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ORIGINAL ARTICLE FACIAL SURGERY

The MICRO-Lift: A Ligaments-Based Anatomic Technique for Lower Face and Neck Rejuvenation Using Bipolar Radiofrequency.

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Abstract

Background The aim of this paper is to present the results of a new technique for lower face and neck rejuvenation named the MICRO-lift (Minimally Invasive, Combined Radiofrequency, Outpatient lift). This technique is based on a bipolar radiofrequency treatment applied to specific ligamentous areas.

Methods Inclusion criteria were patients with skin laxity of the neck and jowls, with or without fat accumulation. Patients who presented platysma sag and alteration of subplatysmal structures were excluded from the study. The distribution of the energy was adapted to the ligament anatomy, differentiating three areas based on the energy concentration.

In all patients, sex, age at surgery, type of anesthesia, radiofrequency parameters and complications were registered. In all cases, standard photographs and satisfaction interviews were conducted preoperatively and postoperatively. Satisfaction evaluation was also assessed.

Results Sixty-five patients underwent MICRO-lift technique for the lower face and neck. All patients in our series were female. There were no major complications. Minor complications included transient paralysis of the marginal mandibular (4,6%), infection of the submental incision that required incisional drainage (3,1%), and deep skin burn in the neck (1,5%). Fifty-nine patients were satisfied a year after the treatment (90,8%).

Conclusions The MICRO-lift can produce outstanding and satisfying improvements in cervicofacial appearance. This new approach offers a predictable strategy to achieve the desired aesthetic results, making this procedure more reliable and reproducible for both novel and experienced surgeons with bipolar radiofrequency.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords RFAL · MICRO-lift · Face and neck rejuvenation · Minimally invasive plastic surgery

Introduction

Interest in facial and neck rejuvenation have become trends in recent years. The development of new technology together with the increasing interest of the population for less invasive techniques, have made minimally invasive facial rejuvenation techniques gain popularity [1].

On the other hand, a deeper knowledge of the different facial and cervical retaining ligaments has led us to a better understanding of the aging process [2]. The ligaments consist of collagen bands intermingled with elastic fibers that support hundreds of pounds of stress per square inch [3]. In the face and neck, ligaments serve as a hammock for soft tissue suspension. However, during the aging process, the stability of a ligament has been argued to show fatigue and to bend along its course promoting the sagging appearance of the respective fat compartment [4]. For this reason, the fatter portion of the face will gradually descend to the lower face, giving an inverted triangle appearance

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characteristic of the more senior faces. Moreover, the blurring of the jawline and the loss of definition of the cervicofacial angle can be observed in aging individuals.

In recent years, we have developed a new technique named the MICRO-lift (Minimally Invasive, Combined Radiofrequency, Outpatient lift), which is based on a bipolar radiofrequency treatment applied to specific ligamentous areas to rejuvenate the lower face and neck (Fig. 1). Radiofrequency-Assisted Lipocoagulation (RFAL) has become one of the most revolutionary technologies in facial and body reshaping [5, 6]. RFAL utilizes radiofrequency energy applied to the soft tissues in a bipolar manner, to stimulate contraction and collagen formation by thermal effect to the skin while coagulating and liquifying adipose tissue and stimulating profound contraction of the ligaments and the fibroseptal network [7].

Our novel technique combines the advantages of RFAL technology with the most advanced knowledge of cervicofacial anatomy. Although some studies have demonstrated the efficacy of radiofrequency in facial and cervical rejuvenation, this is the first time this technology has been applied based on the ligamentous regions in a protocolized way [8–10]. The purpose of this study is to present the indications, operative technique, outcomes and complications of the MICRO-lift.

Patients and Methods

Between December of 2019 and September of 2021, all consecutive patients treated with the MICRO-lift by a single surgeon were included in the study.

