40] We must chek objectively if the starting condition is similar, which implies to register physiological variables that inform about this condition, for example the EMG of the agonists and antagonists (Vander Glas and col., 1989) [37]. The answer can be registered as a result of the developed force, the obtained displacement, or by the electromyography signal (EMG) produced at level of the activated muscle (Geddes, 1989) [28]. The stimulus must be produced by an automatic firing pin that always strikes with the same mechanical impulse; in addition it must generate a synchrony signal that allows measuring the latency of the components of the reflex (Of Laat and col., 1985; Vander Glas and col., 1981) [38,23]. Given the complexity of the nervous activity, one single determination cannot be carried out, so that it is necessary to repeat it several times and to analyze the results statistically (Bickford, 1972) [20]. Using a computer the obtaining can be controlled, the results can be stored to process them later and to generate a numerical or graphical report that is

easily interpretable and comparable (Garci'a Moreira and col., 1988; Vander Glas and col., 1989; Zulqarnain and col., 1989) [27, 37, 40]. This registry constitutes the EMG that is an objective innocuous tool to measure and to analyze the occurrence of the reflex.

Design of the Reflex meter

In 1987 in Mexico 1987 our group began to use the blow to the chin like stimulus, the characteristics of the experiments that were outstanding only to the silent period being maintained (Bessette and col., 1971; Ramfjord and col., 1985; Sharav and col., 1989) [17, 34, 35]. In the beginning, it was observed an important variability between the registries obtained in a same patient and during the same session.That was why it was considered that the starting condition (occlusive effort) [3], had to remain within the limits of ceratin parameters; in order to obtain this, it was considered that the patient had to control his effort while the result and the deviation of this effort was monitored. It was used the bioretro-feeding technique that consists of informing the patient about the present result of his effort, in such a way that he himself modifies it within the limits of certainparameters. This equipment was used in 50 healthy voluntary young people without dysfunction of the temporomandibular joint and with a normal dental relation, obtaining good results thus diminishing the variability (Garci'a Moreira and col., 1989; Angels and col., 1987) [24, 25, 8]. *Figure 1*

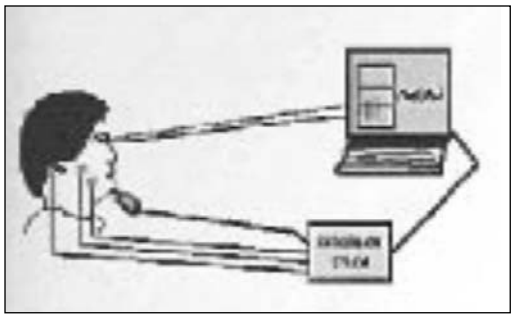

Figure 1 visual Bioretroalimentación of the EMG

The successive registries of equal efforts during the same session,denominated the electromyography's retorts, so that we had a signal by each retort. The existence of the motor activity and not the random detail of the EMG being of interes, each retort was rectified. Even rectified, the retorts are not identical, which made it necessary to calculate an average and a dispersion around the same one. As we used analog conversion to digitalis to introduce the registry to the computer, we had a list of values corresponding to samples of signal EMG spaced by equal intervals of time, reason why the average and the variance calculated with base in the values obtained for a same interval in the successive retorts; in the end we counted an average and a variance for each part of the signal. The promediation also implied the previously added values of samples of each new retort with the accumulated values for each one of the time intervals, so that, when accumulated, the retorts defined the tendency and the dispersion of the values of the signal. This allowed to separate what happened systematically in signal EMG from what happened accidentally. *Figure 2.*

The accumulated registry exhibited an interval, previous to the blow (during the voluntary occlusive effort), in which the points varied between the retorts significantly.Nevertheless, after the blow, a clear reduction of the variation between retorts occurred because all the registries contained a great wave of inhibition (silent period), with a later duration longer than 30 ms. to the inhibition finally delineated a wave of involution with differences between the retorts and, when returning at the basal level (after 150 ms), reappeared the initial variation between retorts. The previous thing showed that it was counted on a signal constituted by ample and slow waves mixed with random noise; in order to eliminate the noise a filter was used that eliminated the fast variations. The result was called "reflex gram" (RFXG), observing a defined outline of the obtained signal the blow, of the inhibiting wave, the potenciadora wave and the return at the basal level. *Figure 3*

