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SHORT REPORT

Advanced film-forming gel formula vs spring thermal water and white petrolatum as primary dressings after full-face ablative fractional CO_2 laser resurfacing: a comparative split-face pilot study

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Abstract

Background Aesthetically pleasing results and fast, uneventful recovery are highly desirable after rejuvenating ablative laser procedures. Wound dressings following ablative laser procedures should ideally improve and optimize the wound healing environment.

Objective The purpose of this comparative split-face, single-blinded, prospective observational study was to assess the efficacy and acceptability of two primary wound dressings immediately after a full-face fractional CO_2 laser resurfacing procedure.

Methods The assessments of an innovative film-forming dressing called Stratacel (SC) vs spring thermal water + Vaseline (V+) were conducted after a standardized, single-pass, full-face ablative fractional CO_2 laser skin resurfacing procedure. Clinical parameters, such as haemoglobin – HB; surface temperature – ST; micro-textural modifications – MT; superficial melanin – M; intrafollicular porphyrins – P, were assessed at different phases of the healing process using standardized, non-invasive technologies.

Results Five female volunteers were enrolled in this inpatient, controlled pilot study. Most of the clinical parameters considered, including 3D surface texture analysis, revealed a better performance of SC vs. V+ during the early, more delicate phases of the healing process.

Conclusions This preliminary study, even if performed on a small number of volunteers, confirmed a definite advantage of the tested semipermeable film-forming formula (SC) over a more conventional postoperative skin care regime (V+). Clinical results could be explained by a better uniformity of distribution of SC over the micro-irregularities induced by ablative fractional CO_2 laser resurfacing. Its thin, semipermeable film might, in fact, act as an efficient, perfectly biocompatible, full contact, temporary skin barrier, able to protect extremely delicate healing surfaces from potential environmental irritations.

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Conflicts of interest

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Introduction

Minimally invasive dermatosurgical procedures have become popular worldwide due to the advent of more sophisticated technologies.[1] The skin can be carefully and precisely "injured" at various depths satisfying different indications: diagnostic, corrective and aesthetic.

Ablative fractional laser resurfacing (AFLR) is among the most commonly used as it generates precise arrays of variable depth, thermally induced, multiple micro-channels within skin layers, leading to faster wound healing compared to full surface laser.[2]

None of such procedures are really concluded until the treated tissues are completely recovered. Postoperative skin care is therefore as crucial as the procedure itself as a good clinical result depends on an optimal wound healing process.

An ideal primary dressing should be formulated as a transparent, semipermeable, easily applicable and removable topical gel, able to transform into a highly pliable, super-thin film, perfectly conforming to all irregularities of the skin. Its external layer should dry rapidly and resist environmental stress, while its inner layer should provide a uniformly moist environment

Table 1 Non-invasive evaluation protocol applied to all facial units considered in the study

Clinical and Non-invasive Skin Assessment Protocol	
T0 – day of laser procedure	
T0a	Cleansed facial skin – **15 min after acclimatization**
T0b	Treated skin – **immediately after full-face ablative fractional laser resurfacing (AFLR)**
T0c	Treated skin – **45 min after laser procedure with 15-min primary dressing contact time**
T7 – 7th postoperative day	
T7a	Treated skin – **1-h primary dressing contact time**
T7b	Treated skin – **15 min after gentle removal of primary dressing with previous primary dressing contact time of 1 h**

because of the well-recognized fact that acute wounds heal 40% faster when kept moist.[3–9] Currently, there is no consensus on the ideal wound care product, which optimizes all three subsequent wound healing phases: inflammatory, proliferative and tissue remodelling.[10–12]

Methods

Our clinical assessment is based on a split-face, single-blind, comparative pilot study with five volunteers (mean age 44.8) with a Fitzpatrick type 2–3, affected by early photo-ageing receiving AFLR.

Different measurements were obtained at T0 of the AFLR procedure (Energy: 20–22 W; dwell time: 800 µs; spacing: 500 µm; scanner setting: random mode; two passes – SmartXside Dot®, Deka, Florence, Italy), according to the following protocol: immediately before AFLR on cleansed skin (T0a); immediately after AFLR without any dressing (T0b); 45 min after AFLR (T0c). T0c measurements were obtained after 45-min contact with a temporary primary dressing consisting of sterile TNT gauzes soaked in sterile 0.9% N/S solution, combined with chilled ice packs. The two study primary dressings were applied immediately after. Further measurements were performed after 7 days (1 h after application of the two primary dressings by volunteers (T7a), and 15 min after gentle removal of primary dressings using TNT wet gauzes containing sterile 0.9% N/S (T7b) (Table 1).

