

## ABSTRACT

**Background:** Oxygenation of the skin has been shown to improve cell growth and cell biosynthesis, which can subsequently improve the skin's appearance.<sup>1,2</sup> However, the majority of skin oxygenation techniques are invasive.<sup>3,4</sup> A noninvasive skin oxygenation treatment, also known as a carboxytherapy facial, with TriPollar<sup>®</sup> radiofrequency device has emerged called OxyGeneo<sup>™</sup>, which is provided by the geneO+<sup>™</sup> skin care platform (Pollogen Ltd., Tel Aviv, Israel). **Objective:** This study addresses the clinical effectiveness of the aforementioned noninvasive skin oxygenation treatment on skin texture, fine lines/wrinkles, and skin pigmentation over an eight-week time period. **Methods and materials:** Ten patients with fine lines, wrinkles, hyperpigmentation, and rough skin texture received six weekly treatments over a two-month period. Five patients received NeoRevive<sup>™</sup> and five received NeoBright<sup>™</sup> topical infusions, with the selection made according to each individual's skin conditions and type. These patients were evaluated using the VISIA complexion analysis system (Canfield Scientific, Inc., Parsippany, New Jersey) and patient and evaluator assessments and satisfaction surveys. Photo consent was obtained and are on patient records. The OxyGeneo<sup>™</sup> treatment equipment was commercially available at the time of the study and did not require IRB approval for cosmetic use. **Results:** Each individual measurement varied by patient, but the change in value of each category that was assessed prior to treatment and post-treatment indicated an improvement. All patients in the study stated an improvement in overall skin appearance, skin texture, brightness, and shininess. Nine out of the 10 patients reported that their skin was softer and had a more youthful appearance after the treatments, and seven out of the 10 patients saw a minor improvement in fine lines and wrinkles. Lastly, five out of the 10 patients noticed an improvement in skin pigmentation. **Conclusion:** The results indicated the combination of the three-in-one OxyGeneo treatment of exfoliation, infusion and oxygenation using TriPollar radiofrequency prompted an improvement in skin texture and tone. This is an optimal procedure that can be implemented in patients looking for noninvasive, safe, and effective rejuvenation treatments with no associated downtime post-procedure.

**KEYWORDS:** TriPollar radiofrequency, geneO+, NeoRevive and NeoBright, OxyGeneo, aging skin

## Oxygeneo<sup>®</sup>—A Unique Three-in-one Treatment of Exfoliation, Infusion, and Oxygenation via the Bohr Effect and TriPollar<sup>™</sup> Radiofrequency for Skin Rejuvenation

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During the aging process in the skin, there is a general atrophy of the extracellular matrix and a decrease in the number of fibroblasts and levels of collagen and elastin. Research has shown that increasing optimal oxygen delivery to the skin improves cell growth and cell biosynthesis.<sup>1,2</sup> Studies have also suggested that increased oxygenation stimulates fibroblast proliferation and keratinocyte differentiation.<sup>6</sup> This has stimulated a growing interest in oxygen-based skin treatments. However, the stability of oxygen-based compounds in topical formulations has been questioned, as has their ability to penetrate the stratum corneum effectively.

The OxyGeneo<sup>™</sup> treatment (OGT, Pollogen Ltd., Tel Aviv, Israel) provided by the geneO+<sup>™</sup> skin care platform (Pollogen Ltd., Tel Aviv, Israel) is a novel, noninvasive treatment that invokes skin oxygenation in combination with mechanical exfoliation and skin infusion.<sup>7</sup> The treatment includes the performance of a light exfoliation with a simultaneous infusion of active ingredients via two treatment gels, NeoRevive<sup>™</sup> (NR) for drier skin and skin rejuvenation and NeoBright<sup>™</sup> (NB) for oiler skin and skin brightening, respectively. The exfoliation is preceded by TriPollar<sup>®</sup> radiofrequency (RF) technology<sup>8</sup> (Pollogen Ltd., Tel Aviv, Israel) for noninvasive dermal remodeling, and is finished with the exchange of the exfoliation head for a massager head to provide the skin with a more vibrant, glowing appearance.