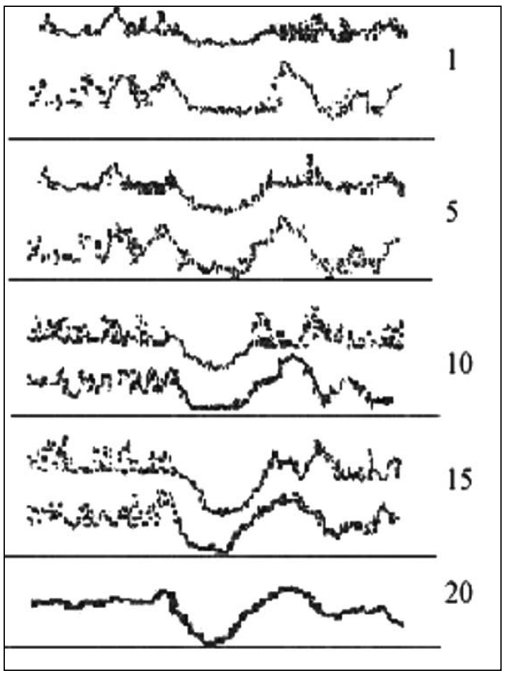

Figure 2. Accumulation, rectification and promediation of 20 stimuli and obtaining of Reflexigrama (RFXG)

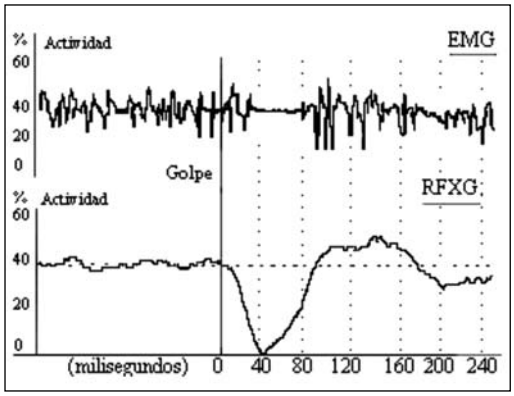

Figure 3. Correspondence between outline EMG (superior outline) and the components of the RFXG (inferior outline), in a healthy subject

Measurement of reflex gram

By virtue of which it is an inhibiting reflex during the characterization of the registry of same the initial wave of inhibition ampler and is prolonged besides to have characteristic a temporary course, that reaches the level of absolute rest around the 40 ms. *Figure 4*

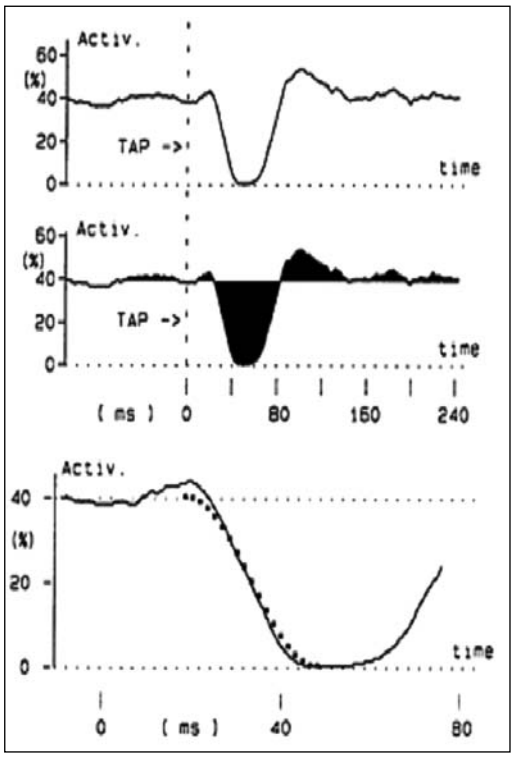

Figure 4. Typical reflexogram of a young healthy subject superior Outline: Reflexogram. Average outline: Areas of the wave (inhibition, involution). Inferior outline: Expansion in both axes to compare the initial phase of the inhibiting wave with a function Cosine from 20 to 50 ms.

