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ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

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UNCONVENTIONAL WOUND-HEALING STRATEGIES: A NARRATIVE REVIEW OF THE LITERATURE, EMPHASIZING AESTHETIC MEDICINE MODALITIES

Mikołaj Herba *[MH] (Corresponding Author, Email: Mikoaj.herba9@gmail.com)*
Upper Silesian Medical Center of Prof. Leszek Giec of the Silesian Medical University Ziołowa 45-47, 40-635 Katowice – Ochojec, Poland
ORCID ID: 0000-0002-8292-261X

Sylwia Boczek *[SB]*
Upper Silesian Medical Center of Prof. Leszek Giec of the Silesian Medical University Ziołowa 45-47, 40-635 Katowice – Ochojec, Poland
ORCID ID: 0009-0001-1947-4594

Kacper Ordon *[KO]*
Collegium Medicum, Nicolaus Copernicus University, Bydgoszcz, Poland
ORCID ID: 0009-0000-1764-3422

Patrycja Misiaszek *[PM]*
Specialist Hospital named after E. Szczeklik in Tarnów, INDEPENDENT PUBLIC HEALTH CARE FACILITY, Tarnów, Poland, Szpitalna 13, 33-100 Tarnów, Poland
ORCID ID: 0009-0002-3962-1034

Maciej Karwat *[MK]*
Independent Public Health Care Center of the Ministry of the Interior and Administration in Krakow, Kronikarza Galla 25, 30-053 Kraków, Poland
ORCID ID: 0009-0007-5917-977X

ABSTRACT

Background. In 2019, the United States devoted $126 billion to wound care—constituting 16.3 % of all patient-borne healthcare expenditures—an increase from 14.5 % in 2014, representing a 1.8-percentage-point rise. In Poland, expenditures on wound management reached $1.45 billion in the same year, accounting for 5.6 % of the national healthcare budget. These figures underscore wound care as a critical, interdisciplinary challenge for healthcare systems worldwide.
Aim. Synthesize current approaches to wound management and to elucidate the adjunctive potential of aesthetic medicine techniques in promoting tissue regeneration.
Material and methods. Between April and June 2025, we conducted a comprehensive literature search of PubMed, PMC and Google Scholar using the following keywords: "aesthetic medicine," "wound healing," "chronic wounds," "mesotherapy," "laser therapy," and "stem cells in aesthetic medicine.".
Results. Mesotherapy enhanced burn closure in rat models (glutathione reduced residual wounds to 22.7 cm^2 versus 46.4 cm^2 controls). Laser therapies (CO_2, Er:YAG, fractional) improved hypertrophic scar remodeling and chronic wound re-epithelialization, reduced inflammation, and increased collagen and angiogenesis. Microneedling and ASC-based mesotherapy accelerated hypertrophic and venous ulcer healing metrics.
Conclusions. The studies cited above have demonstrated that procedures employed in aesthetic medicine may offer significant benefits as an adjuvant therapy in the wound-healing process. In particular, emphasis has been placed on the use of high-energy sources—namely, lasers—which markedly enhance the healing of chronic wounds, especially in patients burdened by multiple comorbidities.

KEYWORDS

Chronic Wounds, Aesthetics Medicine, Mesotherapy, Laser Therapy

CITATION

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1. Introduction

In 2019, the United States devoted $126 billion to wound care—constituting 16.3 % of all patient-borne healthcare expenditures—an increase from 14.5 % in 2014, representing a 1.8-percentage-point rise. In Poland, expenditures on wound management reached $1.45 billion in the same year, accounting for 5.6 % of the national healthcare budget.(Carter et al., 2023; Queen & Harding, 2023; Statistics Poland, 2022) In the US, 10.5 million individuals were living with wounds in 2019, compared with 8.5 million in 2014; notably, the largest relative increases occurred among patients under 65 years of age (men: from 12.5 % to 16.3 %; women: from 13.4 % to 17.5 %)—underscoring that chronic wounds are not confined to the elderly.(Carter et al., 2023; Queen & Harding, 2023; Statistics Poland, 2022)

