

Case Series: The Effectiveness of Fatty Acids from Pracaxi Oil in a Topical Silicone Base for Scar and Wound Therapy

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ABSTRACT

Introduction: Wounding affects the integrity of the skin and can ultimately result in skin scarring. Current therapeutic goals of wound treatment focus on the reduction of scar formation and severity. However, scar formation itself varies not only between individuals based on factors such as ethnicity, but also within an individual based on the location of the wound. Therefore, the preparation of customized treatments for individual patients represents an important therapeutic goal in the fields of dermatology and wound healing. The objective of this study was to evaluate the usefulness of fatty acids found in pracaxi oil in a compounded topical anhydrous silicone base for wound and scar therapy.

Methods: Initially, 21 patients with various surgical, traumatic, or burn wounds and scars were enrolled into this case series. Patients applied a compounded topical anhydrous silicone base containing pracaxi oil with or without additional active ingredients, including pentoxifylline, caffeine, tranilast, and mupirocin. Wound/scar photographs taken before and after application of the compounded pracaxi oil topical formulation (with/without additional ingredients) were reviewed and adjudicated by a blinded dermatology reviewer. Improvements in wound size, coloration, and overall appearance before and after treatment were determined. Patient satisfaction was assessed after application of compounded topical formulation using a self-report questionnaire distributed at the time of dispensing.

Results: A total of seven patients were considered available for analysis and were included in the study. In all seven cases, patients reported improvement in scar and wound attributes, including scar and wound size, severity, color, and pain associated with the scar or wound after application of the compounded medicine. On average, patients

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rated their satisfaction with treatment highly, with a mean score of 10 on a rating scale of 1–10. Retrospective review of wound/scar photographs demonstrated clinically relevant improvements in wound attributes as assessed by a dermatologist. Six of the seven wounds examined were considered “much improved” from baseline.

Conclusions: Application of a compounded anhydrous silicone base containing pracaxi oil alone or in combination with other active substances led to considerable improvements in wound healing and scar attributes and is a potentially useful option in the treatment of surgical, traumatic, or burn wounds and scars.

Keywords: Fatty acids; Pracaxi oil; Scarring; Wound healing

INTRODUCTION

All wounds affect the integrity of the skin and can result in the imperfect, although normal, end point of tissue repair, namely, skin scarring. Phenotypically, scars can range from a fine line to a variety of abnormal scars, including hypertrophic and keloid scars. While skin scarring is often considered trivial, it can be aesthetically unpleasant and disfiguring, and can cause distress and anxiety to the patient [1]. Scarring can also have physical consequences including tenderness, itching, and pain, which can be functionally disabling and can contribute to a diminished quality of life (reviewed in [2]).

Currently, the therapeutic goal of wound and scar treatment is to reduce the severity of scars as much as possible. However, this is difficult as there is considerable qualitative and quantitative variability in skin scarring between individuals. A genetic predisposition to

abnormal skin scarring has been demonstrated in certain ethnic populations [3]. In addition, scars can vary within an individual, as scars are normally more severe in certain locations of the body, including those with frequent movement. Consequently, a personalized approach to the clinical treatment of wounds and scars based on both the wound or scar attributes and the patient allows for improved treatment [2–4]. Compounding, the preparation of customized medications to meet the specific needs of individual patients, allows patients the benefit of a personalized treatment and represents an invaluable therapeutic alternative in dermatology [5]. Compounded medications may be personalized to include special combinations of active substances in particular concentrations, as well as to include specific raw materials or provide certain organoleptic characteristics adjusted to the patient’s skin type and disorder [6]. The use of compounded topical formulations has already proven successful in wound care [7, 8].

Pracaxi oil, derived from the seeds of the *Pentaclethra maculosa* tree indigenous to the Amazon, has several medicinal applications including the treatment of ulcers, stretch marks, bacterial infections, and snake bites [9, 10]. Pracaxi oil contains high amounts of oleic, linoleic, and behenic fatty acids, which are frequently utilized in the cosmetic industry [9] and have been shown to enhance wound closure and improve healing in several wound models [11, 12]. Fatty acids are integral to the formation and maintenance of cell membranes within the stratum corneum, the layer of the skin that provides a barrier to the environment and regulates permeability [13]. In addition, fatty acids have lubricant, emollient, and anti-inflammatory properties, which help to restore the natural oils of the skin and protect the skin from environmental damage [14].