When functional alteration exists, the inhibition wave amplitude and the area it includes must be reduced until its tip appears reduced according to normal. So that an indicator of abnormality was created by the percentage of **faltante** area in the inhibiting wave, from the beginning of its tip to 40 ms. *Figure 5*

Another one of the parameters is the involution wave, which is less ample and finishes before the 140 ms; therefore the relation between the area of involution and the one of inhibition of denominates reason of areas; in the patients with bruxism and dysfunction in moderate articulation exists a exaggeration of the involution and for that reason this area ratio **potenciation**/inhibition this increased. *Figure 6*

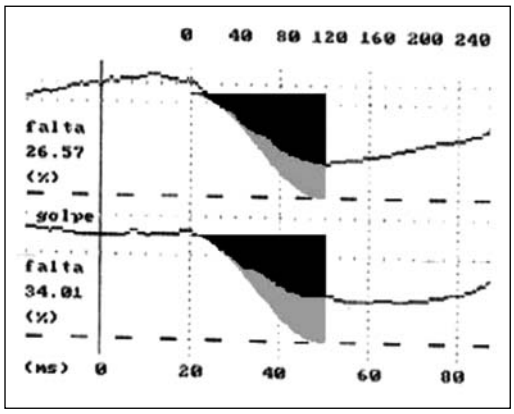

Figure 5. Faltante Area

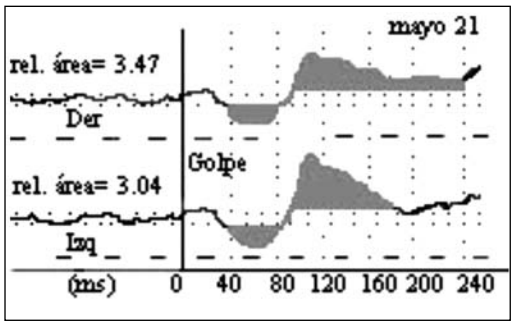

Figure 6. Area ratio

Also with this same program we can make the computer analysis that denominates correlation coefficient and that indicates the temporary relation of the event registered in the right side with respect to the left side. *Figure 7* analysis of the variation in the morphology of the RFXG of a patient in relation to the previous tendency, can constitute a criterion valuable to describe the clinical evolution. The captured digitally with connected electrodes of surface an analogical system of amplification (4x10,000) of two channels controlled and calibrated from a computer with analogical switches (Chips "Ace 4051"), with fixed bandwidth (10 to 1000 Hertz, 30 MB). Signal EMG, once amplified and leaked, is digitized with 8 bits of resolution to 300 segments per second (sps), using for it a converter ("ADC0809") controlled by a chip accountant of time "280-CTC", programmed by a nano-computer. Retorts EMG of each individual store in a system "circular buffer" of 1,6 KB (350 ms of bilateral EMG) in the memory of work of a conventional computer. In a third analogy channel Integra signal EMG with a constant of 10 ms to activate the device of visual bioretroalimentation that it intends to auto regular the intensity of the muscular contraction between 40% and 60% of his voluntary intensity Maxima; when staying this condition, the nano-computer activates a stimulator mechanism that consists of a slight blow to the chin (force=2 Newtons,

