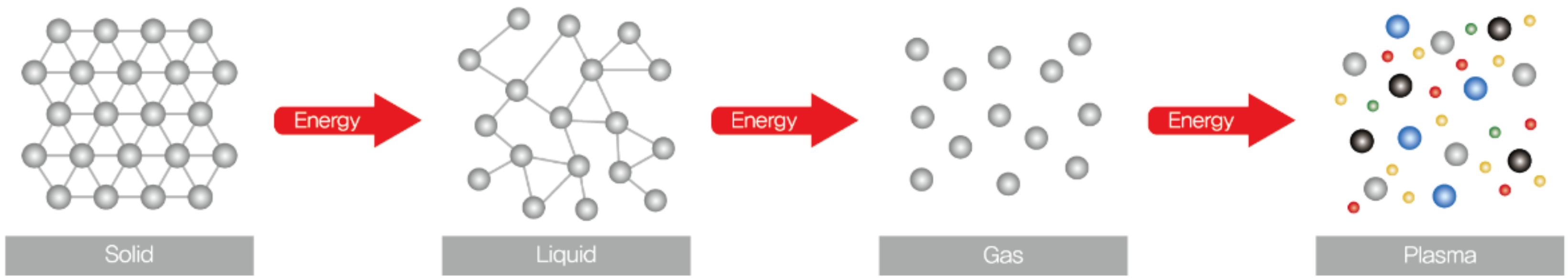
For Export

Plapen Dual

CONTENTS

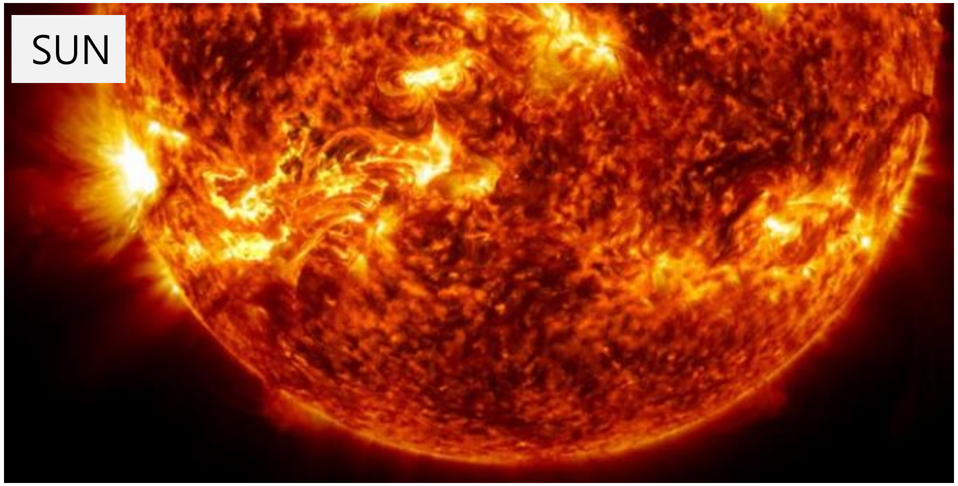
Definition of Plasma

- "Fourth material" Plasma -



Generally, the state of a material is divided into three kinds - solid, liquid, and gas. If high energy is applied again to a material that has been liquified and gasified after receiving energy in its solid state, the gas is separated into electrons and atomic nuclei and becomes a plasma state. For this reason, the plasma is called as the 'fourth material'. The ions generated from the plasma have sterilization, infection prevention, antiviral and anti-inflammatory effects as well as the strong ablation effect on the surface, so it is effective in the treatment of the local area.

Plasma in nature



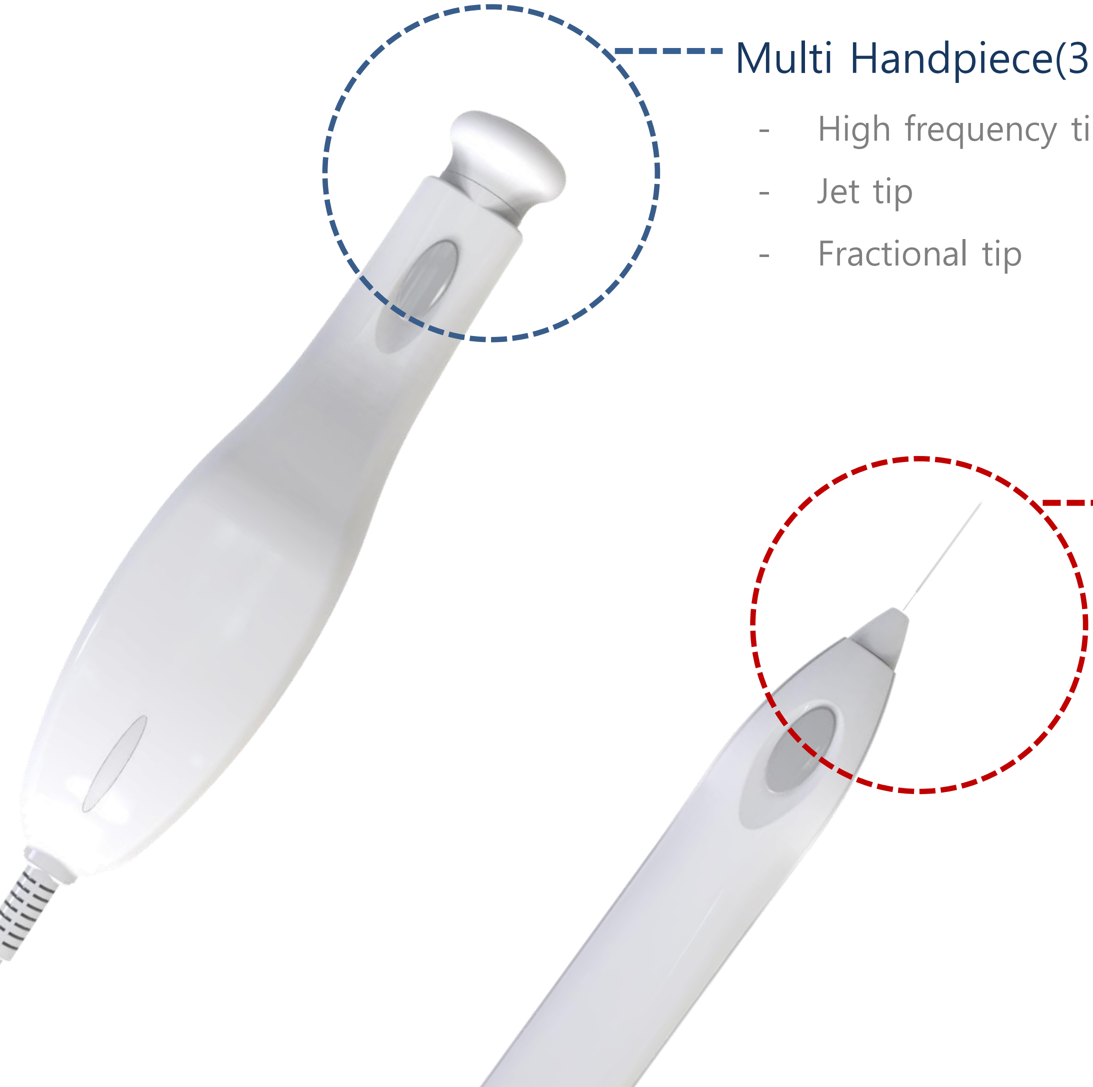
Effects of plasma on human tissue

1) **Sublimation**
2) **Disinfection**
3) **Plasma induced coagulation**
4) **Anti-inflammatory effect**
5) **Reduce itching**
6) **Electroporation**
7) Selective apoptosis
8) Angiogenesis
9) Migration and Adhesion of cells
10) Accelerated wound healings

Plapen Dual is

Skin treatment device using plasma. This device consists of two types of handpieces which can be applied to the treatment of various indications, such as penetration of solution, sterilization of inflammation, improvement of fine lines, removal of blemishes and spots, incision of cutaneous tags and milia.

Handpieces



Multi Handpiece(3 types of tip)

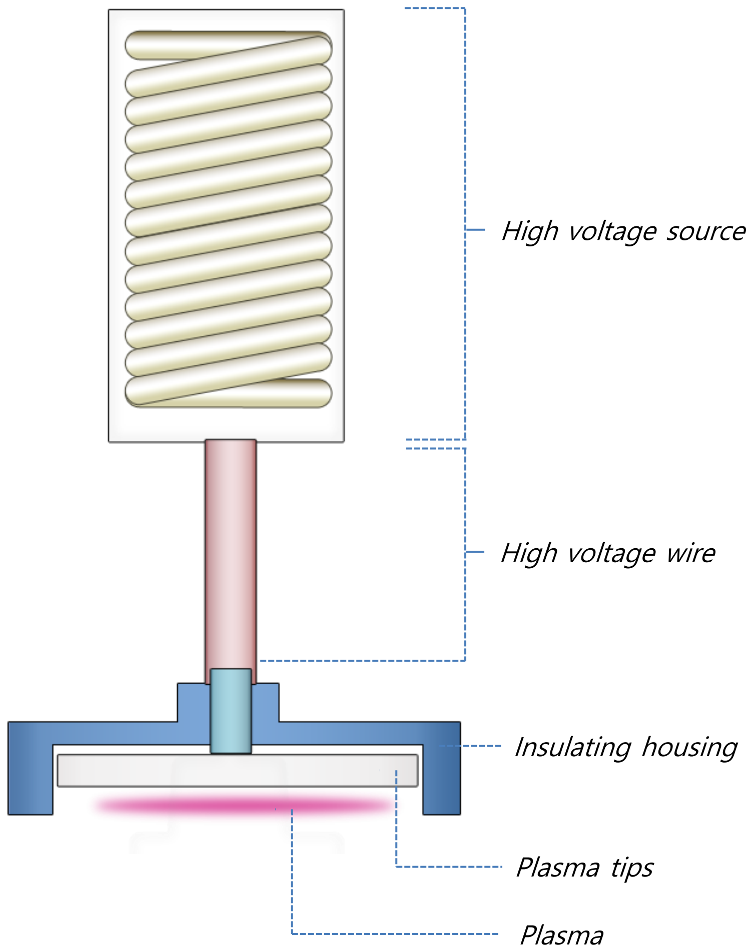
- High frequency tip
- Jet tip
- Fractional tip

Pen Handpiece(with Needle)

- A Ø0.5mm-thick double-sided needle is used for local incision and ablation

Multi Handpiece

Technology

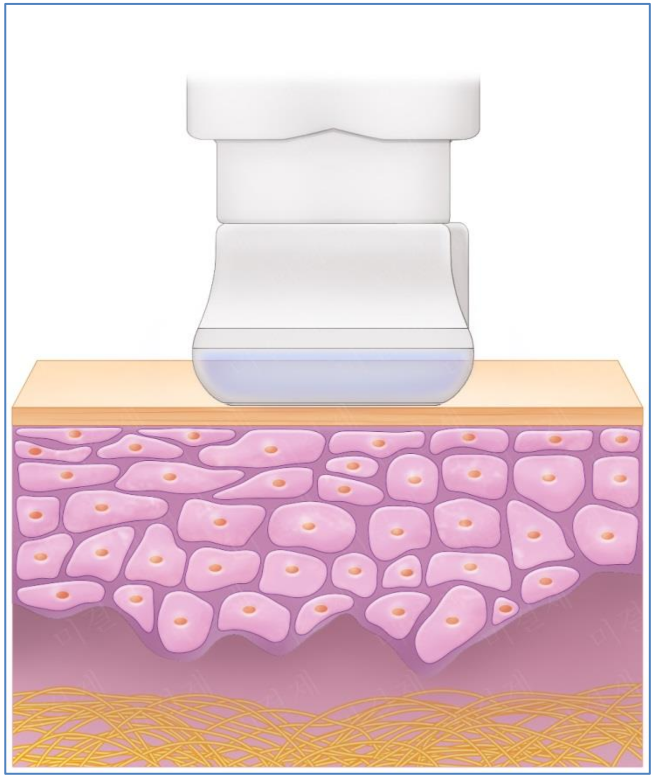


The gas of atmospheric air is separated into electrons and nuclei by discharging a strong voltage into the atmosphere. Generation of plasma ions

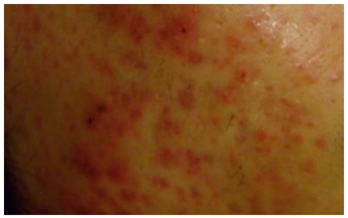
High frequency tip

Generation of plasma ions

Generation of plasma ions leads to the sterilizing effect and the solution-penetrating effect

