COSMETIC TECHNOLOGIES: GAS-LIQUID PEELING

By:
Mergen Antonov,
Dermatocosmetologist
Vera Kiryanova,
M.D., Professor
Marina Kiyashko,
M.D., Physiotherapist

Tsiolkovsky – Rocket – Jet engine. We have all known about it since childhood. But just a few of us know that a flying vehicle leaves deep erosions on the ground after its launch. This "headache" has become a basis of… a new medical technology.

Skin treatment by gas-liquid jet, as has been proposed by Israeli experts, belongs to mechanical polish techniques. It was developed on the base of superficial hydro-oxygen treatment of trophic ulcers, which is widely used in medical practice. This method calls for the use of unique abrasive properties of a high-speed two-phase stream of fine-dispersed liquid and gas. When microdrops are contacting the skin surface, it develops microerosions. To better understand this technology, we will first consider its physical and technical aspects.

Technique

How is a liquid-gas jet formed? A standard medical device has a distribution block to ensure 6.8 atm working pressure of a gas and special-purpose headpieces. The device is connected to a gas tank and sterile solution container (normally saline solution).

Compressed gas (oxygen or carbon dioxide) speeds up to supersonic velocity by means of a tiny nozzle which is built in the headpiece. While moving from the source to the headpiece, the gas jet sucks in the liquid from a separate tank, like a water-jet pump. This liquid is fed to the acceleration zone through microneedles, which are installed along the axis of the micronozzle. Drops are detached from the needle by ultrasonic gas jet and speed up to 200 m/sec. The drop diameter is 1-5 μm, their inside pressure reaches 1,000 atm due to capillary force. While possessing a huge kinetic energy, these drops act as solids when contacting the skin and exert a marked abrasive effect (see Fig. 1).

Skin develops a dimple, with erosion formed in the bottom due to scarifying and layer-by-layer removal of epidermal cells under the action of the jet. The depth of the erosion (and respectively exfoliation) is basically determined by nozzle position relative to skin surface and by the time of exposure. Favorable aerodynamic conditions allow removal of peeled cells from the dimple.

Nozzles of the headpiece 3 are arranged in-line with each other and on the same surface, and a professional can adjust the nature and level of exposure by varying the jet position relative to the skin surface. Cumulative effect is enhanced at repeated consecutive treatment of the same area. Concurrently, deep skin layers are impregnated with gas and liquid. Static pressure and cold around the jet help alleviate the pain.

Active factors of gas-liquid jet are therefore the following:

- Static pressure;
- Low temperatures around the jet area due to a rapid gas expansion;
- High-speed flow of microscopic drops.

Gas-liquid exfoliation surely belongs to efficient mechanic peeling techniques, because it can be widely applied in cosmetology. Along with abrasive applications, gas-liquid skin treatment is used for intracutaneous injections of liquids (and agents dissolved therein) and gases.

Figure 1. Jet peeling technology:
Gas-liquid mixture is sprayed through a special nozzle (headpiece)
Liquid drops are speeded up to supersonic velocity
High-speed jet removes subjacent skin layers

This phenomena is sufficiently described by the term of "barophoresis": when skin is deformed by the jet, micropores are formed and expanded in the epidermis (wedge-like effect) to be used for conveying jet components, with gas and liquid vacuoles created in the tissues (see Image 1). Any of the active components (regardless of their molecular mass) can be brought inside the skin through the expanded channels, including gas, e.g., oxygen (in 100% concentration in case of compressed oxygen, and in 20% concentration in case of air), by means of pressure gradient.

Technology

Gas-liquid peeling requires no special skin preparations, except that skin must be clean, dry and inflammation-free.

The procedure consists in smooth "scanning" the skin areas to be peeled. By varying the working headpiece distance from the skin, various effects can be achieved. While moving the headpiece over 1.5-2 cm above the skin surface, the skin is being massaged, its blood circulation improved and lymphatic drainage provided. This can be used either as an independent rejuvenating procedure or to prepare the skin for a more comprehensive exposure.

When the working headpiece is at a 7±2 mm distance from the skin surface, kinetic energy of the drops grows making them acquire the abrasive properties with the concurrent barophoresis effect.

At repeated consecutive treatment of the same area:

- Skin turns pink during superficial peeling due to initial irritation (epidermal exposure);
- Then, skin turns pale due to vascular ischemia under high pressure (compression);
- The first dew-like blood drops appear, and that attests to a certain depth of the exposure (papillary derma is affected). This pattern is indicative of a medial peeling;
- When the procedure is over, skin color is gradually resumed, since vascular constriction is replaced with vascular dilatation (with vascular lumen restored to normal).

