

Bone level technique: personal technique for miofacial functional treatment

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Abstract

The ageing process of the face involves a level of bone erosion that generates a morphological change in the main features of a person's face. Consequently, the muscular structures of facial expression also undergo changes in their functionality.

Another important factor that can shift bone ageing in one district over the other is altered mimicry due to altered skeletal growth.

The study carried out that led to the standardisation of this technique involves the restoration of the bone gap due to physiological bone ageing and bone compensation in those cases where there is an alteration of normal maxillary and mandibular development and growth.

The technique involves supraperiosteal bolus infiltrations of 2-phase hyaluronic acid-based gels with very high cohesiveness for maximum volumetric compensation with a small quantity of product.

This functional treatment aims to achieve a dynamic and functional modification of each patient's subjective physiological muscle contraction. The study was substantiated by a team of specialists who highlighted the changes by means of electromyographic and ultrasound examination and photography.

Key words: miofacial function, miofacial treatment, Skeletal anterior open bite, Orofacial myofunctional status, Orofacial myofunctional therapy, Filler, Anthropometry; Facial beauty; Facial measurements; Quantitative analysis.

Introduction

The ageing process of the face involves a level of bone erosion that generates a morphological change in the main features of a person's face. Consequently, the muscular structures of facial expression also undergo changes in their functionality.

Another important factor that can shift bone ageing in one district over the other is altered mimicry due to altered skeletal growth. It has been reported several times in the literature that an open bite leads to a more energetic contraction of certain muscles such as the chin muscle, the mouth angle depressor and the buccinator muscle.

The study carried out that led to the standardisation of this technique involves the restoration of the bone gap due to physiological bone ageing and bone compensation in those cases where there is an alteration of normal maxillary and mandibular development and growth.

The technique involves supraperiosteal bolus infiltrations of 2-phase hyaluronic acid-based gels with very high cohesiveness for maximum volumetric compensation with a small quantity of product.

The points we studied are strategic points with an indirect dynamic action on the mimic muscles and thus on their balance with an inevitable postural change.

This effect produces a lifting of the skin, subcutaneous tissue and some surrounding structures of the face. This functional treatment aims to achieve a dynamic and functional modification of each patient's subjective physiological muscle contraction.

The points standardised by Dr Francesco Calvani have been studied for maximum muscular effect. The study was substantiated by a team of specialists who highlighted the changes by means of electromyographic and ultrasound examination and photography.

Materials and methods

32 patients were recruited for this study between the ages of 38 and 55. All patients underwent infiltrative treatment on standardised points.

All patients had natural and complete dentition. 26% had dental restorations in the posterior sectors.

All patients had dental alignment with skeletal classes in first class (12 patients), second class (16 patients) and third class (4 patients).

No patients underwent orthognathic surgery.

All patients had no current orthodontic treatment.

All patients underwent infiltrations of supraperiosteal hyaluronic acid at the points standardised by the technique, which included 3 mandibular points, 2 maxillary transmu-

cosal points, 2 zygomatic points and 2 fronto-temporal points, totalling 10 points.

The points were studied from a bone and vascular point of view to allow maximum effect with minimum vascular risk.

Patients were studied by means of electromyography performed in static and dynamic situations with aelectromyography neuromian 2to record potential changes before and after treatment. The study mainly involved recording the orbicularis of the mouth, the chin muscle, the mouth angle depressor, the buccinator and ultrasound. The ultrasound study (Mindray 23 MHz linear probe) was conducted in three phases. The first phase involved the process of checking and mapping the patients to investigate the possible presence of previous treatments that could influence the study. As a matter of fact, patients who had previous treatments with non-absorbable fillers and had no memory or knowledge of them were excluded from the ultrasound investigation. In the second phase, anatomical and especially vascular 'full face' mapping of the patients was carried out in order to highlight any anatomical variants that might have jeopardised the safety of the study. The third ultrasound phase assessed the result of the filler placement in all points but especially in the functional points both at the chin and jaw level (Calvani point)

Electromyography was performed before the infiltration and after the infiltration to record changes at rest and in dynamics with a recording of each patient's normal postural and subjective contraction.

The change in each patient's postural automatism was highlighted by recording the pre and post results and comparing them.

90% of the patients experienced an improvement in muscle contraction resulting in a reduction in muscle hyperactivity after infiltration.

The affected areas were ultrasound-mapped, highlighting the muscular and vascular structures with precision and safety.