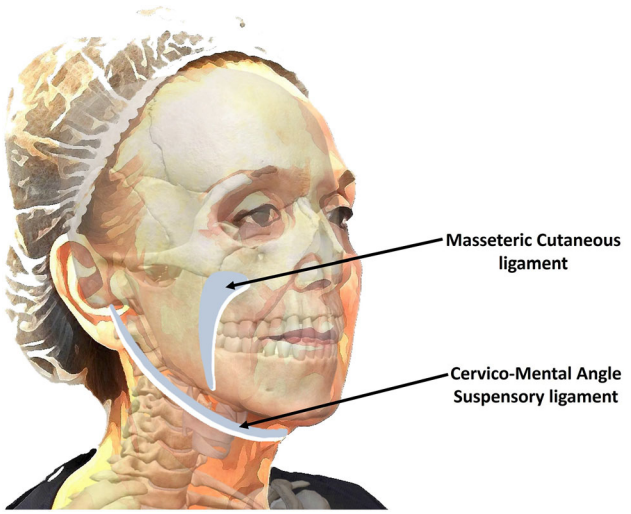

Fig. 1 Location of the masseteric cutaneous ligament and the cervico-mental angle suspensory ligament.

Patient Selection

Inclusion criteria included patients with skin laxity of the neck and jowls, with or without fat accumulation. Patients who presented platysma sag and alteration of subplatysmal structures as hypertrophic submandibular gland, large anterior belly of the digastric muscles or deep cervical or interdigastric fat were excluded from the study. Cervical ultrasound was performed preoperatively in some cases to improve patient selection.

In all patients, sex, age at surgery, type of anesthesia, radiofrequency parameters and complications were registered. In all cases, standard photographs and satisfaction interviews were conducted preoperatively and postoperatively. For satisfaction evaluation, patients were assessed in our clinic 12 months after the procedure by the following two questions: "Are you satisfied with the result?" and "Would you recommend this procedure?" Only when patients answered affirmatively to both questions was the result considered satisfactory. All patients signed an informed consent preoperatively.

Markings

Before the procedure, all patients were marked in the standing position (Fig. 2). Firstly, the mandibular border and the anterior border of the sternocleidomastoid muscle

Fig. 2 Markings of the MICRO-lift.

were marked in blue. In the face, a black line was marked from the root of the helix to the oral commissure. A red triangle was marked in the depressor anguli oris muscle region. Treatment in this area should be avoided in order to preserve marginal mandibular innervation since this is the area where the marginal branch of the facial nerve is more superficial. The area between both triangles should also be avoided to preserve mentalis, and depressor labii inferioris innervation. After asking the patient to force a smile, a transition zone between the mobile area and the immobile area of the face can be observed (Fig. 3). This is the location of the masseteric cutaneous ligaments which should be marked. In the neck, the midline is marked to divide it into two equal halves. Lastly, the site of the cervico-mental angle suspensory ligament is also marked. The position of this ligament typically corresponds to the first cutaneous neck crease as described by Labbé et al [11] (Fig. 4). If the first cutaneous neck crease is not visible, clinical simulation of a cervico-mental angle can be done in order to mark this area (Fig. 5).

Fig. 3 Area of the Masseteric cutaneous ligaments (between the black arrows), that typically corresponds to the most lateral facial crease after asking the patient to force a smile. If this crease cannot be observed, it corresponds to the transition zone between the mobile area and the immobile area of the face.

Fig. 4 Cervico-mental angle suspensory ligament (black arrows). The position of this ligament typically corresponds to the first cutaneous neck crease.

Anesthesia

The procedure requires a surgical facility. Depending on patient's preferences, cases were performed either under local anesthesia or under a combination of local anesthesia and sedation. The patient was laid supine with a roll beneath their shoulders and the head was positioned just above the most cranial portion of the table to achieve a hyperextension of the neck.

MICRO-Lift, Surgical Technique

-Minimally Invasive

Five stab incisions were used: one submental, one retrolobular (bilaterally) and one in the root of the helix (bilaterally). These 2 mm-incisions were performed with 11 blades. Then, a 2-mm multiperforated cannula was used to deliver the infiltration solution (500 ml of saline, 40 ml of lidocaine 2% and 0,5 ml of epinephrine).