Mechanic skin polishing professionals can be pretty amazed by what they see, because they are used to more ample bleeding. Everything happens for a reason, however: at the point of skin contact, the two-phased jet is inhibited, static pressure at the treated area grows, and local ischemia prevents bleeding.

It is equally important that creation of high pressure zone in the exposure area will increase pain threshold, and the procedure therefore is almost painless. This is furthered by jet cooling (by 10°C versus ambient temperature), when compressed gas is rapidly expanded at the nozzle outlet. This fact rules out the necessity of preliminary anesthesia, no matter how deep the peeling may be.

The use of oxygen as a carrier gas not only allows an efficient sanitation of exposure area, but ensures a long-term protection by means of barophoresis. Therefore, infectious complications are hardly probable, no matter how deep the peeling may be.

A complete or partial polishing of facial area (periorbital area, around the lips, cheeks, nasolabial folds, and bridge of the nose) will cause a minor erythema or no erythema at all. Swelling ceases within 24 hours, crust will persist for 3-7 days and requires no special treatment. This sparing rehabilitation period is attributed to physiological nature of the exposure: minor bleeding, no skin dehydration which is characteristic of any peeling, and extra skin impregnation with liquid (including the deepest layers).

The procedure can be performed for all parts of face and body, including décolleté, chest, stomach, backside of arms, and scalp.

Indications to gas-liquid massage and peeling are:

- Skin ageing, such as dry skin, hyperkeratosis, atonia, wrinkles (that requires massage and superficial peeling – Beauty Flash or median peeling);
- Hyperpigmentation;
- Acne, including noninflammatory elements;
- Correction of scars (see Image 2) – atrophic, hypertrophic, post-acne, stretches;
- Seborrhea;
- Cellulite;
- Local fat deposits on cheeks, stomach, gills.

Complex nature of jet exposure (MASSAGE + ABRASION + BAROPHORESIS) will ensure a long-term physiological effect.

Such focused gas-liquid jet treatment can be combined with the use of cosmetic and dermatological agents (a preliminary physical action promotes better permeability of skin), as well as electrical methods, ultrasound therapy, and photo rejuvenation of skin.

Image 1. Biological effects of gas-liquid peeling
Immediately after the procedure: epidermis removed, deep tissues impregnated with oxygen and water
Long-term effect – synthesis of neocollagen (1 week after the procedure)
Long-term effect – synthesis of neocollagen (3 weeks after the procedure)

Example:
A 50 year aged woman complains of skin ageing in the form of superficial "purse-string" wrinkles above upper lip, well marked nasolabial folds, and acne complications (such as atrophic scars and hyperpigmented areas in the lower cheek, enlarged pores in the chin area).

Procedure: makeup removal and skin cleansing were followed by gas-liquid polish with Jet Peel-2. Uniform treatment of the entire facial area was lasting for 20 minutes. Polish depth in the problem areas was according to "blood dew" sign. Following the procedure, dexapanthenol-containing regenerative cream was applied on the skin. Re-examination was scheduled a month later.
Skin wrinkles and folds (before the GLP procedure, immediately after, and 1 month later).

Clinical Testing of the Proposed Method

Safety and efficiency of gas-liquid peeling has been studied at several sites.

Zhukovsky Beauty Center

Within February – November 2005, 170 patients aged 19-65 have undergone gas-liquid procedures.
Equipment applied: Jet Peel 2 (TavTech, Israel). The apparatus was connected to medical oxygen tank (maximum gas operating pressure – 6 Bar) and a bag containing sterile normal saline solution.

All patients were interviewed before the procedure to identify their complaints, study their medical and life history, and discuss esthetic problems. Objective and local status were determined by visual examination. Scars were evaluated both visually and palpatory.

The first subgroup included 100 subjects complaining of skin ageing: wrinkles around the mouth, in the eye area, and in the forehead, hyperpigmented areas, poor skin elasticity, dry skin in the face and neck area. They have all undergone 5 superficial or median peeling procedures, every 2-3 weeks each. Procedures were focused on the problem areas (hyperpigmented areas, deep wrinkles, lines, marked ptosis zones). Headpiece – skin distance was 7±2 mm.