These figures underscore wound care as a critical, interdisciplinary challenge for healthcare systems worldwide. Escandona et al. reported a two-year mortality rate of 28 % among outpatients with chronic wounds, with even higher rates likely in hospitalized cohorts.(Escandon et al., 2011) Sena demonstrated that five-year mortality in patients with diabetic foot ulcers parallels that observed in certain malignancies, and quality of life for individuals with chronic wounds is significantly impaired compared to unaffected populations.(Sen, 2021) Moreover, comorbidities such as diabetes mellitus, hypertension, chronic kidney disease, and systemic atherosclerosis have been strongly correlated with increased risk of nonhealing wounds.(Erfurt-Berge & Renner, 2020)

Collectively, these data highlight the pressing need to explore novel and often unconventional therapeutic modalities. A growing body of evidence suggests that selected aesthetic medicine procedures—particularly microneedling mesotherapy and low-level laser therapy—can accelerate the healing process and improve post-repair cosmetic outcomes.(Buz et al., 2016; Prado et al., 2024) This narrative review aims to synthesize current approaches to wound management and to elucidate the adjunctive potential of aesthetic medicine techniques in promoting tissue regeneration.

2. Fundamentals of chronic wound care

The cornerstone of wound management is encapsulated in the TIME strategy, comprising tissue debridement, infection and inflammation control, moisture balance, and edge management with stimulation of epithelialization. Debridement—the first element of this framework—entails the meticulous removal of necrotic tissue, debris and other inhibitors of healing from the wound bed; adequate debridement restores a viable tissue matrix, optimizes the environment for cell migration and proliferation, and substantially reduces the risk of microbial colonization and subsequent infection.(Bartoszewicz et al., 2019) The gold standard is surgical debridement, which involves excision of all necrotic tissue together with a margin of healthy tissue to ensure complete removal of devitalized structures.(Malone & Swanson, 2017)

Within the infection and inflammation control phase, judicious antibiotic therapy is paramount; systemic or topical antibiotics should be administered on the basis of microbiological analyses, including species identification and antimicrobial susceptibility testing.(Bartoszewicz et al., 2019) It is important to recognize that bacterial biofilm formation on the wound surface markedly diminishes antibiotic efficacy and often necessitates higher or prolonged dosing to achieve therapeutic concentrations.(Almadani et al., 2021; Bartoszewicz et al., 2019)

In the edge management and epithelialization phase, priorities include infection prevention, promotion of wound closure and minimization of scar formation. To reduce hypertrophic scarring and support both cellular proliferation and re-epithelialization, maintenance of optimal wound moisture via hydrocolloid or hydrogel dressings is essential. During the healing process, application of ointments containing plant-derived active compounds (for example, chamomile) supplemented with heparin has been shown to alleviate pain and discomfort associated with wound repair.(Bartoszewicz et al., 2019; Garden et al., 2015; Nagle SM, Stevens KA, 2023; Noszczyk, 2019)

3. Research materials and methods

Between April and June 2025, we conducted a comprehensive literature search of PubMed, PMC and Google Scholar using the following keywords: “aesthetic medicine,” “wound healing,” “chronic wounds,” “mesotherapy,” “laser therapy,” and “stem cells in aesthetic medicine.” We included a broad spectrum of study designs in our analysis—meta-analyses, case–control studies, narrative and systematic reviews, cross-sectional surveys, and prospective longitudinal investigations—to ensure a thorough assessment of the available evidence. Given the paucity of studies on this topic, statistical analysis was not performed; instead, we prioritized as a key inclusion criterion those investigations employing procedures routinely utilized in aesthetic medicine.

4. Research result

Although aesthetic medicine initially focused on cosmetic skin rejuvenation, it is increasingly recognized as an adjunct in wound healing, especially for burns. Mesotherapy is a minimally invasive method involving subcutaneous microinjections of pharmacologically active agents into the dermis at minimal dosages. Both mechanical microtrauma from needle puncture and the bioactive substance contribute to healing. Traditionally used for anti-aging, cellulite reduction, and scar management, mesotherapy now shows promise in accelerating burn repair.

