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Innovative Treatment and Care Approaches in Burn Wounds: A Narrative Review

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ABSTRACT

This narrative review aims to provide a comprehensive overview of current and innovative approaches to the treatment and care of burn wounds. A literature search was conducted between August and October 2025 using PubMed, Web of Science, ScienceDirect, EBSCOhost, the Cochrane Library, and Google Scholar. Experimental studies, clinical trials, systematic reviews, and meta-analyses published between 2000 and 2025 were evaluated. The reviewed evidence indicates that interactive and bioactive dressings, mesenchymal stem cell therapies, bioengineered skin substitutes, and nanotechnology-based materials contribute to accelerated wound healing, reduced infection risk, and improved functional and aesthetic outcomes. Innovative debridement techniques, including hydrosurgical and enzymatic debridement, as well as negative pressure wound therapy, have demonstrated favorable clinical outcomes in selected cases by preserving viable tissue, enhancing graft success, and promoting wound healing. Advanced imaging technologies such as Laser Doppler Imaging (LDI), Laser Speckle Imaging (LSI), thermography, Optical Coherence Tomography (OCT/OCTA), Spatial Frequency Domain Imaging (SFDI), and Hyperspectral Imaging (HSI) provide more objective and accurate assessment of burn depth and healing potential. Furthermore, telehealth applications, artificial intelligence–based decision support systems, and virtual/augmented reality technologies are increasingly supporting triage, prognostic prediction, pain management, and rehabilitation processes.

In conclusion, innovative approaches in burn care represent a multidimensional transformation that extends beyond wound closure to improve patient comfort, quality of life, and long-term functional outcomes. However, the safe and effective integration of these technologies into routine clinical practice requires standardized protocols, cost-effectiveness evaluations, and stronger clinical evidence generated through high-quality research.

Keywords: Burn Wounds; Innovation; Treatment; Care

Abbreviations: LDI: Laser Doppler Imaging; LSI: Laser Speckle Imaging; OCT: Optical Coherence Tomography; SFDI: Spatial Frequency Domain Imaging; HSI: Hyperspectral Imaging; MSC: Mesenchymal Stem Cell; DESS: Dermo-Epidermal Skin Substitutes; DNA-Cryo-Acol: DNA-Functionalized Collagen Dressings; TDH: Tetrahedral DNA Hydrogel; ROS: Reactive Oxygen Species; NPWT: Negative Pressure Wound Therapy; SVMs: Support Vector Machines; BoBS: Bochum Burn Survival; VR: Virtual Reality; AR : Augmented Reality; RCTs: Randomized Controlled Trials

Introduction

Burns constitute a significant global health burden worldwide, particularly in low- and middle-income countries [1]. Historically, initial treatments were limited to herbal mixtures, oils, and traditional practices; today, burn care has evolved into a multidisciplinary approach encompassing surgery, nutritional support, infection control, rehabilitation, and advanced technologies [2]. Early excision, autografts, and topical/systemic antimicrobial treatments continue to form the basis of burn care. However, in recent years, the importance of innovative approaches that reduce hospital stays, increase graft success, improve aesthetic and functional outcomes, and enhance patient comfort has grown [3,4]. These innovative approaches affect multidimensional patient outcomes beyond wound healing, including pain, anxiety, fear, body image, quality of life, and family harmony. This highlights the importance of multidisciplinary team members in burn care having up-to-date knowledge grounded in evidence-based practices.

Method

This study is a narrative review addressing innovative treatment and care approaches for burn wounds. A literature search was conducted in PubMed, Web of Science, ScienceDirect, EBSCOhost, the Cochrane Library, and Google Scholar between August and October 2025. Keyword combinations including "burn," "burn injury," "burn wound," "innovative," "innovation," "nanotechnology," "stem cell," "virtual reality," "augmented reality," "3D bioprinting," "negative pressure wound therapy," and their Turkish equivalents were used. Priority was given to English- and Turkish-language articles published between 2000 and 2025 that involved human studies and for which the full text was available. Experimental or clinical studies, systematic reviews, and meta-analyses were included; abstract-only publications were excluded. Artificial intelligence–based tools were used for literature screening, summarisation, language editing, and reference management; however, all content and conclusions were verified by the researcher using sources. Burn care has evolved through the integration of advanced dressings, regenerative therapies, innovative debridement methods, imaging technologies, and digital health applications. The major innovations discussed in this review are summarized in (Figure 1).

