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An Exploration of the Evolution of Wound Dressing: From Antiquity to the AI Age

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Abstract

Wound dressings demonstrate humanity's ongoing pursuit of wound healing and treatment. Since ancient tribes employed honey, glue, and animal skins to treat wounds, dressing has evolved. Ancient Egyptians and Greco-Romans employed linen bandages and herbal remedies for healing. As medical knowledge increased throughout the Middle Ages and Renaissance, wound treatment became more methodical, using clean bandages and early antiseptics. Cotton and gauze were developed throughout the Industrial Revolution and following eras, and wound healing without infection became important. Synthetic materials like hydrocolloid and alginate dressings improved moisture management and the process of wound recovery in the 20th century. The late twentieth and early twenty-first centuries have seen bioactive and interactive dressings including silver, collagen, and growth hormones. These treatments boost natural healing. AI is shaping wound dressings' future. AI-driven technology enables predictive modeling, accurate wound assessment, and personalized dressing strategies that enhance healing. Nanotechnology and bioengineered wound dressings expand wound treatment possibilities. This abstract discusses wound dressings' history, current trends, and how AI and cutting-edge biomaterials may change wound treatment.

Keywords: *Wound Care, Ancient Methods, Industrial Revolution, AI Technology*

1. Introduction

A multitude of processes that are very detailed, dynamic, and complicated are involved in the healing of wounds. The hemostasis, inflammation, proliferation, and remodeling phases are the four stages that may be generically grouped into this sophisticated process. This process involves a sequence of biological processes that are broken down into four stages. [1]. There are millions of people all around the world who are suffering and having a difficult time obtaining the most proficient wound care or therapy. There has been a discernible increase in the prevalence of metabolic illnesses, such as diabetic wound ulcers, throughout several years. Protecting the wound bed from contamination and providing an environment that promotes faster healing are the two basic functions that an efficient wound dressing is designed to facilitate. [2]. Although there are many different approaches to wound care, bandages, and plasters are the fundamental pieces of material technology that Greco-Roman doctors employed to promote wound healing. Plaster has not been thoroughly studied as a distinct medicinal treatment. [3]. Different etiologies lead to different signs of chronic wounds. Chronic wounds can be classified into three primary groups notwithstanding their molecular and clinical diversity: pressure ulcers (PUs), diabetic foot ulcers (DFUs), and venous leg ulcers (VLUs). Based on the characteristics of the wound, such as whether it is dry or oozing, shallow or deep, clean or infected, numerous dressings have been created that are recommended for particular kinds of chronic wounds. These dressings come with several restrictions. Systems that actively regulate the spatial and temporal profile of medication release would be highly advantageous for wound care treatment as our understanding of the wound healing process continues to advance. [4]. Throughout human history, wound healing has proven to be extremely difficult. There is a greater need for wound dressings to speed up the healing process due to the significant increase in chronic illnesses and surgical procedures. By preventing microbial activity and creating an appropriate moist environment for the wound, modern dressings—which come in various forms—offer notable benefits over passive bandages, which have been used for centuries. Even contemporary dressings do not encourage wound healing as anticipated because they are insensitive to the wound circumstances, despite their extensive clinical use and positive outcomes in wound therapy. Conversely, smart dressings can react to wound demands and engage with the environment via their integrated sensors. They can track the progression of wound healing and offer valuable data that may influence the course of treatment. [13]. Dressings for wounds constitute a sizeable portion of the global market for wound treatment products in the medical and pharmaceutical industries. Chronic wounds continue to be difficult to manage, and as a result, they garner a significant deal of interest from the research community. This is even though there is already a large variety of products available. It is the goal of an optimal wound dressing to facilitate speedy healing at an affordable cost and to cause the patient as little discomfort as possible. The selection of a suitable dressing is something that plays a significant impact in both the recovery process and the cosmetic appearance of the tissue that has been regeneration. When it comes to the many different types of wound dressing materials, biomaterial or natural or synthetic polymer-based dressing is becoming increasingly important because of the distinctive qualities that they possess. There is a wide variety of polymer wound dressings available on the market. Each of these dressings serves the purpose of preserving hydration within the wound to maximize regeneration, guard against infection, and prevent disruption of the wound base. [14] Table 1 shows the Basic Classification of Wound Dressing. Traditional methods of wound care involve the use of passive dressings like gauze and cotton, which are incapable of providing real-time monitoring. As a result, these methods have the potential to influence treatment outcomes in either an excessive or an unduly cautious manner. The creation of intelligent bandages has been the subject of a significant increase in study in recent years, to overcome the constraints that have been mentioned.