The use of carbon dioxide (CO<sub>2</sub>) through the Bohr effect has been used in subcutaneous CO<sub>2</sub> injections in order to ensure oxygen delivery to the skin tissues.<sup>3</sup> However, transcutaneous CO<sub>2</sub> injections are invasive, have many side effects, and can be impractical to apply to the entire face.<sup>3,4</sup> There is a need for noninvasive CO<sub>2</sub> treatments that can enhance neocollagenesis with minimal pain or downtime for the patient. OGT is a noninvasive CO<sub>2</sub> treatment that utilizes the Bohr effect. The Bohr effect is represented by an incrementation in the partial pressure of CO<sub>2</sub> or decrease in pH as seen as a rightward shift of the O<sub>2</sub>–hemoglobin dissociation curve. CO<sub>2</sub> incites local cutaneous vasodilation and thereby increases incremental regional blood flow, which in turn increases the oxygen availability in the skin.<sup>9</sup> Transcutaneous CO<sub>2</sub> delivery has been well-documented and studied. CO<sub>2</sub> is water-soluble, making it an ideal gas for transcutaneous delivery.<sup>10</sup>

The light mechanical exfoliation provided by OGT uses a widely employed microdermabrasion system that increases skin permeability to enhance the infusion of active ingredients.<sup>11</sup> This technology also increases circulation and oxygenation in the treated areas, enhancing the delivery and absorption of the active ingredients.<sup>12</sup> In addition, OGT uses the RF technology to heat the dermal layer through electromagnetic energy. This, combined with the exfoliation, induces the activation of fibroblasts for the production

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**FIGURE 1.** The geneO+™ skin care platform from Pollogen Ltd. (Tel Aviv, Israel)

of new collagen fibers. The result is skin tightening and an improvement of wrinkles over time.<sup>13</sup>

The purpose of our study was to determine if the OGT could improve skin texture in a short period of time. We treated 10 patients with six weekly treatments over a two-month period. Five patients received NR and five received NB topical infusions according to their individual skin conditions and type. These patients were evaluated using the VISIA complexion analysis system (Canfield Scientific, Inc., Parsippany, New Jersey) and patient and evaluator assessments and satisfaction surveys.

## METHODS

This was a single-center study that involved 10 healthy female patients 27 to 61 years of age. Study protocol followed the ethical principles of the Helsinki Declaration. Patients gave informed consent to undergo six weekly OGTs with the geneO+ platform device (Figure 1). Patients also gave photoconsent. The inclusion criteria were healthy female patients of any racial/ethnic origin with Fitzpatrick skin types I to VI who were aged between 25 years and 65 years. Exclusion criteria were a current presence or history of skin cancer; pregnancy; lactation; active dermatologic conditions in the treatment area; vascular disorders in the treatment area; recent use of resurfacing products or treatments on the treatment area; known allergies to cosmetics or other products; and/or the performance of any recent surgical, ablative, or invasive procedure including fillers or botulinum toxin.



**FIGURE 2.** A) before the first treatment; B) after the sixth treatment with NeoRevive



**FIGURE 3.** A) before the first treatment; B) after the sixth treatment with NeoBright

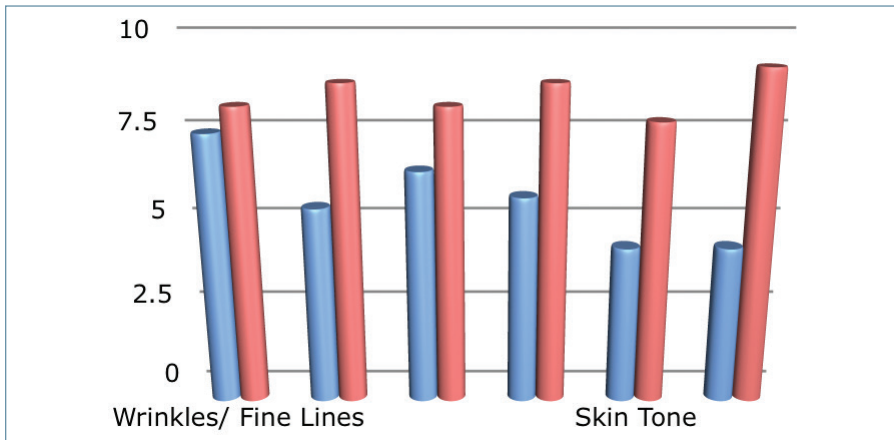
Treatments were performed using the OGT technology (Figure 1) that uses the patented Capsugen™ capsule (Pollogen Ltd., Tel Aviv, Israel) in combination with the NR or NB treatment gels. The disposable capsule is attached to handheld applicator that vibrates the treatment area with the treatment gel, which together creates a CO<sub>2</sub>-rich reaction. This reaction produces a layer of CO<sub>2</sub> microbubbles that exfoliate and optimally penetrate the skin, which drives oxygen-rich blood to the skin to increase its oxygenation and permeability for the infused treatment gels. Treatments in this study were performed using two types of treatment gels: NR, for those subjects with drier skin and skin rejuvenation, and NB, for those subjects with oiler skin and skin brightening. The patients were assigned the gel that best matched their condition and skin type. This was followed by an RF add-on applicator of the geneO+ platform (Figure 1) that uses well-established electromagnetic energy to generate heat to stimulate dermal remodeling. The RF applicator has three preset power levels for the desired pre-programmed threshold temperature and intensity. In addition, there is a safety mechanism to turn off the RF power when the maximal threshold is detected, in order to prevent epidermal overheating. This applicator is treated with a thin layer of treatment gel and moved in slow circular motions, having full contact of the skin in the treatment area. Lastly, the exfoliation capsule is exchanged with a