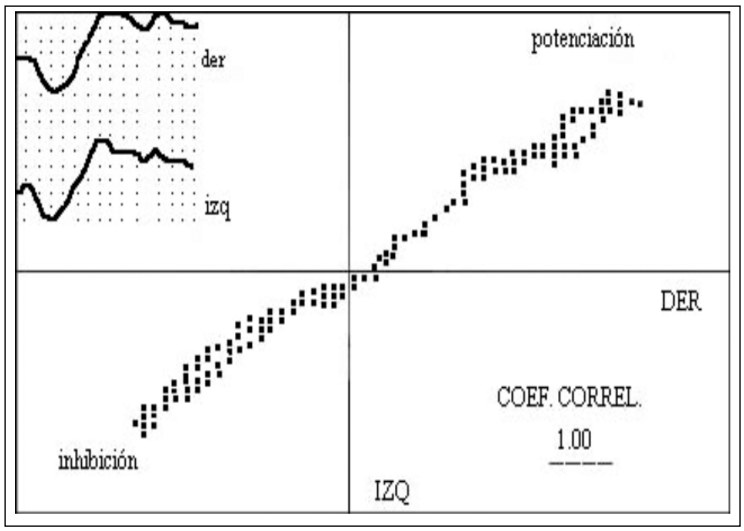

Figure 7. Coefficient of correlation

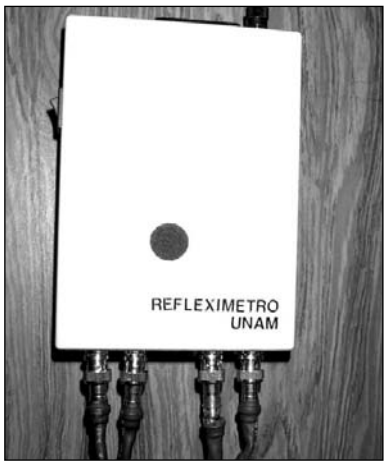

Figure 8. Computerized Reflexometer for odontologic doctor's office UNAM 2001

velocity=1.9 m/s) applied with an electromechanical hammer. Previous samples of EMG of 80 ms stimulus (EMG of voluntary occlusive effort) and 264 are captured ms later to him (reflected EMG). The signals of each retort EMG are rectified, accumulated and mediated so that the coefficient of variation is smaller to 10%. The Reflex meter is property of the Independent National University of Mexico (UNAM) 2001. *Figure 8*

Clinical application of the Reflex meter

The use of the Reflex meter in heterogeneous situations has allowed the modification, adaptation and correction in the technique and use procedures, this has authorized its use in diverse estomatologicals clinical conditions; these years with the RFXG numerous normal physiological conditions could be measured, for example the functional modifications related to different pathologies. It is also useful to evaluate the different types of treatment, their improvement, its time response, etc., allowing a complementation to diagnosis and, in some cases, a modification of the treatment or of its period. The study repeated with the RFGX throughout a treatment has given to a sequential vision of the answer and its modification, basing an objective and clear method on the clinical pursuit of diverse sufferings that couldn't be obtained with other diagnosis procedures. Although, the changes observed in the RFXG under different circumstances emphasize their specific characteristics, counting on a little tool that explores part of the physiological substrates of the masticator system and its different levels of neuromuscular organization, allows to advance in the knowledge of the control and protection mechanisms of these structures. The obtained data respect to the clinical experience in population heals and with some pathology, have been published in Mexican and foreign journals from the first tests in 1981 till present, the most excellent data are concentrated in ***picture 1.***

As a conclusion, the RFXG could be considered a useful tool to evaluate the course of the treatments.

Picture 1.

AUTHOR	PUBLICATION	CASES	FINDINGS
Ángeles F, y col.[14]	Quintaesencia 1981	Adults with natural set of teeth and without pathological, adult data greater edéntulos with complete sets of teeth	Differences in the electromiográphy registry with the total set of teeth and without it, and of these with the obtained registry of subjects indented without pathological data were identified. The electrical activity in patients with sets of teeth is greater than the one than it is obtained without her.
Bonilla M, y col.[21]	Magaz. Mex. Ing. Biomed 1987	Patients with TMJ disfunction	Changes in the morphology of the reflex were observed during the clinical evolution of patients with TMJ disfunction during the treatment with rules. The registries of the silent period by blow to the chin exhibited a duration greater than the evoked ones acoustic

