JetPeel™ a New Technology for Facial Rejuvenation

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ABSTRACT:

JetPeel™ is a new device for cosmetic resurfacing of the facial skin. It uses a new technology of a two-phase stream that creates a jet comprised of gas (oxygen) and micro droplets of fluid (saline) accelerated to supersonic velocities. This jet impacts the skin causing gentle and accurate cosmetic peeling.

Our preclinical and clinical experience with the JetPeel™ for rejuvenation of the face is presented. In a group of 50 patients we found the JetPeel™ technology to be a safe and effective new tool for the usual indications for facial peeling. It was most useful and effective for perioral peel. JetPeel™can be used in combination with other resurfacing modalities such as chemical peeling or laser.
Further investigation is needed to explore other applications of this technology, such as using different combinations of gases and fluids, and transdermal transfer of medication dissolved in the peeling jet.

INTRODUCTION:

The desire to rejuvenate the skin by resurfacing it is very old and dates back to the era of ancient Egypt. The oldest record of cosmetic therapies performed by physicians is the Ebers papyrus (1560 B.C) [1]. Early resurfacing techniques involved direct application of minerals, plant extracts, sulphur, mustard or limestone. Renewed interest for facial skin resurfacing was noted among physicians and surgeons in the early twentieth century. McKee (1903) was the first to report his experience with liquid phenol in the treatment of acne scars [2]. Kromayer (1905) is considered the first to apply mechanical dermabrasion techniques using rotating wheels and rasps for the treatment of acne scars, keratoses and pigmentation disorders [3]. After World War II lay peelers rather than physicians and surgeons developed new techniques and proclaimed to find the fountain of youth for their patients. Skepticism of the medical society gradually resolved in the 1960s with data from numerous studies showing the clinical effectiveness and histological changes in the skin associated with chemical peeling [4-9].
Traditionally peeling techniques are either chemical or mechanical. In chemical peeling the chemical solution applied to the face is designed to cause controlled peeling of the superficial layers of the skin.
In dermabrasion a mechanical device is used to resurface the skin by removing the same layers. A variety of abrading techniques are available, the most popular one being a small rotating abrasive wheel applied to the skin.

Since the early 1990s various types of lasers have been used to resurface photo aged skin. CO2 Laser was first introduced in a nation-wide presentation by Roberts in 1995 [10]. Since then, technologies have been changing and the clinical use has expanded rapidly throughout the world. Many proponents of Laser resurfacing attest to its accuracy and predictability of the clinical results obtained by experienced operators.

The various types of peeling techniques share a common denominator: they all produce a partial thickness injury to the skin. Following the controlled injury to the skin, wound healing processes ensue regenerating the epidermis, replacing and reorienting the fibres in the dermis. The effectiveness of the resurfacing technique is directly related to the depth of the controlled injury to the skin. The physiologic basis of healing following either technique rests upon the ability of the skin to regenerate its epidermal cover by epithelialization through the skin appendages, primarily the pilosebaceous unit. The result is an improved, more youthful appearance and texture of the skin.

This article introduces a novel method for skin resurfacing. The JetPeel™ device is based on a new technology derived from the world of aviation. A mixture of sterile saline and oxygen passes through an open converging-diverging venturi channel, designed to produce supersonic flow accelerating the solution droplets to approximately 200 m/sec and exits through specialized nozzles as a powerful jet directly onto the desired area of skin. This high-energy micro droplet spray gently exfoliates the skin. After removing the epidermal layer additional layers of the upper papillary dermis can be removed accurately to reach the desired end point depth as set by the operator.

STUDY OBJECTIVES:

To determine the safety and the efficacy of the JetPeel™ system as a peeling modality in a preclinical setting and to determine the clinical results and patient satisfaction with the procedure.

MATERIALS AND METHODS:

1. THE TECHNOLOGY

The idea behind the JetPeel™ is derived from the world of aviation using supersonic flow in nozzles. Liquid medium is propelled by sub-atmospheric pressure caused by the rapid flow through a parallel capillary tube. The mixture of liquid and gas is accelerated in an open converging-diverging venturi channel to reach high velocity using a two-phase stream and emits through a specially designed nozzle unit. The jet spray impacts on the skin causing shearing forces strong enough to peel the epidermal and dermal layers of skin as necessary.

2. THE DEVICE

The device used in this study is the JetPeel™ system manufactured by TavTech Ltd., (Yehud, Israel). The JetPeel™ system is a portable device, which produces a spray of liquid mixed with gas under a predetermined pressure of 7 atmospheres. The jet spray consists of liquid droplets, 5-200 m in diameter, emitted at a speed of up to 200 m/sec.

The JetPeel™ device consists of a control unit, a hand piece, a footswitch and tubing line accessories. A source of pressurized oxygen (or any other gas, e.g. nitrogen) is connected to the control unit set to yield a pressure of 7 atmospheres. A disposable solution bag supplies the sterile liquid medium needed. The mixture of gas and fluid occurs inside a sterile, disposable hand piece. A separate suction hand piece removes gas and debris.