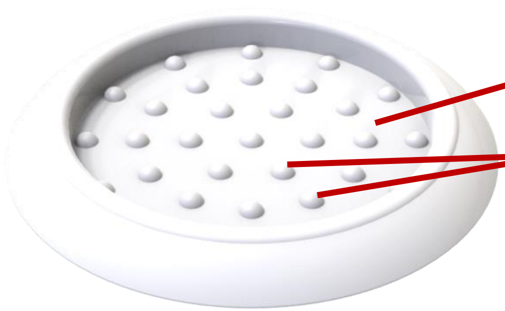


※ Indications



Jet tip

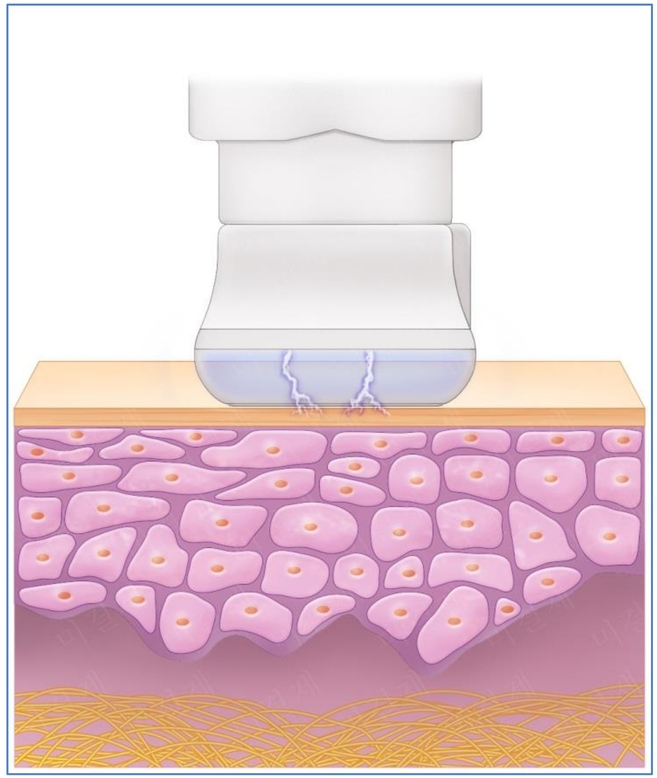
Micro-coagulability points are generated simultaneously with the release of plasma ions, making this device applicable to various skin types



Generation of plasma ions leads to the sterilizing effect and the solution-penetrating effect

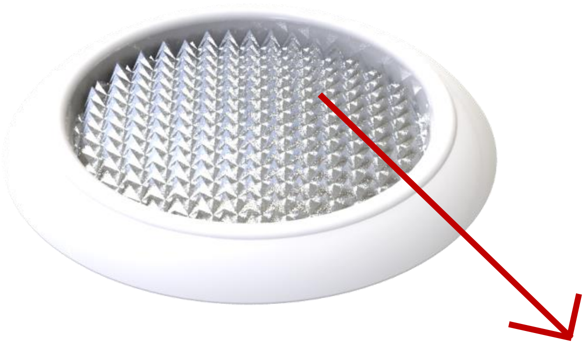
Randomly ejected plasma energy enables epidermal micro-ablation effect

※ Indications

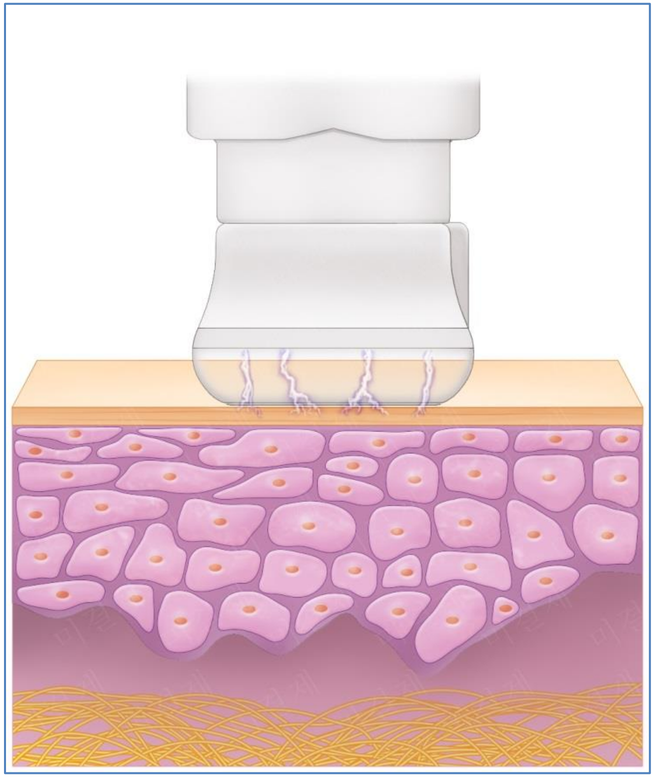


Fractional tip

Randomly ejected plasma energy enables epidermal micro-ablation effect



Thermal plasma is randomly generated from189 projections
Plasma treatment can be performed easily by simply stamping the treatment area

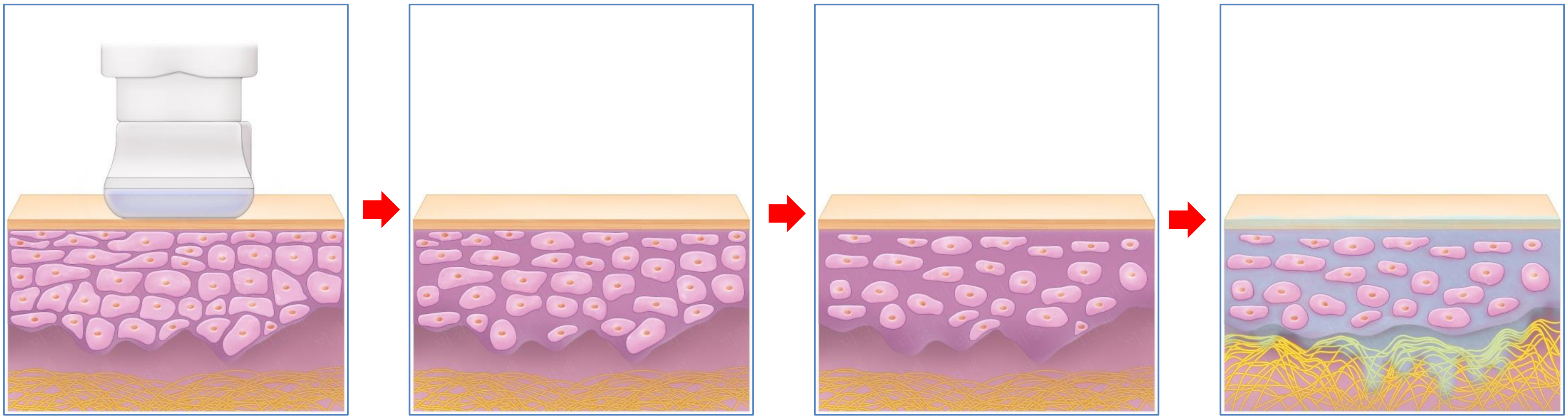


※ Indications



Treatment Process

Solution Penetration



▶ Plasma energy irradiation

▶ Stimulation of keratinocytes

▶ Due to the weakening of the skin barrier function, gaps are created between keratinocytes

▶ Enhanced solution absorption rate of the dermal layer. Fractured lipid layers are recovered within 24 hours

Penetration process

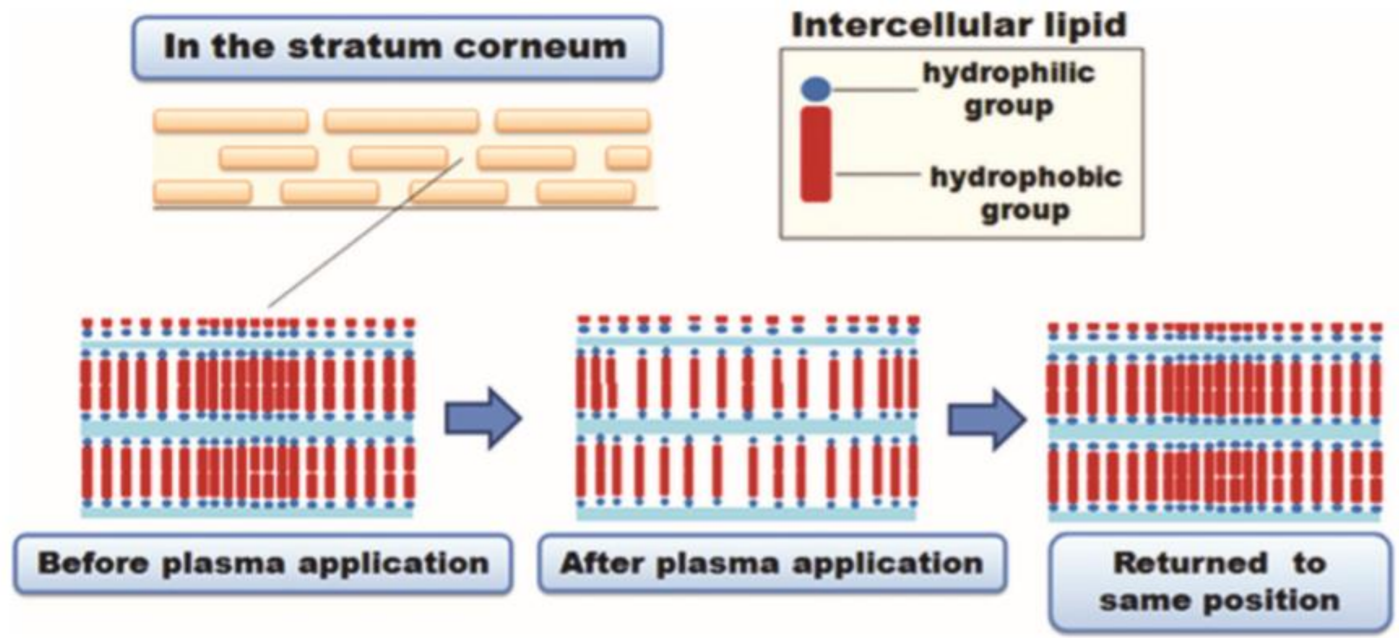


FIG. 15. Dynamic behavior of intercellular lipid bilayers by microplasma irradiation without damage to the SC.

※ Novel method to improve transdermal drug delivery by atmospheric microplasma irradiation(2015)

Electroporation VS Plasma penetration

Classification	Electroporation	Plasma
Treatment type	Rubbing type	Rubbing type
Penetrable time	Short-term penetration Immediate normalization after transient basal layer disturbance	Long-term penetration is possible Normalization within 24 hours after basal layer disturbance
Depth of penetration	*See the graph data below*	
Cellular action	Loss of solution during the penetration through the stratum corneum	Penetration of solution after the stratum corneum is removed (see the data below)

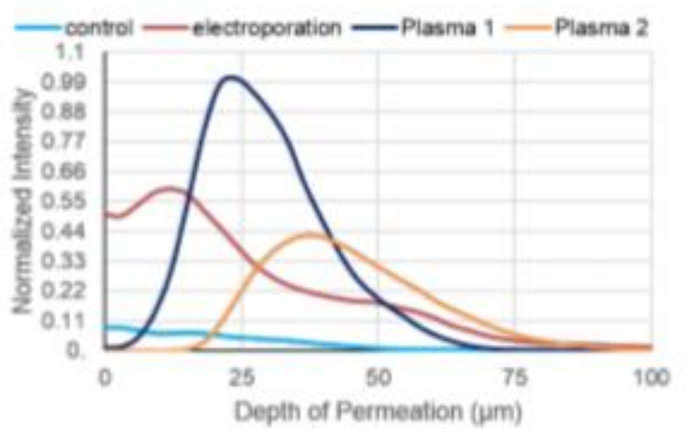


Fig 3. Plasma-enabled transdermal delivery of liposomes.

※ Novel method to improve transdermal drug delivery by atmospheric microplasma irradiation(2015)

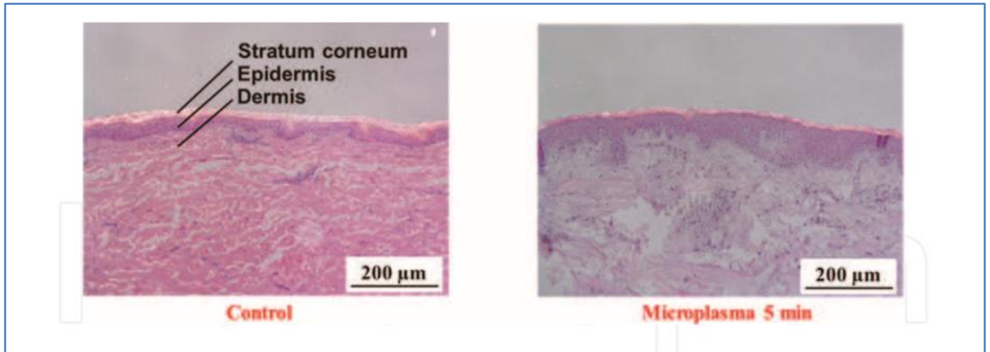
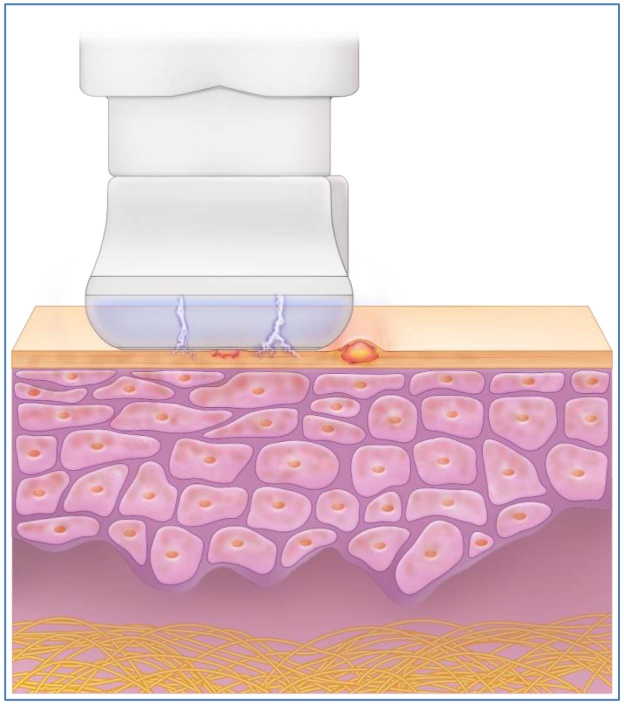


Figure 6. Cross section of pig skin before atmospheric plasma irradiation, the stratum corneum thickness: 18.09 ± 1.64 μm (left—control), and after atmospheric plasma irradiation (right), the stratum corneum thickness: 13.40 ± 1.46 [11, 49].