The technique

The technique involves the use of hyaluronic acid in a two-phase gel with high molecular cohesiveness and high G'.

The product was chosen on the basis of its rheological properties. A 1-phase product was not considered because of its cohesiveness and duration of firmness. This technique involves the sole and exclusive use of two-phase products because it was discovered that in the medium term they leave the most stable and balanced functional result.

The technique involves the infiltration of hyaluronic acid divided as follows:

- 0.50ml in the chin area
- 0.25 ml in the mandibular angle area per side
- 0.2 ml inside the supraperiosteal oral cavity on the maxillary bone in areas 1.4 and 2.4 respectively
- 0.30ml in the dorsal nasal area extending between dorsum and tip
- 0.25 ml at the level of the zygomatic arch per side
- 0.15 ml in the eyebrow orbital area at 1 cm lateral to the fronto-temporal suture per side.
- The variability of the quantity depends on the clinical picture of the patient being analysed.
- The total is 2,5/ ml of hyaluronic acid

10 strategic points to restore bone thrust on muscles and tissues

All patients were treated in one session.

Bolus infiltration was performed over the standardised bone component. A 27G needle was used at each point.

The most important strategic point especially in patients with second dento-skeletal classis the point of chin synthesis called chin protuberance or gnathion. These patients presented, after sub-muscular infiltration at the level of the chin muscle tendon, a support of the chin muscle that produced a reduction in the autonomous contraction of the patient's dento-skeletal hindbrain.

The autonomous contraction is due to the labial incompetence that the bone gap produces.

Strategic points were ultrasound-assessed to study their vascularisation and to avoid complications from compression or arterial cannulation.

The above-mentioned infiltrations produced an improvement reported by the patient as a feeling of relaxation of the entire face, especially the middle and lower thirds with a change in the functionality of muscle contraction, and with a change of contraction not properly said but produced by more basal support as we know that acting on the bone and increasing the physiological resorption of these areas produces a feeling of relaxation and well-being.

Each point provides a certain type of face dynamics.

1 infiltration of the chin area comprising the chin tubercle and the chin protuberance where it anchors into the muscle of the same name.

2 Bilateral retro-masseter mandibular angle where the greatest mandibular bone resorption occurs due to muscle stimulation and contraction.

3 Calvani point located along an oblique line connecting the third/fourth tooth element to the insertion of the zygomatic muscles (major and minor) at the level of the antero-inferior margin of the maxillary bone in its lateral portion. A strategic point for the protrusion of the maxillary bone and acting electromyographically on the zygomatic muscles.

4 nasal root point extending mainly from the root of the nasal pyramid to the cartilaginous component

5 zygomatic point between the junction of the body and the zygomatic arch

6 lateral supraorbital point above the orbital rim, one centimetre lateral to the fronto-orbital suture

After infiltration all patients were evaluated by electromyography at 3 months.

Discussions

The bone level technique involves the infiltration by 2-phase hyaluronic acid of specific bone points for bone restoration due to ageing and compensation of those bone gaps due to altered growth in the jaw bones.

The study focused specifically on dynamic and static muscle changes.

By means of electromyographic examinations, an improvement of these muscular districts involved in compensation phenomena (due to a bone deficit either by physiological resorption due to ageing or due to impaired development and lack of maxillofacial and orthodontic surgical therapies) was revealed.

Facial expressions and the correlation between chewing, swallowing, skeletal class and emotionality of each individual subject is much discussed in the literature.

The technique involves the infiltration of hyaluronic acid divided as follows

Point	Quantity	Region
6	0,5 ml	in the chin area
5D - 5S	0,25 ml	in the mandibular angle area per side
4D - 4S	0,2 ml	inside the suprapariosteal oral cavity on the maxillary bone in areas 1.2 and 2.3 respectively
2	0,3 ml	in the dorsal nasal area extending between dorsum and tip
3D - 3S	0,25 ml	at the level of the zygomatic arch per side
1D - 1S	0,15 ml	in the eyebrow orbital area at 1 cm lateral to the fronto-temporal suture.

The total is 2,5 ml of hyaluronic acid

The variability of the quantity depends on the clinical picture of the patient being analysed.



Figure 1. Patient 1 - pre and post. Patient with second dento-skeletal class. Pre and post treatment photos with bone level technique. Labial incompetence was filled by intramuscular infiltration below the chin muscle and the maxillary muscle.

