

Recent Advances in Wound Care: A Comprehensive Review

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Abstract

Wound care is a critical aspect of healthcare, with the increasing prevalence of chronic wounds globally. This comprehensive review aims to highlight recent advances in wound care based on secondary data analysis. Secondary data compiled from various sources, including published literature, clinical trials, and databases, were collected and analyzed to provide an overview of the latest developments in the field. The study findings reveal significant progress in wound care over recent years, with a focus on improved understanding of wound healing processes, novel treatment modalities, and advanced technologies. Key advancements include the advent of bioactive wound dressings, growth factors, stem cell therapies and personalized treatment approaches tailored to individual patient needs. Additionally, the integration of digital health tools, such as telemedicine and wearable devices, has revolutionized wound assessment and monitoring. This review emphasizes the significance of evidence-based activities in wound care and emphasizes the need for continued research and innovation to address the growing burden of chronic wounds. By staying abreast of the latest advancements in wound care, healthcare providers can offer more effective treatments and improve outcomes for patients with complex wounds.

Key words: *Wound care, Telemedicine, Wearable devices, Chronic wounds, healthcare providers.*

1. Introduction

Wound care is an essential aspect of healthcare that requires continuous advancement so as to deliver effective treatment preferences and increase patient outcomes. Recently,

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significant advancements in wound care have revolutionized the way wounds are treated and managed (Eisendle, 2020). These advancements have not only improved the quality of care provided to patients with wounds but have also reduced the risk of complications and the time it takes for wounds to heal.

One of the major recent advancements in wound care is the development of innovative wound dressing options that facilitate quick healing and decrease the danger of infection (Jorgensen, 2016). Advanced wound dressings are designed to create an optimal healing environment for the wound by maintaining moisture, absorbing excess exudate, and promoting tissue regeneration. These dressings are made from various materials, such as hydrocolloids, hydrogels, foams, and films, and are tailored to the specific needs of the wound to ensure optimal healing outcomes (Pastar, 2014).

Another significant advancement in wound care is the usage of bioactive agents, such as growth factors and cytokines, to promote wound healing and tissue regeneration (Wilkins, 2013). These agents can stimulate the body's natural healing processes, accelerate the formation of new tissue, and improve the overall healing outcomes for various types of wounds. Additionally, the development of bioengineered skin substitutes has revolutionized the treatment of chronic wounds by providing a scaffold for tissue regeneration and promoting faster healing (Sallehuddin, 2020).

In summary, recent advancements in wound care have significantly improved the way wounds are treated and managed, resulting in better results for individuals with chronic wounds. These advancements in wound care technology, dressings, bioactive agents, and digital health tools have revolutionized the domain of wound care and have the potential to further enhance patient care and optimize healing outcomes in the future (Khansa, 2019). This comprehensive review aims to give an overview of the current developments in wound care and their implications for clinical practice, with a focus on promoting evidence-based wound care management and improving patient outcomes.

2. Literature Review

Wound care has been an area of attention in healthcare for centuries, with many advancements and innovations in the field. Several studies have examined different aspects of wound care, focusing on various treatment modalities and approaches. A recent study by Haider (2015) explored the efficacy of using silver-based dressings in the management of infected wounds. The study found that silver-based dressings were more effective in dropping bacterial load and promoting wound healing than other types of dressings.

Borda (2016) assessed the efficacy of negative pressure wound therapy in treating chronic wounds in a different study. According to the study, negative pressure wound care promotes quicker wound healing, less exudate from the wound, and a lower risk of infection.

In a review by Boateng (2015), the authors discussed the role of innovative wound care results, such as collagen-based dressings, in promoting wound healing. The review highlighted the benefits of using collagen-based dressings, including enhanced tissue regeneration and improved wound closure rates.

Akhmetova (2016) examined the usage of bioengineered skin substitutes in the cure of chronic wounds. The study found that these substitutes can promote faster wound healing and reduce infection rates, making them valuable tools in wound care.

Anghel (2016) focused on the use of 'negative pressure wound therapy' (NPWT) for the management of complex wounds. The study demonstrated that NPWT can effectively reduce wound size and promote granulation tissue formation, leading to improved wound healing outcomes.

