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**Assessment on effectiveness and safety of plasma radiofrequency ablation in facial and eye rejuvenation: a preliminary retrospective study**

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**Availability of data and materials:** all data or analysis generated in this study are included in this article.

**Abstract**

The eyes and facial skin play a crucial role in preserving a youthful appearance; they greatly impact the perception of freshness and vitality. Various non-invasive and invasive procedures now treat dermatochalasis and facial wrinkles, including a relatively new technique developed in the past 15 years. Plasma radiofrequency ablation, an advanced, minimally invasive technique, combines the use of plasma energy and radiofrequency to treat various skin conditions, including facial wrinkles and dermatochalasis. This treatment acts to stimulate collagen, tightening skin and improving texture, with minimal downtime and low risk of side effects. Fifteen patients with dermatochalasis and ten patients with facial wrinkles underwent plasma radiofrequency ablation treatments. It is a minimally invasive treatment for dermatochalasis and wrinkles that provides effective results, with short recovery times, but it is not without risks – such as infection, post-inflammatory hyperpigmentation, or scarring – especially in patients who do not follow post-care instructions precisely. This preliminary retrospective study aims to discuss and share the authors' experiences with plasma radiofrequency ablation for the treatment of dermatochalasis and facial wrinkles.

**Introduction**

The eyes and facial skin play a crucial role in preserving a youthful appearance; they greatly impact the perception of freshness and vitality. Often referred to as the mirror of the soul, the eyes are typically one of the first facial features to show signs of aging. The elasticity of the skin around the eyes diminishes with age, resulting in wrinkles on both the upper and lower eyelids (dermatochalasis). Facial skin significantly influences overall appearance and perceived age, and its quality is determined by various factors, including collagen production, hydration levels, and elasticity. As individuals age, the skin typically loses its firmness, becomes thinner, and exhibits signs of aging such as wrinkles and diminished radiance; cosmetic treatments, nutrition, and sunscreens help maintain healthy skin. For dermatochalasis and facial wrinkles, various non-invasive to invasive medical/surgical aesthetic procedures are available. Among the topical treatments, vitamin A derivatives help promote collagen production and accelerate skin cell turnover, reducing fine lines and wrinkles;[1] peptides help stimulate collagen and elastin production, improving skin firmness and elasticity;[2] antioxidants (*e.g.*, vitamin C, E) help reduce the appearance of wrinkles by protecting the skin from free radical damage and promoting collagen synthesis.[3] Chemical peels with alpha hydroxy acids, such as glycolic, lactic, or mandelic acid; beta hydroxy acids, such as salicylic acid; alpha keto acids, such as pyruvic acid; and low-percentage trichloroacetic acid, which provide superficial to medium-depth penetration, promote skin exfoliation, reduce the appearance of fine lines and wrinkles, and improve overall skin tone and texture. Baker-Gordon phenol peels or high-percentage

trichloroacetic acid peels, acting with a deeper penetration, target deeper wrinkles and more advanced signs of aging by removing the outer layers of the skin.[4] Polydioxanone (PDO) thread lifts involve inserting non-surgical threads beneath the skin to lift and tighten areas affected by sagging, such as the jawline, eyebrows, and cheeks, while also enhancing appearance through stimulation of collagen production.[5]

Among the injectable preparations, botulinum toxin, a neuromodulating substance, temporarily paralyzes facial muscles to smooth dynamic wrinkles (such as crow's feet and forehead lines),[6] and dermal fillers (*e.g.*, hyaluronic acid, poly-l-lactic acid, calcium hydroxylapatite, and polycaprolactone fillers) add volume to sagging areas and fill in deeper wrinkles, providing a more rejuvenated appearance.[7]

In the realm of medical devices, lasers are widely used to counteract the signs of aging. Fractional $CO_2$ laser targets deep layers of the skin to stimulate collagen production, reducing wrinkles and tightening sagging skin.[8] Erbium laser is used as a less invasive option for resurfacing the skin and improving texture, fine lines, and wrinkles.[9] Nd-Yag Q-Switched laser targets pigmentation and skin texture issues, promoting collagen remodeling and tightening.[10] The endo-lift laser method for rejuvenation, which includes face and neck lifting, aims to effectively improve the skin laxity, reducing wrinkles, folds, and lines.[11] Radiofrequency (RF) devices, such as bipolar radiofrequency, a non-invasive treatment that uses radiofrequency energy to stimulate collagen production and tighten skin, are used to contrast the skin laxity of the face.[12] Fractional radiofrequency, instead, a combination of microneedling and radiofrequency, helps to tighten and improve skin texture, reducing the appearance of wrinkles.[12] Ultrasound-based treatments employ focused ultrasound energy to stimulate collagen production deep within the dermal layers, effectively lifting and tightening areas impacted by skin aging.[13] Micro-needling, a treatment that uses tiny needles to create micro-injuries in the skin, stimulating collagen production and improving skin texture,[14] when combined with platelet-rich plasma, can enhance collagen production and rejuvenate the skin, making it more effective for wrinkles and sagging skin.[15]

