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Original article

Progressive treatment of lower third of the face laxity using different forms of poly-1-lactic acid (PLLA), from a solution to threads

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Abstract. *Background:* Treating ageing in the lower third of the face focuses on restoring volume and correcting the position of the subcutaneous tissue (SC). Among the various injectable substances used for volume restoration, PLLA (poly-1-lactic acid) has proven to be effective as a collagen biostimulator and can be used to correct both shallow and deep nasolabial fold contour deficiencies as well as other wrinkles. Once the SC volume has been restored, suspension threads can be used for an even more effective repositioning of the SC. *Aim:* In this study we present the findings of using an injective PLLA solution and PLLA suspension threads for an optimal treatment, aiming to combat sagging in the lower third of the face, combining neocollagenesis and mechanical tissue repositioning. *Methods:* Between February 2020 and January 2022, 23 patients with sagging in the lower third of the face were selected to undergo combined therapy using an injected solution of PLLA and a thread-lift using PLLA suspension threads. The injection of PLLA was carried out three times, once a month. One month after the last PLLA injection, PLLA threads were inserted. *Results:* At a 12-month follow-up, all 23 patients presented a more defined jawline, an improvement in the distribution of volume in the lower third, and an increased skin toning, as well as a long-lasting lifting effect. There were no short or long-term complications. *Conclusions:* The reshaping of the lower third using a combination of a biostimulatory solution of PLLA and a PLLA suspension thread-lift is a safe, effective and long lasting therapy. It is worth noting that the final outcome of the acid treatment depends on a careful facial analysis that is necessary to determine the appropriate treatment.

Key words: skin quality, skin laxity, polylactic acid, suspension threads, lower third, PLLA threads

Introduction

The last decade represents a new era for facial rejuvenation, passing from a 2D vision, which was limited to the correction of a single wrinkle or furrow, to the concept of 3D rejuvenation, which targets aging that is not simply limited to the skin, but it is the consequence of a process involving bone resorption, muscle and ligament weakness and the redistribution of facial fat. On this basis, modern facial rejuvenation and/or beautification techniques involve the correction of all the layers of the face, starting with a deep reconstruction, to create a base for other techniques that alter its surface. This is particularly true for the lower third of the face, where the anteriorization and the reduction of the jaw's height, together with the modification of the superior two thirds of the face, the new amount and position of adipose tissue and thinning skin, are collectively the cause of early aging, resulting in a saggy look.[1]

Nowadays, treating the lower third of the face focuses on restoring volume and correcting the position

of subcutaneous tissue (SC). There are many different techniques and substances that can be used to restore the SC volume, including hyaluronic acid (HA), Calcium hydroxylapatite (CaHA) filler, lipofilling and PLLA (poly-1-lactic acid).[2,3] In particular, PLLA is a collagen biostimulator used to correct both shallow and deep nasolabial fold contour deficiencies and other wrinkles.[4] However, non-surgical tissue repositioning, excluding the use of energy-based devices, can be successfully achieved with polydioxanone (PDO), polycaprolactone (PCL) and PLLA suspension threads.[4,5] In this article we present the findings of using an injective PLLA solution and PLLA suspension threads to create the optimal therapy for sagging in the lower third of the face, combining neocollagenesis and mechanical tissue repositioning.

Material and method

Starting from February 2020, to January 2022, 23 healthy patients (22 females and 1 male, with a mean age of 45 and ranging between 38-60) with sagging in the lower third of the face were selected for a combination therapy using an injectable solution of PLLA and a thread-lift using PLLA suspension threads. Each patient was photographed from a frontal, lateral and diagonal angle before the treatment was administered in the Frankfurt plane position (T0), 30 days after the PLLA injection and before the PLLA threads insertion (T1) and after a period of 3 months (T2) and 12 months (T3) from T0. The pictures were then analyzed by an independent observer to evaluate the degree of reduction in skin laxity and the improvement in skin quality.