Table 1 Basic Classification of Wound Dressing

Category	Examples	Advantages	Disadvantages	Reference
Conventional dressing for wounds	gauze dressing, film dressing, foam dressing	commercialized, mature	need additional adhesion or fixture and replacement, not suitable for internal wounds	[5]
Bioadhesive natural wound dressing	fibrin, starch, collagen, chitosan, fibroin, cellulose, alginate	biocompatibility, easy to obtain	insufficient adhesion or cohesion strength, lack of curative effects	[6];[7]
Structurally designed bioadhesives wound dressing	gecko feet, beetle footpads, octopus suction cups	reversible adhesion and release	high fabrication cost, low adhesion to wet surfaces	[8];[9]
Man-made bioadhesive wound dressing	cyanoacrylate	strong adhesion, rapid cure	dry adhesion, low biocompatibility, brittle	[10]
	hydrogels	great tunability, high water content, drug-loading capability	need rational designs	[11];[12]

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These new constructions demonstrate the ability to actively monitor biomarkers, so enabling not only the identification of wounds but also the targeted therapies that facilitate the efficacious healing of chronic wounds.(Prakashan, KaSushik, and Gandhi 2024).We are currently on the verge of entering a new era in the field of wound care, which will be characterized by the incorporation of innovations such as artificial intelligence (AI), smart bandages, and precision medicine. The way we approach wound management is being revolutionized by these contemporary developments, which make it possible to create individualized treatment programs and monitor patients in real-time. This development not only demonstrates the progress made in medical technology, but it also emphasizes the ever-present significance of wound care in the process of preserving health and making sure someone is healthy. As part of this investigation, the history of wound dressing will be traced, beginning with its ancient beginnings and ending with the cutting-edge innovations of the AI age. This investigation shed light on how these changes have transformed healthcare practices.

2. The Changing Faces of Wound Care

In ancient Egypt, bandages made of grease-soaked gauze were used to treat wounds. However, consideration was given to the management of wounds at the time. Over several centuries, this type of care has become somewhat more sophisticated; yet, its core objective, which is to heal, has remained unchanged. Gauze and other traditional dressings are non-occlusive and tend to dry up the wound. As soon as this occurs, they will eventually cling to the wound bed. Even if they do not dry out, capillary loops have the potential to grow into the structure of the dressing, which can lead to the dressing adhering to the wound. As a result of such adherence, wound trauma occurs, which is frequently accompanied by bleeding after the removal of the dressing. This might result in the patient experiencing pain.[15] Based on Winter's first findings, polyurethane films were used to create the first moist interactive dressings. All they did was stick to the surrounding skin and keep the wound surroundings wet. By keeping the wound surface from drying up and soaking the exposed nerve terminals in natural wound secretions, these dressings helped to reduce some of the discomfort. However, the forceful adhesive occasionally resulted in harm during removal; however, this problem is lessened by more current removal techniques. Unless the adhesive bond is decreased by stretching the dressing laterally and parallel to the wound surface before attempting to remove the dressing by gently lifting at a 90° angle above the wound area, strong adhesive bonds in these dressings are likely to cause skin rips upon removal. Even with the removal precautions, their non-absorbency remains an issue. Bacterial growth is promoted when fluid builds up beneath the surface or leakage channels rupture the barrier to the outside world. [15] Several more absorbent moist wound care categories were developed as a result of the limitations of film dressings, and a multitude of items followed in their footsteps:

- Hydrocolloids were demonstrated to generate a moist environment by gelling with wound fluid over the wound bed and below the semi-occlusive film covering;
- Foams supplied an easy-to-remove non-adhesive contact surface (some newer products feature adhesive surfaces);
- Foams were found to be most effective in preventing the spread of infection.
- Hydrogels provided a high-water content in a gel lattice, which rendered them non-adherent and soothing, and provided the wound with the necessary moisture. Alginates, on the other [15]

Bioactive dressings are a broad class of dressings that can affect wound healing in several ways. By encouraging moisture balance, pH regulation, oxygen permeability, and fluid management, these dressings—which include honey, hyaluronic acid, collagen, alginates, and polymers enhanced with polyhexamethylene biguanide, chitin, and chitosan derivatives—create an environment that is favorable for healing. By acting as substrates for bioactive substances, interactive dressings further improve targeted activity. The need for current information in wound care is highlighted by the ongoing evolution of BDs, with new products being developed every year. A useful approach guides the clinician through the dressing selection procedure by considering

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bleeding, infection likelihood, and wound exudate. By making sure the right BDs are chosen based on each patient's needs, this algorithm seeks to maximize wound care and eventually improve wound management results. [16]. A biodegradable polymer and an age-old herbal medication have been utilized in the development of an electrospun scaffold to create an effective wound-healing patch that has significantly improved patient compliance. To enhance the wound-healing activity of the drug, a positively charged drug with a smaller particle size (40 nm) has been developed. This tiny particle size allows for higher penetration through the epidermal barrier. The concept of controlled medication release has been comprehended by utilizing spectroscopic techniques and calorimetric research to gain an understanding of the interactions that occur between the components. According to the findings of an in-vivo study conducted on albino rats, scaffolds have a greater capacity to promote wound healing. This is demonstrated by increased wound area contraction, reduced inflammation, and accelerated epithelialization and vascularization. Studies conducted on cells have also demonstrated that the scaffold is a superior biomaterial. In addition, clinical research has shown that the presence of all three wound dressing materials is associated with rapid healing of various types of wounds, as demonstrated by histological evidence. The fact that the patch has completely biodegraded is evidence that it is more environmentally friendly than the produced patch. [17]. A wide variety of wound characteristics, including temperature, moisture levels, and biochemical markers, can be evaluated in real-time using smart sensors that are implanted within wound dressings. These sensors are equipped with the capability to give non-invasive evaluations of these parameters. This integration makes it possible to do continuous and remote monitoring, which in turn enables medical practitioners to acquire significant insights into the dynamic evolution of chronic skin disorders. A protective barrier is created by the application of advanced wound dressing, which also contributes to the enhancement of the healing process by establishing an atmosphere that is favorable to the restoration of tissue. An increasing amount of focus has been placed on intelligent wearable sensors that are coupled with human-machine interfaces throughout the last few decades. In light of this, the application of artificial intelligence (AI) technology is a promising scientific strategy that might be utilized to enhance the treatment of chronic wounds. Clinical practitioners can benefit from the use of AI methodologies and algorithms when it comes to diagnosing, predicting outcomes, and controlling wounds. These skills make it possible to intervene on time, which can reduce the likelihood of chronic wounds occurring. In addition, this study focus has evolved as a result of the enormous potential that these devices have to revolutionize the medical technologies that are already in use, particularly because of their real-time capabilities for analyzing the biological markers of the human body. The implementation of wireless electronics has brought a significant amount of optimism regarding the instantaneous gathering of real-time data regarding vital signs, the dynamics of bodily mobility, and the sending of emergency signals [1]