massager head that is applied to the treatment area with the remaining thin layer of treatment gel in a circular uniform motion.

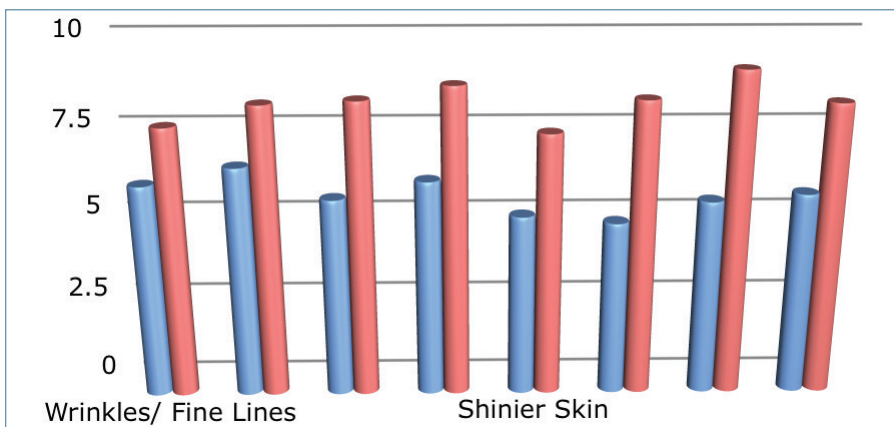
Patients were photographed at baseline, after the first treatment, before the second and fourth treatments, and after the sixth treatment using the VISIA analysis system. This device grades skin texture and hyperpigmentation based on a numerical analysis via ultraviolet, cross-polarization, and standard photography. Five patients were asked to complete a self-evaluation questionnaire scaled from 1 (signifying needs improvement) to 10 (signifying an improvement is visible in regards to various variables such as wrinkles/fine lines, skin pigmentation, skin texture, skin brightness and overall skin appearance) after the first, second, fourth, and final treatments.

## RESULTS

Each individual measurement varied by patient, but the change in value of each category that was assessed prior to treatment and post-treatment demonstrated an improvement. Although fine lines/wrinkles only demonstrated minor improvement, presumably due to the short time course of treatment (i.e., only six weeks), skin texture, pigmentation and brightness all substantially improved, as demonstrated by the investigator evaluation chart in Figure 4. Reports of patient satisfaction collected from all 10 of the patients stated there was a marked improvement in overall



**FIGURE 4.** Investigator evaluation chart demonstrating notable improvements in skin texture, pigmentation, and brightness before the first treatment (blue) and after the last treatment (red) using a 1–10 point scale where 1=needs improvement and 10=improvement is visible



**FIGURE 5.** Patient response chart demonstrating increases in satisfaction and an overall observed physical improvement between before the first treatment (blue) and after the last treatment (red) using a 1–10 point scale where 1=needs improvement and 10=improvement is visible

skin appearance, skin texture, brightness, and shininess. Nine out of the 10 patients reported softer and more youthful appearing skin after the treatments, and seven out of the 10 patients saw minor improvements in fine lines and wrinkles. Lastly, five out of the 10 patients noticed an improvement in skin pigmentation, as seen in Figures 2 and 3, that demonstrates an improvement in post-inflammatory hyperpigmentation on the left cheek. Overall, all of the patients showed a trend of increased satisfaction and overall improvement from the first to last treatment (Figure 5). All of the 10 patients stated they would recommend this product, and eight out of the 10 stated they would continue with the treatment. Cost of the treatment was reported as the reason that the other two participants did not wish to continue the treatment. All 10 patients vocalized that the

overall treatment procedure had minimal to no pain, adding specifically that the first exfoliating portion was slightly abrasive with mild tingling, but tolerable.

