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The "programmed stimulation therapy" as base for the Functional oral re-education that leads us to the concept of "Prevention in orthodontics"

Abstract

The understanding of the action of the stimulants, programmed stimulation therapy, the diagnosis of the functional matrix and its scoring will help us in the normalization of the so called functional triumvirate. In this task a new treatment protocol is established, using the various prefabricated "MFS" devices and their combination to obtain optimum results and so achieve the early re-education of oral functions and a prevention programme in orthodontics re-education

Keywords: Programmed stimulation therapy. Functional triumvirate. "MFS" functional scoring. Prevention in orthodontics. Nasal stimulators. Buccal obturators. Labial stimulators. Lingual buttons. Muscle relaxant. Anti-bruxism device. Open bite device.

Summary

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What is a stimulus?

It's a factor that acts upon the sensory nerve fibres, to create nervous impulses that are conducted towards the spinal cord (generating spinal reflexes without activating the brainstem) or towards the lower part of the brainstem (generating motor reactions).

The components of the "sensing stimulus" are the following:

– *Stimulation:* the stimulus capable of activating certain sensory neurons.

– *Transmission:* the sensory receptor that responds to the stimulus, converting it into a potential generator.

– *Conduction:* the potential that reaches the threshold and activates one or more nerve impulses that are conducted to the central nervous system.

– *Translation:* an area in the central nervous system (cerebral cortex) that translates impulses into sensations.

Sensory receptors can be simple or complex. Receptors associated with pain, temperature, tickling, itching, touch, pressure and vibration are all simple. Sensory receptors that refer to smell, taste, sight, hearing and balance are all considered to be complex.

Based on their location, sensory receptors can be:

– Exteroreceptors: sensitive to stimuli from the exterior.

– Visceroreceptors: sense the body's internal environment (blood vessels and viscera).

– Proprioceptors: report on the body's position and movements (muscles, tendons and joints).

According to the type of stimulus, we can consider:

– Mechanoreceptors: detect mechanical pressure and distortion.

– Thermo-receptors: detect changes in temperature.

– Nociceptors: detect pain.

– Photoreceptors: detect light.

– Chemoreceptors: detect chemical substances.

Regarding skin sensations, these are located in the skin and can be:

– Tactile: touch, pressure and vibrations.

– Thermal: sensitive to cold and heat.

– Painful: refers to pain.

Skin receptors are distributed over the surface of the body. They go in the following order form most to least sensitive:

– Tip of the tongue.

– Lips.

– Tip of the fingers.

– Nares.

- Back of the hands.

- Back of the neck.

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Receptors 1 (tip of the tongue), 2 (lips) and 4 (nares) are of interest in orthodontics, as we are going to work with them with the introduced stimuli.

When a stimulus occurs, it alters homeostasis, leading to an imbalance in the "controlled condition". Receptors (sensory systems throughout the body) detect changes in the internal and external environment, "information" that will be sent to the control centres (different conscious or unconscious stations in the central nervous system), a message that will arrive at the "effectors" (muscles) and generate a response, muscle contraction.

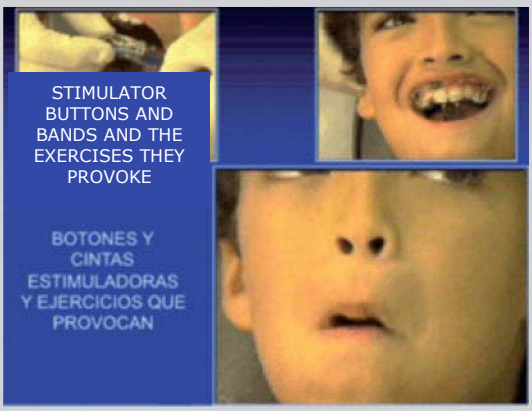
"Negative" and "positive" stimuli and "programmed stimulation therapy"

Stimuli in orthodontics may be "negative" or "positive" (Duran, Echarri): We can consider negative stimuli to be those that interfere in oral functions, deviating from their normal pattern. Early loss of a temporary tooth, and the subsequent empty space in the dental arcade, leads to interposition of the tongue at this level. A burr on a poorly finished amalgam also acts as a stimulus, leading to continuous palpation by the tongue. Poorly positioned teeth generate stimuli on the tongue or lips. An intense overbite leads to interposition of the lower lip. An anterior open bite invites the tongue to be placed within it and press against the teeth even more. Contraction of the superior arcade (cleft palate) helps maintain a position under the tongue. We will be able to identify countless situations in which stimuli act on the activity of the tongue and lips, especially because of their high level of sensitivity.[2,3]

"Positive" stimuli are those that promote muscle contractions that promote our orthodontic interests. When we introduce a stimulus to the mouth, and obtain muscle movements that help achieve our previously-determined objectives, we can call that a "positive" stimulus. The muscle action achieved (exercises or posture changes) is known as "programmed exercises"[2,3].