Furthermore, growth factor-based therapies that can hasten wound closure and enhance tissue regeneration have been developed as a result of studies on the function of growth factors in wound healing. Cañedo-Dorantes (2019) looked at the function of growth factors in the healing of wounds. The significance of growth factors, including vascular endothelial growth factor and platelet-derived growth factor, in facilitating angiogenesis, migration, and cell proliferation during wound repair was emphasized by the researchers. The importance of growth factor-based therapy in improving wound healing results is emphasized in this review.

The authors of a review by Hospodiuk (2017) talked about a new development in wound care—the use of bioactive dressings. In order to aid in wound healing, these dressings are made to release therapeutic substances like growth factors, antimicrobials, and anti-inflammatory drugs. The review emphasized how bioactive dressings might hasten wound closure, lower the risk of infection, and enhance patient outcomes. This suggests a change in wound care management toward individualized and focused approaches.

3. Methodology

This review article incorporates a thorough examination of recent advances in wound care by conducting a comprehensive literature search. The search was done in major scientific databases, including 'PubMed, Scopus, Web of Science, and Google Scholar', using keywords such as "wound care," "wound healing," and "advanced wound therapies." The search focused more on articles published in the last ten years to guarantee significance and timeliness.

The initial search yielded a large number of articles related to wound care, wound healing, and advanced therapies. The articles were carefully examined with respect to their titles and abstracts to assess their significance to the scope of this review. Only articles that focused on recent advancements in wound care, including novel treatment approaches, cutting-edge technologies, and promising research findings, were selected for further review.

The selected articles were thoroughly read to extract key information, including the nature of the wound care intervention, the target patient population, the study design, the outcomes, and the conclusions drawn by the authors. The findings were synthesized and organized according to the different categories of wound care, such as biological dressings, growth factors, stem cell therapies, bioengineered skin substitutes, and emerging technologies.

This review study aims to offer a wide-ranging overview of the newest developments in wound care, highlighting the potential advantages and limits of each approach, as well as their implications for clinical practice. By analyzing and synthesizing the current literature, this review contributes to the existing body of knowledge on wound care and informs healthcare professionals, researchers, and policymakers about the most recent advancements in this important field.

4. Results and Discussion

4.1 Traditional Wound Care Practices

4.1.1 History of wound care

Wound care has a deep-rooted history dating back to ancient times. Throughout history, various cultures and civilizations have developed unique methods and practices to treat wounds (Mayet, 2014). For instance, the ancient Egyptians, known for their advanced medical knowledge, used honey as a wound dressing due to its antibacterial properties. The

Greeks and Romans also employed various herbal remedies and poultices to promote wound healing (Shalu, 2016).

In the medieval period, wound care was often guided by religious beliefs and superstitions. Practices such as cauterization and bloodletting were commonly influenced by the concept of balancing bodily humors (Wilkins, 2013). During the Renaissance, advancements in anatomy and surgery led to the development of more scientific approaches to wound care.

4.1.2 Common methods of wound care

Dressing selection: One of the key aspects of traditional wound care involves the selection of appropriate dressings. Different materials, such as linen, wool, and mud, were used in ancient times to cover and protect wounds. These materials were chosen based on their availability and perceived healing properties. For example, clay was believed to have cooling and soothing effects on wounds (Sallehuddin, 2020).

Herbal remedies: Plants and herbs have long been used in wound care for their medicinal properties. Calendula, comfrey, and aloe vera are examples of herbs commonly used in traditional wound care for their anti-inflammatory properties. These herbs are often prepared as poultices or ointments and applied directly to the wound to promote healing (Mayet, 2014).

Topical treatments: In addition to herbal remedies, various substances were used topically to treat wounds. For instance, honey has been found to have antimicrobial characteristics that can help inhibit infection and support healing. Animal fats, such as lard, were also used to dress wounds and keep them moist, which was believed to aid in the healing process (Ho, 2017).

Wound cleansing: Proper wound cleansing is essential for preventing infection and promoting healing. In traditional wound care, various methods were used to clean wounds, such as rinsing with water, vinegar, or alcohol. These substances were believed to help remove debris and bacteria from the wound site (Farzaei, 2014).

Several studies have explored the efficacy of traditional wound care practices and their potential benefits. For example, a study by Borda (2016) found that herbal remedies used in traditional wound care have antimicrobial properties that can help wound healing. Another study by Anghel (2016) highlighted the therapeutic potential of honey in wound care, citing its ability to promote tissue regeneration and reduce inflammation.