Note: Source: Created by the authors.
Figure 1: Major innovations in contemporary burn care.

From Traditional Approaches to Modern Treatments

Historical records indicate that herbal mixtures, oils, honey, milk, and animal-derived products were used for centuries to treat burns [2,5]. However, most lacked scientific evidence regarding infection control and tissue regeneration. In contrast, modern studies have confirmed antimicrobial and regenerative properties of selected traditional agents such as honey and silver [6-9]. The introduction of systemic antibiotics, topical silver compounds, and antiseptic surgical techniques since the mid-20th century significantly reduced sepsis-related mortality [3,10]. Early excision and grafting techniques minimised complications associated with prolonged open wounds, such as infection, fluid loss, and metabolic stress, thereby markedly improving survival [4,11]. This historical transformation demon-

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strates that burn care has evolved from survival-focused strategies to patient-centred, regenerative, and outcome-oriented approaches. Today, burn treatment integrates advanced dressings, cell-based therapies, nanotechnology, imaging, and digital health systems [1]. Modern burn treatments are addressed within a multidisciplinary framework that encompasses interactive and bioactive dressings, cell-based regenerative therapies, nanotechnology-enabled materials, and advanced imaging and digital health systems. The following chapters will discuss modern wound dressings, cell-based therapies, nanotechnology, advanced debridement methods, 3D bioprinting, advanced imaging techniques, and digital health applications within the context of current innovations in burn treatment.

Modern Wound Dressings and Bioengineering Approaches

Interactive and Bioactive Dressings

Modern wound dressings primarily consist of synthetic polymers. They are classified into three main groups: interactive dressings (semi-permeable films, foams), advanced interactive dressings (hydrocolloid and hydrogel structures), and bioactive dressings (tissue-engineered skin equivalents) [12]. These dressings accelerate epithelialization by maintaining a moist wound-healing environment, reducing the risk of infection due to oxygen permeability, decreasing pain and the frequency of dressing changes, and improving graft retention and scar quality, particularly in deep burns [4,13,14]. In addition, the use of specific traditional components in controlled, standardised forms, alongside modern dressing approaches, is noteworthy with respect to clinical outcomes. It has been reported that applying a mixture of beeswax, olive oil, and Alkanna tinctoria (L.) Tausch in second-degree burns shortens the time to epithelialization, reduces pain during dressing changes, and significantly reduces hospital stay [15]. In recent years, dressings containing nanocrystalline silver, which have become widespread in clinical applications, reduce microbial load due to their broad-spectrum antimicrobial activity, thereby shortening healing time and contributing to pain control [16]. Hydrogel- and biopolymer-based dressings (structures containing chitosan and glycosaminoglycans) accelerate tissue regeneration and promote wound healing by supporting fibroblast proliferation and angiogenesis [17].

Furthermore, carbon fiber-containing dressings have been reported to exhibit antimicrobial properties and to suppress inflammatory responses, thereby contributing to the healing process [18]. In addition to supporting interactive and bioactive dressing approaches, platelet-rich plasma (PRP) applications have been shown to accelerate epithelialization, modulate inflammation, and reduce pain intensity in experimental burn models. PRP is increasingly attracting attention as a complementary biological treatment option alongside modern dressing approaches [13,19].