The solution was delivered to the subcutaneous tissue, superficial to the platysma and to the SMAS, until sufficient turgor was achieved. Then, a 15-minute pause was

Fig. 5 Clinical simulation of cervico-mental angle.

Fig. 6 Energy concentration areas. Maximum Energy Concentration Areas (MECA) are in orange. Intermediate Energy Concentration Areas (IECA) are in yellow. Low Energy Concentration Areas (LECA) are in green.

made to allow for the vasoconstriction effect of the epinephrine.

-Combined Radiofrequencies

We combined internal RF and trans-epidermal fractional bipolar RF in every patient.

The internal RF handpiece was 12 cm of length with a diameter of 24 mm and a hole for fluid and fat aspiration (Non-Dual Sensor NeckTite Applicator, InMode Aesthetics), with an external cutoff temperature of 38–40°C and an energy of 15–20W. The same handpiece was used to perform the complete procedure, both in the face and in the neck. When using dual sensor handpiece does not include simultaneous suction, an external cutoff temperature of 38–40°C and an internal cutoff temperature of 65–68°C were used. The distribution of the energy was adapted to the ligament anatomy, differentiating three areas based on the energy concentration (Fig. 6):

(1) Maximum energy concentration area (MECA): It corresponds to the most ligamentous area. This area comprises the masseteric cutaneous ligaments in the face (MECAf), whereas in the neck it comprises the cervico-mental angle suspensory ligament (MECAn).
(2) Intermediate energy concentration area (IECA): This area is located cranially to MECA. It corresponds to the masseteric muscle region in the face (IECAf) and the submandibular region in the neck (IECAn).
(3) Low energy concentration area (LECA): This area is located caudally to MECA and corresponds to the masticator space in the face (LECAf) and the triangle formed between the anterior border of the sternocleidomastoid muscle, the midline and cervico-mental angle suspensory ligament in the neck (LECAn).

All the areas in the face were performed through the incision located at the root of the helix. Conversely, in the neck, while IECAn was treated through the submental incision, MECAn and LECAn were treated through the retrolobular incision.

Once the energy had been distributed accordingly, we used a 2 mm spatula cannula with one opening for final refinement. When using a handpiece does not include simultaneous suction, more intense liposuction should be done in order to remove all the lipolysis products. The incisions were closed with 6–0 Nylon sutures.

At the end of the procedure, 24-pins trans-epidermal fractional bipolar RF (Morpheus8; InMode Aesthetics) was

subsequently used at a depth of 2 mm and energy of 30-50W with a 50% overlap.

-Outpatient

All patients were treated on an outpatient basis. They were discharged two hours after the procedure had been completed.

Postoperative care

A cervicofacial compression garment was recommended 24 hours a day for 5 days, and 12 hours a day for the next 10 days to reduce inflammation since steroids or non-steroid anti-inflammatory drugs are not indicated. Alternatively, compression garments can be maintained 24 hours a day for 2 days, and 12 hours a day for the next 5 days in combination with lymphatic drainage massage to reduce the downtime.

Results

Sixty-five patients underwent MICRO-lift technique for the lower face and neck. All patients in our series were female. The mean age of the patients was 53,6 ± 10,2 years (range 33–75). The mean amount of energy delivered in the areas of the face was 1,4 ± 0,3 Kj (range 1–2) in MECA, 1,4 ± 0,5 Kj (range 1–2,5) in IECA and 1,3 ± 0,4 Kj (range 1–2) in LECA. The mean amount of energy delivered in the face was 4,1 ± 0,6 Kj (range 3–5,5). The mean amount of energy delivered in the areas of the neck was 2,4 ± 0,4 Kj (range 1,9–3) in MECA, 2,9 ± 1,0 Kj (range 1,5–5) in IECA and 2,0 ± 1,1 Kj (range 0–4) in LECA. The mean amount of energy delivered in the neck was 7,3 ± 1,5 Kj (range 5,1–10,5). (Fig. 7A and B). (Fig. 8A–H).