Both studied dressings were applied immediately postprocedure: the film-forming formulation SC (Stratacel Stratpharma, Basel, Switzerland) was used on the right, V+ (spring thermal water, Avène Laboratories, France, and Vaseline) on the left hemifacial region. Both dressings were applied four times daily by the volunteers.

The assessments were performed using a 3D digital imaging system (Antera 3D Miravex, Ireland) to document skin surface micro-textural changes, superficial melanin variations and superficial haemoglobin distribution. A digital skin analysis system (Visia – Facial Complexion Analysis, Canfield, USA) was used to assess intrafollicular porphyrin variations.

Table 2 Comparative measurements of mean values between T0a (pre-AFRL) and T0b (immediately post-AFRL on injured skin)

	AFLR Cheek (L + R)	STD	AFLR Forehead (L + R)	STD
3D Surface	+18.02%	0.20	−6.03%	0.17
Melanin	−3.81%	0.05	−5.72%	0.05
Porphyrins	+114.02%	2.46	Not collected	Not collected
Haemoglobin	+40.02%	0.17	+19.72%	0.11
Corneometry	−2.04%	0.12	+0.33%	0.21
Temperature	+1.44%	0.03	+6.71%	0.03

Skin hydration levels were assessed by a digital corneometer (MC825, Courage Khazaka, Germany).

Superficial melanin levels were assessed using a digital colorimeter (DSMII Cortex Technology, Denmark).

Results

All volunteers completed the study without reporting any complications and/or side-effects. The statistical analysis did not reveal significant differences between the two primary dressing systems due to the small sample size as per a pilot design.

Mean corneometry values were found decreased due to higher levels of TEWL associated with partial disruption of the skin barrier after AFLR on cheeks (−2.04%; STD 0.12). This observation was not confirmed on forehead regions (+0.33%; STD 0.21). Both measurements compare mean values at T0a and T0b (Table 2).

The reduction in skin surface micro-textural changes was less evident on SC-treated sites (−4.97%) vs V+ (−12.28%) when baseline findings at T0a and T7a were compared.

Higher melanin levels are associated with acute and persistent inflammatory skin alterations. Progressive reactive pigment reduction is associated with a gradual "fading" of post-traumatic inflammatory reactions.[13] SC-treated sites showed a reduction in superficial melanin content (−2.44%) vs V+ (−1.15%) when mean T0a and T7b were evaluated.

Skin porphyrins are mostly produced by Propionibacterium acnes, which is an indirect index of its density and biological activity.[14] Mean T0b values were subsequently compared with T7a and T7b. V+ significantly increases fluorescence vs SC, both at T7a (SC: +3.77%; V+: +45.39%) and T7b (SC: +2.86%; V+: +45.39%) (Fig. 1).

Skin hydration at T7b showed similar levels of epidermal hydration, with slightly higher values on the V+ side. Values measured on cheeks were 44.8 (SC) and 55.73 (V+); the forehead showed a mean of 44.67 (SC) compared to 47.67 (V+).

Superficial dermal haemoglobin represents an indirect index of capillary perfusion of papillary and superficial capillary plexus. Elevated superficial haemoglobin readings identify inflammatory alterations commonly observed during early post-AFLR phases while decreased levels are observed during intermediate phases. Mean superficial haemoglobin variations observed

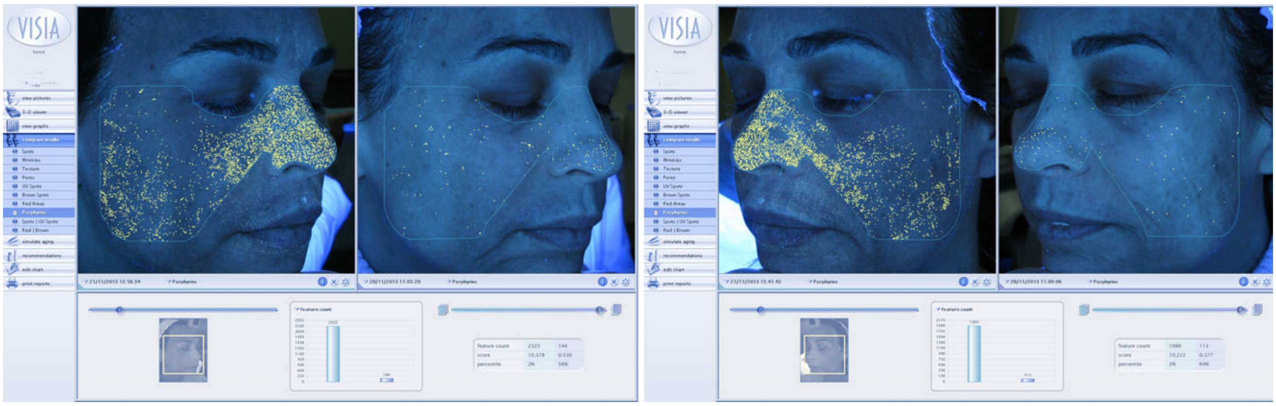

Figure 1 Comparison between Visia images L+R cheek with computer program for porphyrins activated: T0b (immediately after laser procedure) after primary dressing contact time on seventh post-treatment day on volunteer 3.

during our study confirmed a similar trend when comparing data collected at T0b and T7a. SC behaved better on cheeks (−19.48%) vs V+ (−16.31%). V+ showed a higher reduction on the forehead (−16.31%) vs SC (−14.20%).