Mesenchymal Stem Cells and Cell-Based Therapies

Stem cell–based approaches have become a prominent area of regenerative medicine in recent years owing to their potential to accelerate burn-wound healing. In this context, mesenchymal stem cell (MSC) transplantation and cultured keratinocyte and fibroblast grafts are among the cell-based therapies that support tissue regeneration [20,21]. It has been reported that stem cell applications accelerate reepithelialisation by increasing cellular proliferation and differentiation, modulate the inflammatory response, and improve wound healing both functionally and aesthetically [22,23]. In experimental burn models in which MSC transplantation was applied, a marked increase in burn-healing potential, improved reepithelialisation, neovascularisation, and collagen deposition was observed in the treated groups [24,25]. Cytokine analyses revealed that MSC application exerts regulatory effects on the immune response, characterised by increases in IL-6 and IFN-α levels, an early decrease in IL-10 and TGF-β responses, followed by a gradual increase up to day 28, resulting in dynamic immunomodulation. Histological findings also confirm that MSC transplantation supports tissue regeneration and accelerates the wound healing process [25].

Moreover, systematic reviews of cell-based therapies involving keratinocytes, fibroblasts, and various stem cell types indicate that these approaches shorten wound closure time, increase graft take, and reduce scar formation [23,26,27]. In particular, autologous and allogeneic cell grafts, cell–scaffold combinations, and combined graft–cell applications offer significant therapeutic potential for repairing tissue loss and reducing morbidity in severe burns [28,29].

Bioengineered Skin Equivalents and Nanotechnology-Based Dressings

Bioengineered skin equivalents consist of biological or synthetic materials designed to mimic the structure and functions of natural skin and, when enriched with cells and/or growth factors, offer advanced treatment options that support tissue regeneration [26]. In this context, bioengineered dermo-epidermal skin substitutes (DESS) have attracted attention for producing outcomes comparable to natural skin in both functional and aesthetic terms. These products offer clinically significant advantages, particularly for large-surface burns, by reducing the need for donor sites [30]. Recent studies demonstrate that, in bioengineering approaches utilising adipose tissue–derived cells, achieving in vitro capillary network formation enhances vascularisation; this, in turn, strengthens graft take and significantly improves cellular renewal and tissue integrity. One prominent application in this context is DenovoSkin, a bioengineered dermo-epidermal skin substitute developed at the University of Zurich and derived from autologous cells. Clinical findings indicate that DenovoSkin can provide long-term aesthetic and functional outcomes in pediatric patients that are comparable to, and in some aspects superior to, con-

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ventional skin grafts [31]. Positive results from Phase I clinical studies have established a strong foundation for subsequent Phase II trials and suggest that the product may be a promising treatment option for extensive burns and complex skin defects.

Innovative biomaterials, developed as complementary approaches to bioengineered skin equivalents, attract attention for their potential to modulate the cellular microenvironment. DNA-functionalized collagen dressings (DNA-Cryo-ACol), compared with conventional dressings, have demonstrated faster exudate drainage, high absorption capacity, and anti-maceration effects; they have also modulated the immune response, reduced scar formation, and supported tissue regeneration and hair follicle renewal [32]. Similarly, tetrahedral DNA hydrogel (TDH) has exhibited anti-inflammatory and antioxidant effects owing to its biodegradability, ability to scavenge reactive oxygen species (ROS), hemostatic properties, and strong adhesion; by regulating macrophage, fibroblast, and keratinocyte interactions, it has accelerated reepithelialisation and tissue repair. These findings indicate that DNA-based biomaterials possess promising translational potential within advanced bioengineering approaches [33]. Another innovative approach in this field, nanotechnology-based dressings, enables the direct delivery of antimicrobial agents, growth factors, and herbal compounds to the wound site in the form of nanoparticles, nanofibers, nanogels, and nanoemulsions.

These systems offer multifaceted advantages, including reduced risk of infection, support for collagen synthesis and angiogenesis, shorter healing time, and improved scar quality [34-36]. In particular, biopolymeric matrices loaded with herbal compounds and green-synthesised zinc oxide nanoparticles have been reported to significantly support burn healing due to their high biocompatibility and strong antibacterial effects [37].

