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Treatment of facial aging with calcium hydroxyapatite - filling and lifting concept

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ABSTRACT: The face is organized in five different layers (skin, muscles, supportive ligaments, fat pads and bones), which are continuous and interconnected with each other from the scalp to the neck. As a result of aging, changes occur in all its tissues and structures, triggering a cascade of effects in the adjacent areas. Actually, the more it is known about the loss of volume, the better it is to establish the target spots for volume replacement, with consequent more natural- and harmonious-looking outcomes. However, the skin is the outer envelope of the face, which, in the natural process of aging, has a lower capacity to completely accommodate any underlying volume loss or displacement. The result is the formation of creases and folds due to skin sagging. To describe the effects of the injection of calcium hydroxyapatite (CaHA) targeting two objectives at the same time: the restoration of volume loss to compensate the changes in the tridimensional structure and the improvement in skin texture caused by the stimulus to collagen synthesis, thus reducing the sagging of soft tissues envelope. Owing to the mechanism of action of CaHA, its application can be done in two differentiated and little invasive ways so that these objectives can be reached simultaneously. This technique can provide safe, natural and long-lasting rejuvenating effects.

Keywords: Facial aging; Sagging; Collagen; Fill; Lift; Hydroxyapatite.

1. INTRODUCTION

A youthful face has a considerable amount of volume evenly distributed, which shows a slight transition from one area to another and confers a well-rounded 3-D topography delineated by a series of arcs and convexities. Viewed frontally, the following features are highlighted: the primary arc of the jawline, convexities of the temples and multiple smaller secondary arcs of the lips [1]. In profile, the lateral cheek projection (the "ogee" curve), extending as an unbroken convex line from the lower eyelid to the cheek, the arc of the jawline and the arc of the forehead are the strongest characteristics of youth [2, 3].

Until the nineties, facial rejuvenation treatments consisted only of the reduction of wrinkles and folds based on the bidimensional concept. Today, the major change in treatment is the establishment of the tridimensional concept, which recognizes that volume loss significantly contributes to the appearance of the

face as we age [4]. Actually, the more it is known about the areas of volume loss, the better it is to establish the target spots for replacement, with consequent more natural- and harmonious-looking outcomes [5].

The face is organized in five different layers: skin, muscles, supportive ligaments, fat pads (subdivided into superficial and deep) and bones, which are continuous and interconnected with each other from the scalp to the neck [6]. It is known that as we age, changes occur in all facial tissues and structures, triggering a cascade of effects in adjacent areas. Structural alterations are independent, so changes in a certain tissue exert influence on other tissues and cause modifications in the general facial appearance as the individual ages [7]. These are the result of a natural and continuous physiological process characterized by bone reabsorption, the loss or redistribution of subcutaneous facial fat, dermal and hypodermal thinning caused by photo- and chronological aging as well as the appearance of wrinkles due to muscle hypertrophy.

The aging of the different facial structures does not occur at the same speed and rate. It varies from individual to individual not only according to age, but also to genetic predisposition and lifestyle, which will determine the retraction speed and facial asymmetries. For facial rejuvenation, treatment options should include a natural, safe and long-lasting balance restoration between facial skin layers, bearing in mind the complex anatomy of the face and taking into consideration the contribution of each structure to the aged appearance in each patient [6].

Restoration of symmetry, facial volume and skin tonus as well as the improvement in facial contours are the target of the treatment. The balance between the many facial structures must be kept, individually respecting factors like gender, ethnicity and objectives. Upon analyzing each patient's face, it is possible to establish the best treatment in each case and how it should be carried out. Among the most used treatments in recent years are lifting and filling facial, both needs should be taken into consideration, thus allowing for the achievement of more natural results [2, 3, 8].

The progressive loss of elasticity is observed, which is generated by the gradual loss of elastic fibers and the decrease in dermal thickness. When these factors are associated with lipoatrophy in the hypodermis, skin sagging takes place [7]. Clinically, the skin looks thinner, becomes less elastic. The outcome of these alterations is an outer envelope of the facial skin with a lower capacity to completely accommodate any underlying volume loss or displacement, thus causing the formation of creases and folds due to skin sagging [8].