Surgical options are represented by blepharoplasty, a procedure involving the surgical removal of excess skin around the eyes that can help with dermatochalasis and rejuvenate the eyelid area,[16,17] or facelift, a more invasive option that can address extensive sagging and wrinkles, lifting the entire face and improving aesthetic outcome.[18]

Over the past 15 years, alongside the listed methods, a relatively new technique known as Plasma Radiofrequency (PRF) ablation has been developed. PRF is an advanced, minimally invasive procedure that combines plasma energy and radiofrequency to treat various skin conditions, including dermatochalasis and facial wrinkles.[19-21] The technique has gained popularity for its ability to

stimulate collagen production, promote skin tightening, and improve skin texture, while offering minimal downtime and a low risk of adverse effects.[22] The device includes a handheld plasma generator with power and frequency adjustment and a sterile tip. It operates without direct contact and, unlike other plasma radiofrequency devices, offers numerous setting options.

The aim of this study is to report a preliminary retrospective finding on PRF ablation for the treatment of dermatochalasis and facial wrinkles. The authors discuss the methodology, post-treatment effects, and outcomes regarding wrinkle reduction, improved skin tone, and facial rejuvenation. Plasma is "the fourth state of matter", generated through the ionization of neutral gases present in the air. When sufficient energy is applied to the gas by a radiofrequency generator, electrons escape from their atoms, producing a positive charge and causing ionization. This process increases the number of free electrons, leading to the formation of positively charged particles called ions and to the dissociation of molecular bonds.[19] PRF ablation operates by generating a plasma spark through the ionization of air between the skin and the device's tip, which emits energy to the skin's surface uniformly, sublimating superficial skin layers.[19-25] Plasma energy induces controlled micro-injuries on the skin by vaporizing specific areas, leading to a visible retraction of the skin, and transferring the stored thermal energy to the skin surface, heating in a controlled, uniform manner. This process stimulates natural healing, delivers heat to deeper skin layers, tightens collagen fibers, and induces the production of new collagen. It helps improve skin texture, reduce wrinkles, and rejuvenate the skin. PRF ablation is a versatile, minimally invasive technique, effective for various indications, with minimal downtime but not without collateral effects.[19-25]

**Materials and Methods**

Fifteen patients with dermatochalasis (Figure 1A) and ten patients with facial wrinkles (Figure 2A) were voluntarily recruited at the Laser Therapy Clinic of the Dermatology Unit at the University of Campania "Luigi Vanvitelli" (Naples, Italy) in the winter of 2024 for PRF ablation treatments. The inclusion criteria for patient enrollment were facial skin aging and dermatochalasis in Fitzpatrick skin types ranging from I to IV without gender or age restriction. Dermatochalasis was assessed using the Lateral Dermatochalasis Scale classification, which includes 4 grades: grade 0 (no excess skin), grade 1 (mild excess skin), grade 2 (moderate excess skin), and grade 3 (severe excess skin). Only patients classified as grades 2 and 3 were included in the study. Patients with facial wrinkles were selected according to the classification proposed by Peng *et al.*, including individuals presenting static and dynamic wrinkles of the cheeks and crow's feet.[26] Subjects who had skin resurfacing in the past year or aesthetic treatments like chemical peels, tretinoin, botulinum toxin, or fillers in the last 6 months were excluded. Additional exclusion criteria were keloid formation, active oral herpesvirus, collagen

vascular disorders, autoimmune diseases, tanning, infections, diabetes, and malignancy. We informed all patients about the risks, benefits, and possible side effects of the procedure. This study protocol was conformed to the ethical guidelines of the 1875 Declaration of Helsinki and written informed consent and signed photo release agreements were obtained from all included patients. Digital photographs were obtained before treatment initiation (Figures 1A and 2A), immediately after (Figures 1B and 2B), and at 6-month follow-up (Figures 1C and 2C). The frontal photos were standardized using the same camera, settings, twin flash, and lighting. Three independent observers, who were not involved in the study, assessed the images at baseline and again 6 months after the last treatment. They evaluated the effectiveness of this technique by categorizing facial aesthetic results: 1 = no or poor (0%-25%); 2 = slight improvement (25%-50%); 3 = moderate improvement (50%-75%); and 4 = marked improvement (75%-100%). Additionally, patients were positioned in front of a mirror and asked to provide a subjective assessment of the overall results using the following ratings: unsatisfied, not very satisfied, satisfied, and very satisfied. Observers rated all patients at 4 months, showing a marked improvement from baseline. Every patient was either satisfied or very satisfied with the results.