After the treatment program, both patients and professionals have noticed a better skin tonus, reduced depth and length of wrinkles, lifting effect in the periorbital area, improved complexion, and whitening of hyperpigmented areas. Nearly all of the patients have felt refreshed. Several patients showed significant improvement in gills and slack cheeks. However, a general lifting effect was moderate. According to the doctors and patients opinion, improved skin relief was maintained for 7-9 months.

The second subgroup (51 subjects) included patients with acne of various severities. Skin rash was basically noninflammatory. Nearly all of the patients were having atrophic post-acne scars, and hyperpigmented areas. All patients were having combined skin.

Patients have undergone 7-10 superficial gas-liquid peeling procedures, every 1-2 weeks each. An adequate skin care at home was prescribed to all of them.

Reduced rash, smaller skin pores, and lower sebum production were observed after the first treatment sessions. Atrophic spots were disappearing relatively fast. Dryness and irritation have disappeared in several patients. Nearly all of the patients exhibited a uniform complexion.

Focused treatment of atrophic scars was performed until onset of point bleeding. Patients were warned of the damage of crust removal. A pronounced improvement was observed after 2-3 treatments.

It should be emphasized that all of the patients have been fully cooperating with the doctor and were satisfied with the results. They have all marked a pronounced improvement and feeling of comfort during the procedures.

The third subgroup (15 subjects) included patients with stretched skin in the stomach and hips area, "orange peel" effect, and local fat deposits. Stretches (aged 2-8 years) were polished by gas-liquid jet (the scar and adjacent areas). Treatment sessions were performed weekly (5 sessions per treatment cycle). Marked positive changes were observed after the end of therapy: stretches have been lifted to the skin level, slackness reduced. After cellulite treatment, the skin became smoother, its elasticity increased. Fat deposit areas (stomach and sides) have slightly shrinked.

Patients in the fourth subgroup (4 subjects) were having posttraumatic and postsurgical atrophic and hypertrophic scars aged 1 year and more. Treatment sessions were performed weekly (about 5 sessions per treatment cycle). In two cases of hypertrophic scars polishing (facial – aged 1.5 years, and on the stomach – aged 8 years), the scar was reduced after the very first procedure. In general, all of the patients exhibited good and satisfactory results (improved elasticity of scarred tissue and smoothing effect).

While analyzing the first clinical tests, it should be noted that all of the patients have duly appreciated high comfort and efficiency of the proposed therapy. They were thrilled to notice positive changes after the very first procedure. No side effects were observed.

Several patients exhibited a marked improvement of telangiectasia (kuperosis), reduced and "dried up" papillomas on the neck (unexpected positive effects).

MAPO Physiology and Balneology Chair (St. Petersburg)

Gas-Liquid jet affects all skin layers: epidermis, derma, and subcutaneous fat. The use of oxygen as a gas component produces various clinical and physiological effects, including bioenergetic (intensified oxidative phosphorylation), detoxicating, antibacterial (including against various strains of Propionobacterium), and immune corrective actions. The use of carbon dioxide by increasing its skin level stimulates local circulation, increases partial pressure of oxygen (!) in tissues, and initiates lipolysis. Lymphatic drainage is attributed to a short-term compression of veins and lymphatic vessels, and lymph displacement towards large collectors.

Since facial skin is a receptive field, jet-induced efferent input reaches cerebral cortex and subcortical structures, including vegetative centers. The vegetative index of Kerdo have showed two trends of using Jet Peel: harmonization of initial vegetative tonus, and shift towards parasympathetic effects that helps normalize trophic processes. This trend was further supported by dopplerography data ("Minimaxdoppler-K"). A 2.5-fold acceleration of linear blood flow was fixed after the procedure.

Gas-liquid treatment can be used in various applications: peeling, massage, needleless injections, local gas injections (as a part of gas therapy). It stimulates microcirculation, and exerts a trophic stimulating effect by activating parasympathetic nervous system.

JET PEEL SYSTEM

Jet Peel is a unique development of Israeli researchers, which is comprised of a device and a unique headpiece to transform high oxygen pressure and liquid into two-phased ultrasonic jet.

Due to its multi-purpose nature, the device is used for **painless** treatment of a broad spectrum of skin problems:

- Rejuvenation of skin
- Age-specific spots and spots caused by sun exposure
- Fast improvement of skin
- Improved permeability of skin due to opening of pores
- Skin smoothing and polishing
- Postacne scars
- Décolleté and hands care
- Treatment of scars and stretches
- Anticellulite treatment
- Painless delivery of active components to derma (needleless injections)

Rejuvenating effect is attributed to the use of oxygen and water, which are the most important sources of life on the Earth!