Three-Dimensional (3D) Bioprinting and Tissue Engineering

Beyond bioengineered skin equivalents and nanotechnology-based systems, three-dimensional (3D) bioprinting technologies represent the next phase of regenerative medicine, aimed at producing personalised, complex skin tissues. 3D bioprinting enables the creation of structures that more closely resemble natural skin architecture through the computer-assisted layer-by-layer deposition of cells, hydrogels, and biomaterials [38].

It has been reported that 3D-printed patches enriched with bioactive compounds (e.g., bromelain and Aloe vera) reduce oxidative stress through their antioxidant and anti-inflammatory properties and adapt to different stages of wound healing via pH-sensitive controlled-release mechanisms [39,40]. However, technical challenges—including achieving adequate vascularisation, integrating nerve fibres and skin appendages, production time, cost, and potential immune responses—have kept 3D bioprinting primarily at an experimental stage, with limited clinical application at present [41,42]. Nevertheless, for personalised skin grafts and advanced regenerative therapies, 3D bioprinting holds significant potential for the future of burn care [43,44].

Innovative Debridement Methods and Negative Pressure Wound Therapy

Hydrosurgical excision (Versajet®) is a tissue-preserving debridement method that enables the selective removal of necrotic tissue using pressurised saline jets and is particularly suitable for functionally and aesthetically critical areas such as facial and hand burns. Randomised clinical studies have demonstrated that, compared with conventional surgical debridement, this approach yields better scar quality and tissue elasticity. In contrast, histological examinations have shown preservation of greater amounts of dermal tissue [45]. Studies on the application of enzymatic debridement (NexoBrid®) report shorter debridement times, lower rates of bacteremia, and clinical outcomes comparable to surgical excision, including length of intensive care stay and mortality. In addition, it is emphasised that enzymatic debridement methods have gained importance as a complementary or alternative option in burn care, as they can reduce the need for surgical intervention in selected cases [1,46]. Negative pressure wound therapy (NPWT) is widely used in burn care for its support of graft take—particularly in grafted areas—enhanced local perfusion, and accelerated granulation tissue formation. In selected cases, such as electrical burns, NPWT has been reported to promote the formation of adequate granulation tissue within 4–6 days, thereby enabling early reconstruction [47,48].

Next-Generation Imaging and Diagnostic Technologies

Laser Doppler Imaging (LDI) and Laser Speckle Imaging (LSI)

Although clinical assessment remains the gold standard for determining burn depth, the need for objective, quantitative methods is increasing due to interobserver variability [49]. In this context, Laser Doppler Imaging (LDI) is a non-invasive technique widely used to predict burn depth and healing potential. According to meta-analytic findings, the accuracy of LDI in estimating burn depth ranges from 90% to 100%, with sensitivity and specificity of 91% and 96%, respectively [50]. Laser Speckle Imaging (LSI) is a non-invasive imaging method that quantitatively assesses tissue perfusion with high sensitivity. LSI's ability to provide intraoperative guidance offers a significant advantage in surgical decision-making [51]. Experimental studies conducted in a porcine model demonstrated that burns ranging from superficial partial-thickness to full-thickness were monitored over three days, and that changes in blood flow were able to distinguish superficial partial-thickness and deep partial-thickness burns as early as one hour after burn injury [52]. In addition, changes in the reduced scattering coefficient were reported to be decisive in differentiating superficial partial-thickness, deep partial-thickness, and full-thickness burns at an early stage after injury. With these characteristics, LSI is regarded as a powerful diagnostic tool with the potential to guide early diagnosis of burn severity and treatment planning [53].