Gallerano⁹ et al in a 2012 article described a myofunctional treatment after an orthodontic surgical treatment in a study of 30 cases, investigating the language ability of class I,II, III subjects^{12;14;5} showing that 19 out of 30 patients after surgery reported improved swallowing, correct tongue tone and posture, and re-education of the facial muscles. Most of the patients belonged to a third dento-skeletal class with an anterior open bite^{30;32}. All these patients were re-educated using speech therapy sessions for muscular rehabilitation as the muscles underwent a change in axis and posture during the treatment. Of the 19 patients, only 2 were ineffective while the rest had a *restitutia ad integrum* with a reduction in the speech disorder they previously had. This makes us realise that inevitably acting on the bone by changing position and volume can have a

result that is not only functional but also aesthetic on the muscle, tissue and skin²⁹.

The technique we adopted involves a change not of contraction but of muscle axis. By changing muscle axis, a change in the contractile behaviour of the muscle was noted²⁷.

James³ et al carried out an important study on muscle pain related to chewing disorders especially in patients with an anterior open bite. They identified muscular exercises to treat this type of disorder, but also showed that muscle tension especially in the treatment of myofascial pain^{7;8} of the masticatory muscles can only and exclusively be alleviated by performing muscle stretching and making a change in the dental occlusion, all of which results in a change in the axial muscle. Thus changing the muscular axis results in a change of contraction^{33; 36}.