Fatty acids have also been shown to enhance topical drug delivery of many active pharmaceutical ingredients, including water- and oil-soluble products [15]. However, topical application of fatty acids, especially unsaturated fatty acids such as oleic acid, can irritate the skin [16]. Pracaxi oil contains high levels of behenic acid and oleic acid, and has been used topically by native Amazonians to treat a variety of diseases [17].

In this case series, the healing properties of pracaxi oil in a compounded topical anhydrous silicone base were examined in patients with surgical, traumatic, moisture-associated, or burn-related wounds and scars. We hypothesized that incorporation of pracaxi oil in a compounded anhydrous silicone base would have a positive effect on wound healing and scar formation through the beneficial effects of the fatty acids contained within pracaxi oil. Furthermore, the composition of this base allowed for the addition of active substances at different concentrations to produce a personalized treatment. This also allowed for the evaluation of the effectiveness of pracaxi oil in combination with other compounded active ingredients in improving wounds and scars in adult and pediatric patients.

METHODS

Patients

This case series was conducted between March 2013 and March 2014. Twenty-one patients with surgical, traumatic, or burn wounds and scars who used compounded topical anhydrous silicone base containing pracaxi oil were enrolled in this case series. All patients were dispensed medicine at compounding sites

within the United States, with the exception of one patient who was dispensed medicine at a site in Portugal, and all were enrolled during the course of treatment. In August 2014, data from seven patients were adjudicated by an independent dermatology reviewer. All procedures followed were in accordance with an internal committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008. Informed consent was obtained from all patients (or their legal guardians) for being included in the study and for publication of the photographs.

Compounded Topical Base Containing Pracaxi Oil: Composition and Application

The topical anhydrous silicone base used in this study was a proprietary combination of ingredients, which included cyclopentasiloxane, polysilicone-11, PEG-16 macadamia glycerides, dimethicone, C30-45 alkyl cetearyl dimethicone crosspolymer, *Pentaclethra macroloba* seed oil, *Oenocarpus bataua* pulp oil, phosphatidylcholine, tocopheryl acetate, and butylated hydroxytoluene.

The topical anhydrous silicone base containing pracaxi oil was applied alone, or was compounded with one or more additional medications tailored to the specific needs of each patient. These additional medications included 1% pentoxifylline, 1% caffeine, 1% tranilast, or 2% mupirocin. Patients were advised to apply the compounded topical medication to new or existing scar or wound areas by lightly massaging the compound into and around the scar or wound. The recommended application frequency was two to four times daily based on the attributes of the scar or wound, including size and severity, at

baseline (i.e., before application of the topical medication).

Assessment Using a Patient Self-report Questionnaire

A patient self-report questionnaire was developed and distributed to patients or guardians at the time of dispensing the topical medication. The questionnaire gathered information on patient demographics, prior and current wound or scar therapy, duration of use of compounded topical anhydrous silicone base containing pracaxi oil, and whether the base was used alone or was compounded with additional active pharmaceuticals.

Patients rated their overall satisfaction with the compounded topical medication on a scale of 0 (minimum) to 10 (maximum) once at the completion of treatment. Patients were instructed to return the results of the questionnaire after they had stopped using the topical medication. Acceptable methods of reporting the questionnaire results included the following: return of a written copy of the questionnaire to the pharmacist or investigator, verbal answers to the questionnaire via a telephone conversation with the pharmacist, emails to the pharmacist, or video recordings of the patient's experience made available to the pharmacist and investigator.

Assessment of Wound or Scar Improvement over Time

To assess any clinically relevant improvements in wound and scar attributes, photographs of the scar or wound were taken by the patient or guardian at baseline (i.e. prior to application of the topical medication), and at specific time points throughout and at completion of the

application period. Patient photographs were processed using CorelDraw X5 (Corel Corporation, Ottawa, Ontario, Canada) and were reviewed and adjudicated by an independent, blinded dermatologist.

Improvement in the scar or wound attributes over time, including wound size, coloration and overall appearance, were graded by the reviewer using a physician's global impression of improvement scale of "much worse", "worse", "neutral", "improved", or "much improved".

