



COLLAGEN BIOSTIMULATOR WITH POLYMETHYLMETHACRYLATE

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ABSTRACT **Introduction:** Polymethylmethacrylate (PMMA) is a potent agent that induces neocollagenesis and neoangiogenesis when used in dermal and subcutaneous tissue implantation techniques. In this study, the collagen biostimulation technique with PMMA is presented, with adequate and safe concentrations for facial lifting in different laxity degrees. **Objective:** To present the PMMA using technique in collagen's face biostimulation. **Methods:** Material (PMMA) characteristics, concentrations, suspension technique, injection technique, areas subject to treatment, risk areas and post-treatment assessment in several facial laxity degrees were described. **Conclusion:** This study described the particularities of the use of PMMA as an effective and potent biostimulator. The technique proved to be effective in treating varying degrees of facial laxity.

KEYWORDS : Biostimulator, collagen, polymethylmethacrylate, PMMA, flaccidity, laxity.

INTRODUCTION

Collagen biostimulator – PMMA

The use of biostimulators has become popular in the last ten years in the treatment of facial flaccidity¹. Similar to poly-L-lactic acid², calcium hydroxyapatite³, and polycaprolactone⁴, polymethylmethacrylate (PMMA) is a synthetic, particulate, biocompatible, inert, and non-allergenic polymer⁵ that, if properly used, produces excellent results in the treatment of all degrees of facial laxity, providing the patients with great satisfaction.

In this study, the use of PMMA for collagen biostimulation in facial lifting will be presented⁶, considering adequate and safe concentrations for different degrees of flaccidity.

METHODS

Material (PMMA) characteristics, concentrations used, suspension technique, injection technique, areas subject to treatment, risk areas and post-treatment assessment in several facial laxity degrees were described. This study was approved by the Research Ethics Committee of the Veiga de Almeida University under the number 36405420.7.0000.529. The free and informed consent term was not necessary because the data were taken from clinical records.

STARTING POINTS

- Tumescent local anesthesia (TLA)
- Preparation of the PMMA suspension
- Marking of treatment areas
- Marking of danger zones
- Anesthesia
- Recommended cannula
- Treatment planning
- Anatomical plane for the application
- Volume and concentration

- Checking of the puncture wounds
- Massage
- Post-procedure care
- Additional sessions

A. Tumescent local anesthesia solution (TLA)

200 mL of saline
20 mL of 2% lidocaine without vasoconstrictor (400 mg/20 mL)
1 mL of epinephrine 20000 UI/1 mL
10 mL of sodium bicarbonate 8.4%
Total: 231 mL of TLA
Each 1 mL of TLA has 0.17% of anesthetic or 0.15 mg of lidocaine.

B. Preparation of PMMA 30% suspension in lower concentrations

- 10% PMMA: in the proportion of 1 mL of PMMA 30% to 2 mL of TLA.
- 5% PMMA: in the proportion of 1 mL of PMMA 30% to 5 mL of TLA.

The mixture is homogenized using a 3-way stopcock cannula and vigorous mixing (minimum of 20 bottle changes). Whenever the treatment area is changed or the injection takes more than five minutes, the syringe contents should be returned to the vial and the PMMA resuspended.

This composition results in PMMA 10% or 5% with a very small amount of anesthetic (0.15 mg of lidocaine for each mL of TLA) and good flow in 22G cannulas.

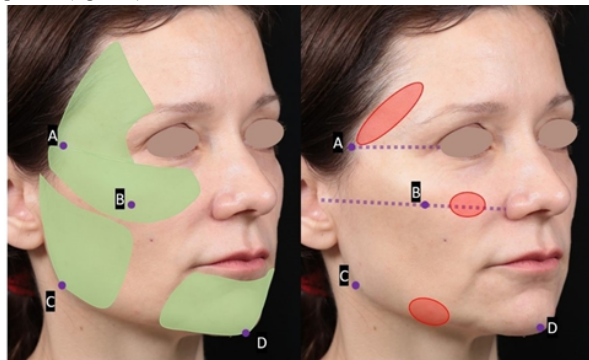
The suspension is fractionated into syringes of 1 mL or 3 mL.

The risk of anesthetic intoxication using TLA during the BioSculpt® procedure is very low since the concentration of anesthetic is below the

value of reference (7 mg/kg) recommended by the literature.⁷

C. Marking of treatment areas

In addition to marking the injection lines, it is important to limit the biostimulation area. This will make the last step of the procedure, vigorous massaging, easier to be seen by the doctor and taught to the patient (figure 1).



(Figure 1 – Treatment areas and entry points danger zones.)

D. Marking of danger zones

The marking of nervous and vascular danger zones in the biostimulation technique is of fundamental importance. For each entry point, the venous, arterial, or nervous pathway that crosses the superficial treatment area must be marked (figure 1).

E. Anesthesia: a bleb of TLA is raised on the cannula entry point

An intradermal bleb of TLA is raised with a 33G 1/2 needle in a 5 mL syringe, injecting 0.2 to 0.5 mL per point and producing a visible vasoconstriction halo.