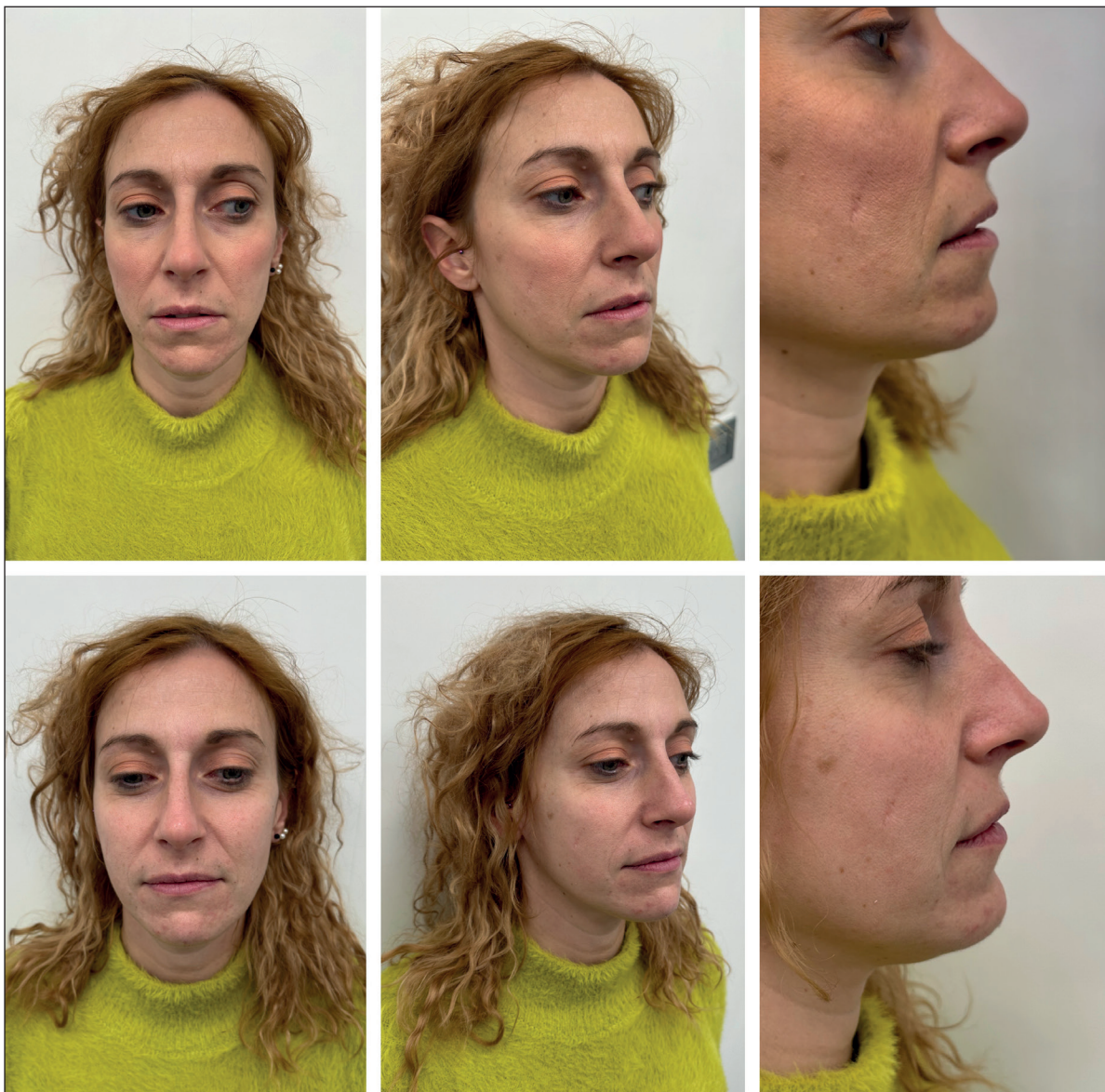


Figure 2. Patient 2 pre and post. Patient with second dento-skeletal class. Pre and post treatment photos with bone level technique. Labial incompetence was filled by intramucosal infiltration below the chin muscle and the maxillary muscle. In the frontal view, increased volume is evident at the level of the lower middle third of the face without superficial skin infiltration but only deep infiltration. The result is achieved by muscular thrust by increasing bone volume and with physiologic resorption of the bone

²⁵. The facial and dental bone component in orthodontic treatments and maxillofacial surgery change their physiognomy. A surgical treatment is aimed at changing the skeletal relationship between the maxilla and the mandible. This shift can have different degrees depending on the planned treatment and the alteration to be corrected²¹. Orthodontic treatment is aimed at rebalancing the correct relationship of the tooth guides. The process of restoring a malocclusion to first class is a process that changes the occlusal, masticatory, swallowing and inevitably mimic posture.

The aim of the technique involves precisely this, i.e. changing the muscular axis^{22,34,10}. This is done with deep supraperiosteal infiltrations that act on the mimic muscles, in some cases creating different contraction axes. This results in a change of contraction automatism that each patient possesses that takes time to change. Of course, there are no studies that can translate this effect into a functional effect at the swallowing level, but the effect is certainly present at the facial mimic and indirectly aesthetic level. All patients in this study experienced a benefit translated into generalised facial muscle relaxation. In the second classes, on the other hand, the patients reported a reduction in the contraction of the chin muscle^{23,24}, orbicularis of the mouth, lip depressor, risorius and buccinator.

Hong Hong¹¹ et al in 2021 carried out an important study on skeletal growth, showing, by means of electromyographic examination, the different contraction that occurs at the level of the lower third compared to the upper third of the face^{15,16,17}.

They showed that in patients with open anterior bite^{18,20}: a greater anterior facial height and a greater degree of incisal protrusion can be found. This study evolved by correlating electromyography with 18 cephalometric measurements and it was found that there is a difference between the contraction of the orbicularis muscles of the mouth and chin and the anterior temporalis and

masseter muscles. When swallowing, this results in an increased muscle contractility of the lower third of the face compared to the upper third.

This reinforces the results obtained with our technique. Infiltrating under the chin parasymphysis, without involving the muscle of the same name in its structure, creates a support of the same at the tendon level and thus a support for the lip especially in dento-skeletal labial incompetencies. By means of electromyography with surface and intramuscular electrodes, a contractile reduction from 15% to 40% was found. Naturally, the percentage increased significantly in dento-skeletal classes II and III. The significant reduction in contraction is of course not due to the muscle itself reducing its contraction but rather to a change in its axis that causes the muscle to contract differently¹⁹.

It is not possible to standardise the change as the individuals changed.

The concept of change of contraction is a broad concept and each person has a different response, so this study only reported improvement in an incorrect posture concept.

Jiaxing Wang² et al conducted a study also defining facial contraction correlated with the individual's ethnic group. It was seen that following muscular exercise, people of different ethnic groups contract correlated muscle groups differently. It is therefore difficult to standardise a result, but our observations have always shown an improvement, especially in those areas where there is hypertonus⁴.