RESULTS

Of the 21 patients enrolled in the case series, 7 completed the patient self-report questionnaire and had clinical photographs for consideration and review. The seven patients ranged in age from 5 months to 72 years and had a variety of wound types including surgical, traumatic, burn, and moisture-associated wounds (Table 1). The mean duration of application of the compounded topical anhydrous base containing pracaxi oil was 11 days [standard deviation (SD) 6.11 days], ranging from 48 h to 3 weeks based on the size and severity of the wound or scar.

Overall patient satisfaction with the use of compounded topical anhydrous silicone base containing pracaxi oil alone, or in combination with other active substances, was high. Using the patient self-report questionnaire to rate satisfaction on a scale from 1 to 10, patients reported a mean score of 10 (SD 1.15) following application. In addition, no adverse effects were reported to the pharmacist or investigator during the course of the study.

Retrospective dermatological review of patients' wounds and scars also revealed clinical improvement in the wound or scar attributes over time following application of the

Table 1 Case series patients

Patient	Age (years)	Sex	Wound/scar type	Wound/scar age	Wound/scar location	Topical formulation	Application duration (days)
Case 1	50	F	Surgical	New	Ankle	Anhydrous silicone base with pracaxi oil	14
Case 2	57	F	Surgical	Existing	Ankle	Anhydrous silicone base with pracaxi oil	7
Case 3	72	M	Burn	New	Head and neck	Anhydrous silicone base with pracaxi oil	14
Case 4	1.25	F	Diaper rash	New	Diaper area	Anhydrous silicone base with pracaxi oil	2
Case 5	0.42	F	Burn	New	Face	Anhydrous silicone base with pracaxi oil	8
Case 6	22	F	Traumatic and surgical	Existing	Face	Anhydrous silicone base with pracaxi oil containing 1% pentoxifylline (antifibrogenic), 1% caffeine (promotes circulation), and 1% tranilast (collagen synthesis inhibitor)	21
Case 7	40	F	Traumatic	New	Bilateral elbows	Anhydrous silicone base with pracaxi oil containing 2% mupirocin (antibacterial)	11

Characteristics, wound/scar attributes, and application regimen
F female, *M* male

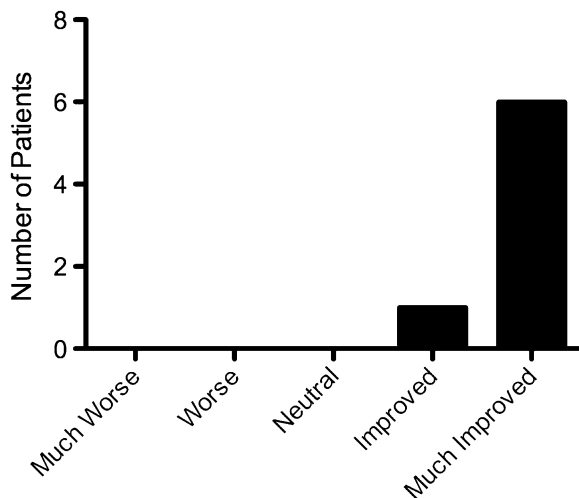


Fig. 1 Photographs of wounds and scars were taken at baseline (prior to application of compounded topical anhydrous silicone base containing pracaxi oil) and at the end of the application period. Photographs were retrospectively reviewed by an independent dermatological reviewer who graded the changes in wounds/scars from baseline to the end of the application period using a scale of “much worse”, “worse”, “neutral”, “improved”, and “much improved”

compounded topical anhydrous silicone base containing pracaxi oil with or without active pharmaceutical substances. Of the seven patient photographs reviewed, six wounds/scars were considered to be “much improved” when compared with their respective baseline images and one wound/scar, which was treated with topical base containing pracaxi oil alone, was considered to be “improved” compared with baseline. No wounds or scars were considered to be “neutral”, “worse”, or “much worse” after application compared with baseline (Fig. 1). The individual compounded topical medications applied and the outcomes of each patient are described in detail in the following sections.

Case 1: New Surgical Ankle Scar

A 50-year-old female diagnosed with osteochondritis dissecans of the right talus

underwent osteochondral allograft surgery for the second time. The patient was advised to wait 10 days after removal of the stitches before applying any topical medication. After 10 days, the patient initiated application of the topical anhydrous silicone base containing pracaxi oil, with no additional active substances, twice daily (Fig. 2a). Following 2 weeks of application, the thickness of the surgical scar was visibly reduced (Fig. 2b), and the wound was graded as “much improved”. The patient reported drastic improvement in the feel and size of the scar, and noted less irritation in the area.