When we add mechanical elements to orthodontic appliances with the intention of stimulating certain muscle groups and achieving "automated exercises", we can consider this to be "programmed stimulation therapy."

Figure 1.



Since 1992, we have been working on this and have used the results obtained through the application of "programmed stimulation therapy" to assess ourselves. Programming exercises using stimuli applied with orthodontic appliances, especially removable appliances, is gratifying because these patients rarely complete the exercises taught to them by the myofunctional re-education therapist due to a lack of time, failed memory or lack of interest (Figure 1)[4-6].

The patient will develop "programmed stimulation therapy" for the duration of the time that the devices are used (during the evening and at night). For this reason, the results obtained are much better than those that depend on patient cooperation.

The "functional triumvirate" and its hierarchy

The three most relevant oral functions are known as the "functional triumvirate: Respiration, swallowing and the masticatory pattern. Each of these functions play an important role in "modelling" dental arcades and the craniofacial complex. Occlusion, aesthetics and even facial expression depend on harmony within the "functional triumvirate" during the subject's growth and development period.

However, there are hierarchies within this triumvirate, and so we can establish an order of importance for these three functions:

- Respiration: A vital function for the body but of primary importance for craniofacial development. Conversely, altering it (mouth breathing) also influences the position of the tongue (low and advanced), swallowing (atypical) or the masticatory pattern (lax). As a result, respiratory dysfunction leads to a "cascade effect" that alters the patterns of the other functions (swallowing and mastication). It is impossible to normalize immature swallowing or a weak masticatory pattern if the respiratory pattern is not normalized first[7-9].
- Swallowing: A function that "stimulates" the development of the maxillae and "models" the shape of the arcade. Swallowing dysfunction makes it impossible to normalize the masticatory pattern.
- Masticatory pattern: The least important function for the "functional cascade", yet which is given more consideration when establishing a diagnosis in orthodontics. The growth pattern is usually determines the muscle pattern. One thing that is certain though not completely accurate is that the pattern of the elevator muscles in chewing are directly influenced by respiration and swallowing patterns.

The concept of "hierarchy" of oral functions is therefore paramount when re-educating the functions. If we do not take it into consideration, we may make the grave mistake of trying to resolve the tail of the "functional cascade" (swallowing or masticatory pattern) and missing its origin (respiration).

Diagnosis of the functional matrix: "MFS" functional scoring.

The orthodontic diagnosis must be supported by recognition of the etiological factors of malocclusions and, as such, the functional alterations that have led to poor development of the "functional matrix".

The concept of the "functional matrix" corresponds to the set of craniofacial structures and to proper occlusion under a functionalist prism that puts more importance on the dynamic aspects than the morphological or static aspects, though the latter are the ultimate result of the first[6].

Diagnosing the functional matrix involves evaluating its functions and establishing the level of the problem for each functional factor analysed. For this reason, we have developed a system for a "scored diagnosis of functions" that we include in the MFS (multifunction system) philosophy. The initial diagnosis of the "functional triumvirate" can be established as a simple description of the possible problems of:

- Mouth breathing: from the clinical evaluation of labial incompetence, microrhino dysplasia or short hypotonic upper lip.
- Atypical swallowing: through the clinical examination of swallowing and detection of suction or pressure movements of the lips or labial or chin pressure or contraction.
- Brachy- or dolicho- muscle pattern: can be determined by measuring the "inferior facial height" on the Ricketts cephalogram.

"Scoring of functions", according to MFS, establishes a score of zero to five for the following clinical aspects:

- Collapse of the nares during deep inspiration (Duran)[10].
- Hypertrophic tonsils, determined clinically (Duran)[10].
- Adenoid hypertrophy, evaluated by lateral teleradiography of the cranium (Ustrell and Duran)[10-12].
- Tongue mobility, determined with the mouth completely open and instructing the patient to touch the palate with the tip of the tongue (Duran)[10].

Scoring the functions allows us to establish the level of severity of the problem and the need for a surgical solution (scores with values of 4 or 5).