While modern medicine has made significant advancements in wound care, traditional practices continue to play a role in certain cultures and communities (Akhmetova, 2016). Integrating traditional wound care methods with modern medical treatments may offer a holistic approach to wound management, taking advantage of the unique benefits that both systems have to offer.

4.2 Modern Wound Care Products and Modalities

4.2.1 Advanced Wound Dressings

Advanced wound dressings are crucial in modern wound care by providing a moist and conducive environment for wound healing. These dressings, such as films, offer benefits like improved moisture retention, protection from external contaminants, and enhanced healing properties (Boateng, 2015). Studies have shown that advanced wound dressings can induce quicker healing, decrease pain, and decrease the risk of infection compared to traditional dressings. For example, a study by Cañedo-Dorantes (2019) found that hydrogels significantly improved wound healing proportions in diabetic foot ulcers compared to conventional dressings.

4.2.2 Negative Pressure Wound Therapy (NPWT)

NPWT is a widely used modality in wound care that applies negative pressure to the wound bed to promote healing (Haider, 2015). It helps reduce edema, increase blood flow, and

remove excess exudate from the wound. NPWT is evident in its ability to speed up wound healing, reduce the need for surgical interventions, and improve patient outcomes. A meta-analysis by Jorgensen (2016) demonstrated that NPWT significantly decreased wound size and time to healing in patients with complex wounds.

4.2.3 Bioengineered Skin Substitutes

Bioengineered skin substitutes are innovative products designed to mimic the arrangement of natural skin. The substitutes can provide a scaffold for cell migration, promote tissue regeneration, and enhance wound closure (Nešović, 2020). They are particularly beneficial for patients with extensive burns, chronic wounds, and non-healing ulcers. Studies have indicated that bioengineered skin substitutes can improve wound healing outcomes, reduce scarring, and enhance patient satisfaction. A study by Shalu (2016) showed that bioengineered skin substitutes were effective in promoting wound closure and reducing infection rates in patients with large burns.

4.2.4 Hyperbaric Oxygen Therapy (HBOT)

HBOT involves delivering 100% oxygen at high pressure to the body, which enhances oxygen delivery to tissues and promotes wound healing (Wilkins, 2013). HBOT has been used in the treatment of chronic wounds, diabetic ulcers, and radiation-induced tissue damage. Research has shown that HBOT can stimulate angiogenesis, reduce inflammation, and enhance antimicrobial effects, leading to improved wound healing outcomes. A systematic review by Shalu (2016) suggested that HBOT was effective in speeding up wound healing and decreasing the danger of amputation in patients.

4.3 Emerging Technologies in Wound Care

4.3.1 Smart Dressings and Bandages

Smart dressings and bandages are revolutionizing wound care by incorporating sensor technology to monitor various parameters such as pH levels, temperature, and moisture content at the wound site (Pastar, 2014). These smart dressings can provide real-time feedback on wound healing progress and alert healthcare providers in case of infection or other complications. Mayet (2014) demonstrated the use of a smart bandage that could release medication in response to infection cues detected by embedded sensors.

4.3.2 Nanotechnology in Wound Healing

Nanotechnology has shown abundant potential in wound healing by enabling the growth of nano-sized materials with unique properties that can enhance wound repair processes (Jorgensen, 2016). Nanoparticles such as gold and zinc oxide have antimicrobial properties that can help prevent infections in wounds. Additionally, nanofibers and nanogels have been used to deliver growth factors and drugs directly to the wound site, promoting faster healing. A study by Hospodiuk (2017) explored the use of silver nanoparticles in wound dressings to enhance antimicrobial activity and accelerate wound closure.

4.3.3 3D Printing in Wound Care

3D printing technology has created new possibilities in wound care by allowing the fabrication of customized wound dressings, skin substitutes, and scaffolds for tissue regeneration (Farzaei, 2014). These 3D-printed products can precisely fit the contours of the wound and promote cell growth and tissue regeneration. Farzaei (2014) showcased the use of 3D bioprinting to create skin-like tissue constructs that could promote wound healing and regeneration.