Blebs of anesthetic are raised according to the areas individually indicated for each patient's treatment, always taking into account the need for biostimulation in the region, anatomy, asymmetries, and facial areas of lower nervous and vascular risk. An 18G needle is used to open the entry point for a 22G cannula.

The proposed anesthetic sites are in the (figure 1):

- A. horizontal hairline of the outer canthus;
- B. midpoint between the ala of the nose and the tragus;
- C. posterior-inferior angle of the mandible;
- D. soft tissue menton.

F. Recommended cannula

Only 22G 7 mm cannulas are used. Needles are absolutely contraindicated for this procedure.

The use of smaller-caliber cannulas is avoided because they clog easily and deposit the product on precise spots, impairing layer formation. Similarly, cannulas of larger caliber should also be avoided, as they deposit larger amounts of product than those recommended in the study, increasing the risk of nodule formation.

G. Treatment planning: retrograde injection in a fan-like fashion

The marking in a fan-like fashion allows for the creation of a layer of product in the subdermal plane, instead of volumizing a specific spot. It is important to note that the linear retrograde injection for the deposition of the product must be carried out continuously, avoiding the perimeter near the entry point. That is, do not inject in the centimeter proximal to the bleb of anesthetic. This practice avoids the formation of nodules due to unstable exertion of pressure to the syringe plunger, as well as product leaking from the cannula entry point due to the injection of the product near it (figure 2).

The suspension must be injected using a continuous retrograde technique, exerting stable and constant pressure on the syringe plunger while removing the cannula from the tissue. The cannula is inserted until the end of the marked line and deposition begins in a retrograde, slow, and continuous movement.

Up to ten injection lines are drawn in a fan-like fashion, converging to the entry point.



(Figure 2 - Entry points and feedback lines)

H. Anatomical plane for the application

The main plane for the application of the biostimulator is subdermal. In the lateral points of the face, the injection plane is limited by the temporal, parotid, and masseteric fascia, in addition to the ascending branch of the mandible. In the orbital region, submuscular application is used. In the zygomatic, mandibular, and mental areas, both the supraperiosteal and the subdermal techniques can be used, the former for when the goal is volumizing the area and the latter for the stimulation of neocollagen formation.

The intradermal plane is contraindicated when using the BioSculpt® technique.

I. Volume and concentration

Considering that the purpose of BioSculpt® is the production of neocollagen and in no way of a subcutaneous nodule, the retrograde injection in a fan-like fashion is fundamental. Each line is injected with 0.1 to 0.25 mL of the PMMA suspension with TLA.

For the eyelid area and for patients with thinner skin, the suspension of PMMA + TLA at 5% should be used, being injected only 0.1 mL per line.

For thicker skins, 0.1 to 0.25 mL of 10% PMMA + TLA is injected per line. At the beginning of the learning curve, the lowest volume per line should be used.

Systematically using the smallest volume and concentration recommended in the BioSculpt® technique, 0.1 mL of the 5% suspension should be injected per line, the actual final volume of PMMA + TLA + gel microspheres adding up to 9 mL on all sides, 0.45 mL of PMMA microspheres and 8.55 mL of TLA + gel.

If the highest volume and concentration recommended for thick skins is used (maintaining low concentration and volume only on periorbital areas), 19.5 mL of final volume will be injected in the nine treatment areas, being 1.85 mL of PMMA microspheres and 17.65 mL of TLA + gel.

Concentration and volume per session

Minimum volume = 9 areas, 10 lines, .0.1 mL per line = 9 mL

Minimum concentration of PMMA = 5% during the whole treatment

**9 mL at 5% =
0.45 mL of PMMA microspheres
8.55 mL of gel + TLA**

**Maximum volume =
(7 areas, 10 lines, 0.25 mL per line) + (2 areas, 10 lines, 0.1 mL per line
= 17.5 mL + 2 mL = 19.5 mL**

**Maximum concentration of PMMA = 17.5 mL at 10% + 2 mL at 5%
Maximum concentration of PMMA = 1.75 mL + 0.1 mL = 1.85 mL**

**1.85 mL of PMMA microspheres
17.65 mL of gel + TLA**

J. Carefully check the puncture wounds

After the treatment, pressure is exerted with two fingers on the cannula entry point in order to remove any excess product. This is repeated after the treatment of each area.

At the end of the procedure and after the final massage, the search for excess product in the entry points is repeated so any excess of product can be removed.

K. Massage vigorously

This is the stage in which the product is homogeneously distributed in the subcutaneous plane. It is a step that must be strictly respected since it prevents future complications such as product accumulation and, consequently, localized neocollagenesis.

The massage must be performed by the doctor responsible for the treatment and aims to distribute evenly the suspension deposited in the injection lines.

The nine treated areas were vigorously massaged for ten minutes (timed).

L. Post-procedure care

Post-procedure care is related to what must be done by the patient for the five days following the procedure.

Sanitize the face and hands with liquid soap immediately before massaging, five times a day.

Massage with continuous pressure, in an outwards direction for five minutes a day for five days.