In a study by Buz et al., fifty male rats with uniform thermal injuries (100–120 cm²) were divided into four treatment arms—normal saline (control), glutathione, taurine, or L-carnitine—and subjected to daily intradermal injections beginning two hours post-burn and continuing for ten days. On day 22, at the end of the proliferative phase, planimetric analysis revealed mean residual unhealed areas of 22.7 cm² in the glutathione group, 28.0 cm² with taurine, 30.0 cm² with L-carnitine, and 46.4 cm² in controls.

Glutathione offers potent antioxidant protection; taurine enhances collagen synthesis and extracellular matrix formation; and L-carnitine, widely used in cellulite therapy, may stimulate fibroblast proliferation. These results underscore mesotherapy’s potential to accelerate burn wound closure, improve tissue quality, and reduce scarring. Further investigations should optimize agent selection, dosing protocols, and evaluate long-term outcomes. These preclinical findings provide a foundation for subsequent clinical trials. (Buz et al., 2016)

In the context of burn-scar management—particularly hypertrophic scars—advanced therapies, most notably laser treatment, are gaining prominence. Zuccaro et al. conducted a systematic review of the literature on the use of lasers for hypertrophic burn-scar therapy.

Laser therapy represents an additional modality in the management of chronic wound sequelae. By delivering precisely calibrated energy doses, lasers stimulate collagen synthesis within the scar matrix, thereby promoting tissue remodeling. Although generally considered safe, laser treatment carries potential risks. The most frequently reported adverse events include hyperpigmentation, infection at the irradiation site, and incomplete wound closure. Caution is therefore advised when treating patients with darker Fitzpatrick skin phototypes.(Samuel Hetz, 2024)

In the systematic review conducted by Zuccaro et al., the use of a CO_2 ablative laser (10, 660 nm) for hypertrophic burn scars was shown to yield significant improvements. Scars were evaluated using the Vancouver Scar Scale (VSS).

The authors cite the study by Blown-Eberwein et al., in which investigators performed objective scar assessments via spectrophotometry (color change), cutometry (elasticity measurement), and Semmes-Weinstein monofilament testing (sensory evaluation). They reported that laser therapy significantly enhanced scar coloration and improved sensory perception, while no change in scar elasticity was observed.(Blome-Eberwein et al., 2016; Zuccaro et al., 2017)

In their systematic review, the authors also described alternative laser modalities such as the 585 nm pulsed dye laser—which demonstrated notable improvements but was not subjected to formal statistical analysis—and intense pulsed light (IPL), although the latter studies relied on non-validated scar assessment scales. The reviewers emphasized that, given the low methodological quality of existing evidence, future rigorous randomized controlled trials incorporating both objective and subjective scar evaluation methods are essential to confirm the efficacy of laser therapy in treating hypertrophic post-burn scars.(Zuccaro et al., 2017)

In recognition of the need for rigorous investigation into aesthetic medicine techniques for hypertrophic scar management, Mota WM et al. assessed the efficacy of microneedling in treating post-burn hypertrophic scars. Fifteen patients with second- or third-degree burns sustained at least three months before therapy initiation (mean latency ten months) underwent treatment. Procedures were performed under local or general anesthesia using a sterile Dr. Roller device with 2.5 mm needles. Microneedling was applied in four orientations (horizontal, vertical, and two diagonals), immediately followed by intralesional triamcinolone (20 mg/mL). Sessions were repeated every one to two months, with further treatments prompted by symptom recurrence (pruritus, erythema, increased scar volume) or patient-driven cosmetic concerns.

Clinical outcomes were evaluated via the Vancouver Scar Scale (VSS) before the first session and four weeks after the final treatment. The Burn Scar Assessment Scale (BSAS) was also used to quantify pigmentation, hydration, surface irregularity, and scar size. Two independent plastic surgeons conducted all assessments, and the data were subjected to statistical analysis.