Thermography, Optical Coherence Tomography (OCT), Spatial Frequency Domain Imaging (SFDI), and Hyperspectral Imaging (HSI)

Thermography is a low-cost, rapid, and non-invasive imaging method that uses temperature differences in burn wounds as prognostic indicators. In severe burns, lesions appear cooler than healthy skin due to reduced blood flow; in contrast, superficial burns yield warmer images because of preserved perfusion and hyperemia. Studies comparing thermography with LDI have reported no systematic differences between the methods, indicating that thermography yields results with high reliability and good validity, comparable in accuracy to LDI, for assessing burn depth [54,55]. In this respect, thermography stands out as a practical tool that supports clinical decision-making processes. Optical Coherence Tomography (OCT) is a non-invasive imaging technique that uses near-infrared light instead of sound waves, unlike ultrasonography. OCT-based angiography (OCTA) systems developed by the University of Washington have been shown to objectively visualise vascular structures, oedema, and the depth of tissue damage in burn tissue [56-58]. These findings demonstrate that OCT/OCTA technologies provide reliable criteria for morphological assessment, burn classification, and treatment planning. Spatial Frequency Domain Imaging (SFDI) is a contactless method that measures tissue optical properties and, through multi-wavelength analysis, enables quantitative assessment of oxygenation, oxy- and deoxyhemoglobin levels, and scattering properties [59,60].

Studies using SFDI have reported that reduced scattering coefficients are consistent with histologically confirmed extracellular matrix changes. At the same time, haemoglobin concentration maps provide valuable information on microvascular development and perfusion in the wound bed [61]. Hyperspectral Imaging (HSI) is an advanced imaging technique that enables mapping of biological parameters, such as oxygen saturation (StO_2) and blood flow, by analysing light across hundreds of narrow spectral bands. Evaluating the spectral signature of each pixel provides substantially more detailed and functional tissue information than conventional methods. Studies employing HSI have shown that the technique provides new insights into burn classification within the first four days and that analyses based on perfusion parameters allow differentiation between superficial and deep burns [62,63]. These advanced imaging technologies are increasingly important in burn care as powerful tools that enable more accurate determination of surgical excision timing, graft requirements, and treatment strategies, while also allowing objective, quantitative, and reproducible monitoring of wounds.

Telemedicine, Telehealth, and Artificial Intelligence–Supported Systems

Telemedicine and telehealth applications are assuming an increasingly important role in the early assessment and management of patients, particularly those located in regions distant from burn centres. By transmitting clinical images and data remotely, these technologies increase the accuracy of burn depth and total body surface area (TBSA) calculations, improve triage processes, and prevent unnecessary patient transfers. Studies have shown that telemedicine-based burn assessments yield results comparable in accuracy to face-to-face examinations and notably support early triage and emergency intervention decisions. As a result, increased cost-effectiveness, more efficient use of healthcare resources, and improved patient satisfaction have been reported [14,64,65]. In parallel with the development of telehealth applications, artificial intelligence (AI) and machine learning–based clinical decision support systems are ushering in a new era in burn care. These systems, trained on large patient datasets, provide healthcare professionals with strong analytical support in predicting burn depth, healing trajectories, and mortality risk 1. In particular, integrating imaging data with machine learning algorithms significantly enhances diagnostic accuracy. One notable example in this field is the development of burn classification systems that combine Spatial Frequency Domain Imaging (SFDI) data with machine learning models, such as Support Vector Machines (SVMs).

In a study using a porcine burn model, this approach predicted burn severity with 92.5% accuracy within the first 24 hours after injury, thereby enabling early and accurate clinical decision-making [66]. In addition, machine learning–based prognostic scores have begun to be integrated into clinical practice. The Bochum Burn Survival (BoBS) Score was developed using data from more than 10,000 patients obtained from the German Burn Registry and employs algorithms such as XGBoost, Random Forest, and Gradient Boosting. This scoring system goes beyond traditional scoring models in predicting burn mortality by providing a more sensitive, individualised, interpretable, and clinically applicable decision-support tool [67]. Collectively, these developments indicate that telemedicine, artificial intelligence, and machine learning–based systems will play a central role in the future of burn care, particularly in early diagnosis, accurate triage, personalised treatment planning, and prognostication.