There were no major complications. Transient paralysis (paresis) of the marginal mandibular was observed in three patients (4,6%). Two patients developed infection of the submental incision that required incisional drainage (3,1%) (Fig. 9A and B). One patient developed a deep skin burn in the central portion of the cervicomental angle that resolved spontaneously without scarring (1,5%) (Fig. 10A and B). Contour irregularities, depressions, or asymmetries were not observed.

Fifty-nine patients were satisfied a year after the treatment (90,8%).

Discussion

The ligaments are composed of collagen bands intermingled with elastic fibers that support hundreds of pounds of stress per square inch [3]. Collagen fibers consist of a triple helix of protein chain, with interchain bonds creating a crystalline structure [12]. Different studies indicate that collagen fibrils will contract and may induce tissue tightening after heating [13, 14]. Collagen fibrils contraction would be produced due to breakage of the intramolecular hydrogen bonds [14]. Moreover, it has been postulated that heated fibroblast may produce collagen deposition [15, 16].

RF generates heat as a result of different tissue resistance or impedance to the electromagnetic current as dictated by the Ohm's law [17]. In this sense, adipose tissue has a high tissue impedance and will generate more heat than skin layers which have lower impedance for a given amount of time [18]. Thus, when RF energy is applied to subdermal adipose tissue, it has been shown to generate temperatures 7-fold higher than those generated by the dermis, leading to fat necrosis with epidermal preservation [19].

As previously exposed, we have established different target zones to shrink cervicofacial ligaments by using bipolar radiofrequency. The use of RF to induce contraction of collagen is not a new concept as it has been previously used in sport medicine and orthopedic surgery to contract ligaments responsible for join instability. Different studies have shown good results when treating shoulder instability, demonstrating that electrothermal shrinkage may have a role in the treatment of patients with mild to moderate laxity [20, 21]. Thabit reported a significant benefit in the arthroscopic radiofrequency treatment of patients with anterior cruciate ligament (ACL) instability [22]. In his series of 25 patients, 23 (92%) had what he considered to be good-to-excellent results. Later, Carter et al published another series of arthroscopic RF treatment for ACL instability concluding that the best result should be obtained when treating native ACL [23]. Because of the excellent blood supply of the native ACL and the inflammatory response that occurs with acute injury, the potential for healing after thermal shrinkage appears to be favorable compared to the chronic stage of ACL laxity, where the blood supply and inflammatory response may be less intense and, thus, theoretically result in decreased healing capacity and an increased risk of failure. This theory could explain the excellent results obtained when treating cervicofacial ligaments due to the rich vascularization of this area. As aforementioned, the ligaments are composed of collagen bands. When applying radiofrequency energy to the rich collagenous areas as the facial ligaments, the stimulation of profound contraction of the soft tissue would

Fig. 7 A 48-year-old woman before (**A**, **C**) and 1 year after performing the MICRO-lift technique (**B**, **D**).

be greater than other traditional treatments which apply external radiofrequency only in the more superficial skin.

In 2002, the FDA approved the first monopolar RF device for facial wrinkle reduction [24]. Later, more sophisticated RF devices have been developed to deliver RF energy in different manners (i.e., bipolar, multipolar, and fractional) with more safety features. Bipolar radiofrequency has gained increasing popularity for aesthetic minimally invasive treatments. Some publications have shown the potential of this technology in cervicofacial rejuvenation [8–10]. They state that the energy must be homogeneously distributed in the areas to be treated. In contrast, we propose a novel approach based on the most advanced knowledge of cervicofacial aging, and on the specific ligaments of the face and neck.

The MICRO-lift technique offers several advantages. Firstly, complete cervicofacial tightening can be achieved through small incisions rather than scars, avoiding lifting stigmas as visible scars or pixie ear deformity. Secondly, the skin quality and small wrinkles are also improved due to the combination of subdermal and trans-epidermal fractional bipolar radiofrequencies (Fig. 11A and B). Thirdly, hematomas are avoided thanks to the coagulation properties of bipolar radiofrequency. Fourthly, lipolysis of the lower thirds of the face allows us to recover the facial volumes characteristic of a young face, especially when

Fig. 8 A 64-year-old woman before (**A**, **C**, **E**, **G**) and 11 months after performing the MICRO-lift technique (**B**, **D**, **F**, **H**). An upper blepharoplasty was also performed.