3. Sensor-Integrated Smart Wound Bandages Use Particular Materials

A more thorough approach to wound condition monitoring to improve the patient's quality of life has been necessary recently due to the treatment of various wounds, from pressure and chronic ulcers to skin injuries. Most wound dressings on the market provide protection and encourage wound lesion regeneration, but they cannot track the advancement of the wound. To address this need, this study presents a novel solution: an optoelectronic diagnostic sensor that is wireless, battery-free, and seamlessly incorporated into a colorimetric, pH-sensitive wound dressing. This dressing is intended to improve wound care and greatly improve patient quality of life. Curcumin-polycaprolactone (C-PCL) dressings provide antibacterial qualities, encourage cell regeneration, and shield wounds. Furthermore, the dressing has colorimetric pH-monitoring properties in a variety of wound scenarios, allowing people without specific training to evaluate the condition of their wounds. This user-friendly colorimetric diagnosis method's precision is improved by the incorporation of a green light-

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emitting diode (LED) and photodiode, which carefully assesses color shifts from yellow to a red of the colorimetric dressing. Patients can now easily and quantitatively examine their wound data in real-time thanks to the incorporation of wireless, battery-free solutions. Rapid wound state evaluation will be made possible by these advancements, guaranteeing prompt interventions and the best possible care for worsening wound conditions. On-demand therapy with smart wound dressing [18]. Figure 1 represents the elements that comprise wound care. [19].

Figure I The Elements of Wound Care

3.1. AI in Wound Diagnosis

Wound healing is a rapidly growing multidisciplinary field drawing clinicians from diverse backgrounds including nursing, medicine, podiatry, plastic surgery, and physical therapy. The prevalence of chronic wounds has increased in association with underlying conditions, such as aging, obesity, and diabetes, which contribute to the nonhealing nature of many wounds. From 2014 to 2019, the number of Medicare beneficiaries with a wound increased from 8.2 million to 10.5 million, with the largest increase in wound prevalence in those less than 65 years of age. A convolutional neural network and superpixel segmentation are two deep learning technologies that have been developed to categorize pressure and diabetic wound images more accurately than previously possible. 99% accuracy, 99% sensitivity, and 99% specificity were achieved by one model, known as the "Alexnet architecture". Such high numbers are required to track the healing process. Compared to clinic staff using a regular digital camera, an AI digital application can take high-quality wound photographs and calculate the surface area of the wound more quickly, saving roughly two minutes on each wound evaluation. [19]. AI is rapid and effective, enabling noncontact visual evaluation of a patient's wound, which may lessen discomfort and infection risk. Additionally, it makes it possible for non-providers to evaluate wounds, which is essential because they frequently need daily support from friends, family, or non-medical caregivers. Lau et al., for instance, created a smartphone application that uses a deep learning-based object identification system to recognize and classify printed photos of pressure injuries in real time. [20]. These advancements in wound identification and assessment naturally lead to their application in wound management.

3.2. AI in Wound Management

With its cutting-edge diagnostic, therapeutic, and monitoring capabilities, artificial intelligence (AI) is transforming wound care and enabling more effective and individualized therapy. AI can evaluate wound severity, forecast healing results, and spot possible issues like infection or delayed healing by using machine learning algorithms to examine patient histories, real-time sensor data, and wound photos. Based on these findings, AI-powered systems can suggest customized treatment regimens, optimize dressing selections, and modify the temperature, wetness, or pressure of smart dressings. Additionally, AI improves remote monitoring by allowing medical professionals to check the status of wounds without making frequent in-person visits, allowing for early intervention when needed. This preventive strategy minimizes hospital stays and prevents problems, which not only speeds up recovery but also lowers healthcare expenditures. AI's capacity to forecast healing patterns and modify treatment in response to them greatly enhances patient outcomes and quality of life in the treatment of chronic wounds, such as pressure sores or diabetic ulcers. [21] In wound prognosis, artificial intelligence is revolutionizing how medical professionals evaluate and forecast the course of wound healing. AI is capable of analyzing patterns and making remarkably accurate predictions course of wound healing by utilizing machine learning algorithms and data from a variety of sources, including clinical records, wound photos, patient demographics, and sensor data. To predict healing timeframes, identify issues early, and recommend the best course of action, these AI systems evaluate variables such as wound size, depth, infection risk, and responsiveness to therapy. AI can also spot minute changes in wound properties that might not be apparent to the human eye, allowing for earlier intervention and possibly lowering the risk of infection or chronicity. Healthcare professionals can improve patient outcomes and lower costs by using AI to inform decisions, customize treatment regimens, and provide prompt interventions in wound care. For patients with complicated or chronic wounds, where conventional prognostic techniques can be less accurate or react more slowly to changes, this predictive ability is very helpful.