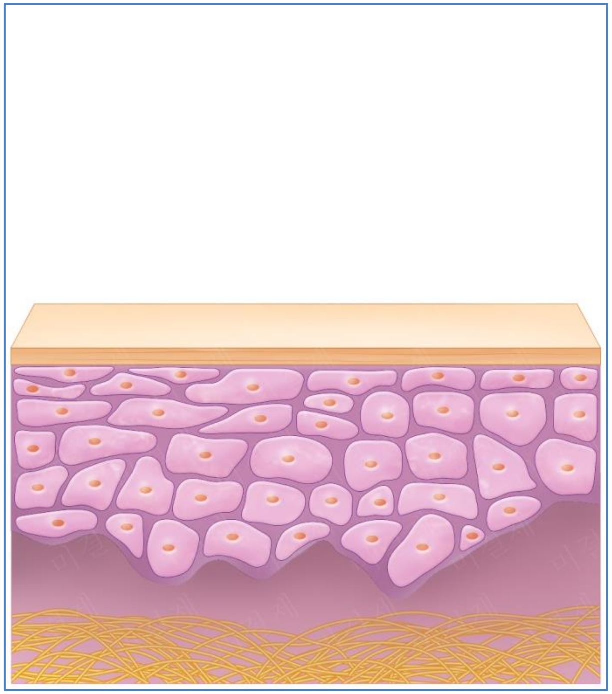
※ Microplasma Drug Delivery

Treatment Process

Sterilization

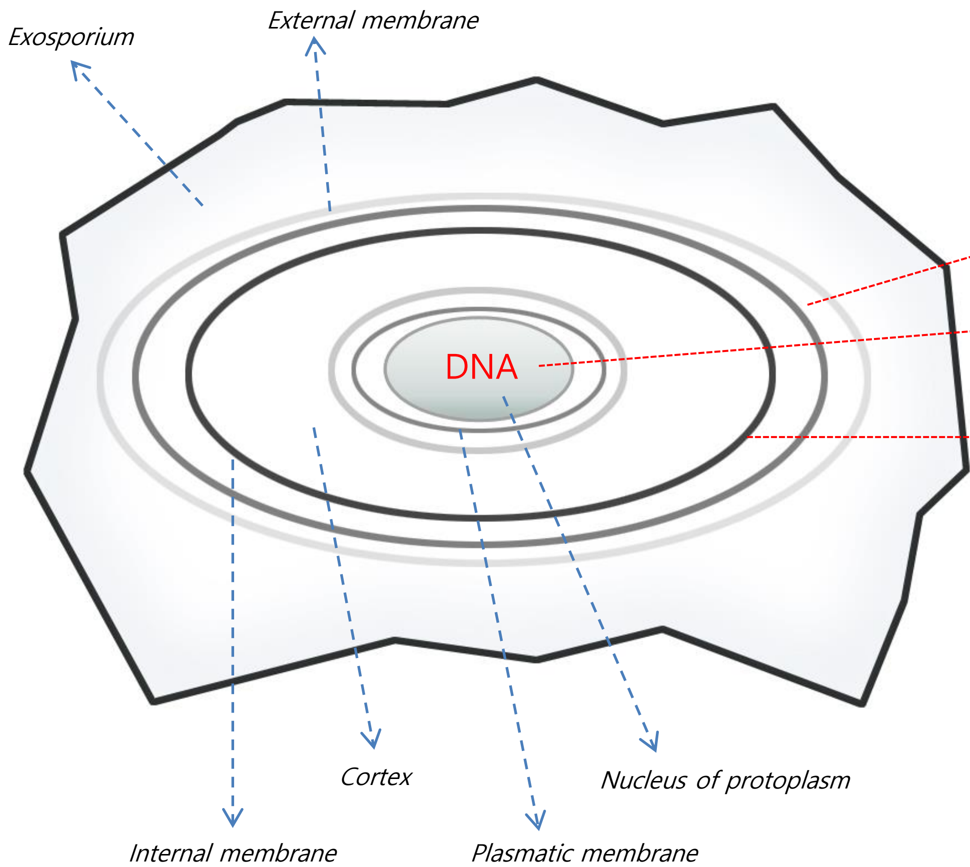


▶ The plasma energy transmitted to skin has a bactericidal effect on acne bacteria and Staphylococcus aureus (atopic bacteria)



▶ Healing of skin through the bactericidal action targeting the inflammation-causing bacteria

Sterilization process of harmful bacteria



Step 1: Destruction of bacterial outer membrane

Step 2: Bacterial DNA damage by ROS

Step 3: Formation of pores in the cell membrane through electrical stimulation (electroporation)

Step 4: Leakage of intracellular materials through pores

Step 5: Destruction of the defense mechanism due to the intracellular material leakage

Research

▼Sterilization of *Candida albicans*

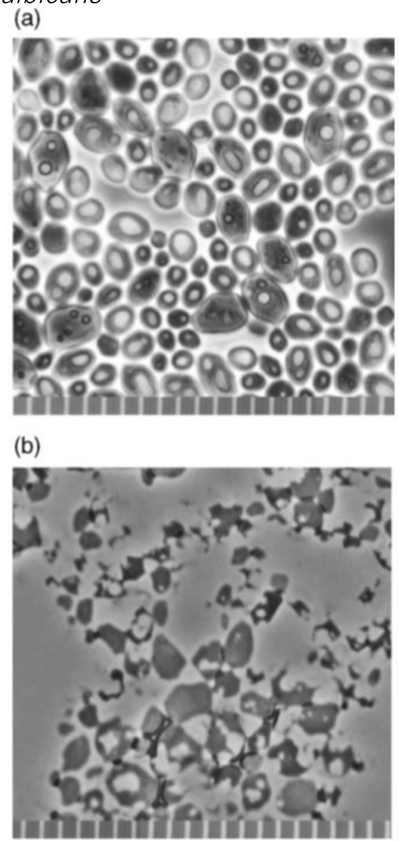


Fig. 5. Sterilization and post-cleaning of *Candida albicans*. Optical-microscope images of *C. albicans* before (a) and (b) after the plasma treatment. RF power and frequency: 670 W, 27.12 MHz; Pulse width and interval: 10 μs; Duration: 5 min. Scale: 5 μm/division.

▼Sterilization of *Staphylococcus aureus*

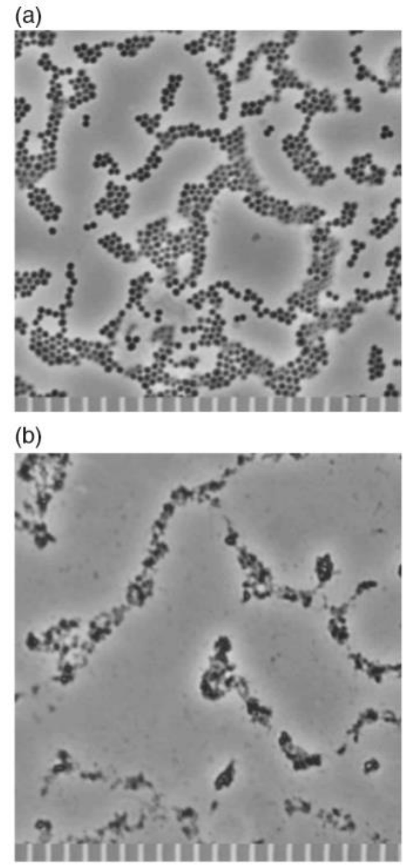


Fig. 6. Sterilization and post-cleaning of *Staphylococcus aureus*. Optical-microscope images of *S. aureus* (a), and (b) after the plasma treatment. RF power and frequency: 670 W, 27.12 MHz; Pulse width and interval: 10 μs; Duration: 5 min. Scale: 5 μm/division.

Pulse-modulated, high-frequency plasma sterilization at atmospheric-pressure(2005)

Research

22nd International Symposium on Plasma Chemistry
July 5-10, 2015; Antwerp, Belgium

Transdermal drug delivery using cold plasmas

S. Kalghatgi, C. Tsai, R. Gray and D. Pappas

EP Technologies LLC, Akron, OH, USA

Abstract: Several attempts have been made to enhance skin permeation by chemical, physical, or mechanical methods to overcome barrier properties of skin. The present study demonstrates the ability of non-thermal plasma to increase skin permeation and enhance transdermal delivery of large molecules including liposomes (100 nm), nanoparticles (50 nm) & proteins (115 kDa) to deeper layers of the skin rapidly without causing skin damage.

Keywords: Non-thermal Plasma, DBD, Transdermal Drug Delivery, Plasma Medicine

1. Introduction

Transdermal drug delivery has many advantages over other traditional methods for drug administration. It can be applied in a localized, non-invasive way, and has the potential for sustained and controlled release of drugs, and other molecules [1, 2]. In addition, transdermal drug delivery avoids first-pass metabolism which reduces the concentration of a drug before it reaches the circulatory system. Percutaneous absorption minimizes the risk of irritation of the gastrointestinal tract, reduces pain and minimizes complication associated with intradermal or intramuscular injections. However, only a small percentage of topically applied compounds can be delivered transdermally due to the skin barrier properties, namely the highly lipophilic stratum corneum (SC). As a result only molecules with a molecular weight of less than 500 Da can be administered percutaneously [3]. In addition, transport of most drugs across the skin is very slow as lag times to reach steady-state flux could be hours. Achieving a therapeutically effective drug level through transdermal delivery is therefore difficult without artificially enhancing skin permeation. Many passive (patches, oils, creams) and active (iontophoresis and electroporation) methods of enhancing skin permeation have been attempted, but have failed for various reasons including limitation on drug formulation, skin damage, pain, patient discomfort, electric shock, skin irritation and involuntary muscle contractions. Efficient drug delivery through the skin barrier still remains a challenge in medicine and dermatology, although topical treatment is most preferred route of administration by physicians and clinicians.

Over the last decade cold plasmas have been widely studied by various groups across the world for clinical and biomedical applications beyond sterilization. These recent research activities led to the formation of a new field called Plasma Medicine [4]. The plasma medicine community has demonstrated that cold plasmas can be safely applied directly to living cells and tissue, thereby enabling it to promote various beneficial effects including wound healing [5], cell transfection [6], cell proliferation [7] etc., but the focus was not related to enhancement of skin permeation for enabling transdermal drug delivery using plasma. A few studies that have been reported are limited to plasma treatment of cells *in vitro* to induce temporary cell permeabilization [8] through the use of plasma jets operating under atmospheric pressure conditions. These processes require high inert gas flow rates to generate plasmas. Additionally, treatment of larger surfaces can be challenging due to the small footprint of the applied jets.

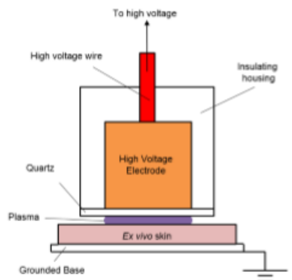


Fig 1. Schematic of dielectric barrier discharge (DBD) plasma treatment setup for skin permeation studies.

In this paper we demonstrate for the first time the use of ambient air-based non-thermal atmospheric pressure dielectric barrier discharges for enhancing transdermal delivery of various molecules including dextrans, nanoparticles, liposomes, and proteins across *ex vivo* porcine skin. We present non-thermal atmospheric pressure dielectric barrier discharge plasma as an alternative technology for non-contact, non-invasive, needle-free and potentially cost effective application that would revolutionize transdermal drug delivery.

Transdermal drug delivery using cold plasma

In this study, it was demonstrated that cold plasma enhances skin penetration and has the ability to enhance rapid drug delivery to deeper layers of skin without causing skin damage dextran molecules (1 nm hydrodynamic radius) through intact porcine skin without thermal damage. Results show that the molecule reached the epidermal layer at a depth of approximately 300 µm. The response was very fast, within one hour after treatment. As expected, dextran molecules remain on the surface of the skin sample that was not treated with plasma. These results show that plasma is able to enable overcome the highly resistive SC and enhance permeation of skin to promote transdermal delivery of molecules that are at least six times as large as those molecules that are freely able to diffuse across skin [3]. This can be attributed to the impact of the high electric field that can cause breakdown of the stratum corneum through the formation of new channels through which the molecules can be transported.

In addition, further experiments have also revealed that 1-min cold plasma exposure enables the transdermal delivery of large dextran molecules: i)10 kDa in size (8 nm hydrodynamic radius) to a depth of 600 µm and ii) 70 kDa in size (49 nm hydrodynamic radius) up to a depth of 150 µm within one hour (data not shown). Authors have also found that under the process conditions described above 50 nm SiO_2 nanoparticles can be delivered to a depth of 200 µm and fluorescently tagged albumin (66 kDa) and human immunoglobulin, IgG (115 kDa) proteins can be delivered to the dermis at a depth of 200 µm within one hour (data not shown).

The study also focused on enhancing the permeation of drug delivery vehicles including liposomes, micelles, etc. These molecules have recently garnered a lot of attention due to their numerous cosmetological and dermatological applications. The advantage of being able to deliver any type of drug without the need for complex formulation and preventing interaction with skin is promising. Unfortunately, most delivery vehicles are significantly large in size, which prevents topical delivery without artificially enhancing skin permeation. This poses a challenge for plasma-assisted drug delivery: *Can non-thermal plasma enable the safe transport of 100 nm liposomes across ex vivo porcine skin in a reasonable amount of time and at sufficient quantities?*

Additionally, a comparison between the efficacies of plasmaporation to that of electroporation was performed. Electroporation is a method that has been widely studied for enhancing skin permeation. 100 nm liposomes at a concentration of 1 mg/ml were applied directly to porcine skin immediately after plasma treatment or electroporation. The depth of permeation was determined using fluorescently enabled confocal imaging 1 hr after skin treatment. Also, the concentration of liposomes was determined by measuring the intensity of fluorescence at different depths using ImageJ (NIH) image analysis software.