Rehabilitation, Pain Management, and Digital Health: VR/AR Applications

Burn dressing and the rehabilitation process are associated with significant pain, fear, and anxiety, particularly in pediatric patients. Therefore, digital health applications, such as virtual reality (VR) and augmented reality (AR), have emerged as innovative, non-pharmacological approaches in burn care. VR applications aim to reduce pain perception through distraction; randomised controlled trials and meta-analyses demonstrate that the use of VR during wound care signifi-

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cantly reduces levels of pain, fear, and anxiety [68,69]. AR-based applications, by contrast, focus on increasing active participation in the rehabilitation process. It has been reported that AR-supported hand rehabilitation improves hand function in patients with pediatric hand burns. At the same time, AR-based educational materials improve the quality of life among individuals with facial and neck burns [70,71].

Among more advanced digital technologies, holographic and mixed-reality applications enhance perceptual interaction through three-dimensional visualisation, and studies have demonstrated their effectiveness in medical education and diagnostic processes [72,73]. Although clinical data on the direct use of hologram technology in burn dressings remain limited, it is considered a worthwhile approach for future research due to its potential to distract and improve the patient experience [74,75]. These findings indicate that digital health technologies provide supportive, feasible, and patient-centred tools for pain management and rehabilitation in burn care.

Clinical Translation of Innovative Approaches in Burn Care

Immediately after presenting innovative approaches in burn management, translating these advancements into clinical decision-making requires a structured evaluation of the strength of the evidence, feasibility, and patient-centered outcomes. (Table 1) summarizes the current innovations by clinical indication, level of evidence, reported benefits, limitations, and practical recommendations.

Table 1: Clinical Translation of Innovative Approaches in Burn Care.

Innovation Category	Clinical Indication	Level of Evidence*	Reported Clinical Benefit	Limitations	Practical Recommendation
Interactive/Bioactive Dressings	Superficial–partial thickness burns	Moderate (Systematic reviews, RCTs)	Faster epithelialization, reduced pain, fewer dressing changes	Cost variability, product heterogeneity	Recommended as first-line in superficial burns when infection risk is controlled
Nanocrystalline Silver Dressings	Contaminated or infection-prone wounds	Moderate	Broad antimicrobial effect, reduced microbial load	Potential cytotoxicity in prolonged use	Short-term use advised in high-risk wounds
Mesenchymal Stem Cell Therapy	Deep partial and full-thickness burns	Low–Moderate (Preclinical + early trials)	Enhanced re-epithelialization, immunomodulation	Limited large-scale RCTs	Promising adjunct in severe burns; further clinical trials needed
Bioengineered Skin Equivalents (e.g., DESS)	Large surface burns	Moderate	Reduced donor-site morbidity, improved aesthetic outcomes	High cost, production time	Consider in extensive burns when autograft availability is limited
3D Bioprinting	Experimental severe tissue loss	Low (Preclinical/early clinical)	Personalized tissue reconstruction potential	Vascularization challenges, cost	Currently experimental; not routine practice
Hydrosurgical Debridement (Versajet®)	Functionally/aesthetically sensitive areas	Moderate (RCTs available)	Dermal preservation, improved scar quality	Equipment cost	Recommended in facial/hand burns where tissue preservation is critical
Enzymatic Debridement (NexoBrid®)	Selected deep burns	Moderate	Reduced surgical need, shorter debridement time	Pain during application	Consider in selected patients as surgical alternative
NPWT	Grafted burns, electrical burns	Moderate	Improved graft take, enhanced perfusion	Device dependency	Strongly recommended post-grafting in selected cases
LDI / LSI	Burn depth assessment (24–72h)	High (Meta-analyses)	High diagnostic accuracy (90–100%)	Equipment availability	Recommended adjunct to clinical assessment
Thermography	Early depth estimation	Moderate	Comparable reliability to LDI	Environmental sensitivity	Useful low-cost alternative
AI-based Burn Prediction Models	Mortality and healing prediction	Moderate	Improved prognostic accuracy	Algorithm transparency	Promising decision-support tool
VR for Pain Management	Dressing changes (pediatric & adult)	High (RCTs & meta-analyses)	Significant reduction in pain, fear, anxiety	Equipment access	Strongly recommended as non-pharmacological adjunct