As we age, craniofacial bone remodeling occurs, and it is considered as the key factor in its pathogenesis. The result is a deep loss of underlying support to the more superficial overlapped soft tissues. Forensic studies show that the deepest bone morphological alterations related to age in terms of head and neck appearance are more evident at around 50 years of age in both males and females. Women showed the greatest alterations, including maxillary and mandibular bone loss, a finding that authors suggest being related to the menopause effects, which can be explained by the rapid decrease in bone mass within the first 10 years of menopause [3, 4]. Therefore, bone loss treatment with the consequent repositioning of soft tissues can be obtained specifically with and injectable agent [6].

There are some techniques to promote facial renewal among them are lifting, that is a surgical procedure to improve visible signs of aging on the face, and dermal fillers that is used to reduce fine wrinkles and restore the natural appearance of the facial skin and is less invasively [9].

Besides the redistribution of facial skin and the simultaneous loss of adjacent volume, fat pads can clearly be detached parts, just like most of the underlying facial structures. Malar fat seems to slide forward and down to bulge against the nasolabial crease, and preauricular and buccal fat seem to slide forward and down to create a jowl, disrupting the defining arcs and the convexities of youth [2, 6]. Repositions of the fat

pads and their volumetric correction, whenever necessary, can also help in the restoration of facial volume [10].

The combination facial volume loss and skin sagging plays an important role regarding age the development of wrinkles and folds and age appearance [6, 8]. Therefore, dermal and hypodermal thinning, combined with the loss of facial volume caused by bone reabsorption and the loss or redistribution of facial subcutaneous fat, lead to changes in facial contouring, which goes from a youthful, oval and full appearance to a soft, square and empty shape [11].

The aim of this study was to describe the treatment with combined application techniques of calcium hydroxyapatite (CaHA), taking into consideration the interactions among bones, ligaments, fat and skin in facial structuring, and simultaneously targeting two objectives: the restoration of volume loss to compensate the changes in the tridimensional structure and the improvement in skin texture through the stimulus to collagen synthesis, thus reducing the sagging of the soft tissues envelope by using the effects of the filling and lifting concept. Because of this balanced approach, rejuvenating effects can be more safely and naturally provided, which, combined with other procedures, will promote satisfactory, long-lasting results and avoid distortions [8].

2. METHODS

2.1. Pre-procedure preparation of patients

All patients were treated at the Cosmetic Dermatology Sector at Faculdade de Medicina do ABC and all procedures were approved by the Ethics and Research Committee of Faculdade de Medicina do ABC (n° 2.611.929). Before application, the following must be investigated: the use of medications, especially those that increase bleeding time; history of diseases; allergies; the presence of other fillers. During the clinical examination, asymmetries should be highlighted, the repercussions of the areas to be treated over the facial structure should be analyzed, and patients should be made aware of the objective of the application in each facial site. Front, lateral and 45-degree angled photos are required for complete documentation. Topical anesthetic must be applied to minimize injection pain. Cold compresses help decrease bruising and minimize injection pain even more.

Just like any other procedure that breaks the skin surface, this treatment carries with it a risk of infection. To minimize the risk, the injection site must be properly disinfected, sterile gloves must be worn, and proper care must be taken to avoid needle contamination during the procedure [12, 13].

Product preparation

CaHA is available in 1.5 ml syringes. In July of 2009, the FDA approved the mix method with lidocaine, promoting more comfort to the patient and making applications easier. In the technique here described, 3mL of lidocaine was mixed with 1.5 ml of CaHA for a total volume of 1.8 ml, the mix in 20% lidocaine without vasoconstrictor is indicated for the filling of face support areas (total volume of 1.8 ml), and the 100% mixed in 1.0 ml of lidocaine without vasoconstrictor and 0.5 ml of saline solution is recommended for areas where the skin is thinner for neocollagenesis induction (total volume of 3 ml).