The score for nasal collapse (Figure 2) gives us an objective measure of respiratory function that does not depend on the subjective response from the patient's parents of guardians. The question: "is the patient a mouth breather?" may be answered by the parents, but not the following question: "do the nares collapse?", when in reality what interests us most is knowing the functional capacity of the nose which we will compliment with scores for adenoid and tonsil hypertrophy, all of which are scored objectively.

Evaluating the tonsils using MFS scoring allows us to analyse the progression of the problem over time and allows us to describe its evolution numerically. In some cases, the scoring may be different for the left and right tonsils, and may be recorded as 2/3, 1/5, 4/2, 3, 1, etc. Rapid worsening of tonsil scoring will not make us think favourably of the problem, whilst stabilisation or gradual increase of this scoring will make us face a stable clinical situation[10].

Scoring the level of tonsil hypertrophy is very useful when deciding on whether or not to perform a tonsillectomy. High scores (4 or 5) indicate the need for a tonsillectomy, intermediate scores (3) indicate the tonsils should be monitored, low scores (1 or 2) rule out the need for a tonsillectomy altogether. A value of zero (0) indicates that a tonsillectomy has already been performed. Communication between professionals (orthodontists, myofunctional re-education therapists, otorhinolaryngologists, paediatricians) is more objective when scores are used (Figure 3).

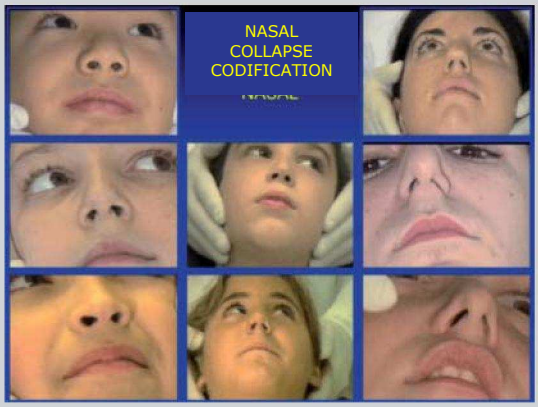


Figure 2.

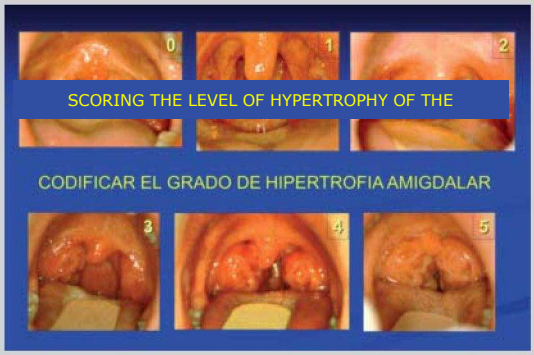
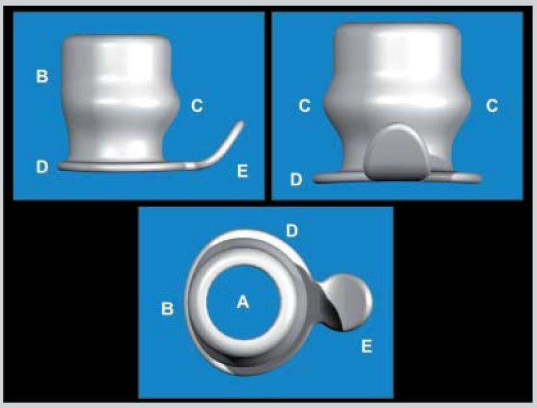


Figure 3.

Figure 4.

Figure 5.

Figure 6.



Scoring adenoid hypertrophy provides us with the same action parameters (Figure 4).

Functional scoring of tongue mobility (Figure 5) does not have anything to do with the presence or absence of the frenulum of the tongue, morphological data that always indicates the presence of a limitation in tongue movement.

A "low tongue position", detected by scoring tongue mobility, allows us to associate this problem with the characteristics or type of malocclusion the patient has. High scores for tongue mobility (3 or 4), a score of 5 (ankyloglossia),are very hard to find and are usually associated with:

– Contraction of the superior arcade with a unilateral or bilateral crossed bite.
– Anterior open bite (dolicho- pattern) or lateral bite (brachy- pattern).
– Generalized diastemata.
– Class III malocclusion[13].

Programmed stimulation therapy with appliances or prefabricated MFAS elements.- Stimuli may applied using added elements in the design of removable appliances (Figure 1) (pearls, buttons, bands or shields) that are added by a professional (holes in the device's acrylic) or through the use of prefabricated MFS elements, such as:

– Nasal stimulators *(EN).*
– Buccal obturators *(OB)*.
– Labial stimulators *(EL)*.
– Lingual buttons *(BL)*.
– Muscle relaxant *(RM)* o Anti-bruxism device *(AB)*.
– Open bite device Anterior *(AM)*.