PLLA solution injection

Patient's selection and preparation

The patients were selected according to the following criteria:

- Laxity degree of the jawline of 1-2 (mild-moderate sagging) according to the Merz scale (table 1).[6]
- 18+ years of age

In the case of infection or local inflammation, active autoimmune diseases, collagen diseases, a pregnancy, presence of definitive cutaneous fillers, anticoagulant therapy or history of keloids or hypertrophic scars, hypersensitivity to any of the components in the products and/or anesthetic solutions, patients have been excluded (table 2). All 23 patients gave consent to their inclusion to test this procedure, after being informed of the possible complications related to the therapy and that the tensor and volumetric effect of the injected PLLA would be observed 3 months after the start of the therapy. They all gave their written informed consent. A topical anesthetic cream (lidocaine 4%) was applied 30-60 minutes before the procedure. A skin antisepsis was performed immediately before the injection using a 2% alcoholic chlorhexidine. All the patients received a total of 3 vials of PLLA – half a vial for half the face every 4-5 weeks, repeated a total of 3 times. After the procedure, all the patients were instructed to massage their face with a hydrating cream for 5 minutes 2-3 times daily, for 7 days, and to avoid sun and UV rays, tanning lamps, saunas, steam-baths and excessive exercise for the same period of time. No other treatments were performed on the lower third of the face during the study period.

PLLA solution preparation

- Every vial contained: L- polylactic acid - 150mg, sodium carboxymethylcellulose - 90mg, non-pyrogenic mannitol - 127.5mg in powder form.
- 5 ml of sterile water were added to the contents of the vial, which was shaken vigorously for approximately 1 minute until a homogeneous suspension was obtained.
- A further 3 ml of sterile water were added and mixed in again until the suspension became homogeneous.
- 1 ml of 2% lidocaine was added to the solution immediately before the injection.

PLLA solution injection

The forehead, periocular area, nose and perioral area were excluded from the treatment. Injections using a 2.5 cc syringe and a 26G needle were performed in the superficial subcutaneous fat, anteriorly to the parotid gland and the masseter muscle; the jaw and chin were treated using a deep subcutaneous injection on the mentum and pre-maxillary sulcus. A linear ret-

ro-injection technique was used in the subcutaneous plane using a layout of several parallel beams (0.2 cc/beam). The procedure was completed with 5 minutes of local massage.

PLLA threads insertion

The inclusion and exclusion criteria were identical to those for the injective therapy (tables 1,2).

The threads were inserted 30 days after the first injection of PLLA.

Threads

3/0 threads of PLLA with cones composed of a PolyLactide/Glycolide (PLGA) resorbable copolymer were used. All the threads were inserted using a 12 cm, 23G needle. Two threads were inserted on each side. Depending on the degree of laxity of the patient's face, according to the Merz scale of Lower third of the face laxity, four wire threads of different lengths were employed:

- Double needle, 27.5cm, with cones spaced every 0.8cm on the wire, for a total of 12 cones, in 5 patients (21.7%) with a 1 degree of laxity.[6]
- Double needle, 30cm, with cones spaced every 0.5cm on the wire, for a total of 8 cones, in 18 patients (78.3%) with a 2 degrees of laxity.[6]

All the patients were analyzed to determine the position of the threads, marking the skin with a dermographic pen. The target areas for tissue repositioning were: nasolabial fat and the superior and inferior jowl fat pads. In order to determine the most efficient pulling point, it was necessary select the area to treat and establish where the pulling force should be applied. The vectors that were as perpendicular as possible to the area were treated. Once the most efficient pulling point was identified – the position of the last cone (point A) – the exit point was marked 1-1.5cm away from the last cone (at point B). In the case of an 8-cone suture, 5-6cm from the last cone were measured (point A, not from the exit of point B) to determine the entry point (point C). The exit point for the anchoring part of the suture (point D) was then placed 6-7cm over the temple area. This same principle was applied to the 12-cone suture, the only difference being that the distance from the last cone (point A, the most efficient pulling point) to the entry point (point C) was 8-9cm, and 9-10cm to the exit point of the anchoring part of the suture (point D) (fig.1). Once the area was marked, the skin was disinfected using betadine 2%. Local anesthesia was performed with 2cc of a lidocaine (2%) plus adrenaline (dilution 1:80,000) solution. After a second disinfection, a puncture with a 18G needle was performed in the middle point of the previously determined lines. The two needles were inserted strictly in the pre-smas layer, in opposite directions, in order to reach the previously marked exit points. Once the needles were removed from the skin, the subcutaneous tissue was manually repositioned and the excess threads were cut using sterile scissors. After the procedure, the patients were advised not to wear make-up for at least 24 hours and to avoid sun exposure and strenuous exercise for 7 days. Antibiotics and an anti-edema therapy was also prescribed.