3.3. AI in Intelligent Pressure Adjustment Wound Dressing

The effectiveness of healing and the formation of scars are significantly impacted by variations in wound pressure. By modifying the pressure at the injury site, negative pressure therapy is a leading method for accelerating wound healing. Nevertheless, the current clinical negative pressure devices have preset settings and are not self-adjusting, which frequently results in less-than-ideal pressure levels. Therefore, including pressure sensors into negative pressure dressings provides a workable approach for intelligent wound pressure modulation by allowing real-time wound pressure data collection and Bluetooth-based information transmission. According to a study, maximizing the pressure level instead of modifying the foam dressing's stiffness may provide a more efficient way to manage the stresses and strains on the skin surrounding the wound, which will ultimately promote angiogenesis, cell migration, proliferation, and wound healing. The gold standard for treating venous leg ulcers (VLUs) and avoiding recurrence is graduated compression, which can be achieved with bandaging or compression stockings. Even for seasoned practitioners, it can be very challenging to apply the necessary pressures to various leg areas. Poor compliance and delayed healing might arise from improperly applied compression. Twenty patients with venous ulcers participated in a randomized controlled trial study, which revealed that while the temporal pattern differed, the interface pressure dropped with time under all three bandages. Therefore, maintaining the ideal interface pressure during compression therapy requires close observation and prompt bandage modifications. [22] An innovative approach to wound care is the use of AI in intelligent pressure adjustment wound dressings, especially for patients who already have chronic wounds or are at risk of developing pressure ulcers. These smart dressings continuously monitor and modify the pressure applied to the wound area using embedded sensors and artificial intelligence algorithms. The dressing can automatically redistribute or alleviate pressure in response to variations in pressure, preventing ischemia (reduced blood flow), a major contributing factor to the development of pressure ulcers. To guarantee ideal healing circumstances, the AI system assesses the state of the wound and modifies the pressure of the dressing in real-time in response to variations in the wound's size, depth, or external elements like patient movement. This flexible, dynamic method can improve blood flow, lessen tissue damage, and hasten healing. Additionally, without doing regular physical examinations, remote monitoring enables medical professionals to monitor blood pressure levels and make data-driven decisions, enhancing patient comfort and minimizing the need for frequent dressing changes. In conclusion, AI-driven pressure-adjusting dressings provide a more individualized, effective, and efficient way to treat wounds, especially in high-risk patients with severe medical problems or limited mobility.