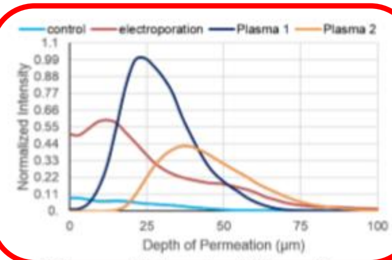


Fig 3. Plasma-enabled transdermal delivery of liposomes.

The normalized intensity values of fluorescence versus depth of permeation were plotted for control and treated samples. As shown in **Figure 3**, in contrast to electroporation and control samples, where majority of the intensity (consequently the concentration) is detected above 20 µm in depth (stratum corneum), plasma treated samples show a high concentration of liposomes below 20 µm (epidermis) in depth. However, the plasma processing parameters seem to affect the concentration and delivery depth of the applied molecules. This demonstrates that non-thermal DBD plasma enables the transport of 100 nm liposomes transdermally by enhancing skin permeation without the side effects associated with electroporation. Furthermore, greater concentration of the liposomes was delivered by plasma to a greater depth in the skin than electroporation.

We hypothesize that non-thermal plasma enhances transdermal drug delivery via the formation of temporary pores in the skin via a process we term 'plasmaporation'. Similar to electroporation, the electric field applied to generate the plasma creates a voltage drop across the skin and most of the drop occurs across the highly resistive stratum corneum (SC). This voltage distribution causes electrical breakdown of the SC. If the applied voltage exceeds a threshold of 75 to 100 V, aqueous micro channels or '*local transport regions*' are created through the breakdown sites of the SC. In modelling studies by *Kushner, et al.*, it has been demonstrated that DBD plasmas applied directly to skin lead to the generation of electric fields with a magnitude of about 100 kV cm^{-1} on the surface and underlying layers of the skin, which far exceeds the threshold voltage needed for electroporation [9]. Further, we have determined that the process of plasmaporation is temporary at certain plasma conditions. For instance, no permeation is observed if the molecule of interest is applied more than 5 min after plasma treatment.

4. Conclusions

We have demonstrated that non-thermal DBD plasma enables the transdermal delivery of significantly large molecules across porcine skin in less than a minute without causing any skin damage. Dextran molecules, nanoparticles, liposomes and proteins were delivered to

O-22-6 3

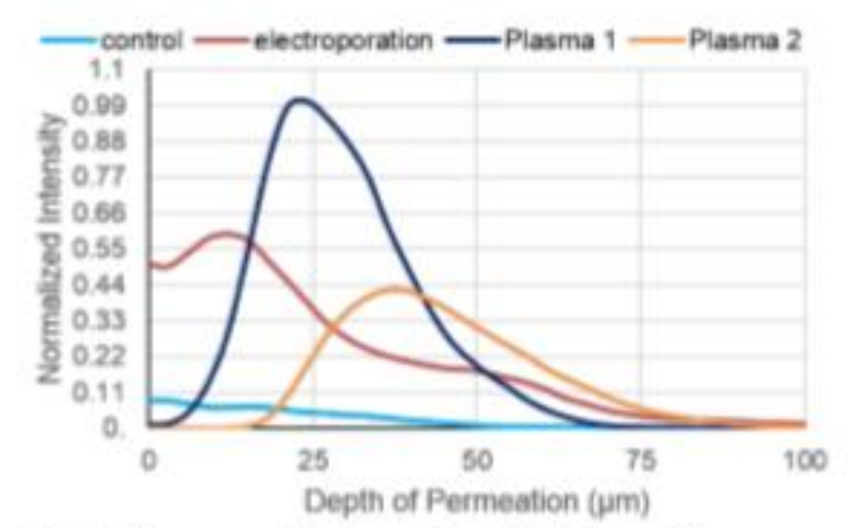


Fig 3. Plasma-enabled transdermal delivery of liposomes.

Percutaneous liposome delivery using plasma
-> Delivery of liposomes to greater depths of skin compared to the electroporation mechanism

Cold plasma improves skin penetration without the side effects associated with the electroporation mechanism. Compared to the electroporation mechanism, cold plasma can also deliver larger liposomes to greater depths of the skin.

Non-Thermal Plasma for Acne and Aesthetic Skin Improvement

Chanchai Chutsirimongkol1, Dheerawan Boonyawan2, Niwat Polnikorn3, Wasini Techawatthanawisan4, Treenuch Kundilokchai5

1 Thailand Center of Excellence for Life Sciences, Bangkok, 10400, Thailand/PhotoBioCare Co.,Ltd. Nonthaburi 11120, Thailand ; 2 ChiangMai University, Chiangmai 50200, Thailand; 3 Kasemrad Hospital, Bangkok 10240, Thailand; 5 Mae Fah Luang University, Bangkok 10110, Thailand.

E-mail: chanchai@pbc.co.th

Abstract.

Non-Thermal Plasma/Cold Atmospheric Plasma (NTP/CAP) technology, that can generate low temperature plasma in normal atmosphere, has been recognized widely as a new emerging tool with potential applications in life science and biomedical fields.

During the last 10 years, there are many reports and publications of NTP, confirming its safety and efficacy in health care and various medical applications.

The promising future of NTP technology has aroused our interest to study a novel NTP device in detail. The device generates Plasma by Dielectric –Barrier-Discharge (DBD) with direct contact or non-contact at a few millimeters gap between electrode surface to and skin. Micro Plasma beam is generated by ionizing surrounding air on electrode surface discharging directly to target tissue.

We have conducted clinical trials of the device called "BIOPLASMA Cell Modulation" (developed by Photo Bio Care, Thailand) as a new application for acne and aesthetic skin improvement.

Introduction

Many reports and reviews in recent publications have confirmed the safety and efficacy of NTP technology in biomedical applications. (1)(2).Details of this new technology have been clearly reviewed by Alexander Friedman in Applied Plasma medicine. (3).This technology offers new method of noninvasive selective targeting therapy at molecular level to biological tissue. There is a high potential for new medical applications in bacterial eradication, dermatology/aesthetic skin, chronic wound care, stimulation of tissue regeneration and a new approach to cancer therapy. (4)(5)(6)(7)(8)(9)(10).

Gregory Fridman and team have reported very high efficacy of direct Plasma as compared to indirect Plasma on bacterial eradication. (11).

Danil Dobbrynin and team of researcher from Drexel Plasma institute (12)(13)(14) have identified and summarized the details of physical and biological mechanism of non-thermal Plasma and biological tissue interaction in their reports. Various plasma parameters and doses have been established. This study has guided the development of new BioPlasma source for medical and therapeutic applications.

1

Non-Thermal plasma for acne and aesthetic skin improvement

Plasma is generated directly or by a non-contact manner between the electrode surface and the skin several millimeters apart. Plasma is produced by ionizing the ambient air around the electrode surface, and clinical trials have been conducted using these devices

alcohol soaked swab **(Fig3)**.
After this procedure the treated skin is usually becomes clean, smooth and it gets mild whitening and reddish pink colored. There is a mild to moderate skin tightening effect, with improvement of line folds and some degree of facial contour change can also be noted after the treatment. The procedure is easy to perform with warm to mild heat sensation. Immediate skin texture improvement is usually noted. Subsequent changes also observable after repeated treatment **(Fig4)**.

(Fig4).Skin texture changes observable immediate after treatment. Picture Before, 1week after 1st Rx, 1day after 2nd Rx

The powered electrode also can be applied without direct contact with skin, with a floating gap of 1-3 mm. A dense and strong streamer filament of 2-6 mm beam size will be discharges to the skin surface. This will create very high power density. This technique is used to coagulate superficial skin lesion such as pustular acne with few seconds' repeated strokes on lesion **(Fig 5)**.

(Fig5).Application: float to near contact acne lesion few seconds for few times. Pictures of before treatment, 1day and 7days follow up.

Plasma skin interaction has shown potential benefits in aesthetic dermatology in many studies (25). With the new Bioplasma source device, it was noticed that there is an improvement in associated acne conditions along with aesthetic improvement in skin texture (26)**(Fig 6)**.This led us to conduct clinical control trial of novel Direct DBD air Plasma contact skin type electrode for Acne treatment.

(Fig6). Before and post2Rx, 6weeks Follow up Before 2weeks post 1 Rx, 4weeks post 2Rx

5

By using the plasma device used in this experiment, acne symptoms and the skin texture were improved.

STUDY

Evaluation of Plasma Skin Regeneration Technology in Low-Energy Full-Facial Rejuvenation

Melissa A. Bogle, MD; Kenneth A. Arndt, MD; Jeffrey S. Dover, MD, FRCPC

Objective: To evaluate the use of multiple, low-energy, full-face plasma skin regeneration treatments.

Design: Plasma skin regeneration delivers energy to the skin through plasma pulses induced by passing radiofrequency into nitrogen gas. Single-treatment, high-energy, 1-pass treatments have been demonstrated to achieve good results with an excellent safety profile. Eight volunteers underwent full-face treatments every 3 weeks, for a total of 3 treatments, using energy settings of 1.2 to 1.8 J. Before each subsequent treatment, the quality of regenerated epidermis, the degree of downtime, and erythema were recorded. Full-thickness skin biopsy specimens were obtained from 6 patients before treatment and 90 days following the last treatment. Patients were seen for follow-up 4 days after each treatment and 30 and 90 days after the third treatment.

Results: Three months after treatment, investigators found a 37% reduction in facial rhytids and study participants noted a 68% improvement in overall facial appearance. Reepithelialization was complete in 4 days. Patients assessed erythema to persist an average of 6 days after treatment. Epidermal regeneration from the first treatment was longer than from the following treatments (9 vs 4 and 5 days, respectively). One patient developed localized hyperpigmentation after the first treatment, which resolved by follow-up at day 30. No scarring or hypopigmentation occurred. A histologic evaluation 3 months after treatment revealed a band of new collagen at the dermoepidermal junction with less dense elastin in the upper dermis. The mean depth of new collagen was 72.3 µm.

Conclusions: Plasma skin regeneration using the multiple low-energy treatment technique allows significant successful treatment of photodamaged facial skin with minimal downtime. Results are comparable to a single high-energy treatment, but with less healing time.

Arch Dermatol. 2007;143:168-174

PLASMA SKIN REGENERATION (PSR) technology uses energy delivered from plasma rather than light or radiofrequency. Plasma is a unique state of matter in which electrons are stripped from atoms to form an ionized gas. The plasma is emitted in a millisecond pulse to deliver energy to target tissue upon contact without reliance on skin chromophores. The PSR device (Portrait PSR; Rhytec Inc, Waltham, Mass) is cleared by the US Food and Drug Administration for multiple, single-pass, low-energy treatments and single-treatment, 1-pass, high-energy treatment of facial rhytids and for the treatment of superficial skin lesions.

The technology can be used at varying energy settings for different depths of effect, from superficial epidermal effects similar to microdermabrasion to deeper dermal heating similar to carbon dioxide resurfacing.[1] Preliminary studies examining a single pass of 1 to 4 J over postauricular skin showed that at 1 to 2 J, thermal energy was limited to the epidermis and dermoepidermal junction. At 3 and 4 J, thermal injury reached the papillary dermis (averaging 8.2 and 11.8 µm, respectively).[2] Studies have focused on high-energy single treatments for acne scarring or wrinkle reduction. High-energy treatments are successful but can be limited by postprocedure healing periods of a week or more. This study was conducted to see if equivalent results with less downtime could be achieved with multiple treatments at low energy.

Author Affiliations: SkinCare Physicians, Chestnut Hill, Mass (Drs Bogle, Arndt, and Dover); Departments of Dermatology, Yale University School of Medicine, New Haven, Conn (Drs Arndt and Dover), and Harvard Medical School, Boston, Mass (Dr Arndt); and Department of Medicine (Dermatology), Dartmouth Medical School, Hanover, NH (Dr Arndt). Dr Bogle is now with the Laser and Cosmetic Surgery Center of Houston, Houston, Tex.