AUTHOR	PUBLICATION	CASES	FINDINGS
Ángeles F, y col.[15]	1987 Rev. de la Fac. Odontología	Patients with TMj disfunction	The voluntary control of the EMG amplitude is introduced unfolding its rectified registry and filtrate in the technique of measurement of the silent period, to use them as criteria of clinical pursuit of the TMJ disfunctions
Bonilla M, y col.[22]	1987 National Congress: Present and future past of the computation (memory)	Healthy young adults	The system designed for reflexometer is described: digital analogic conversions, analysis of the EMG like random signal, filtering of rectified cumulative registries, statistical criterion to detect the waves that form the answer and its experimental application in healthy young adults.
García Moreira C, y col.[24]	1988 Rev. Mex. Ing. Biomed	Healthy young adults and patients with bruxism	The advances in the design of reflexometer are described: channels of acquisition and analogic preparation, module of communications and A/D conversion, estimulador module by means of I strike, general scheme of the programmatic one of the system, programmatic evaluation of the muscular effort, storage of the EMG samples and preliminary clinical results in healthy subjects and patient with bruxism
Ángeles F, y col. [13]	1990 Practica Odontológica	Healthy adult subjects, healthy adults withTMJ disfunction, bruxism	The accumulated experience is transformed during the previous years of basic clinical investigation and reflexometer, that is used provides measurements that indicate the degree of neurofunctional alteration that sublies in the patients with TMJ disfunction and/or bruxism
Vázquez V, y col. [39]	1992 Rev. Med de Ing. Biomed	Edéntulos older adults	The patients who presented/ displayed reflex abnormalities did not adapt to the total próthesis. By means of reflexogram design defects were detected and construction of these próthesis and were asymmetries of the muscular activity

AUTHOR	PUBLICATION	CASES	FINDINGS
Nuño A, y col.[31]	1993 International Journal of Paediactric Dentistry	Children with malocclusión Class I and III, primary and mixed teething	The values of the amplitude of the patterns of interference in the EMG were higher in the Class III than in Class I, before the treatment with miofunctional apparatus the values decreased during and after the treatment.
Ángeles F, y col.[10]	1993 Rev. del Colegio Nacional de Cirujanos Dentistas	Adult patients with different stomatologic clinical conditions	changes that happen with age are observed in reflexogram, in bruxism, TMJ disfunction, edentulism, during the orthodontic treatment and neurological sufferings (frequent crises of migraines and cerebral paralysis).
García Moreira, y col.[26]	1994 Medical Progress through Technology	Healthy young adults, patients with bruxism and patients with TMJ disfunction	**Are advances in the automated registry of the masetérico** inhibiting reflex through the analysis of the occlusive effort by means of visual bioretroalimentation. Normal morphologies of reflexogram settled down and a correlation of this with the clinical conditions of the bruxism and the patients with TMJ disfunction was identified
Alfaro P, y col.[2]	1994 Archivos de Neurociencias	Young adults with Paralysis	The types of PC did not explain the changes of the reflex, the stomatologic clinical variables explained
	1999	Cerebral (PC) **Espástica and Atetósica**	Variations of the reflex, emphasizing the occlusal contacts
Alfaro P, y col.[1]	Medicina Oral	Healthy young adults, adults with TMJ disfunction, with cerebral paralysis	The control of the previous bite force to the **evocación of the masetérico** inhibiting reflex was registered. It was identified that the TMJ disfunction is associated with problems and that the cerebral paralysis associated with TMJ disfunction is the greater problem
Osorno MC, y col.[33]	1999 Temas selectos de Investigación Clínica	Children with primary, mixed and permanent teething without problems of dental occlusion	The reflected answer in the healthy children was characterized and a previous component was identified in them **excitatorio** to the inhibition (P wave) that has been described in adults when the reflex is evoked with electrical stimulation.