Case 2: Pre-existing Surgical Ankle Scar

A 57-year-old female with type I diabetes underwent 3 reconstructive surgeries following a fractured ankle. These surgeries resulted in 3 ankle scars, including one hypertrophic scar. Prior to this study, the patient had applied several different products to the scars, but still experienced itching associated with the hypertrophic scar and was generally not satisfied with the aesthetics of the scar (Fig. 3a). One year after her last surgery, the patient began application of compounded

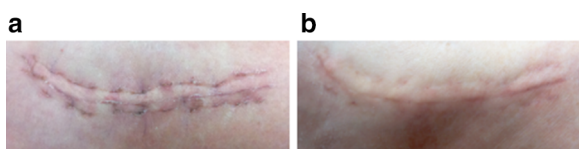


Fig. 2 Surgical scar 10 days after osteochondral allograft surgery **a** before and **b** 2 weeks after application of compounded base containing pracaxi oil

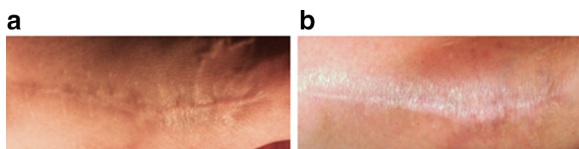


Fig. 3 A hypertrophic surgical scar following reconstructive surgery of the ankle **a** before and **b** 1 week after application of compounded base containing pracaxi oil

topical anhydrous silicone base containing pracaxi oil, without additional active substances, twice daily to the hypertrophic scar. Following 1 week of application, the patient reported that the overall severity as well as the thickness and coloration of the scar were considerably improved (Fig. 3b), and the scar was graded as “much improved”.

Case 3: New Radiation Burn

A 72-year-old male underwent a surgical removal procedure and 33 sessions of radiation therapy on the right side of the head and neck to treat acinic cell carcinoma. The patient experienced radiation burns at the site of treatment with extremely sensitive, dry, and scaly skin resulting in extreme pain and discomfort (Fig. 4a). Topical compounded anhydrous silicone base containing pracaxi oil without additional active ingredients was applied to the radiation burn 4 times daily, or as needed to relieve discomfort. Following 4 days of application, the patient acknowledged significant healing and tissue regrowth. By day 10, the radiation burn was almost completely healed and pain free, and on day 14, the skin was smooth, soft, and pink and the patient reported that he was pain free

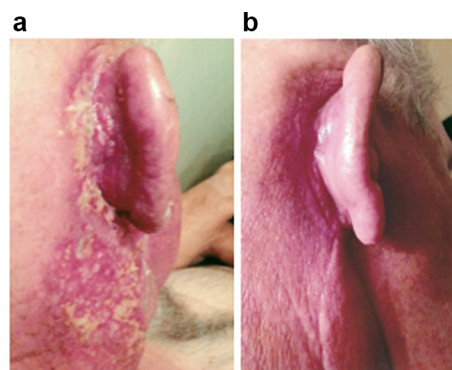


Fig. 4 Radiation burn to the right side of the head and neck **a** before and **b** 2 weeks after application of compounded base containing pracaxi oil

(Fig. 4b). The burn was considered “much improved” by an independent dermatology reviewer.

Case 4: Pediatric Diaper Rash

The guardians of a 15-month-old female suffering from diaper rash, a moisture-associated skin condition, had previously treated the patient with several over-the-counter topical products without success. The condition worsened with time, resulting in increased pain and discomfort for the child (Fig. 5a). Application of compounded topical anhydrous silicone base containing pracaxi oil (without additional active ingredients) was recommended two to four times daily at diaper change. After 48 h of application, the diaper rash had improved (Fig. 5b) and the toddler no longer appeared to experience pain or discomfort. The rash was considered “improved” from baseline by an independent dermatology reviewer.