(REPRINTED) ARCH DERMATOL/VOL 143, FEB 2007 WWW.ARCHDERMATOL.COM
168

Evaluation of plasma skin regeneration technology in low-energy full facial rejuvenation

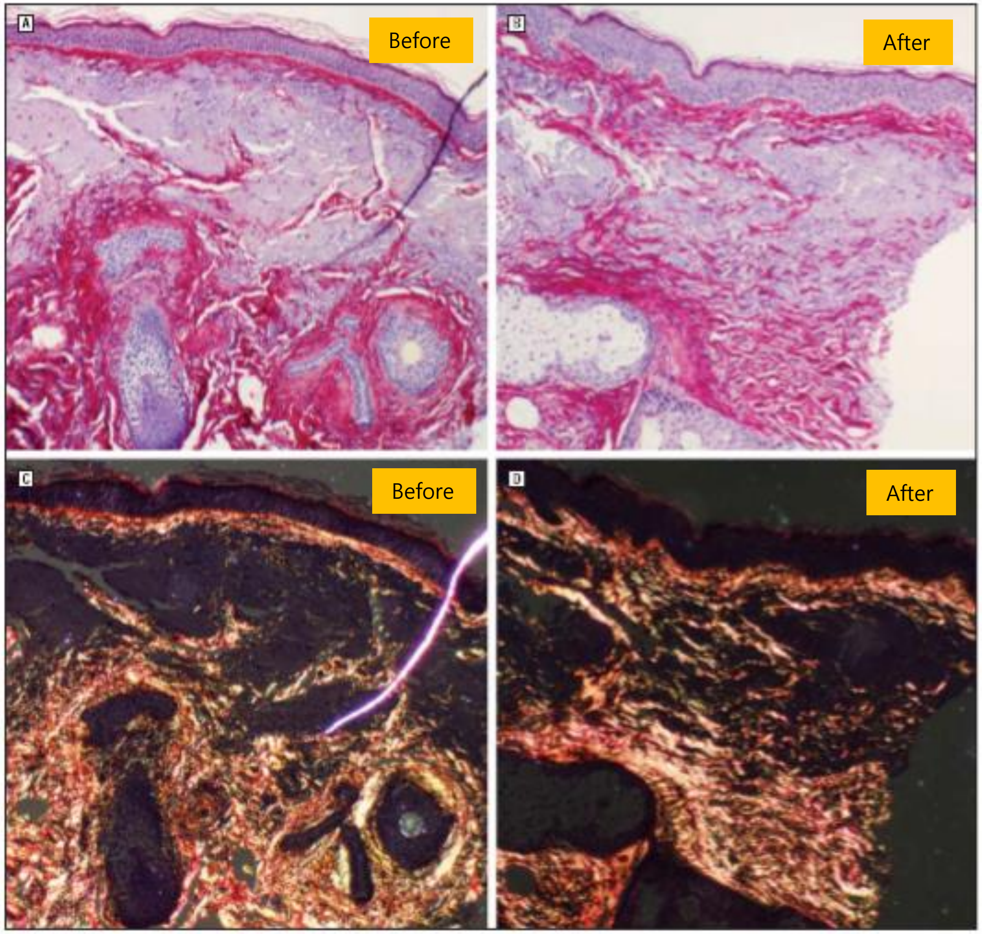


Figure 6. Histologic features from a patient before treatment (A) and 3 months after 3 treatments (B) showing a reduction in solar elastosis and neocollagenesis after the 3 low-energy treatments with a plasma regeneration device (hematoxylin-eosin, original magnification ×100); and polarized histologic features from a patient before treatment (C) and 3 months after 3 treatments (D) highlighting new collagen formation in the dermis (hematoxylin-eosin, polarized, original magnification ×100).

Case Report

Treatment in the healing of burns with a cold plasma source

Mario Betancourt-Ángeles[1], Rosendo Peña-Eguiluz[2], Régulo López-Callejas[2], Nicasio Alberto Domínguez-Cadena[1], Antonio Mercado-Cabrera[2], Jorge Muñoz-Infante[1], Benjamín Gonzalo Rodríguez-Méndez[2], Raúl Valencia-Alvarado[2], José Alberto Moreno-Tapia[1]

[1]*Medical Center ISSEMYM Toluca, Metepec, México;* [2]*Plasma Physics Laboratory, Instituto Nacional De Investigaciones Nucleares, Ocoyoacac, México*

Received November 13, 2017; Accepted December 17, 2017; Epub December 20, 2017; Published December 30, 2017

Abstract: A cold plasma produced with helium gas was applied to two second-degree burns produced with boiling oil. These burns were located on a thigh and a shin of a 59-years-old male person. After the first treatment as benefit the patient neither presented itching nor pain and, after the second treatment, the patient presented new tissue. This result opens the possibilities of the application of a cold plasma source to health burns.

Keywords: Thermal burns, skin burns, cold plasma, helium plasma

Introduction

Thermal burns have always been injuries caused by accidents, being of greater incidence in children and older adults. Surface burns or grade 1 burns are usually treated conservatively because the skin has a potential for reepithelialization, contrary to burns from grade 2 to grade 4 burns, which some of them have mixed patterns, or dermal lesions are deep. These pose an aesthetic and functional risk for the patient and end up compromising their life if they are extensive [1, 2]. There is an urgent medical need not satisfied with new treatments for wounds and burns infections caused by different types of bacteria [3, 4]. Among the results of research carried out in academic, clinical and industrial settings it can be mentioned: ultrasound [5], Laser [6] antimicrobial [7], negative pressure [8], micrografting [9], Colistin [10], etc.

Plasma medicine is an interdisciplinary field based on the exploit of non-thermal atmospheric-pressure plasma (cold plasma) [11, 12], which has been investigated and developed by research groups, institutions, and laboratories worldwide. The plasma medicine potential has been applied in bacteria inactivation [13] and *in vitro* cancer treatment [14-16], likewise, in the living tissues [17, 18] without causing damage due to the plasma temperature is below 40°C. The cold plasma produced at atmospheric pressure consists of charged particles, reactive species of both oxygen and nitrogen, and free radicals.

The cold plasmas of helium and/or argon have been tested in a preclinical environment in studies carried out at the Plasma Physics Laboratory of the National Institute of Nuclear Research [19]. They were applied in an experimental bio-model (laboratory mice of strain Balb/c), which were wounded with a length of ~1 cm and a depth of ~0.5 cm by a scalpel. Over the wound were applied three treatments using an argon plasma and subsequently three treatments with helium plasma, achieving accelerate healing process with the natural one [19]. This is because plasma is a potent generator of RNS/ROS species promoters of sterilization and tissue regenerators [19, 20]. By means combining these plasmas are activated the coagulation proteins and promoted the activation and formation of the platelet of the fibrin filaments [21].

Investigations related to the application of cold plasma in humans are being carried out in an

Treatment in the healing of burns with a cold plasma source

Helium- and argon-based cold plasma were tested in a preclinical study of the Plasma physics laboratory at the National Institute of Nuclear Research. When wounded experimental rats were subjected to a healing process using plasma, it was found that the coagulation protein was activated and platelet production and activation were promoted

Figure 2. Injuries after three hours of the first treatment (A) shin and (B) thigh.

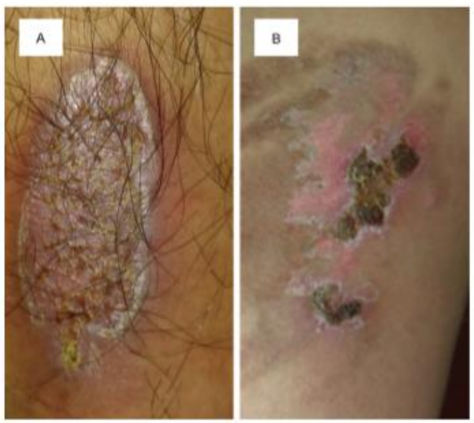


Figure 3. 16 hours after second treatment (A) shin and (B) thigh.

on the already formed crusts, this is observed in both wounds of **Figure 2**.

After three hours of the first treatment with the cold plasma, it is applied for the second time on both wounds and again for three minutes in each of them. The patient returns the next day after 16 hours after the second treatment was applied, the results are shown in **Figure 3**. First, the patient reports having no discomfort except in the crusts that have a little itch, in particular, the crust area was not modified and remained in the 9 cm^2. Also, there is a process of reepithelialization of both wounds and no longer bacterial presence.

Increased levels of free radicals generated by the cold plasma procedure may potentiate the process of wound reepithelialization, aiding the promotion of angiogenesis and influencing the bactericidal capacity of neutrophils and macrophages.

Conclusion

This new procedure for the treatment of burn wounds by the cold plasma can significantly assist in wound healing. Also, burn injuries can be directly treated since the cold plasma generates free radicals during the process preventing the infection of the wound. At the same time that the process of reepithelialization of the wounds presented in this case report did not show any inflammation effect. Possibly with the application of cold plasma early in lesions caused by burn can prevent serious complications thereof, since it can decrease the release of inflammatory mediators and bacterial colonization of wounds.

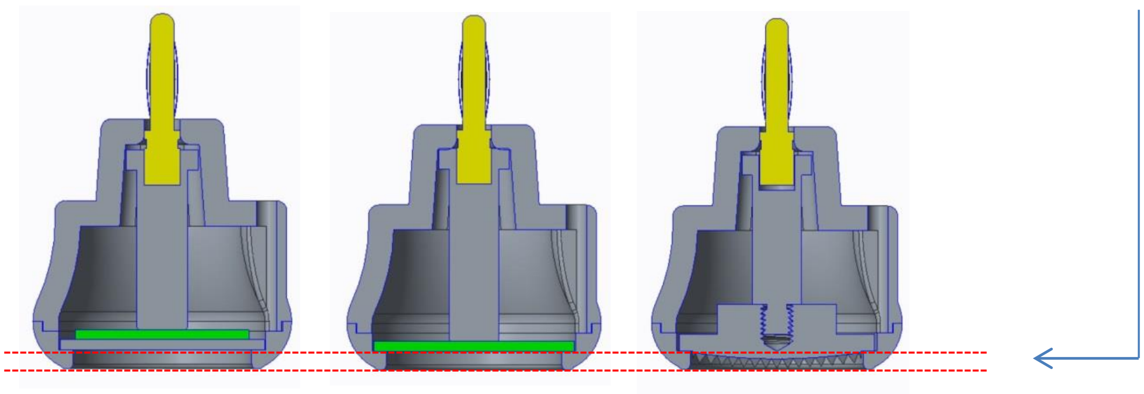
Acknowledgements

The authors appreciate the photographs and information shared by the patient. Likewise, we thank the participation of the nurse MG Navarrete-Granados and the technicians MT

This new procedual for the treatment of burn wounds by the cold plasma can significantly assist in wound healing.

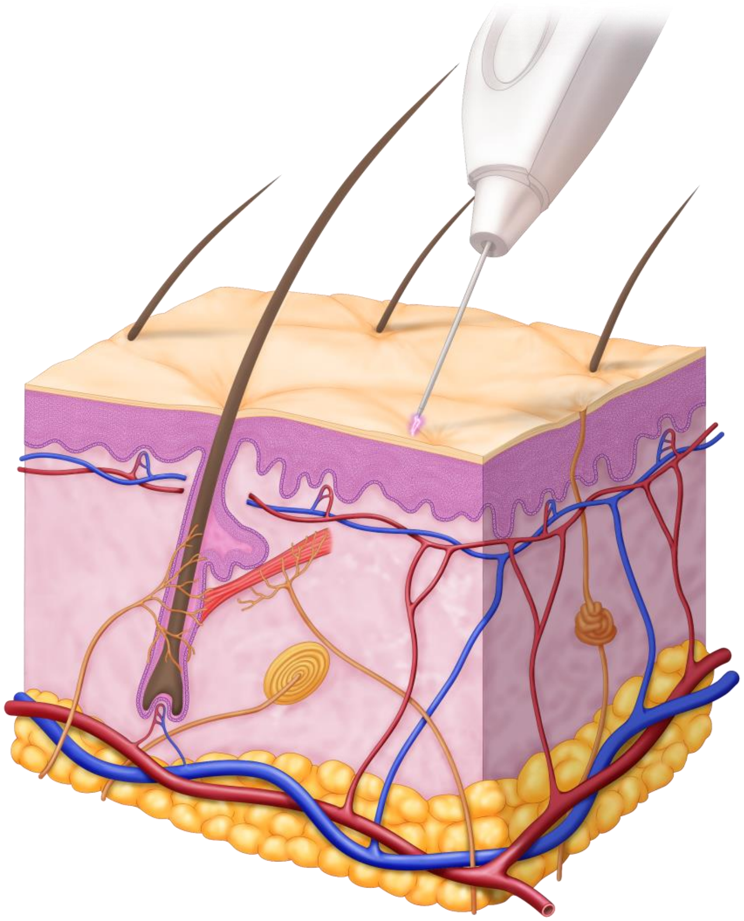
Advantages

1. Multi-use handpiece tip
2. Non-invasive safe procedure
3. Applicable to various indications
4. Can be combined with various solutions
5. Providing the convenience of procedure with the application of a guard to keep the skin contact surface at a certain height



Pen Handpiece

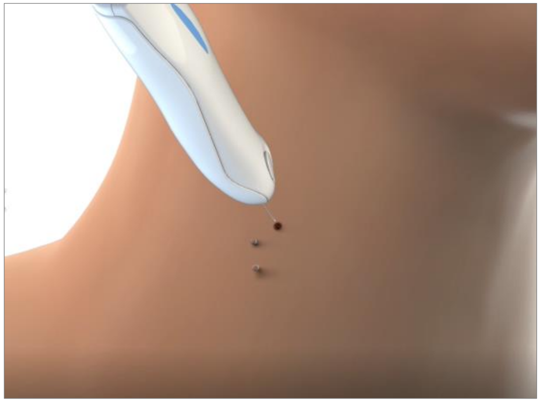
Technology

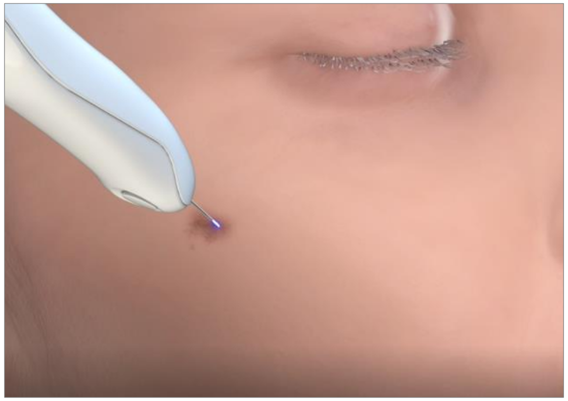


A mechanism of treating skin lesions through strong ablation of the local epidermal region of skin by generating high-voltage plasma through a needle.
It can be widely used for the removal of cutaneous tags, milia, acne milaris, spots, and freckles, and for the removal of wrinkles and lifting at the sensitive areas near the eyes such as eyelids and corners of the eyes.