Evidence Gaps and Future Research Priorities

Despite significant advancements in innovative burn-care technologies, several critical evidence gaps remain that limit their full integration into routine clinical practice. First, although regenerative approaches such as mesenchymal stem cell therapy, bioengineered skin substitutes, and nanotechnology-based dressings demonstrate promising biological and translational potential, the majority of evidence is derived from preclinical models or early-phase clinical trials. Large-scale, multicenter randomized controlled trials (RCTs) with standardized outcome measures are still lacking. Furthermore, heterogeneity in cell sources, scaffold materials, and manufacturing processes complicates reproducibility and cross-study comparison. Second, while advanced imaging modalities (LDI, LSI, OCT/OCTA, SFDI, and hyperspectral imaging) report high diagnostic accuracy, comparative effectiveness studies evaluating cost-benefit ratios, learning curves, and integration into emergency workflows remain insufficient. In many settings, accessibility and equipment costs restrict widespread implementation, particularly in low- and middle-income countries. Third, artificial intelligence–based decision-support systems have shown promising predictive performance in mortality and burn-depth estimation; however, concerns regarding algorithm transparency, external validation, dataset bias, and regulatory standardization persist. Many models are trained on single-center datasets, limiting generalizability across diverse populations and healthcare systems.

Fourth, although virtual reality (VR) and augmented reality (AR) applications demonstrate strong evidence for pain and anxiety reduction during burn dressing procedures, long-term psychological outcomes, optimal session duration, cost-effectiveness analyses, and integration into standard analgesic protocols require further investigation. Additionally, most trials focus on pediatric populations, and evidence in adult and elderly burn patients remains comparatively limited. Another critical gap involves the lack of unified clinical guidelines incorporating emerging technologies into burn-care algorithms. Current burn management guidelines predominantly emphasize surgical and antimicrobial strategies, whereas structured pathways for regenerative therapies, digital tools, and AI-assisted diagnostics are rarely included. This disconnect delays systematic adoption in clinical practice. Finally, standardized reporting frameworks for innovative burn-care interventions are insufficient. Variability in outcome measures—such as wound-closure time, scar quality scales, perfusion indices, and patient-reported outcomes—limits comparability across studies and impedes meta-analytic synthesis. Future research should prioritize:

- Multicenter randomized trials with harmonized outcome definitions
- Long-term follow-up assessing functional and aesthetic outcomes
- Cost-effectiveness and implementation-science studies
- Ethical and regulatory frameworks for AI integration
- Development of consensus-based clinical integration guidelines

Addressing these gaps will be essential to transition innovative burn-care technologies from promising research tools to standardized, equitable, and sustainable components of routine burn management.

Conclusion and Future Perspective

Recent advances in burn care—including regenerative therapies, advanced dressings, innovative debridement techniques, next-generation imaging systems, and digital health applications—have substantially reshaped the field. These developments extend beyond wound closure and infection control, contributing to improved functional and aesthetic outcomes, reduced pain and psychological burden, and enhanced overall quality of life.

The integration of these innovations into routine practice requires strengthened competencies in evidence-based decision-making, objective monitoring, interdisciplinary collaboration, and the safe implementation of digital technologies. However, sustainable clinical adoption remains dependent on standardized protocols, long-term outcome data, and robust cost-effectiveness analyses. Future progress in burn care will likely center on personalized treatment algorithms, artificial intelligence–assisted prognostic systems, bioengineered and bioprinted constructs with enhanced vascular and neural integration, and hybrid digital rehabilitation models. Generating high-quality, multicenter evidence in these domains will be essential to ensure safe translation into practice and to promote equitable access to advanced burn-care technologies.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used artificial intelligence–based tools (e.g., ChatGPT) for literature screening, summarisation, language editing, and reference organisation. After using these tools, the authors reviewed and edited the content as necessary and take full responsibility for the content of the publication.

Conflict of Interest

None.

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