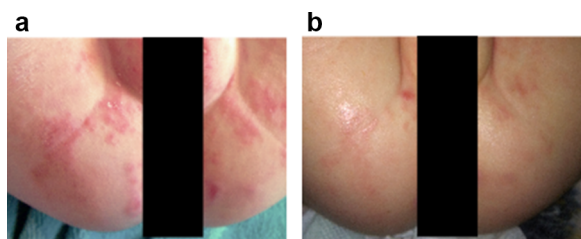


Fig. 5 Diaper rash on a 15-month-old child **a** before and **b** 48 h after application of compounded base containing pracaxi oil

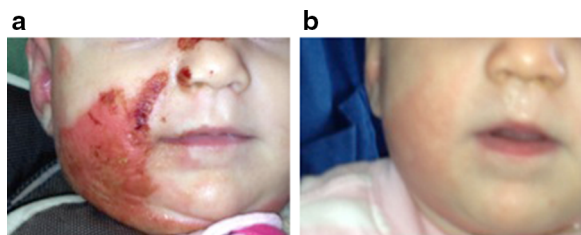


Fig. 6 A second degree facial burn on the face of a 5-month-old infant **a** before and **b** 8 days after application of compounded base containing pracaxi oil

Case 5: Pediatric Facial Burn

A 5-month-old female was severely scalded with liquid on the face, resulting in a major second degree burn (Fig. 6a). Following the incident, compounded topical anhydrous silicone base containing pracaxi oil without additional active ingredients was applied twice daily to the burn, with sterile bacitracin ointment to prevent infection. After 8 days of application, the infant’s facial wound healed completely with no evidence of scarring (Fig. 6b). The burn was considered “much improved” from baseline after the application of compounded anhydrous silicone base containing pracaxi oil.

Case 6: Pre-existing Facial Scars

A 22-year-old female was left severely scarred on the face following a car accident. The patient had undergone six plastic surgery procedures and had previously used several treatments to lessen scar formation. However, she was still unsatisfied with her facial scars and overall complexion (Fig. 7a). Four years after the accident occurred, the patient began application of a medicine containing 1% pentoxifylline (a collagen and wound contraction inhibitor), 1% caffeine (to increase blood flow to the area), and 1% tranilast

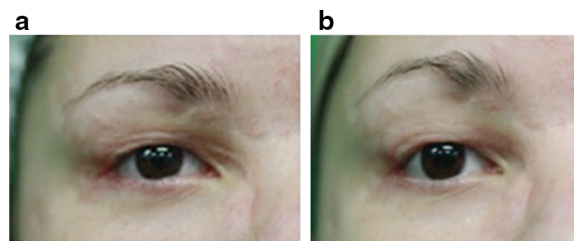


Fig. 7 Pre-existing facial scars following traumatic injury and plastic surgery **a** before and **b** 3 weeks after application of a compounded medicine comprising 1% pentoxifylline, 1% caffeine, and 1% tranilast in a topical anhydrous silicone base containing pracaxi oil

(a collagen synthesis inhibitor) in topical compounded anhydrous silicone base containing pracaxi oil.

The compounded medicine was applied twice daily to the facial scars. After 3 weeks of application, there was an overall improvement in the severity of the scars and the patient reported that the skin around the scar was softer and that the redness of the scar had decreased (Fig. 7b). The scars were considered “much improved” from baseline following application of the compounded medicine.

Case 7: Multiple Elbow Wounds

A 40-year-old female fell on both elbows and was painfully injured as a result of repeated impact with the ground during a fitness competition. Multiple layers of skin were scraped off and the patient presented with open wounds on the right and left elbows (Fig. 8a, b).

The patient was instructed to apply a compounded medication containing 2%



Fig. 8 Traumatic injury to the left (a) and right (b) elbows before and to the left (a) and right (b) elbows 11 days after application of a compounded medicine comprising 2% mupirocin in a topical anhydrous silicone base containing pracaxi oil; the injuries to the left (c) and right (d) elbows were much improved

mupirocin in compounded topical anhydrous silicone base containing pracaxi oil three times a day. Mupirocin 2% was added to the compounded base to prevent bacterial contamination of the wounds. After 11 days of application, the wounds on both the right and left elbows were completely closed and the patient reported fast improvement in the use of her elbows (Fig. 8c, d). The wounds were considered “much improved” from baseline following application of the compounded medicine.

DISCUSSION

The ability to create personalized treatments for the management of wounds and scarring is a particularly attractive premise, as it enables therapies to be tailored to the management of wounds and scars of different sizes and etiologies, and at different locations. Compounding of medications allows for the preparation of specialized treatments containing specific active ingredients at different concentrations and provides personalized therapy for the patient. This case series characterized the effects of pracaxi oil in a compounded topical anhydrous silicone base on wounds and scars in seven patients.