Results

At the 12-month follow-up all 23 patients showed more definition in their jawline, an improvement in volume redistribution in the lower third of the face and an increased skin toning due to an increased dermal thickness, and the long-lasting lifting effect of the suspension threads (fig 2A-5A e 2B-5B). All the patients transitioned to a lower grade of jawline laxity: patients with a grade 1 laxity (mild) resolved their laxity, and patients with a grade 2 laxity (moderate) transitioned to grade 1 (table 3). There were very few short-term complications which were related to the injection technique, such as redness, bruising and swelling. All the patients were submitted to a follow-up and no long-term complications were observed or experienced by the patients.

Discussion And Conclusions

Poly-l-lactic acid (PLLA) is a biocompatible and biodegradable material derived from a synthetic polymer in the alpha-hydroxy acids family, which has

the properties of self-organization and formation of colloidal micelles in an aqueous medium. In 2004, it was approved by the FDA for use in the correction of facial atrophy associated with the human immuno-deficiency virus (HIV).[7] However, the lactic acid derived from the degradation of PLLA can also stimulate the formation of collagen.[8] This leads to an improvement in skin quality, increasing the volume in targeted areas and reducing sagging.[7] Following great popularity after its introduction in the late 90s, PLLA has undergone a dramatic reduction in its usage, due to the complexity of its preparation and its association with the formation of papules and nodules, both early and delated. After its approbation in Europe in 1999, the initial recommended reconstitution was using a volume of 3cc or less, adding sterile water and lidocaine 2%.[9] Furthermore, the intervals between the sessions were short (7-12 days) and the product was injected even in the most mobile areas such as the periocular and perioral areas.

As a result of this, a high incidence of papules and nodules was observed (10-44%).[10] However, clinical studies have shown that with a greater dilution, 8-10cc, with application sessions spaced further apart, i.e. 4-5 weeks, and by avoiding injecting into more mobile areas, the complications rate was drastically reduced (1%).[11] But the reconstitution process remained time consuming (24-72 hours) and somewhat complex. Nowadays it has been proven that the reconstitution of the PLLA solution can be achieved in just a few minutes, without altering its biostimulating effect and injectability.[12] The greater ease of use and the reduction of both short and long-term complications have brought new life to this product, which has been shown to be highly effective in stimulating the synthesis of new collagen.[4,13] Selecting the right patient is fundamental before starting this kind of therapy, both in terms of the degree of skin laxity, which should be mild or medium according to the Merz visual scale, the skin's thickness and the patient's compliance in terms of the their willingness to wait for visible results.[6] The mean time for neocollagenesis after the first injection is a minimum of 3 months, meaning that patients will need to wait a long time before they can see a macroscopic effect after the therapy and, in an era in which people want "everything now," a thorough pre-treatment interview is mandatory in order to explain this.[13]

In order to achieve faster results in terms of lifting and to guide the development of the new synthetized collagen along specific vectors, PLLA suspension threads were inserted one month after the first application of the PLLA solution. Threads with cones closer together were placed in patients with a 2nd degree laxity in order to have more anchorage points and a consequent greater tensor effect. We chose to insert the threads one month after the first PLLA solution injection because the initial collagen synthesis encourages the dermal and subdermal layers to gradually thicken, allowing the threads to be completely invisible. At the same time the threads also act as scaffolding, which can direct the orientation of the development of the collagen molecules.[14] Furthermore, a fibroplasia foundation for the new collagen was created by repositioning the subcutaneous layers along specific vectors, perpendicularly to the vertical lines, and furrows of the lower third of the face, and in opposition to the anteriorly sliding subcutaneous tissue. This acts as a base for the neocollagenesis following the subsequent injections of the PLLA solution. We injected the second solution 30 days after the first injection, immediately before the thread insertions, because one month later there tends to be an initial increase in skin thickness, due to the formation of neocollagen, still immature, around the PLLA microspheres, which becomes evident and more structured after 2.5 months. At the same time, however, a part of the solution, both the sterile water used for dilution and the carriers, are partially reabsorbed, revealing an incomplete correction of the blemish. The new injection, 30 days later, supplies new material, further corrects the defect, while the material of the first injection continues its action with the stimulus to the formation of collagen, which will orient and distribute according to the direction of the scaffolding, represented in this case by the tensile threads[13,14]. In fact, a good correction of the jowl was achieved in all the 23 patients, avoiding an ungraceful look in every step of the therapy. The fact that both the solution and the threads consist of PLLA, combining the tensor effect with the biostimulating effect, yielded very satisfying results in terms of an improvement in skin quality and reshaping of the lower third.[9] Based on our experience, the lack of complications related to the development of papules