AUTHOR	PUBLICATION	CASES	FINDINGS
Ángeles F, y col.[11]	1999 Archives of Medical Research	Healthy, adult adult young people with moderate and severe symptoms of TMJ disfunction	Significant correlation between the clinical groups and the electromiográphic findings was identified. The inhibition was smaller in the patients with moderate and severe disfunction, the involution was greater and the bilateral symmetry was minor
Alfaro P, y col.[6]	2000 Revista de Cienciasclínicas	Young adults in orthodontic treatment	The registry of the reflex allowed to evaluate the impact that the treatment has on orthodontic cases in initial phase (30 days) of the activity reflects **masticatoria**
	2000		The clinical variables explained more of 80% of the changes in the reflected components and reflected changes were not observed associated to the orthodontic treatment.
Osorno MC, y col.[32]	Práctica Odontológica	Young children with primary, mixed and permanent teething, and adults without problems of dental occlusion	The children presented/displayed duration of the prolonged inhibition more than the adults and **is present at of the P wave nonidentified in the adults.**
Alfaro P, y col.[4]	2001 Archivos de Neurociencias	Healthy, children and adults with Cerebral Paralysis and adults with TMJ disfunction	There was a significant correlation between the clinical groups and the electromiográphic findings. The reflected components which could be significantly discriminanted were the presence of the P wave (own of the group of children) and the latencies that were greater in the patients with Cerebral Paralysis and TMJ disfunction
Alfaro P, y col,[5]	2002 Rev. de Ciencias Clínicas	Revision of the Literature related to the neurofunctional masticatory evaluation and the mesenteric inhibitor reflex	Stomatological clinical conditions and voluntary and reflected electromiográphic answers of masticatory muscles are discussed to the relations between, as well as the availability and limitation of the techniques for their registration. The necessity is emphasized the need of counting on standardized parameters to evaluate the neurofunctional masticatory answer and the convenience of relating its study to the one of other functions of the stomatological apparatus (swallowing and phonation).

AUTHOR	PUBLICATION	CASES	FINDINGS
Alfaro P, y col.[5]	2003 Rev. de Investigación Clínica	Adult young people without TMJ disfunction and with any type of malocclusión, under orthodontic treatment with technique of straight arc with brakets Roth prescription	Registry the mesenteric inhibitor reflex before and after orthodontic treatment. Increase of the latencies was identified diminution of the duration and amplitude of the inhibition, and loss of the mesenteric inhibitor reflex capacity.
Ángeles F, y col.[12]	2003 Capítulo en libro: Dolor orofacial y desórdenes temporomandibulares. Aceptado para publicación	Patients with different stomatological clinical conditions	The technique of registry of the mesenteric inhibitor reflex is described, summary findings of investigation in patients with diverse stomatological clinical conditions, as well as the panorama of clinical applications of reflexometer.
	2005		

References:

1. Alfaro P, González H, Angels F, Nuño To, Osorno C, Garci'a J, Galicia To Control of the force of bitten in patients with cerebral paralysis and dysfunction of the joint to temporomandibular. *Oral Medicine* 1999; **2:**53-67.

2. Alfaro P, González H, Sanchez J, Nuño To, Angels F. Inhibiting Reflex Mesenteric and Clinical Conditions Estomatológicals in Patients with Cerebral Paralysis. *Arch Neuroscience (Mex)* 1999; **4(4):**175-182.

3. Alfaro P, Osorno C, Leiva F, Medina To, Lopez H, Nuño To, Angels F, Ramirez J. Models of correlation between clinical conditions with the changes observed in the mesenteric inhibiting reflection during the treatment of orthodontia with wire arc of nitinol. *Magazine of the clinical Investigation, UAM-X* 2000; **1(1):** 17-24.