M. Additional sessions

For patients with mild facial laxity, for instance, those at approximately 40 years of age, three sessions are recommended. In the case of more advanced intrinsic and extrinsic skin aging or high weight loss, the number of sessions is estimated by the doctor responsible for the treatment, which can reach and even exceed twice the recommended amount for mild laxity.

A 45-day-interval between BioSculpt® sessions is recommended. This period prevents the injection of excessive volume of the product and allows for the stimulus to be evaluated considering the physiological cycle of collagen production. Time is needed so the first tightening effects and results of the technique can be seen.

RESULTS



(Figure 3. 54-year-old female, 90 days after the first BioSculpt® session.)



(Figure 4. 66-year-old female, 90 days after the second BioSculpt® session.)



(Figure 5. 70-year-old female, 90 days after the third BioSculpt® session.)

The purpose of the biostimulation is to restructure the septa of the subcutaneous cellular tissue, to tighten loose ligaments and septa, to restore density of facial dermis with new collagen fibers, and to increase tissue nutrition through neoangiogenesis. Changes in the radiance and hydration of the epidermis are seen in figures 3, 4, and 5. As the tension vectors of the technique draw the suspending effect, the superior-lateral traction resulting from the biostimulation with PMMA can be seen. In figure 3, the lifting effect on the jawl, mandibular body, and lateral labial-mantel wrinkle is remarkable. In figure 4, in addition to the hydrated aspect of the skin, there is a good improvement in fine wrinkles and facial restructuring of the region submitted to two treatment sessions with a 45-day interval between them. Finally, in figure 5, marked improvement of fine and medium-depth wrinkles can be seen, as well as a facelift effect of the upper portion of the face outwards, with a slight increase in preauricular and mandibular body region volume.

DISCUSSION

Collagen biostimulation for the treatment of skin laxity has gained notoriety among dermatological procedures. Its local action restores tissues which, by intrinsic and extrinsic skin aging, have lost structure and sagged due to gravity.

Biostimulators such as poly-L-lactic acid, calcium hydroxyapatite, and polycaprolactone are synthetic polymers which undergo degradation and are reabsorbed after 18 to 48 months. Within this period, they stimulate neocollagenesis by chemical and physical means. Although its influence on neocollagenesis is supported by the literature, data on the efficacy and safety of the degradation by-products of these biostimulators are still lacking.

PMMA has been studied in the medical scientific literature for more than 70 years. Similar to other biostimulators, it is a synthetic, non-allergenic, biocompatible polymer; however, different from other products, it is non-absorbable, being inert in biological tissue. After injection into the tissue, it has a low inflammatory response with the initial recruitment of neutrophils and macrophages. This prosthesis-like physical response leads to the release of cytokines by adipocytes, with activation of fibroblasts and myofibroblasts from the seventh day

after the injection, and to neovascularization. PMMA causes local changes that make it adhere to the adjacent tissue. The microspheres are surrounded by collagen fibers, a fixed tissue which does not migrate and move. The initial result can be a solid nodule or a neocollagen layer (type 3 collagen and pro-collagen), depending on the concentration of microspheres per implanted tissue area and technique used in the implant.

In Brazil, since 2006, PMMA has been strictly regulated by ANVISA (the Brazilian National Health Surveillance Agency), which established that the product should not be sold in compounding pharmacies; thus, minimizing the risk of contamination of the product and its use by non-medical professionals. The agency also restricted the size of the microspheres to 40 microns, making PMMA too big to be phagocytosed by macrophages, which have approximately 20 microns, and too small to stimulate an intense granulomatous reaction with giant foreign body cells. Through these actions, PMMA has become a safe product and totally dependent on the expertise of the doctor responsible for the injection.

The technique presented, named BioSculpt® by the author, has orthodox planning. Assessments of superficial and deep fat compartments of the face, as well as septa and ligaments are essential to avoid overcorrections.^{8,9,10} Lower product concentrations, correct application plan, dilution to improve spreadability, retrograde injection technique, and use of microcannulas are necessary for safe results and less adverse events when administering injectables. Respecting the rheology of PMMA on neocollagenesis makes the results predictable as well.

The author's experience with the BioSculpt® facial and body technique is based on the use of absorbable biostimulators and the various studies published research group, of which she is part. In the articles published by the group, the use of PMMA is reviewed in the treatment for progressive hemifacial atrophy (Parry-Romberg syndrome)¹¹, neck laxity¹², and post-liposuction irregularities with combined techniques.¹³ From the same group, PMMA was used as a biostimulator in the treatment of cellulite grades 3 and 4¹⁴, in the correction of Poland's syndrome¹⁵, in gluteal augmentation¹⁶, and in the replacement of gluteal prostheses.¹⁷

CONCLUSION

This study presented a technique that minimizes the risks seen in procedures with injectables in general, such as occlusion, embolism, product migration, nodules, and overcorrections. It also described the particularities of the use of PMMA as an effective and potent biostimulator, especially due to the attention given to application techniques and rheology of the product. Further studies shall bring more data on the use of PMMA as a collagen biostimulator.

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