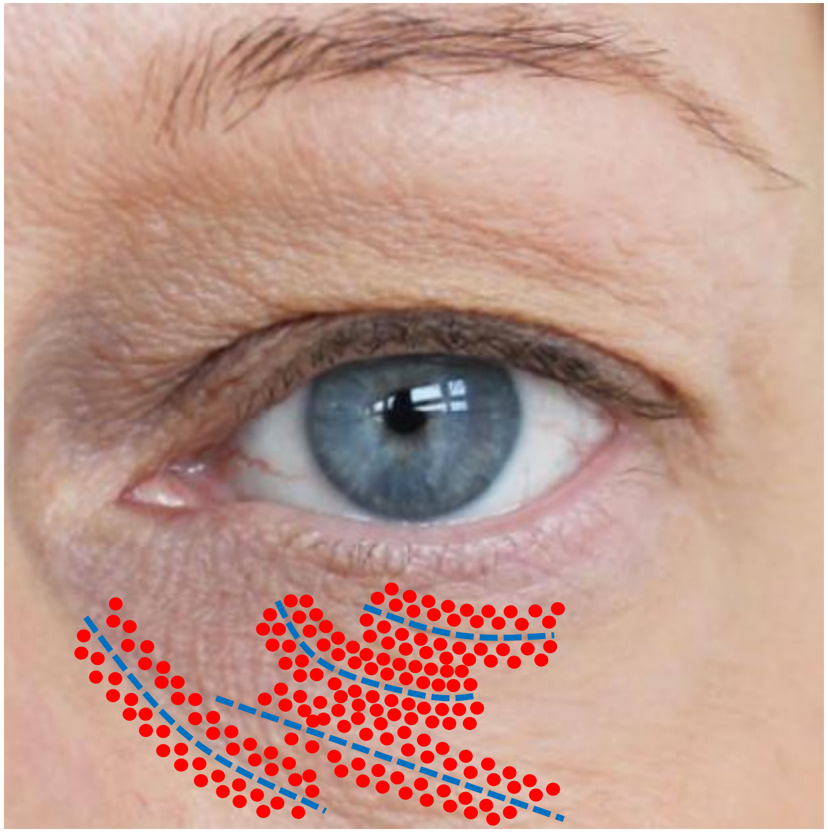
Indications

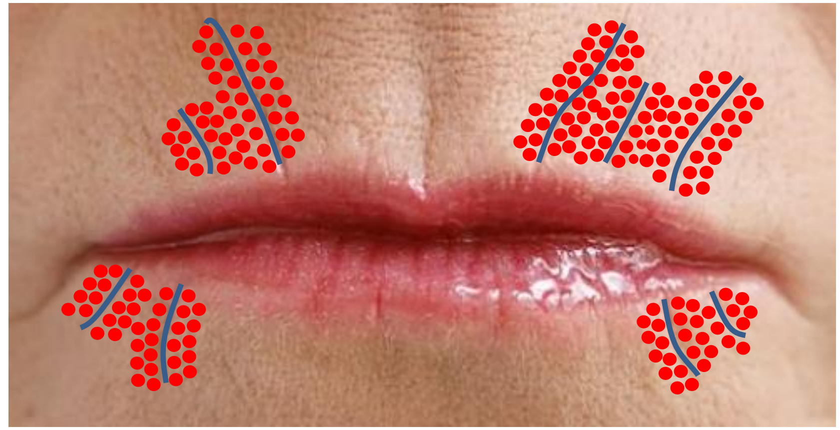
Treatment Areas





Wrinkles removal procedure



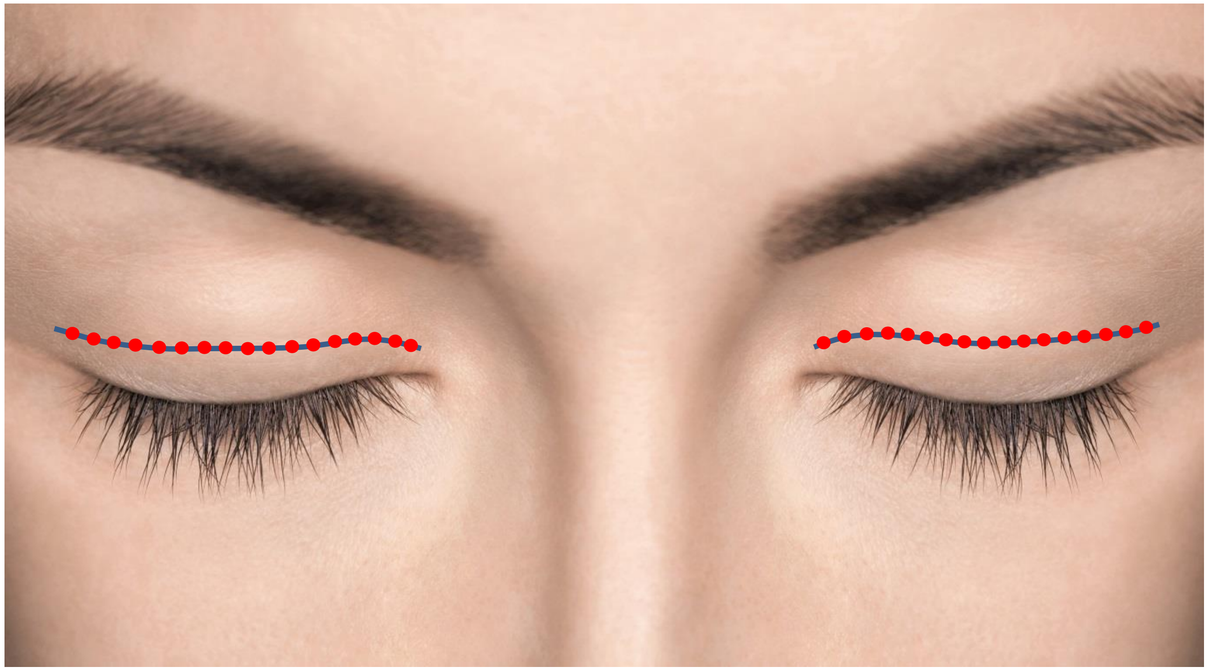


Wrinkles
Plasma Spot

Rather than applying direct treatment on the wrinkles or depressed scars, this treatment is applied to the surrounding area to induce contractions in the epidermal tissue.

In order to obtain the skin contraction-related tightening effect, this treatment is performed by spotting dots in a triangle shape so that the dots are connected in zigzags.

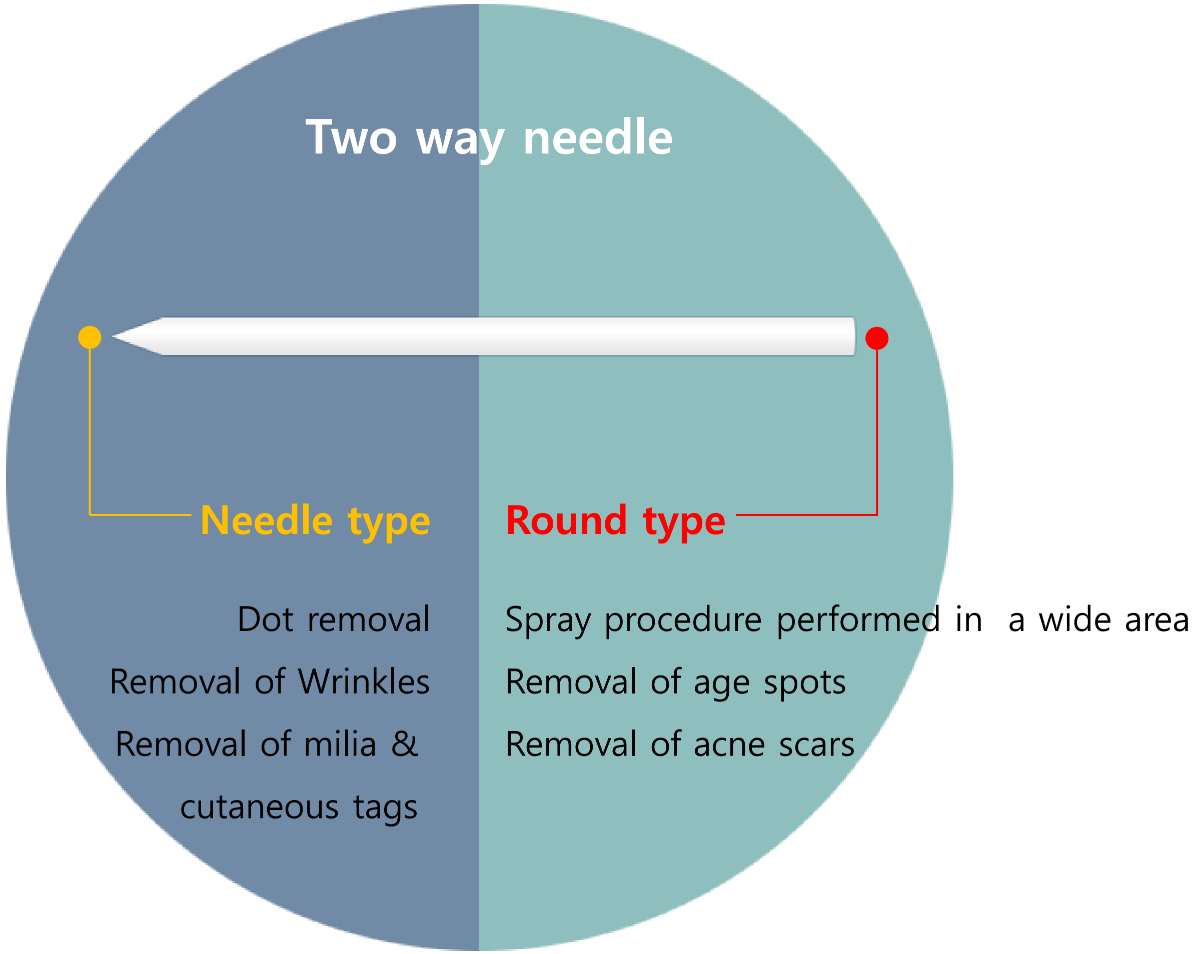
Double-eyelid retouching procedure



Double eyelid line
Plasma Spot

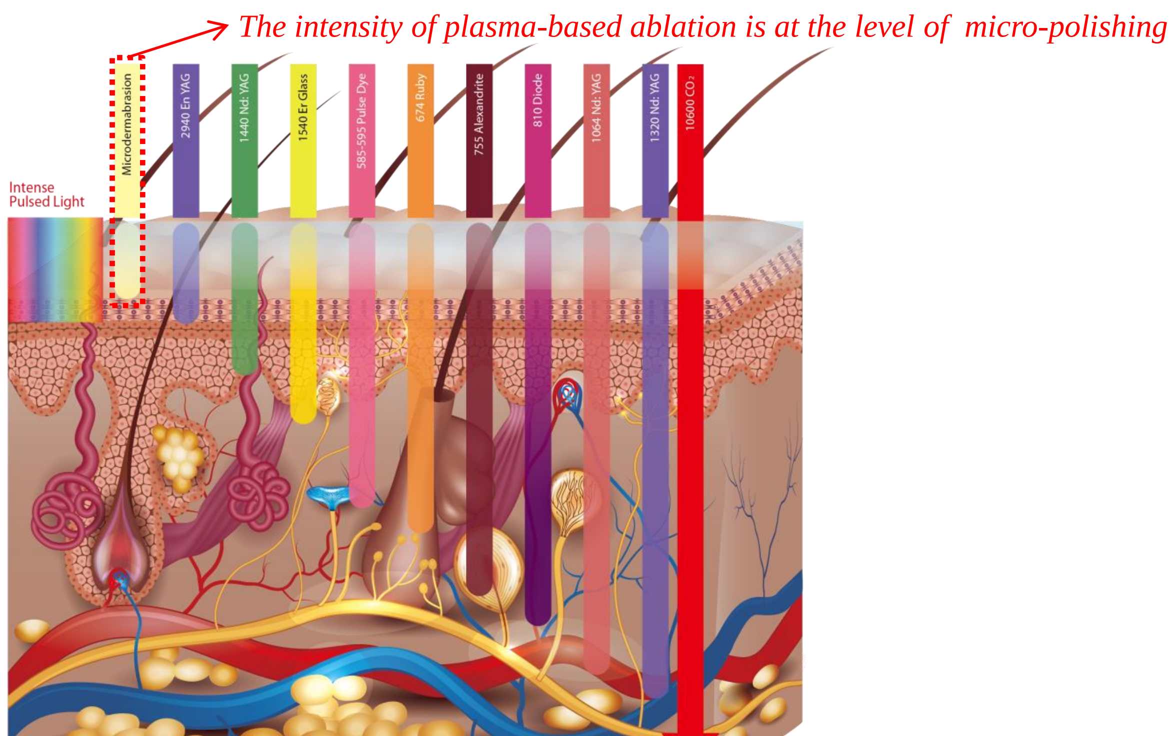
If plasma dots are created along the double eyelid line, the double eyelid line becomes clearer and the surrounding area contracts, achieving natural look of double eyelid line. In this way, double eyelid retouching can be performed.