A total of 50 microneedling sessions were completed, with a mean follow-up of 17 months. Statistically significant improvements were recorded across all VSS parameters—pigmentation, vascularity, pliability, and scar height—and BSAS scores demonstrated gradual enhancement throughout the treatment course. Patients with pre-existing mobility limitations also experienced functional gains. Reported adverse events included minor bleeding and transient burning sensations at the treatment sites.(Mota et al., 2024)

Aesthetic medicine techniques have potential applications in supporting chronic wound treatment. Andrade et al. conducted a systematic review on the impact of low-level laser therapy on wound healing. Beyond enhanced collagen synthesis, low-level laser exposure increases mitochondrial activity, adenosine triphosphate (ATP) production, vasodilation, and protein synthesis; reduces inflammation via decreased prostaglandin release; and promotes neoangiogenesis as well as keratinocyte migration and proliferation. These mechanisms may accelerate healing by elevating fibroblast growth factor levels through keratinocyte proliferation. Elevated ATP also indirectly bolsters collagen synthesis and accelerates re-epithelialization and granulation. The review noted that 4 J/cm² doses enhance type III collagen synthesis, whereas 7–9 J/cm² exert an inhibitory effect.(Andrade et al., 2014) In the study by Hamblin et al., laser therapy was shown to reduce inflammation, alleviate pain, and prevent edema. It also exhibited protective effects on tissues and nerves adjacent to the injury site. These outcomes were achieved using wavelengths of 600–1000 nm and power densities of 1–5 W/cm².(Andrade et al., 2014; Hamblin et al., 2011)

In the systematic review by Li Z. et al., the authors examine the application of fractional ablative lasers in treating recalcitrant wounds. They first reference the study by Shumaker et al., in which a fractional CO_2 ablative laser was applied to a patient with numerous hypertrophic scars and non-healing wounds. Significant acceleration of the healing process was observed one week post-treatment, and by two months the epidermis within the wound area had been nearly completely restored.(Li et al., 2025; Shumaker et al., 2012)

Subsequently, the authors described the study by Philips et al. involving three elderly patients with chronic lower-limb ulcers. Treatment with a fractional CO_2 laser resulted in re-epithelialization of over 60% of the wound surface after three weeks.(Li et al., 2025; Phillips et al., 2015)

The review also assessed the safety of laser application in a paediatric population. Krakowski et al. investigated fractional CO_2 laser therapy in two children, both of whom achieved complete wound healing without any recurrence of symptoms. (Krakowski et al., 2016; Li et al., 2025)

Another patient population included in the review comprised individuals with diabetic foot ulcers. M. Monami et al. investigated the efficacy of fractional CO_2 laser therapy in promoting wound healing among 14 patients presenting with exposed bone tissue as a complication of diabetic foot. Out of the total cohort, five patients additionally received platelet-rich plasma (PRP) as part of their treatment protocol. Among the nine patients treated exclusively with laser therapy, complete wound closure was observed in four cases within three months following the intervention. In one additional case, granulation tissue formation progressed to the extent that it fully covered the previously exposed bone surface. In the subgroup of patients who received both CO_2 laser treatment and adjunctive PRP therapy, complete healing was achieved in two individuals within the same three-month period. In the remaining two patients from this subgroup, extensive granulation tissue formation was observed, covering the entirety of the exposed osseous area.(Li et al., 2025; Monami et al., 2017)

The application of laser therapy was also examined in a cohort of 18 patients undergoing debridement for chronic wounds. Jiang Bo et al. reported that the use of CO_2 laser during the wound debridement process contributed to an acceleration of healing, a reduction in bacterial load, and an overall improvement in local tissue perfusion. These findings suggest that laser-assisted debridement may offer clinically meaningful advantages in the management of chronic, non-healing wounds.(Jiang et al., 2021; Li et al., 2025)

In another study included in the review, Liu Y. et al. compared conventional wound care using standard dressings with an enhanced therapeutic protocol incorporating adjunctive CO_2 laser therapy. The results indicated that there was no statistically significant difference in the degree of wound edema between the two groups. However, patients receiving laser treatment demonstrated significantly greater granulation tissue formation as well as a more rapid rate of wound healing, suggesting a potential advantage of laser-assisted therapy in promoting tissue regeneration.(Li et al., 2025)