3.4. AI in Intelligent Shape Adjustment

Materials used to dress chronic wounds should be able to accommodate uneven wound forms, maintain a moist wound environment, and reduce the risk of infection. Therefore, investigating the physicochemical characteristics of dressing materials facilitates the creation of novel smart dressings that

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regulate the healing of chronic wounds. [22].AI in intelligent shape adjustment wound dressings represents a groundbreaking advancement in wound care, combining artificial intelligence with responsive materials to optimize healing processes. These smart dressings are equipped with AI algorithms and sensors that monitor factors such as temperature, pH, moisture, and pressure, adjusting the dressing's shape, size, and properties in real time based on the wound's condition. For example, the dressing may expand to accommodate excess exudate or contract as the wound heals. AI systems can analyze sensor data to detect early signs of infection, predict healing progress, and even adjust the dressing to maintain ideal conditions for wound recovery. By enabling remote monitoring, these dressings allow healthcare providers to track progress and make informed decisions without frequent in-person visits. This intelligent, adaptive approach has the potential to significantly improve wound healing times, reduce complications, and offer personalized treatment for chronic or complex wounds, ultimately transforming the landscape of modern healthcare.

3.5. AI in Temperature-Triggered Drug Delivery in Wound Healing

AI-powered temperature-triggered medication distribution for wound healing provides a state-of-the-art method for controlling and speeding up the healing process. Wounds frequently undergo localized temperature fluctuations as they go through various healing phases, especially in reaction to inflammation or infection. Smart medicine delivery systems that use embedded sensors to identify these temperature variations can use AI. The AI system can initiate the regulated distribution of particular medications, such growth factors, antibiotics, or anti-inflammatory compounds, straight to the affected area when it detects an elevated temperature, which is frequently an indication of infection or increased inflammation. This guarantees that drugs are given exactly when they're needed, increasing their efficacy and lowering systemic adverse effects. AI can also identify trends in temperature data over time to forecast possible issues like delayed healing or wound infection, enabling early intervention and customized care. AI-driven temperature-triggered devices can greatly speed up healing, lower the risk of infection, and enhance patient outcomes in wound care by tailoring the drug delivery procedure to the changing conditions of the wound.

4. Characteristics and Functions of Smart Dressings

Sensor dressings and intelligent data transmission and processing systems make up the two main parts of smart dressings. While the intelligent data transmission and processing system includes tasks including data emission, reception, storage, and display, the sensor dressings combine biological dressings with smart sensors. There are now two main areas of interest for smart dressing research in wound healing. First off, new sensing components and wound analysis indicators allow for a more thorough and objective evaluation of wound healing to offer scientific direction for clinical wound care. Second, combining bio-dressings with already-existing sensing components to create composite sensors results in smarter dressings that protect and treat wounds while continuously monitoring wound data, thus accelerating healing [22]. Figure 2 represents the characteristics and functions of smart bandages. [22].

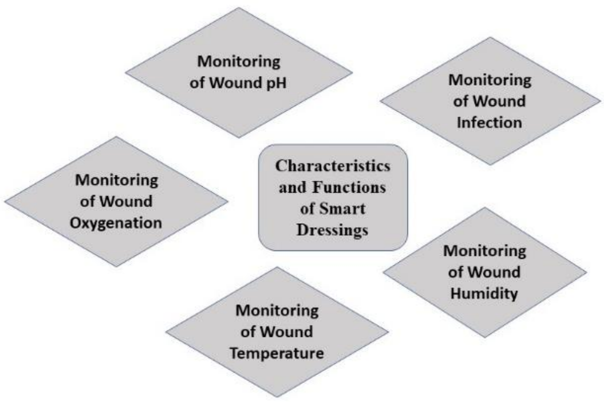

Figure 2 Characteristics and Functions of Smart Dressing

5. Advantages in Wound Healing

Significant benefits can be gained from the application of artificial intelligence in wound care. These benefits include improved diagnosis through the use of image analysis, more effective monitoring