4. Alfaro P, Osorno C, Nuño To, Angels F. The Inhibiting Reflection Mesenteric in Children and Healthy Adults, Paralysis Cerebral and Dysfunction of the Temporomamdibular Joint. *Archives of Neurosciences* 2002;**7(3):** 136-141

5. Alfaro P, Osorno C, Nuño To, Leiva F, Angels F. Effects of the Treatment of the Orthodontia On the Inhibiting Reflection of the Masetero Muscle. *Magazine of Clinical Investigation, National Institute of Medical Sciences and Nutrition, Salvador Zubirán.* 2003;**55(3):**289-296

6. Alfaro P, Osorno C, Romero G. Evaluacio'n to neuromuscular masticatoria. *Magazine of Clinical Sciences* 2000; **4(1):**41-51.

7. Angel R, Epler, W, Iannone To Silent period produced by unloading of muscle during voluntary contraction. *J Physiol* 1965;180-864.

8. Angels F, Bonilla M, the Garci'as C, King R, the Garci'as J, Level R, Méndez J, Nuño L. Analysis Electromiográfico of maseteros muscles to improve the reproducibilidad of the silent period with aims of clinical diagnosis. *Rev Face of Odontolgy UNAM* 1987;**2(1):**4-14.

9. Angels F, the Garci'as C, Alatorre and, Level R, Garci'a J, Bonilla M. Click and tap- evoked completes masseteric EMG responses. J *Dent Head of cattle* 1989; **68:**226.

10. Angels F, Lopez S, Alfaro P, Garci'a C, Galicia To, Vázquez V, Garci'a J, Rodriguez M, Nuño To, Sanchez W, González H. Cambios of the masetérico inhibiting Reflexigrama in situations of clinical interest. *Rev. Col. Nal. of Cir Dent (Mex)* 1994; **1(1):**17-25.

11. Angels F, Nuño To, Alfaro P, Osorno C. Development and Application of Reflex dent in the Quantitative Functional Evaluation of Chewing Control in Patients with Temporomandibular Joint Dysfunction and to Group Control. *File of Medical Research* 2000; **31(2):**197-201

12. Angels F, Romero M. Dolor Orofacial and you disorder temporomandibulares. Accepted for publication Ed. Trillas 2005.

13. Angels F, Garci'a M, Gacía R, Of the Forest P, González H, González C. oclusal Refleximetría: A new tool for the evaluation of the functionality masticator. I general Description of the method and its applications. *Odontológica Practice* 1992;**13(12):**17-23.

14. Angels F, Torrano H. electromiográfica Activity of maseteros muscles in edéntulos patients, *Quintessence in Spanish*, Chicago, III. 1981;**3(10):**4-10.

15. Angels F. electromiográfico Analysis of maseteros muscles to improve the reproducibilidad of the silent period with aims of clinical diagnosis. *Rev Face of Odontol* 1987;**2 (1):**4-14.

16. Bats B, Bonder L. Ageing and oral motor function: evidence for altered performance among to older persons. *J. Dental Head of cattle* 1984;**62:**2.

17. Bessette R, Bishop B, Mohl N. Duration of masseteric silent period in patients with TMJ syndrome. *L Appl Physiol* 1971;**216:**864-9.

18. Bessette R. Effect of biting force on the duration of the mesenteric silent period *J. Dental Head of cattle* 1973;**52:**426.

19. Bickford R, Jacobson J, Cody. Nature of average evoked potentials to sound and to other stimuli in man. *Annals New York Acad Sc* 1964;**112:**204.

20.Bickford R. Physiological and clinic studies of micro-reflexes. *Electroencephalogram Clin Neurophysiology* 1972;**31(supply) 1**:93-108.

21. Bonilla M, Angels F, the Garci'as C, Alatorre M, the Garci'as J, Level R. auditory Induction's of the silent period in the electromyography of the masetero. *Rev Mex de Biomedical Ingenieri'a* 1987; **8:**303-316.

22. Bonilla M, Ángeles F, García C, Nuño L. Estudio neurológico computarizado en paralelo a varios niveles para evaluar la masticación. XXX años de la computación en la U.N.A.M. 1988; vol 2.

23. De Laat A, Van der Glas H, Weytjens J, Van Steenberghe D. The mesenteric post-stimulus electromyography complex in people with dysfunction of the mandible joint. *Arch Oral Biol* 1985;**30:**177-80.