The largest study included in the review was conducted by Wang Mengxiao et al., involving 122 patients with hard-to-heal wounds. The researchers assessed the efficacy of a combined therapeutic approach using CO_2 laser therapy in conjunction with photodynamic therapy. The modified treatment protocol resulted in increased secretion of growth factors within the wound exudate, suppression of bacterial proliferation, and attenuation of the local inflammatory response. Consequently, an accelerated rate of wound healing was observed, with no significant change in the incidence of adverse effects, indicating that the combination therapy was both effective and well tolerated.(Li et al., 2025)

In addition to CO_2 lasers, attention has also been directed toward the use of Er:YAG lasers (Erbium:Yttrium-Aluminum-Garnet). In a study included in the review and published by P. Mezzana et al., the application of the Er:YAG laser was investigated in a cohort of 30 patients with chronic wounds that had not responded to a three-month treatment regimen involving collagen matrix and regenerated cellulose. The Er:YAG laser was employed to perform wound debridement, after which the wounds were covered with collagen matrices. The authors reported initiation of the healing process within seven days following laser application, and by 2.5 months, complete wound closure was achieved in 90% of the treated patients.(Li et al., 2025; Mezzana et al., 2008)

The review also discussed the application of the Er:YAG laser in 18 patients with diabetic foot ulcers. During the initial four weeks of standard wound care, no significant progress in healing was observed. Following the introduction of laser therapy, wound size was reduced by more than 50% within four weeks, and by week 12, 50% of the ulcers had completely healed. Notably, all wounds that failed to demonstrate improvement by week 4 did not derive therapeutic benefit from subsequent laser treatment.(Johnson et al., 2019; Li et al., 2025)

The authors refer to studies indicating that the use of Er:YAG laser for wound debridement, when compared to conventional surgical wound management, is more effective in terms of reducing patient-reported pain levels and leads to a decrease in bacterial concentration within the wound area.(Hajhosseini et al., 2020; Li et al., 2025)

In the final study included in the review, Caliskan et al. conducted a retrospective analysis evaluating the clinical relevance of using the Er:YAG laser in 23 patients with hard-to-heal chronic wounds. After one year of treatment, 79% of the lesions achieved complete epithelialization. Among the nine wounds that did not reach full epithelialization, 44.4% had a wound surface area greater than 50 cm^2, another 44.4% were arterial ulcers, and 11.1% of the patients died due to diabetes-related complications.(Caliskan & Botsali, 2022; Li et al., 2025)

The authors attributed the beneficial effects of laser therapy to several mechanisms. One of the key actions involves improved tissue perfusion, as previously described. Additionally, lasers appear to reduce mechanical tension in the periwound skin, a process associated with enhanced proliferation and migration of keratinocytes from the wound edges. Fractional ablation of the surrounding skin tissue contributes to partial mechanical relaxation, thereby decreasing tension around the wound site. This reduction in peripheral skin tension may limit wound-edge contraction and recurrence risk, ultimately supporting more stable and durable wound healing. Laser application also facilitates the formation of micropores in the skin, enhancing the transdermal absorption of active agents used in wound therapy. Beyond the aforementioned anti-inflammatory effects, laser treatment has demonstrated antimicrobial properties, reducing bacterial load within the wound environment. Furthermore, laser exposure influences intracellular signaling pathways that accelerate the wound-healing process. The microthermal energy generated during CO_2 laser application induces the expression of heat shock proteins (HSPs) at the cellular level. HSPs play a pivotal role in protecting cells from thermal stress while regulating key processes such as apoptosis and cellular proliferation, thereby ensuring cellular integrity and promoting subsequent phases of tissue repair.(Li et al., 2025)

In the scientific literature, increasing attention is being given to cell-based therapies, particularly those involving stem cells, which are also gaining relevance within the field of aesthetic medicine focused on tissue regeneration. A notable example includes a study conducted by J. Kmiecik et al., which examined the impact of antlerogenic stem cells (ASCs) on the wound healing process. The stem cells were derived from a formulation known as"Revitacell: the preparation for regenerative mesotherapy, " which contains stem cells obtained from deer antlers. The final preparation administered to patients included ASCs along with supplementary components such as allantoin and vitamins B3 and B5.(Kmiecik et al., 2021)