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and recordkeeping, and the capacity to develop individualized treatment plans based on patient information. Artificial intelligence has the potential to enhance patient outcomes by enabling early prediction of complications, optimizing processes, and permitting remote care, particularly in places that are underserved. Challenges, on the other hand, include worries about the quality of the data and the privacy of the data, integration with the healthcare systems that are already in place, and regulatory obstacles. Additionally, there is the possibility of biases in decision-making, as well as the risk of over-reliance on artificial intelligence, which could potentially weaken clinical judgment. In addition, in order to achieve widespread adoption, it is necessary to address the issue of clinician confidence and to guarantee that AI systems experience ongoing updates. AI-incorporated wound healing faces several limitations that hinder its effectiveness. One major challenge is the reliance on high-quality, diverse datasets, which are often hard to obtain in wound care, leading to potential inaccuracies in AI predictions. AI models may also struggle to generalize across different patient populations and healthcare settings, as wound healing is highly individualized and influenced by factors like underlying health conditions and socio-economic status. Additionally, the lack of interpretability in many AI systems makes it difficult for clinicians to trust AI-driven recommendations, and the complexity of regulatory approvals can delay the introduction of new tools. Ethical concerns surrounding patient data privacy, potential over-reliance on technology, and resistance from healthcare professionals further complicate the integration of AI in wound care. Finally, AI may not adapt well to complex, multi-faceted wound cases that require personalized, expert clinical judgment. Figure 3 represents the merits and challenges of AI-incorporated wound dressing. Although wound care has advanced, producing a "perfect dressing" that assures excellent medical outcomes remains a top research target. Responsive dressings that can respond to specific situations are being developed. However, achieving the requisite responsiveness to deliver treatments precisely to the target location, at the right moment, and in a physiologically significant dose remains a difficulty. Intelligent technologies that can sense inputs could release specialized drugs on demand in complex microenvironments. These composite dressings become harder to use in clinical practice as their design becomes more complex. Thus, smart dressings are mostly used in research labs and rarely in clinical practice. Before stimuli-responsive systems may be used clinically, sensitivity, specificity, biocompatibility, and effectiveness must be addressed. These dressings must be flexible to accommodate human body deformations. Microfluidic sensors have good deformability, but integrating them into smart wound dressings for synchronized multi-parameter monitoring is difficult. Without an intelligent sensing-based outcome prediction system, wound care relies mainly on medical experience rather than science and standardization. Insufficient sensor and stimulator integration and the risk of detachment causing more injury are also major challenges to smart wound dressing development. [22]

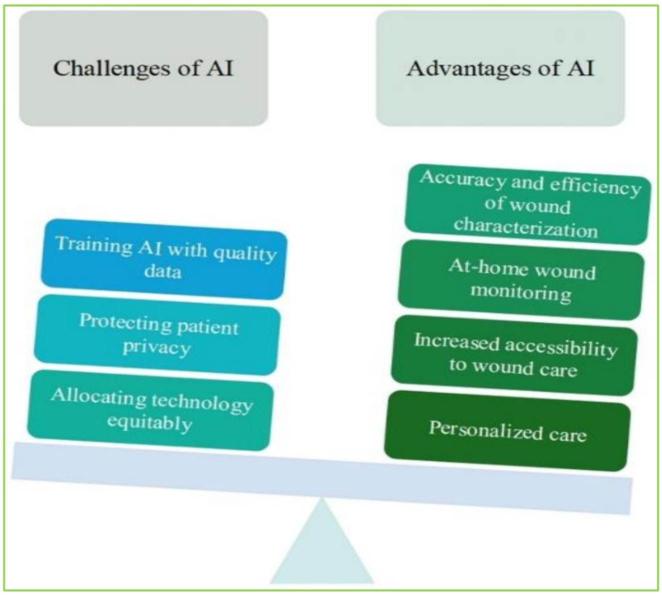

Figure 3 Advantages and Challenges of AI-incorporated Wound Dressing

6. Future Scope of AI Wound Dressing

Integrating wound repair theory, tissue engineering, and polymer materials has resulted in innovative dressings with high efficiency, intelligence, and