Needle of plapen dual



☞ Providing the convenience of procedure by designing the tips at the both ends of a needle in different forms

Plasma VS Laser



Classification	Laser	Plasma
Safety	It can be irradiated to unspecified spaces, thus has potential risks	Generation of energy in the vicinity of the treatment site
Convenience of pr ocedure	The handpiece is heavy, which makes its handling somewhat difficult	Light pen-type handpiece, which makes its handling easy
Ablation depth	Depends on wavelength	Shallower than 2940 Er YAG, which is the shallowest depth
Side-effects	High risk of PH	Lower risk of pH than laser
Device price	Expensive	Relatively cheaper

Research

ECRONICON OPEN ACCESS
EC OPHTHALMOLOGY
Research Article

New Treatment with Plasma Exeresis for Non- Surgical Blepharoplasty

Tsioumas G Sotiris[1*], Georgiadis Nikolaos[2] and Georgiadou Irini[3]

[1]Private Clinic, Diagnostic Clinic and Aesthetic Surgery Ophthalmology, Eye surgeon– Oculoplastic, President of Hellenic Society of Aesthetic Medicine and Non Invasive Surgery, Professor of University of Camerino for Aesthetic Medicine, Greece
[2]Private Clinic, Professor of Ophthalmology, Aristotle University of Thessaloniki, Greece
[3]Private Clinic, Ms Aesthetic Medicine, Eye surgeon, Ph.D. of Aristotle University of Thessaloniki, Greece

*Corresponding Author: Tsioumas G Sotiris, Private Clinic, Diagnostic Clinic and Aesthetic Surgery Ophthalmology, Eye surgeon– Oculoplastic, President of Hellenic Society of Aesthetic Medicine and Non Invasive Surgery, Professor of University of Camerino for Aesthetic Medicine, Greece.

Received: February 21, 2017; **Published:** March 08, 2017

Abstract

The survey aims to highlight new noninvasive techniques on Oculoplastic focusing on the eyelid. Research and test object were 80 patients, age range 40 - 78 years, who had problems of small, medium and high degree of ptosis and problems from older surgical blepharoplasties. Common factor and 80 cases were surgical avoidance desire, due to cost and fear in the process. The method of solving the mentioned problems was the bloodless blepharoplasty using Plasma Exeresis. For the evaluation of the results through Plasma Exeresis method, set a satisfaction scale of 1 to 5 (1 = not at all satisfied - 5 = completely satisfied). All patients have described the results of treatment as 5.

Keywords: Bloodless Blepharoplasty; Plasma Exeresis; Plexr; Soft Surgery; Non-Surgical Blepharoplasty

Introduction

Year after year, the medical community is constantly faced with the requirement for patients to deal with their problems without having to undergo surgery and more economical solution. Also, most patients before entering any invasive procedure, are seeking for real and effective results. Blepharoplasty is defined as a surgery or not, that shapes the eyelid. The eyelid surgery, is also called blepharectomy because is creating a new eyelid or correcting an eyelid. There is also the non-invasive eyelid surgery which uses the Plasma Exeresis (PLEXR®) methodology without using incisions or stitches.

The traditional eyelid surgery is a highly effective method, but lacks of all the above requirements of patients. Traditional - blepharoplasty surgery requires full anesthesia, surgical rooms, sutures, incisions and long recovery periods. In cases where the patient is not satisfied with the results of eyelid surgery, after all this tedious, time-consuming and financially expensive process, it is almost impossible to think again to undergo such a procedure.

These drawbacks of classical blepharoplasty comes to surpass the process of the non – invasive blepharoplasty. Bloodless, without incisions and stitches, economically and with immediate effect. All this is possible by using Plasma Exeresis (Plexr®) method where there are great results especially in the sensitive region of the eyelids.

Methodology and Patients

The object of the study was 80 patients experiencing minor problems, medium and intense vlefarohalasis and having problems posting rehabilitation of traditional eyelid surgery. The group of 80 patients consisted of 60 women and 20 men aged 40 - 78 years. There were smoking and non-smoking and fototype (skin color) 1 to 5. From the group of women, 20 had thyroiditis Hashimoto and two of them mas-

Citation: Tsioumas G Sotiris., *et al.* "New Treatment with Plasma Exeresis for Non- Surgical Blepharoplasty". *EC Ophthalmology* 5.4 (2017): 156-159.

New treatment with plasma exeresis for non-surgical Blepharoplasty

It can be recovered within 7 ~ 15 days of a short period of time. Quick return to normal life immediately after treatment. No complications were reported among 80 patients.
The visual ability of the patient was completely recovered after non-surgical operation

Results

Compared with classical blepharoplasty surgical, outcomes were excellent without sutures and incisions, ectropion and entropion, slanted eyes, lagofthalmos and other complications. The recovery takes place in a shorter period of time (7 - 15 days) and allows the patients to return to their activities even after treatment. It is important to note that in any of the 80 cases of patients, there was no complication as referred to above.

It is important to note that in 10 cases of severe ptosis (both intense covering the eyelashes) the patient had problems in the field of view (he walked with his head raised towards the rear. After the first session of bloodless eyelid surgery the patient fully recovered visual ability.

After and 7 - 15 days of recovery, we asked all patients to rate both the method and the result of their bloodless eyelid using the satisfaction scale from 1 (not at all satisfied) to 5 (absolutely delighted. It is striking how and the 80 incidents described the method and the result by five.

Discussion

The need of the physician to provide improved innovative non invasive techniques to patients with less pain and cost, but also the need of the patient for cosmetic procedures that avoided them in the past for fear of surgery. The major advantage of Plasma Exeresis is security that it provides to the patient on undesirable effects. This was proved by the results of the80 incidents were subjected to bloodless Blepharoplasty with Plasma Exeresis patients being perfectly pleased with the result, recommend the method to other patients. The

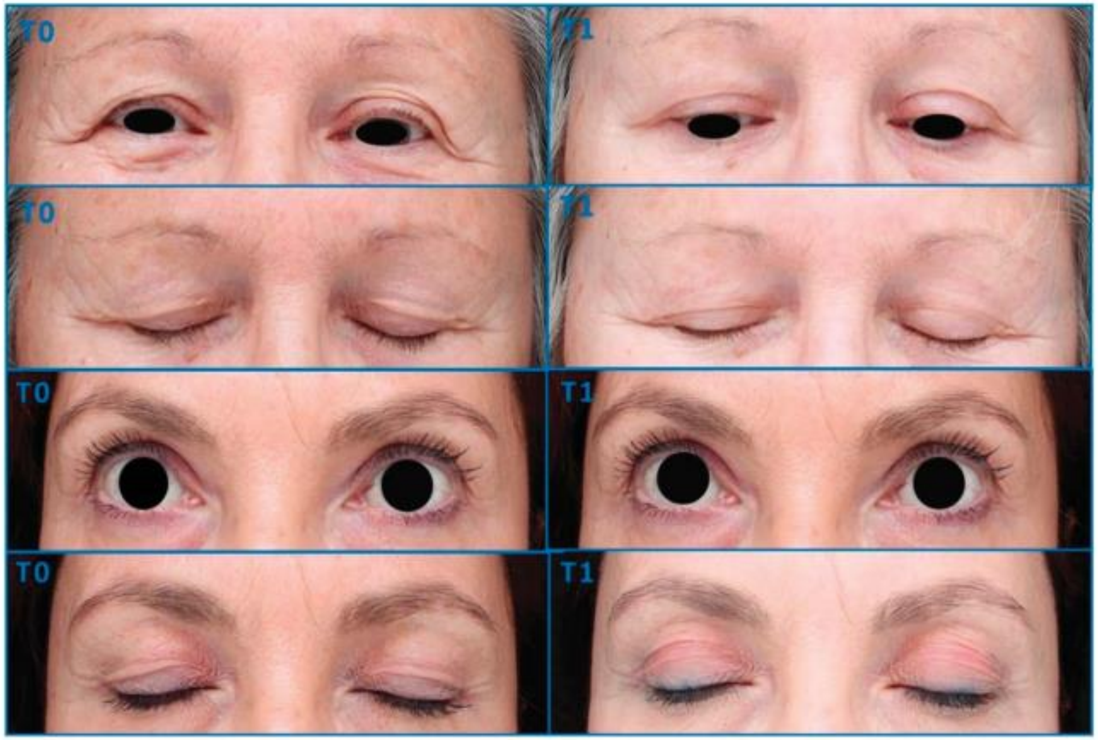
Citation: Tsioumas G Sotiris., *et al.* "New Treatment with Plasma Exeresis for Non- Surgical Blepharoplasty". *EC Ophthalmology* 5.4 (2017): 156-159.

Research

A) before treatment, B) After plasma needle treatment, C) Close the treatment area, D) 1month later

Evaluation Effectiveness of the Voltaic Arc Dermabrasion in Perioral Rhytides Eradication, Antonio Scarano, (J Craniofac Surg 2016;27: 1205–1208

Research



Examples of clinical improvement after 3 sessions of plasma exeresis. Note the restoration of the asymmetry.

Clinical and Confocal Microscopy Study of Plasma Exeresis for Nonsurgical Blepharoplasty of the Upper Eyelid: A Pilot Study, Elena Rossi, Dermatol Surg 2017;0:1–8.

Research

Dermal nevus of the cutaneous portion of the right upper lip before and one month after treatment.

Active acne before and after 3 sessions of plasma exeresis (outcome three months after the last treatment).

Post-acne scarring of the left temporal region: before, immediately after and 20 days after the plasma exeresis.

Foreign body granuloma (determined by ultrasound) resulting from a car accident: photos before and 30 days after treatment.

Applications of plasma exeresis in dermatology, Elena Rossi, AESTHETIC MEDICINE

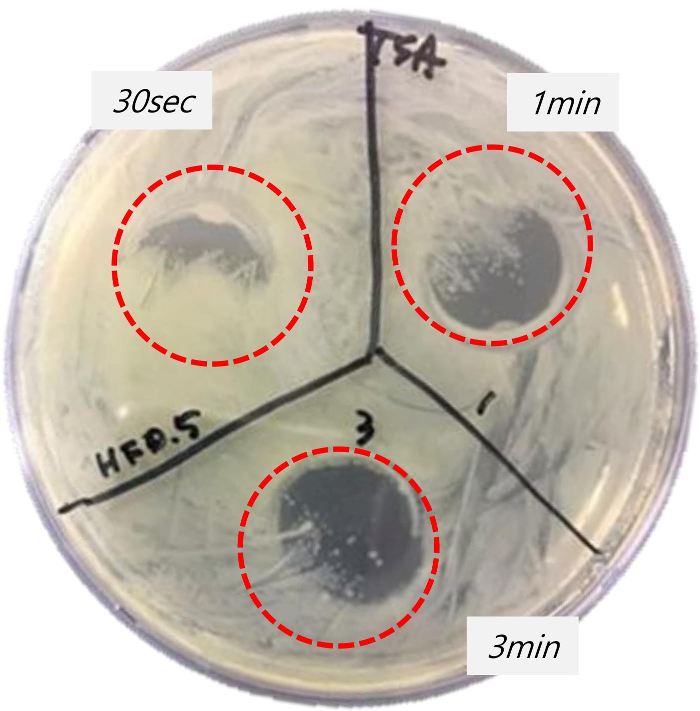
Advantages

1. Multi-use needle
2. Easy to maintain hygiene after the procedure because there is no direct contact with the treatment site
3. Non-invasive safe procedure
4. Applicable to various indications
5. Adjustable to up to nine levels between Step1 ~ Step3 (adjustable to three levels for each step)

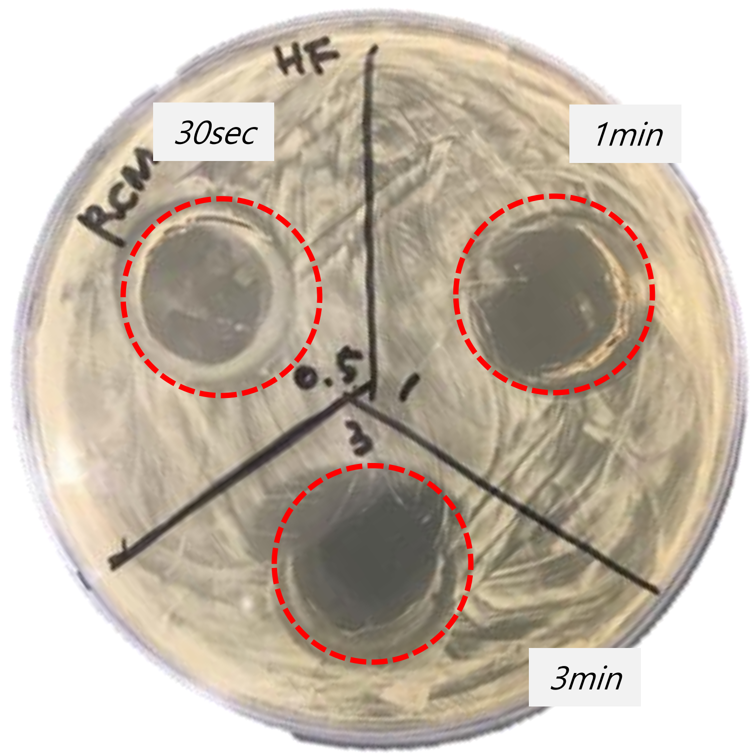
Clinical Results

Experimental Data

High frequency tip



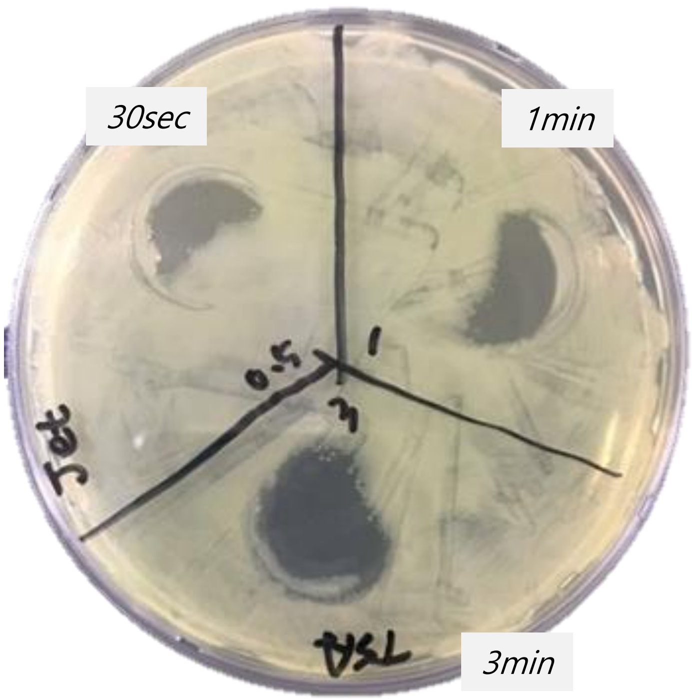
Bacteria: *Pseudomonas aeruginosa*
(Bacteria causing skin folliculitis)