"Nasal stimulators" have been developed for the treatment of nasal collapse during inspiration but are currently applied as respiration re-education elements and to treat snoring. These prefabricated elements are shown in different sizes and have a morphology characterized by (Figure 6):

– A generalized, cylindrical, tube-like shape (A) that allows the passage of air.
– A smooth peripheral zone that contacts the nasal septum (B), avoiding any injury at this level.
– A convex peripheral zone (C) that displaces the naris outwards and puts the perinasal muscles under tension.
– A stopper at the end of the tube (D) to avoid impacting the inside of the nose.
– A tab (E) located in the nares in order to stimulation the insertions of the perinasal muscles.

"Nasal stimuli" have the following clinical effects:

– Remodelling of the nasal cartilages and the morphology of the lower third of the nasal pyramid.
– "Intubation" effect, promoting the passage of air through the nose.
– Stimulation of the perinasal musculature (Figure 7) by the combined effect of:

- The convex contour of the cylindrical body (C) puts the insertions of the perinasal muscles under tension by stretching the nasal area.
- The tabs on the nasal stimulators act as stimulating elements at the level of insertions of the perinasal muscles at level of the nares.

The combination of the clinical effects of "nasal stimulators" improves nasal function during inspiration and corrects nasal collapse (MFS scoring). In a study carried out on a sample of subjects with different initial scores for nasal collapse, nasal stimulators were used (at night) for nine months. From the results of this study, we can confirm there was functional improvement in the sample (Figure 8).

Improvement in scores for collapse of nares improves completely at the end of the nine months of treatment with "nasal stimulators". This result was maintained over the course of the following four months. Afterwards, a recidivism period began, reaching 50% ten months later.

"Buccal obturators" act through a regulation effect on the respiratory pattern by means of a progressive limitation on mouth breathing. The procedure is started by using permeable buccal obturators, which is then followed by semipermeable and, finally, impermeable obturators.

The complex profile of the "buccal obturator" introduces a secondary effect to these prefabricated elements, based on the generation of lip exercises that help reduce labial incompetency, in addition to the buccal obturators effect of the device.

The measured changes between the initial values for labial incompetence compared to those obtained at 3, 6, 9 and 12 months shows progressive improvement in the interlabial gap.

"Labial stimulators" act by stimulating the orbicular muscles, generating approximation exercises in the lips that improve labial incompetence and length of the upper lip.

According to a clinical study carried out on a sample of 36 patients with labial incompetence at the start of the study, nocturnal use of labial stimulators showed an improvement of 3,653 millimeters in labial incompetence at 6 months and lengthening of the upper lip of 1,013 millimeters.

The *"Lingual buttons"* may be cemented to the palatine surface of anterior teeth (incisors or canines) or posterior teeth (premolars or molars) on the superior arcade. These act a stimuli for the tongue. The posture of the tongue is modified thanks to programmed exercise generated by the stimuli (buttons: First by elevating the tip of the tongue and then the dorsum of the tongue. Postural elevation of the tongue is seen in the improvement in the MFS score for tongue mobility, the same as when we introduce palatine stimuli to the acrylic of a removable orthodontic plate.

When regulating the pattern for masticatory muscle elevators, we are able to use different prefabricated elements according to the type of deviation in the muscle pattern in the lower third of the face (evaluated using the "inferior facial height" on the Ricketts cephalogram):

– In brachycephalic patterns we use *"muscle relaxants"* and/or *"anti-bruxism" devices*.

– In dolichocephalic patterns, we use *"open bite devices"*.

"Muscle relaxants" have a function primarily focused on stretching the "buccinator muscle ring" with the resulting effect being relaxation of these muscle groups. In addition, the lateral sectors of the device keep the mouth half-open due to its exaggerated vertical dimension. In a double study (subjective and objective) carried out on a sample of patients with bruxism, the clinical effectiveness of these devices was confirmed.

The *"anti-bruxism"* devices are a modification of the previous devices, adding an anterior bite plate in order to allow for anterior contact of the occlusion (incisors) over the device, thereby impeding occlusal contact of the molars at the same time. These are specific for patients with bruxism.