or nodules after 12 months, shows that this therapy is safe as long as all the precautions are followed meticulously. These precautions include the sterilization both at the time of injecting the PLLA solution and when inserting the suspension threads. Always keep in mind that when inserting the threads, especially into a field with the PLLA solution, it is important to avoid contaminating the area. Therefore, sterile gloves should be worn at all times and only sterile materials should be used. In addition, antibiotic prophylaxis should be prescribed.

These precautions are fundamental in order to avoid one of the most challenging complications of PLLA injection: late onset nodules. These are mostly due to low-grade and biofilm infections.[15] As previously mentioned, the patient's collaboration is fundamental. Therefore, it must be clearly explained to them that the instructions they are given for after the treatment are an integral part of the treatment itself and that they influence the final result. This includes their self-massage in the days following the procedure, as well as all the other common precautions following the injection of fillers. However, after the PLLA threads have been injected, they should not massage the face and follow the antibiotic therapy prescribed as well as the usual precautions for after a thread lift. Despite a 3 month wait being required to see a decisive improvement in skin toning and reshaping, the results are long lasting, as shown in our patients at their 12-month follow-up appointment. Several reports have stated a lifting effect and improvement in skin toning during the follow-up that lased up to 2 years.[16]

In conclusion, reshaping the lower third of the face with the combination of a biostimulatory solution of PLLA and a PLLA suspension threads lift is a safe, effective and long-lasting therapy. It is worth noting that the final outcome of the acid treatment depends on a careful facial analysis to determine the appropriate treatment. Strict adherence to the sterility of the procedure is mandatory.