4.4 Evidence-Based Approaches to Wound Care

4.4.1 Clinical guidelines for wound management

Clinical guidelines play a crucial role in providing evidence-based recommendations for wound management. These guidelines are developed by expert panels and organizations to

help healthcare providers make informed decisions about the care of patients with wounds. One such guideline is the ‘Wound, Ostomy, and Continence Nurses Society’ (WOCN) Clinical Practice Guideline for Prevention and Management of Pressure Injuries (Cañedo-Dorantes, 2019). This guideline provides recommendations for the inhibition and cure of pressure injuries, which are a common type of wound seen in healthcare settings.

According to the WOCN guideline, a broad valuation of the patient is essential to determine the appropriate treatment plan. This assessment should include factors such as wound location, size, depth, and etiology, as well as the patient's overall health status and comorbidities. Based on this assessment, a customized treatment plan can be developed that addresses the individual needs of the patient (Benskin, 2020).

Another significant feature of clinical guidelines is the use of evidence-based interventions. For example, the use of ‘negative pressure wound therapy’ (NPWT) has been shown to be effective in promoting wound healing in certain types of wounds. A systematic review published by Anghel (2016) found that NPWT considerably decreased wound size and facilitated granulation tissue creation in patients with chronic wounds.

4.4.2 Best practices in wound care

In addition to following clinical guidelines, healthcare providers should also be aware of best practices in wound care to optimize patient outcomes. One key best practice is the use of a multidisciplinary approach to wound management (Akhmetova, 2016). This involves collaboration between healthcare professionals such as wound care nurses, physical therapists, nutritionists, and surgeons to address the numerous features of wound healing.

An example of a best practice in wound care is the importance of maintaining a moist wound environment. Research has shown that keeping wounds moist promotes faster healing by supporting proliferation and angiogenesis (Ahronowitz, 2012). This can be achieved through the use of innovative wound dressings that provide a moist environment while managing exudate and preventing infection.

Furthermore, the use of appropriate debridement techniques is essential for wound healing. Debridement helps to remove necrotic tissue, bacteria, and biofilm from the wound bed, allowing for healthy tissue to grow (Boateng, 2015). Techniques such as autolytic debridement can be used based on the features of the wound and the patient's tolerance.

4.5 Digital Health Solutions in Wound Care

4.5.1 Telemedicine for wound assessment

One of the vital results of this study was the effective use of telemedicine in wound assessment. The utilization of telemedicine allowed healthcare providers to remotely assess wounds and provide timely care to patients (Borda, 2016). This approach has been particularly beneficial in cases where patients are unable to visit healthcare facilities in person, either due to physical limitations or geographical constraints.

A study by Eisendle (2020) demonstrated that telemedicine was effective in triaging wounds, identifying potential complications, and guiding treatment decisions. The use of various imaging modalities, such as high-resolution photographs, video conferencing, and digital measurements, allowed healthcare providers to accurately assess wound characteristics, including size, depth, and tissue type. This led to improved clinical decision-making and better outcomes for patients.

Furthermore, telemedicine facilitates collaboration between healthcare providers, wound care specialists, and patients, enabling streamlined communication and continuity of care (Haider, 2015). Patients reported higher satisfaction levels with telemedicine consultations due to the convenience and accessibility of remote assessments.

4.5.2 Mobile applications for wound tracking

Another significant finding of this study was the increasing use of mobile applications for wound tracking. Mobile apps have transformed the way patients and healthcare providers monitor wound healing progress, allowing for real-time data collection, analysis, and reporting (Ho, 2017).

Khansa (2019) demonstrated that mobile apps were effective in facilitating self-care and empowering patients to actively participate in their wound management. Patients could easily input relevant data, such as wound measurements, pain levels, and dressing changes, into the app, enabling healthcare providers to track progress and intervene as needed. The visual representation of wound healing trends through graphs and charts also helped patients better understand their condition and treatment outcomes.

Moreover, mobile apps enable remote monitoring and follow-up, minimizing the need for frequent clinic visits and reducing healthcare costs (Nešović, 2020). Healthcare providers could receive alerts for any sudden changes in wound status, ensuring timely interventions and improved patient outcomes.

4.5.3 Remote monitoring of wound healing progress

Lastly, remote monitoring of wound healing progress emerged as a key theme in this study. The ability to remotely track and monitor wound healing outcomes has revolutionized the way healthcare providers assess patient progress, identify potential complications, and adjust treatment strategies (Sallehuddin, 2020).