Third article

In a study of 50 patients^{11,29} with TMD, taking into consideration the contraction of the orbicularis muscle of the mouth, lips, and masticatory and lingual systems, it was found that changing the muscle axis by pressure maneuvers with the hands showed a remaining masticato-

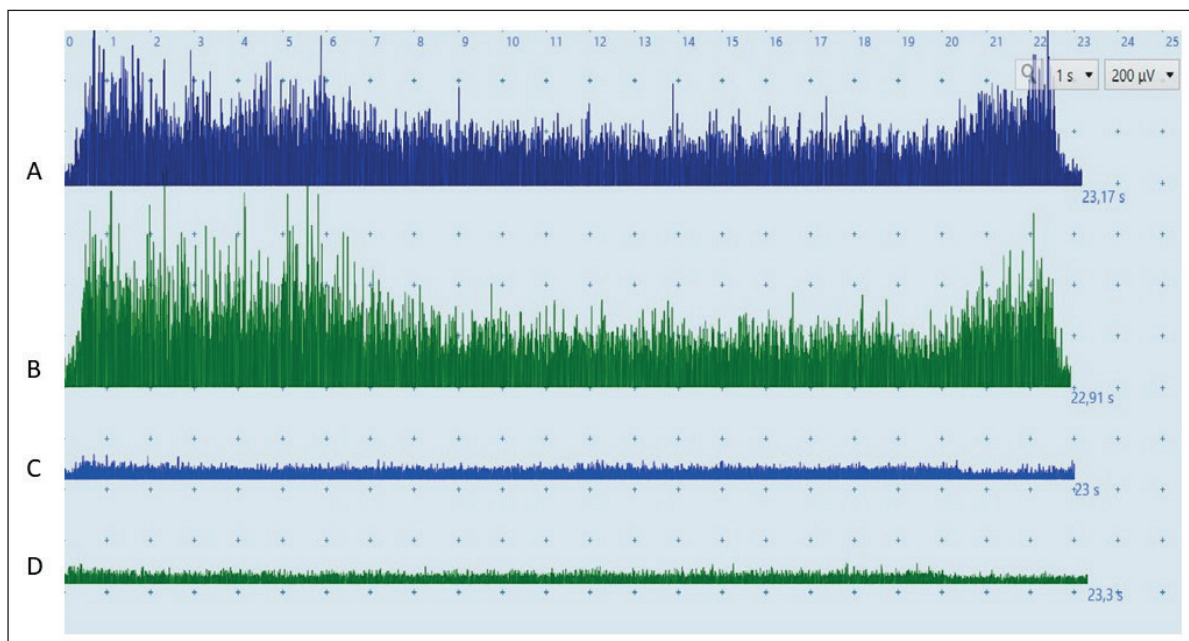


Figure 3. The EMG recording during a maximal effort of 20 seconds shows a global reduction of the amplitude and frequency of voluntary recruitment in the right and left mental muscle after treatment. Pre-treatment: A right mental, B left mental. After treatment: C right mental, B left mental.

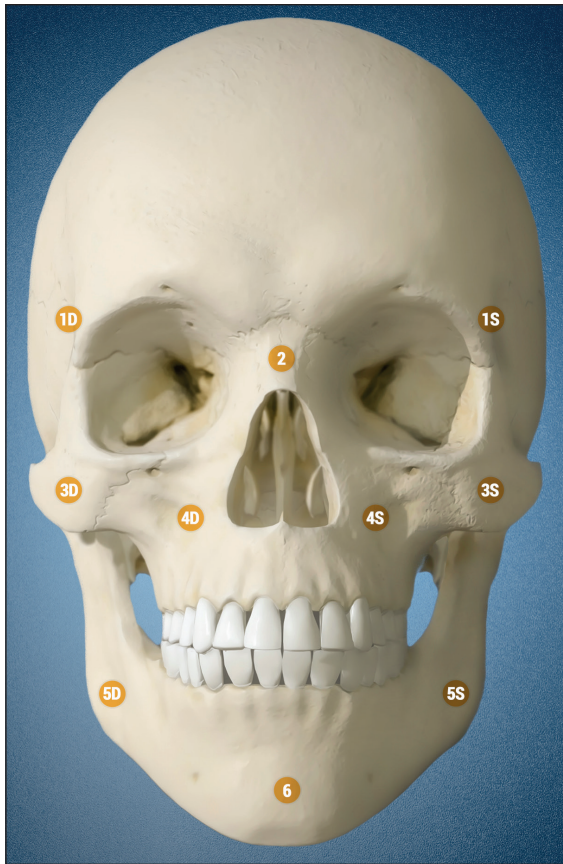


Figure 4. Bone level points. Ten points for modulation of muscle contraction.

ry igloo. By acupressure both the lip and the orbicularis were suspended. This resulted in a masticatory postural change^{28,29}.