Application

CaHA should be retroinjected in the deep dermis (Figure 1) or in the superficial hypodermis with a 27G 13 mm needle, except for the zygomatic arch due to the fact it is a risk site. In this area, periosteal applications must be performed using the bolus technique, from one to three sites, according to the patient's need. It is important to point out that the administration should be carried out slowly and carefully so that the

pain caused by the tissue distension is minimized and the procedure becomes more comfortable for the patient.



Figure 1. Ideal depth for deep dermal application.

In the technique here described, the first application sites were the angle of the mandible and the mandibular contour from the angle of the mandible, the zygomatic arch, the malar and submalar regions for volumization and repositioning of facial structures with a mix of 20% (Figure 2A). Later, the lateral areas of the face were treated in sites where the skin is thinner, and the direction of sagging is determined with a mix of 100% so that neocollagenesis could be induced (Figure 2B).

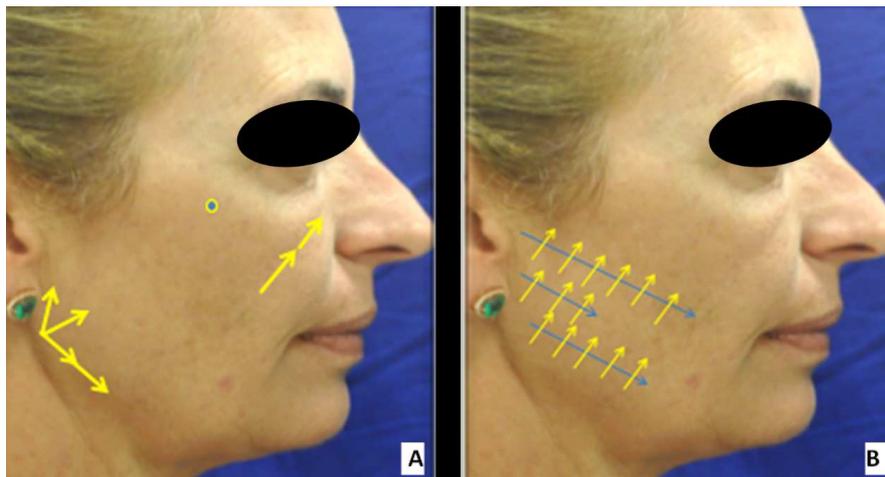


Figure 2. A: Applications in the angle of the mandible using the fan-like technique, in the zygomatic arch using the bolus technique (0.1 ml), and in the mandibular contour, malar and submalar regions in retroinjection (0.1 ml of the product per site). **B:** Applications of 0.1 ml of the product per site, with retroinjections in lines 1 cm apart from each other, above the mandibular margin in the pre-auricular and parotideal regions, following the sustaining vectors where the skin is thinner so that neocollagenesis can be induced and skin texture improved, with support bands for the lifting effect and avoiding the jowl region.

The number of syringes for each application area depends on the individual need of each patient: for volumization, 1-3 syringes may be administrated at intervals of 2-3 weeks; for neocollagenesis, 1-2 syringes at intervals of 4 weeks. Two ways of application can be simultaneously performed. To avoid the formation of nodules due to excessive use of the product or overcorrection, it is important that the treated areas do no overlap.

The technique complemented with applications of CaHA in the temporal and mentonian regions, the nasolabial folds and the puppet lines with a mix of 20% hyaluronic acid that is a polyanionic natural polymer that increases cell proliferation [14]. These mixes were used according to the patient's need or the professional's choice.

2.2. Post-application care

In compliance with the consensus published in 2014, the protocol of post procedure care establishes the immediate placement of ice on the treated areas to reduce and limit bruising and edema of tissues. Massage could be done to improve the spreading of the material. Sun exposition should be avoided for 24 hours after the treatment or until the erythema or eventual bruising completely subside.¹⁰ Follow-up visits should be scheduled for 2-3 weeks after the procedure, and then, if necessary, a new application should be carried out.

3. RESULTS

The figures 3-6 show the results obtained with the applications.



Figure 3. Before (A) e immediately after (B) the application with 1 syringe of CaHA as volumizer and 1 syringe as biostimulator. with 1 syringe of CaHA as volumizer and 1 syringe as biostimulator.