24. García C, Ángeles F, García J, Nuño A. Reflexímetro computarizado para consultorio odontológico. *Rev Mexicana de Ingeniería Biomédica* 1990; **11(1):** 257-273.

25. García C, Ángeles F, García J, Nuño A, Llanos N. Primeros resultados clínicos sobre reflexometría masticatoria. *Rev Mex Ing Biomed* 1987;10-35.

26. García C, Angeles F, González H, Nuño A, García J, Galicia A, Rodríguez M. Improved automatized recording of masticatory reflexes through analysis of effort trajectory during biofeedback. *Medical Progresa Through Technology* 1994;**20:**63-73.

27. García C, García J, Ángeles F, Llanos R, Bonilla M, Alatorre Miguel E, Ortíz B. Normalización del estudio de microreflejos en electromiografía masticatoria. *Rev Mex Ing.Biomed* 1988;**9:**113-120.

28. Geddes L, Baker L. Principles of applied biomedical instrumentation. 3ª. Ed. Wiley-Intersc (New York), 1989.

29. Godaux E, Desmedt J. Interceptive suppression and motor control of masseter and temporalis muscle in normal man. *Brain Res* 1975; **85:**447-58.

30. Kandel E., Schwartz J. Principles of neural Science. Ed. Elsiever (New York) 2000.

31. Nuño A, Cavazos E, Angeles F. Electromyography Changes resulting from orthodontic correction of class III described process allowed to the standardization of the design and construction of the Reflex meter, with the following characteristics: the bilateral mesenteric EMG is malocclusion. *International Journal of Pediatric Dentistry* 1993; **3:**71-75.

32. Osorno C, Alfaro P, Nuño A, Ángeles F. Diferencias entre los Componentes Tempranos del Reflejo Inhibitorio Masetérico en Niños y Adultos Jóvenes Sanos. *Práctica Odontológica* 2001;**22(1):** 8-12

33. Osorno-Escareño C, Alfaro-Moctezuma P, Nuño-Licona A, Ángeles-Medina F. Descripción y Correlación de los Componentes del Reflejo Inhibitorio Masetérico en Niños Sanos. Temas Selectos de Investigación Clínica V, UAM-X. 1999: 53-62.

34. Ramfjord S, AshM. Occlusion 3ª Edic. ed. Saunders Philadelphia,1985.

35. Sharav Y, Tal M. Masseter inhibitory perìods and sensation evoked by electrical tooth-pulp stimulation in subjects under hipnotic anesthesia. *Brain Res* 1989;**479:**247259.

36. Van der Glas H, De Laat A, Van Steenberghe D. Oral pressure receptors mediate a series of inhibitory and excitatory periods in the masseteric post-stimulus EMG complex following tapping of tooth in man. *Brain Res* 1985;**337:**117-125.

37. Van der Glas H, Van Steenberghe D. Comments on standardization of reflex measurements in humans masseter muscle, including silent period. *J Oral Rehabil* 1989;**16:**549-554.

38. Van der Glas H., Steenberghe D. Computer based analysis of electromiography. *Clin Neurophysiol* 1981;**21:**627-641

39. Vázquez V, Sánchez W, García C, Ángeles F, González H, García J, Rodríguez M, Nuño A. Exploración funcional masticatoria para predecir y superar la respuesta a prótesis totales. *Rev. Mex. Ing. Biomédica* 1993;**14(2):**357-368.

40. Zulqarnain B, Furuya R, Hedegar B, Magnusson T. The silent period in the masseter and the anterior temporalis muscles in adult patients with mild or moderate mandibular dysfunction symptoms. *J Oral Rehabil* 1989; **16:**127-137

Correspondence to: Dr. Cesar Augusto Erosa Gonzalez, Miguel Cabrera No. 7, Desp. 9, Col. Mixcoac, Deleg. B. Juarez , Mexico , D.F. , C.P. 03910, e-mail: dr.cesarerosa@yahoo.com.mx