3. PEELING TECHNIQUE

The hand piece is held by the operator at a 45o-90o angle to the skin surface and at a distance of 2-5 mm from the skin. When the footswitch is pressed the jet is released from the nozzles. Care is taken to avoid the eyes and the eyelids. When the jet is applied to the skin a blanching effect is noticed representing a momentary withdrawal of blood from the treated skin segment. This serves as an indicator for proper application of the jet. Gradually the abrasive droplet attack creates enough mechanical energy for peeling of the epidermis. Slow scanning advancement of the jet stream is then begun along a line in a forward direction, exploiting the momentum of power, creating a “front” of peeling and achieving a uniform depth of removal. Areas for which the operator wishes to increase the depth of peeling are retreated in the same manner (for example: along the wrinkle creases in the perioral area). Punctate bleeding and its intensity after discontinuing the jet serve as an indicator for the peeling depth (Figure 1).

4. PRECLINICAL STUDY DESIGN:

Since the porcine model is the most closely analogous to human skin, it was used as the preliminary in vivo model. The porcine model has been well established in the scientific literature [11].

Four porcine (sus scrofa) of a local strain of Landrace x Large Whites, aged less than 2 years and weighing about 15 kg, were used as the experimental model.

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After proper acclimatization, fasting and sedation, general anesthesia was initiated. The back and flank of the anesthetized pigs were clipped, taking care not to cause injury to the skin, and then scrubbed according to standard aseptic practices for preparation of skin (Iodine surgical scrub and Alcohol rinse). A template was used to mark the experimental windows on each side of the back and flank of the swine.

Skin peeling technique was performed using the JetPeel™ system.

Full thickness 8 mm punch biopsies were taken both immediately prior to the procedure and at 7 and 14 post treatment days during the healing phase.

Evaluation was based on gross and microscopic examinations of the biopsies. The parameters examined included peeling depth, dermal inflammation and re-epithelalization.

5. CLINICAL STUDY DESIGN:

The study group consisted of 50 healthy adult volunteers who agreed to participate in our study. The study was conducted in accordance with the Helsinki committee regulations for human experiments.

The indications for treatment were: sun damaged skin, facial rhytids, pigmentation disorders and post-acne facial scarring.

Periocular skin and eyelids were excluded from treatment.

For partial facial procedures the treatment area was anesthetized locally using 5% EMLA cream in all cases. Facial blocks using 2% Lidocaine with 1:200,000 Adrenaline were used as necessary. Full-face procedures were done under general anesthesia or IV sedation.
The skin was aseptically prepared and draped using a Betadine solution mixed with normal saline at a ratio of 1:1.

The procedure was continued until the end result as desired by the operator was reached, judged clinically by direct vision and the intensity of punctate bleeding.

At the end of the procedure petroleum jelly (Vaseline) was evenly applied to cover the entire treatment area. An open treatment regime was used postoperatively and the patients were instructed to cleanse the treated area with warm tap water and mild soap twice daily and then to apply a fresh thin layer of Vaseline.
All the patients were given oral Acyclovir 200 mg 5 times daily from a day prior to the procedure until healing was complete.

RESULTS:

PRECLINICAL:

Biopsies taken from the treated skin showed the effects of removing the epidermis and the upper dermis. Healing was uneventful, occurring from 7 to 14 days post treatment. There were no wound healing complications (e.g. infection, delayed healing, etc.). Clinical and histological examinations proved that the JetPeel™ achieved the desired peeling effect (Figure 2).

CLINICAL:

The study group consisted of 50 healthy adult volunteers, 40 females and 10 males (age 19-62; mean 38)
The indications for treatment were: sun damaged skin, facial rhytids, skin pigmentation and post-acne facial scarring.
Treatment areas were: concealed retro auricular skin in the preliminary 10 cases, partial facial areas (especially perioral) in 32 and full-face peeling in 8.
Healing course was smooth and uneventful. Re-epithelialization occurred within 7 to 9 days depending on the depth and location of the area treated. Regular follow-up visits were scheduled at predetermined intervals, the longest follow up to date being 24 months.

The overall length of treatment ranged 5-70 minutes.
The healing phase was very smooth and easy. Erythema was noted during the first 2-4 weeks post peeling. All the patients were instructed to abstain from the sun as much as possible and to use sunscreens with SPF >= 30 whenever sun exposure was inevitable.
The aesthetic results as judged both by the patients and by the medical staff were good to excellent and patient satisfaction was high (Figures 3,4).