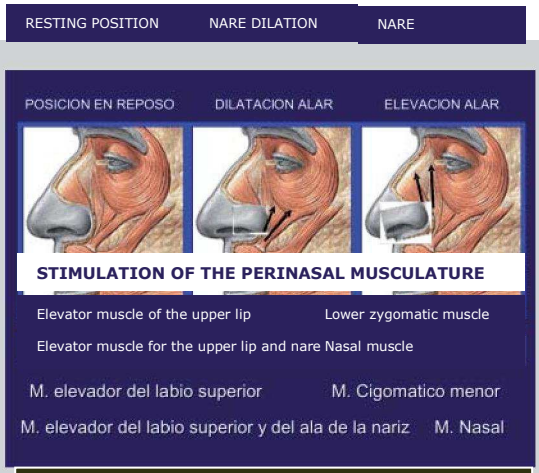


Figure 7.

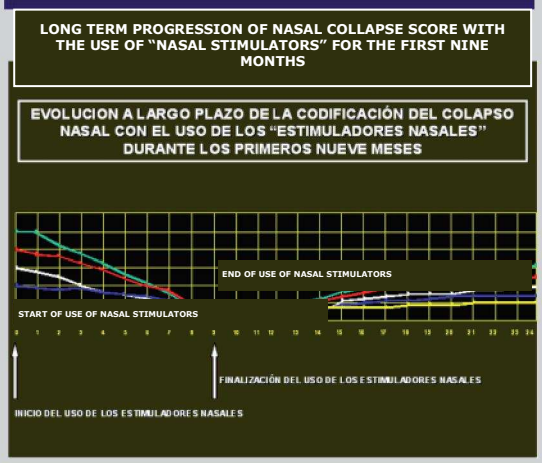


Figure 8.

The *"open bite devices"* have been designed to treat anterior open bite and/or improve lax muscle tone in these patients. In a study carried out on a sample of 22 patients with anterior open bite who used this device at night, a change in the anterior open bite measurement was noted. This change had a mean initial value of 3,432 millimeters to a value of 2,182 millimeters at six months of treatment. This indicates a mean correction of the open bite of 1,25 millimeters in only six months of night-time use of this prefabricated device.

Protocols for re-educating functions

There is a basic sequence for using prefabricated MFS elements based on a protocol for re-education of functions in accordance with the functional triumvirate hierarchy.

Based on the characteristics found on the initial morphological-functional diagnosis for each case, we are able to develop the most appropriate protocol for their normalization. The "key diagnostic factors" can be summarized as follows:

– Nasal collapse (coding MFS) *(CN).*

– Labial incompetence *(I L).*

– Lingual movement (coding MFS) *(ML)*.

– Atypical swallowing *(DA)*.

– Adenoidhypertrophy (MFS score) *(AH)*.

– Tonsil hypertrophy (MFS score) *(TH)*.

– OB – Overbite (OB) or open bite *(OpB)*.

–Brachy- *(BR)* or dolicho- growth *(DO)*. – Bruxism (BX).

According to this diagnostic score *(NC-1, L – LM – AS – AM – BR – DO – BX),* we are going to use the corresponding prefabricated MFS elements *(NS - BO - LE - LB - BA - MA)* either alone or in combination.

We will designing the re-education protocol, according to the hierarchy principles for the "functional triumvirate", in the following order:

Respiration re-education, with "nasal stimulators" *(NS)* and "buccal obturators" *(BO)*, the latter of which should differentiate between permeable buccal obturators *(PBO)*, semipermeable buccal obturators *(SBO)* and the impermeable buccal obturators (IBO), which will be used in this order.

– Swallowing will also follow protocol in accordance with the following aims:

- Seek a posterior postural position for the tongue through exercising the orbicular muscles with the "buccal obturators" *(BO)* themselves or with "labial stimulators" *(LS)*.
- Position the tip of the tongue on the palate with "anterior lingual buttons" (ALB).
- Introduce posterior palate stimulators (PPS) in order to elevate the dorsum of the tongue whilst swallowing.

- In order to normalize the masticatory patterns, we should use the appropriate prefabricated device for the diagnostic circumstance:
  - In a patient with a brachycephalic pattern, use of a "muscle relaxant" *(MR) is indicated.*
  - In the case of a patient with an intense overbite or bruxism, we will use the "anti-bruxism device" *(AB)* device.
  - In those cases with an anterior open bite and/or a dolichocephalic growth pattern, we will use the "open bite device" *(OB)*.

Early re-education of oral functions with an orthodontic prevention program.

The application of these MFS protocols on a population of young patients means acting functionally, before the malocclusion has developed. Therefore, we enter into a concept of primary prevention.

When selecting the sample, individualized priorities should be established in accordance with the key functional diagnostic factors for each case and, whenever possible, the protocols should be standardized based on the functional triumvirate hierarchy.

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