The study population consisted of 20 individuals diagnosed with venous leg ulcers. Thirteen participants were assigned to the treatment group, while the remaining seven comprised the control group. The treatment protocol for all participants included phototherapy, application of specialized dressings (Suprasorb F), and wound management based on the TIME framework. In addition to standard care, individuals in the treatment group received 1–3 mL of ASC extract per wound dressing change, with the volume adjusted based on wound size. During follow-up visits, wound area and perimeter were measured, and healing dynamics were evaluated using several parameters: wound surface area, percentage of healed wound area, total reduction in wound size, and the ratio of wound perimeter to surface area.(Kmiecik et al., 2021)

During the initial evaluation of wound-related parameters—specifically wound surface area, wound perimeter, and the surface area-to-perimeter ratio—no statistically significant differences were observed between the treatment and control groups. However, in subsequent stages of wound healing assessment, statistically significant differences emerged between the groups in the following parameters: wound surface area, wound perimeter, surface area-to-perimeter ratio, reduction in wound surface area after one week of therapy, and the percentage of fully healed wounds during the first week of the healing process.(Kmiecik et al., 2021)

5. Discussion

Aesthetic medicine currently has the potential to complement wound management in selected, highly specific clinical scenarios; nevertheless, its application in this context remains comparatively limited, a reality reflected by the scarcity of robust data in the peer-reviewed literature. Most studies evaluating the impact of aesthetic interventions on the wound-healing process involve small patient cohorts and are frequently conducted in vitro or in animal models, thereby significantly restricting the external validity and clinical applicability of their findings. Although systematic reviews on this topic can be located in databases such as PubMed, the evidence base remains incomplete due to the limited number of high-quality, methodologically rigorous investigations. To date, only a few clinical trials with larger sample sizes have been undertaken, and these have predominantly focused on laser-based therapies; in vivo studies typically enroll only a small number of participants, which diminishes statistical power and undermines the reliability of the results. Consequently, there is an urgent need for further, well-designed clinical research to definitively determine the efficacy and safety of various aesthetic medicine techniques in wound care and to develop standardized, evidence-based therapeutic protocols.

The translation of these findings into routine clinical practice is currently hampered by a lack of standardized treatment parameters and robust long-term data. Future investigations must rigorously define optimal energy settings, session frequency and patient selection criteria—particularly across differing skin phototypes—to ensure safety and maximize therapeutic efficacy. Comprehensive assessment of cost-effectiveness and functional outcomes over extended follow-up periods will be critical to justify incorporation into multidisciplinary wound-care algorithms. Moreover, elucidation of the underlying molecular and cellular mechanisms of action will inform the development of evidence-based guidelines, thereby solidifying the role of aesthetic interventions as well-defined, supportive components within the broader framework of chronic wound management.

6. Conclusions

Aesthetic medicine modalities—most notably high-energy laser therapies—have demonstrated considerable adjunctive benefits in chronic wound management by accelerating tissue repair, improving scar quality, enhancing cellular metabolism, reducing inflammation and stimulating the synthesis of essential structural proteins. Laser interventions are particularly valuable during the debridement phase and in patients with multiple comorbidities, although caution is warranted when treating darker skin phenotypes to mitigate the risk of pigmentary alterations. Mesotherapy and microneedling similarly promote dermal regeneration by inducing controlled mechanical injury that increases collagen deposition, releases growth factors and enables localized delivery of bioactive agents. Despite these promising outcomes, the existing evidence remains preliminary and limited by small sample sizes and heterogeneous protocols; accordingly, aesthetic procedures should be regarded strictly as supportive adjuncts rather than primary wound-healing therapies.

Author Contributions

Writing and editing: Mikołaj Herba, Sylwia Boczek, Kacper Ordon
Conceptualization: Mikołaj Herba, Sylwia Boczek, Kacper Ordon, Patrycja Misiaszek, Maciej Karwat
Methodology: Mikołaj Herba
Resources: Mikołaj Herba, Sylwia Boczek, Kacper Ordon
Supervision: Sylwia Boczek, Kacper Ordon, Patrycja Misiaszek, Maciej Karwat

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