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microenvironment adaptation. These novel wound dressings preserve moisture, absorb exudates, allow gas exchange, insulate from heat, inhibit microbial invasion, and promote wound debridement. Wound repair complexity makes it difficult to cover all needs with one dressing. Thus, multipurpose, therapeutic coverings for different wounds and healing stages are needed. These dressings should speed healing, avoid infection, and intelligently respond to microenvironment changes in real-time. Their variable composition and structure enable exact parameter modifications to create bespoke dressings. The expected development of smart dressing systems that autonomously respond to pathological changes could greatly improve tailored wound treatment. Thus, breakthrough smart materials that sense the wound microenvironment and deliver the desired treatments while maintaining drug activity and integrity are needed. Another important area is developing intelligent systems that can identify disease signs, analyze data, and deliver drugs independently or under physician supervision. Biosensors, flexible electronics, and wearable devices, which are linked to wound monitoring and telemedicine, will be integrated to achieve this. To develop multi-functional dressings and skin substitutes, material science, cell biology, and intelligent technology should be combined. Intelligent wound management, personalized medicine, and streamlined wound treatment will improve. Intended smart dressing product properties have been developed. [22]. AI can swiftly and accurately handle enormous volumes of data for wound diagnosis, characterization, care, treatment, and prognosis. Fair access must be considered with AI-assisted technology. Powerful and sophisticated AI algorithms could help a patient's insurance choose the most cost-effective care approaches. Using the most cost-effective wound treatment approaches from the start could reduce downstream costs. Study integrating smartphone apps into clinical practice, not just trials. AI in healthcare platforms like EMRs may provide real-time wound analysis. Rural providers may be able to guide remote wound care with AI. However, determining who will oversee the data—the provider, hospital, or a third-party data analytics group—will be crucial to seamlessly integrate accurate and accessible AI-assisted wound care technologies. Sepsis and necrotizing fasciitis during wound healing can be predicted with more investigation. AI's predictive ability for both scenarios has been examined, but not for wound healing. AI can be used in molecular biology. Most wound analysis tools have focused on the wound. However, wounds often have various exudates, calluses, edema, maceration, and excoriations. Bacteria kind and quantity affect wound healing. AI analysis of wound exudates, peri-wound regions, and bacteriology could improve healing assessments. Nanotechnology with AI may be able to recognize wound bacteria and their traits, but more research is needed. Researching genetic risk factors for some wounds could improve prognoses. [19].

Conclusion

The voyage of wound dressing from ancient times to the age of artificial intelligence exemplifies the widespread influence that medical innovation has had on the treatment of patients. Even though it was founded on approaches that were frequently simple and practical, early wound care was crucial in laying the groundwork for subsequent developments. Throughout history, the study of infection, healing processes, and the natural defense mechanisms of the body have contributed to the creation of more successful treatments. Artificial intelligence (AI) and smart technologies are not only accelerating the healing process, but they are also giving tailored, data-driven methods to care. Today, wound care has entered a new frontier thanks to these advancements. The continued development of wound dressing reflects the broader progress that has been made in the healthcare industry, which strives to continuously adapt, improve, and embrace new technologies to face the problems of both the present and the future. We may anticipate even more individualized and effective solutions in wound care as artificial intelligence continues to evolve, which will ultimately result in improved outcomes for patients all across the world. The history of wound dressing, from its ancient beginnings to its cutting-edge future, stands as a tribute to the unrelenting search of knowledge by humans and the power of innovation in contributing to the improvement of healthcare procedures. A significant impact could be made by artificial intelligence on wound diagnosis, care and therapy, as well as prognosis. Because it can draw conclusions about important data in electronic medical records (EMRs), patient photos, and entered criteria, it enables efficient and effective guidance. Artificial intelligence can also be used to direct therapies outside of the clinic, which will eventually lead to more fair care. Even though guaranteeing equal access, diverse datasets, and data security presents obstacles, additional research can assist in addressing these concerns and mitigating potential effects. When it comes to the safe application of new technologies in wound care, it will be essential to be open to the enhancements that artificial intelligence (AI) can provide while also addressing issues as they appear.

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