After functional rehabilitation by means of targeted stretching and speech therapy exercises, a significant improvement in function was noted. The results after physiological rehabilitation treatment were exciting^{26,31}. All movements were recorded before and after treatment. The areas most affected were appearance, lip posture, cheek, tongue and jaw mobility, chewing and swallowing functions.

After functional treatment with physiotherapy and speech therapy, it was ascertained that degenerative changes in masticatory dysfunctions due to bone and muscle processes were alleviated and even stopped. The study shows that poor masticatory posture that inevitably involves the musculoskeletal system of both mastication and mimicry can improve if treated.

With our technique we have proven the fact that by inserting supraperiosteal hyaluronic acid there are no alterations to the muscles as the muscles are not affected, but by shifting their axis a valid functional result can be achieved to reduce stress and accentuated contractility especially in very emotional patients with work-related stress.

Emotionality in contraction plays a very important role. A patient with an altered state of aesthetics will present an altered mimicry just as a patient with muscular contractile alterations will present an altered aesthetics.

Jennifer Schmidt⁶ in a 2017 article reported an important

study on facial expressions related to food cravings. The article reports the change in contraction and posture due to a specific emotional stimulus. Thus, the emotion in the facial expression can lead to a change in contraction and posture of the whole face depending on the emotionality of the subject. In a subject with a tired face and a receding chin, a change in masticatory posture can therefore occur. In our technique using electromyography, we noticed a reduction in muscle contraction after the proposed treatment, which brought the patient a functional and indirectly aesthetic benefit. This indirectly led to an increase in self-esteem and a rebalanced contraction of all mimic muscles. Less chin and buccinator contraction, with evident increase in the volume of the part itself and skin rebalancing¹³.

Koletzi²⁶ et al in a study of adolescents found that after muscular rehabilitation of the lower third, there was an increase in tongue thrust at the upper and lower incisors. This resulted in an increased contraction of the orbicularis muscle of the mouth. Thus, altered orbicular contraction is also found in the growth phase. Our protocol provides support at the level of the chin muscle, which nevertheless brings help with the function and muscular posture of the lower third.

Conclusions

In light of the results obtained and the literature in use, we believe that the bone level technique can be an important aid in the contractile processes of the facial muscles. Often the discomfort of patients due to physiological skeletal resorption related to advancing age, loss of dental elements or dental and skeletal malocclusions can lead to an alteration of the physiological contractile harmony of the entire face.

All patients underwent basic EMG examination with supramaximal voluntary contraction of individual muscles, demonstrating full cooperation.

Y-Solution 720 was infiltrated by needle: this is the only hyaluronic acid-based filler with a high G' (517 Pa) and high cohesivity (54 gf) that simultaneously has the best features of biphasic and monophasic fillers: it is described by its manufacturers as belonging to a new class of products called Y-phasic.

These characteristics give the gel a high versatility level: it can be used not only in the classic areas that need volumetric increase, such as cheekbone, chin or mandibular profile, but also in areas such as the nose: the gel has a superior lifting capacity, enabling it to withstand external stresses and retain its original shape without migrating; it has a better lifting capacity that allows it to withstand external stresses and maintain its original shape without migrating.

After 20 minutes EMG was repeated with the same sequence (right buccinator, left buccinator and chin muscle).

The result shows an overall reduction in the amplitude of the electromyographic trace with both spatial and temporal reduction of motor unit recruitment between 25 and 50% compared with the previous condition with the same parameters.

Only two patients showed a reduction of 3-6%: these patients had a first dento-skeletal class and a third dento-skeletal class, respectively.

Our electromyographic observations showed us how an increase in volume at certain strategic points can restore

support to the soft tissues, inevitably triggering a generalised muscular contractile rebalancing. A principle that should not be underestimated is maxillary and mandibular bone resorption. Resorption processes play an important role in the contractile capacity of the face. A face without bone support will inevitably undergo a change in muscular contractility due to both the downward slide of the entire skin muscle system and the inevitable change in muscle axis. The muscles will also undergo stretching due to the weight of all the tissue elements of the face with an inevitable change in their tone especially at the level of the middle third. To rebalance, therefore, this phenomenon will produce an increase in contraction to also support the weight of all the tissues. By rebalancing and compensating the superficial bone volumes with the help of 2-phase hyaluronic acid, it has been noted that these muscles are able to rebalance their contraction. This is the most plausible explanation for the results obtained.

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