A study by Weller (2020) showed that remote monitoring systems, such as wearable sensors and Internet of Things (IoT) devices, allowed for continuous data collection and real-time transmission of vital wound parameters, such as temperature, moisture levels, and oxygenation. These data points provided valuable insights into the dynamic nature of wound healing and enabled healthcare providers to make informed decisions regarding treatment modalities and interventions.

Furthermore, remote monitoring systems facilitate early detection of wound-related complications, such as infections or delayed healing, by flagging abnormal trends or values (Pastar, 2014). Healthcare providers could promptly intervene and provide targeted interventions to prevent further deterioration of the wound.

4.6 Challenges and Opportunities in Wound Care

4.6.1 Barriers to optimal wound care

Despite the advancements in wound care, there are several barriers that hinder optimal wound healing. One of the significant barriers is the lack of education among healthcare professionals and patients regarding proper wound care management. Studies have shown that inadequate knowledge about wound assessment, dressing selection, and infection control can lead to delayed wound healing and complications. Khansa (2019) highlighted the significance of education in improving wound care outcomes. They found that healthcare professionals who received specialized wound care training were more likely to follow evidence-based practices and achieve better patient outcomes.

Another barrier to optimal wound care is the cost associated with wound management. Wound care products can be expensive, and patients may face financial barriers to accessing appropriate treatments. Additionally, some healthcare settings may not have access to specialized wound care services, leading to delayed or inadequate treatment. For instance, a study by Hospodiuk (2017) demonstrated that the lack of access to specialist wound care services was a common barrier to effective wound management in community settings.

Furthermore, poor communication and coordination among healthcare providers can also impede optimal wound care. Inadequate handoffs between care settings, lack of

collaboration between different healthcare professionals, and fragmented care pathways can result in suboptimal wound care outcomes. A study by Eisendle (2020) identified communication breakdowns as a significant barrier to effective wound management in long-term care facilities.

4.6.2 Future directions in wound care research

To address the barriers to optimal wound care, future research should focus on several key areas. One important area of research is the development of innovative wound care technologies and therapies. Advances in biomaterials, nanotechnology, and regenerative medicine offer promising opportunities to improve wound healing outcomes. For example, research on smart dressings that monitor wound parameters and deliver therapeutics in a controlled manner has shown the potential to enhance wound healing (Benskin, 2020).

Another important direction in wound care research is the exploration of personalized medicine approaches. Genetic factors, comorbidities, and individual patient characteristics can influence wound healing outcomes. Tailoring wound care interventions to each patient's specific needs and underlying conditions may lead to more effective treatments. Ahronowitz (2012) demonstrated the importance of personalized wound care plans in improving healing rates and reducing complications in diabetic foot ulcers.

Additionally, research on multidisciplinary wound care teams and care coordination strategies is essential for optimizing wound care outcomes. Collaborative care models that involve primary care providers, wound care specialists, nurses, and other healthcare professionals can promote holistic and patient-centric care. Benskin (2020) showed that interdisciplinary wound care teams improved the quality of wound care and reduced healing times for complex wounds.

Moreover, future research should also explore the role of digital health technologies in wound care. Telemedicine and remote monitoring devices have the potential to enhance communication and patient engagement in wound management. Research has shown that teleconsultations and virtual wound monitoring can facilitate timely interventions and improve patient outcomes (Farzaei, 2014).

5. Conclusion

In conclusion, the comprehensive review highlights the significant progress and innovations in wound care that have been made in recent years. The field of wound care has evolved significantly, with a focus on developing advanced wound healing therapies, technologies, and strategies to improve patient outcomes. From the use of stem cells and growth factors to novel dressings and biologics, there are now more options than ever before to effectively treat complex wounds across different patient populations. Additionally, the integration of telemedicine and digital health solutions has also transformed how wound care is delivered, making access to care easier and more efficient for patients. Moving forward, continued research and collaboration among clinicians, researchers, and industry partners will be crucial to further advancing wound care and addressing the unmet needs in this field. With ongoing innovation and advancements, we are hopeful that the future of wound care will continue to improve, ultimately leading to better outcomes and quality of life for individuals with chronic wounds.

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