Median superficial haemoglobin levels were also evaluated comparing measurements at T7a and T7b. A similar protective effect in both primary dressing systems was observed: increased values on both cheeks (SC +7.23%) and V+ (+8.39%). A similar but opposite trend was observed on forehead regions (SC: +4.99%; V+: +4.31%).

A self-assessment questionnaire confirmed the positive acceptance of SC as a good primary dressing; 100% of the volunteers answered "totally agree" with the skin comfort they perceived on the SC site compared to 40% on the V+ site.

Table 3 Values obtained from 3D computerized surface texture analysis performed 15 min after gentle removal of primary dressing systems 7 days post-AFLR

	SC (5 half face) Surface	V+ (5 half face) Surface
T0b-T7b Forehead	−21.37%	4.02%
T0b-T7b Cheeks	−18.55%	−29.09%
T0a-T7b Forehead	−22.32%	1.12%
T0a-T7b Cheeks	−4.09%	−18.34%
T0b-T7b Combined	−19.96%	−12.54%
T0a-T7b Combined	−13.20%	−8.61%

Discussion

Postprocedural skin care is crucial to protect injured skin from excessive environmental stress during the complex phases of wound healing. Primary dressing systems are intended to be applied directly to injured surfaces and should contribute to speed up a good, uneventful repair. Sterility, biological inertness, transparency, self-adaptation to all kind of surfaces with 100% contact capability, partial permeability to vapour to prevent excessive TEWL, are among the most looked for characteristics.

This pilot study was intended to evaluate the effectiveness of a new sterile primary dressing gel formulation (SC), featuring the ideal characteristics required after an AFLR procedure, compared to one of the most commonly used dressings, consisting of sequential application of spring thermal water and petrolatum (V+). A skin surface analysis at T0b and at T0c confirmed the importance of a dressing, which is transparent and easy to apply. SC showed a great flexibility and resilience on injured tissue with only a small amount used. Its extremely thin, self-drying film was accepted very well by the majority of volunteers who preferred it over V+. The 3D micro-textural skin analysis confirmed a faster and smoother re-epithelialization when SC was used compared to V+. V+ was found to alter the surface texture on a higher degree than SC (Table 3). This is in accordance with the physical characteristics of SC: it is able to form an extremely thin, semipermeable, full contact, self levelling film, perfectly adapting to all micro-textual irregularities of the skin and can temporarily reproduce an epidermal barrier-mimicking film whose micro-protective functions are very similar to original physiological conditions. The V+ formula is thicker and able to "camouflage" skin irregularities, which result in a less pleasant appearance and a severe reduction in the skin permeability due to its occlusive properties. The subjective patient perception was in line with these findings.

Evaluations of surface skin melanin and temperature revealed a significantly smoother transition between the initial inflammatory phase and early remodelling phase on SC-treated sites. SC may have a unique ability to reproduce a temporary epidermal barrier function, similar to the normal physiological conditions. SC may have been able to keep all biologically active cells and their related cytokines and growth factors to work undisturbed during wound healing, which may reduce the risk of postinflammatory hyperpigmentation.

Skin hydration and mean haemoglobin levels did not reveal any substantial differences on both sites.

SC is biologically inert and bacteriostatic. A possible explanation for the extremely moderate increase in intrafollicular porphyrins levels observed on T7, on SC sites vs V+ areas. This particular finding has a very important clinical impact on the biological performance of a primary dressing as it will contribute to decrease potential risks of infection associated with increased intrafollicular bacterial proliferation.[15,16]

Conclusion

This preliminary study suggests that SC, a semipermeable gel formulation, was able to generate a cosmetically acceptable, easy to apply, protective skin surface micro-environment, leading to an optimal and faster wound healing after a full-face CO2 AFLR procedure. Being bacteriostatic, biologically inert and pliable, it allowed 100% protection of injured tissues during acute and subacute phases of wound healing, even on most dynamic and delicate facial regions. This study provides a better understanding of the importance of performing a sequential series of non-invasive analysis of clinical aspects of wound healing to assess the effectiveness of different primary dressing systems during the early phases of skin repair.

Limitations

This was a preliminary split-face pilot study performed on a homogenous group of volunteers with a small sample size. Only a tendency, without a strong statistical significance, could be achieved.

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