Figure 4. Before (A) and 1 month after the treatment (B) with 2 syringes of CaHA as volumizer and 1 syringe as biostimulator.



Figure 5. Before (A), 7 days after the application (B) of 1 syringe of CaHA as volumizer, and 30 days after the application (C) of 1 syringe as biostimulator. Observe the filling and lifting effect.

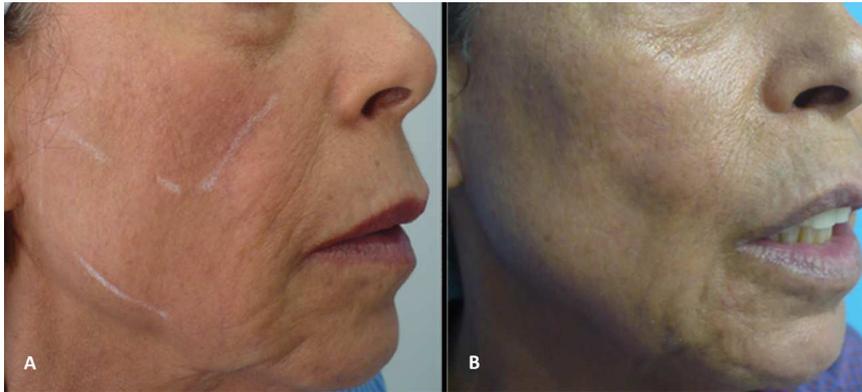


Figure 6. Before (A) and 3 months after the treatment (B) with 1 syringe of CaHA as volumizer and 1 syringe as biostimulator.

4. DISCUSSION

All the knowledge regarding the structural changes that occur in the face allowed for the development of refined facial rejuvenation techniques. Non-invasive cosmetic procedures have become very popular given the fact they are highly safe, and they promote immediate results with a short recovery period. Dermal fillers and volumizers are now widely used for the restoration of facial contour, which contribute to a more youthful appearance [15].

All facial structures undergo changes as we age, and people of different age groups have different needs, like the correction of lines and wrinkles caused by skin sagging and the restoration of volume loss. Therefore, treatments for facial rejuvenation, regardless of the employed method, should offer corrective techniques for the changes that affect the face, such as the improvement of sagging skin, the reposition of fat pads, the relocation of the origin of the muscles and the recovery of fat and bone atrophy, tailored to each patient's needs [6, 8, 16].

The application of CaHA is frequently recommended due to the fact it is a minimally invasive procedure for the restoration of facial symmetry and volume, the improvement in the contour and the recovery of skin tonus caused by the formation of type 1 collagen and elastin in the application site, with effects that last at least 9 months [17]. CaHA contains inert and non-antigenic microspheres of synthetic CaHA composed of Ca ions and phosphate, which are identical to the mineral components found in human bones and teeth. The uniformly smooth-surfaced microspheres measure 25 to 45 μm in diameter, and they are suspended in a

carboxymethylcellulose gel base (30% CaHA and 70% gel carrier by volume). The microspheres are biodegradable, biocompatible and there is no need for a previous test [11].

In 2006, the US Food and Drug Administration (FDA) approved the use CaHA for the restoration and correction of facial HIV-associated lipoatrophy and the augmentation of soft tissues of the face, including the correction of moderate and severe nasolabial folds. In Europe, it has received the CE mark approval for the increase in facial volume, including the treatment for nasolabial folds, puppet lines, pre-jowl sulcus, loss of malar volume, nasal dorsal deformities and facial contouring. CaHA provides an immediate correction especially due to the gel carrier. With time, the gel carrier is gradually absorbed as the microspheres induce the attraction of macrophages and the resultant fibroblastic response with the production of new collagen around them. Over time, the microspheres are broken down into calcium and phosphate ions by a normal metabolic process, which are absorbed by phagocytosis and later excreted, leaving the newly formed collagen fibers [11].

Hence, taking into consideration the dual mechanism of action of CaHA, this combination of techniques targets the filling and lifting effects at the same time [17]. It is important to highlight the fact that both application techniques of CaHA, as a biostimulator or as a volumizer, can be independently used according to each patient's needs.