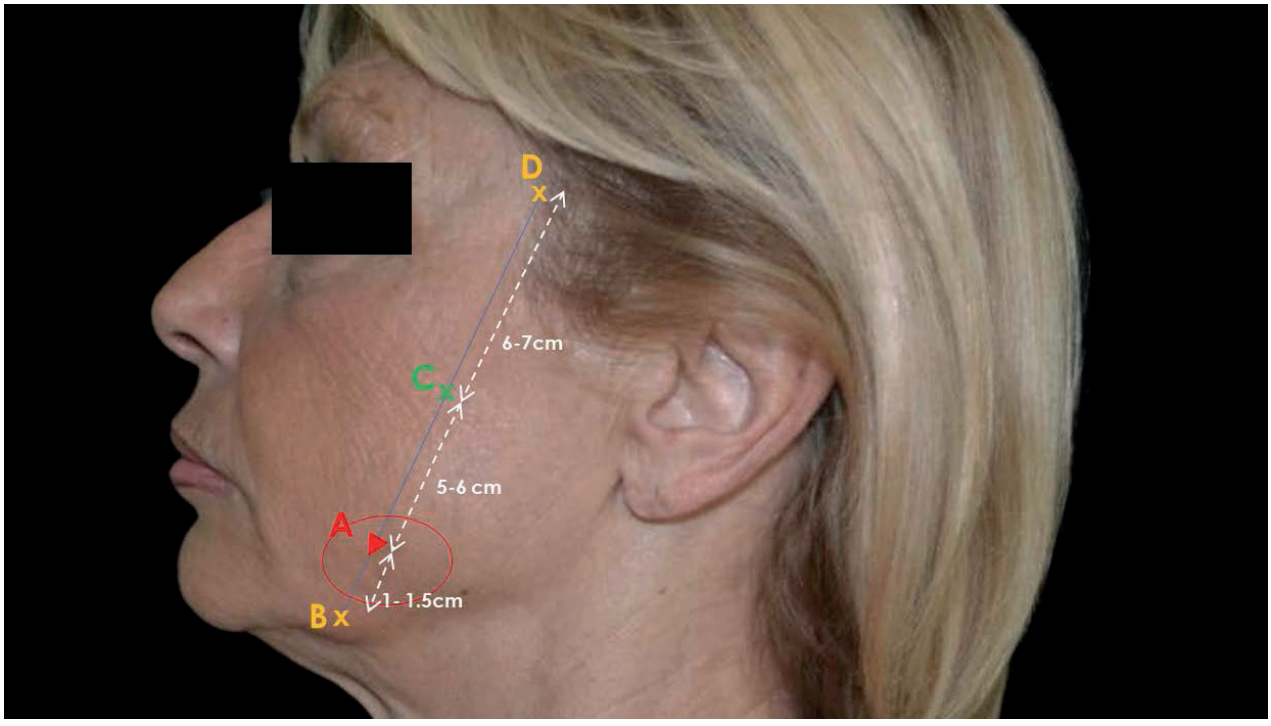
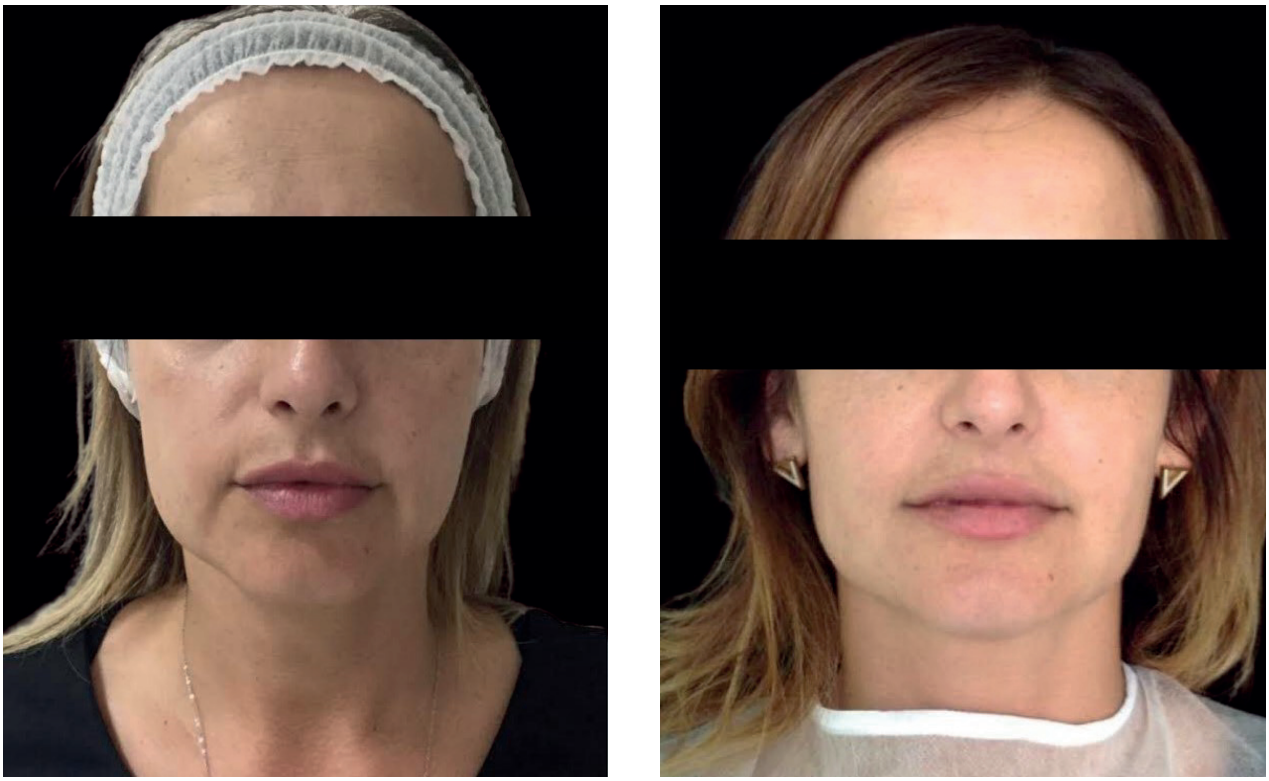
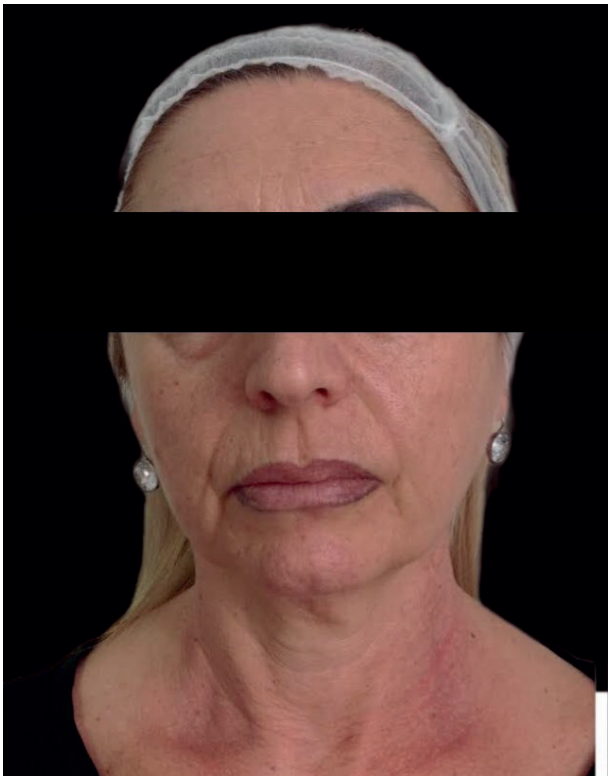
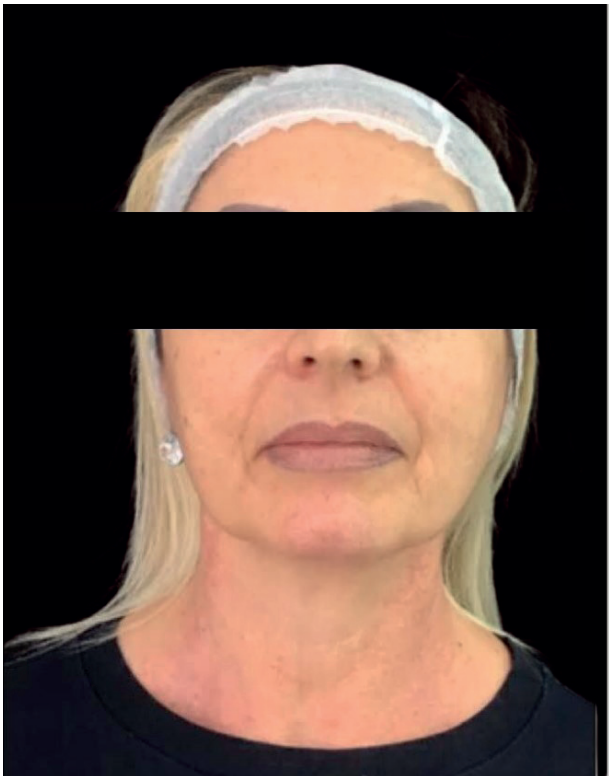