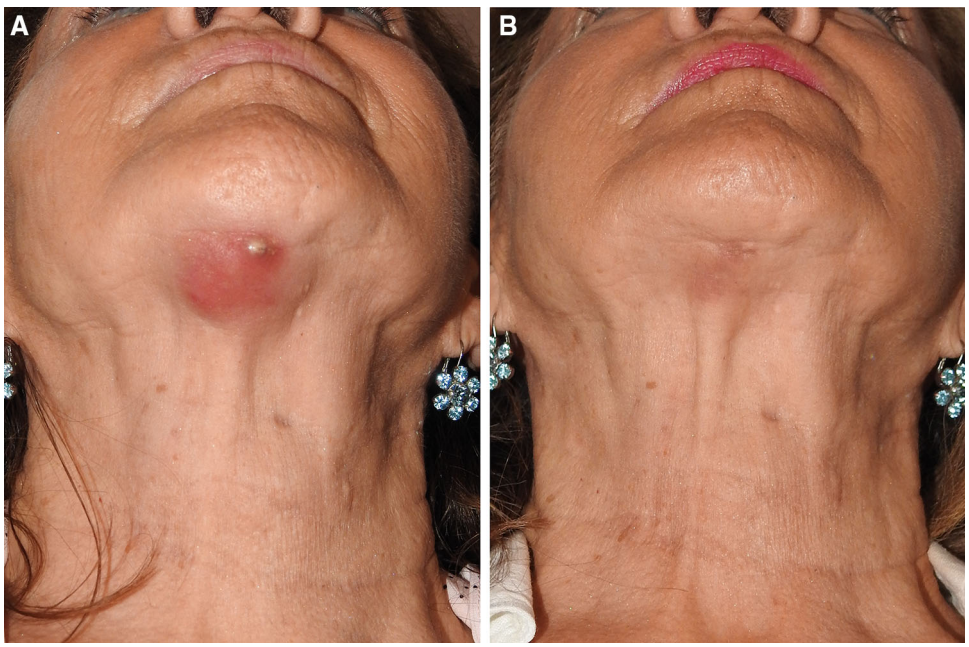

Fig. 9 71-year-old woman who developed abscess of the submental incision (**A**). It required incisional drainage and oral antibiotic treatment. The infection was completely solved after 3 weeks (**B**).

combined with fillers or lipofilling of the malar region, which is very useful to correct the inverted triangle appearance characteristic of older people. Fifthly, a controlled and protocolized energy deposition have allowed us to achieve excellent results, making the technique very reproducible. Finally, the technique was performed as an outpatient procedure in all cases.

In our series, six patients were unsatisfied after the treatment, mainly due to high preoperative expectations. However, we have observed improvement in every case since the patients were carefully selected preoperatively.