Applications in the deep dermis, aiming to replace bone and fat pad volume losses in the affected areas, are not only safer and more effective than deeper injections, but it also allows for a reduction in the amount of the product used. However, in the zygomatic arch, periosteal applications must be performed using the bolus technique due to the fact it is a risk site. The number of sites will depend on the volume loss in each patient [18].

Although in the current study the authors opted for applications with needles, injections of the product using either a needle or a cannula depends on the practitioner and the technique may vary according to the area to be treated. Needles increase the precision of movements and allow for intradermal and periosteal injections and the placement of small volumes; the disadvantages are the pain and burning sensation during the procedure, laceration of vessels and bruising. Cannulas are less traumatic and enable the treatment of larger areas with fewer punctures; the disadvantages include the need of specific training, the use of a larger amount of the product and the impossibility of administering periosteal injections [11-13].

The result of the proposed treatment will depend on the quantity of product injected, which varies according to the patient's age, the quality of the treated tissue and the patient's individual capacity of collagen production. Aged faces with advanced craniofacial remodeling, fat loss and poor skin quality can be successfully treated; however, they will need a greater amount of the product and a larger number of applications for better results. Although this application technique is indicated for any age group, patients who most benefit from the dual mechanism of action are those with the neocollagenesis process completely effective [19]. Therefore, younger patients with the first signs of lipoatrophy and little volume loss respond more rapidly to the treatment with a lower amount of the product. After a single application using 2 syringes and combining both techniques, the effects achieved lasted at least 18 months in most patients. In vivo, the durability depends on many factors, like the injection technique, the site of the application, the patient's age and metabolism.

Many recent studies have analyzed the safety of using CaHA in the long run, with at least a three-year follow-up. No late or long-lasting adverse events have been reported so far [11, 13, 17]. Applications in the perioral and periorbital areas should be avoided since the accumulation of the product due to muscle contractions can lead to nodule formation [12, 17]. The main adverse effects observed were erythema, edema

and occasional bruising. To minimize these effects, patients were instructed to avoid medications that increase bleeding time one week before the procedure, vigorous exercises in the first 24 hours after the procedure, and to keep the head elevated while sleeping until 48 hours after the application. Immediate edema varied from patient to patient and lasted until 48 hours. It can be minimized when the patient sleeps with the head elevated.

With this technique, the risk of vascular embolism and necrosis by intravascular injection or by compression due to the placement of the product is minimum once most of the product is injected deep intradermally, in an area with an intense vascular network without vessels of large diameter [20]. To avoid risk areas, knowledge of the facial anatomy is essential. In addition, nodules of product accumulation can occur due to very superficial applications or injections in areas of intense facial motility, so such approaches should also be avoided. The formation of foreign body granulomas is very rare, and it especially depends on the patient's predisposition.

The following contraindications regarding the use of CaHA are noteworthy: patients with active acne, owing to the risk of contamination; those in treatment with immunosuppressive drugs, since they reduce the inflammatory response with a consequent inhibition of the biostimulation; collagen disease patients, given the risk of the reactivation of the underlying disease; pregnant or lactating patients [11, 12, 21, 22].

This application technique can be combined with the use of laser and intense pulsed light, peeling and fractional radiofrequency therapy, but not simultaneously due to the risk of an increase in the inflammatory response. A combined treatment with hyaluronic acid can be of great value for perioral and periorbital filling, depending on the patient's need, or nasolabial and mentolabial filling, according to the practitioner's choice. Treatment with botulinum toxin is not recommended to be carried out at the same time.

5. CONCLUSION

The face is organized in five different layers, and each layer is composed of specific structures that differently contribute to its aged appearance. Taking into consideration the interactions among bones, ligaments, fat and skin in facial structuring, treatments that enable the restoration of volume loss and improvement in skin texture can provide safe, natural and long-lasting rejuvenating effects. Owing to the mechanism of action of CaHA, its application can be done in two differentiated and little invasive ways so that such effects can be reached simultaneously, resulting in a rejuvenated appearance and improvement in skin sagging.

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