## DISCUSSION

The therapeutic and medical use of CO<sub>2</sub> was first introduced in France for cutaneous use in the early 1900s, specifically for the treatment of peripheral vascular disease.<sup>14</sup> CO<sub>2</sub> treatment is known as carboxytherapy and refers to the cutaneous and subcutaneous administration of CO<sub>2</sub> for therapeutic purposes. In South America and Europe, CO<sub>2</sub> therapy has not only been used therapeutically, but has been applied aesthetically for the treatment of stretch marks, cellulite, and hypertrophic scars, with impressive results.<sup>10,15</sup> When first introduced, treatment was delivered by bathing the skin

in CO<sub>2</sub>-enriched water or natural CO<sub>2</sub> spa gas.<sup>10,16,17</sup> CO<sub>2</sub> injections were later introduced in plastic surgery for skin irregularities or adiposities.<sup>15</sup> Studies have demonstrated that carboxytherapy improves skin elasticity and circulation, encourages collagen repair, reduces the appearance of fine lines and wrinkles, and destroys localized fatty deposits by increasing blood flow, microcirculation, and oxygenation in ischemic tissues as explained by the Bohr effect.<sup>10</sup> However, CO<sub>2</sub> injections are invasive and have many side effects, including pain, bruising, swelling, and a tendency for infection.<sup>4</sup> Therefore, a noninvasive carboxytherapy is optimal. The novel OGT is a ideal option due to its noninvasive nature. Through the Bohr effect, CO<sub>2</sub> diffuses into the capillary blood and into the red blood cells. Inside the red blood cells, CO<sub>2</sub> and water generate carbonic acid that dissociates into protons and bicarbonate ions. These protons induce a conformational change reducing the hemoglobin affinity for oxygen, increasing the tissue oxygen content in the treatment area.<sup>18</sup> The capsules of the OGT handheld applicator are composed of sodium bicarbonate and citric acid. This combination interacts with the treatment gel and releases CO<sub>2</sub> as demonstrated in the following formula:  $3\text{NaHCO}_3 + \text{C}_6\text{H}_8\text{O}_7 \rightarrow \text{Na}_3\text{C}_6\text{H}_5\text{O}_7 + 3\text{CO}_2 + 3\text{H}_2\text{O}$ , where NaHCO<sub>3</sub> is sodium bicarbonate, C<sub>6</sub>H<sub>8</sub>O<sub>7</sub> is citric acid, the arrow represents the interaction with the specialized gel, Na<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub> is sodium citrate, CO<sub>2</sub> is carbon dioxide, and H<sub>2</sub>O is water.

The high carbonate content released into the tissues induces a release of oxygen from the red blood cells' hemoglobin. In addition, the vibration of the handheld applicator induces an exfoliation, increasing the skin's permeability for better infusion of the treatment gels. The RF application then induces neocollagenesis and dermal repair.<sup>8</sup>

## CONCLUSION

The purpose of this study was to assess the aesthetic improvements induced by OGT, a noninvasive carboxytherapy treatment. The data demonstrated that OGT prompts an improvement in overall skin appearance, texture, and feel. Patients were satisfied with the impact on their skin texture, brightness, and overall appearance, although there was no drastic improvement of fine line and wrinkles. The results of this study demonstrate the effectiveness of the OGT on skin texture and

tone and its feasibility as a noninvasive skin treatment with minimal pain and no downtime. The combination of the three-in-one OGT of exfoliation, infusion, and oxygenation and the use of the RF technology makes it an optimal procedure for skin rejuvenation that can be implemented in patients looking for a noninvasive, safe, and effective treatment that will give the desired aesthetic improvement in skin tone and texture within a short period of time (two months) without downtime post-procedure.<sup>19–24</sup>

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