***Standardized technique***

Treatments were administered following our institutional standardized protocol: all patients applied an anesthetic cream (lidocaine 4%) to the skin 30 and 15 minutes before the treatment to ensure numbness. The cream was then removed with sterile gauze before starting the session. The next step was skin disinfection with a non-alcoholic antiseptic solution. PRF ablation was typically performed using a single pass. Depending on the severity of the aesthetic condition and the specific treatment area, energy and frequency settings were selected on a case-by-case basis. The pulse duration at each point was adjusted to achieve the desired endpoint of skin retraction. To achieve effective healing and optimal outcomes while minimizing risks and side effects, the PRF tool was set to low energy levels (0.6-0.8 W) and frequency (1-2 Hz). It was performed with the detached spots technique of sublimation, maintaining columns of intact epidermis, acting only on the edges of excess skin tissue, with overlap of pulses on the most prominent wrinkles, breaking down the thickening, and sparing the underlying linear fold. The treatment generally takes 15 to 30 minutes, depending on the area being treated. Multiple sessions were necessary for optimal results, typically scheduled one month apart. After treatment, patients limited sun exposure and applied a neutral ointment to the treated areas at least two times daily during the healing process.

**Results**

After the PRF ablation procedure, small crusts formed on the treated areas (Figures 1B and 2B), with re-epithelialization occurring within 4 to 7 days, depending on the specific disorder treated and the device settings used. Mild to moderate swelling and redness are common immediately after the procedure, which typically resolve within 2 to 5 days. It is essential to refrain from picking or scratching the skin to facilitate proper healing and to apply a bland ointment post-treatment, as the skin may be highly sensitive. Furthermore, minimizing sun exposure is crucial in preventing hyperpigmentation. All patients tolerated both the treatment sessions and post-treatment periods effectively. At the 6-month follow-up after the last treatment, an improved skin texture, reduced wrinkles, and an overall rejuvenated appearance were observed. When evaluated using a Visual Analog Scale ranging from 0 to 10 for patient satisfaction, all participants reported a score greater than 8.

**Discussion**

New treatments for facial and eye rejuvenation are being developed in response to public interest, and the effectiveness of these treatments depends on the condition of the skin. Typically, less invasive procedures are considered sufficient for milder issues, whereas more advanced signs of aging tend to necessitate more invasive approaches. Surgical options are effective but require significant intervention and extended recovery time. As with any surgery, there are risks, including anesthesia reactions, excessive bleeding, infections, visible scars, pain, and swelling. Additional risks include nerve damage, skin necrosis, and uneven skin tightening or facial asymmetry. Fractional $CO_2$ or Erbium lasers may cause discomfort, require downtime, and carry risks such as persistent redness, hyperpigmentation, prolonged healing, and infections. Safer alternatives, such as topical and non-ablative treatments, may provide results that are not entirely satisfactory or long-lasting. PRF ablation offers significant opportunities and could bridge the gap between ablative and non-ablative procedures; it provides a reliable safety profile with satisfactory and sustained outcomes. PRF ablation is used to treat loose or sagging skin, particularly in sensitive areas such as the eyes, face, and neck. The controlled energy targets fine lines and wrinkles, smoothing and improving skin texture and tone by promoting cell turnover and collagen remodeling, which benefits overall facial rejuvenation. This is a minimally invasive procedure, making it a preferred option for individuals seeking to avoid more invasive alternatives such as facelifts or surgical blepharoplasty. Moreover, compared with more invasive procedures, PRF ablation has relatively quick recovery times. Patients may experience some redness, swelling, and minor scabbing, but these effects usually subside within a few days. Ideal candidates for this treatment are people with mild to moderate fine lines and wrinkles, particularly in sensitive areas such as the eyelids, around the mouth, and the face.

## Conclusions

PRF ablation is a minimally invasive treatment for dermatochalasis and wrinkles, which can offer satisfactory results for facial and eye rejuvenation. It offers high precision with minimal tissue trauma, a short operating time, no risk of bleeding, and limited tissue damage. It also promotes rapid formation of a protective postoperative layer, accelerates wound healing, minimizes inflammatory reactions, and enables a fast recovery with an early return to normal daily activities. However, it is not without risks – such as infection, post-inflammatory hyperpigmentation, or scarring – especially in patients who do not follow post-care instructions precisely. Despite these promising findings, the study has limited generalizability and the robustness of its conclusions is constrained by the small sample size, the absence of randomization and control groups, and the lack of standardized objective outcome measures. Therefore, further clinical studies on larger patient cohorts are needed to better determine the effects of PRF ablation for facial and periocular rejuvenation, including longer-term follow-up.

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**Figure 1. A**) Dermatochalasis prior to intervention; **B**) formation of small crusts immediately after a session of PRF ablation, executed with a single pass utilizing the detached spots technique of sublimation at an energy level of 0.6 J and a frequency of 1 Hz; **C**) improvement observed in comparison to baseline 6 months post-treatment, following two sessions.


**Figure 2. A**) Facial wrinkles before treatment; **B**) small crusts formed immediately following a session of PRF ablation, performed in a paintbrush manner, conducted with a single pass using the detached spots technique of sublimation, and with a longer pulse duration at the same point on the most prominent wrinkles, avoiding the underlying linear fold, at 0.8 J energy and 1 Hz frequency; **C**) noticeable changes in the face and reduction of wrinkles, observed six months after a single session.