COMPLICATIONS:

We noted only a few cases of complications, all of which were minor:
One case of Herpes Simplex Virus (HSV) infection was noted in a 40 year old female with post-acne scarring after a full-face jet peeling procedure despite preventive treatment with Acyclovir. The patient was noticed to have pain, erythema and some small vesicles on her face. The dose of Acyclovir was increased to a therapeutic level given intravenously and an antibiotic treatment was added. Healing was complete with excellent results and no scarring (figures 5 A, B).
Three cases of hyper pigmentation, presumably related to sun exposure, were treated conservatively with Hydroquinone and Isotretinoin based products with satisfactory improvement.
One case of subcutaneous emphysema of the lower eyelid was encountered when the treatment was too close to the periocular area. The emphysema, although troublesome both to the surgeon and to the patient, subsided in 2-3 hours without any sequelae.
This unique complication is due to subcutaneous penetration and dissection of the jet stream in a very loose and thin type of skin. The best way to avoid it is to exclude areas of thin skin (usually the eyelids) from treatment, and to use eye-blocking goggles as a means of protection from inadvertent passage of the jet to emphysematous prone areas.

DISCUSSION:

Whenever a new technology, method or technique is introduced it must prove itself to be superior or at least as good as older "traditional" methods. It is commonly said that a new technology is not necessarily good or better, but every good and useful technology was once new. The most appealing parameters about the JetPeel™ are its simplicity, efficacy and safety.

The results show that the JetPeel™ system is a safe and effective device that achieves mechanical peeling through natural resources such as saline and oxygen. It avoids potentially harmful processes like burns and does not create an eschar of dead tissue.
It appears to be less bloody and cumbersome as compared with traditional dermabrasion devices. The device is quite easy to operate and mandates only minimal dexterity from the operator with a short learning curve as noted by ourselves.
The resources needed for applying the JetPeel™ technology (saline and pressurized gas) aside from the JetPeel™ device itself are readily available in most medical facilities. It is an accurate tool that can be applied to the desired area without any significant collateral damage.

It is a versatile tool which allows for "fine tuning" of the peeling depth by controlling gas pressure and number of passes, thus meeting the requirements of different areas of skin simultaneously. Since the skin is actually peeled off it is not left to become necrotic and slough later. It is our clinical impression that healing is somewhat smoother and swifter as compared to other peeling modalities.
We find the JetPeel™ especially efficient in treating the perioral region. The ability to achieve different depths of penetration in this area is of significant importance.
The JetPeel™ technology can be used in combination with other peeling techniques, for example combining the accuracy of the JetPeel™ in the perioral area with the speed of a chemical peel in the rest of the face.

We believe that further applications of the JetPeel™ technology should be carefully examined. One example is the use of various combinations of liquids with gases that may prove to be superior to others. Another example is the potential transdermal transfer of medications, passing the skin barrier. This type of transdermal transfer deserves serious investigation and might be a useful vector for introduction of various medications, from vitamins to growth factors, for various therapeutic purposes.

It is possible that tissue oxygenation during the treatment with the JetPeel™ device contributes to the accelerated wound healing that was noticeable in this study.

Another application is already in use: a very superficial peeling is performed by para-medical staff for indications like post rhinoplasty intense skin treatment or post Laser eschar removal.

CONCLUSIONS:

These are the first published results from an ongoing study. We find several advantages for the use of the JetPeel™ technology as a peeling technique: it is safe, accurate and versatile. Perioral rhytids, which are numerous creeks compacted closely together, best demonstrate the advantage of JetPeel™ technology as it has the added ability to treat each wrinkle separately. The healing process was noticed to be very smooth and easy. Our patients were very satisfied with the treatment and the results.

The KISS principle (Keep It Safe and Simple) strongly applies to the JetPeel™ system. Further applications of this technology should be investigated.

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Figure 1:

Figure 3A:

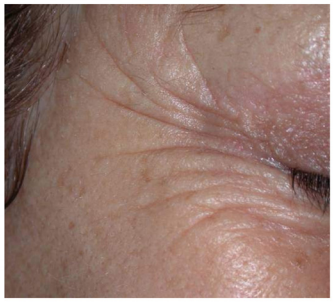

Figure 2:

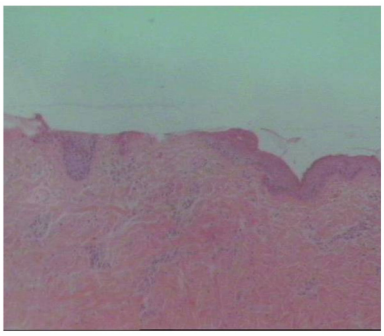

Figure 3B:

Figure 5A:

Figure 4A:

Figure 5B:

Figure 4B:

Legend to figures:

Figure 1: The technique of using the JetPeel™ system.

Figure 2: Histological examination of porcine skin treated with the JetPeel™ device. Level of peeling is at the papillary dermis (H&E X4).

Figures 3 (A, B): Treatment results of the crow's feet: A - Pre treatment, B - Post treatment.

Figures 4 (A, B): Treatment results of perioral rhytids: A - Pre treatment, B - Post treatment.

Figures 5 (A, B): Herpes Simplex Virus Infection. A - Active infection, B - Aesthetic result one month after healing was complete.