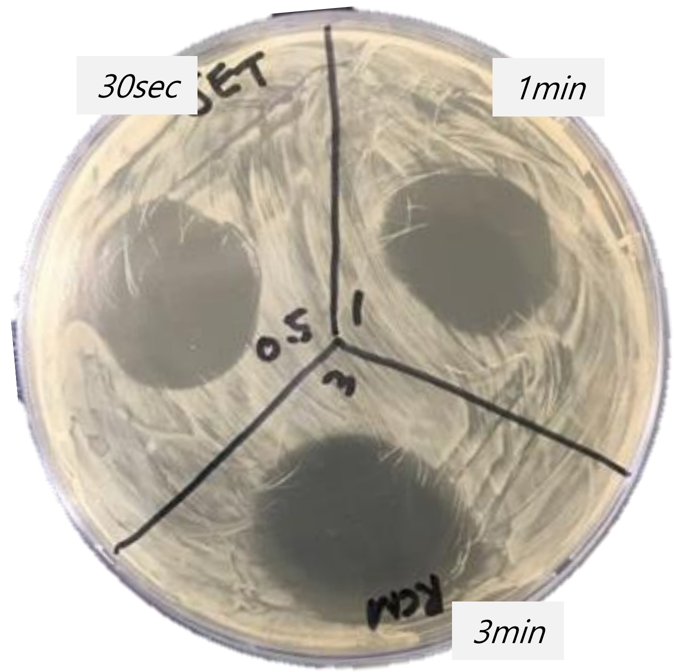
Bacteria: *Propionibacterium acnes*
(Bacteria causing acne vulgaris)

Experimental Data

Jet tip



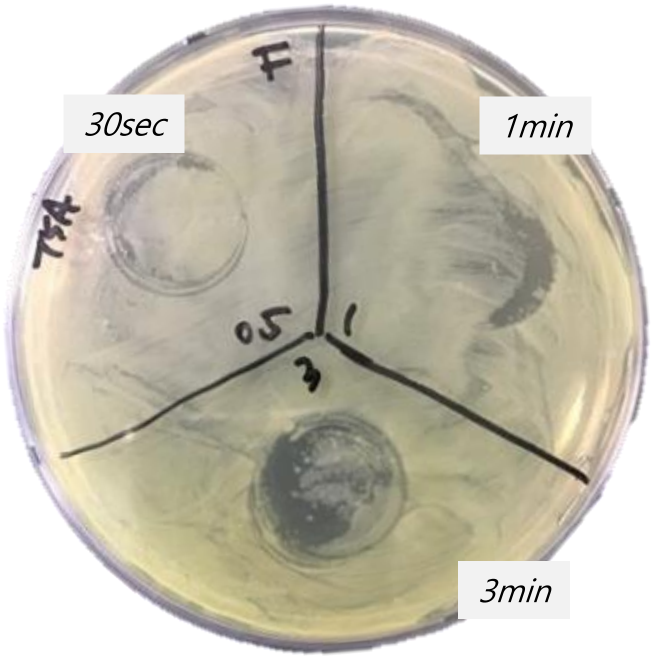
Bacteria: *Pseudomonas aeruginosa*
(Bacteria causing skin folliculitis)



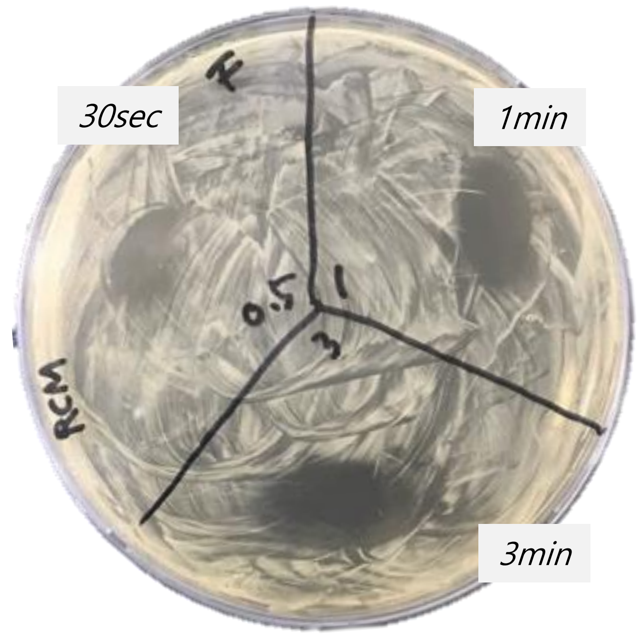
Bacteria: *Propionibacterium acnes*
(Bacteria causing acne vulgaris)

Experimental Data

Fractional tip



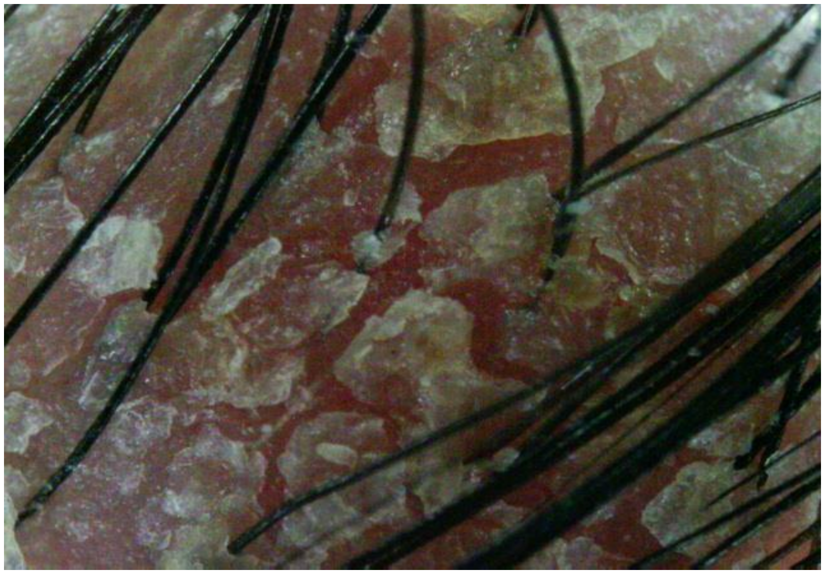
Bacteria: *Pseudomonas aeruginosa*
(Bacteria causing skin folliculitis)



Bacteria: *Propionibacterium acnes*
(Bacteria causing acne vulgaris)

PLAPEN DUAL (7 Session)

[Data : 2018, EunSung Global Lab.]



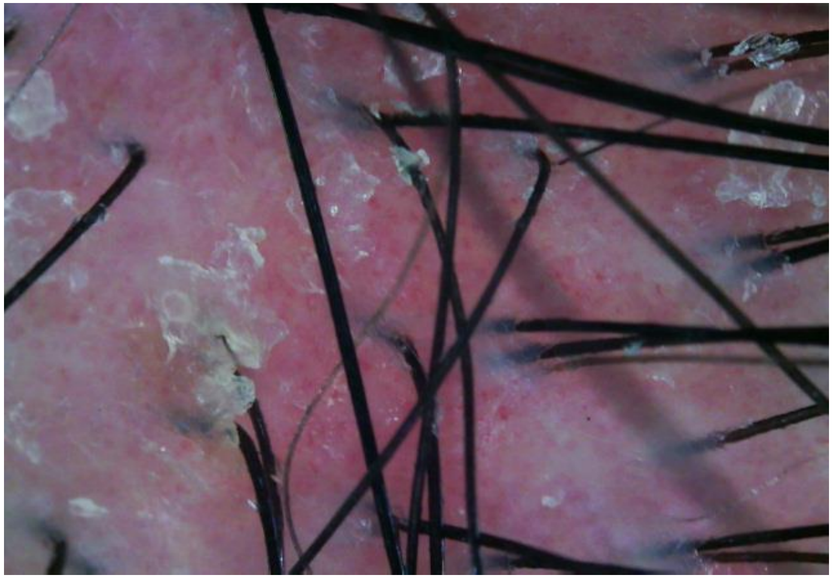
[Before]

[After]

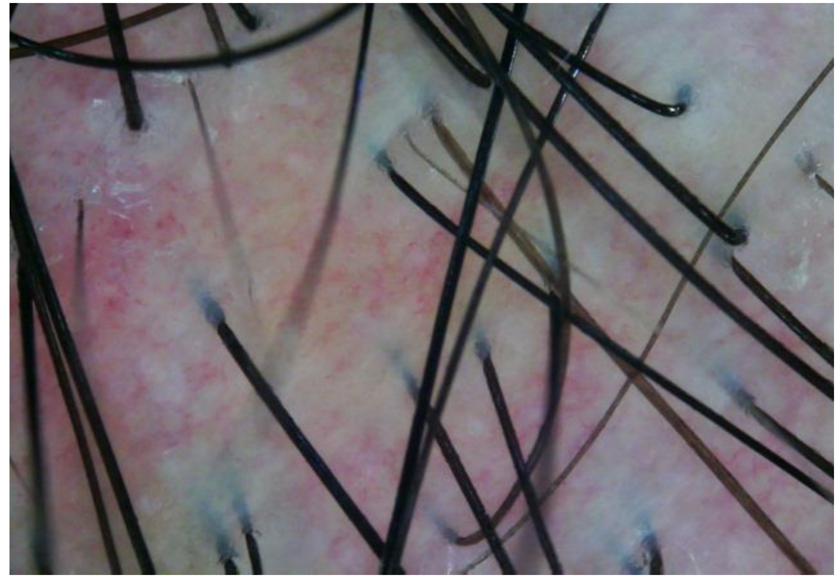
Scalp M / The latter of 30's

PLAPEN DUAL (7 Session)

[Data : 2018, EunSung Global Lab.]



[Before]

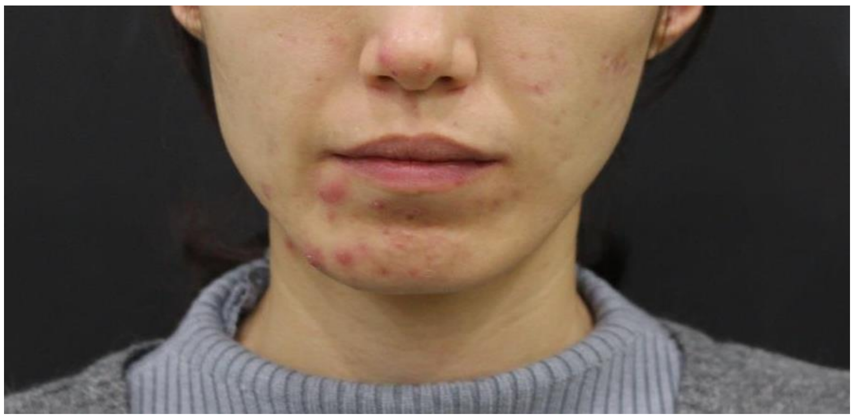


[After]

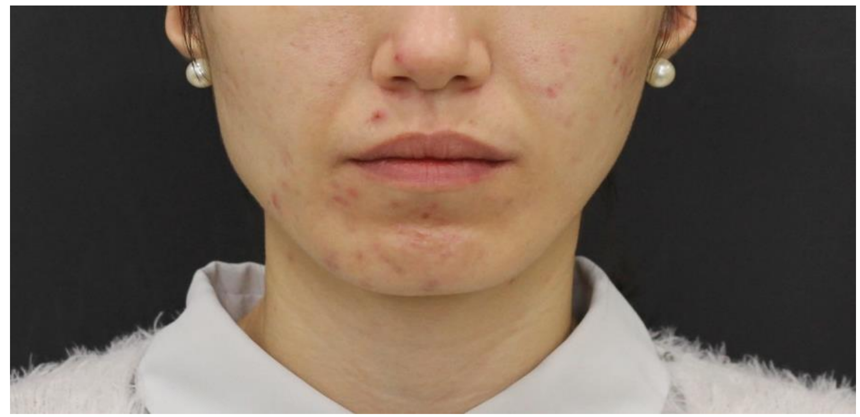
Scalp M / The latter of 30's

PLAPEN DUAL (5 Session)

[Data : 2018, EunSung Global Lab.]



[Before]



[After]

Skin F / The Mid of 30's

PLAPEN DUAL (1 Session)

[Data : 2018, EunSung Global Lab.]

[Before]

[After]

Skin F / The Mid of 50's

PLAPEN DUAL (1 Session)

[Data : 2018, EunSung Global Lab.]

[Before]

[After]

Skin F / The latter of 50's

Specification

Hand-piece	Beauty hand piece	Pen hand piece
MODE	Pulse or Continue	Pulse or Continue
Energy type	Low-temperature atmospheric plasma	Atmospheric pressure plasma
Frequency	28 ~ 34 kHz	65 kHz
Tips	H/F Tip, Jet Tip, F/R Tip	Needle (0.5mm)
Display	10.2 inch TFT Touch LCD	
Electrical requirement	100~240V @ 0.5A	
Weight (kg)	3.35kg	
Demension (W x D x H)	442.3 x 220.5 x 357.4 (mm)	

THANK YOU

FOR FURTHER INFORMATION, PLEASE CONTACT US AT
es@esglobal.co.kr