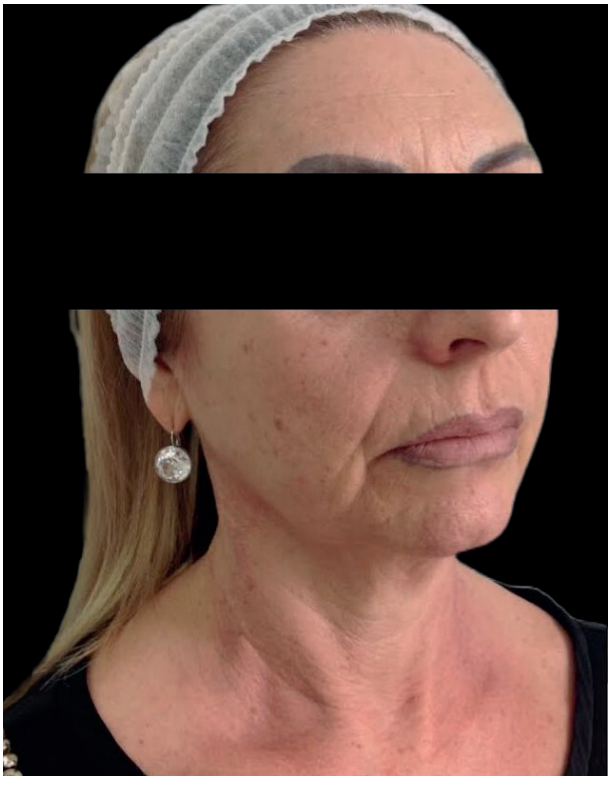
Figure1 - Scheme of PLLA threads injection: identify the most efficient pulling point and thus where the last cone needs to be placed (point A), mark the exit point 1-1.5cm away from the last cone (at point B). In the case of an 8-cone suture, measure 5-6cm from the last cone (point A), not from exit point B) to determine the entry point (point C). The exit point for the anchoring part of the suture (point D) can be placed 6-7cm over the temple area. The same principle applies for the 12-cone suture, but the distance from the last cone (point A, efficient pulling point) to the entry point (point C) should be 8-9cm and 9-10cm to the exit point of the anchoring part of the suture (point D).