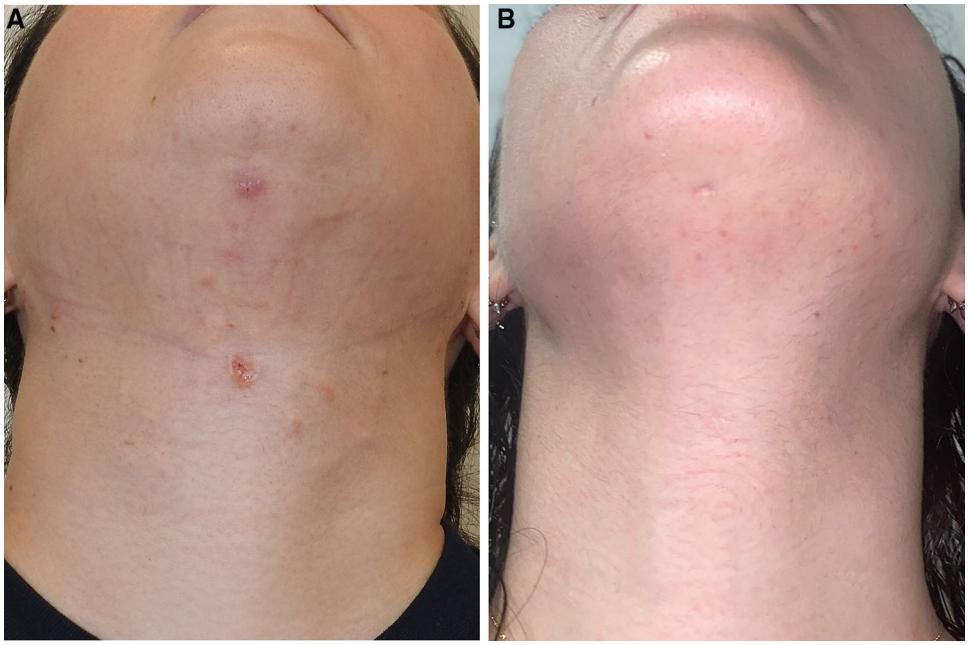

Fig. 10 29-year-old woman who developed a deep skin burn in the central portion of the cervicomental angle (**A**) which resolved spontaneously without scarring (**B**). Care must be taken in this zone since the energy delivered in the left and right MECA zones of the neck could be overlapped causing third degree burns.

Fig. 11 Preoperative (**A**) and 6-month-postoperative (**B**) pictures after MICRO-lift. Note the improvement of the skin quality due to the combination of subdermal and trans-epidermal fractional bipolar radiofrequencies.

Regarding the complications, transient paresis of the marginal mandibular nerve observed in three patients, it was resolved spontaneously after 4–8 weeks. The nerve weakness is generally due to a blunt trauma rather than thermal damage; since all patients recovered the nerve function, and no episodes of permanent paralysis were reported. The incidence of marginal mandibular nerve paresis of our series is comparable to other series that do not use energy devices [25].

Two patients developed infection of the submental incision which required incisional drainage (3,1%). After these complications, the RF was applied more than two centimeters from the stab incisions and there were no new complications. One patient developed a deep skin burn in the central portion of the cervicomental angle which resolved spontaneously without scarring (1,5%). Care must be taken in this zone since the energy delivered in the left and right MECA zones of the neck could be overlapped causing third degree burns.

Another issue that deserves discussion is the costs associated with the treatment. The cost of the device is around 85.000€ in Europe. Moreover, the costs of disposable material per patient should be considered. The cost of internal RF handpiece is approximately 200€ and the cost of trans-epidermal RF handpiece is around 100€.

One of the limitations of the study is that the technique was only performed on women. Men usually presents obtuse and heavier necks, and radiofrequency may achieve

more limited results. However, its efficacy must be evaluated. Another limitation of this study is the short follow up. Long-term outcomes of this technique should be assessed.

In this study, we have presented the results of a new technique based on bipolar fractional radiofrequency for face and neck rejuvenation. One of the most important aspects before performing MICRO-lift is the patient selection. Inclusion criteria should select patients with skin laxity of the neck and jowls, with or without fat accumulation and those without platysmal sagging or alteration of subplatysmal structures. For this reason, a careful physical examination should be carried out, and cervical ultrasound may be needed for candidate selection.

Conclusion

We propose MICRO-lift as a novel tool for minimally invasive face and neck rejuvenation. For carefully selected patients, the MICRO-lift can produce outstanding and satisfying improvements in cervicofacial appearance. To the best of our knowledge, this new approach offers a predictable strategy to achieve the desired aesthetic results, making this procedure more reliable and reproducible for both novel and experienced surgeons with bipolar radiofrequency. The presented technique could be the beginning of a new era of minimally invasive cervicofacial rejuvenation where the redistribution of fat compartments, tightening of the ligaments and skin contraction are crucial to get natural results.

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Declarations

conflict of interest The Author is a consultant for Inmode Iberia. No payments or support were received for the publication of this study.

Human or Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or

Ethical approval This study has been approved following the ethical norms and standards in the Declaration of Helsinki, including ethics committee approval statement and informed consent statement.

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