A recent gas chromatography analysis of pracaxi oil demonstrated that the oil is comprised of approximately 53% oleic acid, 26% linoleic acid, and 5% behenic acid [18], all of which are known to enhance wound closure and improve healing in several wound models [11, 12]. In addition, these fatty acids are known to enhance permeation of the outer layers of the skin, allowing for faster targeted delivery of water- and oil-soluble active pharmaceutical ingredients.

This case series demonstrates the beneficial effects of pracaxi oil alone when used in a compounded silicone base, and also highlights the ability of pracaxi oil to aid in the delivery of topical bactericidal and collagen-modifying drugs during wound healing and scar formation. During this study, tranilast and pentoxifylline, inhibitors of collagen synthesis and wound contraction, respectively [19, 20], were added to the compounded medicine for one patient. As collagen is the major protein deposited during scar formation, inhibition of its synthesis leads to decreased scar formation. Caffeine was also added to the compounded medicine to increase the flow of blood to the area and to aid in healing. In another patient, the bactericidal agent mupirocin was compounded with the topical anhydrous silicone base containing pracaxi oil to prevent infection. The ability to add these types of active ingredients to this base may allow for the treatment of more severe and more complex lesions, such as burns and diabetic ulcers.

Among patients with no known underlying comorbidities, pracaxi oil used alone or in combination with other active ingredients in a compounded topical anhydrous silicone base was effective in aiding wound healing and preventing or improving scars. Positive effects were seen after application in several different types of wounds including surgical, traumatic, and burn wounds. In particular, improvements in bilateral traumatic wounds of the elbow were observed in one patient. The skin of the dorsal elbow is characterized by high mobility to enable flexion and extension of the elbow during everyday use and is an area known to be particularly difficult to treat [21]. Compounded topical anhydrous silicone base containing pracaxi oil was also effective in treating two pediatric patients: one with severe burns on the face and one with extensive diaper

rash. These findings were in agreement with those from a randomized, double-blind, placebo-controlled pilot trial of a compounded topical anhydrous silicone base containing pracaxi oil in 11 adult volunteers with existing surgical, traumatic, or acne-related scarring. Patients treated with a compounded topical anhydrous silicone base containing pracaxi oil had a greater mean percent improvement from baseline in scar length, scar color, pigment intensity, contour analysis, and texture or smoothness after 8 weeks of treatment when compared with patients treated with placebo (standard moisturizer) [22]. Together with the case series described here, these results suggest that the addition of pracaxi oil to a compounded topical anhydrous silicone base leads to qualitative and quantitative improvements in wound and scar attributes.

Overall satisfaction with this compounded base was high among all patients. During the study, no patients reported any adverse effects after application of compounded base containing pracaxi oil, demonstrating that this topical therapy is well tolerated in adults and children.

While the results of this case series demonstrate an improvement in wound and scar attributes following application of a compounded topical anhydrous silicone base containing pracaxi oil, the study was not without limitations. This study was conducted in a small group of patients with varying types and degrees of wounds and scars. Patients in this study applied the compounded medication as directed by their healthcare provider, and these recommendations ranged in both the number of daily applications as well as the duration of application. In addition, as this study was retrospective in nature and not placebo- or comparator-controlled, the data presented here should be interpreted

cautiously. Larger, prospective, placebo-controlled studies examining the use of the anhydrous silicone base containing pracaxi oil may confirm the overall effectiveness and safety of this compound in the treatment of wounds and scars.

CONCLUSION

This case series demonstrates that application of a compounded anhydrous silicone base containing fatty acids from pracaxi oil, either alone or with the addition of other active ingredients, is likely to improve wound and scar attributes in pediatric and adult patients. This study provides the groundwork for future clinical trials investigating the use of compounded anhydrous silicone bases containing pracaxi oil and highlights the utility of compounding in the treatment of wounds and scars.

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Conflict of interest. D. Banov, F. Banov, and A. S. Bassani are full-time employees of PCCA

and declare that they have no conflict of interest.

Compliance with ethics guidelines. All procedures followed were in accordance with an internal committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000 and 2008. The adjudicated review of patient images by a blinded dermatologist was determined to be exempt from IRB review by Liberty IRB. Informed consent was obtained from all patients (or their legal guardians) for being included in the study and for publication of the photographs.

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