Figures 2-5 (A and B) - Examples of two patients in frontal and lateral view before (A) and 12 months after three sessions of PLLA injections and a PLLA threads insertion (B)







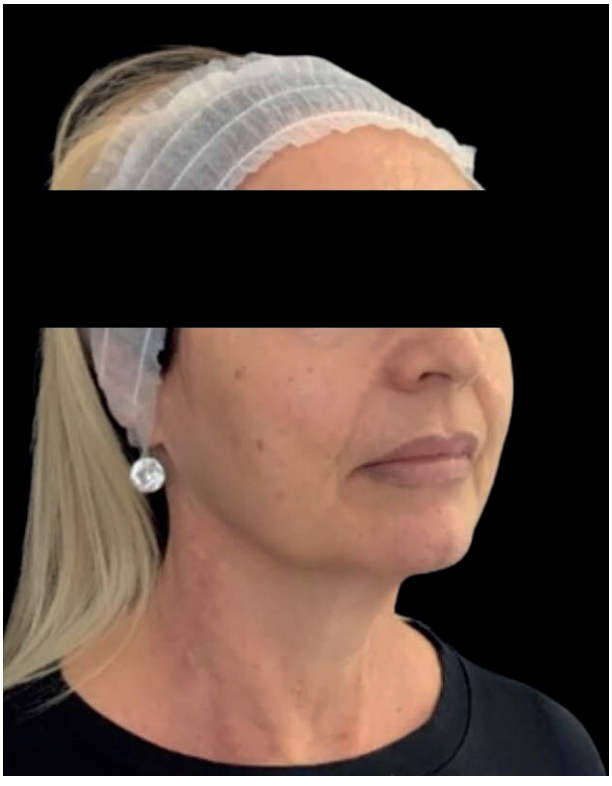


Table 1 - Degree of laxity of jawline at rest of the 23 patients before the treatment, classified according to the Merz Scale of the lower third of the face.

Patients	Mild sagging (1 degree Merz Scale)	Moderate sagging (2 degree Merz Scale)
23	5 (21,7%)	18 (78,3%)

Table 2 - Eligibility criteria for the patients's enrolment.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Laxity degree of 1-2 (mild-moderate sagging) according to Merz scale.[6]	Infection
Over 18 years of age	Local inflammation
	Active autoimmune diseases
	Collagen diseases
	Pregnancy
	Presence of definitive cutaneous fillers
	Anticoagulant therapy
	History of keloids or hypertrophic scars
	Hypersensitivity to any of the components in the product and/ or anesthetic solutions,

Table 3 - Degree of laxity of jawline at rest in 23 patients before (T0) and after therapy with combined PLLA biostimulation and PLLA threads insertion at 12 months of follow-up (T3).

T0	Degree of laxity 1	Degree of laxity 2
23 patients	5pts (21,7%)	18 (78,3%)
T3	Degree of laxity 0	Degree of laxity 1
23 patients	5 pts (21,7%)	18 (78,3%)

DEGREE OF LAXITY	T0 – 23 PTS	T3 – 23 PTS
0	0	5 (21,7%)
1	5 (21,7%)	18 (78,3%)
2	18 (78,3%)	0

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